

PART – C

(ELECTRICAL & MECHANICAL COMPONENT)

Schedule A to F (Electrical Works) Minor Component

(Operative Schedules to be supplied to each intending bidder)

SCHEDULE „A”

Schedule of Electrical quantities (as per PWD-3) enclosed.

Estimated Cost of work	:	
Part-II: Minor component(electrical)		₹16,30,42,087.00

SCHEDULE „B”

Schedule of materials to be issued to the contractor:

Sl.No.	Description of item	Quantity	Rates in figures & words at which the material will be charged to the contractor	Place of issue
1	2	3	4	5
As per Annexure-1 attached				

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
All the required T&P shall be arranged by the contractor.			

SCHEDULE „D”

Extra schedule for specific requirements / document for the work, if any :	As per Proforma of Schedule of major component
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Name of work :- Construction of Academic Building, Student hostel & Electric Substation along with all necessary infrastructure facilities for IIIT Vadodara at Dumad, Vadodara (SH: Execution of balance work at IIIT Vadodara)

SCHEDULE „E”

Reference to General Conditions of Contract:	General Conditions of contract for CPWD-2023 for Construction works amended up to date. (with all amendments up to last date receipt of tender including extension, if any)
i. Estimated cost of works:	As per Proforma of Schedule of major component
ii. Electrical Items of Work	As per Proforma of Schedule of major component
iii. Earnest money:	As per Proforma of Schedule of major component
iv. Performance Guarantee:	As per Proforma of Schedule of major component
v. Security deposit:	As per Proforma of Schedule of major component

SCHEDULE ‘F’(GENERAL RULES & DIRECTIONS)

Officer inviting tender:	As per Proforma of Schedule of major component
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2(v)	Engineer-in-Charge for Electrical Items of Work	Executive Engineer(E), CPWD, Vadodara
2(vii)	Accepting Authority	As per Proforma of Schedule of major component
2(x)	Percentage on cost of materials and labour to cover all overheads and profits	15%
2(xi)	Standard Schedule of Rates: Electrical Items of Work	DSR (Electrical) 2025 with correction slips upto last date of submission of tender including extension, if any and market rates
2(xii)	Department	Central Public Works Department

9(ii)	Standard CPWD contract Form:	As per Proforma of Schedule of major component
Clause 1	i. Time allowed for submission of Performance Guarantee, Programme Chart (Time and Progress) and applicable labour licenses, registration with EPFO, ESIC and BOCW Welfare Board or proof of applying thereof from the date of issue of letter of acceptance.	As per Proforma of Schedule of major component
	ii. Maximum allowable extension with late fee @ 0.1% per day of Performance Guarantee amount beyond the period provided in (i)above	As per Proforma of Schedule of major component

Clause 2	Authority for fixing Compensation under clause 2	As per Proforma of Schedule of major component
Clause 5	Number of days from the date of issue of letter of acceptance for reckoning date of start	As per Proforma of Schedule of major component

Mile stone(s)

Sl. No	Description of milestone	Period for completion (From date of start in days)	Withheld amount for non-achievement of milestone
1.	30% of tendered value (Electrical)	2 Months	1.25% of tendered amount (Electrical).
2	60% of tendered value (Electrical)	3 Months	1.25% of tendered amount (Electrical).
3.	90% of tendered value (Electrical)	4 Months	1.25% of tendered amount (Electrical).
4.	Completion of work in all respect including all statutory approvals and occupancy certificate.	5 Months	1.25% of tendered amount (Electrical).

Note: - The Withhold milestone will only be released when subsequent milestone is achieved within the specified time.

Authority to decide:

(i) Extension of time	As per Proforma of Schedule of major component	
(ii) Rescheduling of milestones	As per Proforma of Schedule of major component	
(iii) Time allowed for execution of work	As per Proforma of Schedule of major component	
Authority to decide:	As per Proforma of Schedule of major component	
Clause 6	As per Proforma of Schedule of major component	
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	As per Proforma of Schedule of major component
Clause 7A	Whether Clause 7A shall be applicable	Yes
Clause 7B	Whether Clause 7B shall be applicable	Yes

Clause 8A	Authority to decide compensation on account if the contractor fails to submit Completion Plans	As per Proforma of Schedule of major component
	The amount to be payable by the contractor, if he fails to submit completion plans	Rs.5,00,000/- for Electrical works
Clause 10A	List of testing equipment's to be provided by the contractor at site lab	As per direction of Executive Engineer (Elect.)
Clause 10 B (ii)	Whether clause 10-B (ii) shall be applicable.	Not applicable
Clause 10 C	Component of labour expressed as percent of value of work	30%
Clause 10 CC	Clause 10CC to be applicable in contracts with stipulated period of completion exceeding the period shown in next column	As per Proforma of Schedule of major component
Clause 11	Specification to be followed for execution of work - For Electrical Items of Work	CPWD General Specifications for Electrical Works Part-I Internal - 2023 Part-II External - 2023 Part-IV Sub Station – 2013 Part V Wet Riser & Sprinkler Systems – 2020 Part VI Fire Detection and Alarm System – 2018 Part VII DG Sets – 2013, Part VIII Gas Based Fire Extinguishing System 2013 Part--Heating, Ventilation & Air-Conditioning (HVAC)-2024 All amended upto date of receipt of tender.
All above Specifications shall be applicable with correction slips up to the last date of submission / uploading of bid. Note: As per DG / CON / 312 , no substitute item is allowed.		

Clause 12		
12.2	Deviation limit beyond which clause 12.2 & 12.3 shall apply for building work	As per Proforma of Schedule of major component
Clause 16	Competent Authority for Deciding reduced rates - For Electrical Items of Work	SE(Vadodara), CPWD Or success or thereof
Clause 18	List of mandatory machinery, tools& plants to be deployed by the contractor at site	As required during execution of work
Clause 19C	Authority to decide for each default	Engineer-in charge of electrical portion
Clause 19D	Authority to decide for each default	Engineer-in charge of electrical portion
Clause 19G	Authority to decide for each default	Engineer-in charge of electrical portion

Clause 25

i)	Conciliator	As per Proforma of Schedule of major component
ii)	Arbitrator Appointing Authority	As per Proforma of Schedule of major component
iii)	Place of arbitration	As per Proforma of Schedule of major component

Arbitrator appointment	Notice for appointment of arbitrator	As per Proforma of Schedule of major component
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Clause 32	Requirement of Technical Representative(s) and Recovery Rate
As per Proforma of Schedule of major component	

Clause 38

(i)	(a)	Schedule / statement for determining theoretical quantity of cement, bitumen etc on the basis of Delhi Schedule of Rates	Not applicable
(ii)		Variations permissible on theoretical quantities:	
	(a)	Cement	Not applicable
	(b)	Bitumen for all works	Not applicable
	(c)	Steel Reinforcement and structural steel sections for each dia, Mtr, section and category	Not applicable
	(d)	All other materials	NIL

RECOVERY RATES FOR QUANTITIES BEYOND PERMISSIBLE VARIATION

Sl. No	Description of items	Rates in figures and words at which recovery shall be made from the contractor	
		Excess beyond permissible variation	Less use beyond the permissible variation
NIL			

Eligibility criteria for main agency with respect to associated Electrical agency to be engaged by main contractor for executing the electrical & mechanical works.

1. The main contractor will have to submit Name (s) of the proposed associate contractor (for each of the E & M works), as per milestone, who fulfil the eligibility criteria for the relevant package. The documents will have to be submitted in detail as required, which will be checked as per NIT for approval of the associate contractors. It will be essential that proposed electrical associate agency qualify the eligibility criteria for package given in NIT document.
2. The department reserves the right to allow the main firm to submit additional Documents / additional names of the associates in case of the deficiencies in documents or in case of no associate getting qualified in respect of certain package. The same will have to be complied with the main contractor within the time allowed. The decision of the department shall be firm & binding on the intending bidders.
3. The main contractor should submit the Consent letter (willingness) and Affidavit of MOU from at least one eligible associate agency of the respective package of E&M work for each of the package of E & M works by clearly indicating the component of work after award of work. The Willingness and Affidavit of MOU shall be signed by both contractors, Main contractor as 1st party and associated contractor as 2nd party, independently for Name of work & Package specified.
4. If the main contractor fails to associate agency for execution of minor components of work after award of work and as per milestone or furnishes incomplete details or furnishes details of ineligible agencies even after the tenderer is given due opportunity, the entire scope of such component of work shall be withdrawn from the contractor and the same shall be got executed by the Engineer-in-Charge at the risk and cost of the main contractor.
5. In support of the eligibility conditions of the proposed associated electrical contractor, copy of their registration documents, Electrical Contractor's License, GST documents, **valid electrical licence for Gujarat state/ Undertaking for obtaining valid electrical licence for Gujarat state during the execution of work**, eligibility documents by competent authority shall have to be submitted. The credentials for work experience submitted by associate contractor shall be for work executed by him in Central / state Government, Government undertaking, autonomous bodies. Such associate electrical contractor will certify that they are not debarred as on the day of application for sale of tender.
6. In event of the concerned E & M contractor not performing satisfactorily or failure of associate / sub-contractor to complete the E&M work, the main contractor on the written direction of the department, shall remove the Associate / sub-contractor deployed on the work and shall submit name of new associate who fulfils the conditions mentioned in NIT to execute the left-over work without any loss of time or variation in cost to the department in this regard. Such associates shall also enter into Agreement with the main contractor and shall meet all the guarantee for the equipments already supplied for which payment has been released by the department in part. If any equipment supplied for the work, during the currency of the earlier Associate / sub-contractor and paid partly by the department, becomes redundant / not in a position to be installed and commissioned and put to beneficial use due to change in contractor for execution of E&M work, the main contractor shall be liable for replacement of the equipment(s) at no cost to Department, No change of Associate Electrical Contractor will be allowed without prior approval of the CPWD competent officer.
7. Executive Engineer (E) shall be the Engineer-in-charge as far as for all electrical & mechanical services / works are concerned.
8. The main contractor shall be responsible and liable for proper and complete execution of the Electrical work and ensure coordination and completion of both civil and electrical work.
9. The main contractor has to enter into agreement with contractor(s) associated by him for execution of E&M subheads. Copy of such agreement shall be submitted to Engineer-in-charge of work. In case of change of associate contractor, the main contractor has to enter into agreement with the new contractor associated by him.
10. The associate or sub-contractor shall attend the inspection of the work by the Engineer- in- charge of E&M

works as and when required. The contractor executing the electrical work should have valid license for LT / HT as applicable and as described in eligibility criteria.

11. Verifiable completion certificates of the work eligibility 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 countersigned by the applicant as well as signed by the associate contractors shall also be submitted. Self-attested GST documents in respect of the associated agencies as well as signed by associate firms shall be submitted.
12. For the different E & M package, the main contractor will have himself / to engage the associate electrical contractor / specialized agency in the respective specialized works / package after award of work and as per milestone as per following:-
 - (i) The main contractor should either himself meet the eligibility conditions for the respective E & M packages or otherwise he will have to associate an agency meeting the eligibility criteria.
 - (ii) Main contractor will have to submit willingness certificate & MOU for each of the package for Associate agencies by clearly indicating the applicable E & M Package.
 - (iii) The composite category contractor is also be eligible to carry out any or all of these works without associating any specialized agency provided :-
 - a. Contractor fulfils the prescribed eligibility criteria respectively for specialized package.
OR
 - b. Contractor 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 eligibility criteria.

The eligibility criterion for Associate agency for different E& M components are given below. They will have to submit willingness certificate for each of the component of the Electrical work for Associate agencies by clearly indicating the applicable component of the work.

(a) The firm should have successfully completed similar works during the last 7 years ending up to last day of previous month of submission of application by main contractor to department. The main contractor will submit the associate agency related documents for approval to Executive Engineer (Elect), as per milestone for each E&M Packages.

(b) 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 application by main contractor to department.

NOTE : The package cost mentioned in below is for the purpose of eligibility criteria only, package wise total cost is given as below which is rough cost and should not be used or interpreted for any other purpose.

Eligibility Criteria for the Main Contractor / Associate Electrical Contractor List of Specialized Works for E&M works

Sl.No.	Name of Package	Package Amt. in Lakhs	Eligibility criteria	Similar Work
1	UPS	23.98	3 similar works, each of value not less than 40% of package cost OR Two similar works, each of value not less than 60% of package cost OR One work of value not less than 80% of package cost. (Capacity of individual UPS not less than 32 KVA)	SITC of UPS
2	Electrical Substation Equipment	274.39	3 similar works, each of value not less than 40% of package cost OR Two similar works, each of value not less than 60% of package cost OR One work of value not less than 80% of package cost. (Capacity of individual Transformer not less than 1280 KVA)	SITC of Substation equipments like Transformer, HT/LT/APFC panel, etc.
3	Addressable Fire Alarm System & Public Address System	92.93	3 similar works, each of value not less than 40% of package cost OR Two similar works, each of value not less than 60% of package cost OR One work of value not less than 80% of package cost.	SITC of automatic addressable fire alarm with PA System
4	CCTV Surveillance & Security System	80.53	3 similar works, each of value not less than 40% of package cost OR Two similar works, each of value not less than 60% of package cost OR One work of value not less than 80% of package cost.	SITC of CCTV Surveillance & Security System
5	Diesel Generator Set	64.06	3 similar works, each of value not less than 40% of package cost OR Two similar works, each of value not less than 60% of package cost OR One work of value not less than 80% of package cost. (Capacity of individual DG not less than 600 KVA)	SITC D. G. set and equipments.

6	Passenger Lifts	36.82	3 similar works, each of value not less than 40% of package cost OR Two similar works, each of value not less than 60% of package cost OR One work of value not less than 80% of package cost.	SITC LIFT and equipments.
7	EPABX System	24.57	3 similar works, each of value not less than 40% of package cost OR Two similar works, each of value not less than 60% of package cost OR One work of value not less than 80% of package cost.	SITC of EPABX System
8	Fire Fighting System	82.97	3 similar works, each of value not less than 40% of package cost OR Two similar works, each of value not less than 60% of package cost OR One work of value not less than 80% of package cost.	SITC Fire Fighting System with Wet Riser System
9	Water Treatment Unit & Hydro pneumatic water supply pump set	31.38	3 similar works, each of value not less than 40% of package cost OR Two similar works, each of value not less than 60% of package cost OR One work of value not less than 80% of package cost.	SITC of Water Treatment Unit (Dual Media Filter, Activated Carbon Filter, Water Softener, Chlorination Unit) & SITC of Hydro pneumatic water supply pump system.
10	Sewage Treatment Plant	89.08	3 similar works, each of value not less than 40% of package cost OR Two similar works, each of value not less than 60% of package cost OR One work of value not less than 80% of package cost. (Capacity of individual STP not less than 130 KLD)	SITC of STP based on MBR technology.
11	HVAC Works	326.77	3 similar works, each of value not less than 40% of package cost OR Two similar works, each of value not less than 60% of package cost OR One work of value not less than 80% of package cost.	SITC VRF/VRV System and Ventilation Equipments

Eligibility Criteria for Internal & External EI : The tenderer shall associate

i) CPWD enlisted contractors of appropriate class in composite category having valid electrical license.

Eligibility Criteria of Specialized Agency for Lifts

Agency should have followings criteria –

The lift manufacturer shall comply with BIS standards, duly certified by the manufacturer itself. The manufacturer shall be compliant to the Public Procurement (Preference to Make In India), Order 2017 (as amended from time to time) issued by the Department of Industrial Policy and Promotion (DIPP), Ministry of Commerce and Industry.

The experience of successful completion of similar works shall be as per CPWD Works Manual/SoP.

Three similar works, each of value not less than 40% of estimated cost of component.
OR

Two similar works, each of value not less than 60% of estimated cost of component.

OR

One work of value not less than 80% of estimated cost of component.

The manufacturer shall furnish an undertaking regarding availability of spares for the entire expected life of the lift i.e. 15 to 20 years.

The complete lift installation including its components, safety devices, various types of controls, etc., testing, inspection, operation & maintenance shall conform to relevant Codes, Standards, code of practices, guidelines, safety rules, inspection manual(s), rules issued by Bureau of Indian Standards, as amended up to the last date of receipt of tenders.

Quality standards shall conform to latest IS/ISO-9001:2015.

The down time of installed lifts being maintained by the manufacturer shall not be more than 8 hours (average) in case of minor faults and 7 days (average) in case of major faults during the last one financial year.

SPECIAL CONDITIONS FOR ALL SPECIALIZED / E & M COMPONENTS

The 1st lowest tenderer has to submit the following documents for association of electrical contractor at least 7 days after to depositing performance guarantee.

1. The applicant should submit the willingness from an eligible electrical contractor to get associated with the applicant for execution of the electrical component of works in wholesome manner and as per the conditions set out in the MOU to be entered into, between the one who is awarded the work and the associated eligible electrical contractor.
2. In support of the eligibility conditions of the proposed associated electrical contractor, copy of their registration documents, Electrical Contractor's License, GST Documents duly attested by the applicants (Main Contractor) shall be submitted to the EE(E). Each such electrical contractor will certify that they are not debarred as on the day of application for sale of tender.
3. The main contractor will submit MOU signed on non-judicial paper with eligible registered electrical contractor of CPWD) only. The MOU in the enclosed form shall be signed by both the parties i.e., main contractor as 1st party and associated electrical contractor as 2nd party.
4. In the event of the concerned E&M agency not performing satisfactorily or failure of associate sub-contractor to complete the E&M work, the main contractor on the written direction of the department, shall remove the Associate / sub-contractor deployed on the work and shall submit name of new associate who fulfil the conditions mentioned in NIT to execute the leftover work without any loss of time or variation in cost to the department in this regard. Such associates shall also enter into tripartite Agreement / Contract along with the main tenderer and the departmental officer and shall meet all the guarantee for the equipment's already supplied for which payment has been released by the Department. in part. If any equipment supplied for the work, during the currency of the earlier Associate / sub-contractor and paid partly by the Department, becomes redundant / not in a position to be installed and commissioned and put to beneficial use due to change in agency for execution of E&M work, the main contractor shall be liable for replacement of the equipment(s) at no cost to Department. No change of Electrical Contractor will be allowed without prior approval of the department.
5. Executive Engineer (E) shall be the Engineer-in-charge as far as electrical works are concerned. Separate tender schedule abbreviated CPWD-8 and Special Conditions for Electrical Work are appended with this tender It will be obligatory on the part of the contractor / tenderer to sign the tender documents for all the component parts.
6. The main contractor shall be responsible and liable for proper and complete execution of the Electrical work and ensure coordination and completion of both civil and electrical work.
7. The associate or sub-contractor shall attend the inspection of the work by the Engineer-in- Charge of E&M works as and when required.
 1. Associate electrical agencies shall submit the fortnightly labour report. Material for use at work shall be procured by the electrical agencies. For this purpose invoice / delivery challan shall be submitted to the department by the associate agencies.
 2. Sample of materials like pipe, conduits wires, of each size etc. may be got tested in the laboratory approved by Engineer -in charge, as and when desired by Engineer-in-charge.
 3. All the materials intended to be used in the work shall be got approved by Engineer-In-Charge before use at site.
 4. Fish wire shall be provided in each conduit where wiring is not carried out.
 5. For power wiring/computer point wiring GI box of 6/8 module shall be in horizontal pattern only.
6. **(a) All the associate electrical contractors for minor work have to submit their shop drawings/ detailed drawings for the individual E&M services for approval by Engineer-in- charge. Main agency has to submit coordinated drawing of all the services of the work including Civil components as well as E&M components for approval.**
(b) All the associate electrical contractors for individual minor components should submit technical data sheets of the equipments and the materials duly conforming to technical requirements as per NIT for approval of Engineer-in-charge well in advance.

IMPORTANT NOTES : -

- a. The scope of the work is execution of balance work of previous incomplete contract. Hence, before commencement of the work, the agency shall carry out testing and inspection of all existing installed E&M systems/components, including circuit wiring, sub-main wiring, rising mains, LT panels, HT panels, ducts, raceways, LT cables, cable trays, Switches / Sockets/DB's/LED fittings etc., in the presence of the Engineer-in-Charge/authorized CPWD representative. The agency shall submit the test reports for record and approval before taking up the execution of the work. Any defects, deficiencies, or abnormalities observed during testing shall be brought to the notice of the Engineer-in-Charge immediately. Nothing extra shall be paid on this account, and the quoted rates shall be deemed to include the cost of such testing, inspection, and submission of reports.
- b. This work comprises the balance scope of the original work, wherein conduits/raceways were laid in the walls, ceilings, and floors, and wiring was carried out in certain locations/rooms only. After the award of the work, the successful bidder shall utilize the existing conduits/raceways for carrying out the balance wiring work. All unused materials available from the original work shall be issued by the Department for completion of the installation, testing, and commissioning of the electrical system.

The Omega make lifts have already been supplied at site. The same shall be got installed through the OEM. In addition, one new lift shall also be installed, tested, and commissioned under the scope of this work.

The fire-fighting pipelines laid underground, in shafts, and on walls are incomplete. The successful bidder shall complete the balance pipeline work, connect it with the newly installed fire-fighting pipelines, and carry out testing and commissioning of the complete fire-fighting system without any additional cost to the Department.

The HVAC and mechanical ventilation ducts have been installed only at certain locations and the work remains incomplete. Some ducts are available in the site store and shall be utilized to the maximum extent possible. Wherever required, new ducting shall also be provided. The complete HVAC and mechanical ventilation system shall be installed, tested, and commissioned without any additional cost to the Department.
- c. The work shall be executed as per CPWD Specifications and GFC drawing may be issued by the department. However minor variation in quantity that are necessary to complete the work and hidden items of the works which not included in the NIT but requires to completion of the all the respective packages should be carried out by the contractor with the approval of Engineer-In-Charge.
- d. Shop Drawing of All E & M Services to be prepared by Contractor & Submit the same for vetting from department before starting of work execution, Nothing extra shall be paid on this account.
- e. The defect liability period of all the wiring, cabling, equipments and components of all the packages should be THREE YEARS from the date of completion or handing over to the client whichever is later and all the LED fittings and STP Membrane Module shall be guaranteed for a period of 5 years.
- f. The Coordination Drawings Considering Reflected Ceiling Plan and all Electrical services Layouts shall have to be submitted by Contractor to CPWD for approval before execution of E&M work at Site. Nothing extra shall be paid on this account.
- g. The External Cabling shall be as per External cable route drawing and external Lighting Drawing and if any missing details in the drawings, the same shall be

executed as per decision made by Engineer-in –charge according to site conditions, nothing extra shall be paid in this account.

- h. The agency shall first utilize all E&M materials issued by the Department and shall not procure fresh materials for the same items until the departmental stock has been fully exhausted in the case of materials issued by the department. The agency shall submit periodic consumption statements supported by detailed measurements. Procurement of fresh materials shall be permitted only after submission of a duly certified Nil Balance Report indicating complete consumption of the departmental materials, with the approval of the Engineer-in-Charge.
- i. The agency shall ensure complete compatibility and integration of all newly supplied materials/equipment with the existing installations. Any accessories, fittings, hardware, software, programming, commissioning, testing, or modifications required for successful integration shall be deemed to be included in the quoted rates, and nothing extra shall be payable.
- j. No payment shall be made for any item or portion of work already executed, measured, or paid under the previous contract. The agency shall execute only the balance quantity of work as certified by the Engineer-in-Charge.
- k. No claim on account of mismatch, obstruction, deviations, dismantling, modifications, coordination with existing works, or difficulties arising due to the partially executed work shall be entertained. The quoted rates shall be deemed to include all such contingencies.
- l. The agency shall take adequate precautions while carrying out the balance work to avoid damage to existing structures, finishes, services, equipment, and installations. Any damage caused due to the agency's negligence shall be made good by the agency at its own cost to the satisfaction of the Engineer-in-Charge.
- m. The intending bidder shall visit the site before submission of the bid and familiarize itself with the extent of completed work, balance work, availability of departmental materials, site constraints, and working conditions. Submission of the bid shall be deemed as confirmation that the bidder has fully understood the site conditions and no claim on this account shall be entertained.
- n. No additional payment shall be admissible for survey, verification, redesign, coordination, reverse engineering, compatibility assessment, software integration, system balancing, testing, recommissioning or any activity necessary for successful completion of the Project.
- o. The agency shall coordinate with other contractors/agencies working at site without any hindrance to the progress of work. No extra payment or extension of time shall be admissible on this account unless specifically approved by the competent authority.
- p. The agency shall complete the balance work, including testing, commissioning, rectification of defects in the executed balance work, and successful integration with the existing system, to the complete satisfaction of the Engineer-in-Charge. Completion shall not be deemed to have been achieved until the entire system functions satisfactorily under load and all statutory clearances are obtained wherever applicable.
- q. The Bidder shall independently verify all engineering details before quoting. The Contract Price shall include all costs necessary for completing and commissioning

the Project in accordance with the department's Requirements. No claim on account of discrepancies, omissions or deficiencies in the previous works shall be entertained.

- r. The Contractor shall provide comprehensive warranty for the complete integrated system irrespective of whether individual components were supplied under the present contract or retained from previous contracts, except for defects specifically excluded by the Engineer-in-Charge at the time of handing over.
- s. In case of any discrepancy, ambiguity or contradiction among the BOQ, Technical Specifications, Drawings, Employer's Requirements and other Contract Documents, the requirement that provides the higher standard of quality, performance, capacity, safety or completeness shall prevail. The Contractor shall execute the work accordingly without any additional payment or extension of time. No claim arising out of such discrepancy shall be entertained. The interpretation and decision of the Engineer-in-Charge shall be final and binding.

**CONSENT LETTER FROM ASSOCIATED ELECTRICAL CONTRACTORS
for Electrical Package**

I, _____
hereby give my / our consent to work as associated electrical contractor for the composite work of Construction of Academic Building, Student hostel & Electric Substation along with all necessary infrastructure facilities for IIIT Vadodara at Dumad, Vadodara (SH: Execution of balance work at IIIT Vadodara)

I / We will be responsible for necessary action to hand over the installation and for rectification of defects and repair during the maintenance period. I / We will execute the work as per CPWD specification and additional conditions of the contract.

I / We will also engage suitable Engineer and qualified staff for the work as per condition of the contract. I / We further certify that the particulars shown in certificate for associated electrical agency and pertaining to me / us are correct.

Date: Signature of Associated Electrical contractor with seal.

[Note: Copy of enlistment order of the CPWD registered associate contractor, duly attested by notary shall be submitted along with consent letter for each package.]

Signature of the Main contractor with date and seal

MANUFACTURERS' AUTHORIZATION FORM

(To be submitted at the time of association of agency)

No.----- dated

To
Dear Sir: _____

We _____ who
are established and reputable manufacturers of _____

(Name & Descriptions _____ of goods offered) having factories at

(address of factory) do hereby authorize M / s _____ (Name and address of Agent) to
submit a bid, and sign the contract with you for the goods manufactured by us against the above IFB.

We hereby extend our full guarantee and warranty as per Commercial Conditions of Contract for the goods
and services offered for supply by the above firm against this IFB.

Yours faithfully,

(Name)
(Name of manufacturers)

Note: This letter of authority should be on the letter head of the manufacturer and should be signed by a
person competent and having the power of attorney to legally bind the manufacturer. (The list of items for
which this is required should be indicated by Department).

UNDERTAKING FROM OEM / MANUFACTURER

It is to certify that as OEM / Manufacturer giving undertaking to support all the spare parts and its allied accessories etc. of **Fire Fighting / Fire Alarm System / CCTV / Substation Equipments / UPS / DG Set / VRF -HVAC/ EPABX / STP / WTP for (07) Seven year** on payment basis for the healthy functioning of the equipments apart from the one-year unconditional guarantee of the item against any manufacturing defects and malfunctioning under defect liability period from the date of commissioning of equipment.

(Signature of Contractor / Agency)

(Signature of OEM / Manufacturer)

Note: This certificate in regard for following equipments:-

All Packages

WILLINGNESS CERTIFICATE
FROM CONCERNED COMPETENT ELECTRICAL CONTRACTOR
(Separate for each package of E&M work)

NIT No. : 03/EE(C)-II/SE-Vadodara/2026-27.

Name of Work : - Construction of Academic Building, Student hostel & Electric Substation along with all necessary infrastructure facilities for IIIT Vadodara at Dumad, Vadodara (SH: Execution of balance work at IIIT Vadodara)

I hereby give my willingness to work as associate contractor for electrical / specialized work (.....Package Name.....) of the above-mentioned work. 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
Contractor Name:

Agency Stamp

Address: Registration detail

Telephone:

Mobile no:

Whatsapp No.:

e-mail: e-mail:

Signature of Associate Electrical
Name:

Agency Stamp

Address:

Telephone:

Mobile no:

Whatsapp No :

MEMORANDUM OF UNDERSTANDING [M.O.U]

(Separate for each package of E&M work)

NIT No. : 03/EE(C)-II/SE-Vadodara/2026-27.

Name of Work :- **Construction of Academic Building, Student hostel & Electric Substation along with all necessary infrastructure facilities for IIIT Vadodara at Dumad, Vadodara (SH: Execution of balance work at IIIT Vadodara)**

M/S [Name of the firm with full address] [Henceforth called the main Contractor And

M/S [Name of the firm with full address]

[Henceforth, called Associated Electrical Contractor or Electrical Contractor] For the execution of Sub-Work / Package :

We state that M.O.U between us is agreed resolution to do work as per contract conditions . Both of us shall be responsible for the execution of work as per the agreement to the extent this MOU allows.

We have agreed as under:

The main contractor / specialized associate agency will execute all works in the wholesome manner as per terms and conditions of the agreement. The main contractor shall be paid as per standard procedure followed by the department as per agreement terms and conditions. Any type of internal transaction between the Associate contractor and the main contractor shall be as per their convenience and mutual understanding without involving the department. The main contractor shall be liable for disciplinary action if he / Associate contractor failed to discharge the action[s] and other legal action as per agreement.

All the machinery and equipments, tools and tackles required for execution of the electrical works, as per agreement, shall be the responsibility of the main contractor.

The site staff required for the electrical / mechanical work shall be arranged by the main contractor as per terms and conditions of the agreement.

Site order book maintained for the said work shall be signed by the main contractor as well as by the Engineer of the Associated Contractor and by Associated Contractor himself.

All the correspondence regarding execution of the electrical /mechanical work shall be done by the Department with the Associated Contractor with a copy to the main contractor. In case of non-compliance of the provisions of agreement, the main contractor, as well as the associated contractor shall be responsible. The action under clauses 2 and 3 shall be initiated and taken against the main contractor.

The main contractor will make payment to associate contractor as and when bill paid by department, failure to which department shall make payment to associate contractor as per contract condition.

Name of the Sub Head / Package:--

Signature of main contractor
contractor Name:

Signature of associated electrical
Name:

Agency Stamp

Agency Stamp

Address:

Address:

Date:

Date :

Place:

Place:

Countersigned Executive Engineer

GENERAL TERMS AND CONDITIONS APPLICABLE FOR ALL E&M COMPONENTS

GENERAL

The work shall be generally carried out in accordance with attached GFC drawing /tender condition and specifications/ SOQ and the following specifications /rules with upto date amendments.

CPWD General Specifications for Electrical work Part I- Internal & Part-II External -2023, as amended up- to-date

CPWD General Specifications Part-VI: Fire Alarm System -2018 as amended upto date.

General Specifications for Heating, Ventilation & Air-Conditioning (HVAC) - 2024 , as amended upto date

CPWD General Specifications for Electrical Works Part IV Sub Station – 2013, as amended upto date.

CPWD General Specifications for Electrical Works Part V Wet Riser & Sprinkler Systems – 2020, as amended upto date.

CPWD General Specifications for Electrical Works Part VI Fire Detection and Alarm System – 2018 , as amended upto date.

CPWD General Specifications for Electrical Works Part VII D.G. Sets – 2013 , as amended upto date.

CPWD General Specifications for Electrical Works Part VIII Gas Based Fire Extinguishing System – 2013 , as amended upto date.

General Specifications for Electrical Works (Part-III-LIFTS & Escalators) - 2003 , as amended upto date

Commercial and Additional conditions for this work. The Indian Electricity Act,2003,as amended upto date. Indian Electricity Rules1956 amended upto date.

COMMERCIAL CONDITIONS

Income tax, GST, labour cess & other statutory deductions etc. shall be made at source as per the prevalent laws. The deductions of security deposit, Income tax, GST, labour cess & other statutory deductions etc. shall be done as applicable on the gross payments and net payment shall be paid accordingly.

RATES

The rates/ offer quoted by the tenderer, shall be firm and inclusive of all taxes (including GST, labour cess, etc.) and all charges for packing forwarding, insurance, freight and delivery, installation, testing, commissioning etc. at site including temporary construction of storage, risks, overhead charges, general liabilities/obligations and clearance from CEA. The fee for the CEA inspections shall be borne by the contractor only , Nothing shall be paid extra on this account.

DOCUMENTS

In case of Specialized E & M works, the contractor should submit the following documents after the acceptance of tender, an undertaking from the OEM for the component.

Authorization certificate.

The OEM is unconditionally support the lowest tenderer technically throughout the execution of contract as well as for Maintenance/Comprehensive Maintenance Contract for the useful life of the system.

OEM is providing all the spares required for healthy functioning of the equipment for at least seven years from the date of supply of equipment.

In case the contractor fails to submit above document, suitable recovery should be made by engineer-in charge.

STORAGE AND CUSTODY OF MATERIALS

The contractor has to make his own arrangements. No storage accommodation shall be provided by the department. Watch and ward of the stores and their safe custody shall be the responsibility of the contractor till the final taking over of the installation by the department/ client.

CARE OF THE BUILDING:

Care shall be taken by the contractor while handling and installing the various equipments and components of the work to avoid damage to the building. 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 cost all unwanted and waste materials arising out of the installation from the site of work.

COMPLETION PERIOD

The completion period indicated in the tender documents is for the entire work of planning, designing, approval of drawings etc., arrangement of materials & equipments, delivery at site including transportation, installation, testing, commissioning and handing over of the entire system to the department/ client.

GUARANTEE

All equipments shall be guaranteed for a period of 36 months (except LED fittings and STP Membrane Module which shall be guaranteed for 5 years), from the date of taking over the entire installation by the user department, against unsatisfactory performance and/or break down due to defective design, workmanship or material. The equipments or components, or any part thereof, so found defective during guarantee period shall be repaired or replaced free of cost, to the satisfaction of the Engineer-in Charge. Incase it is felt by the department that undue delay is being caused by the contractor in doing this, the same will be got done by the department at the risk and cost of the contractor. The decision of the Engineer-in- charge in this regard shall be final & binding on the contractor.

The tender shall guarantee among other things, the following:
Quality , strength and performance of the material issued as per manufacturers standards. Safe mechanical and electrical tress on all parts under all specified conditions of operation. Satisfactory operation during the maintenance period.

POWER SUPPLY & Water Supply

The contractor has to make its own arrangement for power supply and water supply required for execution of the work.

PREFERRED MAKES OF VARIOUS EQUIPMENTS:

The preferred makes of various equipments /components/accessories have been indicated in "preferred Makes" appended with the tender documents. The materials to be used in the work shall be got approved by the Engineer in Charge / his representative before its use at site,if preferred make of any item not available in preferred make list, the contractor has to submit the technical data sheet for approval from competent authority prior to material dispatch. The E-in-C shall reserve the right to instruct the contractor to remove the material which, in his opinion, is not acceptable.

DETAILS AND DRAWINGS TO BE FURNISHED BY THE CONTRACTOR:

The contractor would be required to submit the following details and drawings after award of work for approval duly approved by Engineer-in charge.

any modification or correction during execution or before execution of work,if any in General arrangement drawing, including detailed shop drawings of all E&M components shall be prepared in AUTOCAD or

equivalent software and submitted by the contractor well in advance to get the approval from the Engineer-in-charge.

Details of foundations for the equipments and assembled equipments
Any other drawings necessary for the job.

After completion of work the contractor should furnish three copies of detailed instructions and manufacturer's manuals of all equipments regarding installation, operation and maintenance, preventive maintenance & trouble shooting with all the relevant data sheets, spare parts catalogue, as built drawings etc.

EXTENT OF WORK

1.1 The work shall comprise of entire labour including supervision, all materials necessary to make a complete installation, testing, adjustments and commissioning, as may be required by the department. The term complete installation shall not only mean major items of the plant and equipments covered by specifications but all incidental sundry components necessary for complete execution and satisfactory performance of installation with all layout charts whether or not been mentioned in details in the tender document in connection with this contract as this is a turn key project.

1.2 In addition to supply, installation, testing and commissioning, of all E&M equipment, following works shall be deemed to be included within the scope of work to be executed by the contractor.

Minor building works necessary for installation of equipments, foundation, making of opening in walls or in floors and restoring them to their original condition finish and necessary grouting etc. as required.

All necessary supports may be arranged.

Testing of PTs/CTs for metering & protection purpose & relay calibration & setting.

Getting inspection done & obtaining approval from Central Electrical Authority and local fire authority for energizing the installation. However, necessary fees for inspection shall be borne by the Department.

All E&M equipment/materials shall be tested from the 3rd party laborites as per the guidelines of Quality Assurance Policy & Check List of E&M Services. The laborites shall be preferably be Government Labs/ Government autonomous bodies or as approved by the competent authority. However, necessary fees for inspection shall be borne by the Department.

QUALITY OF MATERIAL AND WORKMANSHIP :

All parts of the equipment shall be of such design, size and material so as to function satisfactorily under all rated conditions of operation. All components of the equipments shall have adequate factor of safety. The work of fabrication and assembly shall conform to sound engineering practice and on the basis of "Fail Safe Design". The mechanical parts subject to wear and tear shall be easily replaceable type. The construction of the equipments shall be such as to facilitate easy operation, inspection, maintenance and repairs. All connections and contacts shall be designed to minimize risk of accidental short circuits caused by animals, birds and vermin etc. All identical items and their component parts should be completely, interchangeable including spare parts.

INSPECTION AND TESTING

All major equipments like Transformers/ DG set/ HT Panel/ All type of LT panels/ Fire Fighting Panel/UPS Panel/Capacitor Panel/VRF/VRV Equipments /Lifts/Rising Main/Cable Tray etc (as per the guidelines of Quality Assurance Policy & Check List of E & M Services/ specifications) shall be offered for initial inspection. Contractor will intimate the date of testing of equipments at the OEM premises before dispatch.

The successful tenderer shall give advance notice of minimum two weeks regarding the dates proposed for such tests to the department's representative to facilitate his presence during testing.

The Engineer-in-charge or his representative may witness such testing. The cost of the Engineer's visit to the factory will be borne by the Department. Equipments will be inspected at the manufacturer (OEM) premises, before dispatch to the site by the contractor if so desired by the Engineer-in-charge. Engineer-in-charge at his discretion may waive off inspection at factory /at the manufacturer's works before dispatch.

The installation shall be subject to necessary inspection during every stage of erection, by the Engineer In-charge or his authorized representative. The contractor shall provide all facilities and assistance for the purpose.

The completed installation shall be inspected and tested by the Engineer-in charge in the manner as will be laid down by him, in consultation the contractor.

All instruments and facilities necessary for the tests shall be provided by the contractor. Copies of all documents of routine and type test certificates of the equipment, carried out at the Manufacture's premises shall be furnished to the Engineer-in-charge. The decision of the Engineer-in-charge in this regard shall be final & binding on the contractor.

After completion of the work in all respects the contractor shall offer the installation for testing and operation. The contractor should submit all the related documents of completed E&M equipment to the department.

COMPLIANCE WITH REGULATIONS AND INDIAN STANDARDS

All works shall be carried out in accordance with relevant regulation, both statutory and those specified by the Indian Standards related to the works covered by this specification. In particular, the equipment and installation will comply with the following:

Factories Act.

Indian Electricity Acts & Rules. B.I.S.& other standards as applicable.

Workmen's compensation Act.

Bombay and delhi lift act.

Statutory norms prescribed by local bodies like CEA, Power Supply Co., Fire authorities, etc.

After completion of the installation, the same shall be offered for inspection by the representatives of the Central Electricity Authority if required and local fire authority. The contractor will extend all help including test facilities to the representatives of CEA/Local fire authority. The observations of CEA/Local fire authority will be attended to by the contractor. The installation will be commissioned only after getting clearance from CEA/Local fire authority. Contractor should get inspection done & obtain approval from Central electrical Authority and local fire authority.

INDEMNITY:

The successful tenderer shall at all times indemnify the department. Consequent on this works contract, the successful tenderer shall be liable, in accordance with the Indian Law and Regulations for any accident occurring due to any cause and the contractor shall be responsible for any accident or damage incurred or claims arising there during the period of erection, construction and putting into operation the equipments and ancillary equipment under the supervision of the successful tenderer to the extent the latter is responsible. The successful tenderer shall also provide all insurance including third party insurance as may be necessary to cover the risk. No extra payment would be made to the successful tenderer on account of the above.

ERECTION TOOLS:

No tools and tackles either for unloading or for shifting the equipments for erection purposes would be made by the department. The contractor shall make his own arrangement for all these facilities.

Scaffoldings & any other T&P required for execution,testing and commissioning of work shall be arranged by the contractor and nothing extra shall be paid on account of this.

COOPERATION WITH OTHER AGENCIES:

The contractor shall co-ordinate with other contractors and agencies engaged in the buildings, if any, and exchange freely all technical information so as to make the execution of this work/contract smooth. No remuneration should be claimed from the department for such technical cooperation. If any unreasonable hindrance is caused to other agencies and any completed portion of the work has to be dismantled and re-done for want of cooperation and coordination by the contractor during the course of work, such expenditure incurred will be recovered from contractor if the restoration work to the original condition or specification of the dismantled portion of the work was not undertaken by contractor himself.

The work will be carried out with least disturbance during shifting & shut down taken in consultation with the client department.

INSURANCE :

All consignments are to be duly insured upto the destination from warehouse at the cost of the contractor. The insurance covers shall be valid till the equipment is handed over duly installed, tested and commissioned.

The contractor shall include storage cum erection insurance including third party insurance right from the storage to commissioning and handing over of various equipments. In insurance, the beneficiary shall be Engineer -In- charge at the cost of the contractor. All insurance which the contractor is required to enter in to under the contract shall be affected any authorized general insurance company and the contractor shall produce the policies of insurance. In case of any delay in ITC & handing over, the insurance cover will be suitably extended by the contractor at his own cost.

VERIFICATION OF CORRECTNESS OF EQUIPMENT AT DESTINATION:

The contractor shall have to produce all the relevant records to certify that the genuine equipments from the manufacturers has been supplied and erected to the satisfaction of the Engineer-in-charge.

PAINTING:

This shall include cost of painting of the entire installation. The major equipments like HT panel, transformers, LT panel, bus duct, cable trays, HVAC equipment, etc. shall be factory final finish painted. The contractor shall be required to do only touching to the damages caused to the painting during transportation, handling & installation at site, if there is no major damage to the painting. However hangers, supports etc. of bus trunking & cable tray etc. shall be painted with required shade including painting with two coats of anticorrosive primer paint.

TRAINING:

The scope of works includes the technical training of two persons(in each package) of user Department at site as decided by Engineer – in - charge. Nothing extra shall be payable on this account.

MAINTENANCE:

Sufficient trained and experienced staff shall be made available to meet any exigency of work during the guarantee period of Three years from the handing over of the installation.

APPROVAL OF DRAWINGS, MAKES AND MODELS OF EQUIPMENT/MATERIALS :

The agency shall submit drawings and details such as makes and models of the equipments/materials offered by him along with specifications for all E&M components to the Engineer-in-charge of the work, before ordering the equipment/materials for approval of the department.

The Engineer-in-charge shall scrutinize the proposal and approve the makes and models which are acceptable as per the schedule, specifications, conditions of the agreement and in form the agency for procurement.

After approval of the equipment/materials by the department the agency shall procure the equipment/materials from the OEM/authorized distributor/dealer as the case maybe.

Adequate care that only tested and genuine materials of proper quality are used in work shall be ensured by firm. The firm shall also ensure that:

Material will be ordered & delivered at site only with the prior approval of the department to ensure timely delivery.

As and when the order is placed for the fittings/ fixtures, cables, switchgears, poles, other main items etc, its copy shall be dorsed to the Engineer-in-charge of work.

The contractor will submit makes & brands of electrical fittings wires & cables, conduits and switch gears, rising mains, poles, outdoor fittings etc. of preferred make list as per tender documents for approval of Engineer-In-Charge, whose decision will be final in the matter.

The firm will be required to procure 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.

Inspection at factory or at godown, as required, shall be arranged by the firm for a mutually agreed date.

Delivery of material shall be taken up only with the consent of department, after clearance of the material.

Department shall reserve the right to waive off inspection in lieu of suitable test certificate, at its discretion.

All the materials to be supplied by the contractor shall be procured & brought to site as per requirement at site of work in consultation with department so that these materials are not damaged & their manufacturer's warrantee.

SAFETY CODES & STATUTORY REGULATIONS:

Nothing in this specification shall be construed to relieve the successful tenderer of his responsibility for the design, manufacture and installation of the equipment with all accessories in accordance with currently applicable statutory regulations and safety codes.

Successful tenderer shall arrange for compliance with statutory provisions of safety regulations and departmental requirements of safety codes in respect of labour employed on the work by the tenderer. Failure to provide such safety requirement would make the tenderer liable for penalty for each default as per agreement clause. In addition, the department will be at liberty to make arrangement for the safety requirements at the cost of contractor and recover the cost thereof from him.

COMPLETENESS OF WORK:

The installations shall be completed in all respects and put in to operation even where certain details have not been mentioned/left out in the specifications. Any discrepancy may be brought out in pre-bid meeting.

All E&M services such as Internal Electrical installations, lifts, firefighting system, & Addressable fire alarm system, HVAC system, PA system, D.G. sets, substation equipments, street lighting, UPS, pumping set, STP, Drip Irrigation System etc. shall be declared as completed after completion of 1 month trial run of completion of whole work. Defect liability period (DLP) of 36 (Thirty Six) months for all works / machineries/ equipments shall commence from date of completion of complete work (project) as well as handing over to the department/ client whichever is later shall be carried out by the agency at their own cost.

All electrical & mechanical fittings/fixture/ appliances, to be provided for the work, where BEE certification is available should have applicable star rating (of BEE) as on last date of closing of bid. Since, the proposed construction is for "GREEN" rating system of GHAR (Green Habitat Accomplished Rating) rating, all fittings and fixtures of shall be provided accordingly.

The CPWD specifications are available at CPWD website "cpwd.gov.in". The department shall not be responsible for the lack of knowledge and also the Consequences thereof to the Contractor. The information and data mentioned in the tender document have been furnished in good faith and for general information and guidance only. The Engineer -in- Charge in no case shall be held responsible for the accuracy thereof and / or interpretations or conclusions drawn there from by the Contractor and all consequences shall be borne by the Contractor and no claim, whatsoever, shall be entertained from the Contractor, if the data or information furnished in tender document is different from data / drawing after Preparation of architectural drawings, design and approved for construction. It is presumed that the Contractor has satisfied himself for all possible contingencies, situations, bottlenecks and acts of coordination, which may be required between different agencies.

All sundry equipment, fittings, unit assemblies, accessories, hardware items, foundation bolts, termination lugs for electrical connections, and all other items which are useful and necessary for efficient assembly and installation of equipment and components of the work shall be deemed to have been included in the tender irrespective of the fact whether such items are specifically mentioned in the tender documents or not.

INCIDENTAL CHARGES:

All incidental charges of any kind including cartage, storage, wastage, idle labour and safe custody of material etc. shall be borne by the Contractor/ agency on their own cost.

QUALITY ASSURANCE:

The Contractor shall make available, on request from the Department, for record, copies of challans, cash memos, receipts and other certificates, if any, vouchers towards the quantity and quality of various materials procured and the same shall be kept in record. These shall also provide information on the name of the manufacturer, manufacturer's product identification, manufacturer's instructions, warning, date of manufacturing and test certificates from manufacturers for the product for each consignment delivered at site, shelf life, if any, for the department to ensure that the material have been procured from the approved source and of the approved quality, as directed by the Engineer -in-Charge. Day to day account of receipt of such material shall be maintained at site of work and shall be regulated by the department. Nothing extra shall be payable on this account.

QUALITY CONTROL AND TESTING OF MATERIALS:

All the material to be used on works shall bear ISI certification mark unless otherwise the make is specified in the item or special conditions appended this tender document. In case ISI mark material or the materials mentioned in the tender documents are not available, as per opinion of Engineer-in-charge, which shall be final and binding, the material to be used shall conform to CPWD specifications applicable in this tender or IS Code. In such cases Engineer-in-charge shall satisfy himself about the quality of such material and give his approval in writing. Only articles classified as first quality by the manufacturers shall be used unless otherwise specified. All material not having ISI mark shall be tested as per relevant ISI specification. The Engineer-in-charge may relax the condition regarding testing if the quantity of the materials required for the work is small. In all cases of use of ISI marked materials proper proof of procurement of materials from authentic manufacturers shall be provided by the contractor to the entire satisfaction of Engineer -in-charge. All materials equivalent to the one specified should be got approved by the Engineer-in-charge before using the said materials in the work.

If the department desires to send any samples of materials for testing in accredited laboratory, the Contractor at his own expense shall supply all materials, labour for preparing and testing samples as required by the Engineer-in-Charge. The transportation and testing charges shall also be borne by the contractor.

SUPERVISION OF WORK:

The Contractor shall depute Site Engineers & skilled workers as required for the work. He shall submit organization chart along with details of Engineers and supervisory staff. It shall be ensured

that all decision making powers shall be available to the representatives of the Contractor at Vadodara itself to avoid any likely delays on this account. The Contractor shall also furnish list of persons for specialized works to be executed for various items of work. The Contractor shall identify and deployed persons having qualifications and experience in the similar and other major works, as per the field of their expertise. If during the course of execution of work, the Engineer -in-Charge is of the opinion that the deployed staff is not sufficient or not well experienced or well familiar with the equipment / machineries of the work; the Contractor shall deploy better & experienced staff at site to complete the work and in stipulated time limit.

OTHERS CONDITIONS:

The description of E&M service & specification are given in general and indicative but they are not exhaustive i.e. does not mention all the incidental works required to be carried out for complete execution of the item of work. The work shall be carried out, all in accordance with true intent and meaning of the specifications and the drawings taken together, regardless of whether the same may or may not be particularly shown on the drawings and/ prescribed in the specifications, provided that the same can be reasonably inferred there from. There may be several incidental works, which are not mentioned in the contract document/specifications but will be necessary to complete the item in all respect. All these incidental works/costs which are not mentioned, but are necessary to complete the work shall be deemed to have been included in the overall amount quoted by the contractor for various components of work. No adjustment of rates shall be made for any variation in quantum of incidental works due to variation/change in actual working drawings. Also, no adjustment of rates shall be made due to any change in incidental works or any other deviation in such element of work (which is incidental to the items of work and are necessary to complete such items in all respects) on account of the directions of Engineer-in-charge. Nothing extra shall be payable on this account.

It is the responsibility of the main contractor for the liasoning work with local bodies / CEA like electrical Inspector of state govt. for obtaining lift related clearances for installation, operation license after final installation, for final NOC for fire protection system for occupation of the building from Fire officer of state govt. as per local by- laws, obtaining service connection from local distribution company. The main contractor is responsible for all the liasoning work and nothing extra will be paid on this account. Any delay w.r.t. obtaining license/ NOC/ connection etc will be on account of main contractor only. Statutory inspection charges if any can be paid by the department on submission of vouchers/bills from appropriate statutory authorities. All clearances from Fire Officer/ Lift Inspector/ CEA / Local Bodies shall be obtained by the Contractor.

No inspection outside the country is permissible if required so the same will be deemed to be waived off and necessary test reports shall be submitted before the dispatch of equipment Contractor must produce original vouchers/challans of all equipments, accessories, fan & fittings etc. and measuring instruments to the department, which is also required during process of "GREEN" rating system of GHAR (Green Habitat Accomplished Rating) certificate. After complete of each package contractor must be submitted 4 sets of completion plan, all drawings, SLD, layout diagrams with complete detailed inventories of all E&M services along with soft copies also. The contractor shall submit the completion plan separately in triplicate on blue print/ computer plotted within 30 days of the completion of work.

Prior to dispatch, all equipments shall be adequately protected & insured for the whole period of transit, storage and erection against corrosion and incidental damages etc. All the equipments shall be delivered with (i) Manufacturer's test certificate, (ii) Manufacturer's technical catalogues and Installation / Instruction (O&M) manuals.

All the LED bulbs/fittings shall be guaranteed for a period of 5 years. Data and Programme to be furnished by the tenderers:

The Contractor shall prepare the Programme chart for the execution of the work showing clearly all activities from the start of work to the completion required for the completion of the work within the stipulated period and submit the same to the Engineer-in-Charge within fifteen days after the issue of letter for commencement of the work. The Contractor shall also submit monthly Programme and progress reports and update / re-schedule the same every month. These shall be submitted by the contractor in soft copy also besides forwarding hard copy of the same.

Running payment for Electrical/Mechanical components shall be made by the EE(E) directly to the main Contractor. The main contractor shall make the payment to associated Contractor within 15 days of receipt of each running account payment and submit proof of payment to engineer in charge for verification of payment.

The main contractor shall be responsible for coordinating the activities of all works and will ensure progress of works as per laid down Programme.

The contractor must be able to work on concrete slabs / walls as and when required and in complete coordination with the civil works. Cutting of chases in the plastered wall shall in no case be allowed. The contractor shall fix conduits and boxes in the walls soon after the brick work is completed and finish the chase to rough surface with proper cement sand mixture. Only in exceptional cases e.g. where cutting of plastered surface cannot be avoided it will be contractor's responsibility to ensure that plastering is done to match the original finish at no extra cost.

Cutting of brick walls shall be with chase cutting machine only. All repairs and patch works shall be neatly carried out to match the original finish and to the entire satisfaction of the Engineer in Charge.

The connection between incoming switch gears and bus bar shall be made with suitable size of thimble and cable at no extra cost.

All MS junction box cover should be of phenolic laminated / good quality plastic sheet of thickness not less than 3mm and for which nothing extra shall be paid on the account. All hardware items such as nuts/ bolts/ screws/ washers etc. to be used in work shall be zinc/ cadmium plated iron.

While laying conduit, suitable size junction boxes shall be provided for pulling the wire as per the decision of the E-in-C.

The procurement of materials should be in confirmation of Make in India policy of Government of India by the Agency as applicable.

If any make of the equipments are not mentioned in the NIT then the decision of the Engineer-in-charge should be final.

All the necessary liaisoning works related to work with different statutory bodies like Electricity service provider, Fire department etc will be done by the agency however all statutory amount paid by him for this purpose will be reimbursed to him against production of original receipts after due verification by department.

Payment terms for E&M packages: The following percentage of contract rates shall be payable against the stages of work shown herein:

Stage	Items	On initial inspection of materials and delivery at site in good condition on pro-rata basis	On completion of pro-rata installation	On completion of testing and commissioning	Obtain NOC from fire / CEA / CEICED
Package	Percentage of Rate on pro rate basis	As per work progress			
Package C1	Internal & External Electrification	70	10	15	5
Package C2	UPS	70	10	15	5
Package C3	Electrical Sub Station Equipments	70	10	15	5
Package C4	Addressable Fire Alarm System & Public Address System	70	10	15	5
Package C5	CCTV Surveillance & Security System	70	10	15	5
Package C6	Diesel Generator Set	70	10	15	5
Package C7	Passenger Lifts	70	10	15	5
Package C8	EPABX System	70	10	15	5
Package C9	Fire Fighting System	70	10	15	5
Package C10	Water Treatment Unit & Hydro pneumatic water supply pump set	70	10	15	5
Package C11	Sewage Treatment Plant	70	10	15	5
Package C12	HVAC Works	70	10	15	5

General Terms & Conditions for Package.

PACKAGE - 1 (Internal & External Electrification works)

GENERAL SCOPE OF WORK:

The following information given is indicative only but not exhaustive. Execution shall be carried out as per functional requirement and design approved by engineer-in-charge.

All electrical works is to be carried out as per drawings, inventories and technical specification. Item given in the drawings, inventories and specification are tentative and if any items are missed but required for functionality is to be executed by agency without any extra payment.

Planning, supplying, installation, testing and commissioning of all internal & external electrical works for Academic Block, Hostel Block, Sub Station & Pump Room as follows:-

Pointwiring,

Circuit / submain wiring.

Power wiring.

Telephone, LANwiring. TVcabling

SITC of LED type Luminaires, fans, exhaust fans, bells, power plugs, TV sockets, RJ 45 LAN sockets, RJ 11 sockets, DBs, Panelsetc.

All necessary cabling / sub- main between Main panel to different panels, DBs, sub DBs etc. Earthings.

Exit Signages –(1)Single sided, (2) double sided

The work shall be generally carried out in accordance with tender conditions and the following specification and rules.

CPWD General Specification for electrical works Part I Internal 2023 as amended up to date.

CPWD general specification for electrical works Part II External 2023 as amended up to date.

CPWD general specification for electrical works Part IV Sub-Station 2013 as amended up to date.

Indian Electricity Act 2003 amended up to date. National Electrical Code. 2020 amended up to date. Indian Electricity Rule 2020 amended up to date.

National Building Code 2026 as amended up to date

“GREEN” rating system of GHAR (Green Habitat Accomplished Rating) and Barrier Free and Accessibility norms.

General Additional Specification.

All internal electrical works shall be carried out with Steel and PVC conduit. All switches, sockets, AC ON & OFF Starter, IP Phone socket, Data sockets, stepped type (2 modules) fan regulators, bell push and accessories along with matching mounting boxes shall be of modular type. All modular switches, sockets, plates, other accessories shall be of same make and model.

All mounting boxes for plate type accessories shall be of metallic construction and of the same make as that of the plate type switches and accessories.

All lighting fixtures should be LED type having efficacy ,CRI ,THD,SDCM, PF,etc. shall be as per BOQ and LM 79 & LM 80 test report from NABL accredited lab should be submitted by the agency. Color temperature may be 3000/4000/6000K as per site requirement. The compound light shall be IK 10, IP 66 rating fitting.Lighting work should be carried out as per National Lighting Code 2010/NBC/ECBC guidelines. Wherever range of illumination for space is mentioned, higher side of Lux level must be taken.

In parking areas, staircase areas, corridors, big halls etc. no switch for individual light control is to be provided all such point shall be executed on looping basis and shall be group controlled by MCB/switch from DB. In these areas Light controls shall be provided in such a manner to switch ON/OFF general lighting as per requirement or section wise.

All suspended light fittings shall use suspension GI wire and assembly either supplied by Light fitting manufacturer or by their recommended OEM.

Wiring & Conduiting for Telephone system shall be terminated in suitable size of G.I. box and terminated in Modular Telephone outlet Socket at one end and Crone Type Telephone Tag box at another end. The wiring shall be suitably tagged/mentioned the location of each point.

Wiring for Intercom / Telephone shall be terminated in suitable size of G.I. Junction box and RJ-11 socket (for analogue phone) & RJ45 socket (for IP phone). All the other end of wiring shall be terminated in krone box at each floor and in the EPABX room. The wiring shall be suitably tagged/mentioned the location of each point. The Wiring for both analogue & IP phone shall be done with CAT-6 armoured/ unarmoured UTP 4 pair cable as required.

Wiring & Conduiting for TV system shall be terminated in suitable size of G.I. box and terminated in Modular TV outlet Socket at one end and Dish TV box at another end. The wiring shall be suitably tagged/mentioned the location of each point.

Wiring & Conduiting with Modular type Boxes shall be provided for Data, WIFI, IP based CCTV, EPBAX, Speakers, Projectors.

All type of recessed / suspended type LED Fittings / ceiling fans to be connected directly from switch point without disconnect the wire, safety hanging rope must be provided to avoid the accident. Flexible steel conduit shall be provided from ceiling to false ceiling for drawing the wire.

Unarmoured and armoured cable in indoor / outdoor shall be provided as per the design and to be terminated in G.I. Junction box & wiring for cable TV with coaxial cable RG-6 grade, 0.7 mm solid copper conductor PE insulated with fine tinned copper braided & protected with PVC sheath shall be provided as per design.

The GI Metal floor trunking (Race ways) for laying/ drawing LAN cables /power cables shall be done for all computer outlets. GI Metal trunking shall have separator in between power cable & LAN cables.

Floor trunking shall be made up of 1.6 mm thick Pre-Galvanised / Hot dipped G.I sheet (minimum 275 GSM) including junction box of suitable size, Couplers, Jointing sleeves, floor fixing supports complete with cover as required. Size of the same shall be as per requirement as per approval of engineer in charge.

The Planning of cable tray and support system may be prepared using suitable software of the OEM of cable tray. Special attention shall be paid toward hanging / suspension support system. The support system shall also be provided by cable tray manufacture as per recommendation of OEM of cable trays.

Proper factory made TEE, Bend, elbows, cross, joints and other accessories shall be used. Cable trays above false ceiling on all other places shall be Perforated Hot Dipped Galvanised Iron (galvanisation thickness i.e average mass of Zinc coating shall not be less than 65 microns for 2 mm thick & 50 microns for 1.6 mm thick as per IS standard) with perforation not more

than 17.5%, in convenient sections, joined with connectors, suspended from the ceiling with G.I. suspenders including G.I. bolts & nuts, etc. as required. Suitable size as per site conditions shall be used with thickness 1.6 mm for cable trays with width ≤ 300 mm & thickness

2 mm for cable trays with width > 300mm.

All exit signages in staircases, exit path and in critical areas shall be on UPS DB.

Minimum size of copper conductor for power wiring/light plug wiring shall be 4 sq mm PVC insulated multi strand with FRLS copper conductor cable and for light/fan points/exhaust fan/call bell point - wiring shall be done with 1.5 sq mm PVC insulated multi strand FRLS copper conductor cable.

To facilitate drawing of wires, 18 SWG GI fish wire shall be provided in recessed conduit. Conduits laid for other services, like fire alarm, PA system etc., where wiring is not done along IEI works, fish wire shall be invariably drawn.

The connection between incoming switch / RCCB and bus bar shall be made with suitable size of thimble and cable.

Essential & non-essential 3 phase VTPN/horizontal TPN DBs shall be provided separately. Incomer for VTPN DB shall be MCCB / MCB of suitable rating & breaking capacity. The size of both type of DBs shall be as per the requirement of number of circuits connected from the DBs. In addition spare for another 2 nos. Circuits shall also be considered in each DB. All distribution boards shall be double door type with RCBO of 300 MA/MCCB sensitivity of suitable rating as incomer & outgoing shall be suitable rating SP MCB /TP MCB

The Make of MCB, RCCB, RCBO etc. shall be of the same as that of MCB DB.

LT panel shall be cubicle modular type with IP 42 protection class and fabricated from CPRI approved fabricator from 2 mm thick CRCA sheet powder coated with 9 (Nine) tank process and shall be equipped with suitable rating of 4 pole MCCBs/ACBs, as incomer/outgoing , Bus bars, suitable size of 2 nos. copper earth strips, digital type Multi function meter to measure parameters like current, voltage, frequency, wattage, power factor, KWH, KVA, phase angle etc. as per drawing approved by Engineer – in –charge. Each outgoing shall be with suitable rating multifunction meter with RS485 port & control MCB. Floor Panels if required in building shall be provided for essential and non-essential. Incomer of essential panel shall be connected with DG set Supply and incomer of non-essential panel shall be connected with main/primary supply. Incomer, outgoing, bus bar, indicating instruments etc shall be designed as per maximum load and shall be got approved from Engineer-in-charge.

MCCB, if used as incomer then it should have inbuilt earth fault protection and time delay. Separate earth leakage modules are not acceptable.

The breaking capacity of MCCB for all types of panel boards except DBs shall be as per fault level of that location. The rated service breaking capacity should be equal to rated ultimate breaking capacities ($I_{cs}=100\% I_{cu}$). MCCBs above 200A shall be provided with micro-processed based with suitable fault level with adjustable O/L, S/C, protection and up to 200A with Thermal Magnetic release of suitable fault level having adjustable settings for O/L and S/C. The breaking capacity of MCCB shall be 25 KA up to 100 A & 35KA for ratings more than 100 A and upto 200A, 50KA for rating more than 200A up to 800 A, 60 KA for ratings above 800 A. The ACB/MCCB shall be same make of approved company.

All Electrical panel shall be fabricated from System integrator/channel partner of the ACB/MCCB manufacturer, CPRI approved and strictly as per CPWD specifications. The drawing of panel boards must be got approved from Engineer – in – charge before fabrication work. The panel board shall consist of 4 pole MCCB of suitable rating & KA as per fault level as incomer & actual required nos. of outgoing with spare outgoing, feeders having 4 strip copper bus bar [The cross section of Bus bar shall be considered so that current density is

160 Amp/sq.cm (1000 Amp/sq inch)] & shall be adopted with 100% neutral, digital type multifunction meter with RS 485 port for remote monitoring through SCADA/BMS on Ethernet, selector switches, LED type indication lamps etc as per standard sound engineering practice.

Size of distribution board shall be as per number of light / power circuits. All distribution boards shall be double door type. MCB/MCCB/RCCB/ RCBO of suitable rating Amps/ breaking capacity shall be provided as main incomer in all DBs'

Any Cable end Box, looping/ Connection Box, Loose wire box above DB's required for termination of cable is to be provided by the agency and no extra cost to be paid.

Each floor Panel shall be fabricated from 2 mm thick M.S. sheet powder coated with 9 tank process and shall be equipped with 4 pole MCCBs, MCBs, Bus bar, digital Multifunction meter, LED indicating lamp extended rotary handle and all accessories as required.

MCCB, if used as incomer then it should have earth fault protection and time delay within the MCCB. Earth leakage modules are not acceptable.

Rising main shall be sandwich type rising mains with COPPER busbar for use on 3 phase 4 wire 415 V, 50Hz A.C. supply with GI/CRCA 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. COPPER bus bars having current density of 160 A/ sq. cm at nominal current rating, necessary joints & expansion joints, fire barrier at each floor, provision of tapping at every meter, continuous earthing with 2 Nos. copper strip of not less than 20 x 3 mm upto 400 Amp & 20 x 5 mm for higher capacity (one on each side) including,

G.I. clamping brackets, angle iron bracket, steel fasteners, connecting to earthing system etc i/c all accessories i.e. adopter box, cable end box, tap-off box with suitable rating MCCB. The size of the section of bus bar shall be as per CPWD specifications for work part I Internal 2023 and General specifications for Electric sub station part IV 2013.

Rising mains :Upward transmission of power inside the buildings shall be done with the sandwiched compact type rising mains with COPPER busbar/c all accessories i.e adapter box, cable end box, tap-off box with MCCB. AHU's shall be fed from essential rising mains. Rising mains shall be conforming to IS 8623/ IEC 61439 or as amendment upto date.

Inside the lift shaft there shall be arrangement of one light point at each floor level and one light point at overhead, one light point in lift pit. All light points shall be in group controlled and wired with 1.5 sq mm FRLS copper conductor cable. 15 amp power plug and 5 amp power plug shall be provided at each floor. Wiring of these power plugs shall be done with 4 sq mm FRLS copper wires. LED Bulk head fittings of suitable rating to provide 150 lux shall be connected with each point of lift shaft.

After completing the work, necessary test results as envisaged in CPWD General Specifications Part-I (Internal)-2023 & Indian Electricity Rules 2020 amended upto date, shall be recorded and submitted to the department.

For accommodating various size of cables incoming to the building, medium class G.I. pipe/DWC pipe of suitable size shall be provided.

All the switch boxes, MCB DBs are to be covered with plastic sheet / petroleum jelly when installed in brick work till the plastering / painting is done to avoid sticking of cement plaster/ splashes of the paint. Cement plaster / paint are to be cleaned immediately after plaster to avoid rusting of switch boxes and MCB DBs. The plastic sheet is to be removed at the time of handing over.

All PVC conduits accessories shall be of the same make as conduits. The Conduits shall be terminated at switch boxes/metallic junction boxes with suitable PVC glands/check nuts.

Earthing: Copper plate earthing system comprising of earth electrode, earth conductor, earth bus, protective conductor etc for building shall be as per provision laid down in CPWD specifications part – I,

2023. Earthing system should be designed such as to maintain earth resistance as specified in CPWD specifications. Earth resistance shall be checked / tested in harsh climatic conditions.

If required additional earthing sets shall have to be provided as per actual site / equipment requirements.

Lightning arresters shall be provided for building as per IS; 2309-1989 as amended up to date and CPWD specifications for internal work – 2023 & aviation lights (LED Type) shall also be provided.

The above details are for general guidelines, however as per site conditions requirements could be changed and same shall be considered while finalising luminaires/fittings.

Completion plan and completion certificate shall be submitted as per chapter 1/ Pt.1.26 of CPWD General Specifications for Electrical work Part – I Internal 2023.

Passive & active components of computer data networking i.e Cat-6 cabling along with network including SITC of metal trunking, modular switch, sockets, RJ45 socket of LAN system are included in the scope of work.

Distribution of electric power to land scapping, area and fascade lighting etc. and gate lights shall be with FRLS XLPE insulated and PVC sheathed aluminium conductor armored UG cable of 1100 V (ISI marked) with loop earthing.

The cables shall be laid direct in ground, pipe, closed or open duct, cable trays or on surface of wall etc. depending upon the site conditions and as per direction of Engineer-In-charge. Tagging of cables on both ends of each circuit of compound lighting and gate lights shall be done.

All lights of land scapping, area and fascade shall be controlled by astronomical time switch. There shall be arrangement of bypass switch so that in case of failure of time switch, the lights can be operated after bypassing the same.

After completing the work, necessary test results as envisaged in CPWD General Specifications Part-I (Internal)-2023 and CPWD General Specifications Part-II (External)-1994 shall be recorded and submitted to the department. The results shall be within the permissible limits.

The material required to be used in the work shall be got approved from the Engineering-charge before its use at site. The Engineer-in-charge shall reserve the right to instruct the contractor to remove the material which, in his opinion, is not as per specifications.

The materials, planning and workmanship shall satisfy the specifications contained herein and codes referred to. Where the technical specifications stipulate the requirement in addition to those contained in the Standard Codes and specifications those additional requirements shall also be satisfied. In the absence of any Standard / Specifications covering any part of the work covered in this tender document, the instructions / directions of engineer-in-charge will be binding on the contractor.

All Electrical installations shall be of high quality, complete and duly operational including all necessary items and accessories whether or not specified herein. All Electrical work shall be completed in accordance with the regulations and standard to the satisfaction of the Engineer-in-charge.

Scope of work covers planning, supply, installation, testing and commissioning of all E & M services such as IEI, Fire alarm, Fire Fighting System, Public Address System, Gas Suppression system, Electric Sub-Station, D.G. Sets, Lifts, Access Control-boom barrier, CCTV, Data Networking, Aviation Light, Lightning Protection system, TV & Telephone System, etc. required to be provided in the said scheme as per norms of various IS codes / NBC 2016 / CPWD specifications/ECBC/CEA, various byelaws and norms of local bodies. The work shall be executed as per scope & specifications of Electrical works given hereafter and given in respective head / part of the scheme sub-head. If any services required to make the bldg. / scheme habitable is not covered in the scope of services same shall either be pointed out in pre-bid

meeting else, it shall be presumed that the same shall be provided within the quoted cost and nothing extra shall be paid on this account.

Following system also need to be considered for "GREEN" rating system of GHAR (Green Habitat Accomplished Rating) and to be provided by EPC agency.

Automatic lighting shutoff shall be provided through PIR based occupancy sensors.

All Motors shall be as per "GREEN" rating system of GHAR (Green Habitat Accomplished Rating).

LPD as per ECBC 2017 or Latest shall be maintained.

All Exterior lighting shall be controlled by photo sensor or astronomical time switch. Exit signs shall not exceed 5W per face.

Transformer losses and all Motors shall be as per latest ECBC.

Metering shall be monitored as per following as per "GREEN" rating system of GHAR (Green Habitat Accomplished Rating):-

UPS

Lighting (Indoor and Outdoor lighting)

Plumbing systems

Lifts and common areas HVAC System

LT CABLES & CABLE TRAYS:- The specifications for supply and laying of Medium Voltage XLPE cables.

All equipments, components, materials and entire work shall be carried out in conformity with applicable and relevant Bureau of Indian Standards and Codes of Practice, as amended up to date. In addition, relevant clauses of the Indian Electricity Act 2003 and Indian Electricity Rules 2020 as amended upto date shall also apply. Wherever appropriate Indian Standards are not available, relevant British and /or IEC Standards shall be applicable.

CABLES :- Conductors shall be insulated with high quality XLPE base compound. A common covering (bedding) shall be applied over the laid up cores by extruded sheath of unvulcanised compound. Armouring shall be applied below outer sheath of PVC sheathing. The outer sheath shall bear the manufacturer's name and trade mark at every meter length. Cores shall be provided with following colour scheme of PVC insulation.

1 Core :	Red/Black/Yellow/Blue
2 Core :	Red and Black
3 Core :	Red, Yellow and Blue 3 ½
4 Core:	Red, Yellow, Blue and Black

LAYING :- Cables shall be laid as per the specifications given below :

When the cable has been properly straightened, the cores are tested for continuity and insulation resistance and the cable length then measured. The ends of all cables shall be sealed immediately. In case of PVC cables suitable moisture seal tape shall be used for this purpose.

Cable laid in trenches in a single tier formation shall have a covering of clean, dry sand of not less 17 cms above the base cushion of sand before the protective cover is laid. In the case of vertical multi tier formation after the first cable has been laid, a sand cushion of 30 cms shall be provided over the initial bed before the second tier is laid. If additional tiers are formed, each of the subsequent tiers also shall have a sand cushion of 30 cms as stated above. The top most cable shall have final sand covering not less than 17 cms before the protective cover is laid.

Unless otherwise specified, the cables shall be protected by the second class bricks of not less 20 cms x 10 cms x 10 cms (nominal size) protection covers placed on top of the sand (bricks to be laid breadth wise) for the full length of the cable. Where more than one cable is to be laid in the same trench, this protective covering shall cover all the cables and project at 5 cm. over the sides of the end cables.

The trenches shall be taken back filled with excavated earth free from stones or other sharp edge debris and shall be rammed and watered, if necessary, in successive layers not exceeding 30 cm, unless otherwise specified.

Route Marker :- Cable route marker marked "MV or HT Cable" shall be provided along with the route of the cable and location of loops. The route markers shall be of tapered concrete slab of 60 x 60cm at bottom and 50 x 50cm at top having a thickness of 10cm including inscription duly engraved. Cable marker shall be mounted parallel to and 50 cm away from the edge of the trench.

Cables in indoor trenches :- Cables shall be laid in indoor trenches wherever specified. The trench shall be made of brick masonry with smooth cement mortar finish with suitable removable covers (i.e. precasted slabs or chequered plates). The dimensions of the trenches shall be determined depending upon the maximum number of cables that is expected to be accommodated and can be conveniently laid. Cables shall be arranged in tier formation in trenches and if necessary, cables may be fixed with clamps. Suitable clamps, hooks and saddles shall be used for securing the cables in position. Spacing between the cables shall not be less than 15 cm centre to centre. Wherever specified, trenches shall be filled with fine sand and covered with RCC or steel chequered trench covers.

Cable on Trays/Racks :- Cable shall be laid on cable trays/racks wherever specified. Cable racks/trays shall be of ladder, trough or channel design suitable for the purpose. The nominal depth of the trays/racks shall be 50 mm. The trays shall be made of G.I. The trays/racks shall be completed with end plates, tees, elbows, risers, and all necessary hardware, entire steel trays/racks shall be hot dip galvanized including widths & accessories. Cable trays shall be erected properly to present a neat and clean appearance. Suitable clamps or saddles made of hot dip galvanized strips with PVC covering shall be used for securing the cables to the cable trays. The cable trays shall comply with the following requirements:

The tray shall have suitable strength and rigidity to provide adequate support for all contained cables.

It shall not present sharp edges, burrs or projections injurious to the insulation of wiring/cables. If made of metal, it shall be adequately protected against corrosion or shall be made of corrosion-resistant material.

It shall have side rails or equivalent structural members.

It shall include fittings or other suitable means for changes in direction and elevation of runs.

INSTALLATION :-Cable trays shall be installed as a complete system. Trays shall be supported properly from the building structure. The entire cable tray system shall be rigid.

Each run of the cable tray shall be completed before the installation of cables.

In portions where additional protection is required, non combustible covers/ enclosures shall be used.

Cable trays shall be exposed and accessible.

Where cables of different system are installed on the same cable tray, non combustible, solid barriers shall be used for segregating the cables.

Cable trays shall be grounded by two nos, earth continuity wires. Cable trays shall not be used as equipment grounding conductors.

At no place the cable tray/ rack/ ladder running horizontally should rest on any building partition like Brickwall, RCC beams etc. but instead proper MS supports/ hangers to be provided at 1500 mm intervals and at every Turning Angles.

Jointing and termination's :- Cable jointing shall be done as per the recommendations of the cable manufacturer. All jointing work shall be done only by qualified/licensed cable jointer.

All jointing pits shall be of sufficient dimensions as to allow easy and comfortable working. Jointing materials and accessories like conductor, ferrules, solder, flex, insulating and protective tapes, filling compound, jointing box etc. of right quality and correct sizes, conforming to relevant Indian Standards.

Each termination's shall be carried out using brass compression glands and cable sockets. Hydraulic crimping tool shall be used for making the end termination's. Cable gland shall be bonded to the earth by using suitable size copper wire/tape.

LED LUMINAIRE SPECIFICATIONS.

S.No	Criteria	Specification
1	Luminaire configuration/ technical requirement	As per the description mentioned in BOQ
2	Housing/ body of fitting	CRCA/ Pressure Die cast Aluminum/ Polycarbonate as specified in Schedule of work
3	Cover/ Diffuser	Poly carbonate/ Acrylic UV protected/ PMMA for indoor and Toughened glass /PMMA for outdoor.
4	Finish	Aesthetically designed housing with corrosion resistant powder coating.
5	Protection	IP 20/40 for indoor & IP 65/IP 66 for outdoor
6	Operating Voltage	150V to 270V universal electronic driver with internal surge protection.
7	Frequency	50 Hz
8	Fixture Ambient	+ 40 deg. Centigrade
9	Operating temperature	Range 0 to +55 deg. Centigrade
10	Power factor	>0.9
11	Optical assembly	Array of medium power LEDs/ COB for Indoor. Array of medium power LEDs for Outdoor
12	Luminous flux	As specified in the items of SOQ
13	Efficacy of luminaire (including power loss)	As specified in the items of SOQ
14	Efficacy of LED	As specified in the items of SOQ
15	Co-related colour temperature	As specified in the items of SOQ
16	C.R.I.	As specified in the items of SOQ
17	Heat dissipation/ Heat sink	Well designed thermal management system with aluminum heat sink.
18	LED driver current	Not more than 750 mA
19	Driver efficiency	> 85%
20	Make of LED	CREE/ Philips Lumiled/ Osram/ NICHIA
21	Light Source	SMD LED Chip
22	Test certificates to be submitted	LM 79 and LM 80
23	Surge Protection	As specified in the items of SOQ

ANNEXURE – X

UNDERTAKING LETTER FROM MANUFACTURERS OF LED FITTINGS

We hereby agree that

All the LED fittings supplied by us are guaranteed for five years including drivers from the date of handing over to the user department.

In case of discontinuation of model and non-availability of spares, we will replace the fittings with equivalent /high end model in case of manufacturing defect during the warranty period of 5years without any additional claim.

ForM/S,

(Authorized signatory of manufacturer of LED luminaries) Counter

Signature,

Major contractor

The following conditions shall be strictly followed

Note:- Models of items of all fixtures should be got approved from the Engineer in charge well before placing any order to the OEM / its authorized dealer. The contractor / agency is required to submit all relevant test certificates documents and along with the proposal. The model along with sample should be approval by Engineer-in-charge before placing any order and supply of same to the site. The decision of Engineer-in-charge is binding in this regard and no variation is acceptable.

Note: If the make of any item to be used in execution is not in the list of approved make, the agency has to submit the makes for approval from Eng-in-charge. The decision of the Eng-in-charge in this respect shall be final and binding to the agency.

Professional / Industrial LED fittings shall have to be part of price list. Model of fittings shall be acceptable as decided by Eng-In-Charge as model available or not available in price list.

Release of part security deposit after the warranty period of LED fittings / LED lamps shall be as per **OM No. Director / SE (E) TAS / 12, dated 03 / 09 / 2019.**

The firm to submit LM 79 & LM 80 report of each make and model of LED fitting & will be furnish a Guarantee Certificate for a period of minimum Five Years from OEM/ Authorized dealer.

The contractor shall give five years performance guarantee in the prescribed proforma for the LED fittings. In addition 5% (Five percent) of the cost of LED fittings shall be retained as security, to watch the performance of the work executed. At the same time, whole of this amount (withheld) shall be released only after expiry of 5 years, after the completion of the work, if no defect comes to notice. If any defect is noticed during the guarantee period, it shall be rectified by the contractor within Seven days after serving the notice by Department and, if not attended to, the same shall be got done through other agency at the risk and cost of the contractor. In any case the guaranteeing firms during the guarantee period shall inspect and examine the LED fittings once every year and make good any defect observed and Certificate to that effect shall be submitted to Department every year. However, the 5% security deposit referred above can be replaced with bank guarantee of equivalent amount for relevant period.

TECHINICAL SPECIFICATION FOR LIGHTNING PROTECTION SYSTEM:

Lighting protection shall be provided as per IS/ IEC 62305:2010 (latest as amended), CPWD Specifications and NBC 2016 norms. The main and most effective measure for protection of structures against physical damage is considered to be the lightning protection system (LPS). An external LPS which consists of air-termination system, down-conductor system and earthing system is intended to:

Intercept a lightning flash to the structure (with an air-termination system).

Conduct the lightning current safely towards earth (using a down-conductor system), and Disperse the lightning current into the earth (using an earth-termination system).

Accordingly a standard lighting protection system will be provided as per IS/ IEC – 62305: 2010 & NBC 2016 Standards as below:

General

Installation of Lightning Protection System shall be strictly in accordance with IS/IEC 62305. The contractor shall prepare & submit the drawings as per design and get them approved from the CPWD / Consultant, before the start of the work. The approval of drawings however does not absolve the contractor not to supply the equipment /materials as per requirement. The drawing consists lay out drawings of the horizontal and vertical conductors including its support details, sections, connections etc. The User approved make list shall be considered for LPS system provide they meet all test parameter defined in the tender specification.

Standard & Code:

1	General Principles	IS/IEC 62305-1:2010
2	Risk Management	IS/IEC 62305-2:2010
3	Physical damage to structures and life hazard	IS/IEC 62305-3:2010
4	Electrical and electronic systems in structures.	IS/IEC 62305-4:2010
5	Wind velocity	IS 875 – 1987
6	Design of lightning protection system	IS/IEC 62305-3 / NBC 2016
7	Material test standard	IEC / EN 62561 (Part 1 to 8)
8	Surge Protection Device for Power Supply	EN 61643-11:2012 / IEC 61643-11:2011 OR latest
9	Surge Protection Device for Data Line	IEC 61643-21:2009 and EN 61643-21: 2010 OR latest

Note:

All the component shall be tested as per applicable IEC 62561 and the bidder must submit the manufacturer’s test report having laboratory with test facility for lightning impulse current, accredited by third party accreditation body like VDE, ILAC, Dakks, UL, KEMA, NABL.

The bidder shall submit the accreditation copy of manufacturer’s test lab from above competent accreditation body as a mandatory technical requisite. In absence of valid test certificate, the tender shall be liable for rejection considering the safety at site.

It is recommended to have ring earthing for the lightning protection system of the building or structures as per IS / IEC 62305-2010. Also the ring shall be interconnected to main earth mat through ISG to make total system equipotential in the event of lightning.

Surge protection system as per NBC-2016/ Electrical Inspectorate/ Electrical Board norms shall be provided in the electrical system (electrical panels, distribution boards (DBs) etc). The surge protection system has to effectively intercept the lightning current entering the electrical system through underground systems & services and the surge occurring within the electrical system as per details below:

The Internal Surge Protection Device shall be selected as per zone of protection described in IEC 62305, 61643-11/12/21, 60364-4/5. Depending on Zone concept of provided in IEC 62305 – 1 & 4.

LPZ -OB & LPZ 1: At Mains entry point (Main LT Panel): Type 1 + 2, i.e. SPD Combined Arrester Spark Gap Technology with Integrated Backup Fuse.

LPZ1 & LPZ 2 : Sub distribution panel at each floor will be used with Type 2 SPD

i.e SPD with ACI Technology - for each Sub Distribution Panel

CCTV control room Panel + Server room Panel + IT building panel will be used with Type 2 SPD for each Panel

All data network will be protected using suitable Surge Protection Device.

Down Conductor		
Material	Remarks	MinimumDimensions
Bare/Tin-plated electrolytic Copper	Recommended for its good conductivity and corrosion resistance	Strip: 25 x3mm Round section: 8mmDia
18/10-304 stainless steel	Recommended in certain corrosive environments	Strip: 30 x2mm Round section: 8mmDia
A5/L	To be used on aluminum surfaces (cladding, curtainwalls)	Strip: 30 x3mm Round section: 10mmDia

TEST CLAMP / JOINT:Each down conductor should have a test joint for disconnecting it with earth for measuring the earth resistance. It should be installed generally at 2m height above the groundlevel.

EARTHING:Each earth should consist following:

Copper bonded rod 17.2mm dia1.8m long of 254 microns–1no.
NABL tested EREC having resistivity of 0.039Ω-m–20kg

Earth chamber of 300mm approx. of CI / concrete / Brick / Polyplastic should be used as earth pit cover. Polyplastic earth pit is preferred since it can with stand all climatic conditions.

3 sets of above earthing should be made each 2m apart and joined by 25*3mm / 8mm dia bare copper rope / 30*3.5mm dia braided copper cable. Suitable non corrosive clamps for connecting strip or cable to copper bonded rods may also be used. All the nuts and bolts should be of stainless steel.Exothermic welding should be done for connecting all joints of strip/cable/rod.

POLYPLASTIC EARTH PIT CHAMBER

MAIN FEATURES:

Factory-built long holes for accessing pipes easily at site Made of heavy-duty polyethylene for extra durability.

Resistant materials, assuring longuse-life.
Green top cap matches the environment.

DIMENSIONS

AtTop : 10 inches (254mm)
AtBottom : 13 inches(330mm)

Height : 10.25 inches(260mm)

PACKAGE – 2 Uninterrupted Power Supply (UPS System)

Scope - Planning , Supply, testing, and commissioning of 3 x 40 KVA (minimum) per set for Academic Block UPS system with 3 parallel redundant configuration with static transfer switch, (Total ups capacity - 120 KVA(minimum)) , suitable nos. of Batteries for 30 minutes back up on full load.

1. Maintenance free lead acid batteries (for backup for 30 minutes) shall be provided on suitable size of rack for each UPS separately. PWM Hi efficiency battery charger in each UPS.
2. Electric Distribution panel with necessary switchgears at incoming side of UPS.
3. Synchronizing panel with necessary switchgears at outgoing side of UPS. (3 x 40 KVA (minimum)- UPS in parallel mode)
4. Incoming/outgoing FRLS armoured XLPE/PVC insulated PVC sheathed copper conductor power cables, interconnecting cables between batteries, earthing etc.
5. Necessary exhaust system in the battery room for UPS shall be provided.
6. Necessary cable glanding with double brass compression gland shall be provided.
7. Necessary copper plate earthings for neutral and body of UPS, panels.
8. UPS (3 nos. x 40 KVA (minimum)) connected to parallel in main UPS Panel.
9. Any other components required as per site conditions.
10. The manufacturer has to ensure that the product conform to the specifications.

The UPS system should have following features.

1. Double conversion topology.
2. PWM technology using IGBT(both at rectifier & Inverter side).
3. Isolation transformer at UPS output side.
4. 2 nos. static transfer switch for each UPS (one for Bypass & second for redundant configuration)
5. Manual bypass switch for each UPS (3 UPS)
6. Active power factor correction at UPS input.
7. LCD display
8. SNMP for remote monitoring.
9. Management software.
10. Remote monitor for alarms/indications.
11. Remote emergency power off.
12. Potential free contacts for remote indications.
13. Voltage stabilizer in bypass line.
14. Battery management system.
15. Eco mode.
16. The battery backup for 30 minutes in full load.
17. TVSS connected at input of each UPS to protect against transients, surges&noise.

General Brief :-

These specifications define the electrical, mechanical characteristics and requirement for a continuous duty, highly reliable, solid state at 0.9 PF Uninterruptible Power Supply Systems. The system shall be modular in design so that any individual unit of minimum 40 KVA can be easily isolated/taken out for repair or any additional added in future for increasing the capacity. The UPS shall be capable of providing high quality AC power for sensitive electronic equipment loads.

It should also supply clean power automatically without any break in the supply in the absence of power. Under no conditions, the protected system will get direct supply from the raw mains unless there is fault in the protected system.

The UPS shall be fully microprocessor controlled till the level of rectifier/inverter.

UPS system output must be independently brought out to the synchronization panel and synchronized (voltage, phase angle and frequency must be equal).

System Description :-

Output Load Capacity : - The rated output load capacity of the UPS shall be 40 KVA(minimum), 415 Volts (using 3 Nos. each of minimum 40 KVA - 1 set) at more than 0.9 lagging power factor .

Duties of Operation :- The UPS shall be designed to operate as an ON LINE reverse transfer system/double conversion with 3 phase input & 3 phase output in the following modes:

Normal with ECO MODE operation -The UPS inverter shall continuously supply the critical load. The rectifier/charger deriving power from AC input source and supplying DC power to the inverter while simultaneously supplying power to load and charging the power reverse battery. The system shall always run in ECO mode to conserve power i.e. depending upon the available load only individual UPS units shall be made active and rest units shall remain in Hot standby.

Emergency -In case of failure of AC input power, the critical AC load shall be supplied by the inverter without any switching, obtaining power from the battery. There shall be no interruption in power to the critical load upon failures or restoration of the AC input source.

Recharge - Upon restoration of AC point power during the emergency mode on operation the rectifier/charger shall automatically restart, walk-in and gradually assume the inverter and battery recharge loads. The battery recharge must be available when UPS is turned off.

Automatic Bypass – The Automatic bypass must be composed by following parts:

If the UPS must be taken out of service for maintenance or repair or should the inverter overload capacity be exceeded, static power transfer switch shall perform reverse transfer of load from the inverter to bypass source with no interruption in the power to the critical AC load. The static bypass switch should be double ended. A manually maintenance bypass switch should be incorporated into UPS cabinet that will connect the load to AC power source bypassing the rectifier/charger inverter and static transfer switch.

Static switch with zero time for intervention, connected in parallel with an electro-mechanic switch which needs a transfer time but with zero heat dissipation among the time; Microprocessor Logic command and control which will attend to:

Automatically transfer the load to the mains, as soon as following anomalous events occur:

- i. overload, over temperature, voltage runaway on the DC buses, anomalies on the inverter;
- ii. Automatically transfer back the load from the mains to the inverter as soon the anomalous event expires;
- iii. Automatically disable the bypass function in case of output voltage and Mains are not synchronized.

All the 40 KVA - 1 Set UPS modules should be operated in Load bus synchronizing configuration.

In case of trouble in any one of the UPS section, the other UPS will continue to feed the load while the faulty section will be isolated without interruption in the output. If all the UPS fails, the load should be transferred to bypass with no interruption in power to the critical AC load.

There should not be any use of parallel circuit/inter phase transformer. If Load Bus Synchronizing circuit is removed all the UPSs should be able to work independently without any modification and addition of another battery bank.

Battery Requirement :- Battery shall be of Sealed Maintenance Free Lead Acid, each consisting of 12 V,suitable numbers to provide approximately 30 minutes back-up to each 40 KVA load backup.

Battery shall be sealed maintenance free lead acid VRLA batteries. The UPS module should have the Battery Circuit breaker mounted near to the batteries. When this breaker is in OFF position no battery voltage should be present in the UPS enclosure. The UPS module should be automatically disconnected when the battery reaches to the minimum discharge voltage level or

when signaled by other control functions. It shall be possible to replace the defective batteries at site. Batteries will be housed in suitable racks and connected to the UPS with cable. The battery shall have the provision for its charging under normal, float and equalizing charge mode.

Product

Fabrication :- All materials of the UPS shall be of 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 shall be complete with input isolator, rectifier/charger, inverter, static transfer switch, maintenance bypass switch & static by pass input switch, housed in a free standing steel enclosure with key lockable door. In order to have expedient servicing, adjustments and installations, it shall have access from the front. The enclosure should comply with IP-20 protection. The construction of UPS shall be that each sub-assembly is separately replaceable.

Service Area Requirements :- All serviceable sub-assemblies shall be modular and capable of being replaced from front of the UPS (front access only) and shall not require rear or side access for service.

Cooling :- Temperature shall be monitored by thermal sensors. The cooling of UPS shall be forced type with a low velocity cooling fan of adequate capacity, the power drawn of which form the UPS.

Input & output power connections :- The UPS shall have suitable arrangements for suitable size of FRLS cable both at input and output side.

Components :-

Inverter/charger: - Battery sharing cubical shall be provided for sharing one common bank of batteries & also criss-cross connections between the rectifiers and inverters of both the UPS system. The inverter shall be fully solid state and complete with controls to convert DC Power from the rectifier/charger or battery to regulated AC power for supporting the critical load. The inverter shall be IGBT based pulse width modulated (PWM) design capable of providing the specified AC output.

Output frequency:- The output frequency of the inverter shall be controlled by an oscillator. The oscillator shall hold the inverter output frequency + 0.1% for steady state and transient conditions.

Display & Controls :-

Monitoring & Control :- The monitoring functions such as metering and alarm shall be displayed on an alphanumeric LCD panel, LCD panel shall be provided with following monitoring functions and indicators (each alarm and notice conditions shall be accompanied with an audible alarm)

Normal: - This symbol shall be lit when the UPS is operating in normal mode. **Eco mode:** This symbol shall be lit when the UPS is operating in eco mode.

Battery:- This symbol shall be lit when the UPS is operating in battery mode.

Bypass: - This symbol shall lit when the UPS is operating in bypass mode.

Warning: - This symbol shall lit when the system is operating in bypass mode notices shall be displayed and shall included.

UPS on maintenance bypass.

Inverter unsynchronized.

Load on by pass.

Mains failure.

Status of battery.

Alarm: - This symbol shall lit when a situation requires immediate attention. All visuals indications shall be accompanied by the audio alarms. Alarm shall include.

Emergency stop. Inverter

Off or failed. Over-temperature.

Overload

Battery circuit breaker open.
Rectifier Off or failed.

Input circuit breaker open. Output
circuit breaker open.

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 LEDs shall indicate the following status. Input voltage OK. Bypass voltage OK Load on Bypass Load on Inverter Battery voltage OK Inverter output OK.

Battery Management system (BMS) :- The UPS Shall have the facility of having inbuilt battery management system (BMS) with the following features.

The BMS shall provide battery time available, or percentage remaining with operating in battery mode.

The battery management system shall provide the imminent shut down to signal a low battery condition.

Controls :- The UPS shall have following controls.
Charger input isolator.

Battery circuit breaker (mounted separately in its own enclosure)
Inverter output isolator.

Bypass line isolator. Maintenance by
pass isolator. Alarm
acknowledge/reset button.

Emergency on-off push button for manually switching of the inverter. Inverter
push button.

Protection :- There shall have following protection :-RC
surge suppressor.

Negative sequence on input side. Semiconductor
fuses in the lines of thyristor. Sustained under
voltage on input side.

Phase loss on input side.

HRC fuses for filter capacitors. Semiconductor
fuses at inverter input. Snubber circuit for device
dv/dt protection. Charger input current limit.

Battery current limit Overload.

Over temperature for the inverter. HRC
fuses in the control circuit. DC over
voltage.

Low battery.

Static Transfer Switch

STS for transfer switch connected between output of ups & isolated transformer. Upon failure of the any primary ups feeders, the STS with transfer the load to its secondary UPS feeder in about 4 to 8 milliseconds.

STS for bypass the UPS
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 over-voltage OR under – voltage. UPS fault conditions.

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 presets limits.

Bypass frequency out of limits.

Bypass out of synchronization range with inverter output.

Uninterrupted Retransfer :- Retransfer of the critical AC load from the bypass source to inverter 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 in one of the following conditions exists.

Bypass out of synchronization range with inverter output. Inverter/
Bypass voltage difference exceeds the preset limit. UPS faulty conditions presents.

Overload conditions exists in the excess of inverter full load ratings.

Maintenance Bypass Isolator :-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, inverter & static transfer switch. With the critical load powered from the maintenance bypass circuit, it shall be possible to check the operation of the rectifier/charger, inverter, battery and static switch.

Output termination: -To facilitate cable connection.

Documentation : - The manufacturer shall supply 2 sets of installation manual with installation start up trouble shooting guide and operation instruction of the specified system.

Installation: - A service engineer fully trained on the UPS by the manufacturer shall install the UPS. The manufacturer will have conduct load/site study prior to the commissioning of the UPS. A copy of load/site study report will have to be submitted with required comments.

Service Capability: - The manufacturer should have the independent service set up with engineers who are fully trained in the UPS. All the service personnel's should have the latest power measurement equipments, which will be required during the process of site study, installation and maintenance.

Technical parameters of 3 x 40 KVA (minimum) - 1 Set UPS system

Input

Input voltage	: 415 V, 3 Phase, 4 wire
Input voltage tolerance	: +20% to -20%
Input frequency	: 50 Hz Input
frequency tolerance	: +/- 10 %
Current distortion	: THD<3%

Output

Module full load rating KVA/KW	: 3X40 KVA/at 0.9 PF
Rated voltage	: 415V, 3Phase, 4 wire
Output voltage regulation	: +/-1%
Output Frequency	: 50 Hz synchronized with input frequency or +/-
1% free run tolerance. +/-	
Output power factor range	: 0.95 to unity
Output voltage harmonics	
Linear Load on nominal power THD :	<1%
Non-linear load on nominal power THD :	<1%
Crest factor of	: 3:1

Overload rating : 115% for 10 Min. with no by pass intervention
Output wave form : Sine wave
Overall efficiency (VFI) : upto 96%
Noise level in db : <46 at 1
mtr. Transfer time should be instaneous
Number of installed power modules for each UPS - 6 of 6700 VA capacity Input/ Output
connection - 3 ph + N + PE connectors

PACKAGE – 3 Substation Equipments SUBSTATION AND HT CABLES:

HT CABLES :-

GENERAL :The cables shall be supplied, inspected, laid, tested and commissioned in accordance with Drawings. A specification, Indian Standard Specifications as per latest IS and cable manufacturer's instructions. The cables shall be of reputed make. The recommendations of the cable manufacturer with regard to jointing and sealing shall be strictly followed. The installation of cables shall be done by an approved, qualified and experienced person in this trade.

MATERIAL : The H.V. cables shall be 11KV, aluminium conductor CROSS LINKED POLYETHYLENE steel tape armoured cable laid underground and or in masonry trenches as shown on Drawings. The conductor shall be made of Electrical purity aluminium wires and stranded together and compacted. The cable shall be of 3 Core type. The insulation shall be of high quality cross linked polyethylene applied by extrusion process. Both conductor and the insulator are provided with shielding made of Semi Conducting compound. Armouring is applied over inner sheath and shall be of flat steel strips. The outer sheath shall be of heat resisting tropodur (PVC) compound. This shall be of black colour.

INSPECTION : All cables shall be inspected upon receipt at site and checked for any damage during transit.

JOINTS IN CABLES : The contractor shall take care to see that all the cables received at site are apportioned to various locations in such a manner as to ensure maximum utilization and avoidance of jointing cable. This apportioning shall be got approved by the Owner/Consultant before the cables are cut to lengths. Where joints are unavoidable, the location of such joints shall be got approved by the Owner/Consultants.

JOINTING BOXES FOR CABLES : Cable joint boxes shall be of appropriate size, suitable for aluminium conductor XLPE insulated cables of 11000 volts ratings, and shall be manufactured by CCI & Indian Cable Corporation or approved equal.

JOINTING CABLES: All cable joints shall be made in suitable, approved cable joint boxes. Jointing of cables in the joint boxes and the filling in of compound shall be done in accordance with the best practice in trade, in accordance with manufacturer's instructions and in an approved manner. All straight T-joints shall be done in epoxy mould boxes with TROPOLIN/M-SEAL epoxy resin or approved equal. All jointing accessories shall also be manufactured by Indian Cable Corporation/CCI or approved equal. All terminal ends of conductors shall be heavily soldered upto atleast 50mm length.

All cables shall be jointed color to color and tested for continuity and insulation resistance before jointing commences. The seals of cables must not be removed until preparations for jointing are completed. Joints shall be finished on the same day as commenced and sufficient protection for the weather shall be arranged. Joints shall be made by means of suitable solder for conductors, the conductors being firmly butted into the connections or thimbles or ferrules and the whole soldered with proper solder and soldering flux or resin. The conductors shall be efficiently insulated with high voltage insulating tape and use of spreaders of approved size and pattern. The joints shall be completely filled with epoxy compound being topped as necessary to ensure that the box is properly filled.

CABLE TERMINATIONS: Cable termination shall be done in terminal cable box using cable glands and the cable ends sealed with sealing compound.

BONDING OF CABLES: Where a cable enters any piece of apparatus, it shall be connected to the casing by means of an approved type of armoured clamp and gland. The clamps must grip the armouring firmly to the gland or casing, so that in the event of ground movement no undue stress is passed into the cable conductors.

LAYING OF CABLES: H.V.cables shall be laid either buried directly underground or in Masonry/Concrete trenches. The cable buried underground shall be at depth of 1.2 mtr. from the ground level. Sand cushion of not less than 80mm shall be provided both above and below the cable with a protective concrete slab on the top of the sand layer. The cable trench shall be back filled and compacted.

PROTECTION OF CABLES: The cable shall be protected by placing precast reinforced 50mm, thick (1:2:4) concrete slabs 200mm wide on the top layer of sand for the length of the cable. Where more than one cable is running in the same trench, the concrete blocks shall cover all the cables and shall project 80mm on either side of the cables.

Cables under road crossings and any surfaces subjected to heavy traffic shall be protected by running them through hume pipes of suitable size.

EXCAVATIONS AND BACK FILL: All excavations and back fill including timbering, shorting and pumping 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 layers not exceeding 150 mm. Each layer shall be properly rammed and consolidated before laying the next layer. The contractor shall restore all surfaces, roadways, sidewalks curbs, walls or other works cut by excavation to their original condition, satisfactory to the Owner/Consultants.

MARKERS AND WARNING PLATES: Approved C.I. cable markers shall be provided along the route of the cable at every 30 M Distance and at both ends of road crossing, indicating H.V. cables. Special C.I. markers shall be provided at all buried cable joints indicating Electrical cable joint.

TESTING OF CABLES: Prior to burying cables, following tests shall be carried out:

Insulation between phases and between phase and earth for each length of cables, before and after jointing.

For H.V. cables, high voltage test by applying 17.5KV DC voltage for 15 minutes for each core and earth.

On completion of cable laying work, the following tests shall be conducted in the presence of the Owner/Consultants.

Insulation Resistance Test (sectional and overall) Continuity resistance test.

Sheathing continuity test. Earth test.

All tests shall be carried out in accordance with relevant Indian standard code of practice and Electricity Rules. The contractor shall provide necessary instruments, equipment and labour for conducting the above tests and shall bear all expenses in connection with such tests.

TRANSFORMER :- 2 x 1000 KVA & 1x1600 KVA(minimum capacity), 11KV/0.415KV, 3 Phase, 4 Wire, 50 Hz, oil type transformer with on load tap changer with required H.T. Panel, H.T. Metering Panel.

GENERAL : The work shall be carried out as per CPWD General Specifications for Electric al Works (Part -IV- Sub Station) 2013,

Guidelinesfor_Substation_and_power_Distribution_Systems_of_Buildings_2019 as amended upto date ones conforming to I.S. specifications.

TRANSFORMER: Losses shall be as per BIS 1180 for 3 star BEE level as amended up to date and Losses shall be meared by using calibrated digital meters of class 0.5 or better. For transformers of capacity equivalent or above 200 KVA shall be equipped with additional current transformers (CTs) and potential transformers (PTs) for loss monitoring.

The transformer shall comply with the latest edition of the relevant Indian Standards / Manual. The transformer shall be copper double wound core type, oil natural air natural cooled suitable for outdoor installation. The transformer shall be designed and manufactured as per latest relevant IS / BS with up to date amendments. Transformer shall be suitable for continuous rating as stated in Specification and on drawings. The transformer winding shall be of electrolytic copper conductors covered with a special material having high tensile and dielectric strength. The Core shall be made up of high grade low loss cold rolled grain oriented steel sheets (CRGO). Core shall be treated with high temperature resistant paint to prevent corrosion at edges of the core plates. Distribution Transformer with on load tap changer, Balanced supply and unbalanced load.

INPUT : 11KV, 3Phase, 3Wire, 50Hz.

OUTPUT : 0.433KV, 3Phases, 4Wire, 50Hz.

RATING : 1000 KVA & 1600 KVA (minimum)

VECTOR GROUP : Dyn-11

OLTC : +/- 2.5, +/- 5%, +/- 7.5%, +/- 10% (If required) on load tap changer

AMBIENT TEMP : -5 TO +50 degree centigrade OIL

TEMP RISE : As per IS 1180.

WINDING TEMP RISE : As per IS 1180.

LOAD LOSSES : It should be as per IS 1180 BEE 3 star transformer.

Generally the transformer shall conform to IS: 2026 and unless otherwise stated following standards shall be applicable and latest amended upto date.

i) IS: 1180, ii) IS: 3839, iii) IS: 6600, iv) IS: 335 v) IS: 1271, vi) IS: 2099, vii) IS: 3639, viii) IS: 2147

ix) IS: 3202, x) IS: 2705,

xi) IS: 10028 (Part II & III): installation & maintenance of Transformer

TANKS & RADIATORS :- Tanks shall be of MS. plates and structures, electrically welded. The construction shall be robust and substantial, suitable for road/ rail transport and to withstand vibration. Radiator tubes shall be electrical resistance welded type, round or elliptical or rectangular. They may be welded to the transformer tank or in case of very large sizes to separate detachable radiator banks connected through intermediate leak proof valves. Detachable radiator banks shall have top and bottom headers with flanged connections, with drain and vent fittings. Tanks shall be provided with lifting lugs and jacking lugs. Inspection hole with cover should also be provided for large transformers. Oil conservators shall be mounted on brackets attached to the top cover on tank. Dimensions of the conservator shall be such as to allow change in volume of oil due to change in temperature from 0 oC to 100oC. Tanks shall be thoroughly cleaned, degreased and sand blasted inside and outside. A coat of rust resisting primer shall immediately be given on outside surface. Inside surface shall be painted with oil resistance enamel paint. Tank and radiators shall be hydraulically pressure tested. Tanks shall also be tested for full vacuum.

TESTS :- The transformer shall be subjected to the following routine tests at the manufacturer's works before dispatch.

Measurement of winding resistance.

Voltage ratio, polarity and phase relationship. Measurement of impedance voltage.

Load losses.

No load losses and no load current. Induced over voltage withstand.

Separate source voltage withstands. Vector group.

DV/DF Test.

Magnetic Balance Test. High Voltage Test.

Insulation Resistance Test

Temperature Rise Test

All other test as specified in relevant BS Code.

Transformer shall include all routine tests to be carried out at the manufacturer's works and all routine tests to be carried out at site as per specifications. The supplier shall give sufficient advance information about the test schedule to enable the owner to appoint his representative.

Testing at Site :- Prior to commissioning of the transformer the following tests shall be performed.

Insulation resistance of the winding between phases and earth of H.V. and M.V. Side. Voltage ratio test at principal tap, minimum tap & maximum tap position.

Magnetic Balance Test.

Performance/Settings of winding Temperature Indicator, Oil Temperature Indicator.

Insulation Resistance Test

Accessories :- Accessories as specified in the attached Data Sheet shall be included in the scope of supply. The tapping and control gears shall be provided on the H.V. side. Tap changer shall be off-circuit type as specified in Data Sheet. The tap charging equipment shall be suitable for carrying the fault current.

Earthing Terminals:- Two earth terminals of adequate mechanical and electrical capacity shall be provided. One separate earthing terminal shall also be provided on each separate radiator banks.

Winding Temperature Indicator (WTI)

Shall comprise of :- Temperature sensing element
Image coil

Bushing or turret mounted C.T.

Local indicating instrument with electrically independent trip/alarm contact brought out to separate terminals.

Painting :- All metal parts shall be thoroughly cleaned to remove rust, scale, grease etc. and painted with two coats of approved color shade over one coat of rust resisting primer. The paint shall not scale-off, crinkle or removed due to normal handling. All metal surfaces not accessible for painting shall be made of corrosion resistant material.

Rating Plate Details :- Each transformer shall be provided with a rating plate giving the details as per IS:11171 or latest amendment upto date. The marking shall be indelible and the rating plate shall be located on the front side.Exact value of transformer % impedance, as determined by tests shall be marked on it and also on the final submission of nameplate.

Drawing & Documents:

- i. All drawings and documents shall be submitted as per the requirements specified in vendor data.
- ii. Complete technical particulars as per Appendix-B of IS: 11171 latest amendment upto date as applicable to Oil Type Transformers shall be furnished with the quotation.
- iii. Make and type of various accessories and protective devices shall be furnished with the quotation.

Guarantee :- The transformer shall be guaranteed for trouble-free service for the period of 36 months from the date of commissioning. Any defects discovered during this period shall be rectified free of charge.

Information Required with Bids :-

Clause-wise deviations to this specification. If the same are not furnished it will be assumed that the offered equipment meet the enquiry specifications in to.

Data to be furnished by bidder after award of contract before approval :-Name of Manufacturer :

Standards followed in design manufacture and testing:

Continuous maximum rating in KVA:

Transformer no-load voltage High voltage:

Low voltage:

Vector group reference:

Terminal Arrangement

H.V. Side :

L.V. Side :

One-minute dry power frequency test withstand voltage in KV :

High voltage :

Low voltage :

Impulse test withstand voltage with 50 microseconds wave in KV:

Type of tap changer :

No. of plus taps :

No. of minus taps :

Iron losses in KW at rated voltage and frequency :

Copper losses in KW at rated full load current and frequency at 75 OC:

Reactance voltage with guaranteed tolerance in percent at rated full load current and frequency 75 OC:

Impedance voltage with guaranteed tolerance in percent at rated full load current and frequency at 75 OC:

Regulation in percent of no-load voltage at full load current at 75 degree C and with power factors of Unity 0.8 lagging :

Efficiency in percent at 75 OC and unity power factor for 100 percent load :

75 percent load :

50 percent load :

No-load current in amperes at rated voltage and Frequency Inrush magnetizing current in percent of normal full load current:

Details of winding insulation :

Class of insulation materials :

Turns insulation high voltage in mega ohm :

Turns insulation low voltage in mega ohms :

Insulation core to low voltage in mega ohms :

Insulation high voltage to low voltage in mega ohms:

Details of 415 V neutral current transformer :

Name of manufacturer :

Current ratio VA capacity :

Accuracy & performance characteristics :

Weights Core and windings in kg :

Complete transformer :

Overall Dimensions :

Length in mm :

Breadth in mm:

Height in mm :

List of tests proposed to be carried out at the factory :

List of tests proposed to be carried out at the site before commissioning :

- 1.0 Positive sequence impedance at maximum voltage tap.
- 2.0 Positive sequence impedance at minimum voltage tap.
- 3.0 Zero sequence impedance at principal tap.
- 4.0 Efficiency at 75OC winding temperature:

- 4.1 At full load
- 4.2 At 75% full load
- 4.3 At 50% full load
- 5.0 Maximum efficiency and load at which it occurs.
- 6.0 Regulation at full load at 75OC winding temperature at:
 - 6.1 Unity power factor
 - 6.2 0.85 power factor lag.
- 7.0 Resistance per phase of :
 - 7.1 H.V. winding : Ohms
 - 7.2 L.V. winding : Ohms
- 8.0 Conductor area (sq.cm) and current density (Amps/cm²)
 - 8.1 HV winding
 - 8.2 LV winding
- 9.0 Type of windings
 - 9.1 HV
 - 9.2 LV
- 10.0 Insulating materials for interturn insulation:
 - 10.1 HV winding
 - 10.2 LV winding
- 11.0 Insulating materials for winding insulation
- 12.0 Insulating materials
 - 12.1 Winding and core
 - 12.2 Laminations of the core.
- 13.0 Make, type, dial rise, number of contacts and contact ratings (current following items, if provided).
 - 13.1 Dial type thermometer.
 - 13.2 Winding temperature indicator.
- 14.0 Thermal with-stand capability under full short circuit conditions in terms of number of times of calculation of short circuit and corresponding anticipation percentage reduction in transformer life. Relevant calculations shall be submitted.
- 15.0 DRAWINGS

The following drawings shall be submitted to Engineer-in-charge for approval in the stipulated time.

- 15.1 General outline drawings showing plan, front elevation, rear elevation, cable boxes / disconnecting chamber section views, location & dimensions of cable entries, terminals foundation floor fixing details and weights.
- 15.2 Bushings: Plan, elevation terminals details, mounting details make and type number, current and voltage rating, creepage distances and principal characteristics.
- 15.3 Rating and diagram plate
- 15.4 Marshalling box terminal connections, wiring diagram
- 16.0 Test results shall be corrected to a reference temperature of 75 OC.
- 16.1 Two copies of test results shall be submitted for the Owner's/Consultants approval before dispatch of transformer.
- 16.2 Additional bound copies, as required by the Owners/Consultants contract, of complete test results including all tests on transformer, bushing, current transformer (if provided), shall be furnished with the transformer.

11 KV METERING AND 11 KV VCB PANEL :-

H.T. METERING PANEL (INDOOR TYPE):

GENERAL :- H.T. Metering Panel shall be made as per regulation of Local Electricity Supply Authority.

CODES AND STANDARDS :- The 11 H.T. Metering Panel shall comply with the following standards as amended up to date.

IS: 2544 : Bus Bar Supports
IS: 2705 / IEC – 185 : Current Transformer
IS: 3516 / IEC – 186 : Potential Transformer

SHOP DRAWING AND TECHNICAL DATA :- The Tenderer shall furnish relevant technical data on H.T. Metering Panel and associated equipment along with the offer.

The Contractor shall furnish relevant descriptive and illustrative literature on breakers and associated equipment and the following for approval before manufacture of the panel.

- a) Complete assembly drawings of the panel showing plan, elevation and typical section views and locations of cable boxes, bus bar chamber, metering and relay compartment and terminal blocks for external wiring connections.
- b) Foundation plan showing location of foundation channels, anchor bolts and anchors, floor plans and openings for cables etc.
- c) All drawings and data shall be in English.

TYPE AND CONSTRUCTION :- The metal clad panel shall be made out of 2.0 mm thick CRCA sheet steel. The steel work should have undergone a rigorous rust proofing process comprising alkaline degreasing, descaling in dilute sulphuric acid and recognized phosphating process and shall then be given powder coating (Electrostatic) paint of manufacturer's standard shade.

- a. C.T. & P.T. Compartment
- b. Energy Meter Compartment
- c. Cable Termination Compartment

The compartments shall be dust & vermin proof and safe to touch. The H.T. Metering Panel shall be suitable for cable termination from bottom only. The Panel shall be supplied with all equipment mentioned in Specification and Drawing or as per regulation of Local Electricity Supply Authority.

11 KV VCB PANEL (AS PER CPWD SPECIFICATION PART IV – SECTION II)

Incomer: 1 No of SCADA Compatible Feeder Protection Relay 50/51(3 phase overcurrent), 50/51N (Earth overcurrent), 67P (3 phase directional overcurrent), 67N (Earth fault directional overcurrent), 51V(Voltage controlled overcurrent), 37 (3 phase undercurrent), 46 (Negative phase sequence overcurrent), 59N (Residual over voltage), 32 (Directional Power protection (Under/Over active/reactive power), 81U/O (Under/over frequency), 49 (Thermal overload), 79 (Auto reclose), 50BF (Circuit breaker failure detection), Cold load pick up, Inrush blocking. Relay will be on Modbus Protocol

Outgoing Transformer Feeder :- 1 No. of SCADA Compatible Feeder Protection Relay 50/51(3 phase over current), 50/51N (Earth over current), 67P(3 phase directional over current), 67N (Earth fault directional over current), 51V (Voltage controlled over current), 37 (3 phase under current), 46 (Negative phase sequence over current), 59N (Residual over voltage), 32 (Directional Power protection (Under/Over active/reactive power), 81U/O (Under/over frequency), 49 (Thermal overload), 79 (Auto reclose), 50BF (Circuit breaker failure detection), Cold load pick up, Inrush blocking. Relay will be on Protocol.

Master Trip Relay :- Transformer Fault Alarm/Trip Aux. Relay. For Transformer Feeder only.

Metering :- Ammeter & voltmeter selector switches shall be four position type. Ammeter selector switches shall have make before break feature to prevent open circuiting of CT secondary. Selector switch shall be suitable for semi flush mounting with only switch front plate and operating handle projecting out.

Multifunction meter: Digital type (Displaying A, V, PF, Hz, KVA, KW, KVAR, KWh, KVARh etc.) Class 0.5 with RS485 port for communication in Modbus protocol.

Auxiliary/Control Wiring :- Control supply for closing and tripping shall be 220 or 110Volts D.C. through external battery source. 230 Volts single phase A.C. supply shall also be available for the operation of spring charging motor and cubicle space heater. Wattage of closing and tripping coils shall be within 250 watts. Aux supply shall be suitably distributed along with switchgear in loop in loop out fashion.

All Switchgear panels shall be supplied completely wired internally upto the terminal block ready to receive external cabling.

All the secondary wiring in the panel shall have high quality PVC insulation and the same shall have conductor size of not less than 1.5 mm² of copper.

Colors of the secondary/auxiliary wiring should conform to IS 375/1963 and latest amendment thereof if any. All wiring shall be neatly run and group of wiring shall be securely fixed by clips so that wiring can be checked without necessity of removing the clamps. Wiring between fixed and moving portion of the panel shall be run in flexible tubes and the same shall be so mounted to avoid any damage to them due to mechanical movements. Ferrules with number shall be provided on both end of the wiring.

All wires directly connected to trip the circuit breaker shall be distinguished by the addition of a red colored unlettered ferrule

Pre Treatment And Painting :- Switchgear front and rear covers shall be painted for aesthetic purposes and Paint shade shall be RAL 7032.

Name Plate And Diagram Plates :- All equipment shall have weather proof and non-corrosive metal plates fixed in suitable position with full particulars engraved thereon with white letters against black background.

The firm shall affix a name plate on each Switchgear panel having following information : Manufacturer's name, Type of Panel, CT Ratio, Rated Voltage, Rated Insulation Level, Rated Frequency, Rated Normal Current, Rated Short Circuit Breaking Current, Order No. and Date, Year of supply.

Tests :- The design of circuit breaker shall be proven through all the routine and type tests in accordance with IS IEC 62271-200 and any amendment thereof. Photocopy of all the test reports must be enclosed with the tender. Type test report earlier than 5 years from the date of tender opening shall not be acceptable.

The Bidder shall submit the type test reports of following type tests for approval of the Purchaser.

Short circuit duty test on circuit breaker, mounted inside the panel offered.

Short time withstand test – on circuit breaker, mount inside panel offered.

Power frequency withstand test on breaker and panel.

Lightning impulse withstand test on breaker and panel.

Temperature rise test on breaker and panel together. Measurement of resistance of main circuit.

Mechanical endurance test on breaker.

Mechanical operation test.

Internal arc current (IAC) test on individual compartments i.e. Bus bar, VCB and cable compartment.

MEDIUM VOLTAGE PANELS: (TTA PANEL –IEC 61439)

GENERAL :- Medium Voltage power control centers (generally termed as switchboard panels) shall be in sheet steel clad cubicle pattern, free floor standing type, totally enclosed, compartmentalized design having multi-tier arrangement of the incomers and feeders as per details given in the schedule of quantities. The panels shall be of extensible type with provision of bus bar extensions. All panels shall conform to the requirements of the latest addition of IS and shall be suitable for 415 V, 3 phase AC supply or 230 V single phase AC supply as required.

CONSTRUCTION :- All switch board panels or power control centers of free standing type shall have a bus bar chamber at the top and the cable compartment at the bottom or as approved by the Developer/Consultants depending upon the specific requirements of the job. The space between the bus chamber and cable compartment shall be suitably compartmentalized to accommodate either air circuit breakers or molded case circuit breaker of various ratings. The

cable terminations shall be carried out on the rear side of the panels for which adequate space and clamping arrangements shall be provided. Where panels have to be installed with very little access space at the rear, the cable terminations shall be carried out in suitable cable alleys provided on the front of the panel. All the live parts shall be properly shrouded with Bakelite barriers. All the equipment shall be accessible from the front. However, protection relays, KWH meters, etc. may be mounted on the rear side/front side. Arrangements and marking of bus bars, main connections and wiring shall be in accordance with latest IS code. The structure of the panel shall be robust and provided with adequate bracing's to withstand the operation of the equipment and stresses due to system short circuit. The panels shall be fabricated out of best quality heavy gauge sheet steel. The panel shall be machine pressed with punched openings for meters, indicating lamps etc.

DIMENSIONS :- All power control centers shall have dimensions of not more than that given on the layout drawings. Panels arranged side by side shall have the same height and depth. The height of the panel should be limited to 2400 mm. All the operating levers, handles etc. of the highest unit shall not be at a height more than 1700 mm from F.F.L. For all incoming cables a removable gland plate will be provided in the panel and a distance of 300 mm will be provided between the gland plate and the nearest terminal for proper dressing and termination of the cable. All the components of a module will be mounted on a component plate using the machine screws and taped holes (excepting the components mounted on the door). These component plates should be fixed with bolts for easy replacement. Standardization will be adopted while making these plates so that the component plates of the same size modules can be changed from one module to another. In case of panel of lengths more than 4 meters the fabrication of any single section will be limited to a maximum length of 4 meters for the purpose of shipping and shifting at the site. These sections will be assembled at the location of installation with the help of nuts and bolts. While making these sections consideration will be given to the place of sectionalization and select the location where the electrical connections are transferred from one section to another. All the hardware used in the assembly will be electroplated for protection and neat appearance.

BUS BARS :- The bus bars shall be suitable for 4 wire, 415 Volts, 50 Hz, system. The main bus bar shall be made of high conductivity electricity conductor grade electrolytic copper and shall be liberally sized. In case of copper bus bar it shall be electrically conductor grade electrolytic copper and at the time of joining of two copper buses tinning will be done on the copper strips ends to a length equal to the lap length of the joint plus one each. The bus bars shall have uniform cross section throughout. The bus bars shall be capable of carrying the rated current at 415 Volts continuously. The bus bar will run in a separate busbar chamber using bus insulators made of non-deteriorating, vermin proof, non hygroscopic materials such as epoxy fiber, reinforced polyester or molding compound. The interval between the two insulators will be designed after considering:

Strength and safe load rating of the insulator, The vibrating force generated during a fault, A Factor of safety of 1.8 A set of insulators at both ends of the bus.

The size of the bus bar calculations must be approved by the consultants. The bus bars shall be designed to withstand a temperature rise of 45 degree above the ambient. To limit the temperature rise in the bus bar chamber a set of louvers can be provided at strategically places considering the air circulation. The louvers provided will have a brass wire mesh covering from inside with more than 100 openings per sq. inch. The overall temperature of bus bar shall not exceed 85°C in any case.

All the bus bars shall be insulated with PVC heat shrinking sleeves suitably throughout (except at joints) the length. The electro galvanized high tensile steel nuts, bolts, plain or spring washers of suitable size will be used in connecting the various section of the bus bar. A minimum of 1.6 times the width of bus bar will be the lapping length of each joint.

EARTHING :- The panels shall be provided with copper earth bus of suitable size running throughout the length of the switchboard. Suitable earthing eyes/bolts shall be provided on the main earthing bus to connect the same to the earth grid at the site. Sufficient number of star washers shall be provided at the joints to achieve earth continuity between the panels and the sheet metal parts.

INTERLOCKING :- The panels shall be provided with the following interlocking arrangement. The door of the switch-fuse compartments is so interlocked with the switch drive or handle that the

door can be opened only if the switch is in 'OFF' position. De-interlocking arrangement shall also be provided for occasional inspection.

It shall not be possible for the breaker to be withdrawn when in 'ON' position.

It shall not be possible for the breakers to be switched on unless it is either in fully inserted positions or for testing purposes in fully isolated position.

The breaker shall be capable of being raked in to 'testing' 'isolated' and 'maintenance' positions and kept locked in any of these position.

A safety latch to ensure that the movement of the breaker as it is withdrawn, is checked before it is completely out of the cubicle shall be provided.

PROTECTION & INSTRUMENTATION :- Protection and instrumentation shall be as per standard specifications.

CONTROL WIRING :- The control wiring of all the panels will be done with PVC single core flexible copper wires of cross section 1.5 sq. mm and 2.5 sq. mm. All the wiring involving current transformers or circuits with currents of more than 5 Amps will be wired with 2.5 sq. mm cross section wire and the others with 1.5 sq. mm. Similarly all the interconnecting between the incoming bus and the outgoing of 100 Amps and above rating shall be done by insulated copper strips of suitable sizes and equipment below 100 Amps rating shall be wired with insulated copper conductors. All of the control wiring will be done by properly dressing all the wires in a laminar manner either in a PVC duct of liberal size or bunched together by PVC strapping tapes at a distance not exceeding 150 mm. Each wire will terminate with a copper ferule crimped to the wire. The PVC ferules will be used to identify each wire of the circuit and the same number will be marked on the drawing for the corresponding wire. Only one outgoing wire will be connected to one connector. When the control wiring is crossing from fixed parts to moving parts such as door etc. the wire will be run in PVC sleeve of suitable size and the same will be mechanically clamped at both the ends i.e. one end of the fixed part and the other on the moving part. Under no circumstances the wiring should be under any kind of stress for which sufficient length of control wiring in the PVC sleeve should be provided. All the potential circuits shall be protected by fuses mounted near the tap off point from the main connections.

SURFACE TREATMENT :- The each part of the fabricated panel will be subjected to seven tank treatment and all sheet metal accessories and components of power control centers and switchboard panels shall be thoroughly cleaned, degreased, de-rusted and hot dip phosphatized before red oxide primer is applied. The panel shall be stove enameled gray shade finish and the Interior surfaces of the panel shall be painted to an off-white shade.

ENCLOSURE :- The panel enclosure shall be totally dust and vermin proof and shall be suitable for indoor installation. All the cubical will be adopted with front located, outward openings, lockable doors having hidden hinges and a bolted back cover both using no deteriorating neoprene rubber gasket. Enclosure design shall be in accordance with degree of protection IP 54 as per latest IS code. All the nut bolts handles, meters, knobs etc. appearing from outside of the panel should be located in symmetry so as to give a neat appearance.

NAME PLATE :- The panel as well as the feeder compartment doors shall be provided with name plate giving the switchboard/feeder descriptions as indicated on the drawings. The above shall be mounted in metal holder with a clear plastic sheet on inside surface of the front door.

TESTING :- The power control centers shall be tested at factory after assembling of all components and completion of all interconnections and wiring. Tests shall be conducted in accordance with the requirements of BS: 3659.

Insulation Test :- Insulation of the main circuit, i.e. the insulation resistance of each pole to the earth and that between the poles shall be measured.

Insulation resistance to earth of all secondary wiring should be tested with 1000 Volt magger. Insulation test shall be carried out both before and after high Voltage test. High Voltage Test A high Voltage test with 2.5 KV for one minute shall be applied between the poles and earth. Test shall be carried out on each pole in turn with the remaining poles earthed, all units raked

in position and the breakers closed. Original test certificate shall be submitted along with panel.

STORING, ERECTION AND COMMISSIONING :-The panels shall be stored in a well ventilated, dry place, with suitable polythene covers shall be provided for necessary protection against moisture.

Erection :- Switch boards shall be installed on suitable foundation. Foundation shall be as per the dimensions supplied by the panel manufacturer. The foundation shall be flat and leveled. Suitable grouting holes shall be provided in the foundation. Suitable MS base channel shall be embedded in foundation on which the panel can be directly installed. The switch boards shall be properly aligned and bolted to the foundation by at least four bolts. Cables shall be terminated on the bottom plate or top plate as the case may be, by using high quality brass compression glands. The individual cables shall then be led through the panel to the required feeder compartments for necessary terminations. The cables shall be clamped to the supporting arrangement. The switchboard earth bus shall be connected to the local earth grid. Pre-commission Tests :-

Panels shall be commissioned only after the successful completion of the following tests. The tests shall be carried in the presence of Developer/Consultant or their representatives. All main and auxiliary bus bar connections shall be checked and tightened.

All wiring termination and bus bar joints shall be checked and tightened. Wiring shall be checked to ensure that it is according to the drawing.

All wiring shall be tested for insulation resistance by a 1000 Volts magger. Phase rotation tests shall be conducted

Suitable injection tests shall be applied to all the measuring instruments to establish the correctness and accuracy of calibration and working order.

All relays and protective devices shall be tested for correctness of settings and operation by introducing a current generator and an Ammeter in the circuit.

METERING, INSTRUMENTATION AND PROTECTION :- Ratings, type and quantity of meters, instruments and protective devices shall be as per Bill of Quantities.

Current Transformers (CT) shall conform to latest IS codes in all respects. All CTs used for medium Voltage application shall be rated for 1 kV. CTs shall have rated primary current, rated burden and class of accuracy as specified in schedule of quantities/drawings. Rated secondary current shall be 5A unless otherwise stated. Acceptable class for measurement shall be 0.5 to 1 and for protection class 10. CTs shall be capable of withstanding magnetic and thermal stresses due to short circuit faults. Terminals of CTs shall be paired permanently for easy identification of poles. CTs shall be provided with earthing terminals for earthing chassis, frame work and fixed part of metal casing (if any). Each CT shall be provided with rating plate indicating:

- Name and make
- Serial number
- Transformation ratio
- Rated burden
- Rated Voltage
- Accuracy class

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

Potential Transformer :- PTs shall conform to latest amendment upto to date IS Codes.

Measuring Instruments :- Direct reading electrical instruments shall conform to latest IS codes in all respects. Accuracy of direct reading shall be 1.0 of Voltmeter and 1.5 for Ammeters. Other instruments shall have accuracy of 1.5. Meters shall be suitable for continuous operation between -100 C and + 5000 C. Meters shall be flush mounting and shall be enclosed in dust tight housing. The housing shall be of steel or phenolic mould. Design and manufacture of meters shall ensure prevention of fogging of instrument glass. Pointer shall be black in color and shall have Zero position adjustment device operable from outside. Direction of deflection shall be from left to right. Selector switches shall be provided for Ammeters and Volt meters used in three phase system.

AIR CIRCUIT BREAKER (ACB) :-

GENERAL :- ACB shall comply with standards IS/IEC 60947-1 & 2.

ACB shall have a rated operational voltage of 415V AC, rated insulation voltage of 1000 volts AC, rated impulse voltage of 12kV.

ACB shall be of 3 pole or 4pole, air break, molded case design for longer life along with less maintenance requirement.

All ACBs shall preferably be of single frame size up to 2000 A to optimize requirement for spares management.

ACB shall have a Ready to close mechanism preferably having a ready to close mechanical indication on front of ACB.

All EDO ACBs ready to close indication contact which shall be used to give a single indication via indicating lamps on panel door if ACB is ready to be closed, after checking all the given conditions (UV release energized, Shunt release de-energized, spring charged, Breaker is not "ON", Breaker has not tripped on fault, Breaker is not mechanically interlocked with other breaker and ACB is not racked in completely in service position) ensuring safety for user and electrical distribution.

ACB shall comply with the environmental directives like RoHS.

PERFORMANCE:

ACB shall have the breaking performance $I_{cs} = I_{cu} = I_{cw} (1sec) = 50kA$ ACB shall life of 20000 operations

The operating mechanism of ACB shall be of the Open/Closed/Open stored-energy spring type. The closing time shall be less than or equal to 70ms, and of fast opening type with have Mechanical break time of breaker should be <30ms to ensure higher life of distribution cables.

ACCESSORIES & AUXILIARIES:

Shunt trip and closing coil (having common AC/DC supply upto 250V) shall be continuous rated. For Incomer ACBs delayed type under voltage release shall be used to avoid nuisance tripping during voltage surges.

ACBs shall have 4 change-over auxiliary contacts, available to be used for indication and interlocking, rated at 10A 240/380V 50 Hz and shall be wired on chassis/cradle. There should be facility to add one more set of 4 contacts if required

Pre wired Fault trip contact should be provided with Release as standard.

Indication lamps to be provided on front door of ACB feeder shall be as shown below: -
Spring charge indication required for EDO ACB only

SAFETY:

Draw-out ACBs shall preferably be provided with a mechanical latch on chassis which latches the ACB at Connected-Test-Disconnected positions while racking in and racking out the circuit breaker. This feature will help the operator in placing the circuit breaker at right position inside the chassis and can help in avoiding the accident.

The racking handle of the breaker shall be stored on the air circuit breaker in such a manner as to be accessible without defeating the door interlocking.

TERMINATIONS:

All air circuit breakers shall be fully tropicalized as standard & suitable for terminating copper or aluminium bus bars. Both fixed & draw-out circuit breakers shall have single pole-pitch. ACBs upto 3200A shall be provided with top horizontal and bottom vertical terminal adapters on both sides for proper cable connections/bus duct connections. Terminal orientation for top and bottom side shall preferably be possible to be changed from vertical to horizontal or vice versa on site as per cable/bus duct entry. Rest of the ACBs shall have both side vertical terminal adapters for better heat dissipation.

PROTECTIONS:

Air circuit breaker shall be provided with microprocessor release, which should be self powered type without the need of any auxiliary power supply during normal operation of the breaker.

The circuit breaker control unit shall measure the true r.m.s value of the current circuit breaker trip unit shall have a display for measurement of current and voltage. It shall be possible to view last 5 trip cause on trip unit.

All trip units provided shall have thermal memory as standard All trip units shall be EMC/EMI tested

The protection release shall have following protections as standard: -

Adjustable over load current (I_r) settings from 40% to 100% of rating of ACB (I_n). Over load time setting (t_r) from 0.5s, 1s, 2s, 4s.....24s as field selectable curves.

Short circuit setting (I_{sd}) from 1.5 to 10 times of I_r setting, Short circuit time delay adjustable from 0 to 400 msec.

Instantaneous (I_i) protection with an adjustable pick-up and an OFF position.

Earth fault setting adjustable in absolute Ampere with time delay settings from 0 to 400ms. Separately powered / Self powered, individual fault trip indication LEDs (For overload, short circuit, earth fault and trip unit failure) shall be available on the trip unit which shall function even if the display fails.

I2t ON / I2t OFF options shall be available for short-circuit & earth fault protections which can be used to ensure discrimination with upstream circuit breaker or fuse.

The trip unit shall have integral test facility to verify the healthiness and to avoid external calibration.

It shall be possible to change the protection settings on line and the circuit breaker need not be switched off while adjusting the settings.

All ACBs in main LT panel shall surely be provided with zone selective interlocking which helps in reducing the thermal and dynamic stress on installation during short circuit and ground faults. The releases shall be suitable to communicate between incomer breaker and outgoing breakers enabling zone selective interlocking. The manufacturer shall supply all equipment like ZSI module, power supply and wiring connectors to implement ZSI.

It shall be possible to view the percentage loading of three phases at once on trip unit via LEDs or LCD display to help the user in identifying the current load balancing of the network. This will help in preventing the deterioration of loads affected by load balancing by identification of the balancing related issue.

All 4 Pole ACBs shall have fully rated neutral equal to rating of the breaker & shall be protected against over-load faults with provisions for settings neutral unprotected, neutral protection at $0.5I_n$ and neutral protection at $1.0 I_n$ to ensure precise neutral protection.

MOULDED CASE CIRCUIT BREAKER (MCCB)

GENERAL:

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

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

MCCBs shall be current limiting type preferably having an encapsulated double or single break design having two fixed contacts, one moving contacts and two arc chutes per pole. The design is required to minimize the effects of short circuit currents i.e. limit the let through energy and improve the life of cables.

MCCB shall not have any line load bias

MCCB shall comply with the environmental directives like RoHS and WEEE

800A and above rating MCCBs - shall be microprocessor based, category B type (drawout design in main panel and fixed type in sub panels) having I_{cw} (1sec) not less than 15kA. Microprocessor trip unit shall measure current and voltage data with last 5 trip records.

Microprocessor based MCCBs in main panel shall have zone selective interlocking feature. Mechanical life shall be 10000 operations.

PERFORMANCE:

The MCCBs shall have a rated service breaking capacity (Ics) equal to the ultimate breaking capacity (Icu) at 415V and as per system fault levels (refer SLD).

The limiting capacity of a circuit breaker is expressed by two curves which are a function of the prospective short-circuit current (the current which would flow if no protection devices were installed): The thermal stress (A2s), i.e. the energy dissipated by MCCB during fault should be as low as possible. Cable selection to be done as per Maximum permissible cable stresses for which manufacture should produce current limiting and energy limiting curves of MCCB's.

SAFETY:

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



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

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

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

All MCCBs provided shall be of single frame size upto 250A to reduce the requirement of spares management.

All MCCBs shall have cross bolted or equivalent type termination where bus bars or cable lugs can be terminated by crossing the bolt between the lugs/bus bars and MCCB connections, to enhance safety and reliability of the terminations. In case spreaders/rear connectors are used in between MCCB and bus bar/lugs then the spreaders shall be cross bolted or equivalent with the MCCB connectors.

AUXILIARIES AND ACCESSORIES :-

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

open/closed position contact trip
signaling contact

Electrical fault trip signaling contact

Rotary handle shall ensure IP40 for direct type and IP 54 for extended Rotary handle.

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

PROTECTIONS REQUIREMENTS:

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

Thermal magnetic trip units shall have variable overload settings from 0.8 to 1 Ir and fixed short circuit settings

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

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

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

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

Selection of Ir MCCB rating

Earth fault sensitivity selection from 20% – 60% In.

The time delay selection in case of Earth Fault from 0.5 to 3 Sec/ instantaneous.

There shall be a separate fault differentiation indication (LED) for Over current and Earth fault. Indication for over current and earth fault tripping shall be extended to the panel door via indication lamps

Separate LED shall be there to show healthiness of earth fault protection system

EF protection module shall be suitable for 3P 4W system. It shall take the input from neutral for correct earth fault protection. Earth fault module shall have auxiliary contacts for earth fault signaling.

BUS DUCTS/RISING MAINS (SANDWICHED

CONSTRUCTION) SCOPE:

The specification covers, manufacturing, supply, installation, testing and commissioning of Sandwich type bus bar trunking for use as feeder bus bars for interconnection between separate electrical equipment/ load centers, and for use as plug in bus bar risers and it should be suitable for 1000 Meter MSL.

GENERAL:

Bus bar Trunking shall be sandwich type construction. It shall be 3 Phase with 100% Neutral and PE conductor enclosed in GI / all sheet steel (CRCA) housing.

Bus bar Trunking shall be rated for operational voltage of 690V with insulation voltage of 1000V, Rated Impulse Voltage withstand-12Kv and shall be suitable for 50Hz frequency.

Sandwich type bus bar shall be suitable for distribution application from 400A to 4000A copper/Al conductor.

Range shall be suitable for horizontal and riser application and should be complete with feeder/plug in and all accessories like expansion joints, reducers, end terminal covers etc. as recommended by the manufacturers. Standard length of bus bar shall not be less than 3000mm & plug in opening shall be provided at regular intervals with safety shutters. Special length shall be designed to connect the end piece and some special requirements.

The Plug in Busway shall be suitable for vertical and/or horizontal installation.

All indoor application shall use IP54 and for outdoor application IP65 with canopy should be used.

Busduct /Rising Main shall have mounting Brackets welded to the housing of Bus duct/Rising Main for Installation of External earth Busbar on both the size, the earthing Contractor shall be Installed in the rising main with proper Hardware and star washer so that paint on bracket is peeled off and proper contact of earthing bus bar is insured with housing of rising mains.

SHORT CIRCUIT AND TYPE TEST :-

Bus way system shall comply with following standards:

IEC 61439-1&6

All type test certificates according to above standards shall be of International Lab of repute such as CPRI/DEKRA/LOVAG /KEMA or equivalent.

Type test certificate shall be produced for validation before ordering for Rated Short Circuit breaking capacity for 1sec.

Type Test certificates confirming Mechanical Operation and Temp. Rise of Tap Off Box of similar design in accordance with IEC-61439 are must.

Busway manufacturer shall produce a Type Test Report determining Rating of Busway at Ambient Temp. with no deration. Failure to submit such reports will disqualify the manufacturer.

A Type Test report confirming Degree of Protection in accordance with IEC 60529 is must. The type test for IEC-60068 of seismic with acceleration of 0.4g. certificate of green premium product from independent test house is a must.

HOUSING:

The bus bar trunking housing shall be constructed of 1.5 mm thick (sheet steel, CRCA housing), IK-10 on all the sides. It shall be provided with a suitable protective finish of epoxy resin paints.

Housing shall be light in weight for ease of installation and maintenance.

The bus bar trunking housing shall be totally enclosed non-ventilated, for protection against mechanical damage and dust accumulation.

Modifications of bus bar trunking to make it totally enclosed by other than the bus bar trunking manufacturer voids the manufacturer's warranty.

For outdoor/Higher IP protection the housing made by the manufacturer shall be considered based on adequate type test reports ratifying their use in desired conditions/locations alongside a confirmation meeting the requirement of basic IP Protection sought above.

Housing shall be non-corrosive and shall be able to withstand 1000 hours of salt spray test. Enclosure Temperature shall not increase more than 50 degree and Temperature rise should be 45 degree.

BUS BARS:

Bus bar conductors shall be high conductivity copper Alloy.

Each bus bar shall be individually insulated Class F (155 Deg C) insulation with multilayer of reputed make UL certified insulation insulating film (Certified Insulation Material as per standards), epoxy or mica insulation not allowed.

Both feeder and plug-in bus bar trunking for all ratings shall be of sandwich construction, with no air gap between bus bars except at plug-in openings.

NEUTRAL BUS BAR:

Internal neutral conductor shall be 100%, which can meet with the requirements of various power systems in the installations.

PLUG-IN UNITS :-

Plug-in Units circuit breaker type shall be operated with visible rotary quick make and quick-break mechanism.

All plug in units shall have MCCBs of suitable breaking capacity as per design. MCCB and bus bar system shall be of same manufacturer. It should also be type tested as per IEC 61439-1&6.

PLUG IN OPENINGS:

On plug-in bus bar trunking there shall be three dead front, hinged cover type plug-in openings on each side of standard three meter lengths.

All openings shall be usable simultaneously.

All contact on joint and plug-in opening should be silver plated copper.

It shall be possible to inspect the plug-in opening and bus bars prior to the installation of the plug-in unit.

PLUG-IN UNIT SAFETY DEVICES:

Plug-in unit enclosures shall make positive earth connection with the earth bus before the jaws make contact with the phase bars.

The Earthing method shall be such that it cuts through painted surfaces to make the positive earth connection.

Plug in box unit shall have an protection of IP 54 along with the housing so that there is no access to live bus bars once connected.

The plug is provided with internal interlocking mechanism to prevent the plug door being opened whilst energized, ensuring operational safety.

Plug in Boxes shall be suitably Type Tested / as per IEC 61439.

BUS BAR TRUNKING :-

JOINT :

The bus bar trunking joint shall be of the on-bolt type which utilizes a high strength steel bolt(s) and washers to maintain proper pressure over a large contact surface area.

The bolt shall be two-headed design to indicate when proper torque has been applied and require only a standard long handle wrench to be properly activated.

Access shall be required to only one side of the bus bar trunking for tightening joint bolts.

On bus bar trunking, it shall be possible to remove any joint connection assembly to allow electrical isolation or physical removal of a bus bar trunking length without disturbing adjacent bus bar trunking lengths.

SUPPORT :

Hanger spacing shall be noted on layout drawings and shall not exceed manufacturer's recommendations.

Indoor Feeder and plug-in bus bar trunking shall be approved for hanger spacing of up to two meters' for horizontally mounted runs and four meters' for vertically mounted runs. Outdoor feeder bus bar trunking shall be approved for spacing of up to 1.2 meters' for horizontally or vertically mounted runs.

VOLTAGEDROP :-

The voltage drop (input voltage minus output voltage) specified shall be based on the bus bar trunking operating at full rated current and at stabilized operating temperature.

INSTALLATION:

The bus bar trunking construction should be such that no two consecutive pieces be installed as successive TOP and BOTTOM, i.e., there should be a clear mechanical preventer to prevent installation of (TOP) RYBN and (BOTTOM) NBYR.

HYBRID POWER FACTOR CORRECTION PANEL (as per "GREEN" rating system of GHAR (Green Habitat Accomplished Rating))

SCOPE

Design, assembly / fabrication, installation, testing and commissioning of 3 phase, 440 V, 50 Hz TP&N PFC system (Auto + manual option) with Super Heavy Duty type capacitors, microprocessor based controller and Copper wound detuned filter. The unit shall improve the monthly average power factor and mitigate harmonic distortion on the LV bus.

ENCLOSURE

The panel shall be indoor type, free standing, and floor mounting with IP42 degree of protection. It shall be completely made of CRCA sheet steel. The enclosure shall have sturdy support structure with angle supports as necessary and shall be finished with powder coating in

the approved color shade/s to match the color of the other panels. The thickness of powder coating should be 60-80 microns.

Suitable provisions shall be made in the panel for proper heat dissipation. Air aspiration louvers for heat dissipation shall be provided as a necessary.

The front portion shall house the switchgear and the rear portion shall house capacitors and series reactors. The enclosure is to be suitably sized to accommodate all the components, providing necessary air clearance between live and non-live parts, providing necessary working clearance.

There should be compliance for the following:

IEC61921: Power capacitors–Low voltage power factor correction banks.

IEC 61439-1: Low-Voltage Switchgear and Control gear Assemblies - Part 1: Type- Tested and Partially Type-Tested Assemblies.

IEC 62208: Empty enclosures for low-voltage switchgear and control gear assemblies – General requirements

IEC 62262: Degrees of protection provided by enclosures for electrical equipment against external mechanical impacts (IK code)

IEC 61326-1 : Electrical equipment for measurement, control and laboratory use - EMC requirements - Part 1: General requirements.

IEC 61000-6-4: Electromagnetic compatibility – Generic standards – Emission standard for industrial environments

APFC PANEL OPERATION :-

The APFC panel shall, in its default configuration, shall implement the following features through an integrated controller. The integrated controller shall ensure that the reactive current requirement of the base load shall be drawn through the capacitors and the additional requirement shall be automatically catered through active filter ensuring stepless compensation of reactive current. The entire system should function like a single unit delivering complete benefits to the end customer with respect to the below mentioned parameters:

Step-less Power Factor Correction (for both leading and lagging current), Control response time : 25 μ s

Harmonics Compensation up to 51st order (2nd priority) Load Current Balancing in the three phases (3rd priority) THE HPFC PANEL SHALL COMPRISE:

Incomer

A suitably sized as indicated in Four pole MCCB or ACB having microprocessor based over-current and short-circuit protection and at least 50kA breaking capacity (100% Ics) as the incomer of the panel.

Metering and Indication

R, Y, B indication lights for the incomer ACB / MCCB

On, Off & Trip indication lights for the incomer ACB / MCCB

A digital multifunction meter showing voltage, current, frequency, PF, THD, kW, kVA, and other related parameters

Three number of cast resin CTs of suitable rating

One number of three phase digital ammeter showing current in three phases of HPFC panel
An active filter part and a passive filter part; the ratio of the rating of active filter to that of the passive filter shall be at least 1:1

The exact distribution of total capacity between the active and passive part shall depend on the rating of the HPFC panel. In case, we require 350 kVARIGBT based active power filter and 350 kVAR detuned capacitor banks integrated together through a single controller to achieve hybrid power factor correction system.

ACTIVE POWER FILTER

The Active Power Filter (Type APF) is intended to remove harmonic distortion from the phase conductors in a 3-phase electrical system resulting in reduced phase current, reduced current distortion and reduced upstream electrical system harmonic voltage distortion.

PRINCIPLE OF OPERATION

APF should measure level of harmonics in supply line and eliminate it by generating the counter harmonics. It should employ a DSP which determines the harmonic current amplitude to be injected in the opposite phase angle of each harmonic order. Along with harmonic compensation, it should be able to take care of power factor (lead and lag) and unbalance correction at the point of connection.

The active filter shall not only provide harmonic mitigation, but also, power factor correction and load balancing. Harmonic correction, PF correction and Unbalance correction should be able to set with priority.

The active harmonic filter shall mitigate harmonics from the 2nd harmonic up to the 50th harmonic and limit harmonic distortion at their point of connection to within the harmonic limits specified herein. The active filter shall be connected in parallel (shunt) to the load.

The active filter shall be suitable for connection at an electrical distribution panel, transformer secondary or at an individual load.

The active filter shall be suitable for connection to a distorted voltage source and its operation shall not be adversely affected by pre-existing voltage distortion.

The active filter shall be suitable for operation on an electrical system having a generator as its power source.

AHF should have high attenuation greater than 97% of individual harmonics

AHF shall allow selection of any 20 order of harmonics out off 2nd to 51st harmonics order. It should be possible to use filter for single harmonic elimination

PF compensation should be leading as well as lagging APF should be capable of unbalance correction

ESSENTIAL REQUIREMENTS FOR THE POINT OF RELIABILITY

For capacities above 200 Amp onwards the filter design should adapt modular construction The display should be Touch screen SVGA display with true RMS values. The wave form should be visible on the display.

High grade cooling blowers shall be used.

In case of future repair requirements, the same shall be done through card level replacement and not the whole module

ELECTRICAL RATINGS:

System Voltage: 400V AC \pm 10%, 3ph 4 Wire/3 wire Line
voltage tolerance: \pm 10%

System Frequency: 50 Hz Frequency tolerance: 50 Hz \pm 5%

Harmonic Cancellation Current: [30, 60, 75, 100, 150, 200, 300, 400, 600, 800 amps]. Multiple filter units for parallel connection may be used to achieve total current requirements for combined power factor correction and harmonic mitigation.

Possible units of same ratings connected in parallel: Infinite.

Current transformers shall be with Class 0.5 or better with 15VA rating.
Flexibility to select CT ratio shall be also be available.

Surge withstand capability per ANSI/IEEE STD C62.41-1991.
Should comply with IEC/IEEE 62040 – 2 category C3.

The Active harmonic filter shall be of certified design confirming to IEC 60529, CE

EMC Certification IEC/EN 61439-1, As per International Standard: cULus (UL508, CSA 22.2 No. 14), CE Certified, ABS,CE EMC Certification IEC/EN 60439-1, EN 61000-6-4 Class A, EN 61000-6-2, Seismic rating: Complies with IBC and ASCE7

BASIC PRODUCT REQUIREMENTS

The active harmonic filter shall meet the following basic requirements: Active filters shall include input surge suppression.

Active filters shall include forced air cooling system.

Active filter shall be able to connect in both open loop and closed loop configuration

Active filter should have a HMI touch screen display having the functionality of a power analyzer and should display parameters as mentioned below:

Current Parameters: Arms, A1rms, iTHD (%), Aunb

Voltage Parameters: Vrms, V1rms, Urms, vTHD (%), Vunb, Frequency

Power Parameters: Active, Reactive, Apparent Power

Power Factor

Displacement Power Factor

Filter Parameters: Apk, Filter Utilization, Stack Temperature, DC Voltage, Filter Runtime, Fan Runtime, Panel Temperature

Voltage and current waveforms

Voltage and current Harmonic spectrum Alarm indications & log details

Product warranty period shall be one (1) year.

Active filter shall be isolated from the power supply when powered "off". IGBT modules shall be self-protected for maximum reliability.

The response time shall be at least 25 μ s and the correction time shall be less than 10 ms AHF shall have auto fold back feature.

Construction:

Constructed on metal panel with IP 42.

Filter shall be suitable for operation upto an ambient temperature 45oC with suitable ventilation and shall give an alarm signal in case of temperature going beyond a set limit.

Shall be able to work with higher temperature with automatic de-rating (80% capacity at 50oC) Storage temperature shall be from 0oC to 70oC with suitable packing

Active filters shall be suitable for operation in relative humidity up to 95% non-condensing. Panel shall have an audible noise level lesser than 65db

Panel shall have a filtering efficiency of at least 97%

Panel shall have a reaction time of at least 25 micro-seconds Power factor correction shall always be set at priority

Priority selection between the remainder features - harmonics compensation and load balancing - shall be programmable at the time of commissioning. In the default mode, harmonics compensation is set at 2nd priority and load balancing is set at 3rd priority

Auto fold-back of the HPFC panel if total current requirement exceeds the rated capacity of the panel

All live parts of the system shall be properly shrouded

Inspection terminal strip, number ferruling, and other labeling shall be suitably provided Stickers marked with "DANGER" shall be provided wherever required

Detailed drawings and manuals shall be provided wherever required Following protections shall be provided:

Over voltage (AC) protection
Over voltage (DC) protection
Phase sequence protection
Over current protection

Over temperature protection

Protection circuits for the inverter stack and its components

All components and wiring used in the system shall adhere to the relevant ISI and IEC standards

SWITCHGEAR & PROTECTION

Incomer switchgear shall be TP&N breaker appropriate rating. Suitable contactor for each step shall be used and must be capable of capacitor switching duty at each step for short circuit protection.

Bus bars shall be suitably color coded and must be mounted on appropriate insulator supports.

Power cables used shall have superior mechanical, electrical and thermal properties, and shall have the capability to continuously operate at very high temperatures up to 125 deg.C.

Internal wiring between main bus-bars, breaker, contactor and capacitors shall be made with 1100 V grade, PVC insulated, copper conductor cable of appropriate size, by using suitable copper crimping terminal ends etc.

Suitable bus links for input supply cable termination shall be provided.

CONTROL CIRCUIT & GENERAL PROTECTION

The control circuit shall be duly protected by using suitable rating MCB.

An emergency stop push button shall be provided to trip the entire system (22.5 mm dia, mushroom type, press to stop and turn to reset).

Wiring of the control circuit shall be done by using 1.5 sq.mm, 1100 V grade, PVC insulated, multi-stranded copper control wire.

Inspection terminal strip, number ferruling, labeling etc. shall be provided. 440 V caution board on the panel shall be provided.

CAPACITORS

The capacitor shall comply with the following standards (and their latest amendments): IS 13340-1993, IS 13341-1992, IEC 60831-1+2

General specifications: 3 phase, delta connected, 50 Hz.

Voltage: Must be designed to withstand system over voltage, increased voltage due to series reactor and harmonics.

Capacitor type: Super heavy duty with double side metalized capacitor tissue paper. Oil impregnated and self-healing type with bi-axially oriented polypropylene film shall be fitted with pressure sensitive disconnecter in each individual capacitor cell.

Over voltage +10% (12h / 24h), + 15% (30m / 24h), + 20% (5m), +30% (1m) as per Clause 6.1 of IS 13340-1993.

Over current: 2.5 x In Peak Inrush current withstand: (350) x In

Total watt-losses including discharge resistors: <0.45 W / k V Ar.

Temperature category: -25 deg.C to 65 deg.C.

Capacitor shall be self-heating type and oil impregnated for longer life. The impregnate shall be non-PCB, biodegradable type, must be properly treated and de-gasified, so as not to have any degeneration properties and shall be non-oxidizing.

The design shall be modular for simple mechanical assembly, no extra accessories/ metal parts to be required. Unit must be free standing with an IP 42 protection level.

CAPACITOR CONSTRUCTION

Capacitor Unit

Each step in the Hybrid power factor correction panel shall comprise of single unit or group of units connected in parallel to form a bank. Each capacitor unit / module shall be provided with Pressure Sensitive Disconnecter or inbuilt fuses for safe disconnection. Each capacitor unit shall comprise of number of single-phase elements connected Delta configuration. All capacitor unit shall be provided with discharge resistors, which shall discharge the capacitors to less than 50 V within 1 minutes.

Capacitor Elements

Each element shall be wound from continuous reels of high quality polypropylene film combined with dual side metalized paper in the dielectric structure to form a cylindrical winding. Elements shall be vacuum dried, impregnated under high vacuum with non PCB oil.

SERIES REACTOR

Application

LV Harmonic Filters Copper Wound 14% reactor shall be used with harmonic filter duty power capacitors to mitigate harmonics, improve power factor and avoid electrical resonance in LV electrical networks. Capacitor voltage shall be 525 V when used with 14% reactors.

Construction, Testing & Protection

The low voltage filter reactor shall be series type having a three phase, iron core construction suitable for indoor use (IP 00). The reactor shall be air cooled and the layout shall be in accordance with IEC 60076.

The complete unit shall be impregnated under vacuum and over-pressure in impregnation resin and shall be suitable for temperature Class H (T60/H) operation.

The reactor shall be tested using a separate source voltage test of 3.0kV (coil to core) for 1 minute as per IEC 60076/3.

The permitted tolerance of inductance shall be + 3% of rated inductance value.

Reactor tuning factor shall be 14% and the current rating of the reactor shall include the effects of harmonics and other possible over-currents.

The limit of linearity of inductance of the filter reactor shall be as follows $1.2 \square \square \square \square$ with $L = 0.95 LN$

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.

ENERGY METERS FOR HT INCOMERS :-

Power Quality Analyser - High end power quality analyser with Class 0.2 active energy Accuracy with Sag/Swell - Waveform capture and Individual harmonics monitoring upto 63rd. Power Quality analyser needs to be capable of Disturbance direction detection with onboard dual ethernet Port communication.

Basic Parameters	Current, voltage, frequency Active, reactive, apparent power Total and per phase Power factor Total and per phase Current measurement range (auto ranging) 0.05 - 10A
Energy Parameters	Active, reactive, apparent energy Settable accumulation modes
Demand Parameters	Current Present and max. values Active, reactive, apparent power - Present and max. values Predicted active, reactive, apparent power Synchronisation of the measurement window Setting of calculation mode - Block/sliding

Power Quality Parameters	Total Harmonic distortion Current and voltage Individual harmonics - Upto 63rd Waveform capture Detection of voltage swells and sags Disturbance Direction detection
Sampling Rate / Cycle	256 Samples/ Cycle
Data Recording	512MB of standard non-volatile memory. 10 MB of standard non-volatile memory dedicated to capture billing data, events, and waveforms.Logs of Min/max of instantaneous values, Event logs, Trending/ forecasting, SER (Sequence of event recording).
Class Accuracy	Active Energy - Class 0.2S IEC 62053-22 , Reactive Energy Class - 0.5S IEC 62053-24, Power Factor - Class 0.5 as per IEC 61557-12
PQ Standards	PQ compliance reporting as per IEC 61000-4-30 Class S, - IEC 62586 PQI-S
Communication	Onboard Dual ethernet port for daisy chaining over ethernet. Meters need to have Modbus Mastering capability by connecting Slave devices over RS485 port
Time Synchronisation	GPS clock millisecond. (RS485) or IRIG-B (digital input) to +/- 1
Digital IO	Standard: 3 digital status inputs for Breaker ON/OFF/Trip monitoring & 1 KY (form A) energy pulse output for interfacing with other systems. Expandable DI/DO, ADI/ADO capability
Display	Bright LCD colour display with meter dimension 96 X 96 mm only

METERS FOR LT PANEL AND OTHERS :-

Multifunction Meter - Multifunction meters with Power and harmonics monitoring capturing abnormalities in the system with date and time stamp	
Basic Parameters	Current - Average line current of 3-phase, per-phase, and calculated neutral current Voltage Average voltage of L-L, L-N parameters, and per-phase Frequency Displacement power factor Average and per-phase signed True power factor Average and per-phase signed % unbalance among the phase for I, V L-N, V L-L
Energy & Power Parameters	Real, reactive, and apparent power Total and per-phase value Accumulated Active, Reactive and Apparent Energy, Received and Delivered registers, Net and absolute energy values, time counters
Demand Parameters	Current average, Active power, Reactive power, Apparent power - Present, Last, Predicted, Peak, and Peak Date Time Demand sync methods Thermal, Timed, Command Sync, and Clocked Sync Demand calculation mode Sliding, fixed and rolling block Demand intervals - settable from 1 to 60 minutes

Power Quality Parameters	THD as per IEC 61557-12 for THD and individual harmonics up to 15th over communication
Sampling Rate / Cycle	64 Samples / Cycle
Class Accuracy	Active energy - Class 0.5S as per IEC 62053-22
Communication	RS 485 port Modbus RTU and disabling RS485 port against unauthorized access.
Calibration LED	configurable from 1 to 9999000 pulses/k_h (kWh, kVAh, or kVARh)
Min/Max values	instantaneous parameters with timestamp
Display	Bright red colour LED display with meter dimension 96 X 96 mm only

SAFETY MATERIALS :-

- A. Insulation Mats
- B. First Aid charts and First Aid Box
- C. Danger Plate
- D. Fire Extinguishers
- E. Fire Buckets
- F. Tool Box
- G. Caution Board
- H. Key Board

APPLICABLE CODES & STANDARDS

- A. IS : 15652 Insulation mats
- B. IS : 2878 Portable CO2 Fire Extinguisher
- C. IS : 2546 : Fire Buckets
- D. ANSI/NFPA 70 - National Electrical Code.

INSULATION MATS

Insulation mats conforming to IS: 15652 shall be provided in front of main switch boards and other control equipment as specified.

FIRST AID CHART AND FIRST AID BOX

Charts (one in English, one in Hindi, one in Regional Language), displaying methods of giving artificial respiration to a recipient of electrical shock shall be prominently provided at appropriate places. Standard First Aid Boxes containing materials as prescribed by St. John Ambulance brigade or Indian Red Cross should be provided in sub-station.

DANGER PLATE

Danger plates shall be provided on HV and LV equipments. LV danger notice plate shall be 200 mm x 200 mm made of mild steel atleast 2 mm thick vitreous enamelled white on both sides and with inscriptions in signal red colour on front side as required.

Size of the HV Danger Notice plate shall be 250 mm x 200 mm and 2 mm thick.

FIRE EXTINGUISHERS

Portable CO2 conforming to IS: 2878-1976 dry chemical (conforming to IS 2171-1976) extinguishers shall be installed in the sub-station at suitable places (like HT/LT panel rooms) as specified.

Foam type fire extinguisher shall be installed in Transformer Room.

FIRE BUCKETS

Fire buckets conforming to IS: 2546-1974 shall be installed with the suitable stand for storage of water and sand.

TOOL BOX

A standard tool box containing necessary tools required for operation and maintenance shall be provided in sub-station.

CAUTION BOARD

Necessary number of caution boards such as "Man on Line" "Don't switch on" etc. shall be available in the sub-station.

The Caution Board shall be of size 300 mm x 200mm made of mild steel, 2mm thick, vitreous enamelled white on both sides and with inscriptions in original red colour on front side as required.

KEY BOARD

A key board of required size shall be provided at a proper place containing castel keys, and all other keys of sub-station and allied areas.

The Key board shall be made of 12mm thick first class teak wood shall be of size 400 mm x 300m and with adequate depth to hold the keys. It shall be provided with a lockable type hinged glass door made of 12 mm. thick first class teakwood frame with 3 mm thick sheet glass fixed with piano hinges. The key board shall enough number of hooks for hanging the castle keys and all other keys of the sub-station and allied areas. It shall be painted with one coat of wood primer and two coats of white enamel paint.

PACKAGE – 4(Addressable FAS & PA System)

INTELLIGENT ADDRESSABLE FIRE ALARM AND DIGITAL EVACUATION SYSTEM

SCOPE: TECHNICAL SPECIFICATIONS FOR FIRE FIGHTING WORK

This section covers the technical requirements of design, manufacture, testing at works, supply, installation, testing at the site of work and commissioning of Fire Alarm system & PA System.

The work comprising of automatic fire alarm & PA system to be carried out as per below:

- As per BOQ of the NIT
- CPWD SPECIFICATION FOR ELECTRICALWORK PART-VI fire detection and Alarm System 2018.
- NBC 2026

INSTRUCTION & TRAINING

A. Instruction shall be provided as required for operating the system. Hands-on demonstrations of the operation of all system components and the entire system including program changes and functions shall be provided.

B. The contractor and / or the systems manufacturer's representatives shall provide a type written "Sequence of Operation."

Certificate need to procured by the agency:

1. FIRE SAFETY CERTIFICATE (After completion of project). All the coordination with fire department and various stake holder has to be done by the contractor for obtaining the Fire NOC.

NO OBJECTION CERTIFICATE FROM LOCAL FIRE OFFICER:

The agency is required to obtain the no objection certificate from local fire authority after the physical completion of the work. The necessary testing and liasoning work to be carried out in close coordination with local fire officer for obtaining the NOC for the building. The work will be treated as incomplete if NOC is not submitted. This will be treated as work in the scope of contractor only any delay in this regard will be delay in the work in the scope of contractor only.

1.1 GENERAL :-

A. The fire alarm system shall comply with requirements of NFPA Standard 72 for Protected Premises Signaling Systems except as modified and supplemented by this specification. The system shall be electrically supervised and monitor the integrity of all conductors.

B. The facility shall have an emergency voice alarm communication system. Digitally stored message sequences shall notify the building occupants that a fire or life safety condition has been reported. Message generator(s) shall be capable of automatically distributing up to eight (8) simultaneous, unique messages to appropriate audio zones within the facility based on the type and location of the initiating event. The Fire Command Center (FCC) shall also support Emergency manual voice announcement capability for both system wide or selected audio zones, and shall include provisions for the system operator to override automatic messages system wide or in selected zones.

C. The system shall support additional, alternate Fire Command Centers, which shall be capable of simultaneous monitoring of all system events. Alternate Fire Command Centers shall also support an approved method of transferring the control functions to an alternate Fire Command Center when necessary. All Fire Command Centers shall be individually capable of assuming Audio Command functions such as Emergency Paging, audio zone control functions, and Firefighter's Telephone communication functions.

D. Each designated zone shall transmit separate and different alarm, supervisory and trouble signals to the Fire Command Center (FCC) and designated personnel in other buildings at the site via a multiplex communication network.

E. The Contractor shall be required to obtain NOC from Chief Fire Officer, and work shall be deemed to be completed only after receiving NOC from CFO & rectification if any. Statutory fee if any shall be paid by department. However all liasoning work / arranging inspection of CFO shall be the responsibility of contractor.

1.2 SCOPE

A. A new intelligent reporting, microprocessor controlled fire and gas detection system shall be installed in accordance to the project specifications and drawings.

B. Basic Performance:

1. Alarm, trouble and supervisory signals from all intelligent reporting devices shall be encoded on NFPA Class A Signaling Line Circuits (SLC).

2. Device Circuits (IDC) shall be wired NFPA Class A as part of an addressable device connected by the SLC Circuit.

3. Notification Appliance Circuits (NAC) shall be wired NFPA Class A as part of an addressable device connected by the SLC Circuit.

4. On Class A configurations a single ground fault or open circuit on the system Signaling Line Circuit shall not cause system malfunction, loss of operating power or the ability to report an alarm.

5. Alarm signals arriving at the FACP shall not be lost following a primary power failure (or outage) until the alarm signal is processed and recorded.

6. Speaker circuits may be controlled by NAC outputs built into the amplifiers, which shall function as addressable points on the Digital Audio Loop.

7. NAC speaker circuits shall be arranged such that there is a minimum of one speaker circuit per floor of the building or smoke zone whichever is greater.

8. Audio amplifiers and tone generating equipment shall be electrically supervised for normal and abnormal conditions.

9. NAC speaker circuits and control equipment shall be arranged such that loss of any one (1) speaker circuit will not cause the loss of any other speaker circuit in the system.

Two-way emergency telephone communication circuits shall be supervised for open and short circuit conditions.

Speaker circuits shall be arranged such that there is a minimum of one speaker circuit per smoke zone.

Speaker circuits shall be electrically supervised for open and short circuit conditions. If a short circuit exists on a speaker circuit, it shall not be possible to activate that circuit.

10. Audio amplifiers and tone generating equipment shall be electrically supervised for abnormal conditions. Digital amplifiers shall provide built-in speaker circuits, field configurable as four Class B, or two Class A circuits.

11. Digital amplifiers shall be capable of storing up to two minutes of digitally recorded audio messages and tones. The digital amplifiers shall also be capable of supervising the connection to the associated digital message generator, and upon loss of that connection shall be capable of one of the following system responses:

- a. The digital amplifier shall automatically broadcast the stored audio message.
- b. The digital amplifier shall switch to a mode where a local bus input on the digital amplifier will accept an input to initiate a broadcast of the stored message. This bus input shall be connected to a NAC on a local FACP for the purpose of providing an alternate means of initiating an emergency message during a communication fault condition.
- c. Speaker circuits shall be either 25 VRMS or 70VRMS. Speaker circuits shall have 20% space capacity for future expansion or increased power output requirements.
- d. Two-way emergency telephone (Fire Fighter Telephone) communication shall be supported between the Audio Command Center and up to thirty (30) remote Fire Fighter's Telephone locations simultaneously on a conference in multiple FFT Risers.
- e. Means shall be provided to connect FFT voice communications to the speaker circuits in order to allow voice paging over the speaker circuit from a telephone handset.
- f. The digital audio message generator shall be of reliable, non-moving parts, and support the digital storage of up to 32 minutes of tones and emergency messages, shall support programming options to string audio segments together to create up to 1000 messages, or to loop messages and parts of messages to repeat for pre-determined cycles or indefinitely.

1.3 DESIGN INTENT

F. Main fire alarm panel with digital voice command system, Fire fighters telephone, amplifier, zone selector keypad and announcement console – Ground floor – Near passenger lift lobby.

- a. Secondary fire alarm panels- At each level – near lift lobby
- b. Active repeater panels at security cabin
- c. All fire alarm panels connected as pier to pier.
- d. Fire survival cables (1010 deg. at 2 hours as per UL 2196)
- e. Class - A cabling to loop all detectors, devices & MCP's to control panel.
- f. Coverage per detector as per NFPA -2015, considering > 60 ACH
- g. System integration (Soft integration) with all standalone panels such as agent release panels for deluge valves, Pre-action panels, lift switchboard, DG fresh air switchboard, etc
- h. Wireless Detectors shall be used in Advocate Chambers to avoid cabling & of same make as of Fire Alarm System.
- i. VESDA (Very Early Smoke Detection Apparatus) to cover the false flooring and room void areas of Data Hall, UPS, Battery rooms and MMR.
- j. Emergency communication system, integral with the Main FACP, including voice alarm system components, microphones, amplifiers, zone selector keypads and tone generators
- k. Audible Alarm Notifications
- l. Fire fighters telephone system as part of main fire alarm system which is two-way, supervised voice communication proposed to link between the MFACP and remote fire fighters' telephone stations throughout the building (at all staircases at all levels)

1.4 GENERAL INSTRUCTIONS

- a. Protect from moisture by using appropriate coverings. Store at dry interior locations.
- b. Sequence work to avoid interferences with building finishes and installation of other products.
- c. Supply as maintenance stock, consumable devices, components as recommended by OEM, but shall not be less than two units of each type/ rating of installed consumable material/ component/ device.
- d. For ease of service all panel I/O wiring terminal blocks shall be removable, plug-in types and have sufficient capacity for #18 to #12 AWG wire. Terminal blocks that are permanently fixed are not acceptable.

1.5 WARRANTY

a. The fire alarm control panel, voice panels and any head-end equipment shall have a manufacturer's warranty of 36 months.

1.6 APPLICABLE STANDARDS AND PRODUCT APPROVALS

a. The specifications and standards listed below form a part of this specification. The system shall fully comply with the latest issue of these standards, if applicable.

b. National Fire Protection Association (NFPA)- USA:

<i>NFPA 12</i>	<i>Extinguishing Systems (low and high)</i>
<i>NFPA 12A</i>	<i>Halon 1301 Extinguishing Systems</i>
<i>NFPA 13</i>	<i>Sprinkler Systems</i>
<i>NFPA 15</i>	<i>Water Spray Systems</i>
<i>NFPA 16</i>	<i>Foam / Water Deluge and Spray Systems</i>
<i>NFPA 17</i>	<i>Dry Chemical Extinguishing Systems</i>
<i>NFPA 17A</i>	<i>Wet Chemical Extinguishing Systems</i>
<i>NFPA 2001</i>	<i>Clean Agent Extinguishing Systems</i>
<i>NFPA 70</i>	<i>National Electric Code</i>
<i>NFPA 90A</i>	<i>Air Conditioning Systems</i>
<i>NFPA 92A</i>	<i>Smoke Control Systems</i>
<i>NFPA 92B</i>	<i>Smoke Management Systems in Malls, Atria, Large Areas</i>
<i>NFPA 72</i>	<i>National Fire Alarm Code</i>
<i>NFPA 101</i>	<i>Life Safety Code</i>

c. Underwriters Laboratories Inc. (UL) - USA:

<i>UL 268, 7th Edition</i>	<i>Smoke Detectors for Fire Protective Signaling Systems</i>
<i>UL 864, 10th Edition</i>	<i>Control Units for Fire Protective Signaling Systems</i>
<i>UL 2572</i>	<i>Mass Notification Systems</i>
<i>UL 217</i>	<i>Smoke Detectors, Single and Multiple Station</i>
<i>UL 228</i>	<i>Door Closers - Holders for Fire Protective Signaling Systems</i>
<i>UL 268A</i>	<i>Smoke Detectors for Duct Applications</i>
<i>UL 521</i>	<i>Heat Detectors for Fire Protective Signaling Systems</i>
<i>UL 464</i>	<i>Audible Signaling Appliances</i>
<i>UL 38</i>	<i>Manually Actuated Signaling Boxes</i>
<i>UL 1481</i>	<i>Power Supplies for Fire Protective Signaling Systems</i>
<i>UL 346</i>	<i>Waterflow Indicators for Fire Protective Signaling Systems</i>
<i>UL 1076</i>	<i>Control Units for Burglar Alarm Proprietary Protective Signaling Systems</i>
<i>UL 1971</i>	<i>Visual Notification Appliances</i>
<i>UL 2017</i>	<i>Standard for General-Purpose Signaling Devices and Systems</i>
<i>UL60950</i>	<i>Safety of Information Technology Equipment</i>

d. Factory Mutual – USA

e. Local and State Building Codes.

f. All requirements of the Authority Having Jurisdiction (AHJ).

The system shall be listed by the national agencies as suitable for extinguishing release applications. The system shall support release of low pressure CO2.

g. The system shall be certified for seismic applications in accordance with the International Building Code (IBC). The basis for qualification of seismic approval shall be via shake table testing.

h. The System shall be FM 6320 (Factory Mutual) approved as a Gas Detection system when employed with the 4-20 monitor module and industry standard 4-20 mA gas detectors.

PART 2.0 PRODUCTS

2.1 MAIN FIRE ALARM CONTROL PANEL OR NETWORK NODE:

a. Main FACP or network node shall contain a microprocessor based Central Processing Unit (CPU) and power supply. The CPU shall communicate with and control the following types of equipment used to make up the system: intelligent addressable smoke and thermal (heat) detectors, addressable modules, printer, annunciators, and other system controlled devices.

b. In conjunction with intelligent Loop Control Modules and Loop Expander Modules, the main FACP shall perform the following functions:

1. Supervise and monitor all intelligent addressable detectors and monitor modules connected to the system for normal, trouble and alarm conditions.
2. Supervise all initiating signaling and notification circuits throughout the facility by way of connection to addressable monitor and control modules.
3. Detect the activation of any initiating device and the location of the alarm condition. Operate all notification appliances and auxiliary devices as programmed.

c. WIRELESS DETECTORS:

1. Class A Hybrid wireless mesh network/ bi-directional communications.
2. India ISM Frequency band 865-867 MHz
3. Channel Bandwidth – 200 KHz / Data power 5dB (3mW) / transmit power -17 dBm/ No Frequency hopping.
4. Range : Max 200-250 meters of distance between last wireless detector to wireless gateway
5. Max # of wireless detectors in a Panel : Each panel irrespective of the panel capacity, should be able to connect to atleast 3 wireless gateways which in turn should be able to connect with 31 wireless detectors per gateway
6. UL Certification – Gateway UL 864 10th Edition | Detector UL268, 521 7th Edition / compliant to EN-54, part 25
7. Battery life : 5 years

System Capacity and General Operation

- A. The FACP shall be able to communicate on a peer-to-peer, inherently regenerative

communication format and protocol. The network shall support communication speed up to 100 Mbps and support up to 200 panels / nodes per network.

B. The control panel shall be capable of expansion via up to 10 SLC loops and 2 SLC Loops as per Items mentioned in SOQ. Each loop shall support 240 analog/addressable devices for a system capacity of 3000 points. The Fire Alarm Control Panel shall include a full featured operator interface control and annunciation panel that shall include a backlit 240 X 64 pixel -character liquid crystal display, individual, color coded system status LEDs, and a QWERTY style alphanumeric QWERTY keypad for the field programming and control of the fire alarm system. Said LCD shall also support graphic bit maps capable of displaying the company name and logo of either come owner or installing company.

C. All programming or editing of thmming or editing of the existing program in the system shall be achieved without special equipment and without interrupting the alarm monitoring functions of the fire alarm control panel.

D. The FACP shall be able to provide the following software and hardware features:

1. Pre-signal and Positive Alarm Sequence: The system shall provide means to cause alarm signals to only sound in specific areas with a delay of the alarm from 60 to up to 180 seconds after start of alarm processing. In addition, a Positive Alarm Sequence selection shall be available that allows a 15-second time period for acknowledging an alarm signal from a fire detection/initiating device. If the alarm is not acknowledged within 15 seconds, all local and remote outputs shall automatically activate immediately.

Smoke Detector Pre-alarm Indication at Control Panel: To obtain early warning of incipient or potential fire conditions, the system shall support a programmable option to determine system response to real-time detector sensing values above the programmed setting. Two levels of Pre-alarm indication shall be available at the control panel: alert and action.

2. Alert: It shall be possible to set individual smoke detectors for pre-programmed pre-alarm thresholds. If the individual threshold is reached, the pre-alarm condition shall be activated.

3. Action: If programmed for Action and the detector reaches a level exceeding the pre-programmed level, the control panel shall indicate an action condition. Sounder bases installed with either heat or smoke detectors shall automatically activate on action Pre-Alarm level, with general evacuation on Alarm level.

4. The system shall support a detector response time to meet world annunciation requirements of less than 3 seconds.

5. Device Blink Control: Means shall be provided to turn off detector/module LED strobes for special areas.

6. NFPA 72 Smoke Detector Sensitivity Test: The system shall provide an automatic smoke detector test function that meets the sensitivity testing requirements of NFPA 72.

7. Programmable Trouble Reminder: The system shall provide means to automatically initiate a reminder that troubles exist in the system. The reminder will appear on the system display and (if enabled) will sound a piezo alarm.

8. On-line or Off-line programming: The system shall provide means to allow panel programming either through an off-line software utility program away from the panel or while connected and on-line. The system shall also support upload and download of programmed database and panel executive system program to a Personal Computer/laptop. A single change to one CPU database shall not require a database download to other CPUs.

9. History Events: The panel shall maintain a history file of atleast 5000 events, each with a time and date stamp. History events shall include all alarms, troubles, operator actions, and programming entries. The control panels shall also maintain a 1000 event Alarm History buffer, which consists of the 1000 most recent alarm events from the 5000 event history file.

10. Smoke Control Modes: The system shall provide means to perform Fire Smoke Control Station mode. This mode controls all dampers, smoke extraction fan, fresh air supply fans, etc during Fire condition. Smoke Control to meet NFPA-92A and 90B and HVAC mode to meet NFPA 90A.

11. The system shall provide means for all SLC devices on any SLC loop to be auto programmed into the system by specific address. The system shall recognize specific device type ID's and associate that ID with the corresponding address of the device.

12. Passwords and Users: The system shall support two password levels, master and user. Up to 9 user passwords shall be available, each of which may be assigned access to the programming change menus, the alter status menus, or both. Only the master password shall allow access to password change screens.

13. Block Acknowledge: The system shall support a block Acknowledge for Trouble Conditions

14. Sensitivity Adjust: The system shall provide Automatic Detector Sensitivity Adjust based on Occupancy schedules including a Holiday list of up to 15 days.

15. Environmental Drift Control: The system shall provide means for setting Environmental Drift Compensation by device. When a detector accumulates dust in the chamber and reaches an

unacceptable level but yet still below the allowed limit, the control panel shall indicate a maintenance alert warning. When the detector accumulates dust in the chamber above the allowed limit, the control panel shall indicate a maintenance urgent warning.

16. Custom Action Messages: The system shall provide means to enter up to 100 custom action messages of up to 160 characters each. It shall be possible to assign any of the 100 messages to any point.

17. Local Mode: If communication is lost to the central processor the system shall provide added survivability through the intelligent loop control modules. Inputs from devices connected to the SLC and loop control modules shall activate outputs on the same loop when the inputs and outputs have been set with point programming to participate in local mode or when the type codes are of the same type: that is, an input with a fire alarm type code shall activate an output with a fire alarm type code.

18. Read status preview - enabled and disabled points: Prior to re-enabling points, the system shall inform the user that a disabled device is in the alarm state. This shall provide notice that the device must be reset before the device is enabled thereby avoiding activation of the notification circuits.

Custom Graphics: When fitted with an LCD display, the panel shall permit uploading of a custom bit-mapped graphic to the display screen.

1. Group Decision Making by Smoke Detectors: The system shall provide means to link one detector with minimum two more detectors in group decision making. The group of minimum three detectors shall work in tandem to take fast and genuine alarm decision mitigating the risk of false alarm. There shall be no requirement of cross zoning or mandatory sequential address setting in the detectors to achieve this function. This shall be a built-in intelligence in the system to take fast & reliable decision on genuine alarm triggering. The alarm event shall be a result of group of detector chamber readings considered as a consolidated alarm signal.
2. ACTIVE EVENT: The system shall provide a Type ID called FIRE CONTROL for purposes of air-handling shutdown, which shall be intended to override normal operating automatic functions. Activation of a FIRE CONTROL point shall cause the control panel to (1) initiate the monitor module Control-by-Event, (2) send a message to the panel display, history buffer, installed printer and annunciators, (3) shall not light an indicator at the control panel, (4) Shall display ACTIVE on the LCD as well a display a FIRE CONTROL Type Code and other information specific to the device.
3. NON-FIRE Alarm Module Reporting: A point with a type ID of NON-FIRE shall be available for use for energy management or other non-fire situations. NON-FIRE point operation shall not affect control panel operation nor shall it display a message at the panel LDC. Activation of a NON-FIRE point shall activate control by event logic but shall not cause any indication on the control panel.
4. Mass Notification Override: The system shall be UL 2572 listed for Mass Notification and shall be capable, based on the Risk Analysis, of being programmed so that Mass Notification/Emergency Communications events take precedence over fire alarm events.
5. Security Monitor Points: The system shall provide means to monitor any point as a type security.
6. One-Man Walk Test: The system shall provide both a basic and advanced walk test for testing the entire fire alarm system. The basic walk test shall allow a single operator to run audible tests on the panel. All logic equation automation shall be suspended during the test and while annunciators can be enabled for the test, all shall default to the disabled state. During an advanced walk test, field-supplied output point programming will react to input stimuli such as Control By Event and logic equations. When points are activated in advanced test mode, each initiating event shall latch the input. The advanced test shall be audible and shall be used for pull station verification, magnet activated tests on input devices, input and output device and wiring operation/verification.
7. Control By Event Functions: CBE software functions shall provide means to program a variety of output responses based on various initiating events. The control panel shall operate CBE through lists of zones. A zone shall become listed when it is added to a point's zone map through point programming. Each input point such as detector, monitor module or panel circuit module shall support listing of up to 10 zones into its programmed zone map.
8. Permitted zone types shall be general zone, releasing zone and special zone. Each output point (control module, panel circuit module) can support a list of up to 10 zones including general zone, logic zone, releasing zone and trouble zone. It shall be possible for output points to be assigned to list general alarm. Non-Alarm or Supervisory points shall not activate the general alarm zone.
9. 1000 General Zones: The system shall support up to 1000 general purpose software zones for linking inputs to outputs. When an input device activates, any general zone programmed into that device's zone map will be active and any output device that has an active general zone in its

- map will be active. It shall also be possible to use general zone as arguments in logic equations.
10. 1000 Logic Equations: The system shall support up to 1000 logic equations for AND, OR, NOT, ONLY1, ANYX, XZONE or RANGE operators that allow conditional I/O linking. When any logic equation becomes true, all output points mapped to the logic zone shall activate.
 19. 100 trouble equations per device: The system shall provide support for up to 100 trouble equations for each device, which shall permit programming parameters to be altered, based on specific fault conditions. If the trouble equation becomes true, all output points mapped to the trouble zone shall activate Control-By-Time: A time based logic function shall be available to delay an action for a specific period of time based upon a logic input with tracking feature. A latched version shall also be available. Another version of this shall permit activation on specific days of the week or year with ability to set and restore based on a 24 hour time schedule on any day of the week or year.
 20. Multiple agent releasing zones: The system shall support up to 10 releasing zones to protect against 10 independent hazards. Releasing zones shall provide up to three cross-zone and four abort options to satisfy any local jurisdiction requirements.
 21. Alarm Verification, by device, with timer and tally: The system shall provide a user-defined global software timer function that can be set for a specific detector. The timer function shall delay an alarm signal for a user-specified time period and the control panel shall ignore the alarm verification timer if another alarm is detected during the verification period. Secure/Access Operation: The system shall have the capability of configuring input modules to monitor status of door contact or other security type sensors. These input modules shall be able to be commanded from the normally 'Secure' state to an 'Access' state. While in the secure state, the module will transmit alarm conditions to the controller, which shall be annunciated on the LCD and LED displays. The modules shall be placed into the Access state either through the LCD display or through predefined operator keys. While in the Access state, all alarms from the module will be shunted. Placing the module into the access state shall cause a discrete LED associated with input point to flash, but no other trouble or disable condition will be annunciated. Change from Secure to Access and reverse shall be transmitted to the central monitoring station on a per zone basis. Systems that cause or indicate a trouble or disable condition are unacceptable.

E. Central Processing Unit

1. The Central Processing Unit shall contain and execute all control-by-event (including Boolean functions including but not limited to AND, OR, NOT, ANYx, and CROSSZONE) programs for specific action to be taken if an alarm condition is detected by the system. Such control-by-event programs shall be held in non-volatile programmable memory, and shall not be lost with system primary and secondary power failure.
2. The Central Processing Unit shall also provide a real-time clock for time annotation, to the second, of all system events. The time-of-day and date shall not be lost if system primary and secondary power supplies fail.
3. The CPU shall be capable of being programmed on site without requiring the use of any external programming equipment. Systems that require the use of external programmers or change of EPROMs are not acceptable.
4. The CPU shall provide an RS-232 interface between the fire alarm control panel and the UL Listed Electronic Data Processing (EDP) peripherals.
5. The CPU shall provide two RS-485 ports for the serial connection to annunciation and control subsystem components.
6. The RS-232 serial output circuit shall be optically isolated to assure protection from earth ground.
7. In the event of CPU failure, all SLC loop modules shall fallback to degrade mode. Systems not offering degrade mode shall offer Redundant CPU. Such degrade mode shall treat the corresponding SLC loop control modules and associated detection devices as conventional two-wire operation. Any activation of a detector in this mode shall automatically activate associated Notification Appliance Circuits.

F. Display

1. The system display shall provide a 240 X 64 pixel -character backlit alphanumeric Liquid Crystal Display (LCD). It shall also provide eleven Light-Emitting-Diodes (LEDs) that indicate the status of the following system parameters: AC POWER, FIRE ALARM, PREALARM, SECURITY, SUPERVISORY, SYSTEM TROUBLE, OTHER EVENT, SIGNALS SILENCED, POINT DISABLED, CONTROLS ACTIVE, and CPU FAILURE.
2. These characters shall be only for fire alarm / trouble information and not for Logo or other purpose. It shall be UL Listed. Repeater panel displays in FACP is not allowed unless until approved by UL
3. The system display shall provide a QWERTY style keypad for ease of operation.

4. The keypad shall have control capability to command all system functions, entry of any alphabetic or numeric information, and field programming without the use of any external Control-By-Time: A time based logic function shall be available to delay an action for a specific period of time based upon a logic input with tracking feature. A latched version shall also be available. Another version of this shall permit activation on specific days of the week or year with ability to set and restore based on a 24 hour time schedule on any day of the week or year.

5. Multiple agent releasing zones: The system shall support up to 10 releasing zones to protect against 10 independent hazards. Releasing zones shall provide up to three cross-zone and four abort options to satisfy any local jurisdiction requirements.

6. Alarm Verification, by device, with timer and tally: The system shall provide a user-defined global software timer function that can be set for a specific detector. The timer function shall delay an alarm signal for a user-specified time period and the control panel shall ignore the alarm verification timer if another alarm is detected during the verification period. Secure/Access Operation: The system shall have the capability of configuring input modules to monitor status of door contact or other security type sensors. These input modules shall be able to be commanded from the normally 'Secure' state to an 'Access' state. While in the secure state, the module will transmit alarm conditions to the controller, which shall be annunciated on the LCD and LED displays. The modules shall be placed into the Access state either through the LCD display or through predefined operator keys. While in the Access state, all alarms from the module will be shunted. Placing the module into the access state shall cause a discrete LED associated with input point to flash, but no other trouble or disable condition will be annunciated. Change from Secure to Access and reverse shall be transmitted to the central monitoring station on a per zone basis. Systems that cause or indicate a trouble or disable condition are unacceptable.

G. Central Processing Unit

1. The Central Processing Unit shall contain and execute all control-by-event (including Boolean functions including but not limited to AND, OR, NOT, ANYx, and CROSSZONE) programs for specific action to be taken if an alarm condition is detected by the system. Such control-by-event programs shall be held in non-volatile programmable memory, and shall not be lost with system primary and secondary power failure.

2. The Central Processing Unit shall also provide a real-time clock for time annotation, to the second, of all system events. The time-of-day and date shall not be lost if system primary and secondary power supplies fail.

3. The CPU shall be capable of being programmed on site without requiring the use of any external programming equipment. Systems that require the use of external programmers or change of EPROMs are not acceptable.

4. The CPU shall provide an RS-232 interface between the fire alarm control panel and the UL Listed Electronic Data Processing (EDP) peripherals.

5. The CPU shall provide two RS-485 ports for the serial connection to annunciation and control subsystem components.

6. The RS-232 serial output circuit shall be optically isolated to assure protection from earth ground.

7. In the event of CPU failure, all SLC loop modules shall fallback to degrade mode. Systems not offering degrade mode shall offer Redundant CPU. Such degrade mode shall treat the corresponding SLC loop control modules and associated detection devices as conventional two-wire operation. Any activation of a detector in this mode shall automatically activate associated Notification Appliance Circuits.

H. Display

1. The system display shall provide a 240 X 64 pixel -character backlit alphanumeric Liquid Crystal Display (LCD). It shall also provide eleven Light-Emitting-Diodes (LEDs) that indicate the status of the following system parameters: AC POWER, FIRE ALARM, PREALARM, SECURITY, SUPERVISORY, SYSTEM TROUBLE, OTHER EVENT, SIGNALS SILENCED, POINT DISABLED, CONTROLS ACTIVE, and CPU FAILURE.

2. These characters shall be only for fire alarm / trouble information and not for Logo or other purpose. It shall be UL Listed. Repeater panel displays in FACP is not allowed unless until approved by UL

3. The system display shall provide a QWERTY style keypad for ease of operation.

j. The keypad shall have control capability to command all system functions, entry of any alphabetic or numeric information, and field programming without the use of any external master voice controller and amplifier over fiber optic cable network without using any third party media converter.

k. Failure of Fire Panel CPU shall not affect the operation of DVC. In case DVC / Amplifiers are controlled by Fire Panel CPU, a separate panel with dedicated CPU shall be

considered for each DVC & Amplifier.

I. Power Supply

1. The Main Power Supply shall operate on 120/240 VAC, 50/60 Hz, and shall provide all necessary power for the FACP.
2. The Main Power Supply shall provide the required power to the CPU using a switching 24 VDC regulator and shall incorporate a battery charger for 24 hours of standby power using dual-rate charging techniques for fast battery recharge.
3. The Main Power Supply shall provide a battery charger for 24 hours of standby using dual-rate charging techniques for fast battery recharge. The supply shall be capable of charging batteries ranging in capacity from 7-200 amp-hours within a 48-hour period.
4. The Main Power Supply shall provide a very low frequency sweep earth detect circuit, capable of detecting earth faults.
5. The Main Power Supply shall be power-limited per UL864 requirements.
6. The Main Power Supply shall communicate power supply, line voltage, battery status and charger status to the local LCD display. Any abnormal condition shall be annunciated and logged to the system alarm history log.
7. The interface to the power supply from the Fire Alarm Control Panel (FACP) shall be via the Signaling Line Circuit (SLC) or other multiplexed means Power supplies that do not use an intelligent interface are not suitable substitutes. The required wiring from the FACP to the addressable power supply shall be a single unshielded twisted pair wire.
8. The addressable power supply shall supervise for battery charging failure, AC power loss, power brownout, battery failure, NAC loss, and optional ground fault detection. In the event of a trouble condition, the addressable power supply shall report the incident and the applicable address to the FACP via the SLC.
9. The addressable power supply shall have an AC Power Loss Delay option. If this option is utilized and the addressable power supply experiences an AC power loss, reporting of the incident to the FACP will be delayed. A delay time of zero, two, eight or sixteen hours shall be programmable.
10. The addressable power supply shall have an option for Canadian Trouble Reporting and this option shall be programmable.
11. The addressable power supply mounts in either the FACP backbox or its own dedicated surface mounted backbox with cover.
12. Each of the power supply's four output circuits shall be programmed- for Notification Appliance Circuit or General Purpose 24 VDC power. Any output circuit shall be able to provide up to 2.5 amps of 24 VDC power.
13. The addressable power supply's output circuits shall be individually supervised when they are selected to be either a Notification Appliance Circuit when wired Class "A" or by the use of an end-of-line resistor. When the power supply's output circuit is selected as General 24 VDC power, the circuit shall be individually supervised when an end-of-line relay is used.
14. When selected for Notification Appliance Circuits, the output circuits shall be individually programmable for Steady, March Time, Dual Stage or Temporal.
15. When selected as a Notification Appliance Circuit, the output circuits of the addressable power supply shall have the option to be coded by the use of a universal zone coder.
16. The addressable power supply shall interface and synchronize with other power supplies of the same type. The required wiring to interface multiple addressable power supplies shall be a single unshielded, twisted pair wire.
17. An individual or multiple interfaced addressable power supplies shall have the option to use an external charger for battery charging. Interfaced power supplies shall have the option to share backup battery power.

J. Audio Amplifiers

1. The Audio Amplifiers shall provide Audio Power @25 Volts RMS@70 Volts RMS 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:
 - a. Earth Fault Detection & Annunciation for Communication bus
 - b. Audio Amplifier Failure Trouble Annunciation
 - c. External trigger input indication in case of Amplifier failure
 - d. Audio Detected on Firefighter's Telephone Riser
 - e. Receiving Audio from digital audio riser
 - i. Short circuit on detection & annunciation on each speaker circuit

- j. Communication Status
- n. Board failure
- r. Active fiber optic media connection
- t. Power supply monitoring of below conditions –Earth fault, Low Battery,
Charger Trouble

- 4. Adjustment of the correct audio level for the amplifier shall not require any special tools or test equipment.
- 5. Includes audio input and amplified output supervision, back up input, and automatic switch over function, (if primary amplifier should fail).
- 6. System shall be capable of backing up digital amplifiers.
- 7. One designated backup amplifier shall be capable of backing up multiple primary amplifiers mounted in the same or adjacent cabinets.
- 8. Multi-channel operation from a single amplifier shall be supported by the addition of an optional plug-in amplifier card.
- 9. System shall support distributed architecture of voice evacuation system to enable remote installation of amplifiers. Remote Amplifier's shall communicate with the centrally located Digital Voice Command.
- K. Controls with associated LED Indicators
 - 1. Speaker Switches/Indicators
 - a. The speaker circuit control switches/indicators shall include visual indication of active and trouble status for each speaker circuit in the system.
 - b. The speaker circuit control panel shall include switches to manually activate or deactivate each speaker circuit in the system.
 - 2. Emergency Two-Way Telephone Control Switches/Indicators
 - a. The emergency telephone circuit control panel shall include visual indication of active and trouble status for each telephone circuit in the system.
 - b. The telephone circuit control panel shall include switches to manually activate or deactivate each telephone circuit in the system.
- L. Field Programming
 - 1. The system shall be programmable, configurable and expandable in the field without the need for special tools. There shall be no firmware changes required to field modify the system time, point information, equations, or annunciator programming/information.
 - 2. It shall be possible to program through the standard FACP keyboard all system functions.

All field defined programs shall be stored in non-volatile memory. Two levels of password protection shall be provided in addition to a key-lock cabinet. One level shall be used for status level changes such as point/zone disable or manual on/off commands (Building Manager). A second (higher-level) shall be used for actual change of the life safety program (installer). These passwords shall be five (5) digits at a minimum. Upon entry of an invalid password for the third time within a one minute time period an encrypted number shall be displayed. This number can be used as a reference for determining a forgotten password.

The system programming shall be "backed" up via an upload/download program, and stored on compatible removable media. A system back-up disk shall be completed and given in duplicate to the building owner and/or operator upon completion of the final inspection. The program that performs this function shall be "non-proprietary", in that, it shall be possible to forward it to the building owner/operator upon his or her request.

The installer's field programming and hardware shall be functionally tested on a computer against known parameters/norms which are established by the FACP manufacturer. A software program shall test Input-to-Output correlations, device Type ID associations, point associations, time equations, etc. This test shall be performed on an IBM-compatible PC with a verification software package. A report shall be generated of the test results and two copies turned in to the engineer(s) on record.

- M. Specific System Operations
 - 1. Smoke Detector Sensitivity Adjust: A means shall be provided for adjusting the sensitivity of any or all addressable intelligent detectors in the system from the system keypad. Sensitivity range shall be within the allowed UL window and have a minimum of 9 levels.
 - 2. Alarm Verification: Each of the intelligent addressable smoke detectors in the system may be independently selected and enabled to be an alarm verified detector. The alarm verification delay shall be programmable from 0 to 60 seconds and each detector shall be able to be

selected for verification. The FACP shall keep a count of the number of times that each detector has entered the verification cycle. These counters may be displayed and reset by the proper operator commands.

N. System Point Operations

1. Any addressable device in the system shall have the capability to be enabled or disabled through the system keypad or Graphics User Interface.
2. System output points shall be capable of being turned on or off from the system keypad or the video terminal.
3. Point Read: The system shall be able to display the following point status diagnostic functions without the need for peripheral equipment. Each point shall be annunciated for the parameters listed:
 - a. Device Status.
 - b. Device Type.
 - c. Custom Device Label.
 - d. Software Zone Label.
 - e. Device Zone Assignments.
 - f. Analog Detector Sensitivity.
 - g. All Program Parameters.
4. System History Recording and Reporting: The fire alarm control panel shall contain a history buffer that will be capable of storing up to 5000 system events. Each of these events will be stored, with time and date stamp, until an operator requests that the contents be either displayed or printed. The contents of the history buffer may be manually reviewed; one event at a time, and the actual number of activations may also be displayed and or printed. History events shall include all alarms, troubles, operator actions, and programming entries.
5. The history buffer shall use non-volatile memory. Systems which use volatile memory for history storage are not acceptable.
6. Automatic Detector Maintenance Alert: The fire alarm control panel shall automatically interrogate each intelligent system detector and shall analyze the detector responses over a period of time.
7. If any intelligent detector in the system responds with a reading that is below or above normal limits, then the system will enter the trouble mode, and the particular Intelligent Detector will be annunciated on the system display, and printed on the optional system printer. This feature shall in no way inhibit the receipt of alarm conditions in the system, nor shall it require any special hardware, special tools or computer expertise to perform.
8. The system shall include the ability (programmable) to indicate a "pre-alarm" condition. This will be used to alert maintenance personnel when a detector is at 80% of its alarm threshold in a 60 second period.

System Maintenance Analysis and Reporting

The system shall automatically track NFPA 72 installation and testing requirements for all addressable devices to ensure that every device is functionally tested upon installation and then periodically as required by the Code.

If after twelve months any device has not been functionally tested a led shall illuminate on the CPU or Network annunciator indicating the device that needs testing.

The system shall automatically track device testing to ensure that a visual inspection is performed at least semi-annually.

If after six months a device has not been indicated as "visually inspected" a led shall illuminate on the CPU or Network annunciator indicating the device that needs testing.

A hand-held IR tool may be used to interact with each SLC device to indicate that a visual inspection has been performed. The IR device will explicitly identify the device by loop and address to ensure the correct visual inspection has been performed.

A comprehensive report shall be available from the laptop programmer which shows a predictive report of all devices that have upcoming testing requirements. These reports shall be configurable as either 30, 60 or 90 day predictive, current status, and "all database." Systems that do not automatically track the individual testing requirements of the field devices will not be accepted.

2.2 SYSTEM COMPONENTS

A. Network Control Annunciator

A network control annunciator shall be provided to display all system intelligent

points. The NCA shall be capable of displaying all information for 200,000 points on the network. Network display devices, which are only capable of displaying a subset of network points, shall not be suitable substitutes.

The NCA shall include a 240 X 64 pixel character liquid crystal display. Additionally, the network display shall include environmental adjustment controls to maximize LCD legibility and the ability to scroll events by type. i.e. Fire Alarm, Supervisory Alarm, Trouble, etc.

The network control annunciator shall have the ability to display multiple events in order of priority and time of occurrence. Counters shall be provided to indicate the total number of events by type.

The NCA shall mount in any of the network node fire alarm control panels. Optionally, the network display may mount in a backbox designed for this use and shall connect to the network over either a wire or fiber interface.

The network control annunciator shall have an event history buffer capable of storing a minimum of 1000 events in non-volatile memory. Additionally, the NCA shall have a fire alarm history buffer capable of storing a minimum of 200 events in non-volatile memory. Systems that do not protect fire alarm events from being overwritten by other events are not suitable substitutes.

The NCA shall include Three USB connection, USB C, USB B Micro, and USB A, industry standard RS-232 ports for UL864 listed printers and CRT's. These peripheral devices shall print or display network activity.

The network control annunciator shall include control switches for system wide control of Acknowledge, Signal Silence, System Reset, Drill, and local Lamp Test. A mechanical means by which the controls switches are "locked out", such as a key, shall be available.

The NCA shall include long life LEDs to display Power, Fire Alarm, Pre-Alarm, Security Alarm, System Trouble, Supervisory, Signals Silenced, Disabled Points, Other (non-fire) Events, and CPU Failure.

The network control annunciator shall include a Master password and up to nine User passwords. Each password shall be up to eight alpha-numeric characters in length. The Master password shall be authorized to access the programming and alter status menus. Each User password may have different levels of authorization assigned by the Master password.

The NCA shall allow editing of labels for all points within the network; control on/off of outputs; enable/disable of all network points; alter detector sensitivity; clear detector verification counters for any analog addressable detector within the network; clear any history log within the network; change the Time/Date settings; initiate a Walk Test.

The network control annunciator shall support an optional Windows™ based program utility. This utility shall allow the user create an NCA database, upload/download an NCA database, and download an upgrade to the NCA executive. To ensure program validity, this utility shall check stored databases for errors. A compare function shall be included to identify differences between databases.

For time keeping purposes the NCA shall include a time of day clock.

B. Network Control Station / Graphics User Interface

The NCS shall utilize a Microsoft(™) operating system. Each Network Control Station shall be capable of graphically annunciating and controlling all network activity and at least 2,50,000 network points. Network display devices that are only capable of displaying a subset of network points shall not be suitable substitutes.

The NCS shall be an IBM (or compatible) personal computer with the following minimum requirements: Intel Pentium II(™)-processor, operating at a minimum of 400 Mhz, 128Mbytes of RAM, 8 Mbytes Video RAM, 1.44 Mbyte floppy drive, 3.2 Gbyte hard disk, mouse, 32X CD-ROM, 3PCI / 1 ISA expansion slots, internal 3.2 Gbyte tape drive, sound card, 200 watt power supply, and SVGA graphics with a screen resolution of 1024 x 768. The network control station shall include a 19-inch monitor.

The NCS shall be capable of storing over 100,000 network events in a history file. Events shall be stored on hard disk and shall be capable of back-up storage to a tape drive. The history buffer allows the operator to view events in a chronological order. A filter shall be available for displaying chronological events by operator, date, time, fire alarms, troubles (including security, supervisory and system/device), disabled points/zones, system programming, operator response and operator log in/log out. The ability to print NCS history files shall also be available.

The NCS shall use a Windows(tm) dialog box technology to address, interrogate, control, and/or modify intelligent points on each fire alarm node. This shall include, and not be limited to: Activating outputs, enabling or disabling points, adding or removing intelligent points, viewing intelligent detector sensitivity levels and modifying point information (custom messages, detector type, verification, day/night selection etc.)

The NCS shall include the ability to display system information in a graphical (floor plan) form. Each view, created using standard Windows bitmap files, shall include icons created for intelligent devices. These icons shall blink and change to the appropriate programmed icon when an event occurs. When the device has been acknowledged, the icon shall become steady. Once the point has returned to normal, the normal icon is displayed. In addition to the graphical representation of the device, the user shall be able to link pictures, documents and sound files to the device. The NCS shall also provide the ability to auto-vector to the floor plan (screen) of the device that is active. By selecting a device in the graphic presentation, the operator of the NCS shall have the ability to log onto the corresponding node and interrogate the associated intelligent point.

The NCS shall have the ability to provide the following information through a Windows(tm) pull down menu: An Event Counter that contains the number of new and total events on the network. The information that is displayed shall consist of Fire Alarms, Pre-Alarms, Security Alarms, Supervisory Alarms, and Troubles. A Detailed Event window that contains all Off-Normal events, both unacknowledged and acknowledged that are present in the system. It shall contain two views, Fire events and Non-fire events that shall be user selectable. A Current Event window that shall contain all network and local events as well as system messages with a maximum of 1,000 events displayed. A Disabled Device window that shall contain all disabled devices in the system.

The NCS shall have the option, from a Windows pull down menu, to connect to a third party paging service that allows the NCS to automatically send text-based messages regarding system status to a typical text pager.

The NCS shall include help screens, available to aid the user without leaving the selected application screen.

The NCS shall be UL-Listed for fire protection (UL864) and burglary (UL1076). The

NCS shall interface with other panels as a node in the peer to peer network.

The operator shall be able to monitor the FFT system from GUI software and shall be able to monitor and control Integrated Voice Evacuation System.

The NCS shall have a flexible way of assigning operator passwords. There shall be an unlimited number of possible operators, each with specific levels of control. Each operator shall have his/her own password. Operator password and control selection shall be available to a high level "administrator" who shall have complete control over levels of control. If no action has taken place on the NCS after 10 minutes, the current operator shall be logged out and require a new log-in.

The NCS shall include an industry-standard RS-232 port for a UL864 listed printer.

The NCS shall be a table top hardware configuration.

C. Interactive Firefighters' Touchscreen Display

The network will interface and report the individually monitored system's alarm status via a user-friendly Graphical User Interface (GUI) based software.

The software shall operate under Microsoft® Windows® 7 or Higher Operating System in Embedded platform as manufactured by Microsoft Corporation.

The GUI based software must be capable of graphically representing the facility being monitored with floor plans and icons depicting the actual locations of the fire alarm device locations. It shall be capable of mapping at least 2,50,000 network points

The software shall use a 1280 pixel x 1024 pixel GUI display capable of showing a large primary floor plan display, a site plan representative of an aerial view of the facility, the first active fire alarm on the system The software shall permit automatic navigation to the screen containing an icon that represents the first fire alarm device in alarm in the event of an off-normal condition.

The fire alarm device icon shall be visible only when it is in an alarm (or active) condition.

The software shall display the activated smoke detectors in a time sequence to track smoke progression.

The software shall allow the importation of externally developed floor plans in Windows Metafile (WMF), JPEG (JPG), Graphics Interchange Format (GIF) and Bitmap (BMP) format.

The software shall provide a intuitive and easy way to navigate to different screens representing floors and areas within a facility.

The system shall provide for continuous monitoring of all fire alarm conditions regardless of the current activity displayed on the screen.

The software shall display "YOU ARE HERE" along with icons representing standard building objects (stairs, elevators, etc) to be shown on the floor plan.

The software shall allow icons that represent hazardous materials stored in a facility.

The software shall provide a screen that displays preprogrammed building contact information.

The software shall provide a screen the displays building occupancy and other general building information.

The software shall allow a site plan to be imported that shows an aerial view of the facility. The software shall display all active fire, supervisory, and security events within an event list.

Bidders also have the option to propose UL Listed Software with UL Listed Industrial Grade Hardware to achieve this functional requirement.

A. Cloud Based Facility Management Software

Remote health monitoring solution utilizing cloud based software-as-a-service web application & supplementary network gateway hardware. System shall provide secure web access to cloud based web application using any of the web browsers like Google Chrome (preferable), Internet Explorer etc. from any computer/ tablet/ smartphone connected over internet via defined credentials – username and password. Supplementary FACP gateway hardware furnished in this section shall be programmable directly from the embedded webpage in the hardware, upon completion of this project. The use of configurable or programmable controllers that require additional software tools for post-installation maintenance shall not be acceptable. The cloud based web application shall capture all fire alarm system data as received from the system via supplementary gateway hardware. Owner shall receive login and passwords at first training session. The Owner shall have full licensing and full access rights for remote monitoring system.

Cloud Based Application: The cloud hosted web application shall provide an intuitive user interface and shall provide the following features as a minimum:

Real time view of fire system effectiveness
Multi-location unified view

Custom dashboard view

Device level detailed information including current status Event list

System reports Fault Handling

Device Replacement & contamination Panel & System report

Custom reports

Report export in PDF/ DOC format

Report scheduler Settings – add, delete, modify email addresses
Email ID settings for emailing critical alarms

Web Browser Navigation: The cloud hosted web application shall provide a comprehensive user interface. Using a collection of web pages, it shall be constructed to "feel" like a single application, and provide a complete and intuitive mouse/menu driven operator interface. It shall be possible to navigate through the system using Google Chrome web browser to accomplish requirements of this specification. The Web application shall provide for navigation, and for display of intuitive dashboards, device information, alarms/events, reports, configuration menus for report settings

Login: On launching the web browser and selecting the appropriate domain name or IP address, the operator shall be presented with a login page that will require a login name and strong password. Navigation in the system shall be dependent on the operator's role-based application control privileges.

Navigation: Navigation through the web application shall be accomplished by clicking on dynamic links on dashboards to access detailed system information and by clicking on appropriate tabs for application settings and preferences. Both the tabs and dynamic links shall be displayed simultaneously, enabling the operator to select a specific system information and application settings and preferences.

System Dashboards: The system dashboard shall provide several functional information for each system specified. This view shall be accessed by right after logging in to the system: Each building dashboard (in case of multiple buildings) shall be visible along with system effectiveness and fire alarm system information like –

Number of panels
Number of loops
Number of devices

Detailed information Section – this can be accessed upon clicking relevant links. Detailed system information like device list along with corresponding address, current status and time stamping can be viewed. Events data is also visible.

Search: User shall have multiple options for searching data based upon device type, device status.

Reports: The Web application can be used to access system health reports of past and as-on-date. Provision for system reports to be emailed to predefined email IDs and time intervals in PDF or DOC format. Different report types –

Fault Handling report – Effective measurement of turnaround time (TAT) of various issues and capable of drawing detailed report at individual fault level.

Device Replacement Report - Proactive alerts along with active insights on the faulty devices & detectors which need attention or replacement helping customers save time and reducing fire risk.

Device Contamination Report - Real time statistics of device contamination showing dirt levels along with detector efficiency

Panel & System Report - List of panel faults with trouble date and time stamped, beyond the panel memory of 5000 events can store upto 100,000 events

Alarms: Alarms associated with a specific equipment and or device, shall be displayed dynamically in a window.

The Alarm remain in the application until it is acknowledged or Panel is reset. The Alarm status also viewed in the LIST VIEW section of the application.

Security Access: Cloud hosted Remote monitoring web application for fire alarm system can be accessed by Google chrome web browser and shall require a Login Name and Strong Password. Separate access credentials for owner and service provider shall be provisioned.

2.3 GATEWAY AND WEB SERVERS

A. BACnet Interface Gateway: The system shall be capable of being interfaced with BACnet compliant clients. A BACnet interface supporting BACnet/IP communication shall be available from the fire alarm control panel manufacturer. BACnet shall support 14000 data points. BACnet gateway shall communicate with all the panels in a peer to peer network.

B. MODbus Interface Gateway: The system shall be capable of being interfaced with MODbus compliant clients. A MODbus interface supporting MODbus/TCP communication shall be available from the fire alarm control panel manufacturer. MODbus shall support 12000 data points. MODbus gateway shall communicate with all the panels in a peer to peer network.

C. Webserver: The system shall support a webserver allowing remote connection via the Internet or Intranet. Authorized users will have the ability to view panel/network history, event status and device properties. The webserver shall also support sending event information via email or text to up to 50 registered users, the webserver shall be available from the fire alarm control panel manufacturer.

D. Web Portal Interface: The system shall be capable of being interfaced with a web portal to integrate with Inspection and Service Manager utilities. The web portal and inspection and service manager utilities shall be available from the fire alarm control panel manufacturer.

2.4 SYSTEM COMPONENTS - ADDRESSABLE DEVICES

A. Addressable Devices – General

1. Addressable devices shall provide an address-setting means using rotary decimal switches. Addressable devices that require the address be programmed using a programming utility are not an allowable substitute.

2. Addressable devices shall use simple to install and maintain decade, decimal address switches.

3. Addressable devices, which use a binary-coded address setting method, such as a DIP-switch, are not an allowable substitute. Addressable devices that require the address be programmed using a special tool or programming utility are not an allowable substitute.

4. Detectors shall be intelligent (analog) and addressable, and shall connect with two wires to the fire alarm control panel Signaling Line Circuits.

5. Addressable smoke and thermal detectors shall provide dual alarm and power/polling bi-colour LEDs. Both LEDs shall flash green under normal conditions, indicating that the

detector is operational and in regular communication with the control panel, and both LEDs shall be placed into steady red illumination by the control panel, indicating that an alarm condition has been detected. If required, the LED flash shall have the ability to be removed from the system program. An output connection shall also be provided in the base to connect an external remote alarm LED.

6. The fire alarm control panel shall permit detector sensitivity adjustment through field programming of the system. The panel on a time-of-day basis shall automatically adjust sensitivity.

7. Using software in the FACP, detectors shall automatically compensate for dust accumulation and other slow environmental changes that may affect their performance. The detectors shall be listed by UL as meeting the calibrated sensitivity test requirements of NFPA Standard 72.

8. The detectors shall be ceiling-mount and shall include a separate twist-lock base with tamper proof feature. Base options shall include a sounder base with a built-in (local) sounder rated at 85 DBA minimum, a relay base and an isolator base designed for Style 7 applications. The system shall also support an intelligent programmable sounder base, the programmable sounder base shall be capable of providing multiple tones based on programming and at a minimum be capable of providing a Temp-4 tone for CO (Carbon Monoxide) activation and a Temp-3 tone for fire activations and be capable of being synchronized with other programmable sounder bases and common area notification appliances; 85 DBA minimum.

9. Detectors shall also store an internal identifying type code that the control panel shall use to identify the type of device (PHOTO, THERMAL)

10. Detectors will operate in an analog fashion, where the detector simply measures its designed environment variable and transmits an analog value to the FACP based on real-time measured values. The FACP software, not the detector, shall make the alarm/normal decision, thereby allowing the sensitivity of each detector to be set in the FACP program and allowing the system operator to view the current analog value of each detector.

11. Addressable devices shall store an internal identifying code that the control panel shall use to identify the type of device.

12. A magnetic test switch shall be provided to test detectors and modules. Detectors shall report an indication of an analog value reaching 100% of the alarm threshold.

13. Addressable modules shall mount in a 4-inch square (101.6 mm square), 2-1/8 inch (54 mm) deep electrical box. An optional surface mount Lexan enclosure shall be available.

14. Detectors / Bases with connection terminals exposed to Ceiling / False Ceiling shall be provided with Protective Insulation of the same make as of Detectors.

B. Addressable Manual Call Point (Break Glass / Pull Down Type)

1. Addressable manual call point shall send data to the panel representing the state of the manual switch and the addressable communication module status. They shall use a key operated test-reset lock, and shall be designed so that after actual emergency operation, they cannot be restored to normal use except by the use of a key.

2. All operated stations shall have a positive, visual indication of operation and utilize a key type reset.

3. Manual fire alarm boxes shall be constructed of Lexan / ABS Plastic with clearly visible operating instructions provided on the cover. The word FIRE / Fire Sign shall appear on the front of the stations.

C. Intelligent Photoelectric Smoke Detector:

The intelligent photoelectric smoke detector shall use the photoelectric (light-scattering) principal to measure smoke density and shall, on command from the control panel, send data to the panel representing the analog level of smoke density.

1. Designed to meet UL268 7th Edition.
2. Modern profile with White color for improved aesthetics.
3. Sensitivity Range of 0.5% to 4.0% obs/ft
4. Stable communication technique with noise immunity.
5. Low standby current. 200 micro Amps @ 24 VDC
6. Two-wire SLC connection.
7. Rotary, decimal addressing
8. Dual bi-color LED design providing 360° viewing angle. LEDs blink green in normal condition and illuminate steady red on alarm
9. Remote test feature from the panel.
10. Walk test with address display
11. Built-in functional test switch activated by external magnet.
12. Built-in tamper-resistant feature.
13. Sealed against back pressure.
14. Expanded color options.
15. Optional relay, isolator, and sounder bases.

D. Intelligent High Sensitivity Photo Smoke Detector

The intelligent high sensitivity photo smoke detector shall be a spot type detector that incorporates an extremely bright high sensitivity diode and an integral lens that focuses the light beam to a very small volume near a receiving photo sensor. The scattering of smoke particles shall activate the photo sensor.

Designed to meet UL268, 7th Edition

1. The high sensitivity detector shall have conductive plastic so that dust accumulation is reduced significantly.
2. The intelligent high sensitivity photo detector shall have nine sensitivity levels and be sensitive to a minimum obscuration of 0.02 percent per foot.
3. The high sensitivity detector shall not require expensive conduit, special fittings or PVC pipe.
4. The intelligent high sensitivity photo detector shall support standard, relay, isolator and sounder detector bases.
5. The high sensitivity photo detector shall not require other cleaning requirements than those listed in NFPA 72. Replacement, refurbishment or specialized cleaning of the detector head shall not be required.
6. The high sensitivity photo detector shall include two bicolor LEDs that flash green in normal operation and turn on steady red in alarm.

E. Intelligent Multi Criteria Detector

The intelligent multi-criteria detector shall be an addressable device that is designed to monitor photoelectric and thermal technologies in a single sensing device. The detector design shall allow a wide sensitivity window, 0.5 to 4.0% per foot obscuration. This detector shall utilize advanced electronics that react to slow smoldering fires and thermal properties all within a single sensing device.

1. Designed to meet UL268, 7th Edition
2. The microprocessor design shall be capable of selecting the appropriate sensitivity levels based on the environment type it is in (office, manufacturing, kitchen etc.) and then have the ability to automatically change the setting as the environment changes (as walls are moved or as the occupancy changes).

3. The intelligent multi criteria detection device shall include the ability to combine the signal of the thermal sensor with the signal of the photoelectric signal in an effort to react hastily in the event of a fire situation. It shall also include the inherent ability to distinguish between a fire condition and a false alarm condition by examining the characteristics of the thermal and smoke sensing chambers and comparing them to a database of actual fire and deceptive phenomena.

F. Intelligent Thermal Detectors

The intelligent thermal detectors shall be addressable devices rated at 135 degrees Fahrenheit (58 degrees Celsius) and have a rate-of-rise element rated at 15 degrees F (9.4 degrees C) per minute. A high heat thermal detector rated at 190 degrees Fahrenheit (87.8 degrees Celsius) shall also be available. The thermal detectors shall connect via two wires to the fire alarm control panel signaling line circuit.

Modern profile with White color for improved aesthetics. Advanced thermal technology for fast response.

Fixed temperature model factory preset to 135°F
Rate of Rise model preset to 15°F/min

High temperature model factory preset to 190°F Low
standby current. 200 micro Amps @ 24 VDC Two-
wire SLC connection.

Rotary, decimal addressing

Dual bi-color LED design providing 360° viewing angle. LEDs blink green in normal condition and illuminate steady red on alarm

Remote test feature from the panel. Walk
test with address display

Built-in functional test switch activated by external magnet. Built-
in tamper-resistant feature.

Sealed against back pressure.

Optional relay, isolator, and sounder bases.

A. Intelligent Duct Smoke Detector

The smoke detector housing shall accommodate an intelligent photoelectric detector that provides continuous analog monitoring and alarm verification from the panel. When sufficient smoke is sensed, an alarm signal is initiated at the FACP, and appropriate action taken to change over air handling systems to help prevent the rapid distribution of toxic smoke and fire gases throughout the areas served by the duct system. The Intelligent Duct Smoke Detector shall support the installation of addressable Photoelectric detector capable or being tested remotely.

B. Advanced Multi-Criteria Intelligent Fire/CO Detector

1. Advanced Multi-Criteria Fire/CO detector be an addressable advanced multi-criteria smoke detector with a separate signal for carbon monoxide (CO) detection per UL 2075 standards.

2. The detector shall be comprised of four sensing elements, including a photoelectric (light-scattering) particulate sensor, an electrochemical CO sensor, a daylight-filtered infrared (IR) sensor and solid state thermal sensor(s) rated at 135°F (57.2°C). The device shall be able to indicate distinct smoke and heat alarms.

3. The advanced multi-criteria detection device shall include the ability to combine the signal of the photoelectric signal with other sensing elements in order to react quickly in the event of a fire situation. It shall also include the inherent ability to distinguish between a fire condition and a nuisance alarm condition. The detector shall be capable of selecting the appropriate sensitivity levels based on the environment type (office, manufacturing, kitchen, etc.) in which it is installed, and then have the ability to automatically change the setting as the environment changes.

4. The CO detector component shall be capable of a functional gas test using a canned

test agent to test the functionality of the COsensing cell.

5. The detector shall be capable of automatically adjusting its sensitivity by means of drift compensation and smoothing algorithms. The device shall provide unique signals to indicate when 20 percent of the drift range is remaining, when 100 percent of drift range is used, and when there is a chamber fault to show the unit requires maintenance.

6. The detector shall indicate CO trouble conditions, including six months of sensor life remaining and sensor life has expired. The detector shall indicate a combined signal for any of the following: low chamber trouble, thermistor trouble, CO self-test failure, IR self-test failure, and freeze warning.

7. The detector shall provide address-setting means on the detector head using rotary switches. Because of the possibility of installation error, systems that use binary jumpers or DIP switches to set the detector address are not acceptable. The detector shall also store an internal identifying code that the control panel shall use to identify the type of detector. Systems that require a special programmer to set the detector address (including temporary connection at the panel) are labor intensive and not acceptable. Each detector occupies any one of at least 159 possible addresses on the signaling line circuit (SLC) loop. It responds to regular polls from the system and reports its type and status.

8. The detector shall provide a test means whereby it will simulate an alarm condition and report that condition to the control panel. Such a test may be initiated at the detector itself (by activating a switch) or initiated remotely on command from the control panel. There shall be four test methods: functional magnet, smoke entry aerosol, carbon monoxide aerosol or direct heat method.

1. The detector shall provide two LEDs to provide 360° visibility. The LEDs shall be placed into steady red illumination by the control panel indicating that an alarm condition has been detected. An output connection shall also be provided in the base to connect an external remote alarm LED. The detector must be capable of connecting to a sounder base that provides both temporal 3 and temporal 4 patterns for fire and CO alarm.

2. Two LEDs on the sensor shall be controlled by the panel to indicate sensor status. Coded signals, transmitted from the panel, shall cause the LEDs to blink, latch on, or latch off. Refer to the control panel technical documentation for sensor LED status operation and expected delay to alarm.

3. The detector shall be plug-in mounted into a twist-lock base. The detector shall be constructed of off-white, UV-resistant polymer and shall be detachable from the mounting base to simplify installation, service and maintenance. Mounting base wiring connections shall be made by means of SEMS screws. The detector shall allow pre-wiring of the base and the head shall be a plug-in type. The mounting base shall be mounted on a junction box that is at least 1.5 inches (3.81 cm) deep. The mounting base shall be available to mount to standard junction boxes. Suitable boxes include:

- a. 4.0" (10.16 cm) square box with and without plaster ring.
- b. 4.0" (10.16 cm) octagonal box.
- c. 3.5" (8.89 cm) octagonal box.
- d. Single-gang box.
- e. Double-gang box

4. Meets Agency Standards

- a. ANSI/UL 268 -Smoke Detectors for Fire Alarm Signaling Systems
- b. CAN/ULC-S529- Smoke Detectors for Fire Alarm Systems
- c. FM 3230-3250- Smoke Actuated Detectors for Automatic Fire Alarm Signaling
- d. UL 2075 – Gas and Vapor Detector and Sensors – Systems Connected

I. Intelligent Addressable Aspiration Detector

The intelligent aspiration detector shall be an addressable aspiration detector that communicates directly with the fire alarm control panel via the SLC communication protocol, no

modules or high level interfaces shall be required.. The aspiration detector shall have Infra-red laser optical smoke detection for a wide range of fire detection with enhanced immunity to nuisance particulates. The FACP shall be capable of monitoring and annunciating up to five smoke event thresholds and eleven trouble conditions. Each event threshold shall be capable of being assigned a discrete type ID at the FACP.

J. Intelligent Addressable Reflected Beam Detector

1. The intelligent single-ended reflected beam smoke detector shall connect with two wires to the fire alarm control panel signaling line circuit (SLC). The detectors shall consist of a transmitter/receiver unit and a reflector and shall send data to the panel representing the analog level of smoke density. The detector shall be capable of being tested remotely via a keyswitch; It shall be equipped with an integral sensitivity test feature.

2. The Beam Detectors shall be long range, projected beam type smoke detectors which consist of a Transmitter and receiver in a single unit and reflector on the other side.

3. The Beam Detector shall have a range upto 100 mtrs. There shall be multiple sensitivity levels. Starting from 25 %, 30 %, 40 %, 50 % and acclimate levels also 30 % to 50 % and 40 % to 50 %. There shall be trouble alarm if obscuration block is more than 96 %.

K. Addressable Dry Contact Monitor Module

1. Addressable monitor modules shall be provided to connect one supervised IDC zone of conventional alarm initiating devices (any N.O. dry contact device) to one of the fire alarm control panel SLCs.

1. The IDC zone shall be suitable for Class A or Class B operation. An LED shall be provided that shall flash under normal conditions, indicating that the monitor module is operational and in regular communication with the control panel.

L. Two Wire Detector Monitor Module

1. Addressable monitor modules shall be provided to connect one supervised IDC zone of conventional 2-wire smoke detectors or alarm initiating devices (any N.O. dry contact device)

2. The IDC zone may be wired for Class A or B operation. An LED shall be provided that shall flash under normal conditions, indicating that the monitor module is operational and in regular communication with the control panel.

M. Addressable Control Module

1. Addressable control modules shall be provided to supervise and control the operation of one conventional circuit of compatible Notification Appliances, 24 VDC powered, polarized audio/visual notification appliances

2. The control module NAC may be wired for Class A/B with a current rating of 2 Amps

3. Audio/visual power shall be provided by a separate supervised circuit from the main fire alarm control panel or from a supervised UL listed remote supply.

N. Addressable Releasing Control Module

1. An addressable releasing module shall be available to supervise and control compatible releasing agent solenoids

2. The module shall operate on a redundant protocol for added protection.

3. The module shall be configurable for Class A/B and support one 24 volt or two 12 volt solenoids.

O. Addressable 4-20 mA Module

Addressable 4-20 mA module shall be available to monitor industry-standard, linear-scale, 4-20 mA protocol sensors. The module converts the sensor output to communication protocol that can be interpreted by the FACP for monitoring and display

1. The module shall support programming of up to five programmable event thresholds.
2. The System shall be FM 6320 (Factory Mutual) approved as a Gas Detection system when employed with the FMM-4-20 monitor module and industry standard 4-20 mA gas detectors.

P. Addressable Relay Module

1. Addressable Relay Modules shall be available for HVAC control and other network building functions
2. The module shall provide two form C relays rated at up to 3 Amps resistive and up to 2.0 Amps inductive.
3. The relay coil shall be magnetically latched to reduce wiring connection requirements, and to insure that 100% of all auxiliary devices energize at the same time on the same pair of wires;
4. For multiple relay control a module shall be available that provides 6 programmable Form-C relays.

Q. Addressable Two-In / Two-Out Monitor/Relay Module

1. An addressable Two-In / Two-Out module shall be available.
2. The two-in/two-out module shall provide two Class B/Style B dry-contact input circuits and two independent Form-C relays rated at up to 3 Amps resistive and up to 2.0 Amps inductive.

R. Isolator Module

Isolator modules shall be provided to automatically isolate wire-to-wire short circuits on an SLC Class A or Class B branch. The isolator module shall limit the number of modules or detectors that may be rendered inoperative by a short circuit fault on the SLC loop segment or branch. At least one isolator module shall be provided for each floor or protected zone of the building.

1. If a wire-to-wire short occurs, the isolator module shall automatically open-circuit (disconnect) the SLC. When the short circuit condition is corrected, the isolator module shall automatically reconnect the isolated section.
2. The isolator module shall not require address-setting, and its operations shall be totally automatic. It shall not be necessary to replace or reset an isolator module after its normal operation.
3. The isolator module shall provide a single LED that shall flash to indicate that the isolator is operational and shall illuminate steadily to indicate that a short circuit condition has been detected and isolated.
4. If Isolator Bases are proposed, Vendor needs to consider Isolator base for all detectors

S. Serially Connected Annunciator

1. The annunciator shall communicate to the fire alarm control panel via an EIA 485 (multi-drop) two-wire communications loop. The system shall support two 6,000 ft. RS-485 wire runs. Up to 32 annunciators, each configured up to 96 points, may be connected to the connection, for a system capacity of 3,000 points of annunciation.
2. An RS-485 repeater shall be available to extend the RS-485 wire distance in 3,000 ft. increments. The repeater shall be UL864 approved.

3. Each annunciator shall provide up to 96 alarm and 97 trouble indications using a long-life programmable color LED's. Up to 96 control switches shall also be available for the control of Fire Alarm Control Panel functions. The annunciator will also have an "ON-LINE" LED, local piezo sounder, local acknowledge and lamp test switch, and custom zone/function identification labels.

4. The annunciator may be field configured to operate as a "Fan Control Annunciator". When configured as "Fan Control," the annunciator may be used to manually control fan or damper operation and can be set to override automatic commands to all fans/dampers programmed to the annunciator.

5. Annunciator switches may be programmed for System control such as, Global Acknowledge, Global Signal Silence, Global System Reset, and on/off control of any control point in the system.

6. An optional module shall be available to utilize annunciator points to drive RS-485driven relays. This shall extend the system point capacity by 3,000 remote contacts.

7. The LED annunciator shall offer an interface to a graphic style annunciator and provide each of the features listed above.

T. Speakers

1. The Speaker appliance shall be listed to UL 1480 for Fire Protective Signaling Systems. It shall be a dual-voltage transformer speaker capable of operation at 25.0 or 70.7 nominal Vrms. The speaker shall have a frequency range of 400 to 4,000 Hz and shall have an operating temperature between 32°F and 120°F. It shall mount to a 4 x 4 x 2 1/8-inch back box.

2. A universal mounting plate shall be used for mounting ceiling and wall speaker products

3. The notification appliance circuit and amplifier wiring shall terminate at the universal mounting plate.

4. Speakers shall be plug-in and shall have the ability to check wiring continuity via a shorting spring on the universal mounting plate. The shorting spring shall also provide tamper resistance via an open circuit if the device is removed. Speaker design shall isolate speaker components to reduce ground fault incidents.

5. The speaker shall have power taps (from ¼ watt to 2 watts) and voltage that are selected by rotary switches. All models shall have a maximum sound output of 86 dB at 10 feet and shall incorporate an open back construction.

6. All notification appliances shall be backward compatible.

U. Advance Speaker Strobes

1. The Speaker Strobe appliance shall be listed to UL 1971 and UL 1480 and be approved for fire protective signaling systems. It shall be a dual-voltage transformer speaker strobe capable of operation at 25.0 or 70.7 nominal Vrms. The speaker shall have a frequency range of 400 to 4,000 Hz and shall have an operating temperature between 32°F and 120°F. It shall mount to a 4 x 4 x 2 1/8-inch back box.

2. A universal mounting plate shall be used for mounting ceiling and wall speaker strobe products. The notification appliance circuit and amplifier wiring shall terminate at the universal mounting plate. Also, Advance speaker strobes shall be powered from a non-coded notification appliance circuit output and shall operate on a nominal 12 or 24 volts (includes fire alarm panels with built in sync). 12-volt rated notification appliance circuit outputs shall operate between 8.5 and 17.5 volts; 24-volt rated notification appliance circuit outputs shall operate between 16.5 to 33 volts.

3. Speaker strobes shall be plug-in and shall have the ability to check wiring continuity via

a shorting spring on the universal mounting plate. The shorting spring shall also provide tamper resistance via an open circuit if the device is removed. Speaker strobe design shall isolate speaker components to reduce ground fault incidents.

4. The speaker strobe shall have power taps (from ¼ watt to 2 watts) and voltage that are selected by rotary switches. All models shall have a maximum sound output of 86 dB at 10 feet and shall incorporate an open back construction. The strobe shall consist of a xenon flash tube with associated lens/reflector system and operate on either 12V or 24V. The strobe shall also feature selectable candela output, providing options for 15 or 15/75 candela when operating on 12V and 15, 15/75, 30, 75, 110, or 115 when operating on 24V. The strobe shall comply with NFPA 72 and the Americans with Disabilities Act requirement for visible signaling appliances, flashing at 1 Hz over the strobe's entire operating voltage range.

5. All notification appliances shall be backward compatible.

6. Strobe lights shall meet the requirements of the ADA, UL Standard 1971 and be fully synchronized.

V. Programmable Directional Sounders

1. Shall follow NFPA 72 2019 edition Clause 18.4.8.

2. Electronic sounders shall operate on 24 VDC nominal.

3. 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.

4. Shall be capable to broadcast preprogrammed Voice Message.

5. Shall be flush or surface mounted as shown on plans.

6. Shall produce broad band directional sound with 20 Hz to 20 Khz frequency band to guide occupants to safe exists even in complete darkness.

W. Addressable Portable Emergency Telephone Handset Jack

1. Portable emergency telephone handset jacks shall be flush mounted on stainless steel plates as indicated on plans. Handset jacks shall be approved for emergency telephone system application.

2. Insertion of a remote handset plug into a jack shall send a signal to the fire command center which shall audibly and visually indicate the on-line condition, and shall sound a ring indication in the handset.

3. The two-way emergency telephone system shall support thirty five (35) handsets on line without degradation of the signal.

4. Remote Telephone Handset shall be capable of making paging announcement across all the zones in the system.

X. Addressable Fixed Emergency Telephone Handset

1. The telephone cabinet shall be painted red and clearly labeled emergency telephone. The cabinets shall be located where shown on drawings.

2. The handset cradle shall have a switch connection such that lifting the handset off of the cradle shall send a signal to the fire command center which shall audibly and visually indicate its on-line (off-hook) condition.

3. The two-way emergency telephone system shall support thirty five (35) handsets on line (off hook) without degradation of the signal.

4. Remote Telephone Handset shall be capable of making paging announcement across all the zones in the system.

Y. Batteries

The battery shall have sufficient capacity to power the fire alarm system for not less than 48 hours in standby plus 2 hours of alarm upon a normal AC power failure.

The batteries are to be completely maintenance free. No liquids are required. Fluid level checks for refilling, spills, and leakage shall not be required.

If necessary to meet standby requirements, external battery and charger systems may be used.

PART 3.0 - EXECUTION

3.1 INSTALLATION

A. Installation shall be in accordance with the NEC, NFPA 72, local and state codes, as shown on the drawings, and as recommended by the major equipment manufacturer.

B. All conduit, junction boxes, conduit supports and hangers shall be concealed in finished areas and may be exposed in unfinished areas. Smoke detectors shall not be installed prior to the system programming and test period. If construction is ongoing during this period, measures shall be taken to protect smoke detectors from contamination and physical damage.

C. All fire detection and alarm system devices, control panels and remote annunciators shall be flush mounted when located in finished areas and may be surface mounted when located in unfinished areas.

1. Manual fire alarm boxes shall be suitable for surface mounting or semi-flush mounting as shown on the plans, and shall be installed not less than 42 inches (1067 mm), nor more than 48 inches (122 mm) above the finished floor.

3.2 CAUSE & EFFECT LOGIC

System shall be programmed as per the attached cause & effect logic.

3.3 TESTING

The service of a competent, factory-trained engineer or technician authorized by the manufacturer of the fire alarm equipment shall be provided to technically supervise and participate during all of the adjustments and tests for the system. All testing shall be in accordance with NFPA 72.

Before energizing the cables and wires, check for correct connections and test for short circuits, ground faults, continuity, and insulation.

Open initiating device circuits and verify that the trouble signal actuates.

Open and short signaling line circuits and verify that the trouble signal actuates.

Open and short notification appliance circuits and verify that trouble signal actuates.

Ground all circuits and verify response of trouble signals.

Check presence and audibility of tone at all alarm notification devices.

Check installation, supervision, and operation of all intelligent smoke detectors using the walk test.

Each of the alarm conditions that the system is required to detect shall be introduced on the system. Verify the proper receipt and the proper processing of the signal at the FACP and the correct activation of the control points.

When the system is equipped with optional features, the manufacturer's manual shall be consulted to determine the proper testing procedures. This is intended to address such items as verifying controls performed by individually addressed or grouped devices, sensitivity monitoring, verification functionality and similar.

3.4 FINAL INSPECTION

A. At the final inspection, a factory-trained representative of the manufacturer of the major equipment shall demonstrate that the system functions properly in every respect.

3.5 INSTRUCTION & TRAINING

A. Instruction shall be provided as required for operating the system. Hands-on demonstrations of the operation of all system components and the entire system including program changes and functions shall be provided.

B. The contractor and/or the systems manufacturer's representatives shall provide a typewritten "Sequence of Operation."

3.6 SUBMITTALS

- a) Power calculations.
- Battery capacity calculations.

Supervisory power requirements for all equipment. Alarm power requirements for all equipment.

Justification showing power requirements of the system power supplies.
Voltage drop calculations for wiring runs in worst case condition.

b) Complete manufacturer's catalogue data including supervisory power usage, alarm power usage, physical dimensions, finish and mounting requirements.

c) Submit panel configuration and interconnection of modules and all other data as required to make an informed judgment regarding product suitability. Data shall be submitted on the following:

Main system including all fire detection with main and secondary control panels. Circuit interface panels including all modules.

3.7 CAUSE & EFFECT LOGIC

System shall be programmed as per the attached cause & effect logic.

3.8 TESTING

The service of a competent, factory-trained engineer or technician authorized by the manufacturer of the fire alarm equipment shall be provided to technically supervise and participate during all of the adjustments and tests for the system. All testing shall be in accordance with NFPA 72.

Before energizing the cables and wires, check for correct connections and test for short circuits, ground faults, continuity, and insulation.

Open initiating device circuits and verify that the trouble signal actuates.

Open and short signaling line circuits and verify that the trouble signal actuates.

Open and short notification appliance circuits and verify that trouble signal actuates.

Ground all circuits and verify response of trouble signals.

Check presence and audibility of tone at all alarm notification devices.

Check installation, supervision, and operation of all intelligent smoke detectors using the walk test.

Each of the alarm conditions that the system is required to detect shall be introduced on the system. Verify the proper receipt and the proper processing of the signal at the FACP and the correct activation of the control points.

When the system is equipped with optional features, the manufacturer's manual shall be consulted to determine the proper testing procedures. This is intended to address such items as verifying controls performed by individually addressed or grouped devices, sensitivity monitoring, verification functionality and similar.

3.9 FINAL INSPECTION

A. At the final inspection, a factory-trained representative of the manufacturer of the major equipment shall demonstrate that the system functions properly in every respect.

3.10 INSTRUCTION & TRAINING

C. Instruction shall be provided as required for operating the system. Hands-on demonstrations of the operation of all system components and the entire system including program changes and functions shall be provided.

D. The contractor and/or the systems manufacturer's representatives shall provide a typewritten "Sequence of Operation."

3.11 SUBMITTALS

d) Power calculations.
Battery capacity calculations.

Supervisory power requirements for all equipment. Alarm power requirements for all equipment.

Justification showing power requirements of the system power supplies.
Voltage drop calculations for wiring runs in worst case condition.

e) Complete manufacturer's catalogue data including supervisory power usage, alarm power usage, physical dimensions, finish and mounting requirements.

f) Submit panel configuration and interconnection of modules and all other data as required to make an informed judgment regarding product suitability. Data shall be submitted on the following:
Main system including all fire detection with main and secondary control panels. Circuit interface panels including all modules.

1. Appropriate glands shall be provided where the cable enters the junction box.
2. Cables are to be supplied along with all accessories, crimped termination etc. Cable is to be laid by the Trained & Experienced personnel only.
3. The cable when running in outdoor area shall not be taken overhead. It shall be laid underground according to IS 1255-1983 (Latest Edition)
4. The manufacturer shall have their proper sales office and well established service centre in India.
5. The manufacturer shall have their own adequate number of trained personnel, based in India, who are specialized for termination and installation of MICC cables, which is specialty of this cable.
6. The Bidder should submit an authorization letter from OEM in original for the tender called. Where false ceiling are proposed Cable shall be laid on Surface/ Cable Tray and where false ceiling are not proposed Cable shall be laid in suitable size of M.S. conduit in Slab.

PACKAGE – 5 (Surveillance & security system - CCTV)

Description In General

The agency shall supply and commission an IP Camera based CCTV system with the objective shall be to provide High degree of Electronic surveillance system. 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 essential to programming of recording of CCTV image/ video should be stored at least 30 days to facilitate investigations of a reported case. The Video Management Software & Camera should have ONVIF Profile S & G Compliance.

The Hardware required for the System including servers, workstations, monitors, networking components, cables, connectors, conduits, power supplies etc. Any additions to the Take-off Quantities given in the tender, if required by the Bidder at the tender Stage will need to be spelt out by the Bidder at the time of the Bid itself.

Strategically placed video surveillance cameras shall enhance security by providing continuous monitoring of all parts of the premises. All equipment and materials used shall be standard components that are regularly manufactured and used in the system. All systems and components shall have been thoroughly tested and proven in actual use.

Applicable Standards

Original Equipment Manufacturer Standard

All the cameras, Access Control Readers & Controllers should be UL Listed and FCC Part 15, EN & CE

CCTV OEM Prequalification Criteria:

Sl.No.	Specific Requirements	Documents Required
1	Security/IP CCTV System & Components OEM should have its direct registered presence in India for more than 10 years. (not as joint venture, partnership firms or through any other association) They should have their own registered Offices; The CCTV OEM for CCTV shall have its own/authorized CCTV service/repair facility in atleast two metropolitan regions for last 5 years with one Service centre being in Delhi NCR. The OEMs must also have its own R&D Centre as per ISO; Six Sigma; CMMI level 5 quality standards in India.	Certificate of Incorporation; GST Registration Copy; Copy of PAN Card; Details of Addresses of Service Centers & R&D Centers in India; Service Support Escalation Matrix with details of contact address & nos.; Registered Office addresses & contact details.
2	The Security/IP CCTV System OEM whose products shall be offered/quoted in the bid must have a minimum cumulative turnover of 500 Crores INR (Security & Safety System & Components/IP CCTV System- Cameras; Recording Software/Application etc in India in the past Five FYs and shall be a profit making organization for past 5 years . This is to ensure that the OEM is Serious about its business in India and has been consistently doing Business in India which will ensure long term After sales support for such a Mega project.	Audited Financial Statements; B/L and P&L sheets duly certified CA & cross signed & sealed by OEM designated authority

3	<p>IP CCTV System OEM must provide a Non Malicious Code undertaking by agreeing in writing for all proposed Cameras; Recording Software/Application; NVMS & Analytics Software; Camera Firmware; SDK; APIs etc shall not contain any embedded malicious code which may:-</p> <p>Inhibit the desired and designed functions of the equipment"s and Solution.</p> <p>Cause damage to the user or his equipment / Solution during the operational exploitation of the equipment"s / Solutions</p> <p>Tap information regarding network, network users and information stored on the network that is classified and or related to national Security, there by contravening Official Secrets Act 1923. (iv) There are / will no Trojans, Viruses, worms, Spy wares or any malicious software offered or Software that will be developed.</p> <p>Without prejudices to any other rights and remedies available to End-User/Final END CUSTOMER, OEM shall be liable under information Technology Act, 2000 and Indian Penal Code 1860 in case of Physical damage ,loss of Information and those relating to copy right and intellectual property rights (IPRs), caused due to activation of any Such malicious code in offered / developed software.</p> <p>The OEM related to IP CCTV System should be free from any foreign government control /ownership or financial aid in India or in any foreign country.</p>	<p>IP CCTV System OEM must submit undertaking duly sealed signed by designated authority .</p>
4	<p>Proposed software/application – Camera Firmware; VMS; API/SDK; Recording Software/Application; etc. Software / Application & Licenses should be developed under CMMI Level quality control as per CMMI Level 5 guidance & manuals. All proposed software/application should be licensed in the name of end-customer. Bidder should not propose any free / demo software for this project.</p>	<p>Copy of Certificate from IP CCTV System OEMs confirming CMMI Level 5 Quality Control compliance. Bidder & IP CCTV System OEM Undertaking Letter pertaining to the compliance of Licensed & latest versions of Software/Application aspects.</p>
5	<p>The IP CCTV System OEMs should own the MAC Address of the proposed components &/or network devices</p>	<p>Self-Declaration sealed & signed by competent Authority confirming & validating they own MAC ID compliance.</p>

6	IP CCTV System OEM need to confirm in their letterhead that any component/ hardware / parts / assembly / software including firmware used in the offered solution (hardware / software) do not comply to GB28181, GB/T 28181-2011; GB/T28181-2011; GBT 28181- 2011; GBT28181-2011 standards. Also, the IP CCTV System doesn't have CCC.	Documentary evidence and declaration from IP CCTV System OEM
7	IP CCTV System OEM products must have UL, EN; CE; ROHs, FCC and Valid Cyber Security certification. Any offered products should not have CCC certification.	Documentary evidence , certificates & Declaration from OEMs duly sealed & signed
8	The CCTV Company should have created enough Job opportunities in India as per the current PMO directive of Make in India and should have minimum 1500 employees on its payroll in India. Any OEM which is part of a larger group company but meeting the 1500 employee criterion is also eligible. This is to justify that CCTV OEM has made substantial investment in India and is serious about its business in India which will ensure long term after sales support and spare support from the OEM.	Declaration letter from the HR to be submitted along with the bid
9	The CCTV OEM should have atleast 5 project references (implemented or under implementation) of any City Surveillance or smart city projects in India with minimum 100 camera each in each project and with a total of minimum 5000 cameras combining all the 5 projects.	PO Award copies / work completion certificates to be submitted
10	The CCTV OEM should have its toll free number in India for any technical support query from the SI or end customer which is very much required for such a big project.	Toll free nos should be mentioned in the manufacturer's authorization letter and submitted along with the bid.

Scope of Work

The Scope and purpose is to monitor & supervise the entire area for security purpose, as well as record and inform officials on unwanted, untoward incidents. It is also essential to programming of recording of CCTV image/ video should be stored at least 30 days to facilitate investigations of a reported case.

The hardware required for the system including servers, workstations, monitors, networking components, cables, connectors, conduits, power supplies etc. will be in vendor's scope. It will be the responsibility of the vendor/bidder to make the entire system fully functional as per the specifications. Vendor/bidder shall consider any equipment/devices required to make the system functional if not mentioned herewith.

System Architecture

Video Management System (VMS) shall be a fully digital IP-based video surveillance system that brings together in one system a network video recorder (NVR) with unlimited storage capacity and integrations onto various DVRs/NVRs, and analog video switchers. It shall provide tight integration to the Access Control System and Intrusion Detection System. As a software-based enterprise-level video and data management system, VMS shall provide a single GUI that monitors, records, and offers functionality to deliver the timely, accurate information required for effectively responding to any challenge. VMS shall be a fully scalable enterprise-class media management system. This advanced network-based system architecture enables simultaneous live monitoring from multiple stations and is easily configurable for storage both on and off site. The software can be configured to store and to view images captured by one camera or thousands of cameras and monitor connections across an unrestricted number of servers. VMS can be designed to effectively integrate with access control, intrusion detection system and video equipment including DVRs, NVRs, keyboards, encoders, decoders and cameras to leverage and protect investments in legacy infrastructure and equipment.

The following diagram explains the relationship of various system and integration components:



Detailed Technical Specifications of Cameras as per BOQ.

ONVIF Certified Video Management Software

General Video Management System requirement

The Video Management System (VMS) shall control multiple sources of video surveillance subsystems in a facility to collect, manage and present video in a clear and concise manner. VMS shall intelligently determine the capabilities of each subsystem across a single or multiple site, allowing video management of any compatible analog or digital video device through a unified configuration platform and viewer.

VMS shall be based on server client architecture with server & controller containing a database of all network-connected cameras, integrated components and their configurations; and Workstations that will render video and act as a main user/machine interface.

VMS shall provide a single graphical user interface (GUI) to monitor, control and administer digital video surveillance equipment from multiple systems and platforms.

VMS shall include a fully scalable enterprise-class media management system to enable simultaneous live monitoring from multiple stations and be configurable for storage both on and off site.

VMS software shall be configured to store and to view images captured by one camera or numerous cameras and monitor connections across an unlimited number of servers.

The VMS application shall have following major capabilities:

Capable of managing pentaplex user operations of attached recording devices simultaneously, including live viewing, recording, playback, archiving of video data to an external storage device, and handling the exchange of data between the server and a remote workstation.

Live viewing of up to 64 cameras on a single workstation with up to four monitors set up at CIF resolution. For 1080p and up to 4K resolution, the number of live streams shall be benchmarked based on the client hardware configuration deployed.

The number of recorders and switchers shall be scalable within a network to handle any size of installation.

Capable of managing the integration with multiple digital IP cameras through compatible recording devices.

Integration with electronic access control systems.

Integration with video analytics and a data management utility.

Capable of managing failover and redundant capabilities of the recording device(s) and the database server. 1+1/N+M Recorder failover and failback automatically or manually. View and playback on one client panel.

Capable of managing the investigation and video archive search tools of the recording devices.

Capable of managing advanced search capabilities of the recording devices.

Capable of managing motion detection-based recording.

Multi-level user access rights for managing viewing rights and access to the recorder functions.

Capable of managing continuous, scheduled, manual, event-based and alarm-based recording features of the recording devices.

Support for Unicast/multicast network topologies and communication protocols.

Macro capability to allow for custom scripts and to provide both customization and third party integration.

Support for both centralized and distributed architectures.

Simultaneous use of multiple video compression including H.264, H.265, MPEG-4 and M-JPEG.

Utilization of off-the-shelf computer workstations, servers, networking and storage equipment.

Cyber Security Features of VMS:

Enhanced password security – non-recoverable passwords, enforcing complex passwords, password expiry, and no default passwords.

Addressed Unauthenticated/Unauthorized channels.

Secured firewall configuration.

Secured Web client – enabled HTTPS and SSL, and protection from CSRF and XSS attacks. Restricted folder and Registry access to operators.

Secured Assemblies – Digital signing.

Mode for User Login: VMS Server and Workstation shall have the option of two modes of user logins

Windows Authentication: Uses the Windows logged-in user name.

User DB Authentication: Uses a preconfigured user name and password.

VMS Workstation shall provide the following operator functions:

Configuration: The operator (with Administrator privileges) shall have the option to configure VMS. VMS shall support live updates of all configurations. The following configurations shall be possible:

Recorders Configuration: Option to add/edit/delete recorders.

Camera Configuration: Option to add/edit/delete cameras and associate to a particular recorder or switcher and map to a particular site, partition or event group.

Monitor Configuration: Option to add/edit/delete monitors and map to a particular site, partition, event group or keyboard. It shall provide an option to add a digital monitor and associate it with a particular workstation. It shall provide an option to configure a digital monitor with a default salvo and startup in full screen. It shall provide an option to add an analog monitor and associate it with a particular switcher. Option to save a digital correction in the video input page.

Switcher Configuration: Option to add/edit/delete analog video switchers.

Keyboard Configuration: Option to add/edit/delete keyboard controllers.

User Management (Users and Roles): Option to add/edit/delete roles and associate to predefined privileges and then add/edit/delete users and associate users with roles. Option to associate permissions with salvo selection and tool bar buttons.

Site Configuration: Option to add/edit/delete a site.

Workstation Configuration: Option to add/edit/delete a workstation.

Event Group Configuration: Option to add/edit/delete event groups. Support of bulk event association to enable/disable and adjust events for recorders and inputs in bulk.

Partition Configuration: Option to add/edit/delete partitions.

Sequence Configuration: Option to add/edit/delete a scan sequences.

Intercept Key Configuration: Option to add/edit/delete intercept keys from Ethernet joystick keyboards to change the key function to a new and desired function.

System Macro Configuration: Option to add/edit/delete macros. Option to restore macros. Execute button option to trigger selected macros provides mechanism for testing written macros.

Port Configuration: Option to add/edit/delete keyboard controllers and analog video switchers to the ports available on the controller VMS Operations & Management Console

Capable of being launched multiple times on the same workstation a minimum of four (4) times to display four (4) viewers on four (4) separate monitors per workstation.

Main video viewing screen capable of showing 1x1, 2x2, 3x3, 4x4, 5x5, 6x6, 7x7, 8x8, 1x5, 2x8, and 1x12 salvos of live or recorded video. The Viewer application shall be capable of a full screen mode where only the video salvo is displayed.

Each Viewer has the capability to be associated to a specific monitor on a workstation and be assigned a unique output number that is either selectable from the viewer device tree, an Ethernet Joystick controller, or from a system macro.

Capable of saving current salvo as a View and allowing the user to select the saved view by either dragging and dropping it into the viewer, using an joystick controller or a system macro.

Capable of selecting a particular camera or salvo by using the mouse to drag it onto the main video viewing screen. Users shall also have an undo/redo option for camera drag/drop and salvo selection from the viewer and joystick controller.

Capable of choosing My Salvos (unique to the current operator) or Shared Salvos while saving a salvo.

Capable of allowing duplicate salvo names to be set by different users and in different locations.

Capable of dragging any monitor defined in the system onto a video panel and take control of that monitor.

Option to send a command to the controller to switch a particular analog camera onto the analog monitor through a drag and drop operation.

Capable of configuring and running scan sequences.

Capable of independently adjusting the contrast, brightness, and saturation settings for each camera.

Support for both analog and digital PTZs through the GUI or the keyboard.

Innovative "One-Click" or "Mouse Drag" 3D PTZ control experience that does away with legacy PTZ controls of continuous clicking.

Intelligence events from cameras can be viewed at the alarm panel and trigger event recording on recorders for further investigation.

360° de-warping "spreads" the distorted fisheye image into natural panoramic and/or multiple tile views. Operators can view and focus on zones of interest on live and recorded video.

Capable of exporting user selected images or video clips. A digital signature shall be attached to every exported clip.

Clip Creation: The Clip Creation facility shall permit multi-camera clip generation

Story clips allow for selecting multiple cameras at different times to create a single clip to play the cameras back in order. Also supports saving salvo information in a story clip.

Salvo clips provide an instant clip export button to create an instant clip while maintaining the salvo information. Supports pre-determined pre- and post-times that are user-configurable in the preferences.

Clip preview window facility supports play back of the individual cameras prior to commencing clip creation.

Capable of manually setting the clip duration in the clip creation window for each camera

Capable of playing back the exported video clips. Each video channel that is being recorded by the recording system shall be overlaid with text and a time stamp that is customizable by the user.

Allows the user to initiate recording through the GUI or controller.

Capable of complete alarm management for the alarms coming from recorders or switchers. Quick and responsive alarm actions can be initiated from the preview pane options.

Application launch pad launches other applications from within the Viewer.

Control of operator messaging, allowing operators to communicate with each other. Operators can exchange text, images and annotated video sources. Operators can hand over a video source to another operator using messaging.

Ability to set up surrounding camera views. Support for setting presets in surrounding cameras.

Option to perform various operations through the context menu on a particular video (live/recorded/sequence). These operations include: Full screen, point and drag, enable square select, maintain aspect ratio, toggle text, digital PTZ, add bookmark, send message, start recording, stop recording, mark in, mark out, save image, save image as, and show surrounding cameras.

Ability to manage the timeline control of the recording device, which provides camera recording statistics. Timeline control shall have the following features: Mark in/out (with looping facility), bookmark (including for all playing cameras or all selected cameras or removing all bookmarks), snapshot, time slider, time search, time jump, and play controls. Timeline control shall also include dedicated buttons for step reverse and step forward and keyboard shortcuts for playback operations.

Support for bookmark searches based on cameras, time duration, and comments. Controllable by a keyboard controller connected to the VMS server/controller with the following major features: selecting salvos, ending monitor commands, switching operations, and PTZ control operations.

Preference configuration including: fps of unselected panels, rendered type, preview pane, and text display format.

Search: The Search facility shall include searches based on date and time.

Reports: The Report facility shall include event history reports and audit log reports.

Remote Monitor: The Remote Monitor facility shall allow operators to control a remote monitor connected to another workstation and perform review capabilities so that both the local operator and the remote viewer can simultaneously watch the same video.

Recording Server (NVR) shall have following major capabilities

Record and monitor up to 500 IP channels at 3840 fps @ 1080p (4 Mbps bitrate). Network band width throughput supported per NVR with Incoming: 500 Mbps, Outgoing: 425 Mbps providing a Total: 800 Mbps. Archival support of 25 channels @ 4 Mbps bitrate each, with outgoing archival storage throughput of 275 Mbps. Multi-stream support with maximum 128 streams. Support for configuring one (1) preferred stream for continuous recording and one (1) preferred stream for live video/motion based recording per camera. Support for One-Way

Audio (for specific IP cameras) with live, playback and clip export on NVR desktop client for up to 64 IP channels.

Live viewing of up to 64 IP cameras on a single remote workstation with Single Monitor @ min D1 resolution and/or up to Four (4) monitors set up at reduced resolution per workstation supported. Enhanced HD video rendering on remote desktop clients with support for monitoring of up to 23 1080p HD cameras in real time (30 fps)/690 fps 1080p HD with no-time lapse using the GPU capabilities of in-built processor graphics with 6th generation Intel® Core™ Processors for client systems. Up to 4 1080p HD @ 30 fps/120 fps on local client.

Capable of managing motion detection-based recording with pre-event and post-event recording based on camera based motion detection or Server based motion detection events (SMART VMD) and “advanced” search on recordings from remote client.

Preview and Calendar Search permitting search for videos and events based on user-selected date and time from remote client. SMART motion search — fast and efficient forensic search and investigation for objects/motion on recorded video using SMART motion detection Analytics algorithms on the client PC without impacting the NVR Server load.

Simultaneous use of multiple video compressions including MJPEG, MPEG-4, H.265 and H.264.

Internationalization – supports the following languages: French, German, Russian, Italian, Spanish, Dutch, Arabic and English.

Email on alarm.

Instant clip creation from snapshot.

Dynamic IP Camera Discovery – Automatically discover all compatible cameras connected to NVR.

Multi-level user access rights for viewing and manages access to the recorder functions. Capable of managing continuous, scheduled, manual, event-based, and alarm-based recording features.

Advanced security features with encryption support for communication between desktop client to NVR and secure https login for Web Client and mobile apps.

Support for web client and mobile apps.

The following video recording options shall be supported:

Scheduled based recording: The system shall support the ability to schedule recordings for each individual camera for times in the future. By default, the NVR shall be pre-loaded with the

following four schedules: 24x7, Weekday, Daytime, and Nighttime, which cannot be edited. A maximum of 50 schedules can be created in the NVR.

User based recording: The user shall be able to configure user activated settings for recording moments of interest while viewing live video from a camera. After configuring the user activated settings, the operator can start recording of video when needed. The video is recorded for the time period specified in the System settings for user activated recording. The User based Recording Time Duration shall be selectable from a list of values ranging between 30 seconds and 5 minutes.

Event based recording: Event based recording shall be possible on SMART Video Motion Detection and alarm triggers. The NVR must be capable of managing motion detection-based recording with pre-event and post event recording based on camera and Server-based motion detection events. The server-based SMART VMD analytics must be object-based and not traditional pixel-based, reducing false alarms due to changing light conditions, video noise, rain or other false alarm triggers that occur using pixel-based (traditional) VMD.

Video format support — only playable in desktop clients and standalone Clip Player. Features quicker exports of raw video and support for estimating clip size and split to multiple clips to ensure clip storage media matches. Include the clip player with exported clip for easier review of video evidence and efficient investigation. Clip Player — Portable standard secure player for archived and exported clips (*.mpvc), 360 camera de-warping and 2x2 Salvo support. Smooth playback support with up to 256x review speed. No software needed to run on a Windows PC, with the option to include the clip player with the exported clip.

Video Management System Server Specification

Server shall operate with no performance degradation using the following minimum hardware and operating system configuration for min 10 concurrent Client Station.

Processor: Single Intel® Six Core Xeon E5 2530V2 2.6 GHz S1150

System Memory (RAM):16 GB Optical Drive: DVD+/-RW

Hard Disk Drives: Two separate hard drives or two sets of RAID arrays. Disk/RAID set 2 utilizing 7200 SATA or 10K-15K RPM SCSI 146 GB free fault tolerance is required, RAID set one is RAID 1 for OS with 1TB HDD Dual 1GBPS Network Interface Card (NIC)

Human Interface: 102-key keyboard and a mouse pointing device

Graphics Adapter: 32-bit color or higher, video resolution 1280x768 pixels, 65K colors non-interlaced

Operating System: Original software CDs and startup installation diskettes for: Windows® Server 2016 Standard 64-bit OR Windows Server 2012 Standard 64-bit Microsoft SQL Server/Express 2016 OR SQL Server/Express 2012

Windows Media Player Version 12 Recording

or Media Server Specification

<i>PROCESSOR</i>	<i>2 x Intel E5-2620 V4, 2.1GHz, 08 core, or Intel® Xeon® Silver 4110, 2.1 GHz 08 Core</i>
<i>SYSTEM MEMORY (RAM)</i>	<i>32GB</i>
<i>OS & APPLICATION - HARD DISK DRIVE OR PARTITION</i>	<i>2 x 300 GB SSD RAID 1</i>
<i>GRAPHICS ADAPTER</i>	<i>In-built Processor Graphics (GPU):Intel® HD Graphics 530, 4600, or equivalent for local client GPU rendering support (Optional)</i>
<i>NETWORK INTERFACE</i>	<i>Min 4 Network Card 1GBPS</i>
<i>OPTICAL DRIVE</i>	<i>DVD-RW</i>
<i>MONITOR RESOLUTION</i>	<i>Video resolution 1280x1024 pixels, 32 bit</i>
<i>KEYBOARD/MOUSE</i>	<i>102-key keyboard and mouse</i>

Insertion : Nil

Correction: Nil

Omission: Nil

OPERATING SYSTEM
OPTIONS
Win 10IoT/Enterprise 64 Bit/ Windows Server 2016 R2 (64 bit OS versions recommended)

VMS Monitor Workstation

Workstation shall operate with no performance degradation using the following minimum hardware and operating system configuration:-

Processor: Intel Core i7-7700K, 4.2GHz

System Memory (RAM): 16 GB

Optical Drive: DVD-RW

Hard Disk Drives: Single disk or RAID 7200 SATA 250 GB or 10K to 15K SCSI 250 GB;
RAID 0 or 0+1.

Network Interface Card (NIC): 1 Gbps

Human Interface: 102-key keyboard and a mouse pointing device

Graphic Card - In-built Processor Graphics (GPU): Intel® HD Graphics 630 and NVIDIA Quadro NVS 315 1 GB PCIE x 16 LP supporting 2/4 Monitors., Two(2) PCI-Express Expansion Slots 2/4 USB, 2 serial, and 2 HDMI/VGA Adaptor

**PACKAGE – 6(DIESEL GENERATOR SETS)
GENERAL :-**

The entire work shall be carried out as per following CPWD General Specifications for Electrical works wherever applicable and as amended up-to-date. CPWD General Specification for Electrical works (Part- VII) DG Set 2013, CPWD General Specification for Electrical works (Part-I) Internal – 2023 CPWD General Specification for Electrical works, (Part-II) External- 2023 CPWD General Specification for Electrical works,(Part-IV) Sub- Station-2013

Battery Charger: The battery charger shall be suitable to charge required numbers of batteries at 12V/ 24 volts complete with, transformer, rectifier, charge rate selector switch, indicating ammeter & voltmeter etc. Connections between the battery charger &batteries shall be provided with suitable copper leads with lugs etc.

Foundation: For DG Sets installed outside in open area- A PCC (1:2:4, grade) foundation of weight 5 times the operating weight of the Generator set with enclosure or as recommendation by the Generator set manufacturer OEM/OEA, whichever is higher. The cost of foundation shall be included within the quoted rate of item.

Performance Testing and Type Tests: DG sets shall be tested at varying loads at manufacturers works prior to dispatch DG sets to site. The performance tests at the works shall be carried out in presence of authorized representative from the Engineer-in-Charge. Due notice for the programme performance testing at works shall be given to the Engineer-in-Charge to enable to arrange for their representatives for this inspection to be at manufacturers works to inspection and testing. The costs for the arrangement shall be borne by the Contractor. The performance test on DG Set shall be of minimum 12 hours duration on rated KW including 1 hrs. On 10% overloading after continuous run of 12 hrs. All instruments, materials, consumables (fuel oil, lube oil etc.) load and labour required carrying out of the test shall be provided by the Contractor.

Commissioning: The Contractor shall provide fuel (Diesel) / Lubricants etc supplied with initial 1st filling into the Fuel Tank to run DG Set after commissioning at Site.

Providing, Installing, Testing and Commissioning of 'Standard Type' Diesel Generating set alongwith having Prime Power Rating of 750 KVA (minimum), 415 volts at 1500 RPM,

0.8 lagging power factor at 415V suitable for 50 Hz, 3 phase system, outdoor type with water cooled, as per CPWD General Specifications for Electrical Works Part VII DG Set – 2013, CPCB norms, the equipment furnish shall conform to the latest Indian and BS Amendment upto date standard, except where modified or supplemented by this specification, the installation work shall conform to Indian Electricity act and Indian Electricity Rules as amended upto the date of installation.

This specification covers the manufacture, assembly, packing, dispatch, transportation to site, supply, erection, testing, commissioning, performance and guarantee testing of Diesel Gen.

Set, complete in all respects with all equipment, fitting and accessories for efficient and trouble free operation as specified here under.

Diesel engine complete with all accessories, an Alternator directly coupled to the engine through flexible/rigid coupling complete with all accessories for starting, regulation and control, including base frame, interconnecting piping and accessories, power and control cable, glands and lugs etc.

D.G. Local/Remote control panel including all type of control cables, special cables (if any) between D.G. Set's, instrument panel, PLC control panel and Main LT panel etc. Equipment necessary for engine cooling system, Radiator Type, inter connecting pipes etc. and for fuel storing and distribution, day oil tank (990 Lt.), pipings, pumps, valves, level indicators etc.

Exhaust piping, flexible connections and Dry exhaust manifold with hospital exhaust silencer, including thermal lagging, cladding etc.

Batteries with good quality iron battery stand and battery charging equipment, including their connections as necessary, along with tools & accessories for battery maintenance. (Contractor shall submit the list of tools along with Tender)

Anti Vibration Mountings, Power & Control cabling, cable tray etc.

Preparing all related shop drawings for approval from CPWD/consultant and all statutory bodies as required and as applicable.

Obtaining statutory approval of the installation including permission for operation of Diesel Generators by the Electrical Inspectorate, Pollution Control bodies and any other statutory bodies as applicable.

Minor civil works like chasing, grouting etc. for execution of jobs. All civil works relating to DG Sets, Exhaust & foundations etc.

Carrying out performance and guarantee test at site at available load which shall not be more than the capacity of D.G. Set.

The fuel oil installation shall meet all statutory requirements of Govt. of India as amended upto the date of installation. Any approval required from statutory authorities shall be obtained by the

Contractor. Nothing in this specification shall be construed to relieve the contractor of these responsibilities.

The Indian standards are available from: Indian Standards Institution, Manak Bhawan, 9, Bahadur Shah Zafar Marg, New Delhi - 110 002 (INDIA).

The Indian electricity Rules and the Electricity act mentioned above can be obtained from: Kitab Mahal, State Emporium Building, Baba Khark Singh Marg, New Delhi - 110 001 (INDIA).

Equipment conforming to any other National/International Standard which ensures equal or better quality may be accepted. In such case the bidder shall furnish copies of the standards in English along with his bid and shall clearly bring out the salient features of comparison with corresponding listed standards.

The equipment furnished under this specification have to operate in a tropical climate and shall be given tropical and fungicidal treatment as per relevant specification

SPECIFICATIONS :-

PERIOD OF OPERATION/DUTY CYCLE : The sets are intended to supply power only during an emergency for all services and may be idle for long periods except for periodic routine tests once in a week. When there is a total failure of main power supply, the sets shall be required to operate continuously at full load for a period which at times may exceed even 24 hours.

ENGINE :- The diesel engine shall be of stationary type four stroke (Prime Duty) with vertical in line or (V) type cylinder arrangement, Turbo-charged, cooled with Radiator Type.

Rating: Power BHP rating of the engine shall be such that the DG set deliver the specified net electrical output while supplying power/driving all electrical and mechanical auxiliaries connected to alternator terminals and engine shaft at specified site conditions and ambient temperature of 50oC. (The engine and alternator shall be suitably rated for 50oC ambient operating condition.

It shall also be capable of satisfactorily driving the alternator at 10% over load at the rated speed for one hour in any period of 12 hours of continuous running.

The contractor shall have to furnish copy of deration chart from the original manual of the engine manufacturer and supporting calculations to arrive at diesel engine rating.

Speed and Vibration Levels: Speed shall be 1500 revolutions per minute. Speed governor/over speed protection shall be provided. At due running conditions, speed shall be stabilized at plus or minus 2% nominal speed, regardless of load. At transient condition, engine speed shall vary not more than 10% plus or minus. Governor class shall be A1 (4% drop) for normal application unless otherwise specified. The engine vibration level shall be as latest upto date amended BS standard.

Lubrications: The engine shall have a closed cycle forced & splash lubricating system with positive oil pressure and a crank chamber for collection/storage of the lubricating oil during circulation. Lubricating oil shall be circulated in the engine by an engine driven pump.

A lubricating oil filter of an efficient full flow type of ample capacity shall be provided for operation under normal conditions for a period of 300 hours without the necessity of its replacement or cleaning. Filters shall be capable of removing all foreign matter above a particle size of 5 microns.

In case lubricating oil coolers are required it shall be supplied as an integral part of the Diesel Generator Set. Necessary temperature and pressure gauges and other instruments shall be supplied and fitted on the lubrication system. A lubricating oil level dipstick suitably graduated shall be provided and located in the accessible position. The tenderers shall state the guaranteed lubricating oil consumption in litres per hour.

Fuel System: The engine shall be capable of satisfactory running on all types of diesel fuel oil normally available locally/ in India.

The fuel consumption of the engine shall be expressed by the Contractor in the bid in litres per gross/net kWh output from the alternator (after supplying the requirements of auxiliaries) at full, three quarters and half of its rated power output and at 0.8 and unitary power factor.

If guaranteed fuel consumption is exceeded, the contractor shall make such amendments or alterations as are necessary to bring the consumption to within the guaranteed figures.

Tolerance of +5% as defined in latest upto date BS shall be allowed.

A fuel service tank of 900 liters (Minimum) capacity with each D.G. Set shall be provided on a suitably fabricated steel platform. The tank shall be complete with level indicator marked in liters, filling inlet with removable screen, an outlet, a drain plug, an air vent and necessary piping. The fuel tank shall be painted with oil resistant paint. All pipe joints should be brazed/welded.

Air Intake System: The diesel engine shall be provided with special dry type air filters having low resistance to air passage, high dust retaining efficiency and provision for easy cleaning. Filters shall be suitable for achieving satisfactory engine operation and ensuring the engine life under tropical humid conditions, with sulphur dioxide fumes, abrasive dust and coal particles of 5 to 100 microns present in the atmosphere. The minimum efficiency of filters shall be 90% down to 5 micron size.

Engine Governor: The governor shall be Electronic ISO-Chronous type to maintain zero speed rate or regulation and shall be AI type as per latest BS in order to take care of heavy motor starting. It shall have necessary characteristics to maintain the speed substantially constant even with sudden variation in load. However, a tripping shall be provided if speed exceeds maximum permissible limit. The governor shall be suitable for operation without external power supply.

Turbo Charger: It shall be of a robust construction, suitable of being driven by engine exhaust having a common shaft for the turbine and blower. It shall draw air from filter of adequate capacity to suit the requirements of the engine.

Quietness Of Operation:The engine shall be designed to achieve maximum quietness of operation.

Efficient hospital silencer shall be provided as per engine manufacturer's approved make only for the exhaust. Noise level of the DG set shall be as per The CPCB Norms

Engine Starting :- Engine starting shall be by electric starting motor complete with manual/automatic starting arrangement. The starter motor shall conform to latest IS and shall be of adequate power for its duty and be of inertia or pre-engaged type. The pinion shall positively disengage when the engine starts up or when the motor is de-energized.

The engine wiring shall be appropriately modified, ferruled to totally match with schematic drawings of the panel.

Time for Run-up to Speed: From the initial operation of the starting device, the engine shall start, run up to normal speed and be capable of accepting 60% of full load in steps within a maximum time of 20 seconds, and full load within a further 20 second.

Starter Battery: The battery shall conform to the requirement of latest IS. Starting battery each of 12 V, heavy duty high performance approved make/quality shall be provided to enable crank & start the engine even in cold/winter morning conditions. Type/voltage/AH capacity of same on 20 hour rated discharge period shall be indicated in the offer. The battery set shall be capable of performing at least (5) five normal starts without recharging.

The battery shall be provided with good quality iron battery stand painted with acid proof black paint with min 3mm thick rubber mat below the battery.

Batteries shall be of load container type only and not with PVC moulded sealed container so that each individual cells are available for individual monitoring during its life span. Each cell shall be provided with electrolyte filling cap with level floats for easy monitoring of electrolytic level.

The battery shall be provided with 2 Nos. cables, minimum 1.5m long heavy duty rubber/PVC insulated cabling with brazed tinned lug at one end and with brazed tinned brass terminal lug at battery end - for connecting batteries to cranking system - with 0.25 m long inter battery connecting cable.

The lugs shall be clearly stamped (+) or (-) and positive cable also red sleeved for easy identification.

The batteries Set shall be supplied fully filled and first charged ready to use.

Batteries set shall be supplied with spring type hydrometer, thermometer with specific gravity correction scale and cell testing voltmeter etc.

BATTERY CHARGING SYSTEM :- Float rate charging and quick rate charging system shall be provided at the generator panel with appropriate bridge charger system, LC network, rate selector switch and generously rated charging transformer and silicon one rectifier bridge, so that the cranking battery system can be kept fully charged at all times from E.B. supply network with quick charging rate limited to 0.8 times rated discharge current with provision in control transformer and Si rectifier present to enable boost charging the battery at 2 times rated discharge current in case of emergencies. To this and in the mode selector switch boost charge position shall be present which however shall be kept disconnected at mode selector switch normally.

DC ammeters to clearly indicate float charging current and quick/boost charging current shall be provided.

Dropper resistor network on the load side of battery charger system shall be provided so that higher charger voltages in quick or boost conditions does not get impressed on the I/L and Contactor coils, which voltage shall remain well within +10% of rated voltage.

Battery charging subsystem shall be designed for continuous operation at cubicle ambient of 50oC corresponding to 45oC ambient outside and should be designed to operate at 1.5 times rated maximum current corresponding to boost charge current which can reach in practice as high as 2.5 times or 3 times rated discharge current.

Any charger dynamo and dynamo charging current network present on the set shall be made in operative so that both for AMF and manual application the cranking battery system is kept charged from the charger at the panels at all times during or shut down periods of the set.

To the above and in case of manual DG sets, the input to charger subsystem viz., 240 V AC is foreseen to be provided from customer network from the portion that is normally supplied by manual DG Set during DG operation or being fed by E.B. System.

Battery charger shall form part of D. G. protection and PLC panel.

ENGINE FITMENTS :- The engine shall be provided with but not limited to following essential basic fitments:

Crank case breather - Dry type element (Breather outlet shall be fitted with a filter cap capable of preventing entry of dust).

Air Cleaner - Dry type mounted.

Corrosion resistor - to control acidity and impurities from coolant Lubricating Oil Cooler -

Filters - Lub oil & fuel oil, paper element
type. Coolant Pump - Gear Driven.

Fuel Pumps - Priming & Transfer

Governor - Electronic Class A1.

Turbo Charger - Exhaust gas driven in case of turbo charged engines.

Flywheel with flywheel housing - SAE Type

Vibration dampers - One Set

Exhaust/Intake manifolds -

Oil Sump (crank case) with dip stick Engine Supports

Residential type silencer in exhaust system Electrical starter 24 V

Safety controls & instruments
Flexible coupling with guard
Engine Instrumentation

The following instruments mounted on instrument panel shall be essentially present as minimum:

Engine speed tachometer with service hour counter
Lub oil pressure gauge

Coolant water temperature gauge

The instrument panel shall be mounted on engine using rubber dampers for vibration isolation. The gauges shall have clear red marking to identify the limiting dangerous levels, 'Zone Markings' on the scale to indicate the normal healthy & abnormal operating zones for the parameters concerned.

The metering could be either normal electro-mechanical analogue type or electronic digital type, latter being preferred as manufacturers fitment only.

The engine control panel must be supplied by the engine manufacturer only.

MOUNTINGS AND FOUNDATIONS:-The engine and direct coupled attenuator shall be rigidly secured to a common rigid base frame fabricated from MS section.

The DG set shall be placed on the CC floor with approved make anti-vibration mountings. A lifting hook of required capacity shall be provided above the finalized location of the DG set to facilitate installation and subsequent maintenance of the DG Sets.

The design of mounting arrangement with anti-vibration mountings shall be as recommended by the DG manufacturers and shall be such that a maximum of 2% vibration are transmitted to the structure.

The tenderer shall confirm the type & design of mountings provided and the vibration isolation efficiency in the tender.

EXHAUST PIPING :- The engine shall be fitted with a hospital type silencer (design approved by manufacturer) to reduce the noise level. Silencer outlet shall be connected to exhaust piping carried to the top of the building through shafts provided for the purpose. Exhaust piping shall be fabricated from MS pipes conforming to IS 3589 of size suitable to limit back pressure to within permissible limit (2.5" of Hg.). Tenderer shall submit design calculation in support of the back pressure being within limits along with the tender.

It is important to ensure that the surface temperature of the exhaust piping does not exceed 50oC. For this purpose, the entire length of exhaust piping shall be treated as mentioned in the Bill of Quantities.

Exhaust piping shall connected to the engine by means of flexible section or an expansion joint and shall also be graded to a drain pocket inside the building. The pocket shall be fitted with a drain cock.

TOOLS :- Two sets of standard tools kit for maintenance shall be provided by Contractor. Tenderer shall submit a list of the tools along with the tender.

Low Lubricating Oil Pressure :- Pressure sensors shall be fitted such that in the event of a fall in the lub oil pressure, an alarm and indication shall be actuated. In addition, the engine shall

be automatically shut down in the event of lub oil pressure dropping to a predetermined low value.

Over Seed:- Speed control shall be so arranged that a 10% increase over normal rated speed shall cut off fuel supply, thus stopping.

Overload Protection:- The engine shall be adequately protected against operating under overload conditions. The requirements shall be met by the provision of a fixed overload limit stop on the fuel pump rack control rod to prevent the set being subject to a load exceeding the site rating plus 10%.

Excess Starting Time:- The starting circuit for the automatic mains failure diesel generator sets shall be arranged to attempt upto three starting cycles, each not exceeding 10 seconds

duration with a similar OFF period between each cycle. If the set fails to start upon completion of the third attempt the starting circuit shall be locked out until it is restored manually. An alarm shall be given and "Set failed to start" indication given on the panel.

Fuel Level Protection:- A level sensor shall be provided in the day fuel tanks to give visual and audible alarms if the level in the tank falls to below ¼ of full.

ALTERNATOR:- The alternator shall have brushless type with rotating field and static excitation circuit controlled by field control unit suitably compounded for voltage and load current for a self excited self regulated system.

The alternator shall be in SP-DP enclosure, foot mounted with ball and roller bearings on end shields. The alternator shall conform to latest IS/BS and shall be suitable for tropical conditions.

The alternator shall comply with the following specifications:

Rating - 1 No.x 750KVA (minimum) DG Sets shall be capable of 10% over loading at the rated speed for one hour of 12 hours continuous running without exceeding permissible temperature rise.

Phase - 3 phase, 4 wire

Voltage - 415 V

Regulation - To be filled by the
Tenderer Speed - 1500 RPM

Frequency - 50 Hz.

P.F. - 0.8 lag

Enclosure - SPDP
IP:23 Insulation - H

Execution - Self excited, self-regulated with brushless system and separately excited with PMG static voltage control unit suitably compounded for voltage and current to maintain terminal voltage constant at ± 5% at all load for p.f. not less than 0.8. lag.

Terminal Box - Bus duct chamber

Earthing Studs - 2 Nos. for each DG Set.

Neutral Point : The winding of the alternator shall be star-connected with the neutral connection brought out to a separate terminal.

Terminal Box and Connection:-The alternator output terminals shall be enclosed in a terminal box mounted in an accessible position on the alternator frame. As far as possible, connections between the exciter and alternator shall be contained within the machine frame and connections carrying A.C. and D.C. shall be segregated from each other. The terminal box shall be of sufficient size to conveniently terminate the size and number of the Owner's cables, which shall be intimated during detailed engineering. Suitable tinned copper pads shall be provided for power cable termination along with all necessary hardware and cable lugs.

Glands and lugs shall be provided for control cables also. For single phase cables, gland plate shall be of non-magnetic material. Gland plate shall be removable type.

The generating set shall be so designed that it is capable of reaching its full voltage and frequency and shall be ready to take full load within 30 seconds of a remote starting impulse being received.

ENGINE SAFEGUARDS:- Safeguards shall be provided and arranged when necessary to stop the engine automatically by the following:

Energising a solenoid coupled to the stop lever on the fuel injection pump rack. De-energising the "fuel on" solenoid

Energising the "fuel - cut off" solenoid.

The operation of the safeguard shall at the same time give individual warning of the failure by illuminating an appropriate local visual indicator and remote alarm at generator panel.

The contactors, relays and other devices necessary for signal and control, for above purposes shall be provided at Generator panel.

At the set at a easily accessible place an "EMERGENCY STOP" mushroom head stay put type P.B shall provided to stop the set in emergency mode.

The safe guard to "STOP THE SET" shall stop the set irrespective of mode selection of the set viz Auto, Manual or test for following cases, with simultaneous isolation of alternator ckt.

Emergency stop P.B's operation Over speed.

Low lube oil pressure. Earth fault

Over current

High water temperature

TESTS: The alternator of each type and rating shall be type tested for the following tests as per latest IS/BS. Test certificates to be provided for routine and type tests from the manufacturers.

ERECTION, TESTING, COMMISSIONING AND PERFORMANCE & GUARAANTEE

TESTS/PROCEDURE AT SITE:- The entire work of erection, testing and commissioning of equipment supplied under this package shall be carried out by contractor and performance and guarantee tests to be conducted at site are also included under the scope of this specification. For this purpose the contractor shall depute suitable qualified technical supervisor to site on advance intimation to the Owner along with all special testing equipment required for testing and performance and guarantee tests. The supervisor(s) shall be responsible for the installation, testing, commissioning checks and performance & guarantee tests mentioned in relevant clauses of this volume and the checks recommend by the contractor.

The contractor shall ensure that the equipment supplied by him are installed in a neat workman like manner such that they are leveled, properly aligned and well oriented. The tolerances shall be established in Contractors drawings and/or as stipulated by the Owner. All special tools and tackles and spares required for erection, testing and commissioning of equipment shall be supplied by the contractor.

Erection, testing and commissioning manuals and procedures shall be supplied, prior to dispatch of the equipment.

The contractor shall ensure that the drawings, instruction and recommendations are correctly followed while handling, setting, testing and commissioning the equipment.

Commissioning Check Tests/Performance and Guarantee Test: In addition to the checks and test recommended by the manufacturer, the contractor shall supervise the following acceptance tests to be carried out on each test at site.

Load Test :The DG Set shall be given load test at site for a period of at least 6 hours depending upon the actual power factor of the load and set shall be subjected to the maximum achievable load without exceeding the engine or alternator capacity.

This full load test is to be followed immediately by a 10% overload run for one hour.The performance of the engine, alternator shall be satisfactory at the end of this overload run. During the load test half hourly records of the following shall be taken: Ambient temperature, Cooling water temp, Lubricating oil pressure, Speed, Voltage, wattage and current output, Oil tank level

Speed and Governing: The speed of the engine shall be verified to ensure that it conforms to the requirement of latest BS.

Check of Fuel Consumption: A check of the fuel consumption shall be made through out the test run of constant full load and constant overload.

Noise Level: The noise level shall be as per latest CPCB norms.

PRE-COMMISSIONING CHECKS: All standards checks including the ones elaborated in the specifications to ensure that the installation of the DG sets and associated systems has been carried out satisfactorily shall be done on completion of installation. These shall include:

DG Sets: Checking of piping interconnections, Checking of electrical interconnections, Checking of insulation resistance, Checking of earthing, Checking of instruments and controls Checking of alignment

Checking of vibration transmission to building a structure Checking of expansion joints Exhaust System:
Checking of silencer operation

Checking of surface temperature of exhaust piping
Checking of back pressure.

Fuel System:

Checking of automatic operation of fuel transfer pumps

Performance Testing: DG sets shall be tested at varying loads at manufacturers works prior to dispatch of the sets to site. The performance tests at the works shall be carried out in presence of authorized representative from the Owners to enable them to arrange for their representatives for his inspection to be at manufacturer’s works for this inspection and testing. Inspection waiver shall be solely as per owner wish.

The performance test on each DG sets shall be of minimum 8 hours duration.

All instruments, materials, consumables (fuel oil, lube oil etc.) load and labour required for carrying out of the test shall be provided by the Contractor.

Following test acceptance criteria shall be applicable:

Consumption at 50%, 75%, and 110% load	of guaranteed performance. Actual alternator efficiencies as determined in the manufacturers works tests shall be used as the basis of calculation of specific fuel consumption ratio.
Speed regulation from no load to full load	
Frequency regulation from no load to full load	
Maximum water temperature	As per guaranteed performance
Maximum Lub Oil temperature	As per guaranteed performance
Maximum Lub Oil pressure	As per guaranteed performance
Oil Consumption	As per guaranteed performance

Type Test: Copies of manufacturer’s type test for the engine and the alternator of all ratings shall be enclosed along with the dispatch of the DG sets.

Exhaust Blower: The exhaust fans shall be propeller type with steel hub and blades, mounted directly on the shaft of a totally enclosed motor.

The fan blades shall be of pressed steel of aerofoil design for high efficiency and static pressure.

The mounting frame shall be of cast /sheet steel brackets to connect the frame, with the fan/motor assembly. Rubber mounts shall be provided between the mounting frame and the mounting brackets.

The fan motor shall be totally enclosed squirrel cage type.

DG CONTROL AND OPERATION: Operation of DG Sets shall be monitored and controlled by a programmable logic controller (PLC) based logic panel. **SPECIAL INSTRUCTIONS TO TENDERERS**

Compatibility & Coordination with PLC: A microprocessor based PLC panel for Automatic Mains Failure, Auto Changeover/ Interlocking and Auto Load Sharing, Auto Load Management and auto synchronizing functions of the DG sets is incorporated with the Main LT Panel of the system. All parts of the DG set shall be compatible for being integrated with the PLC operation.

Completeness of contract :

The Contractors shall undertake the complete installation and shall be responsible for the overall satisfactory operation of the DG sets with the associated accessories. All equipments shall be selected and installed for the lowest operating noise level.

Supply of various equipments shall include cost of correspondence with manufacturers, submission of shop drawings and documents and their approval by the Consulting Engineer,

procurement of equipment, transportation, shipping, payment of all taxes and levies, storage, supply of equipments at site of installation, furnishing all technical literature required, replacement of defective components and warranty obligations for the individual equipment. Statutory approvals from all concerned authorities (State Electricity Authority, HERC, Pollution Control Board, Department of Explosive etc.)

Installation of various equipments shall include all material and labour associated with hoisting and lowering of equipment in position, insulation of the components where ever required, vibration isolation as required, grouting and anchoring or suspension arrangements and all incidentals associated with the installation as per the specifications and manufacturer's recommendation.

Vibration isolators shall be installed with components as required. Performance ratings, power consumption and sound power data for each component shall be verified at the time of testing and commissioning of the installation, against the data submitted with the tenders.

Shop coats of paint that have become marred during shipment or erection shall be cleaned off with mineral spirit, wire brushed and spot primed over the affected areas, then coated with enamel paint to match the finish over the adjoining shop painted surfaces.

Testing and commissioning shall include furnishing all labour, materials, equipment, instruments, fuel oil and incidentals necessary for complete testing of each component as per the specifications and manufacturer's recommendations, submission of test results to the Project In-charge and obtaining their approval and submission of necessary documents and completion drawings.

All piping shall be installed conforming to the relevant Indian standards, approved shop drawings and shall be tested as per Standards.

Fuel piping and installation shall be as per the requirement of Department of Explosive. Quoted rate shall include cost of radiographic tests of welded joints randomly selected by Project In-charge in addition to hydrostatic pressure testing.

Piping installation shall include all costs toward supplying and fixing pipes and fittings (elbows, tees, reducers) cutting, threading, joining, welding, soldering and effecting connection as required; providing non hardening sealing material as well as neoprene rubber gaskets for screwed flanges, providing and installing adequate number of clamps, hangers, saddles, brackets, rawl plugs and other accessories for pipe supports, providing minor dressing of walls and floor, providing and installing pipe sleeves etc. as required.

Exposed steel pipes shall be given two coats of approved paint as per the relevant Indian standards for color coding of pipes and direction of flow of fluid in the pipes shall be visibly marked with identifying arrows.

All buried pipes shall be wrapped with Pipekote 4 mm thick wrapping as per manufacturer's standards.

Valves, unions, strainers, drain and air valves, expansion joints, pressure gauges and thermometers shall be provided in the various pipe lines as per the approved shop drawings and specifications.

After completion of the installation, the entire piping system shall be tested for leakage as required.

Proper co-ordination shall be done with Engineer-in-Charges and Project In-charges for civil works such as Fuel lorry platform, bulk fuel area fencing etc. as required.

Package - 7) Passenger Lifts

Supplying, installation, testing and commissioning of MRL passenger lift as per following specifications. The work shall be executed as per CPWD's specification, Part-III (Lifts & Escalators)-2003, CPWD handbook on barrier free & accessibility, IE Rules, Gujarat Lift Act, Indian Standards amended up to date and as per direction of Engineer-in-Charge. The additional specifications are to be read with above standard and specifications in case of any variations in specifications given in the tender shall apply.

Sl. No.	Description	Academic Block		Hostel Block	
1	Type of lift	Machine Room Less Passenger Lift			
2	Number of lift required	4 Nos.	2 Nos.	2 Nos.	4 Nos.
3	Passenger/ Load	16 Passengers (1088 Kg)	13 Passengers (884 Kg)	16 Passengers (1088 Kg)	10 Passengers (680 Kg)
4	Rated Speed	1.5 mps			
5	Number of floors Served	G + 5 upper floors (6 Stops)		G + 9 upper floors (10 Stops)	
6	Type of operation	Microprocessor based duplex selective collective with/ without attendant for 2 nos. lift on each bank.		Microprocessor based triplex selective collective with/ without attendant for 3 nos. lift (16 passenger – 1 No. & 10 passenger – 2 Nos.) On each bank.	
7	Potential free Contacts	Potential free contacts, in each floor and RS 485/ Modbus card in the controller shall be provided for monitoring position, up and down movement of the lift etc. which can be used for building automation system.			
8	Traction	Polyurethane coated flat steel belts , lubricant free			
9	Control	Microprocessor Control System			
10	Drive	Closed loop, Variable Frequency & Variable Voltage regenerative drive with +/- 3 mm stopping accuracy.			
11	Machine	Magnet gearless machine with synchronous permanent magnet motor without need any lubrication.			
12	Lift well size	2500 mm (W) x 2100 mm (D)	2500 mm (W) x 1900 mm (D)	2500 mm (W) x 2100 mm (D)	1900 mm (W) x 2100 mm (D)
13	Clear inside size of lift car	As per standard design manufacturer subject 2000 mm (W) x 1300 mm (D) (Nominal size)	As per standard design manufacturer subject 2000 mm (W) x 1100 mm (D) (Nominal size)	As per standard design manufacturer s 2000 mm (W) x 1300 mm (D) (Nominal size)	As per standard design manufacturers 1300 mm (W) x 1350 mm (D) (Nominal size)
		16 Passengers (1088 Kg)	13 Passengers (884 Kg)	16 Passengers (1088 Kg)	10 Passengers (680 Kg)
14	Pit Depth	1600 mm			
15	Head room height	7750 mm		6500 mm	
16	Floor height	4200 mm		3300 mm	

17	Total car travel	21 Mtrs.	29.25 Mtrs.
18	Car entrance door		
	Size of doors	Minimum Height – 2000mm	Minimum Height – 2000 mm
		Minimum Width – 1000mm.	Minimum Width- 2000 mm
			1000mm.
			Minimum Width- 900mm.
	Type of doors	Centre opening automatic power operated doors. Stainless Steel (SS 304) 1.5 mm thick with Hairline finish with multi beam sensor	
	Car open	In front only	
19	Construction design and finish of car body work	CPWD General Specification for Electrical Works Part-III (Lifts & Escalators)-2003, CPWD handbook on barrier free & accessibility	
20	Car Interior Finish		
	Panels	Shall be Stainless Steel(SS 304) 1.5 mm thick with hairline finish	
	Flooring	Shall be granite tiles	
	Ceiling	Stainless Steel SS 304 mirror finish.	
	Lighting	LED lights with illumination level of minimum 150 Lux& automatic switch off mode.	
	Ventilation	Cross flow Blower/fan with louver minimum – 2 nos. & auto fan cut off.	
21	Type of signal system	(i) Digital floor position indicator in the car and at all landings TFT type in all lifts.	
		(ii) Travel direction indicator in the car and at all landings (to be provided in car operating panel & at landing operating panels) in all lifts.	
		(iii) Gongs & Visual indication on all landings for pre arrival of the car for two or more cars	
		(iv) Overload Warning audio and Video Indicator inside the car (lift should not start on overload) in all lifts.	
		(v) Battery operated alarm bell and Emergency light shall be provided in all lifts.	
		(v) Car operating panel with fade proof Luminous buttons in car and with intercom shall be provided in all lifts.	
		(vi) Luminous hall Buttons at all landings and inside car with Braille language signage.	
		(vii) Firemen's switch at ground floor	
22	Landing entrance		
(i)	Location of landing entrance in different floors	All doors on the same side shall be provided in all lifts.	
(ii)	Type of doors	Horz. Sliding Centre opening automatic power operated doors shall be provided in all lifts.	
(iii)	Fire resistant rating of the doors	Shall have fire resistance rating of one hour shall be provided in all lifts.	
(iv)	Lift in use/lift out of order sign	Lift out of order indication shall be in-built with floor Position indicator in all lifts.	
23	Electric supply	(i) Power – 415 Volts, AC supply , 3 Phase, 50 HZ, 4 wire system	
		(ii) Lighting – 230 Volts, AC supply , Single Phase, 50 HZ	
		The entire lift equipments should be suitable for operation at minimum +10% to -10% of the rated supply voltage	
24	Is neutral wire available for control circuit	Yes	

25	Emergency supply	Suitable maintenance free battery and inverter power pack with necessary contactors for operating light in the liftcar, Alarm bell and communication equipment shall be provided in all lifts.
26	Intercom System in all lifts	Inter communication shall be provided for communication between the lift car, respective enquiry room & lift lobby/control room. Note: Intercom in lift car shall be press & speak type.
27	Automatic rescue device ARD shall be provided in all 12 Nos lifts as per following	ARD should monitor the normal power supply in the main controller and shall activate Rescue operations within ten seconds of normal power supply failure. It should bring the elevator to the nearest floor at a slower speed than the normal run. While proceeding to the nearest floor the elevator will detect the zone and stop. After the elevator has stopped, it automatically opens the doors and parks with door open. After the operation is completed by the ARD the elevator is automatically switched over to normal operations as soon as normal power supply restores.
		In case the normal supply restores during ARD in operation the elevator will continue to run in ARD mode until it reaches the nearest landing and the doors are fully opened. If normal power supply resumes when the elevator is at the landing it will automatically be switched to normal power operation in all lifts.
		All the lift safeties shall remain active during the ARD mode of operation in all lifts.
		The battery capacity should be adequate so as to operate the ARD at least seven times a day. Provided the duration between usage is at least 30 minutes. Dry maintenance free batteries.
28	Levelling accuracy	±5mm at all load condition for all Lifts.
29	Speed variation	±1% rated speed for all Lifts.
30	Voice announcement system	Voice announcement system car to announce the position of the elevator in the hoist way as the car passes or stops at a floor served by the elevator shall be provided in all lifts.
31	Braille switching system	Braille switching system in car panel and each landing floor shall be provided in all lifts.
32	A hand rail	A hand rail at a height of 900 mm above floor level to be fixed on the full length at all three sides of the lift car shall be provided in all lifts..
33	Door Close Safety	Full height Infrared light curtain door safety shall be provided in all lifts.
34	Other features -	Remote elevator monitoring system, Pulse system, anti-nuisance car call protection, independent service (for duplex/ triplex), overload device, nudging, emergency firemen's service, manual rescue operation, belt inspection drive, door time protection.
35	Liasoning	Contractor has to provide all working drawing and documents and liason services for obtaining all necessary permission from lift inspector and other authorities.
36	Maintenance in Warranty period	36 months from handing over the lifts in good conditions to the department. The maintenance of lifts shall be consist regular checkups, replacement of defective parts, emergency service on the complaint register.

37	Civil Work	Any civil works in lifts installation such as architraves, brick fascial/ steel/ haistway/ structure, cutting of wall/ floor, grouting, etc. shall be carried out by Main agency in this agreement.
38	Electrical Work	Any electrical works in lifts commissioning such as electrical lift panel, light / power points in the lift well, etc. shall be carried out by Electrical wing – In Internal Electrical package in this agreement.
39	The testing of Lift installations	The testing of Lift installations shall be carried out in accordance with General Specifications for Electrical works III Lift and Escalators 2003 Section – IV testing of lift installations and Appendix – III).
	ry payments/fees	utory payments/fees for obtaining permission and lift from Lift Inspector, Govt. of Gujarat shall be borne by the contractor.

LAN System:

A. Technical details of 19" Floor Standing Rack: 42U

Dimension: The maximum dimension of the rack should be 800W X 42U X 1000D (mm)
 Basic Structure: Frame Of sturdy 1.5mm frame section construction, consisting of sixteen folded rolled hollow frame section punched in 25mm DIN pitch pattern. All profile edges are radiused. The corners are stiffened with welded zinc die-cast corner connectors, gland plates in 3 parts, which are removable and interchangeable

Doors: 1.5mm sheet steel Glass Door, with foamed seal polyurethane gasket, square section tubular frame with punching in DIN pitch pattern, rod-type 4 point lock system and Key inserts to DIN 43668 (with single door: hinge fitting r/h or l/h freely selectable on site). Hinges with captive hinge pins, door opening angle 130° to VDI, can be retrofitted for 180°. Enclosure fitted with 2 sets of 19" angles, pairs of depth rails (73 X 23mm rails) fitted with swivel spring load lock handles.

Rear Door: 1.5mm sheet steel perforated door, with foamed-on seal, with 3 point locking mechanism ergo - form handle system.

Roof panel: with foamed-on seal, removable. Vented roof plate with option of having cable entry provision from top. Load Carrying Capacity: 1000KG Static Load, Seismic Rated Zone-4 Certified

Surface finish: Sheets cleaned, degreased, phosphate, electro- Dip coat primed and electro statically powder coated with textured Polyester paint RAL 7035..

Supply Include: Floor Standing Rack, Front and rear perforated doors, screw fixed side panels, top and bottom covers with cable entry, castor wheels, 4 fan with fan tray and thermostat, , PDU 6 Point, 5A Universal- 2No., 1 Fix Tray, Keyboard Tray, earthing kit and 5 Nos of 1U open MS Cable manager with PVC Loops. Swivel handles on front and rear doors.

B. Technical details of 19" Floor Standing Rack: 24U

Dimension: The maximum dimension of the rack should be 800W X 24U X 1000D (mm)
 Basic Structure: Frame Of sturdy 1.5mm frame section construction, consisting of sixteen folded rolled hollow frame section punched in 25mm DIN pitch pattern. All profile edges are radiused. The corners are stiffened with welded zinc die-cast corner connectors, gland plates in 3 parts, which are removable and interchangeable

Doors: 1.5mm sheet steel Glass Door, with foamed seal polyurethane gasket, square section tubular frame with punching in DIN pitch pattern, rod-type 4 point lock system and Key inserts to DIN 43668 (with single door: hinge fitting r/h or l/h freely selectable on site). Hinges with captive hinge pins, door opening angle 130° to VDI, can be retrofitted for 180°. Enclosure fitted with 2 sets of 19" angles, pairs of depth rails (73 X 23mm rails) fitted with swivel spring load lock handles.

Rear Door: 1.5mm sheet steel perforated door, with foamed-on seal, with 3 point locking mechanism ergo - form handle system.

Roof panel: with foamed-on seal, removable. Vented roof plate with option of having cable entry provision from top.

Load Carrying Capacity: 800KG Static Load, Seismic Rated Zone-4 Certified

Surface finish: Sheets cleaned, degreased, phosphate, electro- Dip coat primed and electro statically powder coated with textured Polyester paint RAL 7035.

Supply Include: Floor Standing Rack, Front and rear perforated doors, screw fixed side panels, top and bottom covers with cable entry, castor wheels, 4 fan with fan tray and thermostat, , PDU 6 Point, 5A Universal- 2No., 1 Fix Tray, Keyboard Tray, earthing kit and 4 Nos of 1U open MS Cable manager with PVC Loops. Swivel handles on front and rear doors.

FIBER OPTIC CABLING SYSTEM - MULTI-MODE

Type: Multi mode OM3 fiber cabling system and all its components; must be from a single OEM (Cables + Components)

Should support 1Gbps, 10Gbps and 40Gbps

Standard Compliance:ITU-T G.652A, B, C & D, IEC - 60793-2-50, TIA/EIA 568-C.3

Performance Testing:Fiber-channel compliance to ANSI/TIA568 -C.0 forOS2

should be 6 core multi-mode,tight-buffered 900µm fibers surrounded by aramid yarns strength members, and Fire Resistant Polyvinyl Chloride FRPVC OFNR jacket rate, TIA/EIA 598-C color coded fibers for easy identification per EIA 359-A. UL 1666/CSA rated for OFNR performance.

Fiber Type:Multimode, 50 / 125

PIGTAILS(SINGLEMODE OR MULTIMODE, AS APPLICABLE)

Should be SC or LC style, SM or MM OM3/OM4 as required. Simplex, 1 meter,compliant to ITU-G657.B - Bend Insensitive Fiber.

Operating temperature:-20 deg C to + 50 deg C

Durability:(500 Matting's): < 0.2 dB Max

Pre-radius ceramic zirconia ferrule. Bayonet coupling: 2.5 mm zirconia ferrule attenuation not more than 0.75 dB per mated pair Meets or exceeds ITU specifications UL Listed or equivalent.

FIBER OPTIC CABLE PATCHCORDS(SINGLEMODE OR MULTIMODE, AS APPLICABLE)

	LC-LC or SC-SCstyle, SM or MM OM3/OM4 as required. Available as either 1.6mm or 3mm simplex or duplex patch cord. Compliance to ITU-G657.B - Bend Insensitive Fiber.	
	Single mode 9/125 & Multimode OM3/OM4250 micron primary coated buffers.	
	e construction type PVC outer jacket	
	Outside Diameter:1.6mm x 3.0mm (Simplex) or 1.6mm x 3.3mm(Duplex)	
	ting Temperature:-20 deg C to + 60 deg C	

Package - 8) EPABX

SERVER BASED IP EPABX SYSTEM

S. No.	Description
1	IP Telephony System Architecture

		The IP telephony system must be based on a pure IP technology that is a software-only solution build server.
		The IP telephony system must support unified communication (UC) server & gateways architecture for SIP, Digital and Analog trunks connectivity.
		The system must be capable of supporting Analog, IP-Digital Phones, and SIP based video desk phones, Wifi phone, conference phones or any similar SIP devices
		The communication servers must work in an Active/Active redundancy mode. It should be possible to define servers load balancing mode. Can be possible to install one server at different geographical location like Disaster Recovery site.
		It should support cluster mode Active-Active server redundancy configuration any time in future. If ordered 2nd server, all two servers must be work in a cluster mode so that if one cluster server fails, one of the other cluster servers in the network must be able to take the complete load of the calls automatically (without any manual intervention) and without dropping any existing calls (IP,TDM & PRI) or data (CDR, CTI). Management of all servers in cluster should be from same web page. All two servers should have same database.
		The telephony system must be able to register any SIP devices like IP phones/video phones directly to it
		System should have Distributed Architecture
		It should be possible to install Telephony system in VMware EXSi 5.5 or higher.
		All Data (Numbers, COS, Routing, Applications) should reside in all the Servers
		Database replication in both servers should be automatic
		Must support N+1 Redundancy Architecture
		Must support Remote Self Survival Nodes
		In case of failure of one server, all the IP Phones, SIP Gateways, should register with second Server automatically w/o dropping the ongoing calls.
		System Diagnostics should be done in Server
		It should support Hot Standby for SIP Phones and Gateways i.e SIP Phones and Gateways should register automatically to next available telephony server without dropping on going calls
		COTS - commercial off-the-shelf Servers should be used for telephony system, card based or appliance based solution not acceptable.
		Telephony system should use Linux Operating System
		It should be possible to define one user with up to 6 devices like Hard phone, soft phone on PC, SIP client on mobile etc.
		system should support CSTA phase III Protocol
		Full continuation for call signaling and media must be supported
		Calls must not be disconnected and control must remain throughout the swap to an alternate server including full call control (transfer, conference actions, continuation of CDR data for the existing call).

		Load Balancing of end points must be possible by the administrator
		There must be no restriction on the number of endpoints being backed up in case of one server failure.
		UC platform servers must provide full failover and redundancy
		System should support the following SIP RFCs:
		RFC 3261 (SIP: Session Initiation Protocol)
		RFC 3262 (Reliability of Provisional Responses in Session Initiation Protocol)
		RFC 3263 (Locating SIP Servers)
		RFC 3264 (An Offer/Answer Model with Session Description Protocol (SDP))
		RFC 3265 (Specific Event Notification)
		RFC 2327 (SDP- Session Description Protocol)
		RFC 1889 and 1890 (RTP/RTCP)
		RFC 3515 (REFER)
		RFC 2833 (DTMF over IP)
		Scalability
		It should be possible to add more sites and users without the need to change the software and existing hardware.
		The system must be scalable to at least 10,000 endpoints in a single cluster architecture.
		Each server hardware must support a minimum of 3000 endpoints from day one, it should achieve desire capacity without changing any server hardware.
		The call signaling server must handle traffic at a minimum of 100K BHCC.
		System Survivability
		The UC platform must consist of one or many servers where each server in the cluster provides complete 100% application functionality.
		In case of a failed server, all endpoints registered with that server need to register instantly with a different server in the cluster with no interruption to on-going calls.
		Media Gateways must have self-survival mechanisms that allow them to maintain 100% of the telephony services for their users in case of failure in the WAN links when the signaling with the call server drops.

		The life cycle of the entire system being provided must be at least Seven (7) years.
		The system gateway must be able to restart automatically without human intervention when the external AC power supply is resumed after complete power failure (even after the batteries are discharged).
		The telephony system must be capable of providing 99.999% availability.
		Distributed Architecture
		The UC platform must have distributed architecture and centralized control for all the sites in the network.
		The proposed solution must support Hybrid cloud solution in order to guarantee business continuity with overall survivability regardless of a failure at any single location.
		The proposed solution must enable part of the cluster to be hosted in a Cloud Service Provider (CSP) to run all applications.
		The proposed solution must have built in redundancy using a cloud solution to provide automatic disaster recovery option.
		The proposed solution should have provision to be installed using an image of the application an easily implemented on the Cloud Service Provider servers.
		Quality of Service (QOS)
		The voice and signaling frames must be marked [tagged] in order to be recognized.
		Server – Physical Attributes
		COTS – Commercial Off-the-Shelf servers must be used.
		The redundant server must have separate hardware, not sharing elements like hard drives and RAM etc., to avoid a single point of failure.
		The system must be based on server gateway architecture with external appliance servers
		No card based processor systems / soft switch should be quoted.
		The call processor must run on Linux OS.
		Minimum Server Specifications:
		The CPU must be from the Intel® Xeon® Octa Core or better processor
		The server must have at least 16GB RAM, DDR-III ECC B RAM Speed 1333 Mhz or better
		The server must have Minimum 600GB HDD or Better
		The server must have a Dual 1 GB network interface.
		19" Rack Mountable

		Must Have redundant Power supply
		Gateways
		The media gateways shall be capable of being centrally managed via the telephony management application. The system should support multiple media gateways.
		The Media gateway must have redundant power supply.
		The system gateway should be able to restart automatically without human intervention when the external ac power supply is resumed after complete power failure
		The system gateways should support the following type of extensions:
		Analog
		IP-Digital Phone
		Cordless (SIP based DECT) Extension
		SIP IP Phone
		SIP Video Phone
		The system gateway should support the following type of trunks :
		Analog: E&M (2W), E&M (4W), DC loop signaling, Decadic, DTMF
		Digital: 2Mb stream with the following signaling protocols (Digital CEPT, R2MFC)
		Standard ISDN PRI
		SIP
		ISDN (30B+D / 23B+D / 2B+D)
		GSM (2G/3G/4G)
		ISDN QSIG (30B+D / 2B+D)
		Q-sig over IP
		Security
		Administration of the system should be using HTTPS
		It should support the Interop with leading SBC
		System should use TLS (Transport Layer protocol) to encrypt SIP, HTTP, FTP and SRTP (Secure Real-time Transport Protocol) and SRTCP to encrypt RTP and RTCP

		System should have auto Provisioning profiles contain pre-configured sets of features that must automatically polls and updates registered phones with the latest phone firmware and configuration files.
		Mobility
		The system should have Call Back feature. If the user dials his own extension from predefined number (mobile/landline) then system should disconnect the call and then system should call the user to provide the dial tone so that user can make intercom or PSTN calls.
		The system should have Call Through feature. If the user dials his own extension from predefined number then system should provide dial tone to make intercom or o/g calls.
		The system should have FlexiCall (Forking, reach-me-anywhere) feature. Users should be able to receive calls on any of their phones, from almost anywhere. An incoming call rings on all or specific phones until the user answers the call. The user can transfer the call, establish a conference, and so on, whether the answering device is an internal device. If the answering phone is an external device, the call automatically becomes an authorized mobility call.
		The system should support SIP Client on smart phone.
		SIP Endpoints (IP Phones)
		All SIP phones must support the standard SIP protocol. No proprietary protocols are allowed to be used.
		SIP phones must support the configuration of programmable buttons with functions such as Break-in, Conference call, Deflect, silent monitoring and more.
		SIP phones must work in conjugation with the following applications:
	1	Contact Centre (Agents Phones)
	2	Attendant Console
	3	Video Communication
	4	Managed Audio Conferencing
	5	Managed Video Conferencing (Applicable for Video enabled SIP Phones)
	6	UC clients
	7	IP Paging
		System Administration
		System administration should be secured using https web page.
		All programming of system should be done through a web-based GUI interface.
		All users should have access to their own web-based GUI interface to configure his features and presence using dedicated user name and password. User should be able to change his password any time.

		The administrator should have Dynamic Profiles.
		The system should allow for complete multi-level administration. The administrator must be able to define at least five (5) different administration level profiles that can be applied to allow subsets of users to access and manage particular pages in the systems Web Portal
		System Features
		ANI (Caller ID) Restriction
		ARS (Automatic Route Selection)
		Multi Level Auto Attendant
		Call Forward Busy
		Call Forward No Reply
		Call Forward Unconditional
		Caller id based routing for individual extension
		Deflect (Divert) Call
		Direct-In-Dial
		Direct-In-Line (DIL)
		Hot Line
		Interactive Voice Response (IVR)
		Least Cost Routing
		Numbering Plan (up to 6 Digit)
		Personal Routing Rules based on caller id and DNIS
		Predetermined Night Answer
		Toll Restriction – Digit Analysis
		Toll Restriction – Trunk Groups
		Trunk to Trunk Connection
		Trunk to Transfer Restriction
		Classes of Service

	Night Transfer
	Page Queue
	Recall
	Second Ring back Tone
	Speed Dial Public (System) and Private
	Virtual Numbers
	Multiple Music On Hold
	Voice Page
	Zone Page
	Barge In
	Wake up with announcement
	Extension Features
	Caller Line Identification
	Call Waiting
	Auto-Answer
	Automatic Disconnect
	Automatic Number Identification (ANI) Display
	Browse Personal Directory
	Busy Lamp Field
	Call Forward All
	Call Hold
	Call Log
	Call Parking and Call Pickup
	Caller id based routing for individual extension
	Calling Number and Name

		Camp-on Idle
		Configurable DSS Buttons on IP
		Direct Dial without Off Hook (Hands Free)
		Directed Call Pickup
		Display Automatic Number Identification (ANI)
		Display Dialed Number and Name
		Display Dynamic Call Divert Information
		Display Select Hold Display
		Display Time/Date Function
		Do Not Disturb (DND)
		DSS/BLF
		Elapsed Time Display
		Group Call Pickup
		Hands Free
		Last Number Redial
		Login and Logout
		Message Waiting Indication
		Multi Appearance (Call Waiting)
		Multiple Line Appearance
		On-Hook Dialing
		Placing Multiple Calls on Hold
		Privacy – ANI Restriction
		Reminder/wake up Call
		Restrictions – Station
		Self-extension announcement

		System Non-Exclusive Hold
		Transfer with Consultation
		Transfer without Consultation (Blind)
		Voice Page on IP phones
		Emergency message broadcasting
2		Voice Mail specification
		The System must have in skin Voice mail facility for all users and should be from OEM of IP Telephony system. Voice mail should not use any additional /external hardware. The user should be able to review voice message directly from his email inbox including caller ID, duration of voicemail.
		The user should be able to review voice message and fax information directly from your email inbox including caller ID, duration of voicemail, fax sender, and number of pages
		User should be able to listen to voice messages with any audio player or review messages over the phone while having a full control over the played media
		Should support to view fax messages with any TIFF or PDF image viewer
		User should be able to forward voice and fax messages to any email address directly from your email inbox
		Should support to archive voice and fax messages to any local folder
		User should be able to listen to, delete, save, reply to, and forward emails through the phone
		Should be able to forward emails to a fax machine
		Should support redirect fax messages from your voicemail box to any fax machine when email inbox is not available for fax viewing
		Should support below mentioned Unified Messaging Features:
		Fax-to-Mail
		Messages to email
		MWI – Message Waiting Indication
		Voice mail Activation via Soft Keys
		Users should be able to check and handle voice messages from all devices, including the email client, Webmail client, PDA and telephone.
3		Audio Conferencing - 60 party expandable up to 120 Party

		The Emergency communication Conference resource should be from the same telephony server and have the facility to automatic dial out to connect up to 60 participants in a single conference. System should also have 60 party managed meet me conference. It should be possible to further divide 60 party conference bridge into any combination like 12 X 5 Party, 6 X 10 party, 3x 20 party etc. if required. The meet me conference should be secured means to enter to the conference bridge, the user should enter the password.
		The emergency communication be controlled by a user defined as Group Operator. There should be provision to view status and control the emergency communication participant from web based GUI if required using touch screen based monitor. Documentary proof should be submitted.
		The conference must be controlled by a user defined as Group Operator
		The Group Operator should have following features as below:
	1.	The Group Operator must be able to add / remove members
	2.	The Group Operator must be able to add other conference members
	3.	The Group Operator must be able to mute / unmute (User, None, All)
	4.	The Group Operator must be able to lock / unlock the conference
	5.	The Group Operator must be able to close the conference
	6.	It must be possible to dial out a pre-defined group (or multi-groups) of participants/numbers
	7.	Each pre-set conference must have its own unique dial number such that when this group number is dialed; all the number stations will ring simultaneously.
	8.	Any combination of stations and external numbers must be able to be defined as members of the Group Call.
	9.	Participants may join a conference in the audible or in the mute mode, if in mute mode, the right to speak must be selectively offered to attendees per their request by a special signal sent to the Group Operator by the attendees.
	10.	Attendees must be able to be added or excluded at any time by the Group Operator
	11.	The conference must be terminated when the Group Operator leaves (auto terminate if all members left are muted).
4		Video Conferencing
		The proposed system should have multiparty (30 party) Video conferencing facility.
		User can be use this facility from own Laptop/All in One computer/Computer with USB camera & headphone/Mobile phones
		System should support minimum features like One to one Video call / One to many Video Call/screen Sharing/Chat/file sharing etc.
		Moderator can be mute the individual or all participants to reduce noise.

		If live video conferencing is running & any participant want to speak he should have option to rise hand or indicate moderator by pressing any button on screen so Moderator can allow him to speak.
6		E1- PRI Gateway specification
		PRI gateway should have Configuration of Single Port PRI (30 Channels); It should be possible to place the PRI gateway anywhere in the campus on LAN. There should not be any distance limitation from the telephony server. Should be from the same OEM of the telephony system.
		Voice Processing – G.711, G.729A, G.723.1, GSM, iLBC, echo cancellation: G.168 with 64ms echo tail; dynamic jitter buffer; VAD and CNG
		Calling Control – called/calling party number translation; second stage dialing; voice detection; auto dialing with DTMF; ring back tone generation and detection; voice announcement
		Voice Proxy – RTP voice proxy function for NAT/firewall traversal
		Fax Relay – T.30 transparent mode, T.38 fax relay
		Call Handling – configurable dialing plan
		Configuration Interface – Web Utility
		Remote Management – Telnet, HTTP, TR069
		PSTN – ISDN PRI standard: ANSI, NI-2, DMS, 5ESS
		SIP – RFC3261, RFC2976, RFC3515, RFC3581
		DTMF – tone detection generation and detection; DTMF relay: RFC2833, INFO (SIP)
		Flexible digit translation
		DTMF detection and progress tone detection
		Early cut through
		Play ring-back tone
		T.30 and T.38
		RTP proxy for NAT traversal
		Ethernet – RJ-45, 10/100 Base-T
		Trunking Interface – RJ-45

7		Specifications for Self-Survivable Media Gateway:
		IP Media Gateway should have up to 100 Analog Ports and should be expandable up to 320. The same gateway should have 8 Port FXO to connect analog PSTN lines. It should be possible to place the gateway anywhere in the campus on LAN. There should not be any distance limitation from the telephony server. Licenses for the same should be on the Main Server Only.
		<p>Technical Specifications:</p> <p>Voice codecs : G.711, G.729A, G.723.1, GSM, iLBC;</p> <p>Features –Caller ID, Call Forward, Call Transfer, Call Forking, Hotline, CRBT, Do-not-Disturb, Speed Dialing.</p> <p>Caller-ID Detection (FSK/DTMF),</p> <p>Gateway should have dual 10/100/1000 Mbps auto Sensing Ethernet port with Media redundancy. The Gateway should function as a Self-Survivable unit when the Ethernet connectivity at gateway end breaks. Media gateway should have redundant Power supply – 48VAC/DC Operating Temperature: 0 to 40°C;</p> <p>Humidity: 5% to 90% (Non condensing)</p> <p>Should be from the same OEM of the telephony system</p> <p>FXS/FXO Media Gateway should have 04 inbuilt Gigabit Ethernet and 01 SFP Port inbuilt.</p>
8		Specification of SIP Phone – Basic (Type-1)
		SIP phone should be from the same OEM of IP telephony system. SIP phone key programming for features should be from centralized telephone system administration web (not from phone web).
		132 x 64 -pixel graphical LCD with backlight
		2 VoIP accounts
		Local phonebook up to 500 entries
		Auto provision via FTP/TFTP/HTTP/HTTPS for mass deployment from telephone system
		HD voice: HD handset, HD speaker
		Wideband codec: G.722
		SRTP/ HTTPS/ TLS, 802.1x
		PoE, Headset, Wall-Mountable
		Volume adjustment, ring tone selection
		Voicemail, MWI
		Call park, call pickup, directory
		Narrowband codec: G.711, G.723.1, G.726, G.729AB

	Full-duplex hands-free speakerphone
	SIP v1 (RFC2543), v2 (RFC3261)
	DTMF: In-Band, RFC2833, SIP Info
	IP Assignment: Static/DHCP/PPPoE
	1xRJ9 headset port
	Transport Layer Security (TLS)
	LED for call and message waiting indication
	2xRJ45 10/100M Ethernet ports
	Power over Ethernet (IEEE 802.3af)
9	Specification of IP based Operator Console/IP-Phone (Type-2)
	SIP phone should be from the same OEM of IP Digital telephony system. SIP phone key programming for features should be from centralized telephone system administration web (not from phone web).
	4.3" 480x272-Pixel Color Display with backlight
	16 SIP Accounts and 5 Way Conference
	Local phonebook up to 8000 entries
	Auto provision via FTP/TFTP/HTTP/HTTPS for mass deployment from telephone system
	HD voice: HD handset, HD speaker
	Wideband codec: G.722
	SRTP/ HTTPS/ TLS, 802.1x
	PoE supported, 1Xusb 2.0,Headset, Wall-Mountable
	Volume adjustment, ring tone selection
	Built-in Bluetooth 4.2, Voicemail, MWI
	Built-in dual band Wi-Fi-2, 4G/5G
	Call park, call pickup, directory
	Narrowband codec: G.711, G.723.1, G.726, G.729AB
	Full-duplex hands-free speakerphone

		SIP v1 (RFC2543), v2 (RFC3261)
		DTMF: In-Band, RFC2833, SIP Info
		IP Assignment: Static/DHCP/PPPoE
		1xRJ9 headset port
		Transport Layer Security (TLS)
		LED for call and message waiting indication
		2xRJ45 10/100M Ethernet ports
		Power over Ethernet (IEEE 802.3af)
10		Call Billing Software
		The system must have call billing software that is able to log all calls made and received by an extension (either internal or external), should support High Availability in a Server Cluster –
		In case of server failure and the call passed to another server, the CDR record must continue on the other server with all the information
		If the call was disconnected due to server failure, the CDR record for the call must be closed and saved
		All CDR (Call Detail Records) must be sent on-line for immediate update and to external Windows based Billing system for complete recording of Internal, External and Network calls to generate various types of traffic reports
		The following details must be provided:
		Reports must indicate the extension ID
		Reports must indicate the call start date & Time
		Reports must indicate the elapsed time
		Reports must indicate the trunk group ID
		Reports must indicate the trunk ID
		Reports must indicate the caller ID
		It should be possible to generate extension wise report for different time periods like daily, monthly etc.
11		Special Instructions to bidder
		Servers, Self-Survival Media Gateway, PRI Media Gateway, etc. will be placed at suitable server rack, all the cable termination will be well dressed & should be properly tagged. Any other hardware or software required to

		achieve desire functionality or necessary for proper installation will be under the scope of bidder.
12		Certification Requirements
	1.	The OEM must comply with ISO 9001 certification in all the company's activities. Certificate must be attached
	2.	System should be TEC certified. Certificate must be attached

Package - 9) Fire Fighting System

SCOPE: TECHNICAL SPECIFICATIONS FOR FIRE FIGHTING WORK

This section covers the technical requirements of design, manufacture, testing at works, supply, installation, testing at the site of work and commissioning of fire fighting Wet riser & down comer system equipment.

The fire fighting work comprising of Wet riser & Down Comer systems to be carried out as per below:

- As per BOQ of the NIT
- CPWD SPECIFICATION FOR ELECTRICAL WORKS PART-V Wet-riser & Sprinkler Systems – 2020
- NBC 2026

INSTRUCTION & TRAINING

A. Instruction shall be provided as required for operating the system. Hands-on demonstrations of the operation of all system components and the entire system including program changes and functions shall be provided.

B. The contractor and / or the systems manufacturer's representatives shall provide a type written "Sequence of Operation."

Certificate need to procured by the agency:

1. FIRE SAFETY CERTIFICATE (After completion of project). All the coordination with fire department and various stake holder has to be done by the contractor for obtaining the Fire NOC.

NO OBJECTION CERTIFICATE FROM LOCAL FIRE OFFICER:

The agency is required to obtain the no objection certificate from local fire authority after the physical completion of the work. The necessary testing and liasoning work to be carried out in close coordination with local fire officer for obtaining the NOC for the building. The work will be treated as incomplete if NOC is not submitted. This will be treated as work in the scope of contractor only any delay in this regard will be delay in the work in the scope of contractor only.

Planning, supplying, installation, testing and commissioning of complete Wet Riser & Downcomer System confirming to CPWD Specifications Part-V Wet Riser and Sprinkler System(2020) and guidelines of the National Building Code-2016, relevant BIS Codes and requirements of the Chief fire officer, Vadodara Fire Brigade.

Work under this section shall consist of furnishing all labour, materials, equipment and appliances necessary and required to completely install electrically operated and diesel driven fire pumps, wet riser, fire hydrant system / fire extinguishers as required by the drawings submitted by the agency and duly approved by the Engineer-in-charge. The fire fighting system for Academic building will be wetriser type and for hostel building down comer.

The contractor shall be responsible for providing fully detailed hydraulic calculations of hydrant system to comply with CPWD Specifications, NBC-2016, Relevant BIS Codes, NFPA Standards and as per the requirement of CFO, Vadodara Fire Brigade.

This package covers all requirements except construction of underground tank. There shall be following minimum installations in the pump house:-

Horizontal Split Casing Main Electric Driven Fire Hydrant Pump 2280 LPM at 88 mtr. Head - 1set

Diesel Engine Driven Fire Pump 2280 LPM at 88 mtr. Head - 1set

Horizontal Type Electric Driven Jockey Pump 180 LPM, at 88 mtr. -1Set

Horizontal Type Electric Driven Booster/Terrace Pump 900 LPM at 35 mtr-2set Airvessels for wet riser system.

Electrical panels for Fire Fighting Controlsystem.

The number of pumps and capacity of the pump will be calculated as per the NBC 2016 and as per requirement of Chief Fire officer, Vadodara FireBrigade.

The tentative location of External fire hydrants shall be marked in the drawing submitted by the Agency and shall be got approved by Engineer in charge and as per requirement of CFO Vadodara FireBrigade.

The provision of Four way fire brigade connection shall be made as per the provision of NBC2016.

The separate ring mains for external hydrants shall be laid and appropriate number of external hydrant shall be provided as per the guidelines of NBC 2016 and CPWD Specification.

The distribution pipe and range pipe in the sprinkler system shall be laid as per the relevant IS code and CPWD Specification Part V (Wet Riser &Sprinkler system)2020.

The provision of sleeves in the beams shall be kept for running the distribution range pipe to utilize the space available above the falseceiling.

Different types of fire extinguishers shall be provided in all the floors as per the guidelines of NBC2016.

All Fire Shaft of each floor with door and glass shall be provide the following accessories.The fire door design shall be approved from Engineer-in-Charge.

M.S Hose Reel Drum with 20mm dia. RRL Hose Reel of 36 mtr. Long, GM / brass Nozzle and Control valve.

M.S. Hose Cabinet with 63mm dia. Hose Pipe Type-B having male, Female coupler with G M / brass branch pipe 63 mmdia.

Landing Valve as per IS 5290- Double Headed Gun MetalValve. In External Hydrant

M.S. hose cabinet box with Double headed gun metal valve with 63 mm dia hose pipe Type-B having Male, Female coupler with G.M. branch pipe 63 mm dia.

In addition to that one no. M.S. Hose cabinet box with single Headed gun metal valve, 63mm dia. Hose pipe Type B having male, female coupler with G.M. branch pipe shall be provided at Terrace as required.

Suitable No. of M.S. Hose Reel drum with 20mm dia RRL Hose reel of 36 mtr long, GM / brass Nozzle and control valve shall be provided at terrace floor.

Earthing & Loop earthings for pump sets & panel as per CPWD specifications.

Drain pit / traps of suitable size in pump house i/c providing suitable capacity of drain pump & necessary piping work as required.

Specifications of Fire Pumps, Motors, Engine And Accessories:

Electric Driven Main FirePump

Horizontal type, multistage, centrifugal, split casing pump of cast iron body and bronze impellerwithstainlesssteelhalf,mechanicalsealtoensureaminimumpressureof3.5 kg/sq.cm. at highest and farthest outlet at specified flow of 2280 LPM at 88 Metres head conforming to IS 1520. (The pump should be capable of delivering 150 % rated discharge at a head not less than 65% of the ratedhead)

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 toIS-325

M.S. fabricated Common base plate, coupling, coupling guard, foundation bolts etc. as required.

Suitable cement concrete foundation duly plastered and angle iron frame of size 35 mm x 35 mm x 3 mm on top edges of foundation with anti vibration pads.

Diesel Driven Fire Pump

Horizontal type, multistage, centrifugal pump of cast iron body and bronze impeller with stainless steel shaft, mechanical seal to ensure a minimum pressure of 3.5 kg/sq.cm. at highest and farthest outlet at specified flow of 2280 LPM at 88 metres head conforming to IS 1520. The pump should be capable of delivering 150% rated discharge at a head not less than 65% of the rated head.

Suitable HP, 1500 RPM water cooled with radiator diesel engine conforming to relevant BS & IS standard complete with auto starting mechanism 12/24 Volts electric starting equipment, Diesel Tank, exhaust pipe extended minimum 1 m outside pump house or as per actual requirement at site. 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 indication, painted with post office red colour etc. as reqd.

M.S. fabricated Common base plate, coupling, coupling guard, foundation bolts etc. as required.

Suitable cement concrete foundation duly plastered and angle iron frame of size 35 mm x 35 mm x 3 mm on top edges of foundation with anti vibration pads.

Electric driven Jockey Pump for Hydrant System –200-300 LPM

Horizontal type, multistage, centrifugal pump of cast iron body and bronze impeller with stainless steel shaft, mechanical seal and flow of 180LPM at 88 metre head (Negative Suction) 5m NPSH conforming to IS:1520.

Suitable HP SQ cage induction motor TEFC type suitable for operation on 415 volts, 3 phase 50 HZ. AC with IP 55 class of protection for enclosure, horizontal foot mounted type with Class-'F' insulation, conforming to IS : 325.

M.S.fabricated Common base plate, coupling, coupling guard, foundation bolts etc. as required.

- a. Suitable cement concrete foundation duly plastered and angle iron frame of size 35 mm x 35 mm x 3 mm on top edges of foundation with anti vibration pads.

Electric driven Terrace Pump for sprinkler and Hydrant – 900 LPM

Horizontal multi stage split casing centrifugal end suction type pump of cast iron body and bronze impeller with Stainless steel shaft mechanical seal and flow of 900 LPM at 35 m head conforming to IS : 1520

Suitable HP squirrel cage induction motor TEFC type suitable for operation on 415 V 3 phase 50 Hz AC supply with IP 55 degree of protection for enclosure horizontal foot mounted type with Class F insulation conforming to IS : 325

M.S.fabricated Common base plate, coupling, coupling guard, foundation bolts etc. as required.

- d). Suitable cement concrete foundation (1:2:4) duly plastered and angle iron frame of size 35 mm x 35 mm x 3 mm on top edges of foundation with anti vibration pads.

All Pump shall be capable of discharge not less than 150% of rated discharge at a head of not less than 65 % with rated head. The shut off head shall not exceed 120% of rated head.

HYDRANT SYSTEM:

The Hydrants System shall consist of one main electric pump of suitable capacity Motor, standby diesel engine driven pump of suitable capacity and jockey pumps of suitable capacity and Terrace pump of suitable capacity with suitable capacity Motor.

An underground tank / sump for Hydrants System of required capacity as per NBC-2016 for this type of project shall be provided. The system shall be complete with all required accessories including valves, strainers, special fittings, instrumentation, control panels and any other components required to complete the system in all respects.

The Hydrant system shall be kept pressurized all the times.

In the event of fire when any of the hydrant valves in the network is opened, the resultant fall in the pressure shall start the jockey pump first through pressure switch automatically. In case jockey pump fails to maintain the pressure hydrant pump shall start at the preset pressure. In case of failure the Main pump the diesel standby pump shall start.

The hydrant risers shall be terminated with air release valve at the highest points to release the trapped air in the pipe work.

To provide for an air cushion for counteracting pressure surges/ water hammer, an air vessel shall be furnished in the pump room near the fire pumps. The air vessel shall normally be kept partly full of water.

One No. four way Fire Brigade Inlet Connections shall be provided for filling of Underground Fire tank in case of emergency and in addition one no. four way Fire Brigade connection shall be made to each internal Fire riser in case fire pumps fail to start.

DIESEL ENGINE:

General:

The engine rating shall be decided considering the de-rating factors which are based on Site conditions as per BS :5514.

The diesel engine shall be of multi cylinder type four/six stroke cycle with mechanical (airless) injection, cold starting type.

The Engine shall be turbo-charged and watercooled.

The Engine shall be capable of operating continuously on full load at the site elevation for a period of 8 hours.

The Engine shall be provided with an adjustable governor to control the Engine speed within 10% of its rated speed under any condition of load upto the full load rating. The governor shall be set to maintain rated pump speed at maximum pump load.

The Engine shall be provided with an in-built tachometer to indicate R.P.M of the Engine.

Engine, after correction for altitude and ambient temperature, shall have bare engine horse power rating equivalent to the higher of the following two values:-

20% in excess of the maximum brake horse-power required to drive the pump at its duty point.

The brake horse power required to drive the pump at 150% of its rated discharge with at least 65 % of rated head.

The coupling between the Engine and pump shall allow each unit to be removed without disturbing the other.

All parts susceptible to temperature changes shall have tolerance for expansion and contraction without resulting in leakage, misalignment of parts or damaged to parts. The engine shall have 10 % overload capacity for 1 hour in any period of 12 hours continuous run.

STARTING:

The engine shall be capable of both automatic and manual start. Generally the engine shall start automatically, bu

Provision shall be made for two separate methods of Engine starting viz.

- a) Automatic starting by means of a battery powered high torque D.C. electric starter motor incorporating the axial displacement type of pinion, having automatic repeat start facilities initiated by a drop in pressure in the hydrant and sprinkler pipe line installations.
- b) Manual starting by Electric Starter motor

The starter motor used for automatic starting may also be used for manual starting provided there are separate batteries for manual starting.

Engine shall be able to start without any preliminary heating of combustion chamber, manual cranking mechanism shall also be provided. All controls/mechanisms, which have to be operated in the starting process, shall be within easy reach of the operator.

The high torque D.C motor charged by battery shall initiate automatic start of diesel engine. The battery shall hold adequate retainable charge to provide the starting of the diesel engine. Starting power will be supplied from storage batteries. The battery capacity shall be adequate for ten consecutive starts without recharging with a cold engine under full compression. Battery shall be lead acid / as per OEM standard (sealed maintenance free type of 12V, 25 plate, 2 Nos. 180 Ah capacities batteries.)

The battery banks shall be used for no other purpose other than starting of the engine and shall be fully charged at all times with provision for trickle & boost chargers. After start of the engine the charger shall be disconnected. The battery being fed from the engine alternator. An over speed shutdown device to shutdown the engine at speed approximately 20% above rated engine speed with manual reset, so that the automatic engine controller will indicate an over speed signal until the device is manually reset to normal operating position.

Fuel System:

The diesel engine shall be suitable to run on High Speed Diesel (HSD), the tank provided being enough to hold the volume required for 8 hours (minimum) continuous operation on full load. The tank shall be of MS sheet of 3.0 mm thickness.

The fuel tank shall be of welded steel construction to relevant Indian Standard. The tank shall be mounted above the Engine fuel pump to give gravity feed or as recommended by the manufacturer. The tank shall be fitted with an indicator showing the level of the fuel in the tank at higher level.

Cooling System :

The engine shall be radiator water cooled with cooling water drawn from the discharge side of the pump and with pressure reducing valve, strainer and all necessary accessories.

Oil Pressure Gauge: The engine shall be provided with oil pressure gauges indicating lubricating oil pressure.

Temperature Gauge: The engine shall be provided with a temperature gauge to indicate cooling water temperature.

Automatic Control Wiring :

All connecting wires for automatic controllers shall be harnessed or flexibly enclosed, mounted on the engine and connected in an engine junction box to terminals numbered to correspond with numbered terminals in the controller, for ready wiring in the field between the two/sets of terminals.

Engine Exhaust Pipes:

The exhaust pipe shall be 'C' Class MS Pipe and sized in accordance with the manufacturer's recommendations. The exhaust pipe shall be insulated with 50 mm of fiber glass / glass wool with 1.0 mm thick aluminium sheet cladding for its entire length and to be left outside the building extended 1 mtr. or as per actual requirement at site. A stainless steel flexible connection shall be provided between the engine exhaust outlet and the

exhaust pipe. An exhaust silencer shall be provided as required to satisfy the acoustic requirements.

Installation: Installation of the Diesel Engine shall be carried out exactly as per manufacturer recommendation.

Foundation and Anti Vibration Mounting:

The foundation shall be constructed as per the requirement of Diesel Engine Manufacturer. The engine shall be provided with inlet filter and silencer, outlet muffler, expansion joints, dampers etc. as necessary for efficient operation. Intake air shall be taken from inside the

building in which the engine is located, but the exhaust shall be discharged into the air at location as desired by the employer.

Suitable vibration mounting duly approved by Engineer-in-charge shall be approved for mounting the units so as to minimize transmission of vibration to the structure. The contractor shall provide all accessories, fittings and fixtures necessary and required for a complete operating engine set.

The diesel engine shall be provided with instrumentation as under:

Engine Instruments and Standard Control Panel: It shall be complete with required connections and comprising of following items:

Inlet and outlet water temperature gauge (dial type) with key.

Lubrication oil pressure gauge.

Lubrication oil temperature gauge.

Automatic start stop device (push button type).

Auto /Manual Selector switch shall also be provided.

Manual: the Engine can be manually operated by means of Push Buttons.

Start Stop and failure control device.

Start key for manual starting.

Stop Push Button for manual stopping of engine. Starting failure indication by lamp and horn unit.

Engine temperature control with failure indication by red lamp indication.

Engine temperature 'very high' indication by audio alarm and automatic stopping of engine.

Engine set is 'running' and 'in operation' indication by green lamp.

Mains supply available indicated by yellow lamp.

Push Button for Audio Alarm reset.

Push Button Failure indication by lamps.

The Panel shall also have an auto/manual/test/off selector switch.

CODES AND STANDARDS FOR PUMPS, MOTORS AND DIESEL ENGINE:

The pumps shall conform to the standards and codes as given below:-IS:

1520 Horizontal centrifugal pumps for clear, cold and fresh water. BS: 599 methods of testing pumps.

PTC:8ASME Power test Codes – Centrifugal Pumps.

The following codes shall be applicable for the motor :-IS:

325 Induction motor, three – phase.

IS: 900 code of practice for induction motors, installation and maintenance. IS:

7816 guide for testing insulation resistance of rotating machines.

IS: 4029 guide for testing three phase induction motor. 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.

SETTING OF PRESSURE SWITCHES/OPERATING CONDITIONS FOR FIRE PUMPS:

The fire pumps shall operate on drop of pressure in the mains as given under clause below. The pump operating sequence shall be arranged in such a manner to start the pump automatically but should be capable of being stopped manually by stop push buttons only.

It is thus to be noted that Jockey Pumps shall start and stop automatically through pressure switches. Jockey Pump shall stop when main pumps start as specified. Diesel Engine driven fire pumps shall start automatically when pressure drop below the specified limits, and failure of Main Hydrant pump but stopping shall be manual.

INTERLOCKING AND CONTROL PANEL:

The System has been designed for operation automatically so that as and when water is drawn from the system through any hydrant/sprinkler, the pumps will operate automatically

and feed water into the system. However once a Fire Pump start working, it will be stopped only manually (except jockey pump).

Facility shall also be provided for manual operation. A selector switch for auto/manual selection shall be provided for each pump.

The Control system shall be planning to provide the following sequence of operation:

The Pressurization Pump shall maintain pressure in the system and shall operate only on account of minor pressure drop. In case of the sudden major pressure drop i.e. below the specified pressure i.e., (3.5Kg/cm²) in the system the Pressurization Pump shall stop and the Main Hydrant pump/Sprinkler pump shall start and shut down when the system pressure reaches the pre set value. Both limits shall be adjustable.

The Diesel Engine driven Fire Pump will start on sudden major pressure drop, only in case of power supply of Main Electric hydrant Pump is not available or within a pre-set time the Main Hydrant Pump fails to start or fail during the operation. No other pump will be working when Diesel Engine Driven Fire Pump is in operation. Audio-Visual Alarm shall be available to indicate the failure of Main Electric Hydrant Fire Pump.

A three attempts starting facility will be provided for diesel pump.

If within a pre-set time, the Diesel Engine Driven pump also fails to start or fails to develop pressure, the Diesel Engine Driven pump shall also be shut down and locked out. An audio visual alarm indication shall be given at the controlpanel.

Only one pump will be working at a time in auto mode. In manual mode more than one pump can be started.

Water level in UG and terrace tanks shall be monitored and in case of low water level, pumps connected with the tank shall not operate (even on manual mode) or stop operation as the case may be. An audio-visual alarm shall be given at the controlpanel. The System Controller shall be designed to operate the fire pumps with interlocking and fault indication as brought out above. Annunciation window provided in the panel shall indicate following faults:

Low water level in UG Tank
Low water level in Terrace Tank

Main Hydrant Pump/Main Sprinkler Pump failed to start

Main Hydrant Pump/Main Sprinkler Pump Main pump failed during operation
Diesel Pump failed to start

Diesel Pump failed during operation

Supply to Main hydrant/ Main Sprinkler pump failed

Supply to pressurization pump failed

Supply to terrace pump failed

Suitable sensors, differential pressure switches, monitors etc. shall be provided at respective location. The control system shall be operational on 12/24 Volt supply.

PIPE, FITTINGS, VALVES, SUPPORTS AND OTHER ACCESSORIES:

General:

All materials shall be new of the best quality conforming to the specifications and subject to the approval of the Engineer in charge.

Pipes and fittings shall be fixed truly vertical, horizontal as required in a neat workman likemanner.

Pipes shall be fixed in a manner as to provide easy accessibility for repair and maintenance and shall no cause obstruction in shafts, passages etc.

Pipes shall be securely fixed to walls and ceilings by suitable clamps at intervals specified as per CPWD specification. Only approved type of anchor fasteners shall be used in RCC ceilings and walls.

Valves and other accessories shall be so located that they are easily accessible for Operations, repairs and maintenance.

ISI marked Pipes and fittings of following types (depending upon the design & drawing submitted by the Agency and shall be got approved by the Engineer in charge) and ISI marked only shall be used as per requirement of CFO VADODARA Fire Brigade. The piping system and components shall be capable of withstanding 150% of the working pressure including water hammer effects and test pressure upto 10 kg/cm² as per specification.

Flanged joints shall be used for connections to vessels, equipment, flanged valves and also on suitable straight lengths of pipeline of strategic points to facilitate erection and subsequent maintenance work.

Flange thickness shall be as per table below IS: 6392 – 1971 and CPWD General Specification for Electrical Work Part-V (Wet Riser & Sprinkler System) 2006

For tappings of 50 mm/40mm/32mm/25mm from headers, half socket connections with one side threading shall be employed. The half socket shall be welded at the centre of the header, either on the side or on the top.

Wherever two horizontal headers are to run side by side, the two headers shall be located at different levels, if possible, so as to avoid unnecessary bends at tapping off from the headers. Accordingly, the supports shall also be staggered to support pipes at two levels.

Pipe Support:

All pipe clamps and support shall be G.I.

Pipe shall be hung by means of expandable anchor fastener of approved make and design. The hangers and clamps shall be fastened by means of galvanised nut and bolts. The size/diameter of the anchor fastener and the clamp shall be suitable to carry the weight of water filled pipe and dead load normally encountered as per relevant Specification / IS Code.

While all piping shall have clevis type hanger supports from the ceiling with fasteners, for pipe headers of 100 mm dia and above, additional wall/column mounted supports shall be taken. Clevis type hanger supports shall be at not more than 3.0 m intervals or as per load design on straight run of pipe and on both ends at every turn. MS angle supports at wall and columns shall be at 10 m intervals. The angles shall be cut by gas cutter and evened out by grinder. All welding to angles shall also be cleaned by grinder. Angles shall not be less than 40 x 40 x 6 mm size.

For fixing clevis hanger and angle support, only dash fasteners shall be used. Exposing of steel reinforcement and welding to them shall not be permitted except in exceptional circumstances.

Pipes in vertical shafts shall have MS angle brackets at every floor level. The bracket shall be mounted behind the pipe. A base plate of 50 wide x 6 mm thick shall be welded to the bracket. The base plate shall be fixed to the wall by means of fasteners, GI 'U' clamps shall be used to fix the pipe to the bracket.

Each riser shall also be anchored to the floor slab with MS angles mounted on the slab. The angles shall be 40mm x 40mm x 6mm size, one mounted before the pipes and the other after the pipes. Extra cleat pipe pieces shall be welded to the pipes at this point which shall be welded to the angle iron support.

Wherever angle type supports are being used, profiled packing materials or wood or materials as approved by the Engineer shall be used. The packing materials shall be at least 25 mm thick and tight fitted with the pipe.

Hose Reel:

Wall mounting the swinging type first aid hose reel with drum shall be provided conforming to IS: 884-1985.

The rubber tubing shall be 20 mm dia high pressure rubber hose 36.0 mtr. long as per IS : 444 with gunmetal shut off nozzle having 6.5 mm dia orifice and control valve, shut off valve of approved make. The wall mounted bracket shall be fixed by means of fasteners. The hose reel shall have a gun metal nozzle.

The hose reel shall be connected directly to the riser by means of 25 mm dia GI pipe with threaded bends, union & one no. ball valve.

The drum can swing up to 180 degree.

Hose Cabinets:

Hose cabinet shall be fabricated from 16 gauge MS powder coated sheet of fully welded construction with hinged single/double door partially glazed door with suitable locking arrangement, stove enameled fire red paint with 'Fire Hose' written on it prominently. Glass panels shall be 4 mm thick.

The hydrant cabinet shall hold double headed GM hydrant, 2 nos. Hoses and 1 no. GM branch pipe and 1 no. Butterfly valve.

The cabinet shall have two pipe studs of 200 mm dia in MS with base which shall be fixed to the back of the cabinet and shall be used to hold the RRL hose.

RRL Hoses:

The hoses for the internal and external hydrant system should be rubber impregnated woven jacketed type conforming to IS:636 Type-A Reinforced rubber lined. Each fire hose shall be provided with quick coupling, branch pipes, nozzles, spanners etc.

Hose pipes of all types shall be capable of withstanding an internal water pressure of not less than 42 Kg/Sq.cm without bursting. It must also withstand a pressure of 25 Kg/Sq.cm without undue leakage or sweating.

Each hose shall be fitted with instantaneous spring lock type couplings at both ends. Hose shall be fixed to the coupling ends by copper rivets and the joint shall be reinforced by 1.5 mm galvanised mild steel wires and leather bands.

Branch Pipes and Nozzle : Gun metal / brass Standard Branch Pipe shall be used conforming to IS : 903 with Gun metal / brass nozzle of 20 mm (nominal internal dia) to fit standard instantaneous type 63mm dia hose coupling. Suitable spanners of approved design shall be provided in adequate numbers for easy assembly and dismantling of various components like branch pipes, nozzles, quick coupling ends.

Hydrant Valve:

Gun Metal Hydrant valve shall be of oblique pattern provided as per IS: 5290 complete with hand wheel, quick coupling connection, spring and blank cap and chain.

The hydrant shall have flanged inlet of 100 mm dia and 63 mm female instantaneous type outlet. The hydrant shall have a rubber plug with chain fixed to the Main body of the Hydrant.

Pressure Switch:

The pressure switches shall be employed for starting and shutting down operation of pumps automatically, dictated by lines pressure. The Pressure switch shall be diaphragm type, it shall be suitable for line pressures upto 15 kg/cm².

The switch shall be suitable for consistent and repeated operations without change in values. The enclosure shall be of aluminium and pressure element and wetted parts shall be of stainless steel. The switch shall be snap acting type with 1 no. NO/NC contact.

Air Vessel:

The air vessels shall be provided to compensate for slight loss of pressure in the system and to provide an air cushion for counter acting pressure surges whenever the pumping 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 MS sheet conforming to IS: 2002 grade 2A having 8 mm thickness shell with 10 mm thick dished ends and suitable supporting legs with M.S. Plate size 75mmx75mmx5mm at bottom. It shall be provided with a 80 mm dia/100 mm dia flanged connections from pump, one 25 mm drain with ball valve and 15 mm sockets for pressure gauge and pressure switches. The air vessel shall be hydraulically tested to 25 kg/cm² pressure for 30 minutes.

The pressure vessel shall be provided for hydrant and sprinkler system. The pressure switches shall be mounted on the drain end of each air vessel. The air vessel shall also be provided with safety valve mounted at the top. The presser vessel shall be supplied of size 250 mm dia x 1200 mm height.

Fire Department Connections:

Fire Brigade Inlet (4/2Way) to Hydrant Ring/Hydrant Riser:

Gun Metal four way fire brigade tank filling connection having 63 mm dia instantaneous type inlet and 150/100 mm dia flange outlet conforming to IS : 904 with blank cap and chain with necessary 150/100 mm dia MS (heavy duty pipe) and flanges, nuts and bolts etc. alongwith non return valve and butter fly valve.

The inlet assembly shall be in glass fronted wall box and size of wall box shall be adequate to allow hose to be connected to the inlets, even if the door cannot be opened and the glass has to be broken.

Each box shall have fall of 25 mm toward the front at its base and shall be glassed with wired glass with "FIRE SUPPLY TO TANK" painted on the inner face of the glass in 50 mm size blockletter.

Each such box shall be provided with a steel hammer with chain for breaking the glass.

Under Ground Tank Filling for Fire Brigade Connection:

Gun Metal four way fire brigade tank filling connection having 63 mm dia instantaneous type inlet and 150/100 mm dia flange outlet conforming to IS : 904 with blank cap and chain with necessary 150 mm dia MS (heavy duty pipe) and flanges, nuts and bolts etc.

The inlet assembly shall be in glass fronted wall box and size of wall box shall be adequate to allow hose to be connected to the inlets, even if the door cannot be opened and the glass has to be broken. Each box shall have fall of 25 mm toward the front at its base and shall be glassed with wired glass with "FIRE SUPPLY TO TANK" painted on the inner face

of the glass in 50 mm size block letter. Each such box shall be provided with a steel hammer with chain for breaking the glass.

The inlets shall be provided with ABS quality plastic blank caps with chain.

Valves:

Sluice Valves:PN1.6

Sluice valve of o f s i z e 150m m d i a (N B) and above shall be flanged type with cast iron body. The spindle, wall seat and wedge nuts shall be of bronze. They shall generally have non-rising spindle and shall be of the particular duty and design called for. All sluice valves will be provided with supervisory switch & PN 1.6 rating.

The valves shall be supplied with suitable flanges, non-corrosive bolts and asbestos fibre gasket. Sluice valves shall conform to Indian Standard IS: 14846: 2000 and IS: 2906. Sluice valves for water works purposes suitable for seat test pressure of 16 Kg/Sq.cm. & PN1.6

Butterfly Valve:

The butterfly valve PN 1.6 shall be suitable of size 32mm to 150mm dia (NB) for water works and tested to minimum of 15 Kg/Sq.cm pressure.

The body shall be of cast iron to IS: 210 in circular shape and of high strength to take the water pressure of 16 Kg/Sq.cm. The disc shall be heavy duty cast iron with anti corrosive epoxy or nickel coating.

The valve seat shall be of high grade elastomer or nitrile rubber. The valve in its closed position shall have complete contact between the seat and 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 EN 8 grade carbon steel.

Butterfly valve shall be of best quality conforming to IS: 13095 of class specified. The valves shall be supplied with manual gear operated opening/closing by lever. The valves shall be supplied with supervisory switch.

Gun Metal Valves:PN1.6

Gun metal valves shall be used for smaller dia pipes, and for threaded connection.

The valves shall bear certification as per IS: 778-1984 and shall be rated to 16 Kg/Sq.cm pressure.

11.11.3.1.1 The body and bonnet shall be of gun metal to IS : 318. The steam gland and gland nut shall be forged brass to IS: 319. The hand wheel shall be of cast iron to IS: 210.

The hand wheel shall be of high quality finish to avoid hand abrasions. Movement shall also be easy. The spindle shall non rising type.

All valves shall be approved by the Authority Representative before they are allowed to be used on the work.

Non-Return Valve: PN 1.6

Non-return valves shall be cast iron dual plate type. An arrow mark in the direction of flow shall be marked on the body of the valve. The valve shall bear IS: 5312 certification.

The valve shall be of cast iron body and cover. The internal flap in the direction of water shall be of cast iron and hinged by a hinge pin of high tensile brass or stainless steel. Cast iron part shall be as per IS : 210.

The gasket shall be of high quality rubber and flap seat ring of leaded gunmetal. At high pressure of water flow the flapper shall sit tightly to the seat. The valve shall be capable of handling pressure up to 15 Kg/Sq.cm

Air Valves:

Provide 25 mm dia screwed Gunmetal ball valve shall be provided on all high points in the system.

Drain Valve:

Drain Valve of size not less than 65mm dia GM Ball valve shall be provided in Sprinkler Drain line.

Air valves shall be provided at low points of all water riser and mains to ensure that all sections of pipe works and plant can be drained.

Pressure Gauge:

Pressure gauge shall be provided near all connections to hydrant system and isolation valves of sprinkler system and where required. Pressure gauge shall be stainless steel 150 mm dia gunmetal Bourden type with a scale range from 0 to 15 Kg/cm² and shall be constructed as per IS 3624. Each pressure gauge shall have a siphon tube connection with ball valve, tapping and connecting pipe and nipple. The gauge shall be installed at appropriate level and height for easy readability.

Fire Man's Axe :

Fire man's axe for fire fighting purpose shall be used conforming to IS:926 – 1985

Painting:

All hydrant pipes shall be finished with post office red colour paint. All M.S/G.I.. pipes shall first be cleaned thoroughly before application of primer coat. After application of 2 coats of Red oxide primer, two coats of enamel paint shall be applied. Wherever required all pipe headers shall be worded indicating the direction of the pipe and its purpose such as "TO RISER NO 1" etc.

Testing:

All piping in the system shall be tested to hydrostatic pressure of 10 Kg/Sq.cm without drop in pressure for at least 24 hours during laying of pipes & after completion of work.

Rectify all leakages, make adjustments and retest as required and directed.

The following codes and standards and their subsequent modifications shall apply for the design, manufacture, shop testing, erection, fabrication at site, resting and trial operation of piping, valves and specialties 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 valve for water work purposes.

IS:14846:Sluice valves for water-work purposes(50mm to 1200mm).

IS: 901 : Couplings, double male and double female, instantaneous pattern for firefighting.

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-work purposes. IS:

5290 : Landing Valves.

IS:10221:Anti corrosion treatment for underground MS pipes. IS:

5312 : Swing check type reflux (non-return) valves.

GUARANTEE:-

The contractor shall submit a warranty for all equipment, materials and accessories supplied by him against manufacturing defects, malfunctioning or under capacity functioning.

The warranty shall be valid for a period of Three years from the date of commissioning and handing over to user department.

The warranty shall expressly include replacement of all defective or under capacity equipment. Engineer in charge may allow repair of certain equipment if the same is found to meet the requirement for efficient functioning of the system.

The warranty shall include replacement of any equipment found to have capacity lesser than the rated capacity as accepted in the contract. The replacement equipment shall be approved by the Project Director.

Inspection by Local Fire officer :-

After completion of work and testing to the entire satisfaction of Engineer – in- charge, the installation shall be offered for inspection by Chief Fire Officer or his representative. Testing as desired by the Fire Officer shall be carried out. The contractor will extend all help including manpower during testing. The observation of Chief Fire Officer which are a part of agreement shall be attended by the contractor. The building will be issued NOC for occupation only when all the safety provisions i/c Fire Fighting work are complete to the satisfaction of the Fire Officer.

TECHNICAL DATA

(to be submitted by the firm to whom work is awarded, after the award of work as per the time schedule set)

Diesel Engine Driven Fire Pump:

Quantity	
Make	
Model	
Fluid Handled	
Type	
Suction	
Delivery	
Impeller Type	
Coupling	
Base Plate with Foundation Bolt	
No. of Stage	
Flow Rate (m3/hr)	
Total Head (m)	
Speed of Pump (RPM)	
Efficiency at rated duty point	
Material of construction (MOC)	
Casing material	
Impeller material	
Shaft material	
Shaft sleeve	
Casing Ring	
Impeller Ring	

Engine for Diesel Pump:

Quantity	
Make	
Model	
Horse Power	
Engine	
RPM	
Engine over speed setting	
ing Cycle	
Number of Cylinder	
Accessories	

Dynamically balanced flywheel	
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Flexible coupling and coupling guard	
Electrical standing equipment and starting system	
Governer	
Fuel pump and water pump	
Lubricating oil pump	
Fuel, Air and Lubrication Oil Filter	
Instrument and Protection Device complete as per Engine Model	
Lubricating oil pressure	
High Cooling Water Temperature	
High Lubricating Temperature	
Engine Cooling and Oil System	
Capacity of Diesel Tank	
Detail of Batteries	
Battery Charger	
Other necessary accessories as per Model No in order to make the Diesel Engine Functional	

Electrical Motor Driven Fire Pumps:

Description	Fire Hydrant Pump	Jockey Pump
Quantity		
Make		
Model		
Fluid Handled		
Type		
Suction		
Delivery		
Impeller Type		
Coupling		
Base Plate with Foundation Bolt		
No. of Stage		
Flow Rate (m ³ /hr)		
Total Head (m)		
Speed of Pump (rpm)		
Efficiency at rated duty point		
Material of construction (MOC)		
Casing material		
Impeller material		
Shaft material		
Shaft sleeve		
Casing Ring		
Impeller Ring		

Electric Motor For Main Fire Pumps:

Description	Fire Hydrant Pump	Jockey Pump
Make		
Model		
Type of Motor		
Horse Power		
Voltage (V)		
Full Load Amps – A		
Speed of Motor		
Enclosure		
Mounting		
Class of Insulation		
Ambient Temperature/ Temp in Degree		
Starting Temperature as % of full temp		
Efficiency at 100% load efficiency at 75% load		
Type of rotating movement		
Coupling		
Type of lubrication		
Frequency		
Make and type of starter		

LIST OF IS CODES (Relating to Fire Fighting works)

The following codes and Indian Standards shall be applicable with amendments up to date.

CODE OF PRACTISE

Code of practice for fire safety of building (general) fire-fighting equipment and maintenance. IS :1648

Code of practice for installation of internal fire hydrant in multistoried buildings.- IS : 3844
 Recommendations for providing first aid and fire fighting arrangements in public buildings.-

IS :2217

Code of practice for the selection, installation and maintenance of portable first aid and fire appliances - IS :2190

National building Code.

FIRE FIGHTING APPLIANCES

External fire hydrants.- IS :5290
 Internal landing valves. - IS :5290

1 & 3 way suction collecting heads. - IS :904
 First aid hoses. - IS :884

Dunlop high pressure rubber pipe. - IS :5132

HAND APPLIANCES

Specification for portable CO2 fire extinguisher.
portable chemical fire extinguisher foam type –IS : 933

-IS : 2878 Specifications for

PIPING AND VALVES

MS tubes up to 150 mm

– IS : 1239 (Part-I)

MS tubes 200 mm above

– IS : 3589

G.I. Pipes – IS : 1239 (Part I)

C.I. double flanged sluice valves class I – IS : 780

C.I. double flanged non return valves – IS : 5312 PUMPS AND MOTORS

Centrifugal pump – IS : 1520

Electrical motors PUMPS AND VESSELS – IS : 7538

Specification for horizontal centrifugal pumps for clear cold fresh water – IS :1520 Steel plates for pressure vessels for intermediate and high temperature service including boilers – IS :2002

Code for unfired pressure vessels – IS :2825

Code of practice for lining of vessels and equipment for chemical processes Part 1 : Rubber lining – IS : 4682 (Part 1)

Specification for sewage and drain age pumps – IS : 5600

Specification for submersible pump sets for clear, cold, fresh water –IS : 8034

Specification for horizontal centrifugal self priming pumps- IS:8418.

Package - 10) Water Supply/Pumps & Water Treatment.

. SCOPE OF WORK includes:

Planning, Supply, installation testing & commissioning of hydropneumatic type pumpsets System for Domestic Water Supply along with following.

The design shall include supply of Drinking water to Academic building (G+5) and Hostel block (G +9).

Electric motor driven type open well water supply pump set with Cast iron housing / Delivery casing, S.S / Bronze impeller, SS Shaft, coupled with suitable capacity AC motors, common base plate, (1 working + 2 Standby) suitable for operation on 3 phase 415 Volts A.C. supply, handling clear water at following head and discharge as below:

- Capacity per pump - As per design.
- Head - As per building heights.

(1 working + 2 standby =1 set comprising of 3 nos. pumpsets)

GI piping 'heavy class' (common header for suction and discharge), suitable size control valves & non return valves, pressure gauges etc. complete as required.(All accessories shall be provided for each individual pumps)

Pump control panel:-

Before starting the fabrication, the contractor shall prepare General arrangement drawings of Panel which shall be got approved from the Engineer-in-Charge.

The Panel shall be fabricated with heavy gauge CRCA sheet of 2 mm thickness with powder coated paint respectively.

Service connection to pump control panel and inter-connecting power and control cabling from individual pump-motor set to control panel etc. complete as required.

Making cement concrete foundation / necessary brackets clamps fixtures, grouting suitable for electrical pump set etc accordance with manufacturer's design and approved by the Engineer-in-charge.

Earthing with copper plate earth sets and loop earthing to individual pumps and panel.

General Conditions

The work shall be carried out in accordance with the General specification for Electrical works of CPWD Part-I 2023 & Part-II 2023 amended up to date, relevant I.E rules & as per directions of Engineer-in-Charge.

The work is to be carried out in workman like manner & generally in accordance with the plans. However, the contractor will be bound to carry out the work with minor deviations over the plans supplied if desired by the Engineer-in-Charge.

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 the site, if required.

: Sewage Collection Tank
 : Fine Screen Chamber
 Stage 2: Biological : Anoxic Tank
 : Biological Reactor and MBR Tank
 : Ultra Violet System
 : Treated Water Storage Tank

Stage 3: Sludge Treatment: Centrifuge for dewatering the sludge
 : Sludge Drying Beds

END USE OF THE TREATED SEWAGE WATER

The treated sewage will be used for the following purpose of gardening/ irrigation and flushing (with addition of softener if required) resulting in the reduction of significant natural water resources with following features:-

Skid Mounted Unit

Single Skid ensures an easy transportation and relocation if required at any stage
Ability to withstand high temperature feed water.

Long membrane Life of >5years.

Specially designed and flat sheet membranes results in low fouling of membranes.
Low Trans membrane pressure results in low power requirement.

MBR system reduces requirement of chemicals for disinfection purpose. Exceptional
Effluent Quality and >98% TSS Removal

It will also meet the further more stringent water quality standards. Compact:
Smaller Bioreactor, No Sand Filter/Activated Carbon Required Highly Aerobic:
No offensive Odours

Year round Nitrification: Even in cold temperatures
Adaptable to Existing Tanks (Civil Constructions) Very
little sludge to handle

High resistant to both chemical and biological contaminants

Compact modules with high degree of flexible configurations and scalability.

The following works covered and to be done by the contractor The
raw sewage will brought into the sewage treatment plant.

All type of piping and valves, channels from inlet (sewage suction line) to outlet (gardening/
flushing delivery line) , Fresh water supply line, electric supply lines, Electrical panel, etc. in the
STP room.

All types of electrical and mechanical works (equipments in the Tanks, Foundation,
platform) and also minor civil works (Construction of the STP RCC Tanks in the scope of
the Civil wing) Tools, tackles, man power, storage facility for the safety of the equipment
and other utilities during erection and commissioning.

Liaising of any kind with any state, central or local governing body.

The treated water shall meet the local as well as National Standards as amended up to date.
The system for the STP plant are indicated in the drawing and schedule items however it will be

the responsibility of the contractor to ensure complete system functional as required and provide items additional if any for the same.

The contractor shall submit the drawings and specifications if any changes in the drawing provided by the department in respect of the STP works will be started after getting the drawing approved by the Engineer-in-charge.

After installation the equipment shall be tested by the contractor, for which all consumables, chemicals, lubricants, etc. including first charge during commissioning provided by him.

Warranty of all equipments supplied and installed shall be covered by warranty for one year against defective due to faulty materials, faulty design or inferior quality of materials it shall be required or replaces at site free of charge by the contractor at his own cost during the warranty period. The warranty shall cover consequential damages to the equipment supplied and installed by the contractor due to poor workmanship or defective materials.

Painting of entire installation complete in all respect.

Technical training of operation and maintenance of the STP to the two persons at site.

All the materials required to be used in the work shall be got approved from the Engineer-in-charge before its use at site.

All necessary piping works with MS pipe "C" Class (Heavy duty).

All necessary valves like CI butterfly valve, Non return valve, ball valve (gun metal type), etc. as per requirement.

The following services are included for 3 months stabilization test running operation .

Supply of chemicals like hypochlorite solution, pH strips, biomass culture & lubricants for trial months

Checking of regular parameter / test such as BOD, TSS, COD, Total Nitrogen/ Phosphorus every 10 days and pH checkin every day.

Regular operation of pump.

Checking of regular water level of sewage collection tank ofSTP.

Treating of critical parameter to ensure desired water quality ofSTP.

All necessary measure will be taken to operate the system satisfactory.

Regular cleaning of pumps & checking of inletline.

Regular removal of chemical as and when required.

Maintaining all sort of records as per the requirement such as log sheet of the system, performance sheet of the system, chemical consumption record, electrical consumption record etc, to minimize the down time of any utility and to enhance the performance of entire system.

Operation & preventive maintenance of pumps.

All necessary measure shall be taken for quality control ofSTP. Preparation of hypo solution to make dozer fit.

Dosing of chemical solution in water.

Checking of sewer inlet tanks for general parameters (Color, pH&Temp.).

Checking of water of treated water tanks.

Cleaning of pumps and water tanks.

checking of gland packing leakages with packing of all the water pumps and sewerage pumps.

Greasing & oiling of water pumps.

Clearing of pipe line (suction &delivery).

Greasing of various equipment, if required.

Regular preventive maintenance of the mechanical equipment like pumps, valves and take corrective action whenever required for the smooth operation of pumps.

Checking parameter as per GSR 422 E for the smooth operation of the STP and take corrective measures in case of any deterioration of these parameter.

Disposal of sludge from sludge Drying beds.

Preparation of chemical solution & dosed to respective tank / doses as required.

To undertake regular preventive maintenance of the mechanical equipments as pumps, valves and take corrective action whenever required for the smooth operation of pumps. Sampling & testing of treated water from the authorized laboratory for the pollution control purpose shall be in scope of contractor.

All the parameter of treated water shall be well within state pollution control norms at any time.

BRIEF PROCESS DESCRIPTION

Bar Screen : Raw sewage from the source is usually received into the bar screen chamber by gravity. Screen provided will remove all floating and big size matter such as plastic bottles, polythene bags, glasses, stones, etc., which may otherwise choke the pipeline and pumps.

Oil & grease trap : Complete oil and grease trap with siphon arrangement to arrest all oil contents in the trap will be provided. This trap will have specific RCC partition with underflow arrangement to trap oil contents in each chamber. In last chamber there will be a siphon arrangement as outlet for effluent. The tarp oil contents can be cleaned manually. There can be a provision of oil skimmer application on higher volume of oil contents.

Sewage Transfer: These wage transfer pump will be installed the near equalization tank and the transfer distance is not recommended more than 5 meters. The transfer pump can be either submersible or non-submersible type for this application. The pump should not run dry and to ensure sufficient sewage is available in the Equalization Tank.

Collection cum equalization tank : The oil free water is then collected in a collection cum equalization tank to meet the peak hour's requirement and to get a homogenous mixture. Equalization tank helps in sedimentation of grit in the absence of grit chamber. An aeration grid can be provided to keep the suspended matter in suspension and to avoid septic conditions. The tank is provided with air distribution piping with adequate number of Coarse Bubble diffusers.

Primary treatment :- The Sewage will first pass through the Screen Chamber having coarse bar screens to trap the floating debris if any. Then it will be collected in Oil and grease trap to remove the oil and other fats. After that, this sewage will be collected into the Sewage Collection tank. From where, it will be transferred to the fine screen chamber followed by anoxic tank for the removal of nitrogen. From anoxic tank, the sewage will be collected into the Biological reactor for biological treatment.

Membrane system :- The MBR system is a customized system comprising an activated sludge process and membrane separation. The first tank will be aeration tank which will act as the biological reactor. The other tank will be the MBR tank which will be used for housing the membrane skids. Below the membrane skids tube diffusers will be provided for air scouring during filtration

Biological Reactor System : It is the aerobic system with fine bubble diffusers to provide sufficient dissolved oxygen levels to treat the wastewater by removing COD, Nitrogen, Phosphorus, BOD and TSS etc. Generated sludge is recycled to the aerobic zone by the RAS line. The flow rate of RAS is decided based on the Mixed Liquor Suspended Solids (MLSS) concentration present in the aeration zone. The excess sludge produced can be wasted from the tank using the WAS (Waste Activated Sludge) line.

Membrane Filtration (MBR Tank) : Effluent from biological reactor is sent to MBR tank for further treatment and filtration. During filtration, a suction pressure is applied to the lumen of the membrane fibers. The suction pressure is usually created through the use of a self-priming centrifugal pump/vacuum pump, where the suction pressure pulls water to the inside of the fibers, leaving particulate matter on the external surface. The operating flux is typically kept constant, and as solids accumulate on the feed side of the membrane fibers and in the membrane pores, more suction pressure is required to maintain a constant flow rate. The rate of fouling is reduced

by continuous aeration, where air is applied at the bottom of the vertically aligned fibers. The aeration creates a two-phase flow that scours the membrane surface and continuously removes the fouling. The Poly-tetra fluoro-ethylene (PTFE) MOC of the lumen helps in low fouling of membrane surface which results into higher life of membrane.

Membrane Relaxation : Normal service operation consists of repeated cycles of filtration and relaxation. The relaxation helps remove the residual foulants that are not removed by air scouring during filtration. The relaxation time is adjustable and typically takes 10% to 20% of total cycle time depending on membrane fouling, e.g. seven to nine minutes of filtration and one to two minutes of relaxation.

Maintenance Cleaning : Maintenance cleaning (MC) is typically conducted on a weekly basis to preserve the operating flux. The MC can be triggered by a timer or manually by the operator. The MC is conducted by dosing chemicals such as Sodium Hypochlorite (NaOCl) into the permeate side of the membranes. The membrane is soaked in the chemical while the solution flows simultaneously in the reverse direction from the membrane permeate side to the feed side.

Conduct MC at least once per week using 500 ppm of NaOCl.

Cleaning In Place : A cleaning-in-place (CIP), also named as Recovery Cleaning (RC), is performed on a quarterly or half yearly basis to remove foulants that are difficult to be removed by air scouring and MC. The concentration and type of chemicals used for CIP, as well as the soaking time, depend on the extent of fouling. The use of chlorine aid in the removal of biological fouling while citric acid moves in organic scaling. The CIP can be initiated by a timer or manually by the operator. Similar to MC, the chemical solution flows from the permeate side to the feed side of the membrane, thus attacking the foulants on the membrane surface. This method minimizes the amount of CIP chemicals required.

Conduct CIP :- a) Once per 3 – 6 months using between 2000- 4000 ppm of NaOCl.

b) At least once per 6 – 12 months using 1 – 2% of citric acid.

Continuous aeration is used during the filtration and relaxation cycles to scour the membrane surface and remove fouling. The turbulence caused by the two-phase air- water flow is effective in removing the foulants deposited on the membrane surface. The MBR membrane must always be immersed in water and under continuous aeration even if the membrane filtration system is not in operation. The air diffusers consist of a hard pipe covered by a rubber material with slits in it. This design feature is useful in eliminating the backflow of sludge into the air diffusers that clogs the diffuser.

Operation Sequence of MBR System - Filtration and relaxation cycle time can be adjustable, such as filtration for 9 minutes and relaxation for 1 minute.

Tertiary treatment : After MBR treatment, there is no need of any Pressure sand filter or Activated Carbon Filter. However, disinfection unit is required to kill the pathogenic organisms. The treated effluent is collected into the treated water storage tank & will be used for irrigation and flushing.

Sludge Treatment : The sludge generated from MBR tank will be collected in sludge holding tank & will be diverted to the Centrifuge for dewatering. The dewatered solid sludge can be used as organic manure in gardening.

**Package - 12) HVAC WORKS
(Air Conditioning)**

This package involves supply, installation, testing and commissioning of VRV/VRF type HVAC system for functional requirement of the Institute and as per Institutes guidelines issued by ASHRAE, BIS specifications and CPWD General Specification for Heating Ventilation & Air-Conditioning-2024 and amended up to date and the requirement of authority of Institutes and additional specifications. The VRV/VRF System plant has to be installed with minimum capacity 878 HP for Academic building. This is only indicative & minimum requirement. If on designing or during execution of work if higher capacity of VRV/ VRF AC system is required then the same shall be provided the contractor without any extra cost & decision of Engineer in charge in this respect will be final & binding on contractor.

The scope of the work includes planning, supplying, installation, testing and Commissioning of inverter technology based D.C Twin Rotary / Scroll compressor Type VRV/ VRF type system of air conditioning for the building as per individual or season requirement including submission of other parameters as required by engineer in charge conforming to CPWD specification for HVAC 2024 and in accordance with the site requirements. The contractor shall calculate equipment capacity based upon design parameters specified for the system design & verify all the quantities and sizes of refrigerant pipe, fitting, cables, control cable, pipes, insulation, indoor units and outdoor units etc. This also includes all necessary civil work and GI framework for installation of outdoor and indoor units in VRV / VRF based air conditioning system. The design shall include AHUs with duct able VRF system for including equipment load. The system shall also include the Ecofriendly green refrigerant gas & its charging for proper & specified functioning of air conditioning system. The scope of work of the contractor also includes a) Cutting of walls and floors/ceilings) Making holes, c) Sleeves, d) Foundations.

Civil work & GI frame work for indoor and outdoor units related to VRV / VRF equipments, all cuttings should be properly finished as existing surrounding. The installation of outdoor unit on the rear side / terrace of the building should be checked up structurally & their mounting should be structurally safe for the outdoor unit to ensure in such a way that after installation operation of equipment is safe and satisfactory & no damage to the building structure takes place.

The outdoor units shall have cooling mode, consisting of one/ multiple outdoor unit with single circuit of refrigerant piping and multiple indoor units of various types. It shall be possible to connect minimum 10 indoor units on one refrigerant circuit. The indoor units on any circuit can be of different type and also controlled individually. Each indoor unit should have capability to cool as per seasonal weather changes. This shall also include complete capacity calculation for indoor and outdoor units complete with CAD drawing, designing & layout of following.

- i) Outdoor Units
- ii) Indoor Units
- iii) Refrigerant piping
- iv) Condensate water piping & disposal.
- v) Power and Control Cables between Outdoor units & Indoor units including CRC (Centralized Remote Control) controller.
- vi) AHUs and ducting arrangement.

While designing the system care should be taken to select outdoor units of suitable capacity based on design data provided below & to economize the available area for installation of outdoor units as well as optimum utilization of outdoor units. Based on the heat load analysis, the requirements of capacities of the indoor and outdoor units shall be calculated. The indoor units should be designed based upon the heat load calculations for

individual rooms/ areas to be air-conditioned and over capacities should be avoided. The design should also specifically take care of disposal of condensate drain water so that there is no leakage of condensate water inside the room as well in the route of condensate water pipeline. The layout of refrigerant piping is to be designed in such a way so that it should not disturb the aesthetic of the building/ room, inadvertent damage in the route of pipe should not occur in future & optimum length of pipe line for efficient air conditioning. After completion of the work four sets of "As actual erected/ commissioned drawings" of activities listed above shall be submitted.

The work of VRF/VRV air-conditioning system - outdoor and indoor units is required to be carried out at New Academic Building at IIIT, Vadodara. Design shall include parameters like inadequate heat insulation of the building, air leakage from doors, windows or other outlets such as staircases, corridor, ventilators, shaft, CFM & fresh air requirement. In case of any deviation from the parameters specified below, the technical issues involved shall be brought to the notice of Engineer incharge for seeking necessary approvals to achieve these parameters. Engineer-in-charge, however, reserves the right to permit any deviations from the parameters as specified.

Outside conditions:-	Summer	-	43° C DB, 25.6° C WB
	Monsoon	-	31.1° C DB, 26.1° C WB
	Winter	-	10.0° C DB, 6.1° C WB
Indoor conditions :-	Summer		24.0° C ± 2° C
	Monsoon		RH not exceeding 55% ± 5%
	Winter		± 1° C

Note: 1 HP unit = 0.81 TR (Approximately)

It is proposed to provide VRF/VRV air conditioning system for entire building as per building drawings. The under deck insulation on top floor of main building and auditorium shall be a part of the work. The system has to be designed for proper CFM considered air changes & fresh air requirement as per reference standards. Outdoor type cubical panel for distribution of electrical supply to outdoor units along with suitable capacity MCCBs/RCCB/MCB and cabling shall be considered.

REFERENCE STANDARDS: The entire System will be designed in accordance with following Standards

1. National Building Code 2016.
 2. ASHRAE Application 2007
 3. ASHRAE Fundamentals 2005
 4. Indoor Air Quality as per ASHRAE 62-1999.
 5. ISHRAE Codes.
 6. Duct construction standards as per relevant BIS Codes, IS 655:1963
 7. Motors, Cabling, wiring and accessories as per BIS code
- Cable Insulation – IS8130, IS 5831.

ASSUMPTIONS: Description Estimated Value

- | | | |
|-----------------------------------|---|------------------|
| 1. Fresh air in conditioned areas | : | As per Ashrae |
| 2. Occupancy | : | As per Drawing |
| 3. Lighting load: | : | 1.5 watts / sqft |
| 4. Equipment load | : | Actual |

The project is required to be executed in time bound and professional manner along with the other services. The equipments involved in air-conditioning are complex in nature comprising of instrumentation and control. The job, therefore calls for highest order of technical expertise and also requirement of experience of air-conditioning installation with proven performance. The contractor shall, obtain, the consent of OEM and furnish the same. This consent shall covers

aspects of desired assistance in the field of design, development, testing, execution, completion & maintenance/ maintenance spares of the air conditioning system.

Not with standing the technical details as specified in the tender, the manufacturers may offer/ indicate systems and necessary design & features applicable for the offered products at the tendering stage.

It is proposed to install outdoor unit at the rear side /terrace of the building or in open court yard depending upon the availability of site. The outdoor & indoor unit shall be connected through existing shaft from the Ground floor to top of the building.

OUTDOOR UNIT :-

The outdoor unit shall be factory assembled, weatherproof casing (The Material of casing shall be OEM's standard design), constructed from heavy gauge GI sheets steel panels and coated with baked enamel finish. The outdoor unit shall be completely factory wired, tested with all necessary controls & filled with first charge of refrigerant.

VRF outdoor units must be Made in India. OEM certification is required. All the compressors of the outdoor units must be 100% DC inverter hermetically sealed scroll type. Each module of outdoor unit must have combination of only Inverter Compressor, suitable to operate at heat load proportional to indoor unit requirement. All the VRF Machines must include compressors manufactured by OEM only. OEM Certification is Must.

The system shall have the feature of variable refrigerant temperature which enables variation in evaporator temperature automatically based on the load requirements and ambient conditions. This feature shall work in conjunction with VRV technology to achieve best part load efficiency.

All outdoor units must be equipped with night time quiet operation function which results in less sound level in night time operations of the outdoors.

The outdoor units shall have a unique feature of auto sequencing which is automatically enabled to ensure balanced operation of each outdoor unit to improve longevity of equipment and stable operation. It should also be provided with duty cycling for switching starting sequence of multiple Outdoor units.

All the compressors installed in outdoor unit shall be inverter driven. The modules with capacities above 14 HP shall have at least two inverter compressors. In case of combined capacity (single circuit) of outdoor units 30 HP or above, the combined outdoor unit shall have at least 3 inverter compressors so that the operation is not disrupted with failure of any compressor. The inverter technology based D.C Twin Rotary/ Scroll type VRV / VRF equipment should be capable so that refrigerant piping between indoor units and outdoor unit shall be extendable up to 165m of equivalent length with maximum level difference between outdoor & indoor unit of 50m & level difference between two indoor units shall be maximum up to 15m.

Selected module should have COP 4.7 at 50% load as per AHRI 1230 and each module should have at least one inverter compressor/unit.

The COP for the same may be furnished as per standard proforma.

All the details pertaining to power consumption as per ARI standard should be duly filled and furnished as per the sheet enclosed.

The above COP values as indicated are required to be furnished in Original by the tendered directly from the original equipment Manufacturer (OEM) with OEM's seal and signature on all documents.

The outdoor unit shall be factory tested and filled with first charge of ecofriendly green refrigerant gas before delivering at site.

It should also be provided with duty cycling for D.C inverter Twin Rotary/ Scroll compressors capable of changing the rotating speed of compressor by inverter controller to follow variation in

cooling loads & switching starting sequence for better stability and prolonging equipment life or similar features if available in D.C Twin Rotary/Scroll will also be accepted.

The unit shall be provided with its own microprocessor control panel with provision for integration with the building management system for Air-conditioning system.

The machine must have a sub cool feature to use coil surface more effectively through proper circuit bridge so that it prevents the flushing of refrigerant from long piping due to this effect thereby achieving energy savings.

The noise level shall not be more than 68 dB (A) at anechoic chamber conversion value, measured horizontally 1m away and 1.5m above ground level.

The outdoor unit should be fitted with low noise aero spiral design fan with aero fitting grill for spiral discharge airflow to reduce pressure loss and should be fixed with DC/AC fan motor for better efficiency and should have the capability of modulating the speed with reference to the load. The unit should also be capable to deliver minimum 75 Pa external static pressure to meet long exhaust duct connection requirement.

In case of trouble occurs in an indoor unit(s), the continuous operation of system should be possible.

The outdoor unit shall be designed in such a way that cleaning of condenser coil should be easy & inspection/ replacement of compressor should be easy.

The condensing unit shall be designed to operate safely when connected to multiple fan coil units.

Mounting shall be done on duly painted GI stand made up of 50x50x6mm thick angle iron, which shall be provided without any additional cost.

The units shall be suitable for Refrigerant R-410A. Compressors

The compressor shall be highly efficient inverter based D.C Twin Rotary / Scroll type.

The system should respond efficiently in accordance to the variation in cooling or heating load requirement. The Compressor should be provided with intermediate back pressure mechanism to minimize operation loss due to refrigerant leakage, to ensure stable low-load operation.

ii. All outdoor units shall have multiple steps of capacity control to meet load fluctuation and indoor unit individual control. All parts of compressor shall be sufficiently lubricated stock. Forced lubrication may also be employed.

iii. Oil heaters shall be provided in the compressor casing or alternate oil heating arrangement needs to be provided as per manufacturer standard equipments.

Oil Recovery system

Unit shall be equipped with an oil recovery system to ensure stable operation with long refrigeration piping lengths. If required, the system must be provided with oil balancing Circuit to avoid poor lubrication.

Refrigerant Circuit

The refrigerant circuit shall include liquid and gas shut-off valves and a solenoid valves at condenser end. The equipment must have inbuilt refrigerant stabilization control for proper refrigerant distribution. All necessary safety devices shall be provided to ensure the safe operation of the system.

Heat Exchanger

The heat exchanger shall be constructed with copper tubes mechanically bonded to Aluminum fins to form a cross fin coil. The aluminum fins shall be covered by ant-corrosion resin film. The unit shall be provided with necessary number of direct driven low noise level propeller type fans arranged for vertical discharge. Each fan shall have a safety guard.

Safety Devices

All necessary safety devices shall be provided to ensure safe operation of the system.

Whatever safety devices are required shall be part of outdoor unit:- high pressure switch, fan drive overload protector, over load relay, overload & Over voltage protection having inverter based technology & digital based technology.

The outdoor roof mounted units shall be provided in such a fashion that these do not affect the overall aesthetics and ambience of the building. If required these units shall be suitably camouflaged to give good aesthetic look.

INDOOR UNITS

All indoor units as specified shall have, in general at the highest operating level, noise Levels less than 46 db. For critical applications noise levels below these limits may, however, be specified during design stage.

- i. Each unit shall have electronic control valve to control refrigerant flow rate respond to load variation of the room.
- ii. The address of the indoor unit shall be set automatically or through central controller in case of individual and group control system. The fan shall be direct driven type, mounted directly on motor shaft having support from housing. The fan shall be dual suction, Aerodynamically designed turbo, multi blade type, statically & dynamically balanced to ensure low noise and vibration free operation of the system.
- iii. The cooling coil shall be made out of seamless copper tubes and having continuous aluminum fins. The fins shall be spaced by collars forming an integral part. The tubes shall be staggered in the direction of airflow. The tubes shall be hydraulically / mechanically expanded for minimum thermal contact resistance with fins. Each coil shall be factory tested at 21 kg/sq.m air pressure under water.
- iv. Indoor unit shall have cleanable type filter fixed to an integrally moulded / moulded plastic frame. The filter shall be slide in and neatly insertable type. It shall be possible to clean the Filter either with compressed air or water.
- v. Each unit shall have Electronic control expansion valve for variable refrigerant Flow effect.
- vi. Each indoor high unit shall be with corded/cordless LCD type remote controller as per requirement. The remote controller shall memorize the latest malfunction code for easy maintenance. The controller shall have self-diagnostic features for easy and quick maintenance and service. The controller shall be able to change fan speed and angle of swing flap individually as per requirement.
- vii. $\pm 5\%$ variation in indoor capacity of cassette/Hi Wall is acceptable subject to the Manufacture standard.

Suitable drain pan and drain arrangement shall be part of all IDUs.

Each type of unit shall be supplied complete with Air distribution panel whether specified or Not.

The panel shall have removable return air core for cleaning air filter and maintaining motor etc.

Indoor Control Unit shall have Cordless Type controllers.

The drain pan of the units shall have an antibacterial treatment that uses silver ions and prevents the growth of slime, mould and bacteria that causes blockage and odours.

Unit must be insulated with sound absorbing thermal insulation material, Polyurethane foam.

The units shall have air filters, which has anti mould and anti-bacterial treatment that prevents the growth of mould generated from dust or moisture that may adhere to filter. Unit shall have variable air volume function which will automatically adjust the fan speed based on load condition. The controller shall be able to change angle of swing flap individually as per requirement.

All the indoor units regardless of their difference in capacity should have same decorative panel size for harmonious aesthetic point of view. It should have provision of connecting branch duct.

16 CEILING MOUNTED CASSETTE TYPE UNIT (Indoor Unit) :-

The cassette unit shall be ceiling mounted.

The units include pre-filter, fan section and DX coil section. The housing of units shall be lightweight powder coated galvanized steel. Units shall have external casing of ABS Plastic for supply and return air. The body shall be light in weight and shall be able to suspend from four corners. Unit shall have an external attractive panel for supply and return air which should be treated with a dirt repellent coating. Unit shall have round way supply air grilles on sides and return air grille in center.

i) 4 Way Cassette type indoor units:

- (a) These units shall be installed between the bottom of finished slab & top of false ceiling.
- (b) Unit shall have provision of connecting fresh air without any special chamber & without increasing the total height of the unit (320 mm maximum).
- (c) The unit must have in built drain pump, suitable for vertical lift of 750 mm.
- (d) Unit must be insulated with sound absorbing thermal insulation material, Polyurethane Foam. The sound pressure level of unit at the highest operating level shall not exceed 46 dB (A).
- (e) The unit must have drain pump kit if. The drain pump must be suitable to lift drain up to 1000 mm from the bottom of the unit.

ii) 4 Way Compact Cassette type indoor units.

- (a) The compact cassette unit should perfectly fit into ceilings and match the standard architectural modules, without the need to cut ceiling tiles.
- (b) The flaps fold tightly against the ceiling when operation stops so that the ceiling is affected only slightly even if air conditioning is installed.
- (c) Designed for simple & easy installation and maintenance. It should be slim in design only 268 mm in height even when an electrical box is located inside the unit.
- d) The unit must have drain pump kit if. The drain pump must be suitable to lift drain up to 1000 mm from the bottom of the unit.

17 HIGH WALL MOUNTED UNITS (Indoor Unit) :-

The units shall be wall-mounted type. The unit includes pre filter, fan section & DX coil section. Wall mounted units must be compact & stylish design that does not detract from the Décor of the room. The housing of unit shall be light weight powder coated galvanized steel.

- (b) Each indoor unit must have electronic expansion valve operated by microprocessor thermostat based temperature control to deliver cooling/ heating as per the heat load of the room.
- (c) The unit must have provision of adding drain pump kit if required and same shall be provided. The drain pump must be suitable to lift drain up to 1000 mm from the bottom of the unit. The drain pan and air filter of the unit should be kept clean by mould proof polystyrene.
- (d) The sound pressure level of unit at the highest operating level shall not exceed 46 dB(A).
- (e) Refrigerant control in the indoor unit shall be through Electronic Expansion Valve.

18 Concealed duct type units

- (a) These units shall be ceiling suspended with suitable supports to take care of operating weight of the unit, without causing any excessive vibration & noise.
- (b) The cold air supplied by these units will be supplied to the area to be air conditioned, through duct system specified in the tender.
- (c) Each indoor unit must have electronic expansion valve operated by microprocessor thermostat based temperature control to deliver cooling/ heating as per the heat load of the room.
- (d) The Sound Pressure level of unit at the highest operating level shall not exceed 38 dB(A), at a vertical distance of 1.5 m below the units with duct connected to unit.

The unit must have provision of adding drain pump kit & shall be provided as per requirement. The drain pump must be suitable to lift drain up to 1000 mm from the bottom of the unit.

Installation:

- (a) The units shall be mounted on ribbed rubber pads for vibration isolation. The contractor shall supply the required charge of refrigerant, lubricant and other consumables, for commissioning and testing of the equipment.
- (b) All the equipment shall be thoroughly tested and checked for leaks. All safety controls shall be suitably set and a record of all settings shall be furnished to the project supervisor.
- (c) Providing and fixing GI structural support for condensing unit with vibration isolator pad in-between support and structure and vibration isolation suspender and pads for evaporating units shall be in scope of contractor.

19 Refnet Joints / Header Joints

Design, Supply & installation of the V-Joint/ Refnet separation refrigeration pipe joints and headers in the appropriate orientation to enable correct distribution of refrigerant. The Distribution Joints should be Duly insulated with pre-formed sections of Expanded Polystyrene/Equivalent.

20 Refrigerant Piping

- (a) All refrigerant pipes and fittings shall be type 'L' hard drawn copper tubes and wrought copper fitting suitable for connection with silver solder. The copper thickness of wall shall be 20G/ 22G (0.7 to 1 mm).
- (b) All joints in copper piping shall be swaged joints using low temperature brazing and/ or silver solder. Before joining any copper pipe or fittings, its interior shall be thoroughly cleaned by passing a clean cloth via wire or cable through its entire length. The piping shall be continuously kept clean of dirt etc. while construction of the joints. Subsequently, it shall be thoroughly blown out using nitrogen.
- (c) Refrigerant lines shall be sized to limit pressure drop between evaporator and Condensing unit to less than 0.2 kg per Sq.cm.
- (d) After the refrigerant piping installation has been completed the refrigerant piping system shall be pressure tested using, Freon mixed with nitrogen at a pressure of 20 Kg per Sq. cm. (High side) and 10 Kg per Sq. cm (Low side). Pressure shall be maintained on the system for 24 hours.
- (e) The system shall then be evacuated to a minimum vacuum of 70 cm. of mercury and held for 24 hours, during which time; change in vacuum shall not exceed 12 cm of mercury.
- (f) All refrigerant piping shall be installed strictly as per the instructions and recommendations of air conditioning equipment manufacturers and shall include charging connections, suction line insulation and all other items normally forming part of proper refrigerant circuits except Y joint/separation tubes.

i. Refrigerant piping for the air-conditioning system shall be upto 19.1 mm dia of soft seamless copper tubes & for above 19.1 mm dia the pipe material shall be of hard seamless copper tubes with pipes material being hard drawn copper pipe

ii. Before jointing any copper pipe or fittings, its internals shall be thoroughly cleaned by passing a clean cloth via wire or cable through its entire length. The piping shall be continuously kept clean of dirt etc. while constructing the joints. Subsequently it shall be thoroughly blown out using nitrogen gas.

The supplier of air-conditioning system shall choose sizes as designed and erect proper interconnections of the complete refrigerant circuit. The thickness of copper piping shall not be less than 20 SWG for pipes upto 19.1 mm, 18SWG for pipes between 19.1 mm to 31.9 mm and above 31.9mm shall be 16 SWG for larger dia as specified by OEM.

iii. The suction line pipe size and the liquid line pipe sizes shall be selected according to the manufacturer's specified diameter. All refrigerant pipes shall be properly supported and anchored to the building/ structure using steel hangers, G.I. trays, fasteners, brackets and supports which shall be fixed to the building/ structure by means of inserts or expansion shields or anchor fasteners of adequate size and number to support the load imposed thereon.

iv. The refrigerant piping should be laid in such a way that it should not distort the interior of the room as well as exterior elevation of the building, wherever the refrigerant pipe has to be laid across the room, it should be laid in a concealed manner by making appropriate boxing arrangement matching with the interior of the room. All associated minor Civil Engineering works (like chasing on wall, ceiling & replastering & repainting etc.) related with the above

Items are included in the scope of work.

v. To protect Nitrile rubber insulation of outdoor installed copper piping from degradation due to ultra violet rays and atmospheric condition, it shall be covered with polished coating of at least two coats of resin and hardener (poly bond make or equivalent). Fiber glass tape shall be helically wound with adequate overlap & coated with two coats of resin with hardener to give smooth & plain finish.

vi. Entire liquid and suction refrigerant pipe lines including all fittings, valves and strainer bodies, etc. shall be insulated with 19mm/ 13mm thick electrometric nitrile rubber.

The joints shall be properly sealed with synthetic glue to ensure proper bonding of the ends.

21. Drain Piping duly insulated

The drain pipe connection of each fan coil unit to the main header should be should be minimum 25 mm dia / 32 mm dia as required or as per OEM design as required. The header pipe should be of 40 mmdia/32 mm dia as required. The drain-pipe should be heavy CPVC pipe ISI marked and conforming to relevant to IS: 4985 - Class I complete with fitting as required whereas the connection of the fan coil unit to the rigid PVC (heavy gauge ISI marked) pipe should be with flexible braided pipe. The drain piping should be insulated with 6 / 9 mm thick tubular nitrile rubber insulation having K valve 0.037 W/mk at a mean temperature of 200 C at min. density of 55 kg./m³. The joint shall be properly sealed with synthetic glue or solvent cementing as per manufacturer recommendation to ensure proper bonding of the ends.

For proper drainage of condensate U trap shall be provided in the drain piping, wherever required. All pipe supports shall be prefabricated and pre-painted slotted angle supports, properly installed with clamps. The condensate drain pipe arrangement for disposal of condensate water be made in such a way that there should not be any leakages of condensate water inside rooms as well in the route of drain water pipe line & water should be discharged at the proper location. All associated Civil Engineering works as per requirement at site in above connection like making chase in the wall & restoring it original shape by re-plastering & repainting, etc. are included in the scope of work. The arrangement of drain-pipe shall be made in such a way that it should not affect the aesthetic of the building as well as is maintenance friendly & easily accessible.

22. Air Handling Unit

The AHU shall be ceiling suspended/ floor mounted, double skin construction type considering of blower section, cooling coil section, filter section and insulated drain pan.

The capacity of cooling coil, air quantity from blower, and static pressure shall be as per Calculation done by designer and approved by Engineer in Charge. The coil shall be designed for face velocity of 155 m/min.

The double skin panel shall be 25 mm thick consisting of pre coated G.I casing of thickness 0.8 mm outside layer and plain G.I. casing of thickness 0.8 mm inside layer with 25 mm thick CFC free polyurethane foam PUF insulation with thermal break profile, having density 40kg/cum factory injected by injection moulding machine.

The cooling coil shall be made of copper with minimum thickness of 0.5mm and aluminum fins shall be 0.15 mm minimum thick with minimum no. of fins 4.7/cm length of coil. For coastal area like

5. Mumbai fins shall be phenolic coated.
6. The coil shall be 4 or 6 row deep for normal recirculated application
7. Water coil shall be capable of holding maximum pressure of 10 kg per sq. cm.
8. The blower shall be AMCA certified.
9. The fan impeller shall be statically and dynamically balanced.
10. The fan housing shall be made of G.I sheet and impeller shall be fabricated from heavy gauge sheet steel.
11. The fan motor shall be IP55 TEFC IE2 rated suitable for 415+-10% V, 50 Hz, 3phase AC supply and have VFD of suitable rating.
12. Drain pan shall be made of 2 mm stainless steel sheet externally insulated with proper insulation.
13. Filter shall be as per the specification laid down in Air Filter section.

23. VARIABLE FREQUENCY DRIVES FOR AHU's

The VFD shall convert 380 – 440 V, 3 phase, 50 Hertz utility power supply to an adjustable output voltage and frequency. The voltage to frequency ratio shall be suitable for fan control.

The VFD shall work in conjunction with any I.E.C. standard design motor and shall not require the motor to be derated or cause the motor temperature to rise above the class 'B' rise expected on normal mains operation.

The VFD shall be capable of controlling parallel motors of mixed ratings and allow disconnection of any machine while running without causing tripping. The VFD shall be capable of running with no motor connected for service functions.

The VFD shall be fully tested at the manufacturer's works. The test certificates shall be submitted.

5 The VFD shall be of sufficient capacity to provide a quality wave form so as to achieve full output of the motor, without causing additional heat rise. The VFD shall have following features:

Efficiency @ 100% load - above 96% @
20% load - 92%

- b) Rated input voltage 380V ± 10%, 3 phase, 48-62 Hz + 1%
- c) Working ambient temperature range – 10C to +40C, humidity to 95% RH.
- e) Output voltage range 0 to full mains input voltage, 3 phase even at (-) 10% of full mains voltage input.
- f) Connection of oversized motors within the current rating of the VFD shall be allowed.

- g) Output torque shall be limited to 1.05 x F.L.T. to prevent damage to connected plant.
- h) The VFD shall accept 3 analog inputs of either 0-10V; 4-20 mA as well as resistive inputs as a control signal.
- i) The VFD shall provide two output relays to provide signals including – ready, run, tripped and be programmable for other selected information. Two analogue outputs of 4/20 mA or 24 V.D.C. shall be programmable to transmit speed or 25 other parameters to the B.M.S.

The VFD shall log and display “Kwhr’s consumed” and “Hours Run” by the motor without additional instrumentation.

- j) The VFD module shall be CE marked.

24. Filters for Air Handling Unit and Fresh air intakes

A set of filter shall be supplied with each air handling unit.

The filter shall be washable constructed out of preformed pleated extended surface type deep non-woven blend of cotton and polyester fibers supported with aluminum mesh at downstream side and finished with HDPE mesh at upstream side.

The average efficiency of filter shall be 35-40% based onASHRAE 52-76 for MERV 8 & MERV13 filters as per 52.2 and arrestance for The MERV 8 filter with eff. 90%down to 10 microns with pressure drop of 4-12 m and MERV 13 filter with efficiency 80% down to 5 microns andpressure drop of 6-25 mm.

Filter shall be capable of operating to maximum of 500 fpm air velocity without impairingefficiency.

5. Dust Holding Capacity: shall not be less than 375 gm/sq m.

Media shall be treated with Antimicrobial agents so as to protect the media from microbial growth. Media shall be in “Engineered Gradient Structure” (Progressive Density Structure). Filters shall be UL certified.

25. INSULATION

The insulation of water piping, air handling units, ducting, chillers etc. and acoustic treatment of AHU enclosures, plant room, etc. as applicable, shall be carried out as per specifications given under:

Materials

The materials to be used for insulation shall be as follows, unless some other material is specifically mentioned elsewhere.

Table 1.1

Sr no.	Application	Material	Density (Kg/M3)	'K' Value (W/MK)
1	Duct Thermal insulation	Elastomeric closed cell Nitrile Rubber	40-55 Kg /M3	0.37°c
2	Acoustic insulation of duct, walls, ceiling etc.	Elastomeric open cell Nitrile Rubber.	140-180 Kg/m3	0.047kK
3	Double skin AHU's umps Expansion etc.	As per CPWD general specification for HVAC 2017		
4	Pipe supports	As per CPWD general specification for HVAC 2017		
5	Under Deck Insulation	Elastomeric closed cell Nitrile Rubber	40-55Kg/M3	40-55Kg/M3

The thickness of thermal insulation for duct shall be minimum 19 mm for duct running in Non-AC areas and minimum 9 mm for duct running in AC areas with aluminium foil of minimum thickness 60 microns.

The thickness of acoustic insulation for duct shall be minimum 15 mm and for AHU room minimum thickness shall be 25 mm.

The thickness of underdeck insulation on the top floor ceiling shall be minimum 25 mm with aluminum foil of minimum thickness 60 microns.

26.SHEET METAL WORK

Duct Work

1. Duct work shall mean all ducts, casings, dampers, access doors, joints, stiffeners and hangers.
2. The ducts shall be Factory fabricated in BOX form as per SMACNA Standard from galvanized steel sheets conforming to IS: 277 (latest edition).Ducts flange joints shall be as per SMACNA standards. The L shape Factory fabricated duct shall not be used at site.
- 3.The thickness of sheet for fabrication of rectangular ductwork shall be as per CPWD general specification for HVAC 2017

Dampers

All duct dampers shall be opposed blade louver dampers of robust 16 G GSS construction and tight fitting.

Dampers shall be placed in ducts at every branch supply or return air duct connection for the proper volume control and balancing of the air distribution system.

All supply and return air ducts at AHU room crossings and at all floor crossings shall be provided with Motor operated Fire & smoke damper of at least 90 minutes rating as per UL555/1995 tested by CBRI.

4. Motor operated damper shall be linked with Fire detection/ Fire Management system.
5. CO2 sensor shall be provided in return air duct.

Supply and Return Air Diffusers

Rectangular Diffusers shall be extruded aluminium construction, square & rectangular diffusers with flush fixed pattern for different spaces.

Supply air diffusers shall be equipped with fixed air distribution grids, removable key operated volume control dampers, and anti-smudge rings as required in specific applications

Linear Diffuser shall be extruded aluminium construction with removable core, one or two way blow type.

Centralized Intelligent Touch Remote controlle Centralized

Intelligent Touch Remote controller

- 10.1 A multifunctional compact centralized controller shall be provided with the system.
- 10.2 The Graphic controller shall act as an advanced air conditioning management system

to given complete control of VRV air conditioning equipment. It shall have ease of use for the user through its touch screen. Icon display and colour LCD display.

10.3 It shall be able to control of various nos. of Indoor Units or the complete VRV system to be installed with the following functions:

10.3.1 Starting/stopping of air-conditioning as a zone or group of individual units.

10.3.2 Temperature setting for each Indoor units of zone.

10.3.3 Switching between temperature control modes, switching of the fan speed and direction of airflow, enabling/disabling of individual remote controller operation.

10.3.4 Monitoring of operation status such as operation mode & temperature setting of individual indoor units, maintenance information, and trouble shooting information.

Display of air conditioner operation history.

10.3.5 Daily management automation through yearly schedule function with possibility of varying schedules.

10.3.6 The controller shall have wide screen, user friendly colour LCD display which could be wired by a non polar 2 wire transmission cable to a distance of 1 km. away from the Indoor unit.

Mechanical ventilation

Mechanical ventilation shall be provided in the kitchen, toilets, canteen area, sub station area, pump room and required places as per design and decision of Engineer-in-charge.

Pressurization system

Pressurization system for Staircase and Lifts and required places as per design and decision of Engineer-in-charge.

27. VARIOUS SIZES PVC INSULATED COPPER CONDUCTOR WIRING CABLES

XLPE / PVC insulated multi stranded sheathed copper conductor wiring cable for working voltage upto& including 1100 Volts, ISI marked conforming to IS 694/1990 (Latest Version).

Wiring of installation shall be in conformity with IS 732/1989 (Latest Version), IS 4648/1968 (Latest Version).

28.RIGID PVC CONDUIT PIPE/ STEEL WIRE REINFORCED FLEXIBLE UPVC CONDUITPIPES

Laying conduit shall be in conformity with IS: 732/1989 (Latest Version), IS 4648/1968 (Latest Version).

Fitting for rigid non-metallic conduit shall conform to IS 3419/1989 (Latest Version) and accessories shall conform to relevant IS.

29.GENERAL

An assurance shall be uploaded on firm's letter head as below :-

“ In case of lowest, I shall submit an undertaking from the OEM regarding the following” :-

- i) Authorization Certificate
- ii) The OEM shall unconditionally support – technically throughout the execution of contract as wellas for maintenance for the useful life of the system.
- iii) OEM shall provide all the spares required for healthy functioning of the equipment for at least seven years from the date of supply of equipment.

30. Guarantee

i) The contractor shall guarantee the complete system to maintain the specified conditions under all conditions of ambience and internal loads subject to the condition that designed outside conditions & designed internal loads are not exceeded. Also the inlet/ outlet temperatures shall be guaranteed.

ii) All equipments shall be guaranteed for a period of 36 months from the date of taking over of the installation by the Department against unsatisfactory performance and or breakdown due to defective design, material, manufacture, workmanship or installation.

The equipment or component or any part thereof so found defective during the guarantee period shall be repaired or replaced free of cost to the satisfaction of the Engineer-in-Charge. In case it is felt by the department that undue delay is being caused by the contractor in doing this, the same will be got done by the department at the risk & cost of the contractor. The decision of Engineer-in-Charge in this regard shall be final.

Any leakage of refrigerant and/or oil due to defective design, manufacture, workmanship or installation during the guarantee period shall be made good by the contractor free of charge

Additional technical specifications of HVAC Work:

Specification:-The work shall be executed as per CPWD's general specification for Electrical Works, Part -I-2023, Part-II-2023 Heating, Ventilation & Air - Conditioning (HVAC) –2024 ,Part-IV-2013 for Sub-Station. Indian Standards amended upto date and as per direction of Engineer-in-Charge. The additional specifications are to be read with above and in case of any variations, specifications given along with the tender shall apply.

Power Supply & HVAC Electrical

Stabilised three phase four wire AC supply i.e. 415 Volts \pm 10 % & 50 Hz \pm 5 % with double earthing shall be made available near AC Main Panel / Sub Panels or Starter Panel of Fans & AHUs etc.

Stabilised single phase power supply with earthing near each inline fan, propeller fan, Air Cooled Hi Wall Split Unit, Chilled water Hi Wall Split Unit, Fan Coil Unit etc or wherever as required by EPC Contractor.

Aircooled HiWall Split unit etc power cum control wiring shall be of copper.

Rubbermat 1000mm wide to withstand 1.1KV dielectric strength as per latest IS15652- 2006 shall be considered for main AC panel and starter/subpanel.

Building External Parameters

Building external thermal parameters shall be based on architectural drawings in compliance with ECBC 2017 draft issue. Actual to be worked out by EPC Contractor & to be shared with main consultant.

Exposed Wall U Factor - Asper "GREEN" rating system of GHAR

Partition Wall U Factor	-Asper "GREEN" rating system of
GHAR Floor/Ceiling U Factor	-Asper "GREEN" rating system of
GHAR Exposed Insulated Roof U Factor	-Asper "GREEN" rating system of
GHAR Exposed Glass U Factor	-Asper "GREEN" rating system of
GHAR Exposed Glass Solar Gain Factor	-Asper "GREEN" rating system of
GHAR	

Noise & Vibration Control

The EPC contractor must take all necessary precautions to have minimum noise generation and its transmission. Minimum vibration as permitted by IS relevant code shall be ensured. A few points for guidance only are given below. Refer the particular section in NBC/ISHRAE/ ASHRAE / CPWD guidelines for details.

Noise Criteria

It shall be recommended to maintain Noise Criteria or all the space. eNC/NR level should as per NBC/ISHRAE/ASHRAE/CPWD guidelines.

Air Distribution

Ducting shall be made of GI sheet of suitable thickness and major quantity of duct shall be GSS factory fabricated ducting as per CPWD specification & complying with DSR/DAR2025. Bends, plenum, reducer etc shall be made from site/hand made ducts as per CPWD specification & complying with DSR/DAR 2025.

COMMERCIAL AND ADDITIONAL CONDITIONS FOR HVAC

Data Manual and Drawings to be furnished by the tenderers:

The successful tenderer should furnish well in advance three copies of detailed instructions and manuals of manufacturers for all items of equipments regarding installation, adjustments operation and maintenance i/ c preventive maintenance & trouble shooting together with all the relevant data sheets, spare parts catalogue and workshop procedure for repairs, assembly and adjustment etc. all in triplicate.

The Contractor shall preserve the copies of invoices, test certificates; gate passes etc. to prove the genuineness of material/purchases. The responsibility of procurement, genuine material of specialized works shall rest with the contractor.

Additional conditions for HVAC Package

- **None of the equipment/ machines supplied shall be more than Six months old from date of supply at site,** In case of where as per NIT condition specialized agency is associated by main contractor as per agreement terms & conditions, all materials to be procured by associate specialized agency and all bills shall be in the name of associate agency in such cases.
- The entire work of manufacture/ fabrication, assembly and installation shall conform to sound engineering practice. The entire installation shall be such as to cause minimum transmission of noise and vibration to the building structure.
- The department also reserves the right to inspect the fabrication job at factory and the successful tenderer has to make arrangements for the same. The materials duly inspected by Engineer-in-Charge or his authorized representative shall be dispatched to site by the contractor. All expense & arrangements for inspection by department officials shall be borne by the agency & nothing extra shall be paid on this account.
- **Submission of programme:** Within fifteen days from the date of receipt of the letter of acceptance until otherwise mentioned in NIT, the successful tenderer shall submit his programme for submission of Design Calculation, drawings, Heat Load Calculation, Documents to be submit to Local Bodies, Air and water distribution layout and drawings, Selection of Equipment, supply of equipment, installation, testing, commissioning, getting approval from Local body. Any other activities as required in NIT and handing over of the installation to the Engineer-in-Charge. This programme shall be framed keeping in view the milestones stipulated in the contract, building progress. Items like ducting, piping etc. that directly affect the building progress shall be given priority.
- **Drawings for approval on award of the work-**The contractor shall prepare & submit three sets of hard copy & one Digital/ soft copy in AutoCAD format of following drawings (2D/3D) and get them approved from the Engineer-in-Charge before the start of the work. The approval of drawings however does not absolve the responsibility of contractor to supply the equipments/ materials as per agreement, if there is any contradiction between the approved drawings and agreement. In case of applicability of BIM modeling as per NIT then all drawings and data's shall be develop and extracted from BIM platform. Ducting drawings showing sizes, locations of dampers, grilles & diffusers. Plumbing drawings showing the layout of entire piping, dia & length of pipes, valves and isometric drawings showing

connections to various equipment. Electrical wiring diagrams for all electrical equipments and controls including the sizes and capacities of the various cables and equipments

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

Any leakage of refrigerant and/or oil due to defective design, manufacture, workmanship or installation during the guarantee period shall be made good by the contractor free of charge.

Annexure-1 (Electrical Items)

List of Electrical Materials at IIIT VADODARA

S.NO	Discription of Item
1	1.5 Sqmm Copper conductor pvc insulated Wire
2	4 Sqmm Copper conductor pvc insulated Wire
3	6 Sqmm Copper conductor pvc insulated Wire
4	10 Sqmm Copper conductor pvc insulated Wire
5	5/6 A Modular switch
6	15/16 A Modular switch
7	3 pin 5/6 A Modular socket outlet
8	6 pin 15/16 A Modular socket outlet
9	Telephone socket outlet
10	TV antenna socket outlet
11	blanking plate
12	Fan Regulator 2M
13	TV SOCKET
14	1 Module Plate With Frame
15	2 Module Plate With Frame
16	3 Module Plate With Frame
17	4 Module Plate With Frame
18	6 Module Plate With Frame
19	8 Module Plate With Frame
20	12 Module Plate With Frame
21	Twin Socket
22	Computer socket
23	Modular Switch 1 way
24	TPN MCB DB 8 way
25	TPN MCB DB 6 way
26	TPN MCB DB 12 way
27	Cable End Box TPN 12 way
28	25A DP MCB
29	32A DP MCB
30	32A FP MCB

31	40A DP MCB
32	40A FP MCB
33	63A FP MCB
34	10 A SP MCB
35	16 A SP MCB
36	25 A SPMCB
37	Fire Alarm Panel 10 LOOP
38	Fire Alarm Panel 2 LOOP
39	Smoke Detector
40	MCP
41	Hooter
42	Graphics Software
43	Telephone Jack
44	Speaker
45	Amplifier
46	Notifier Module
47	Fire Fighter Phone
48	16 Zone Voice Alarm Controller
49	Beam Detector
50	Response Indicator
51	RRL Hose Pipe 15 Meter
52	Landing Valve
53	Hose Reel Drum
54	Branch Pipe
55	2 Way
56	Hose Box
57	Fire man axe
58	Pressure Gauge
59	SS Hydrant Valve 63 mm
60	Dual Media filter
61	Activated carbon filter
62	softener for domestic water
63	Hyd system Pumpset for domestic water
64	Hyd system Pumpset for Irigation water
65	Hyd system Pumpset for Housing water
66	Domestic water Pump set
67	LCRHPN LCR HPN system(Model LCR 15/6)
68	LCRHPN LCR HPN system(Model LCR 15/4)
69	LCRHPN LCR HPN system(Model LCR 10/8)
70	LCRHPN LCR HPN system(Model LCR 10/4)
71	800A Straight Run feeder IP-54 Indoor & its accessories
72	1000A Straight Run feeder IP-54 Indoor & its accessories
73	1600A Straight Run feeder IP-66 Outdoor & its accessories
74	2500A Straight Run feeder IP-66 Outdoor & its accessories
75	Plug In /Tap off Box (32A/100A/125A/160A/200A/250A)
76	1 Incomer + 3 O/G = 4 VCB Panel LK make 11 kv
77	1 Incomer + 2 O/G = 3 VCB Panel LK make 11 kv

78	1 Incomer + 1 O/G = 2 VCB Panel -ICOG LK Make 11 kv
79	Dome Camera
80	NVR
81	Cat6 Cable
82	600mmx600mm recessed/ surface mounted Panel LED light fitting(36W)
83	LED recess/surface mounted light fitting (20W)
84	LED Batten light of 1200mm length (12W)
85	Surface mounted downlighter-10W
86	Recess mounted downlighter-10-12W
87	Surface mounted downlighter-12W
88	Surface mounted downlighter-20W
89	mirror light-12W
90	Bulkhead light-10W
91	PIR sensor
92	MS Pipe 100 mm
93	MS Pipe 80 mm
94	U.G. Alu Conductor XLPE Cable (3.5Cx300sqmm)
95	Raceway- Floor Trunking
96	Cable Tray i/c accessories
97	GI Duct of various sizes
98	Micro Cellular rubber sheet (9mm thick) (Assorted size)
99	KFlex Class O Closed Cell Alu Foil Nitrile Insulation Sheet (19mm&9mm) (Assorted size)
100	Omega Make 13 Passenger
101	Omega Make 16 Passenger
102	Omega Make 10 Passenger

Note: The above listed 102 Materials shall be issued by the department to the successful bidder as per available at Site IIIT, Dumad, Vadodara.

Preferred Make List (for E&M Services)

LIST OF PREFERRED MAKES FOR ELECTRICAL AND MECHANICAL PACKAGES

The contractor shall obtain prior approval from the Engineer-in-Charge before placing order for any specific material. The contractor shall make a detailed submittal with catalogues and highlighted proposed specification.

Wherever applicable, the Engineer-in-charge may approve any material equivalent to that specified in the tender subject to proof being produced by the Contractor for equivalence to his satisfaction

The Engineer-In-Charge shall verify that manufacturers must have valid IS Certification as on date for materials wherever applicable. The contractor has to comply PPP (MII) 2017, Make in India Policy.

The following brands shall be used if not otherwise mentioned in the items.

Sr. No.	Description of items/equipment's	Approved Makes
1	Modular Switches/ Sockets / Telephone socket / Data Socket (Rj45 socket / TV socket / Fan regulator / Modular Plate with base frame / GI switch box etc.	Legrand - Arteur / Schneider- Opala / L & T - Englaze / Honeywell - MK - Element / Panasonic – Vision (Other associated accessories / material will be same make to be used)
2	PVC / M.S. conduit (ISI marked) with accessories	Astral / Precision / AKG / BEC / Steel kraft
3	PVC insulated Copper conductor Wire	ISI marked: Finolex / Havells / RRRKabel / Polycab / Bonton/AKG
4	U.G. XLPE Armoured Cable	Duly ISI marked: Havells / Polycab / R RRKabel / Bonton / Kenter / Ravin/ AKG
5	MCB / MCB- DB/RCCB / Industrial socket and plug, Isolator, ELCBS / Loose wire box /SMDBs etc (Any one make shall be followed for Box/ DB's/MCB/ ELCB- RCCB etc.	Legrand / Lauritz Knudsen (LK) / Siemens / Schneider /ABB
6	MCCB (ICS=100% ICU at 415V) / Auto Changeover Switches.	Legrand / Lauritz Knudsen (LK) / Siemens / Schneider / Hager/ABB / C&S (Any one make shall be followed for all panels & DB's)
7	ACB	L&K (U power omega) / Schneider (NW) / Siemens (3W1) / ABB(Emax) /Legrand(DMX3)
8	Indicating Lamp (LED type) / Push Button / Selector switch / Toggle switch	L&K / RAAS Control / Schneider Electric /Vaishno / BCH / Siemens
9	Energy meter	Havells / L &K / Siemens / HPL / AE / T / Schneider Electric
10	Raceways- Pre galvanized / Hot dipped GI Under floor Trunking & Junction Box	OBO / Legrand / MK
11	Rising main, Bus duct, Tap off box, End feed unit - Sandwich	Legrand / LK / Schneider Electric / BCH
12	LED light fixture/ LED Street Light / LED Flood Light/LED Bulk Head Fitting/Led Lamp/Mirror Light etc.	Phillips / Lightning Technology / Trilux / Jaquar/Wipro
13	Aviation light	Philips / LT/ Trilux / Bajaj / Insta power / Spectrum / Crompton / Jaquar
14	Call Bell / Buzzer, Ceiling rose, Brass Holder (ISI Marked).	Anchor / Vinay Clair / Polo Rider / North West.

15	BLDC FAN, Exhaust FAN, Wall fan	Usha / Atomberg / Crompton/ Orient/ Havells/ Bajaj
16	G.I. Pole i/c Highmast Pole	Bajaj/ Crompton/ Philips/Wipro/ KP Green / Ambica / Valmont
17	DG set	Cummins India / KOEL- Kirloskar / Volvo penta / Caterpillar/Sterling Wilson / Mahindra Powerol / Cummins / Escorts
18	Alternator / Engine	Stamford/ ABB / Siemens / Kirloskar / Lorey somer / Kirloskar / Crompton / Mahindra /Perkin / Mitsubishi / Escorts / Cummins
19	AMF Panel	OEM / OEA of DG Set
20	HT VCB Panel	ABB / Siemens / Schneider Electric / L&K /Crompton
21	HT Meter	As per approved GSECL make – L&K/ Secure/ HPL
22	Current Transformer / Potential Transformer	AE / Kappa / L&K / Neptune
23	LT panel /MV Panel / APFC Panel and other Electrical Panels (CPRI Approved) as per IEC 61439 part- 1 & 2 Fabrication facility up to IP 54/55. 9 Tank Pre Treatment facilities for sheet. Equipped with latest CNC Bending machine, Powder Coating, Bus Bar Bending & Punching Machine and Compressor etc.	Lauritz Knudson / Schneider / SPC/ Siemens / ABB / Emco Switchgears Pvt Ltd / Adlec / BCH / Tricolite electrical industries Pvt. Ltd. / Pristine, Ghaziabad / Shiv Shakti, Ahmedabad / Abak, Navi Mumbai / ITE Gurgaon / Power Engg Pvt (I) Ltd
24	Power Transformer	ABB / Voltamp / Siemens / Schneider/ Crompton / Kirloskar / Power Engineering (I) Pvt Ltd / Power Star / Indian Transformers & Electricals Pvt Ltd, Gurgaon. / Western Transformer
25	Termination Kit	Raychem/ Densons /Biral3M / M-seal/ XICON
26	APFC Relay / Reactor / Thyristor Module / Contactors	L&K / ABB / Siemens /Schneider Electric / Neptune (Ducati)/Emerson / EPCOS/ Legrand
27	Cable Gland /Cable Lugs/ Thimble	Comet / Jainsons / Braco / Dowells
28	Cable Tray -Perforated hot dipped GI	OBO / MK / BEC / steelways / slotco / Rallison/Pilco
29	Rubber Mat	DURATUF/S P Rubber Industries or any conform to IS 15652:2006 Marked
30	UPS	APC (Schneider) / Legrand – Numeric / Mitsubishi / Tata Libert / Vertive Emerson / Automatic Allience (Pegasus) /Eaton /Techser Power Solutions Pvt Ltd / Labotek
31	Batteries (Lead Acid / maintenance Free)	Exide / Amaron / OKAYA /Luminous/Rocket / Tata Green / Amarraja
32	Centrifugal / Axial / Vane Axial / In-line fans and their fan motors	Kruger / Wadbros / Nicotra / Wolter / Ostberg with motor from their approved OEM
33	Lift	Kone / OTIS / Schneidler / Johnson / Omega / Mitsubishi
34	DWC Pipe / HDPE Pipe	Rex / Polymer / Gemini / Duraline / Aashirwad/ Natani/ Tirupati
35	Intelligent Addressable Main Fire Alarm Control Panel with Battery Backup / Repeater panel / Mimic Panel , Addressable Fire Detectors, Optical cum Thermal Detectors, Smoke Detectors, Thermal Detectors, Addressable Manual call Points, Monitor Module, Control Module, Fault isolator, Low Intensity Hooters	NOTIFIER / BOSCH / Siemens/ Edward / Honeywell/ Johnson Controls

36	PA System (Speakers, Amplifier, controller)	Bosch / Honeywell / Bose / Notifier / Notofire / Siemens
37	PC based Operator Console	Panasonic / Siemens / Avaya / Coral / Alcatel /Unify / Crystal
38	Personal Computer	Hewlett Packard / Lenovo / IBM / Dell
39	FBC, RRL Hose pipe, Butterfly valve, Hydrant valves, Fire Brigade Inlet, Hose Cabinet, First Aid Hose reel, Y-Strainer/etc. (ISI marked)	Padmini / New Age / Omex / Safe Guard / Life guard/Jayshree/Suprex/Getech/ Dunlop/AAAG / ArmorFire / FlameKlog
40	Fire survival armored cable	Polycab / RR Kabel / Finolex / Bonton/ Notofire / Havells
41	Pumps	Grundfos / Kirloskar / Mather & Platt / KSB / Crompton
42	Fire Extinguisher (Portable)	Cease Fire / Minimax / Omex / Fire Quip / Safety First / Safe Pro/Flame Klog / Kanex /Suprex
43	Flow switch	HD / Honeywell / Siemens / system sensor / Johnson Controls
44	Anchor Fastener	Fisher / Hilti / OBO/ Canon
45	Balancing Valve	Audco / Advance / Danfoss / Hammer / Oventrop
46	GI / MS Pipe	Duly ISI marked: TATA / Sail / Jindal (Hissar) / Zenith
47	Valves - Gate Valve/ NRV / Ball Valves / Check Valves / Sluice Valve	Leader / Zoloto / Kirloskar / Advance / Audco / Sant
48	Coupling Pump	Lovejoy / Dunlop / As per OEM
49	Pressure gauge	H-Guru / Metzger / Bestobell / Star Scientific / Fiebig/ Danfoss

50	Pressure Switches	Indfos / Danfoss / Honeywell / Johnson / Stefa
51	Differential Pressure Switches	Honeywell / Siemens / Johnson Control
52	Propeller fans	Usha / Marathon / Khaitan / ALSTOM (GEC Alsthom) / Havells / Almonard / Edgetech
53	EPBAX IP based Server with Licenses & Telephone instrument – IP & Digital	Siemens / Avaya / Unify / Cisco/Panasonic/ Coral / Alcatel
54	Analog Telephone instrument	Siemens /Unify / BEETEL/ PANASONIC/ /Cisco /Alcatel/ Coral /Avaya
55	Actuator for fire damper	Siemens / Honeywell / Edward/ Belimo / Anergy
56	VRF / VRV type Outdoor Units, Indoor Units, Y joints and fittings, Central and Remote controller etc.	DAIKIN / Mitsubishi / O-General / Toshiba/ Blue star/ Voltas / Carrier
57	Air Filters	THERMODYNE / PUROLATOR / ANFILCO / Camfil / Pyramid
58	Air Flow Switch	Omicron / Kele / Greystone
59	Air Handling Unit, Fan Coil unit	System Air / Zeco / EdgeTech / Carrier VTS / Trane / Blue Star / Voltas / Wave / Caryaire / Daikin / Nutech
60	Air washer, Air curtain, Dry Scrubber	System Air / Zeco Aircon / Edge Tech / VTS TF Air Systems / Wave/ TRION/ Espair / Russel / RO OTS AIR / BRIGHTFLOW / HUMIDIN
61	Control (VRF & VRV system)	As per OEM
i)	Room thermostat/ Temperature sensors	Honeywell/Johnsoncontrols/ Siemens / Steford
ii)	HP /LP cutout switch	As per manufacturers Recommendations
iii)	Oil Pressure safety switch	As per manufacturers Recommendations
iv)	Refrigerant solenoid valves	As per manufacturers Recommendations
v)	Expansion Valves	As per manufacturers Recommendations

vi)	Flow switch	As per manufacturers Recommendations
vii)	Non-return Valve for drain water line of Split AC	As per manufacturers Recommendations
62	PUF Pipe Support	Malanpur / Lloyd / Best Puf
64	GI Duct – Factory Fabricated	Zeco / Rollastar / Ductofab / Voltas / Wave / EdgeTech / Ecoduct
65	GI sheet	Duly ISI marked: TATA / Sail / JSW/ Uttam Galva
66	Grille/ Diffuser / Jet Nozzle	System Air / Caryaire / AirFlow / Conaire / Mapro/Dynacraft / Cosmos / Pineair
67	Volume Control Damper, Fresh / Exhaust air louver	Titus / Trox / System Air / Caryaire / Conair / Mapro / Airmaster / Dynacraft / Cosmos
68	Insulation – expanded polystyrene	Beardsell / UP-Twiga / Styrene packaging/PR Packaging
69	Insulation i/c PUF, Fibre Glass, rock wool, Phenolic Foam	UP-TWIGA / LLOYD INSULATION /Supreme Industries / Owens Corning / ARMAFLEX / Vidoflex / FGP
70	Insulation – Crossed linked	Torcellene / Thermobreak
71	Polyethylene- INSULATION	
72	Insulation -Nitrile Rubber	ARMAFLEX / Vidoflex / Eurobatex / Therma flex /A- Flex / K-Flex / Paramount
73	Miscellaneous (For VRF & VRV system)	
	i) Vibration Isolators	Resistoflex(P)Ltd /SuryaIndustry/ Emerald / Kanwal / Dunlop /Emerald
	ii) Flexible pipe connections	Resistoflex / Surya Industry / Finolex
74	Motorized Fire Damper	System Air / Caryaire / GreenHeck / Ruskin /Kruger / Belimo / Dynacraft
75	Motorized Valves (Butterfly, Modulating and Balancing etc)	Johnson Control / Honeywell / Siemens / Danfoss
76	Sensor (Duct Temperature, Duct Humidity, Immersion Temperature, Outside Air Temperature, Room Temperature, Room Humidity)	Honeywell / Schneider/ Edward/Siemens /Johnson Control
77	PID Control Valve with actuator, motor & thermostat	Danfoss / Siemens / Oventrop / Honeywell / Flowcon / Belimo / Johnson Control
78	Thermometer	H-Guru / Metzer / Bestobell / Star Scientific
79	Two in one auto cum balancing valves	Johnson Control / Danfoss / Flowcon / Anergy/ Belimo
80	Cat 6 Patch cord, Cat 6 LAN cable, Fibre Optic Cable, Fibre Patchcord	Legrand / Molex / Schneider/ R & M/ Commscope / Belden / Bonton /Notofire/ Polycab / AKG
81	CCTV Camera, Digital Video Storage, Recorders & Management Software	BOSCH / Honeywell / PELCO / Impulse / Panasonic/Sony

82	LAN Network Switch / Core switch /Distribution edge	Cisco/Juniper/HP/Legrand/ Extreme
83	Hard Disk	Seagate / WD / Toshiba
84	SFP Modual	Cisco / juniper/Netgear / Honeywell/ HP
85	LED Display Monitor	Samsung / Sony / LG / Panasonic
86	LIU	Cisco / Legrand / HP/ Juniper
87	Softening plant	As per OEM
88	STP - MBR tank, Filter press, and other equipments	Thermax / Ion exchange / Eureka Forbes / Texol/ Doshion/Kelvin
89	Telephone Cable / wire	Duly ISI marked: Finolex / Legrand / Polycab / Mollex / Bonton / Notofire /RR Kabel
90	Telephone Junction box & Module	ITL / Krone / MALSON
91	Telephone Tag box	ADC Krone / Legrand / Cisco / ITL / D Link
92	LV Rack	Valrack (Legrand) / Rittal / Cisco / Schneider
93	Water cooler and purifier (RO) with cooling Chiller	Blue star/ Eureka Forbes/ Ion-Exchange/ Aquaguard / Voltas
94	Hydro pneumatic Pump	Mather and Platt(Willo)/ Grundfoss/ DP/Lubi
95	Submersible type drinking water pumpsets	Mather & Platt (Wilo) / Grundfos / Kirloskar / KSB /Crompton /Greaves/Lubi
96	System Integration Unit	Honeywell (Trend) / Siemens / Johnson Control
97	Exit LED Signage board	Mr Lite/ Safex/ Ceasefire/Instapower / GloLine / ASES

Note:-

The above makes of materials are subject to the compliance of make in India norms. Make of the any other material not mentioned above shall got prior approval from the Engineer – in – charge before use at site.

