

Proposed Construction of Fire station cum Training & Classroom, Industrial Training Tower, Rescue Tower ,Change room & Visitor Gallery, B.A. Training Gallery and Simulation Building for Fire Training Institute at Bihta and other infrastructure including Parade Ground and Fire Hydrant facilities in the state of Bihar.

DESIGN BASIS REPORT FOR ELECTRICAL

1. INTRODUCTION:

The content of this document is to identify and record all the pertinent input requirements, analysis & design criteria for electrical aspect of all the buildings of Campus. It is aimed at formulating the basis of electrical aspects compatible with architectural design, functional requirement while confirming to the Indian Standards and other statutory norms to achieve safe, visually appealing but still economically feasible.

The EPC contractor shall carry out Entire Design, Engineering, Supply, Installation, Testing & Commissioning of complete Internal & External Electrification works including Extra Low Voltage System (ELV) and other works as required for smooth functioning of the proposed residential cum office buildings Fire Training Academy (FTA) At Bihta, Patna, Bihar, shall be designed and executed as per latest codes of practice for Electrical installations and meeting the requirements of Indian Electricity Rules/Act, applicable I.S. Codes/Rules and relevant I.S./CPWD Specifications, Special requirements of Electricity Board latest up to date.

All Electrical & LV works shall be designed and executed as per latest codes of practice for Electrical

Installations and meeting the requirements of Indian Electricity Rules/ Act, applicable I.S. Codes/

The rating and capacity of equipment indicated herein below are minimum to be provided. However, during detailed designing, if required and found necessary, the capacity/rating of the equipment may be upgraded. However, during detailed designing, if required and found necessary, the capacity/rating of the equipment may be upgraded by the Contractor. This project is a Fire Training Academy (FTA) at Bihta, Patna, Bihar.

- 1) All external electrical poles will be powered by solar power with backup provision of Electricity. Hybrid all in one Solar Street Light (3 days backup) along with suitable size of 6 Mtrs. Height octagonal Poles with base plate and shall have electrical backup provision.
- 2) The details mentioned in DBR and technical specification / conceptual drawings are indicative in nature.
- 3) The bidder/Contractor will ensure to complete the work and make functional as per NBC 2016, statutory requirements and good engineering practices etc.
- 4) The area statement given is indicative in nature. The works is to be completed as Fire Training Academy (FTA) at Bihta, Patna, Bihar.
- 5) As per approved concept design, drawings, scope of work, finishing schedule and Prevalent codes, NBC 2016, statutory requirement guidelines etc.

- 6) Bidder/Contractor is advised to do their own survey/exploration; nothing extra will be paid on deviation of soil report.
- 7) All drawings/ specifications / makes / shop drawings and construction methodologies are to be got approved from BSBCCCL or their Department as required prior to execution / procurement. However, it does not imply that bidder absolves themselves from code provisions/statutory requirements.
- 8) Entry point/exit point should have boom barriers with RFID facility as well as PVC speed breakers as required.
- 9) The scope of work also includes providing mock-up/sample of one each type i.e. Fire Training Academy (FTA) at Bihta, Patna, Bihar and other common areas including Pre-function Area, Receptions, Lift Lobbies, Terraces and Staircases. Sample work shall initiate immediately after erection of Ground floor roof slab.
- 10) All lifts to be fitted with CCTV Cameras.
- 11) Preparation of Detail design and drawings based on DBR.
- 12) Preparation of Shop drawings and its approval from BPBCC & from Proof checking Agency.
- 13) The EPC contractor shall bear the complete responsibility and cost for the surveys; Investigation studies; design development of the employers design/ performance criteria up to detail design level, Engineering (including all specialised engineering equipment mentioned in the contract or needed for the successful completion and handover of the project); Manufacture; Delivery; Construction; Erection and Installation; Testing, Commissioning, Handing Over and provision of required warranties of the entire facility.
- 14) The EPC contractor is expected to discharge his responsibility in conformity with the contract as per the tender documents and those documents specified therein to constitute the contract document and in conformity with all laws, regulations, acts, statutes, bye-laws, applicable to all aspects of the investigation, design, engineering, construction, manufacture, delivery and shall indemnify the owner against any claims or damages, fines, suits, legal or administrative actions/ strictures penalties, etc. Resulting from the neglect or inability or avoidance of the above said laws, regulations, statutes, etc.
- 15) It is re-emphasised that the employer expects the Contractor to comply with all Municipal regulations, environmental regulations and health and safety regulations and comply with all the requirements spelled out in this regard in the contract. Where there is a difference between the employer's requirements and regulatory requirements the more stringent provision shall prevail. It is assumed the Contractor has completed his due diligence on this prior to filling the tender and no change in cost shall be considered for this.
- 16) The EPC Contractor shall follow all best practices, codes, standards and adhere to specifications and shall meet or exceed performance requests as spelled out in this contract.
- 17) The EPC Contractor shall carry out the procurement of all the materials, equipment, installations, accessories as may be required for completion and installation & commissioning of work for the project.

- 18) The EPC Contractor shall undertake the construction of the project in accordance to Fire Training Academy (FTA) at Bihta, Patna, Bihar. The Employer approved Design Development Documents.
- 19) The scope of the execution work shall be in accordance with the design development documents, as prepared by the Contractor and approved by the Engineer's Representative, inclusive of, but not limited to, civil and structural works, architectural works, hard and soft landscaping works, signage works, all builders work associated with MEP, Fire Protection, Conveying Systems, Special Systems, and ELV Systems, and all associated works for the Project, as further described herein and as per the Works Requirements. The work is inclusive of all coordination with other Contractors and Departments working on the Project. Specific requirements are elaborated below.
- a) The scope of work is not exhaustive however; the contractor is required to execute all the items as per Scope of work, and Design basis reports (DBR) /specifications, Technical Specifications, Drawings etc. to make the buildings & complex fit for its intended purpose i.e. handing over for functional use as technical institute. The details mentioned in DBR and technical specification / conceptual drawings are to be followed. The bidder will ensure to complete the work and make functional as per BIS/NBC 2016 and other standards as mentioned.
 - b) The EPC contractor has to obtain all the statutory/ municipal and mandatory approvals, along with environmental approval/ NOCs, during the execution of electrical work and after the completion of work. The statutory fee for such approvals / clearances shall be borne by the EPC Contractor on behalf of Client directly to statutory authorities.
 - c) If any modification in Electrical and ELV System Design & Drawings due to change in Civil/Structural design/ drawing is needed as per site Conditions and/or change in Architectural Design and/or change in client's requirement, the agency shall do/ redo the electrical design drawings without any extra cost as well as suggest solutions to the problems coming across during actual execution. The decision of the Engineer-in-charge shall be final and binding. No claim whatsoever will be entertained in this regard.
 - d) All Elec. & ELV System drawings/specifications/make/shop drawings and construction Methodology etc. are to be got approved from BSBCCCL or their Department prior to Execution / procurement. However, it does not imply that bidder absolves themselves from code provisions/statutory requirements.
 - e) In case of any discrepancies between Specification due to DBR, Scope of Work, Technical Specification, CPWD Specification, IS Codes etc. Stringent of all will be applicable.
 - f) All the specialised work agencies as envisaged in CPWD manual and Departments needs to be fulfilling the similar eligibility criteria as per NIT condition for their contract value as mentioned in NIT for pre-qualification of bidder. All sub vendors/specialised agencies as mentioned have to be got approved from BSBCCCL/Client/BSBCCCL Department along with submission of documentary evidences on similar line as mentioned in NIT.
 - g) The materials, design 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 pacification those additional requirements shall also be satisfied.

- h) 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.
- i) All Electrical installations shall be of high quality, complete and duly operational including all necessary items and accessories whether root specified here in. All Electrical work shall be completed in accordance with the regulations and standard to the satisfaction the Engineer-in-charge.
- j) Scope of work covers planning, designing, supply, installation, testing and commissioning of all E&M services such as IEI, D.G. Set(125kva), Lifts, Access Control-boom barrier, Lightning Protection system, required to be provided in the said scheme as per norms of various IS codes / NBC 2016 / CPWD specifications, 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 of stand nothing extra shall be paid on this account.
- k) The scope of works also covers the preparation of layout plans, drawings for Electrical schemes and approval of the same from the respective local bodies before the commencement of work. During execution, if the local bodies etc. require a modification, the same shall be executed without any extra cost. Finally, after execution, approvals/NOC/clearances from local bodies etc. shall be the responsibility of successful bidder for which nothing extra is payable in case any modification / extra work is required. All statutory fees/charges required for obtaining clearances from Local Bodies shall be paid by the agency.
- l) Power supply required for construction shall have to be arranged by the bidder at his own cost I/O required for testing & commissioning .Water required for testing of equipment is also in the scope of agency.
- m) Suitable size shafts, cut-outs, Niche, openings etc. shall be provided to facilitate installation of Bus Duct, Cable Trays, and Ducts etc. in all floor slabs of various Buildings and Auditorium Building for various service areas, as required. All shafts, cut-outs, Niche, openings etc. provided on floor slabs shall be suitably closed after lying of services lines as per fire safety norms as per NBC 2016. Doors shall be provided for all shafts at all floors as per fire safety norms as per NBC 2016.
- n) All Services as required like electrical power, telephone points, LAN/Data points, UPS points, HVAC provisions, ducting etc. shall be adequately provided.
- o) The Electrical Load requirement has been calculated on the basis of built-up area of various segments of Proposed Fire Training Academy (FTA) At Bihta, Patna, Bihar, however the contractor shall calculate the load as per NBC 2016 & relevant guidelines and get it approved from engineer-in-charge and Department. Load for the Lifts, Pumps, External Lightning, STP, WTP etc. has also been taken in to account.

2. SCOPE OF CONCEPTUAL DESIGN OF ELECTRICAL SERVICES

SCOPE OF SERVICES:

Electrical & Allied Services' required for proposed Fire Training Academy (FTA) AT BIHTA, PATNA, BIHAR, covers one D.G Set Installation work, Internal Electrical Installations, HT/ LT Panels, Distribution Boards, External Electrical Installations, Road/Compound Lighting, Solar Lighting Poles, Internal & External Electrical Distribution work. Lighting Management System, Lifts (MRL Gearless Passenger lift having contract speed of 1.0 mps serving different floors in the lift shaft), Information Display (SINGNAGE) System etc. and audio video system (Integrated Presentation & Sound Reinforcement System) in Auditorium.

Suitable size shafts, cut-outs, Niche, openings etc. shall be provided to facilitate installation of, Cable Trays, Ducts, etc. in all floor slabs of various buildings for various service areas, as required. All shafts, cut-outs, Niche, openings etc. provided on floor slabs shall be suitably closed after laying of services lines as per fire safety norms as per NBC 2016. Doors shall be provided for all shafts at all floors as per fire safety norms as per NBC 2016.

All Services as required like electrical power, telephone points, UPS points, raw/soft/ hot water supply, drainage, plumbing, HVAC provisions, ducting etc. shall be adequately provided by the EPC Contractor as per OEM requirements for all Electrical Equipment etc.

The scope of works generally includes the following disciplines of the engineering & the following electrical portion of the aspects is to be covered in scope of this report:-

Sl. Code Description
No.

- i) Supply Company Sub-station Internal Layout and Space approval, Lessoning.
- ii) Load Sanctioning.
- iii) Electrical Inspector Approval & B.S.B.C.C.LTD. Approval
- iv) Special IT requirements
- v) Obtaining CFO NOC guidelines and approvals

3. CODES & STANDARDS:

The design engineering manufacturing and the installation shall be in accordance with established codes, sound engineering, practices, and specifications and shall conform to the statutory regulations applicable in the country. EPC Contractor shall obtain all approvals from statutory authorities' e.g. Electrical inspector, pollution control boards, concerned SEB as applicable before commissioning of electrical/DG sets, Elevators, Indian Electricity Act, Indian Electricity Rules, Factory Act, Pollution Control Act.

1. All electrical work shall be governed by CPWD Specifications for electrical works amended till date unless otherwise specifically mentioned separately.
2. IS-732: Code of practice for electrical wiring installation system voltage not exceeding 650V.
3. IS 3043: 1987 with latest amendments- Earthing.
4. IS-2309: Code of practice for the protection of buildings and allied structure against Lightning
5. IS-7689: Guide for control of undesirable static electricity.
6. IS-3716: Insulation co-ordination application guide.

7. IS-8130: Conductors for insulated electrical cables and flexible cords.
 8. IS-5831: PVC insulation and sheath of electric cables.
 9. IS-3975: Mild steel wire, strips & tapes for armoring cable.
 10. IS-3961: Current rating of cables
 11. IS-694: PVC insulated (heavy duty) electric cables for working. Voltage up to and including 1100volts.
 12. IS-424- 1475 (F-3): Power cable flexibility test.
 13. IEC-439/IS-7098: Specification for cross linked polyethylene insulated PVC sheathed cable for working voltage up to 1.1KV.
 14. IS-1554: PVC insulated cables up to 1100volts.
 15. IS-10810: Test procedures for cables.
 16. IS-6121: Cable glands.
 17. IS-10418: Cable drums.IEC-754(1): FRLS PVC insulated cable.
 18. ASTM-D-2863: Standard method for measuring minimum oxygen concentration to support candle like combustion of plastic (oxygen index).
 19. ASTM-D-2843: Standard test method for measuring the density of smoke from burning or decomposition.
 20. ASTM E-662/IEC 754(A).
 21. IS 2309: 1989 with latest amendments- Advance Lightning Protection System.
1. Specification, particular specification if any, and drawings. Indian regulations/codes and standards.

Note: The reference shall be made to the relevant codes and standards as applicable though it is not listed above In addition to above any additional code wherever applicable to be followed. In absence of Indian codes, international codes to be followed. In case of revisions in code, latest codes to be followed.

4. ELECTRICAL SERVICES:

This chapter describes from the very beginning of receiving of power to installation of equipment to Distribution of power in the entire premises with all electrical protection measures of the building.

5. LOAD CALCULATION:

5.1. ELECTRICALLOADS:

The Electrical loads for (FTA) at Bihta, Patna, Bihar has been worked out as per following norms/ guidelines:

- 1) Guidelines for Fire Training Academy (FTA) at Bihta, Patna, Bihar- Scale of amenities- Electrical Services.
- 2) National Building Code 2016
- 3) ECBC 2017
- 4) Following electrical loads shall be considered:.
 - a) FTA at Bihta, Patna, Bihar External Street lighting, boundary wall light and guard room electrical works.
 - b) Fire- fighting loads.
 - c) Water Supply
 - d) STP
 - e) Future load provision.
 - f) Any other electrical load required to make the complete campus functional.

- g) Loads to be considered for DG set rating:
- h) Essential load and few non-essential load of nonresidential buildings of FTA shall have D.G. Backup for Fire Training Academy (FTA) at Bihta, Patna, Bihar, (including Common area, lift lobby, lifts, , Parking, External Street lighting, boundary wall light and guard room lighting etc. shall have also DG support. (DG Support Essential load and few non-essential load shall be only for nonresidential buildings and 100% back up to Auditorium.)

The electrical Load has been calculated on an approximate area basis with following details of different buildingS

6.3 STANDARDS

Unless otherwise specified elsewhere in this Specification, the RMU, Switchboard (Switchgear), Load break isolators, Instrument Transformers and other associated accessories shall conform to the latest revisions and amendments thereof of the following standards.

Manufacturers not meeting these criteria shall be technically rejected.

6.9 INTERLOCKS

Interlocks shall be designed according to IEC 62 271-2

6.10 CABLE BUSHINGS

The units shall be fitted with the standardized bushings that comply with EN 50181 standards. All the bushings shall be at a height of min 700mm from the gland plate. All the cable bushings must be accessible from front only.

6.11 CABLE COMPARTMENT

All the cable compartments shall be air insulated suitable for dry type cable terminations. The cable boxes at each of the ring switches suitable for accepting HV cables of sizes 3C x 240 /as required and circuit breaker cable suitable up to 3C x 240 sq.mm/as required . Necessary Right-angle cable-T-connector shall be supplied by the RMU manufacturer. The cable compartments shall be tested for internal arc fault for 25kA/1sec. All the cable compartments must be accessible from front only. Side and rear cable access shall not be accepted.

The cable compartment cover must be interlocked with the switch position in all the feeders. The cable compartment cover shall open only when the load break Switch / Disconnect or is in earth position. This ensures the complete safety of operator accessing the cables.

6.12 CABLE TESTING FACILITY

It shall be possible to test the cable without disconnecting them from the cable bushing. The access to the cable must be available only after earthing the respective feeder to ensure complete safety of the operators. To fulfill this feature the cable compartment covers shall be logically interlocked with the feeder earth switch.

6.13 CAPACITIVE VOLTAGE DETECTION SYSTEM

The RMU shall be equipped with a capacitive voltage detection system (CVD) for checking voltage on the cable. There should be a facility to check the synchronization of phases with the use of external device. It shall be possible for the each of the function of the RMU to be equipped with a permanent CVD as per IEC 61243-5 to indicate voltage on the cables.

6.14 FAULT PASSAGE INDICATORS (FPI):

These shall facilitate quick detection of faulty section of line. The fault indication may be based on monitoring fault current flow through the device. The unit should be self-contained requiring no auxiliary power supply. The FPI shall be integral part of RMU. 1 no load break switch per RMU shall be equipped with FPI. It shall be self-powered from a Lithium battery of a minimum lifetime of 10 years and should be functional even after the main incomer feeder has tripped. Battery life of the device shall have operation duty of at least 2000 hours flashing. It should be suitable to mount on cable of diameters: Phase Sensor: 30-45 mm, Earth Sensor: 80-105 mm with accuracy of 10% or 15%. It shall be of the suitable for sensing Phase fault load current from 200-800/1200A and Earth fault load current range from 10-100A or from 40-300A. FPI should onboard LED's for local light indication of R, Y, B, E fault and low battery.

Based on the timing and recurrence of fault (if any) the FPI shall distinguish by means of single blink or double blink. The maximum operating temperature shall not be less than 70° C. The FPI sensors shall be IP67 compliant and FPI shall be IP50 compliant to restrain operation of FPI due to inrush / switching current, delay of 40-500 ms shall be available. FPI should have a User configurable Momentary Fault Override function. The connection from the Current Sensors to the FPI unit shall be preferably be Plastic Optic fiber connectivity to provide high immunity to EMI /EMC which could affect the accuracy and /or performance of the FPI system in normal load or switching conditions.

The fault indication shall onboard potential free binary outputs that are user configurable via DIP Switch to follow the type of fault (SC/EF or both) to get connected to the FRTU/FRTU which shall itself forward the alarm to the control center according to its configuration. The Battery low condition monitoring of the FPI shall made available (if configured) to the binary output.

The Fault indication must have the following reset functionality.

- 230 VAC input ,50/60Hz. (to reset on restoration of Voltage in RMU)
- Auto reset based on time: 1h, 2h, 4h, 8hours.
- The Fault indication reset shall consist in stopping the local light indication flashing and resetting the Binary Output latched contact.

Manual reset, Function check & battery check shall be possible by pressing push button available at fascia. FPI shall include self-test feature and additional sensor cable test feature usable when it is on the line (powered or not). FPI and RMU shall be of the same make.

6.15 WIRING & TERMINALS:

The wiring should be of high standard and should be able to withstand the tropical weather conditions. All the wiring and terminals (including take off terminals wiring for future automation, DC, Control wiring), Spare terminals shall be provided by the contractor. The wiring cable must

be standard single-core non-sheathed, Core marking (ferrules), stripped with non-notching tools and fitted with end sleeves, marked in accordance with the circuit diagram with printed adhesive marking strips.

The wiring should be of high standard and should be able to withstand the tropical weather conditions. All wiring shall be provided with single core multi strand copper conductor wires with P.V.C insulation.

The wiring shall be carried out using multi-strand copper conductor super flexible PVC insulated wires of 650/1100V Grade for AC Power, DC Control and CT circuits. Suitable colored wires shall be used for CT phase identification and ferrules shall be provided at both ends of the wires for wire identification. Connections and terminal should be able to withstand vibrations. The terminal blocks should be screw type for controls and disconnecting link type terminals for CT leads.

Flexible wires shall be used for wiring of devices on moving parts such as swinging Panels (Switch Gear) or panel doors. Panel wiring shall be securely supported, neatly arranged readily accessible and connected to equipment terminals, terminal blocks and wiring gutters. The cables shall be uniformly bunched and tied by means of PVC belts and carried in a PVC carrying trough.

The position of PVC carrying trough and wires should not give any hindrance for fixing or removing relay casing, switches etc., Wire termination shall be made with solder less crimping type of tinned copper lugs. Core identification plastic ferrules marked to correspond with panel wiring diagram shall be fitted with both ends of each wire. Ferrules shall fit tightly on the wire when disconnected.

Wiring shall be done for all the contacts available in the relay and other equipment and brought out to the terminal blocks for spare contacts.

The wiring shall be in accordance to the wiring diagram for proper functioning of the connected equipment. Terminal blocks shall not be less than 650V grade and shall be piece-molded type with insulation barriers.

6.16 ACCESSORIES & SPARES:

The following spares and accessories shall be supplied along with the main equipment at free of costs. This shall not be included in the price schedule.

- 1) Charging lever for operating load break isolators & circuit breaker of each RMU
- 2) Any other spares & Tools, which are all essentially required at the time of emergency and routine maintenance.

Provision shall be made for padlocking the load break switches/ Circuit breaker, and the earthing switches in either open or closed position with lock & key.

6.17 TESTING OF EQUIPMENT & ACCESSORIES:

Provision for testing CTs, Relays, Breakers and Cables shall be made available. Procedure and schedule for Periodical & Annual testing's of equipment, relays, etc. shall be provided by the supplier.

6.18 TYPE TEST

The Bidder should, along with the Bid documents, submit copies of all Type test certificate of their make shape as confirming to relevant IEC of latest issue obtained from domestic / international test lab.

6.19 ACCEPTANCE AND ROUTINE TESTS

All acceptance and routine tests as stipulated in the latest IEC- shall be carried out by the supplier in the presence of Board's representative. The supplier shall give at least 7 days advance intimation to the Board to enable them to depute their representative for witnessing the tests. The costs incurred during inspection towards boarding, lodging, local conveyance / transport etc shall be borne by the Purchaser.

6.20 TECHNICAL SPECIFICATION FOR RMU

. Parameters for Switch Gear of DT and load break isolators

Type	: Metal enclosed
No of Phases	: 3
No. of poles	: 3
Rated voltage	: 36 KV
Operating voltage	: 33 KV(+10% to -20%)
Rated lightning impulse withstand voltage	: 170 KV
Rated power frequency withstand voltage	: 70 KV
Insulating gas	: SF6
Rated filling level for insulation	: ≤0.5 bar/As Per IEC.
Max. permissible site altitude at the above gas pressures	: ≤1000m
Rated short time current	: 25 KA.
Rated short time	: 3s
Rated peak withstand current	: 50 KA.
Operating mechanism: Circuit breaker with stored energy mechanism	
Rated current (Bus)	: 630 A
Rated current (breaker)	: 630 A
Circuit Breaker interrupter	: VCB
Rated frequency	: 50 Hz
Rated operating sequence	: O-3min-CO-3min-CO

Endurance class of **Three Position Disconnect or (Isolator)**

DISCONNECTING: mechanically	M0 / IEC 62271-102 / 1,000 times
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Endurance class of **Three Position Switch (Load break switch)**

LOAD BREAKING:
mechanically

M1 / IEC 62271-103 / 1,000 times

E3 / IEC 62271-103 / 100 times rated
load current
2.5 times rated short-circuit making
current I_{ma}

EARTHING :
short-circuit making current I_{ma} Endurance class

E2 / IEC 62271-102 / 2.5 times rated
of **Circuit breaker (VCB)**

Breaking :
mechanically without maintenance

M2 / IEC 62271-100 / 2,000 times
E2 / IEC 62271-100 / 2,000 times
rated normal current without maintenance
C2 / IEC 62271-100 / Very low
probability of restripes
S1 / IEC 62271-100 / for cable
systems

Rated no of operations of VCB at STC – up to 20 operations @ full STC of 25KA/3sec

- a) **Lighting Arrester** :-30 kV rated Voltage,36 Kv rated insulation class BIL 170 kV peak single phase 50 Hz, Gapless type station class, outdoor, lighting arrester along with surge counter and insulation base, (30KV,10KA Class II) with Strain Insulator.

7.4. EARTHING AND PROTECTIVE EARTHING

Copper earthing bus shall be provided. It shall be bolted/ welded to the frame work of each panel. The earth bus shall have sufficient cross time fault currents to earth without exceeding the allowable temperature rise. Suitable arrangement shall be provided at each end of the earth for bolting Owner's earthing conductors and earth bus shall run inside at the back of the panel for entire length. Facilities shall be provided for integral earthing of bus bars &feeder circuit.

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10. DG SET (1x 125 KVA):

GENERATOR BACKUP:

It is proposed to have 100% Generator backup provided for all users and common area loads which Comprises of the following:

- > HVAC System
- > Fire Fighting System
- > Water Pumping system
- > All lifts
- > All Essential Loads of Office Buildings.

12. LT DISTRIBUTION AND WIRING SYSTEM:

For LT Panels Bidder should be either an Original Equipment Manufacturer (OEM) or the bidder should attach an Authorization Letter from the OEM (Manufacturer) of Switch Gears, specific to this tender enquiry and addressed dept. All Electrical Items, Shop Drawings of LT. Panels shall be approved by Architect/Consultant.) Digital multifunction meters shall also be installed at various Main panels & distribution Panels, Plumbing Panel, Fire Pump Panel, Lifts Panel, & common area lighting + power panels to monitor, voltage, current & KWH Consumptions.

12.1. MAIN LT PANEL&AC UNITS PANEL, APFC PANEL, FIRE FIGHTING PANEL, MAIN LT PANEL OF AUDITORIUM, PLUMBING PANELS ETC.

All LT Panels of FTA Campus, having 800 A and above as incomer shall be TTA Panels and as per **IEC 61439-1 & 2** suitable for operation on 415V, 50Hz, 3 Ph. AC supply and fault level 50 KA. Degree of protection shall be IP42. Panel shall be fabricated out of 2 mm thick CRCA sheet steel in cubicle compartmented modular construction complete with supporting rigid structure, interconnections, aluminums bus bar strip. The panel manufacturer shall have a pre-painting 7-tank facility for sheet cleaning and should have a CPRI/ERDA approval for same rating panel for 50KA fault level and impulse withstand test for 8-12kV at 600-690V (For ACB- 12kV & MCCB 8 kV). For operator safety (TTA PANEL) IP2 X (touch proof) protection to be available even after opening the feeder compartment door. The compartmentalization to be achieved by using metal separators, use of PVC sheet / Hylem sheets shall not be allowed.

12.2. HYBRID APFC PANEL:-

Company Authorized System Instigator makes Hybrid APFC Panel of suitable for operation on 415V, 50Hz, 3 Ph. AC supply and fault level 50 KA with stage rating. The APFC Panel shall be fully type tested at an Independent Laboratory and shall comply with IEC 61439-1&2 and IEC 61921. The APFC Panel shall be IP31 type, weather, and dust and vermin proof suitable for humidity up to 95%. Average daily temperature: +35°C max, Ambient temperature: -5°C to 45°C, Maximum altitude: 2000m. The equipment shall be manufactured as directed by the Engineering-charge and Shop drawings from OEM shall be approved by Architect/Consultant. Automatically controlled power factor capacitors shall be installed at the Main LT Panel to maintain Power factor above 0.95. Capacitor banks shall automatically be brought in and out of the circuit in steps, according to load & PF variation with the help of a Dual sense APFC Relay

Real time Hybrid Automatic power factor control panels with ultra-heavy-duty capacitors, IGBT switched, harmonic filters (Active & Passive) are proposed to be provided in the substations to achieve overall power factor 0.8 (lagging) from existing Power Factor, with operation in both Auto and Manual mode. Power factor Correction Panel shall be BMS Compatible. The capacitor panels shall be provided in each substation to achieve THD less than 3%. Connection from Main LT Panel to Capacitor Panel is to be provided through suitable size PVC insulated XLPE aluminum armored cable. It should work on both Grid as well as DG Power. Hybrid APFC panel should be totally type tested as per IS 16636:2017, IEC 61921, IEC 61439.

Capacitors shall conform to IS: 13341-1992, 13340-1993. The capacitors shall be suitable for 433/440 volts, 3 phase, 50 Hz. Capacitors shall be suitable for indoor use up to ambient temperature of 50°C. Capacitors shall be hermetically sealed in sturdy corrosion proof, sheet steel containers and impregnated with non-inflammable synthetic liquid. The capacitors shall withstand voltage of 2500V (power frequency test voltage). The insulation resistance shall not be less than 50 mega ohm when tested with 500V mugger. To eliminate failures due to harmonics in the system, it is recommended to use de-tuned copper wound reactor filters with the capacitors. Capacitors shall

have a long life in excess of 150,000 hours with low losses in the range of 0.2 watt / KVAR.. The Hybrid APFC Panel shall have Thyroster Switching Module (TSM) with 7% detuned copper wound reactors along with Rasin filled cylindrical type capacitors of 480 V and Active harmonic filters as per current rating.

Relay shall be True RMS relay, Compact panel mounting type 144x144 mm DIN en-closure. Relay shall have built-in digital PF meter. Capacitor banks shall be installed at least 30CM away from the walls on suitable metal frame work of welded construction. The earth terminals provided on the body of capacitor bank shall be bonded to the main capacitor panel earth bus with 2 Nos. 8 SWG copper or 6 SWG GI earth wires. APFC relay shall be Micro-controller based intelligent with inbuilt harmonic filters to Work under high harmonic content loads with of 8 stages.

External Lighting Panel (IP-55) Out Door Feeder Pillars and all other LT panels (IP-42) of different office buildings, Meter Panel for residential buildings (Each residence must have smart energy meter (Smart KWH Meter) in meter panel located in ground floor etc, must have 2mm thick CRCA sheet and 3 mm thick gland plates.

13. ELECTRICAL POWER DISTRIBUTION: - (INTERNAL & EXTERNAL ELEC. WORKS)

The Electrical Power Distribution for electric supply shall be as detailed below.

Suitable size and required Runs of 3.5 core PVC insulated XLPE armoured aluminium cable should be provided from Transformer, DG Sets to Main LT Panel, Synchronizing Panel and Main LT Panels to HVAC Panel, firefighting panels, Pump motors panel, Capacitor Panel, Floor Panels, External lighting panels etc.

Adequate runs of XLPE insulated armoured Aluminium conductor cables shall be laid from Main LT Panel to Distribution Panels/ Meter Boards Distribution of individual floor for all blocks.

Auditorium must have LT Panel Rooms to accommodate all Panels (ELEC. &HVAC) in Ground Floor and Elec. Room in Each Floor of minimum size as mentioned in floor Plan. All Buildings (Office & Residence, Hostel, Guest houses etc) hostel should have one Elec. Panel Room in Gr. Fl. (minimum size-4 mtr x 3.5 mtr) to install LT Panel of said Building and to receive power from Main LT Panel of Sub- Station and in addition to that each floor should have at least one Electric Room. Each Building Main LT Pane will cater all floors distribution panels. (Floor Light & Power Panelised.).In addition to that buildings which have ups back must have one UPS room of size 10ftx12ft. One central Control room is also required to monitor centralized CCTV system, EPBEX System, Data Networking system. (Size of Room should not be less than 5mtr x 4mtr

All the LT Panels of must have multifunction meter with RS 485 port) and all incoming feeders of all LT Panels must have micro processor based ACB/MCCB & outgoing MCCBs of required capacities and numbers feeding the (double door) DBs etc. For the protection of equipment & feeders, switchgear shall be provided with required O/C ,S/C & E/F release. Selection of switchgear rating shall be made on the basis of load Current &fault withstands capacity.

VFD:-

All LT Panels which will cater Motors/HVAC system related motors /AHU /Chiller Pump motor/Ventilation fans/ Pressurization fans, Plumbing Pump Motors must have VFD protections.

For Neutral isolation, 4 Pole switch gears shall be provided in the incomer and outgoing of all the LT Panels & DBs. All final MCB distribution boards shall have 30mA sensitivity RCCB's as sub incomer along with F/P MCB as incomer (for all TPN Light and power MCB DB). All MCB's shall not be of less than 10KA fault withstand capacity & of C Series in the final DB's. (Lighting & Power DB). DB shall have 100% sized neutral bus bar & Earth Bus-Bar. All electrical equipment & not current carrying metallic parts shall be effectively earthed. From each floor panel to distribution board the wiring (Sub Main Wiring) shall be with FRLS PVC Copper Wire in recessed PVC Conduit as per CPWD norms.

Separate feeders from the Main LT Panel shall be provided for: (As per NBC)

- Firefighting pumps
- Lifts
- Plumbing pumps

Alternate / Standby / Duplicate feeders shall be provided for: (This is as per NBC)

- Firefighting pumps
- Lifts
- **Note:** These alternate feeders shall be from two different sections of the Bus / Power source through change over switch.
- Staircases & corridors lighting shall be on separate circuits & shall be operable from ground floor and shall be MCB DB controllable.

Surge Suppression

In order to handle switching surges & spikes, it is recommended to install a suitable surge

- Suppressor (TVSS) in the Main LT Panel, HVAC Panel, APFC Panel, Plumbing Panel, Fire Fighting Panel, Main Panel for auditorium, Administrative Block, LT Panels for Dispensary and all important LT Panels which have minimum 200 A as incomer. Automatic GAS flooding shall be provided in the HT Panel, Main LT Panel & DG/Emergency LT Panels

Harmonics Mitigation

With the increased use of HF electronic ballasts with the light fixtures, VFD's with motors, Dimmers for lighting controls, computers & UPS system for office automation, the electrical systems are encountering harmonics.

It is therefore, recommended to have:-

- a. 100% sized neutral in the all distribution panels meant for power supply to floors.
- b. 100% sized neutral in all L+P boards.

Construction Guidelines

- a. Following architectural provisions need to be made for easy and safe installation of electrical equipment's: **Electrical Rooms & Shaft Construction & Doors:** - All electrical rooms, substation rooms & shaft's construction and doors need to be provided as per fire ratings specified in NBC-2016.
- b. **Sealing Of Shafts & Cutouts:-** All sleeves & cutouts after passing of electrical services such as conduits, cables, cable trays & ELV cutouts etc. need to be 'Fire Safe Sealed' to prevent spread of fire between floors.

The power cabling shall be sized so that the distribution losses do not exceeds 3% of the total power uses in buildings. Voltage drop for feeders shall not exceed 2% at design load and for branch circuit; it shall not

Exceed 3% at design load. Meter Box & Energy Meters- Meter Box with energy meters (single/double source) shall be provided for each apartment unit with Dual source energy meter.

13.1. ELECTRICAL DISTRIBUTION:-

13.1.1. Power Intake

This concept report is based on the following assumptions:

- a) One /two number 33kV intake supply (Dual Feeder) for dedicated 33/ 11Kv outdoor Sub Station & 11/.433 KV indoor substation which will feed to all LT Panel, LT dual feeder.
 - b) For indoor sub Station 11kV intake supply.
- Normal voltage levels 415V, AC, 3-phase, 3-wire/240V, AC, 3-phase, 4-wire
Normal frequency range 50 Hz + 1% 415V – transformer neutral earthing: Solidly earthed neutral

The total load demand of the campus shall be met by substation planned outside in open.

- a) Indoor Substation shall have, all indoor high-voltage and low-voltage service equipment will be in dedicated locked rooms with separate areas provided for power and communication systems.
- b) Main LT Panel for non-residential buildings shall have dual energy metering for both DG and normal supply.
- c) Electrical space and clearances will be provided around and above electrical equipment, in as much as possible, no HVAC ducts or pipes will penetrate dedicated electrical, electronic or communication rooms.
- d) A numbering system will be set up by the project, based on the project tag numbering of components specified in general contract requirement so that all electrical equipment and circuits will be uniquely identified and labelled.
- e) All equipment will be sized and rated to deliver best performance within the environmental conditions of the site.

13.1.2. SUB-BOARD AND DISTRIBUTION BOARD:-

- a) Sandwich Type Bus Ducts shall be provided from Transformer to main LT Panel. Multi Run AL. AR. PVC XLPE Cable, from DG Set to Synchronizing Panel and to other panels. (AL. Cable)
- b) Sub-mains will be provided for mechanical equipment e.g. Chiller Plant, AHU, fans, fire equipment, and Plumbing System motor pumps panels. , Fire Fighting System Panels, feature equipment, lift machines & equipment etc.
- c) Separate Distribution boards will be provided for lighting and power distribution
- d) Cables shall be provided from main LT panel to end feed units for all sub main services, above 10Sq.mm shall be aluminium and including & below 10 Sq.mm. shall be FRLS PVC copper Wire.
- e) All life safety equipment's cabling shall be fire survival category viz. Fire Alarm System, Lift, Fire Pumps, Voice, Evacuation system, Security System, Emergency Lighting distribution system. For internal wiring up to 10 Sq. Mm shall FRLS PVC Copper wires and above that Al Ar. Cable run through wire mesh cable Tray.

13.1.3. Distribution Panels:-

Down line distribution LT Panels shall be manufactured through any authorized panel builder of approved switch gears companies with CPRI approval for over load and short circuit as per project demand. All distribution Panels must have multifunction meter for monitoring energy at every end, having LED display accuracy Class 1 as per IEC 62053-21, RS-485 port, Aux Supply: 44-277Vac/dc. Parameters: Volts, Amps, PF, THD, F, W, Wh, KWh, VA, VAh, Var, Varh, Runners,

On hrs. Interrupts, THD for V&I per phase, individual harmonics for V&I up to 15th level complying with IEC61557-12. Min/Max for eight parameters. .

13.1.4. PROTECTIVE DEVICES:

ACB, MCCB, RCCB, MCB, ELCB etc. of appropriate rating and at apt. location shall be provided to ensure safety of the end users of various electrical appliance and visitors in general. Illumination level shall be maintained as per mentioned in above sections to ensure safe working environment for all concerned. Electrical sign board and exit signs shall be provided at strategic locations, as per requirement. Entire (FTA) At Bihta, Patna, Bihar will have TPN Double Door Horizontal Essential & Non-Essential DB and accordingly there shall be Sub Distribution Panel in each Floor as Floor- wall mount Distribution Panel.

All Sub-Distribution Board (Floor Panels) for each floor shall be with meter box having modular multifunction meter having LED display accuracy Class 1 as per IEC 62053-21, RS-485 port, with S/S, indicators (RYB) and required value of 3 nos. CT.

- a) ACB of Out Door LT Panel: These shall be EDO type mechanism. The short circuit mechanism and breaking capacity as shall be supported by test certificate. The test certificates should be from CPRI / any Govt. approved recognized test house / laboratory.
- b) The circuit breaker shall be fitted with CT operated thermal overload and short circuit releases devices for suitable current rating.
 - a) Overload releases should be settable from 50% to 100% of the rated current I_n .
 - b) Ambient temperature compensated type and there should not be de-rating of ACB current Carrying capacity at 50°C. The testing of ACB for the temperature rise shall be carried out by the manufacturer as per the prevailing, IS / IEC or any other international standards.
 - c) ACB shall be provided with very sensitive overload and short circuit release. Short circuit release should have settable value as required with an adjustable times having setting range of 40 – 460 m seconds, to have a proper co-ordination with short circuit release of Outgoing MCCBs.
- 1) 3 phase, 4 wire, neutral earthed having link arrangement.
- 2) Rated current thermal current - as required
- 3) Service voltage - 415 volts
- 4) No. of break / pole - one
- 5) Frequency - 50 c / s
- 6) Rated insulation voltage - 1000 volts
- 7) Rated short circuit breaking capacity
Rated services S/C breaking capacity I_{cs} (rms) – 50kA
Rated ultimate S/C breaking capacity I_{cu} (rms) – 50kA
- 8) Break Time - less than 40ms
- 9) S/C making capacity 1cm (peak) - 105kA

- 10) Rated short time withstands current - I_{cw} 50kA for 1 sec.
- 11) Suitable for outdoor installation.
- 12) It shall conform to IS 13947 / pt.2 / 1993 with latest amendment, if any.
- 13) Performance category - Utilization category – B.
- 14) The status of open and close shall be clearly visible.
- 15) The trip indication separated for overload and individual phase wise trip indication for Short circuit to be provided.
- 16) The ACB shall have the provision to lock the operating mechanism in off position.
- 17) The operating mechanism should be form front and the compartment should have the Degree of protection IP – 54.
- 18) Separator shall be provided between all phases inside. ACB enclosed to prevent travel of arc during short circuit.
- 19) The CT's mounted for thermal overload release shall have secondary winding Inaccessible including tripping mechanism of O/L and magnetic releases to avoid tampering CT's should also have provision of separators.
- 20) Two nos. earthing bolts for propose of earthing of ACB may also be provided & suitable for G.I stay wire of size 7 / 10 SWG.
- 21) The bus bar size shall be confirming to relevant IS and the neutral bus bar shall be of same wire of size as phase bus bar and should be suitable for connecting neutral.
- 22) The ACB shall be tested in accordance with the provision of IS: 13947 – Part I or relevant IEC..

LT Panels:-

- a) Bus bar shall be of high conductivity aluminum (E91E) supported on insulators made of non-hygroscopic, non-inflammable material with tracking index equal to or more than that defined in BIS. The main bus bars shall have uniform current ratings throughout their length as specified in data sheet / job specification. The current rating of the neutral shall be half that of the phase bus bars. Removable neutral links shall be provided on feeders to permit isolation of the neutral bus bar.
- b) Only zinc passivity or cadmium plated high tensile strength steel bolts, nuts and double spring washers shall be used for all bus bar, joints and supports.
- c) The hot spot temperature of bus bars including joints at design ambient temperature shall not exceed 95°C for normal operating conditions. It must be recorded during type tests.
- d) The current rating of the bus bars shall be as required for design ambient temperature at site conditions and for being inside the cubicle at fully loaded condition. The vendor shall suitably de-rate the nominal rating to suit the above condition.
- e) Minimum clearance between live parts, between live parts / neutral to earth shall be 19mm. However clearances between terminals at components shall be as per applicable individual standard for components.

- f) Interconnections between the main bus bars and individual units shall be made using vertical / horizontal aluminum bus bars of adequate rating

Following points are to be taken care before placing the price of Main LT Panel Cum Synchronizing Panel, APFC Panel and External Lighting Panel :-

- i). Power Factor Improvement Capacitor Panel shall comprise of 433 volts, 3 phase, 50 Hz capacitor banks and associated switchgears.
- ii). Capacitors shall conform to IS: 13341-1992, 13340-1993. The capacitors shall be suitable for 433/440 volts, 3 phase, 50 Hz. Capacitors shall be suitable for indoor use up to ambient temperature of 50°C.
- iii). Capacitors shall be hermitically sealed in sturdy corrosion proof, sheet steel containers and impregnated with non-inflammable synthetic liquid. The capacitors shall withstand voltage of 2500V (power frequency test voltage). The insulation resistance shall not be less than 50 mega ohm when tested with 500V megger.
- iv). Main connections from the active element shall be brought out through porcelain bushing. Care shall be taken to solder the bushing to the cover to ensure perfect hermetic sealing. Capacitor units shall be provided with externally mounted discharge resistors to reduce the residual voltage to less than 50 volts in one minute of switching off
- (v). Individual unit shall be provided with adequate capacity of MCCBs, contactors (capacitor duty) bus bars and terminal chambers to make bank of required KVAR. Terminal chamber shall be suitable for bottom/top cable entry. Two earth terminals shall be provided to each capacitor bank
- vi). All routine and type tests as per IS: 2834 relevant to capacitor banks as amended up to date shall be carried out at manufacturer's works and test certificates shall be furnished to the department
- vii). Capacitor banks shall be installed at least 30CM away from the walls on suitable metal frame work of welded construction. The earth terminals provided on the body of capacitor bank shall be bonded to the main capacitor panel earth bus with 2 Nos. 8 SWG copper or 6 SWG GI earth wires.
- viii). Insulation resistance with 1000V DC Megger shall be carried out test results recorded.
- ix). APFC relay shall be Micro-controller based intelligent with inbuilt harmonic filters to Work under high harmonic content loads with of 8 stages. Relay shall be True RMS relay, Compact panel mounting type 144 X 144 mm DIN enclosure. Relay shall have built-in digital PF meter

Technical Features:

1. A micro controller & RISC processor.
2. Intelligent switching operation, fast response, high break relays
3. Polarity reversal indication.
4. Phase wise dynamically reactive compensation.
5. Operating power factor 0.6 – 0.99Lag.

7.0 Earthing.

- g) Earthing arrangement shall be provided for earthing each cable, PVC cable gland, neutral bus bar, chassis and frame work of the cubicle with separate earthing terminals at two ends. The main earthing terminals shall be suitably marked. The earthing terminals shall be of adequate size, protected against corrosion, and readily accessible. These shall be identified by means of sign marked in a legible manner on or adjacent to terminals
- h) Neutral bus bar strip shall be connected to Earthing terminal with help of GI strip of suitable capacity & nut-bolt arrangement.

The sequence of routine testing shall be as follows:

- i). Visual and dimension check for completely assembled transformer
- Measurements of voltage ratio
- Measurements of winding resistance at principal tap and two extreme taps
- ii). Vector Group and polarity test
- iii). Measurements of insulation resistance*
- iv). Separate sources voltage withstand test.
- v). Measurement of iron losses and exciting current at rated frequency and 90%, 100% and 110% rated voltage
- vi). Induced voltage withstand test.
- vii). Load losses measurement at 50 % & 100 % of load.
- viii). Impedance measurement of principal tap (HV and LV) of the transformer.
- ix). Routine test of tanks
- x). Induced voltage withstand test (to be repeated if type tests are conducted).
- xi). Measurement of Iron loss (to be repeated if type test is conducted).
- xii). Measurement of capacitance and Tan Delta for Tr. winding and for transformer oil.
- xiii). Ratio of CT
- xiv). Oil leakage test on completely assembled transformer
- xv). Magnetic balance test
- xvi). Power frequency voltage withstand test on all auxiliary circuits
- xvii). Certification of all test results.
- xviii). Temperature Rise Test #
- xix). Dissolved gas analysis
- xx). Calibration of temperature indicators and relays.
- a) *Insulation resistance measurement shall be carried out at 5kV for HV and 1kV for LV.

Value of IR should not be less than 1000 M Ohms. Polarization Index (PI

=IR10min/IR1min) should not be less than 1.5 (If one minute IR value is above 5000Mohms and it is not being possible to obtain an accurate 10 minutes reading, in such cases Polarization index can be disregarded as a measure of winding condition.)

b)#Temperature rise test may be necessary to be carried one unit/lot. Purchaser's engineer, will at its discretion, select transformer for temp. rise test from any lot offered for inspection at manufacturer's works and witness the same for comparison with ERDA/CPRI type test results.

a) All MS. sheet steel used in the construction of Distribution boards shall be 2mm thick and shall be folded and braced as necessary to provide a rigid support for all components. Sheet steel shrouds and partitions shall be of minimum 2 mm thickness. Joints of any kind in sheet steel shall be seam welded, all welding slag grounded off and welding pits wiped smooth with plumber metal. The height of the panels should not be more than 2200 mm. The operating levels shall not be more than 1800 mm. The operating level of the lower most cubicle shall not be less than 450 mm.

b) The Panels / Distribution boards shall be totally enclosed, completely dust and vermin proof. Synthetic rubber gaskets (neoprene/DPDM) between all adjacent units and beneath all covers shall be provided to render the joints dust proof. All doors and covers shall be fully gasketed and shall be lockable. Doors shall have concealed hinges. All the doors shall be suitably reinforced by channel to provide rigidity.

c) All panels and covers shall be properly fitted and secured with the frame, and holes in the panel correctly positioned. Fixing screws shall enter into holes tapped into an adequate thickness of metal or provided with bolt and nuts. Self threading screws shall not be used in the construction of the panels/DBs etc.

d) A base channel of 75mm x 40mm x 5mm thick shall be provided at the bottom. A clearance of 300mm between the floor of the Panels/ Distribution Board and the bottom of the lower most unit shall be provided.

e) The Panels/ Distribution boards shall be preferably arranged in multitier formation. These shall be of adequate size with a provision of 20 Percent vacant space to accommodate future additional switch gear in addition to spare feeders presently provided. The size of the boards shall be designed in such a way that the internal space is sufficient for hot air movement, and the electrical component do not attain temperature rise more than 40 degree Celsius.

f) Knockout holes of appropriate size and number shall be provided in the gland plate of Panels/Distribution board in conformity with the number, and size of incoming and outgoing conduits/cables.

g) Alternatively the Panels/Distribution boards shall be provided with removable undrilled gland plates (3mm thick).

i) The switch boards shall be designed to facilitate easy inspection, maintenance and repair.

j) The Panels/Distribution boards shall be sufficiently rigid to support the equipment without distortion under normal and short circuit condition. They shall be suitably braced for short circuit duty. Provision shall be made for permanently earthing the frames and other noncurrent carrying parts of the switchgear by two independent earth connections.

k) All indoor Panels/Distribution boards shall have degree of protection conforming to class IP 42. While outdoor panels shall be weather proof dust and water tight IP-55.

a) Each circuit breaker shall be housed in separate compartments and shall be enclosed on all sides. Sheet steel hinged lockable door shall be duly interlocked with the breaker units in "ON" and "OFF" positions. Safety interlocks shall be provided for air circuit breaker to prevent the breaker from being drawn-out when the breaker is in "ON" position.

b) The door shall not form an integral part of the draw out position of the circuit breaker. All instruments and indicating lamp shall be mounted on the compartment door. Sheet steel barrier shall be provided between the tiers in a vertical section.

c) Separate and adequate compartment shall be provided for accommodating instruments, indicating lamps, control contactors/relays, and control fuses etc., these components shall be accessible for testing and maintenance without any danger of accidental contact with live parts of the circuit breaker units, bus bars and connections.

d) The outgoing terminals and neutral link shall be brought out to a cable alley suitably located and accessible from the panel front. The current transformers for instruments metering shall be mounted on the terminal blocks. No direct connection of incoming or outgoing cables to internal components of the Panels/Distribution board is permitted, only one conductor may be connected in one terminal.

e) A horizontal PVC wire way with screwed covers shall be provided at the top to take interconnecting control wiring between different vertical sections.

f) Cable compartments of adequate size shall be provided in the Panels/Distribution Boards for easy termination of all incoming and outgoing cables entering from bottom or top. Adequate supports shall be provided in the cable compartments to support cables. All outgoing and incoming feeder terminals shall be brought out to terminal blocks in the cable compartment.

g) GI earth bars of suitable size but not less than 25 mm x 3 mm shall be provided in the Panels/Distribution Boards for the entire length of the panel. The frame work of the Panels/Distribution board shall be connected to this earth bar. Provision shall be made for connection from this earth bar to the main earthing bar coming from the earth pit on both sides of the Panels/Distribution board and to take tapping to the outgoing earthing strips to connect to the main distribution boards.

h) The earth continuity conductor of each incoming and outgoing feeder shall be connected to this earth bar. The arm our shall be properly connected with earthing clamp, and the clamp shall be ultimately bonded with the earth bar. CT earthing also shall be connected to this earth bar.

i) Engraved PVC labels shall be provided on all incoming and outgoing feeders. Single line circuit diagram showing the arrangements of circuit inside the Panels/DBs shall be pasted on inside of the panel door and covered with trans-parent laminated plastic sheet.

k) The panel shall be provided with a thermostatically controlled heating arrangement (200 W) to take care of high humidity conditions. A 6/16A socket with sitch as service outlet (single phase) and 1 no. 10W LED LAMP with holder shall be provided in one of the compartments

as service outlet in the panel. The complete panel shall be fuse less type, for control circuits 2A SP MCB's to be used.

l) For the protection of equipment & feeders, switchgear (ACB & MCCB) shall be provided with required O/C, S/C & E/F releases. Selection of switchgear rating shall be made on the basis of load current & fault withstand capacity.

The air circuit breaker shall comply with the requirements of IS:13947-2 (1993) and shall have:

- i) A service short circuit breaking capacity shall be as specified and equal to short circuit withstand values. All short circuit ratings shall be Ics values
- ii) A short circuit making capacity of 105 KA.
- iii) A short time withstand capacity of 50 KA for 1 second.
- iv) Mechanical and electrical endurance for 2000 operating cycles out of which 100 cycles should be for electrical endurance.
- v) Electrical overload performance at 6 times the rated current, 110% of the rated voltage as recovery voltage and 0.5 power factor..
- vi) Dielectric test of 2.5 KV applied for one minute on main circuits. Test evidence from a recognized independent laboratory/institution shall be furnished for compliance of the breakers with the above requirements.

Each pole of the ACB's shall be equipped with an inverse time delay thermal over current trip device and an electromagnetic instantaneous over current trip device. The ACB's shall be equipped with under voltage trip relay. The trip devices shall be direct acting. ACB shall be capable of providing short circuit overload and earth fault protection (in absolute values) if required, thru microprocessor based control unit sensing the true RMS values to ensure accurate measurement meeting the EMI/EMS requirement as per the standard.

viii) Disconnecting devices of approved type shall be provided to facilitate the removal of the circuit breakers from the housing for test and maintenance purposes.

ix) The ACB's shall be fitted with detachable type arc quenching device on each pole. The ACB's shall have auxiliary contacts for signalling, interlocking etc. The ACB's shall have slow close facilities for checking contact operation and contact gap adjustment.

x) All contacts subject to arcing shall be tipped with arc resisting material. Main contacts shall be silver plated to ensure reliability in service.

xi) Isolating contacts shall be of the silver plated, MultiFinder, spring loaded type. Facilities shall be provided to isolate the circuit breaker for inspection purpose. Feature of contact wear inspection indicating the life of contacts shall be provided. The ACB shall have double insulation (class-II) with moving and fixed contacts totally enclosed for enhanced safety and inaccessibility to live parts.

The breaker shall have three distinct positions within the cassette as follows:

- a) 'Service Position' - with main and auxiliary contacts connected.
- b) 'Test Position' - with power contacts fully disconnected and control circuit contacts connected.

c) 'Isolated position' - With both power and control circuit contacts fully disconnected.

xii) Interlocks shall be provided to :

a) Prevent the breaker from being isolated unless it is in the OFF position.

b) Prevent the breaker from being racked into the service position unless it is in the OFF position.

c) Prevent the breaker from being accidentally pulled completely OFF the guide rail.

xiii) Safety shutters of an insulation material shall be provided to prevent access to all live contacts, when the breaker is in the inspection position or completely withdrawn. Page 87 of 331 Shiva Consultancy Services (P) Ltd.

xiv) Facilities for pad locking the safety shutters when breaker is completely withdrawn shall be provided. Facilities shall be provided for earthing the circuit breaker.

xv) Air circuit breaker shall be capable of clearing the maximum fault current which can occur.

xvi) All electrical closing of breaker should be with Electrical motor wound stored energy spring closing mechanism with Mechanical indicator to provide ON/OFF status of ACB.

For all ACBs the operating handle should be provided for charging the spring in continuous action. The spring shall be released with ON/OFF push button command in one operation at the correct speed independent of operator speed. A direct mechanical coupling should indicate the ACB in ON to OFF position thus qualifying to disconnection as per the IS/IEC indicating the true position of all the contacts. One set of NO/NC potential free contacts to be provided for operation on building management system. All accessories like shunt, under voltage motorised mechanism etc shall be front mounted and can be fitted at site.

a) For the protection of equipment & feeders, switchgear shall be provided with required O/C, S/C & E/F releases. Selection of switchgear rating shall be made on the basis of load current & fault withstands capacity.

b) MCCBs shall satisfy the requirements of IS-13947 Part (II) and shall be of current limiting type. MCCB shall provide type 'C' protection to the contactors as per IEC 158-1B. MCCBs shall be quick make, quick break, independent manual type with trip free feature with mechanical ON, OFF, and TRIP indications. A trip button shall be provided for tripping the breaker. MCCB shall have electro-magnetic, under voltage and earth fault releases.

c) Alarm and auxiliary contacts, terminal shrouds, sliding type front operation kit with facility for door interlocking and pad locking shall be provided (ICS=ICU).

d) MCB:- Miniature circuit breakers shall be quick make and break type and conform to IS: 8828. The housing of MCBs shall be heat resistant and having a high impact strength. The fault current of MCBs shall not be less than 9000 amps, at 230 volts. The MCBs shall be flush mounted and shall be provided with trip free manual operating mechanism with mechanical "ON" and "OFF" indications. The circuit breaker dollies shall be of the trip free pattern to prevent closing the breaker on a faulty circuit.

- e) The MCB contacts shall be silver nickel and silver graphite alloy and tip coated with silver. Proper arc chutes shall be provided to quench the arc immediately. MCB's shall be provided with magnetic fluid plunger release for over current and short circuit protection.
- f) The over load or short circuit devices shall have a common trip bar in the case of DP and TPN Miniature Circuit Breakers. All the MCB's shall be tested and certified as per Indian Standards, prior to installation.
- g) The contactors shall meet with the requirements of IS:2959. The contactors shall be of MN series only. The contactors shall have minimum making and breaking capacity in accordance with utilization category AC3 and shall be suitable for minimum class II intermittent duty.
- h) If the contactor forms part of a distribution board then a separate enclosure is not required, but the installation of the contactor shall be such that it is not possible to make an accidental contact with live parts.
- i) Where ammeters are called for C.T's shall be provided for current measuring. Each phase shall be provided with separate current transformer of accuracy class-I and suitable VA burden for operation of associated metering and controls. Current transformer shall be in accordance with IS:2705 as amended up to date.

13.1.5. ELECTRICAL POWER DISTRIBUTION

The Electrical Power Distribution for electric supply shall be as detailed below:-

Outdoor type Al.Sandwich Bus Duct as per IEC61439 including adaptor box, Tap-off and other plug-in system of suitable capacity shall be provided from Transformer to Main LT Panels and DG to Synchronizing Panel Multi Run AL. AR. Cable shall be provided. Main LT Panels to all other panels suitable size 3.5 core PVC insulated XLPE armored Aluminum cable for Main LT Panel to HVAC Panel & Capacitor Panel. Adequate runs of XLPE insulated armored Aluminum conductor cables shall be laid from Main LT Panel to Distribution Panels/ Meter Boards Distribution of individual floor for all buildings.

In all Buildings of FTA At Bihta, Patna, Bihar, shall have a LT Panel Room in ground floor to receive power from the substation Main LT Panel. & Main Panel shall be connected with Al. Ar. Cable of individual building LT Panels. All blocks shall have suitable Nos. of Floor Panels to be located in floor Elec. Rooms for catering entire load of Lighting, power, HVAC, etc. connected to Main LT Panel, as applicable.

Each floor panel with incoming & outgoing MCCBs of required capacities and numbers feeding the Meter boards, double door DBs/SDBs. Sub mains from floor panel to DBs shall be connected with FRLS PVC CU WIRE (maximum 10 SQ MM) and above 10 Sq, mm it should be AL. armored cable on surface/cable tray. The power cabling shall be sized so that the distribution losses do not exceeds 3% of the total power uses in buildings. Voltage drop for feeders shall not exceed 2% at design load and for branch circuit; it shall not exceed 3% at design load.

13.1.6. Meter Box & Energy Meters:-

Main LT Panel should have double sources' Energy Meter and energy meters (single/ Three Phase) shall be provided for each Residential building Panel.

13.1.7. SAFETY ITEMS:-

All safety items as per current Indian Electricity Rules and Act are to be provided:-

- i) 1000 mm x 600 mm x 20 mm thick chequered Rubber Matting of tested quality to withstand 33 KV dielectric strength Insulation mats complete in all respects.

- ii) 1000 mm x 600 mm x 12 mm thick chequered Rubber Matting of tested quality to with stand 15KV dielectric strength IS: 15652 Insulation mats complete in all respects.
- iii) 440V grade Rubber Hands Gloves. As per IS: 4770.
- iv) Tool kit with 1 pair 33 KV & 11 KV rubber hand gloves of approved make, as per IS: 4770. (1 Pair for each Sub Station)
- v) First Aid Box with all necessary materials and medicine as approved by Indian Red Cross / St. John's conforming to IS: 2217. (for Outdoor & Indoor Sub Station-2 sets for each)
- vi) Shock Treatment Chart with glass in Aluminum frame and to be fixed on wall in Hindi and English one set in each substation.
- vii) Carbon dioxide (Co₂) type fire extinguisher of 4.5 Kg. Capacity duly charged confirming to IS: 2878. (2 sets in each substation)
- viii) 3 Nos. 9 Liter capacity G.I. buckets duly painted white inside and red oxide paint outside and written 'FIRE' with white paint and filled with dry sand and mounted on MS angle iron bracket of size 50x50x6mm thick and 1200mm long including grouting in wall/floor etc. as required confirming to IS :2546. (One Set in each Sub Station)
- ix) Approved single line diagram framed in 1000 x 800 mm size glass frame and installed in main switch room.
- x) ANSI/NFPA 70 - National Electrical Code

13.2. INTERNAL WIRING:-

13.2.1 Recessed conduit system of wiring is to be done using copper conductor PVC insulated single core multi-strained wires drawn through ISI marked rigid PVC conduits. Optimum number of LED lighting fixtures, power outlets, telephone/intercom outlets, LAN outlets) etc. is to be provided in different areas of the building. Modular type switches and sockets is to be provided. Following works shall be carried out in coordination with the civil work within the buildings complete in all respects as per latest IS Codes and CPWD Specifications.

- a) Wiring & Conducting (PVC Conduits) for internal electrification, LV & Allied works, but of fire detection system MS Conduits are to be used.
- b) LED Light fixtures, Fan (Ceiling & Wall) & Exhaust Fans. (All Ceiling Fans shall be energy efficient 5 star BLDC type)
- c) 6A Light Point /UPS Modular Switch & Socket Outlets.
- d) 16A/ 20A Power/UPS Modular Switch & Socket Outlets
- e) L.T. Cables and Sub main wiring, circuit wiring.
- f) Wire Mesh Cable Tray & G.I. Raceways.
- g) Bus Duct.
- h) Floor Panels, Meter Boards, Distribution Boards & SDBs
- i) Earthing
- j) Extra Low Voltage system like Telephone/ IPBAX, LAN –Wi-Fi, Fire Detection & Alarm System, CCTV System, Public Address system, Access control system, Boom Barriers etc.

2. Following points shall be generally followed for internal and external electrification of various areas:

- a) Internal areas like rooms, corridors, lobbies, staircases, terraces, washrooms etc. of Buildings of FTA At Bihta, Patna, Bihar and blocks shall be adequately illuminated conforming to provisions stipulated in NBC 2016, ECBC and CPWD technical specification maintaining indicated Lux level and Light Power Density.
- b) The Internal Electrification work shall be carried out in recessed PVC conduits in accordance with CPWD General Specifications for Electrical Works Part-I (Internal)-2013 and Part-II

(External)-2012 with up to date amendments. ESPECIALLY FOR RESIDENTIAL BUILDINGS AS PER GPRA NORMS.

- c) MS/ PVC Conduits shall be surface mounted or laid on MS angle/channels with suitable hanging supports in areas wherever there is false ceiling provision. In case there is no provision for false ceiling, MS/PVC Conduits shall be concealed in concrete during slab casting. **Wiring for lighting/ power shall be generally done in PVC Conduits whereas wiring for LV works shall be generally done in PVC conduits unless stated otherwise mentioned, for Fire Detection system use HR FRLS in M/S Conduit as per NBC-2016 & Relevant BIS Codes**
- d) FRLS PVC insulated Copper conductor wires will be used for points, circuit & sub-main wiring conforming to relevant IS-Codes.
- e) Agency shall execute the work after obtaining necessary approval of the layout for internal electrification of (FTA) at Bihta, Patna, Bihar, common areas and staircases. The staircase lighting shall be in group control system.
- f) Modular type switches, sockets and Two Module Stepped Electronic Regulator for Ceiling Fans, and bell push button along with matching mounting boxes of same make shall be used.
- g) Color coding of the conduits, switches, sockets shall be provided for Normal & UPS power supply as per NBC2016.
- h) LED Type Lighting fixtures with DALLY dimmable drivers for almost all areas in Auditorium Main Hall with Motion sensors, and occupancy sensors for Toilets, Corridors and passages except for some exceptions as defined further in built harmonic suppression mechanisms shall be provided along with occupancy sensors in corridors, toilets (common Toilets & rooms Toilets) etc.
- i) LEDs shall have maintained values 25% of rated life time up to a maximum of 50,000 hours. LEDs are directional light sources, giving lamp. The use of reflectors, lenses and diffusers allows a designer to direct light in many different ways. The efficiency and depreciation of the optical system must be considered and factored into the overall efficiency of the luminaries. Color spectrum of light shall be equivalent to 4000k neutral white and 5000-7000 k cool white or shall be required as per site/ interior designer. All LED LIGHTS fixtures should have minimum 100Lm/W or above lumens per watt. Minimum Life- 50000 hrs, and LM 79 and LM 80 reports need to be submitted with all accessories by the contractor. Light fittings with high frequency, electronic Ballast with THD<10 % starter, control gears, lamps holder, power factor for LED lights for improvement, etc.
- j) All LED Light Fixtures shall have **50,000 Burning Hours and minimum 2 yrs warranty.**
- k) Suitable size & capacity Energy efficient Ceiling Fans (Energy efficient BLDC motor BEE Five star rated) / Wall Fans (White/Off White color) shall be provided as per detail drawings/ RCP and as required, where there is provision neither for air- conditioning or for forced ventilation. However, Ceiling Fans/Wall Fans as required shall be provided for FTA at Bihta, Patna, Bihar as directed by Engineer-In-Charge.
- l) Separate shafts shall be provided for laying of pipes for Electrical, ELV, Mechanical and Fire Services.
- m) Laying of DWCHDPE/Hume pipes for road crossing no ring pucca portion & CC path etc. for electric/telephone/LAN/Street Lighting Cables complete with adequate number of cable chambers shall be provided by the agency.
- n) After completing the work, necessary test results as envisaged in CPWD General Specifications Part-I (Internal)-2005 & Indian Electricity Rules 2005, shall be recorded and submitted. The results shall be within the permissible limits.
- o) Aviation Lights (LED Type) shall also be provided as per prevalent norms & IS Codes.
- p) G.I. Raceways, with accessories, shall be provided on floors as per requirements. The cover plate of raceways' junction boxes shall be stainless-steel (SS304 or SS316). 3 way /Part DLP Trunking can also be used in all office buildings for Data Net working, Voice Solutions ,etc

- and electrical points UPS/Raw points
- q) Special lighting with LED light fixture shall be provided on terraces.
 - r) Power Points, LAN Points, UPS power point, Telephone Point (with telephone instrument as required) shall be provided for all Common areas, Rooms, Office, Conference Hall, Control Room, Elec. Room, Server Room , suitable places in Auditorium, and all buildings of FTA, Campus where ever is required..
 - s) If required requisite size of metal raceways shall be provided in slabs with fillers, wherever required for drawing the wires and cables for the work stationed.
 - t) For areas where grid type false ceiling, recessed type LED Light Fixtures of size 595mmX595mm shall be provided as per directions of Engineer-In-Charge unless otherwise stated. For false ceiling with Gypsum board, LED down Lighter type fixtures of suitable size shall be provided as per the directions of Engineer- In-Charge unless otherwise stated. Surface mounted Light Fixtures shall be provided in the areas without False Ceiling.
 - u) Wire Mesh (STEEL WIRE) Cable Tray shall be used in internal electrical works & ELV System in all buildings of Fire Training Academy (FTA) At Bihta, Patna, Bihar wherever it is required :-
 - a. Cable Tray shall be manufactured by steel wires, welded together, and bent in to final shape.
 - b. All cable Trays shall be manufactured with a longitudinal "T" Welded safety edge.
 - c. The cable Tray shall demonstrated by means of Salt Spray Test (SST) as per the standard EN 9227.
 - d. Hot dipped galvanized as per the standard EN ISO 1460 at least 360H of SST.
 - e. The deflection of the cable trays must be no more than 1/200th of the distance between supports and tested in accordance with the standard IEC 61537.
 - f. Anchor fastener size 50x10mm.
 - g. All supports, brackets (Hangers), 50mm rods shall be original company make and shall be mechanically tested as per the standard IEC 61537 and optimum span shall be 1.5 Mtrs. For above.
 - h. Gap between true ceiling to cable tray shall be 450 to 500mm and near beam it should be 150 to 200 mm

SCALE OF AMMENITIES FOR ELECTRICAL INSTALLATION IN GENERAL POOL RESIDENTIAL ACCOMODATION (ANNEXURE-1 d)

ESPECIALLY FOR RESIDENTIAL BUILDINGS AS PER CPWD (GPRA) NORMS ASPER DETAILS BELOW :-

Sl. No.	DESCRIPTION	TYPE- II (TYPE-B)			
1	DETAILS OF ELEC POINTS AS PER CPOWD (GPRA) NORMS	FOLLOWER (TYPE-B) LVL-1 (20 Units) (G+4) (TYPE-II)	CONSTABLE (TYPE-B) LVL-3 & 4 (16 Units)(G+4)= 16x4=80Units (TYPE-II)	HEAD CONSTABLE (TYPE-B) LVL-5&4 B-3 (14 Units) (G+3)	HEAD CONSTABLE (TYPE-B) LVL-5&4 B-1&2 (18x2=36 Units) (G+4)

a)	BED ROOM-2 Nos. & 1 NO. LEAVING ROOM		TOTAL ELEC. POINTS	TOTAL ELEC. POINTS	TOTAL ELEC. POINTS	TOTAL ELEC. POINTS
i)	Power plug point (16 A 6 pins)	2 in each room 1 in kitchen 1 in utility area	Rooms:- 2x3=6 Kitchen:- 1x1-1 Utility :- 1x1=1	Rooms:- 2x3=6 Kitchen:- 1x1-1 Utility :- 1x1=1	Rooms:- 2x3=6 Kitchen:- 1x1-1 Utility :- 1x1=1	Rooms:- 2x3=6 Kitchen:- 1x1-1 Utility :- 1x1=1
		Total 8 Points.	Total:- 8 Points	Total:- 8 Points	Total:- 8 Points	Total:- 8 Points
ii)	Light plug point (6A)	2 in each room 1 in kitchen 1 in utility area	Rooms:- 2x3=6 Kitchen:- 1x1-1 Utility :- 1x1=1	Rooms:- 2x3=6 Kitchen:- 1x1-1 Utility :- 1x1=1	Rooms:- 2x3=6 Kitchen:- 1x1-1 Utility :- 1x1=1	Rooms:- 2x3=6 Kitchen:- 1x1-1 Utility :- 1x1=1
		Total 8 Points.	Total:- 8 Points	Total:- 8 Points	Total:- 8 Points	Total:- 8 Points
iii)	Decorative Wall Bracket lights with normal fittings & with LED LAMPS	1 in each room 1 in kitchen 1 in each toilet 1 in utility	Rooms:- 1x3=3 Kitchen:- 1x1-1 Toilet- :- 1x1=1 Utility :- 1x1=1	Rooms:- 1x3=3 Kitchen:- 1x1-1 Toilet- :- 1x1=1 Utility :- 1x1=1	Rooms:- 1x3=3 Kitchen:- 1x1-1 Toilet- :- 1x1=1 Utility :- 1x1=1	Rooms:- 1x3=3 Kitchen:- 1x1-1 Toilet- :- 1x1=1 Utility :- 1x1=1
		Total 6	Total:- 6 Points	Total:- 6 Points	Total:- 6 Points	Total:- 6 Points
iv)	Ceiling fans (1200mm - BLDC TYPE)	1 in living room 1 in each bed room	1 in Living Rooms :- 1 no one In each Bed Room 2 nos.	1 in Living Rooms :- 1 no one In each Bed Room 2 nos.	1 in Living Rooms :- 1 no one In each Bed Room 2 nos.	1 in Living Rooms :- 1 no one In each Bed Room 2 nos.

		Total 3	Total:- 3 Points	Total:- 3 Points	Total:- 3 Points	Total:- 3 Points
v)	Cell ball point	1 no	1 no.	1 no.	1 no.	1 no.
vi)	Exhaust fans (TOILET-230mm & KITCHEN-300mm (METAL BODY))	1 no. In Each Kitchen & 1 no. In each W/C	Kitchen-1 no. W/C - 1 no.	Kitchen-1 no. W/C - 2 no.	Kitchen-1 no. W/C - 2 no.	Kitchen-1 no. W/C - 2 no.
		Total:- 2 nos.	Total:- 2 nos.	Total:- 2 nos.	Total:- 2 nos.	Total:- 2 nos.
vii)	AC point with MCB connected except socket outlet with wiring	1 no. In each room except kitchen & Toilet	Bed Room- 2 nos. Leaving Room:-1 no.	Bed Room- 2 nos. Leaving Room:-1 no.	Bed Room- 2 nos. Leaving Room:-1 no.	Bed Room- 2 nos. Leaving Room:-1 no.
		Total:- 3 nos.	Total:- 3 nos.	Total:- 3 nos.	Total:- 3 nos.	Total:- 3 nos.
viii)	Geyser point with MCB connected socket outlet with wiring	1 in bathroom	Bathroom- 1no.	Bathroom- 2no.	Bathroom- 2no.	Bathroom- 2no.
		Total:- 1 nos.	Total:- 1nos.	Total:- 2nos.	Total:- 2nos.	Total:- 2nos.

ix)	EDB & MCB point (single phase)	1 no.	1 no.	1 no.	1no.	1no.
x)	EDB & MCB point (3 phase)					
xi)	Cable point (TV POINT)	1 in Living Room 1in each Bad Room	Living Room-1no. Bedroom-1no.			
		Total:- 2 nos.	Total:- 2 nos.			
xii)	Telephon e point as per the approve of competent authority	1 in each Living Room 1ineach Bad room	Living Room-1no. Bad room-1x1=2			
		Total:- 3nos.	Total:- 3nos.			
xiii)	Decorativ e light fitting with Led Bulb.					
xiv)	For Led bulb with t bulb					

xv)	Led tube light fittings with LED Tube Light.	1in each Room 1 in Kitchen	Room- 1x3=3 Kitchen- 1x1=1			
		Total:-4	Total:-4			
xvii)	Modular switches					

Sl. No.	DESCRIPTION		TYPE-III (TYPE-C)		
1	DETAILS OF ELEC POINTS AS PER CPOWD (GPRA) NORMS		INSPECTORS (TYPE-C) LVL-7 (26 Units) (G+4)	INSPECTORS (TYPE-C) LVL-7 (26 Units) (G+4)	SUB-INSPECTORS (TYPE-C) LVL-6 (60 Units) (G+4)
a)	BED ROOM-2 Nos. & 1 NO. LEAVING ROOM				
i)	Power plug point (16 A 6 pins)	2 in each room 1 in kitchen 1 in utility area	Rooms:-2x3=6 Kitchen:-1x1=1 utility:-1x1=1	Rooms:-2x3=6 Kitchen:-1x1=1 utility:-1x1=1	Rooms:-2x3=6 Kitchen:-1x1=1 utility:-1x1=1
		Total 8 Points.	Total 8 Points.	Total 8 Points.	
ii)	Light plug point (6A)	2 in each room 1 in kitchen 1 in utility area	Rooms:- 2x3=6 Kitchen:- 1x1=1 Utility :- 1x1=1	Rooms:- 2x3=6 Kitchen:- 1x1=1 Utility :- 1x1=1	Rooms:- 2x3=6 Kitchen:- 1x1=1 Utility :- 1x1=1
		Total 8 Points.	Total 8	Total 8	Total 8
iii)	Decorative Wall Breaket lights with normal fittings & with LED LAMPS	1 in each room 1 in kitchen 1 in each toilet 1 in utility	Rooms:- 1x3=3 Kitchen:- 1x1=1 Toilet- :- 1x1=1 Utility :- 1x1=1	Rooms:- 1x3=3 Kitchen:- 1x1=1 Toilet- :- 1x1=1 Utility :- 1x1=1	Rooms:- 1x3=3 Kitchen:- 1x1=1 Toilet- :- 1x1=1 Utility :- 1x1=1

		Total 6	Total 6	Total 6	Total 6
iv)	Ceiling fans (1200mm-BLDC TYPE)	2 in living /Dinning room 1 in each bedroom	2 in living /Dinning room 1 in each bedroom	2 in living room / Dining room:- 2 no. 1 in each bed room:-2 no.	2 in living room / Dining room:- 2 no. 1 in each bed room:-2 no.
		Total 4	Total 4	Total 4	Total 4
v)	Cell ball point	1 no	1no.	1no.	1no.
vi)	Exhaust fans (TOILET-230mm & KITCHEN-300mm (METAL BODY)	1 no. In Each Kitchen & 1 no. In each W/C	Kitchen-1 no. W/C - 1 no.	Kitchen-1 no. W/C - 1 no.	Kitchen-1 no. W/C - 1 no.
		Total:- 2 nos.	Total:- 2 nos.	Total:- 2 nos.	Total:- 2 nos.
vii)	AC point with MCB connected except socket outlet with wiring	1 no. In each room except kitchen & Toilet	Room- 2 nos. Kitchen - 1x1=1 Toilet- 1x1=1	Room- 2 nos. Kitchen - 1x1=1 Toilet- 1x1=1	Room- 2 nos. Kitchen - 1x1=1 Toilet- 1x1=1
		Total:- 3 nos.	Total:- 3 nos.	Total:- 3 nos.	Total:- 3 nos.
viii)	Geyser point with MCB connected socket outlet with wiring	1in bathroom	Bathroom- 2no.	Bathroom- 2no.	Bathroom- 2no.
		Total:- 1 nos.	Total:-2nos.	Total:-2nos.	Total:-2nos.

ix)	EDB & MCB point (single phase)	1 no.	1no.	1no.	1no.
x)	EDB & MCB point (3 phase)				
xi)	Cable point (TV POINT)	1 in Living Room 1 in each Bedroom	Living Room-1no. Bedroom-1no.	Living Room-1no. Bedroom-1no.	Living Room-1no. Bedroom-1no.
		Total:- 2 nos.	Total:- 2 nos.	Total:- 2 nos.	Total:- 2 nos.
xii)	Telephone point as per the approve of competent authority	1 in each Living Room 1 in each Bedroom	Living Room-1no. Bedroom-1x1=2	Living Room-1no. Bedroom-1x1=2	Living Room-1no. Bedroom-1x1=2
		Total:- 3nos.	Total:- 3nos.	Total:- 3nos.	Total:- 3nos.
xiii)	Decorative light fitting with LED Lamp.				
xiv)	For Led bulb with bulb				
xv)	Led tube light fittings with LED Tube Light.	1 in each Room 1 in Kitchen	Room- 1x3=3 Kitchen-1x1=1	Room- 1x3=3 Kitchen-1x1=1	Room- 1x3=3 Kitchen-1x1=1
		Total:-4	Total:-4	Total:-4	Total:-4
xvii)	Modular switches				

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Sl. No.	DESCRIPTION		TYPE-IV (TYPE-D)	
1	DETAILS OF ELEC POINTS AS PER CPWD (GPRA) NORMS		DOCTORS (TYPE-D) LVL-9 (10 Units) (G+3)	ASSISTANT COMMANDANT (TYPE-D) LVL-9 (7 Units) (G+2)
a)	BED ROOM-2 Nos. & 1 NO. LEAVING ROOM			
i)	Power plug point (16 A 6 pins	2 in each room 1 in kitchen 1 in utility area	Rooms:-2x3=6 Kitchen:-1x1=1 Utility:-1x1=1	Rooms:-2x3=6 Kitchen:-1x1=1 Utility:-1x1=1
		Total 8 Points.		
ii)	Light plug point (6A)	2 in each room 1 in kitchen 1 in balcony area	Rooms:- 2x3=6 Kitchen:- 1x1-1 Utility :- 1x1=1	Rooms:- 2x3=6 Kitchen:- 1x1-1 Utility :- 1x1=1
		Total 8 Points.		
iii)	Decorative Wall Breaket lights with normal fittings & with LED LAMPS	1 in each room 1 in kitchen 1 in each toilet 1 in utility	Rooms:- 1x3=3 Kitchen:- 1x1-1 Toilet- :- 1x1=1 Utility :- 1x1=1	Rooms:- 1x3=3 Kitchen:- 1x1-1 Toilet- :- 1x1=1 Utility :- 1x1=1
		Total 6	Total 6	Total 6
iv)	Ceiling fans (1200mm-BLDC TYPE)	2 in living /Dinning room 1 in each bedroom	2 in living /Dinning room 1 in each bedroom	2 in living /Dinning room 1 in each bedroom
v)	Cell ball point	1 no		

vi)	Exhaust fans (TOILET- 230mm & KITCHEN- 300mm (METAL BODY)	1 no. In Each Kitchen & 1 no. In each W/C	Kitchen-1 no. W/C - 1 no.	Kitchen-1 no. W/C - 1 no.
		Total:- 2 nos.	Total:- 2 nos.	Total:- 2 nos.
vii)	AC point with MCB connected except socket outlet with wiring	1 no. In each room except kitchen & Toilet	Room- 2 nos. Kitchen - 1x1=1 Toilet- 1x1=1	Room- 2 nos. Kitchen - 1x1=1 Toilet- 1x1=1
		Total:- 3 nos.	Total:- 3 nos.	Total:- 3 nos.
viii)	Geyser point with MCB connected socket outlet with wiring	1 in kitchen 1 in each toilet	1 in each toilet 1 no.	1 in each toilet 1 no.
		Total:- 1 nos.	Total:- 1 nos.	Total:- 1 nos.
ix)	EDB & MCB point (single phase)	1 no.	1 no.	1 no.
x)	EDB & MCB point (3 phase)			
xi)	Cable point (TV POINT)	1 in Drawing Room 1in each Bedroom	Drawing Room- 1no. Bedroom- 2 no.	Drawing Room-1no. Bedroom- 2 no.
		Total:- 3 nos.	Total:- 3 nos.	Total:- 3 nos.
xii)	Telephone point as per the approve of competent authority	1 in each Drawing Room 1ineach Bedroom	Drawing Room- 1no. Bedroom- 2 no.	Drawing Room-1no. Bedroom- 2 no.
		Total:- 3nos.	Total:- 3nos.	Total:- 3nos.

xiii)	Decorative light fitting with LED Lamps.			
xiv)	For Led bulb			
xv)	Led tube light fittings with LED Tube Light	1in each Room 1 in Kitchen	1 in drawing room 1 each in dining room 1 in each bedroom 1 in each kitchen	Drawing Room- 1x1=1 Dining Room- 1x2=2 Bedroom- 1x2=2 Kitchen- 1x2=2
		Total:-7	Total:-7	Total:-7
xvii)	Modular switches			

Sl. No.	DESCRIPTION		TYPE-V (TYPE-E)
1	DETAILS OF ELEC POINTS AS PER CPOWD (GPRA) NORMS		DEPUTY COMMANDANT (TYPE-E) LVL-11 (4 Unit) (G+1)
a)	BED ROOM-2 Nos. & 1 NO. LEAVING ROOM		
i)	Power plug point (16 A 6 pins	3 in drawing room 3 in dining room 2 in each Bedroom 2 in kitchen 1in utility area	Drawing room- 3x1=3 Dining room- 3x1=3 Bedroom- 2x3=6 Kitchen- 2x1=2 utility area- 1x1=1
		Total 15	Total 15
ii)	Light plug point (6A)	2 in each room 1 in kitchen 1 in store 1 in main balcony	Room- 2x3=6 Store- 2 no. Kitchen- 2 no. Balcony- 2 .no

iii)	Decorative Wall Bracket lights with normal fittings & with LED LAMPS	1 in each store 1 in each toilet utility	1 in Store - 1x3=6 Toilet- 1 no. Utility- 1no.
iv)	Ceiling fans (1200mm- BLDC TYPE)	2 in drawing room 1 in dining room 1 each bedroom 1 in each balcony	Drawing Room- 2x1=2 Dining Room- 1x1=1 Bedroom- 1x2=2 Balcony- 1x1=1
		Total 6	Total 6
v)	Cell ball point	3 no.	3 no.
vi)	Exhaust fans (TOILET-230mm & KITCHEN-300mm (METAL BODY)	1 no. In Each Kitchen & 1 no. In Toilet	Kitchen-1 no. Toilet - 1 no.
		Total 2 no.	Total 2 no.
vii)	AC point with MCB connected except socket outlet with wiring	1 no. In each room except kitchen & Toilet	Room- 2 nos. Kitchen - 1x1=1 Toilet- 1x1=1
		Total:- 3 nos.	Total:- 3 nos.
viii)	Geyser point with MCB connected socket outlet with wiring	1 in kitchen 1 in each toilet	1 in each toilet 1 no.
		Total:- 1 nos.	Total:- 1 nos.
ix)	EDB & MCB point (single phase)		
x)	EDB & MCB point (3 phase)	1 no.	1no.

xi)	Cable point (TV POINT)	1 in Drawing Room 1 in each Bedroom	Drawing Room-1no. Bedroom- 2 no.
		Total:- 3 nos.	Total:- 3 nos.
xii)	Telephone point as per the approve of competent authority	1 in Drawing Room 1 in each Bedroom	Drawing Room-1no. Bedroom- 2 no.
		Total:- 3 nos.	Total:- 3 nos.
xiii)	Decorative light fitting with LED Lamp.	3 in drawing room 3 in each dining room	Drawing room- 3 no. Dining room- 3 no.
	For Led bulb with bulb	2 in each bed room 1 in kitchen	Bedroom- 2x3=6 Kitchen 1x1=1
		Total 13	Total 13
xv)	Led tube light fittings with LED Tube Light.	1 in drawing room 1 each in dining room 1 in each bedroom 1 in kitchen	Drawing room- 1no. Dining room- 2 no. Bedroom- 2 no. Kitchen- 1 no.
		Total 6	Total 6
xvii)	Modular switches	Yes	

Sl. No.	DESCRIPTION		TYPE-VI (TYPE-F)
1	DETAILS OF ELEC POINTS AS PER CPOWD (GPRA) NORMS		COMMANDANT (TYPE-F) LVL-13 (1 Unit) (G+1)
	BED ROOM-2 Nos. & 1 NO. LEAVING ROOM		
i)	Power plug point (16 A 6 pins	3 in drawing room 3 in dining room 2 in each Bedroom 2 in kitchen 1 in utility area	Drawing room- 3x1=3 Dining room- 3x1=3 Bedroom- 2x3=6 Kitchen- 2x1=2 Utility area- 1x1=1

ii)	Light plug point (6A)	2 in each room 1 in kitchen 1 in store 1 in main balcony	Room- 2x3=6 Kitchen- 2 no. Store- 2 no. Balcony- 2 .no
iii)	Decorative Wall Bracket lights with normal fittings & with LED LAMPS	1 in each store 1 in each toilet 1 in utility	Store - 1x3=6 Toilet- 1 no. Utility- 1no.
1v)	Ceiling fans (1200mm- BLDC TYPE)	2 in drawing room 1 in dining room 1 in family lounge 1 in each bedroom 1 in each balcony	Drawing Room-2x1=2 Dining Room- 2 no. Family Lounge- 1x1=1 Bedroom- 1x3=3 Balcony- 1x3=3
		Total 12	Total 12
v)	Cell ball point	3(One with image display system)	3(One with image display system)
vi)	Exhaust fans (TOILET-230mm & KITCHEN-300mm (METAL BODY)	1 no. In Each Kitchen & 1 no. In Toilet	Kitchen-1 no. Toilet - 1 no.
vii)	AC point with MCB connected except socket outlet with wiring	1 no. In each room except kitchen & Toilet	Room- 2 nos. Kitchen - 1x1=1 Toilet- 1x1=1
viii)	Geyser point with MCB connected socket outlet with wiring	1 in kitchen 1 in each toilet	1 in each toilet 1 no.
ix)	EDB & MCB point (single phase)		

x)	EDB & MCB point (3 phase)	1 no.	1 no.
xi)	Cable point (TV POINT)	1 in drawing room 1 in dining room 1 in each bedroom	Drawing Room- 1no. Dining room- 1 no. Bedroom- 1 no.
		Total 3 no.	Total 3 no.
xii)	Telephone point as per the approve of competent authority	1 in drawing room 1 in dining room 1 in each bedroom	Drawing Room- 1no. Dining room- 1 no. Bedroom- 1 no.
		Total 3 no.	Total 3 no.
xiii)	Decorative light fitting with LED Lamp.	3 in drawing room 3 in dining room 2 in each bed room	Drawing room- 3 no. Dining room- 3 no. Bedroom- 2x3=6 no.
xiv)	For Led bulb with bulb	2 in Kitchen	Kitchen- 2 no.
xv)	Led tube light fittings with LED Tube Light.	1 in drawing room 1 each in dining room 1 in 1 in each bedroom 1 in kitchen	Drawing room- 2 no. Dining room- 2 no. Bedroom- 2 no. Kitchen- 1 no.
		Total 7	Total 7
xvii)	Modular switches	Yes	Yes

Sl. No.	DESCRIPTION	TYPE-VII (TYPE-G)
1	DETAILS OF ELEC POINTS AS PER CPOWD (GPRA) NORMS	COMMANDANT (TYPE-F) LVL-13 (1 Unit) (G+1)

a)	BED ROOM-2 Nos. & 1 NO. LEAVING ROOM		
i)	Power plug point (16 A 6 pins)	2 in office 4in drawing room 3 in dining room 2 in family lounge 2 in each bedroom 2 in Kitchen 1in Utility area	Office- 2x2=4 4x1=4 3x1=3 no. Kitchen- 2 no. Drawing Room- Dining Room- Family lounge- 2 no. Bedroom- 2x3=6 no. Utility area. 1 no.
		Total 22	Total 22
ii)	Light plug point (6A)	1 in each office 2 in each room 1 in kitchen 1 in store 1 in each balcony	Office- 1x3=3 Kitchen- 1x1=1 Balcony- 1x3=3 Room- 2x3=6 Store- 1x1=1
iii)	Decorative Wall Bracket lights with normal fittings & with LED LAMPS	1 in each store 1 in each toilet 1 in utility	Store - 1x3=3 Toilet- 1x3=3 Utility- 1x1=1
1v)	Ceiling fans (1200mm- BLDC TYPE)	2 in drawing room 1 in dining room 1 in family lounge 1 in each bedroom 1 in each balcony	Drawing Room-2x1=2 Dining Room- 2 no. Family Lounge- 2 no Bedroom- 1x3=3 Balcony- 1x3=3
		Total 12	Total 12
v)	Cell ball point	4(One with image display system	4(One with image display system
vi)	Exhaust fans (TOILET-230mm & KITCHEN-300mm (METAL BODY)	1 no. In Each Kitchen & 1 no. In Toilet	Kitchen-1 no. Toilet - 1 no.

vii)	AC point with MCB connected except socket outlet with wiring	1 no. In each room except kitchen & Toilet	Room- 2 nos. Kitchen - 1x1=1 Toilet- 1x1=1
viii)	Geyser point with MCB connected socket outlet with wiring	1 in kitchen 1 in each toilet	1 in each toilet 1 no.
ix)	EDB & MCB point (single phase)		
x)	EDB & MCB point (3 phase)	1 no.	1 no.
xi)	Cable point (TV POINT)	1 in office 1 in drawing room 1 in dining room 1 in family lounge 1 in each bedroom	Office- 1no Drawing - 1no. Dining Room- 1no. Family Lounge- 1no.
xii)	Telephone point as per the approve of competent authority	1 in office 1 in drawing room 1 in dining room 1 in family lounge 1 in each bedroom	Office 1no. Drawing Room. 1no. Dining Room- 1no. Family lounge. 1no. Bedroom- 1x3=3no.
xiii)	Decorative light fitting with LED Lamp	3 in office 3 in drawing room 3 in dining room	Office- 3x1=3 Drawing Room- 3x1=3 Dining Room. 3x1=3
	For Led bulb with bulb	3 in family lounge 2 in each Bedroom 2 in Kitchen	Family Lounge- 3x1=3 Bedroom - 2x3=6 Kitchen- 2 no.
		Total 22	Total 22

xv)	Led tube light fittings with LED Tube lights	1 in Office 1 in drawing room 1 each in dining room 1 in Family Lounge 1 in each bedroom	Office- 1x1=1 Drawing Room- 1x1=1 Dining Room- 1x3=3 Family Lounge- 1x1=1 Bedroom- 1x3=3
		Total 9	Total 9
xvii)	Modular switches	Yes	Yes

3. LED recessed/surface/wall/suspended/down lighter shall be used for internal and external electrical works of FTA, Campus AND lighting the displays is to be provided Design and selection of Lighting fixtures would be in line with indicative BOQ as these have been selected as per architectural requirements and technical data sheets and samples of Lighting fixtures would need to be approved by Engineer-in – charge before actual procurement. Specialized lighting design for office & rooms shall be provided. Recessed LED panel/down lighter to be used for false ceiling and suspended/wall/ceiling mounted shall be provided as per requirement. Led decorative Spot Lights, Picture lights are to be used in Officer's & other Mess, Auditorium reception area, Room, Passages, Corridors and as per site requirement. Decorative LED lights, LED Wall washer etc. are also used as per site requirements. Lift Shaft shall be provided with basic light points and power sockets for maintenance at every landing. Emergency lighting shall be provided to cater the immediate visibility requirement during transition of load from Mains to DG set in case of a Mains supply failure. Facility of Energy metering shall be provided at every distribution points (like Light & Power floor Panels) by using Digital multifunction meters at various main panels & Floor Panels, plumbing panel, fire pump panel, lifts panel, & common area lighting + power panels to monitor, voltage, current & KWH Consumptions.

For all Office Buildings where UPS Back up are mentioned above shall have following coverage:-

The UPS backup emergency lighting will be provided to be put on within 1 sec of the failure of the normal lighting supply.(Office Buildings, Mess/guest house and auditorium etc as mentioned in UPS Chart) :-

- b) At each exit door,
- c) Near each change of direction in the escape route,
- d) Near each staircase so that each flight of stairs receives direct light,
- e) Near any other change of floor level,
- f) Outside each final exit and close to it,
- g) Near fire-fighting equipment, and
- h) To illuminate exit and safety signs as required by the enforcing authority.

13.2.4. Energy Conservation Measures

Efforts shall be made to employ equipment, fixtures & systems which will conserve energy. Following shall be considered towards energy conservation:

1. Use of transformers with NO LOAD & ON LOAD watt losses as per ECBC.
2. Using energy efficient light fixtures with good photometric properties & Lighting Management.

3. Using Ceiling mounted P.I.R. Sensor, Occupancy Sensor Light Level Sensor with coverage range of 6 & 20 meters.
4. DALI Dimming Gateways for maximum 0-15 group of DALI drivers in auditorium,
5. Using occupancy sensors for switching on/off a group of 6-8 Lighting fixtures (as per circuit) at DB level . Using in common spaces, Toilets etc.
6. Ceiling fans energy efficient (BLDC Fans) / exhaust fans (as per circuit) at DB level shall be used.
7. Putting external lighting control on time switch / timer control along with lighting control system for External lighting and Façade Lighting.
8. Using time switch control / timer control for Stilt/Ground floor parking lighting.
9. Employing LED light sources for all of the external lighting fixtures.
10. Employing solar powered lighting for part of the external lighting fixtures.
11. Using high efficiency motors 'EF1' for pumps & ventilation fans.
12. Capacitors shall have a long life in excess of 150,000 hours with low losses in the range of 0.2 watt / KVAR.

13.2.5 Role of Lighting:-

Scope of work under this section shall include supply inspection/testing at suppliers/manufacturer's premises at site, receiving at site, safe storage, transportation from point of storage to point of erection, erection and commissioning of light fittings, fixtures and accessories for back of the house area including all necessary supports, brackets, down rods and painting etc as required.

The role of lighting is manifold while the obvious application is to help people to see and perform their particular task. Lighting plays a critical role in enhancing space, in improving user productivity and well-being. Light constitutes an element of fundamental relevance for the design of spaces and therefore it plays a significant role. It facilitates quick and accurate work. It contributes safety of workers. It creates a comfortable visual environment.

Good Lighting includes:

- a) Occupational eye-strain and risk of accidental injury.
- b) Agreeable luminous environment.
- c) Different illumination levels for different tasks Lighting is a key enabler for Green Certification aiding compliance for following generic criteria
 - a) Auditorium and Officer's Mess and SO Mess room, minimizing lm/w - using most efficient light source.
 - b) Minimizing light spill - using most efficient/appropriate optical system.
 - c) Minimizing Energy Wastage - using motion controls.
 - d) Use of 24 hrs, time control for all external lighting.
 - e) Design Innovation - Apply innovative concepts and technologies. Light tuning to synchronize with human circadian rhythm to maximize productivity, data management and analytics for maximizing space utilization, fault management and minimizing own time.
 - f) By using LED lights with DALI dimmable with controlled in sitting area of Auditorium building and also shall be used. by occupancy+ Lux sensors for various scene in common areas like Toilets, corridors and passages of Auditorium..
 - g) Lighting for all exterior applications need to have on astronomical clock/ timer as per Lighting policy to be designed for various areas to be able to achieve a balance between optimum energy saving and safety of occupants .
 - h) All common area in all office, buildings use of occupancy or motion sensor.
 - i) The Contractor has to comply all the specific requirement at their own cost such as barricading the site at required height, covering the construction material, sedimentation tank, conserve the top soil, arrangement of wheel wash for all inward and outward vehicle, segregation of all scrap material, disposal of hazardous extract generated during construction at appropriate place etc.
 - j) Interior lighting systems in auditorium and Mess/Guest House buildings shall be equipped:-
 - a) Table lamps, floor lamps, picture lights and mirror lights in all Mess /Guest rooms.

- ii) All lights in toilets.
- iii) Wardrobe of all Mess /Guest Room in-built light which will operate with opening of wardrobe door in guest house only.
- iv) All lights in kitchen, dormitory and general utility areas.

Auditorium Sitting Area lighting Design:-

- a) 2000 Lumens Antiglare Controlled Beam Dali Dimmable Down lighter shall be used in sitting Area.
- b) DALI Controller for 3 DALI outputs up to 115 DALI devices including 3 x 20 A feed through Switched circuits for DALI driver.
- c) Relay controller for robust control of switched loads up to 20 A inductive need to be supported.
- d) Touch Panel for Control of the illuminate of the down lighter.
- e) Programming module for Controller and the Touch Panel compatibility.
- f) Network Gateway for Passive integration to a PC or RS232 system.
- g) Networked Touch screen for Advanced automation and control.

13.2.6 Energy Efficiency:-

- i.) Ensure that the project meets the mandatory requirements of ECBC* & all fans must be BEE star rated.
- ii.) Peak heat gain through building envelope (for each AC individually) should meet Building Envelope Peak Heat Gain Factor thresholds.
- iii.) 100% of outdoor lighting fixtures (lamps + lamp housing) should meet the luminous well energy efficient.
- iv.) All lamps + lamp housing must demonstrate luminous efficacy of at least 100 lumens/watt.

13.2.7 EMERGENCY LIGHTING INSTALLATION

Emergency lighting will be powered from a source independent of that supplying the normal lighting.

Escape lighting will be capable of

- a) Indicating clearly the escape routes,
- b) Providing adequate illumination along such routes to allow safe movement of person's toward and through the exits,
- c) Ensuring that fire alarm call points and fire-fighting equipment provided along the escape routes can be readily located.

The horizontal luminance at floor level on the centre line of an escape route will be not less than 10 Lux. In addition, for escape routes up to 2 m wide, 50 percent of the route width will be lit to a minimum of 5Lux.

13.2.8 NOTE:-

For the purposes of this clause 'near' is normally considered to be within 2 mtr. Measured horizontally.

Emergency lights through centralized UPS system with 30+30 minute battery backup (As per NBC) shall be provided for 50% of the Stairways and 10% of circulation space, corridor, lift lobby, car parking area (if required) plant room and all the aviation lamps shall be provided. Self-illuminated Exit Signs shall be provided on all entry and exit locations.

Emergency lighting systems will be designed to ensure that a fault or failure in any one luminary does not further reduce the effectiveness of the system.

The luminaries will be mounted as low as possible, but at least 2.2 mtr. Above the floor level (except in stage & sitting area of Auditorium) .Signs are required at all exits, emergency exits and escape routes, which should comply with the graphic requirements of the relevant Indian Standards.

It is essential that the wiring and installation of the emergency lighting systems are of high quality so as to ensure their perfect serviceability at all times.

The self-powered emergency lighting system will be capable of continuous operation for a minimum duration of 2 hrs. Even for the smallest premises.

The emergency lighting system will be well maintained by periodical inspections and tests so as to ensure their perfect serviceability at all times.

13.2.9. SYSTEM DESCRIPTION:-

a) Emergency exit signage will provide visual indication of egress paths in case of an emergency or power failure.

b) The emergency lighting will be designed to achieve an average illumination of not less than specified in NBC.

c) Emergency Luminaries will be provided, but not limited to, the following areas:-

i) Corridors and stairwells

ii) Security room/fire command room

iii) Telephone equipment rooms

iv) Electrical rooms& plant rooms

v) Public toilets

vi) Main lobby

13.2.10 TRACK LIGHT:-

3W/ 6W/ 9W **Focus light** shall be provided for art pieces to be highlighted within pre function area, VIP rooms of Mess, all impotent location of Auditorium, VIP Room, reception, lobby, as well as outside the building for areas such as landscape, play yard, etc.

Good protection against water and dust ingress and impact,

Provision of **LED wall washer light** indoor& outdoor application (IP-65 & IP67) (warm Light) Grey Colour energy saving wall light 7 W LED packed with features applications (3000/4000K) shall be used all important buildings of FTA Campus or as guided by client.

13.2.11. Step light (warm Light) LED 3 W step-light is IP44 easy to install, maintain and comes with suitable mounting box, energy saving step light grey colour packed with features applications (3000/4000K) for Architectural: accent , Good protection against water and dust ingress and impact, with all accessories. (Indoor& outdoor application of Auditorium Step).

13.2.12 Illumination level recommended for different section of building is as follows:-

Sl. No	Area	Illumination level, lux	Height of measurement(m)
1	Corridors and lift lobbies	150/200	1.2
2	Main Entrance	200/300	1.2

3	Toilets	100/150	1.2
4	Pantry Area/ Cafeteria	300	.85
5	Stair	100/150	.85
6	Store room	200	At shelf level
7	OFFICE/ROOM	500	.85
8	Car Parking & Adjoining Area	50	1.3
9	Halls/Auditorium	400/500	Double & Single.
10	Rooms	300/350	1.2

13.3. EXTERNAL LIGHTING:

13.3.1. High efficiency LED lighting fixtures shall be provided for external road lighting, compound/landscape lighting including Hybrid Solar Street Lighting. The lighting control /operation of external Lighting shall be automatically controlled with digital timer control switch through outdoor type Feeder Panels. External Lighting proposed shall be the combination of conventional wired external lighting Poles & Hybrid Solar street lighting in 6 mts. Octagonal G.I. poles with 60 w Hybrid solar street light (All in One with three days backup).and shall also be connected with campus elec. Supply through Al. armored cable.

Time Controller for outdoor lighting fixtures (External light fixtures, Street Lights, Post off Lamps& Bollards) with time control switch and modular automatic change over.

SOLAR ALL-IN-ONE STREET LIGHTING WITH HYBRID SWITCH 60 W

40 nos. All Hybrid Smart Integrated Solar Street lights shall be of 12 V DC 60W hybrid Switch Smart integrated Solar Streetlight with built in Mono Crystalline Panel, Battery- Lithium Ferro Phosphate, LiFePo4, with Integrated MPPT Charger Controller, dimming profile and PIR Sensor with Colour temp. 6000-6500K System efficiency 150-175 lm/W Warranty 3 Yrs against manufacturing defect with Front Cover UV stabilized Polycarbonate LED Burning Hours >50,000 hrs. @ L70 Battery Capacity>170Wh, Dimming:- 50% after 5 hours with Three days back up recommended pole height 6 Mtrs. Octagonal Pole and and LM 79 and LM 80 reports need to be submitted with all accessories. All Solar Street Lights shall be also connected through power supply with 4 C 16 Sq mm Al. AR. Cable. (All 60 Watt t Hybrid Solar Street light shall be installed on 6 Mtrs. Octagonal Poles.)

Rated Power 60 W

Charge Controller In built

Efficiency > 90%

LED Make Cree / Lumileds / Osram/ Nichia

LED viewing angle 120°

Color Temperature 5700 K

Luminous Efficacy > 125-175 lumens / watt

LED Efficacy 150 Lumens / watt @350 mA

Life Span > 50000 hours

Dimming 50% after 5 hours

CRI > 70 Ra
Driver In Built DC- DC type
Driver Efficiency >90 %
Body Die Cast Aluminum Body with brand / Logo Embossed
Heat Sink
Optimized thermal design to ensure maximum life to LED.
Dust and Water protection IP 65 Standards
Microprocessor based MPPT Charge Controller Details: In Built
Rated Capacity 12V, 7.5 A
Type MPPT
Solar charging current Up to 7.5 Amps continuous
Idle Current Consumption Less than 20 m Amps
Low-Voltage indication Red LED
Charging indication Green LED
Temperature compensated
charging and discharging
Works well in cold and hot environments
Polarity protection
Designed to withstand the application of reverse
battery polarity and reverse panel polarity
:

13.4.Lightings Pacifications:-

13.4.1. For Public Area staircases, Building, suitable LED lighting will be selected in accordance to **IS-3646, NBC**. The average illumination levels are as per below.

LIGHTING PARAMETERS	CUSTOMER SPECIFICATIONS
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Avg. Lighting Level over calculation surface (lux)	a. Office Spaces – 300-500 b. Guest rooms.- 300-500 c. Wash rooms-50-100-150 d. Passages-50-100-150 e. Electrical & Control Rooms-100-150-200 f. Outdoor Street and Landscape-5-10-15 g. Staircase - 100~150lux h. Car park - 5~20 lux i. Plant rooms - 150~200lux j. Public area - 150~200 lux l) k. Driveways & Ramps - 20~30~50 lux l. Elevator Lobbies - 150~200 lux
Uniformity (E-min/E-avg.), E-min/E - max)	Based on application (Min 40%
Color Temperature (Tc)	3000K/4000K/6500 K
Color Rendering (Ra)	>80

13.4.2. ALL-IN-ONE STREET LIGHTING with Hybrid Switch

All in One Solar Street Light Shell be **12 V DC 60W** hybrid Switch Smart integrated Solar Streetlight with built in Mono Crystalline Panel, Battery- Lithium Ferro Phosphate, LiFePo4, with Integrated MPPT Charger Controller, dimming profile and PIR Sensor with Colour temp. 6000-6500K System efficiency 150-175lm/W Warranty 3 Yrs. against manufacturing defect with Front Cover UV stabilized Polycarbonate LED Burning Hours >50,000 hrs. @ L70 Battery Capacity>170Wh, Three days back up recommended pole height 6 Mtrs. HDG Tubular pole (cost inclusive of 6 Mtrs. with base plate welded at bottom 300mmx300mmx8mm thick for each set) and also it should be interconnected with hybrid on line Roof Top Solar system of campus for that all required accessories for connectivity are to be executed by the vendor (like 2X2.5 Sq.mm Copper cable with 25mm UPVC pipe in buried trench.(LM 79 and LM 80) reports need to be submitted with all accessories. (Includible of 6 Mtr GI Octagonal pole, with base pale and fixing arrangement solar street light inclusive of copper cable, UPVC pipe, buried trench etc.) All above all in one Solar Street Lights shall be also back up with campus AC power supply.

14. Gas /Fire Suppression system:-

14.1. As we know that Electrical Panels/enclosures are backbone in any Infrastructure and building for operation of all utilities. In some cases the panels/enclosures might be a single and small panel while in others it may involve a large room containing electrical cabinets LT Panels which are responsible for major electrical operations. It is also aware that, if a fire occurs in any of the cabinets, it would typically destroy the contents, but unchecked fire could take the room or even the building, costing money and down time.

- 14.2. Regardless of the number of enclosures in the State-of -the-Art Novec 1 230 Automatic Fire Detection and suppression Systems offers a non-electric, modular, self-contained, reliable and cost effective method to increase the fire protection of these areas by early detection and suppressing the Fire at the point of origin in the cabinet itself.
By using Novec 1230 Agent you get:
20 Years Blue Sky Warrantee against any regulatory bans or restrictions.
Facilitation in LEEDS Rating for Green Buildings.
Environment Friendly agent.
No refilling required for 30 years.
- 14.3. **MAKES:** Firetrex, Trace fire, Safe fire.
- 14.4. So for safety and protection point of view all LT Panels of all Non-residential Buildings must have Gas (Fire) Suppression system by using Novec 1230 Agent.
- 14.5. Contractor should provide all engineering design and materials for a complete agent suppression system including FK-5-1-12 storage cylinders with steel bracket, extinguishing agent, detection tube, cylinder valve and associated accessories including but not limit to; adaptors, pressure switch, tube fittings etc, required for complete operation of system.
- 14.6. All necessary safety requirements such as warning signs, discharge alarm shall be part of system.
- 14.7. The necessary nomenclature such as pressurization level, agent volume, gross/net weight of cylinder shall be clearly marked on cylinder.
- 14.8. **GENERAL SITE CONDITIONS:**
 - i) Max. Ambient Temperature: 45 degree C and 50 degree C (designed)
 - ii) Min. Ambient Temperature : 4 degree C
 - iii) Max. RH: 97%
 - iv) Min. RH: 30%
 - v) Altitude: 1000 meters

Electrical Panel Protection System: This includes Supply, Installation, Testing and Commissioning of FK-

5-1-12 (Dodecafluoro-2-Methylpentan-3-one) / Novec-1230 or equivalent gas Suppression system in accordance with the Contract Documents. Main LT. Panel, Main Panel for Auditorium , APFC Panel, Fire Pump Panel, Plumbing Panel, HVAC Panels, Panels For AHU, and other selective panels if required.

14.9. Scope of Work:-

- a) Supply, Installation, Testing and Commissioning of clean Agent (Novec 1230/ FK5-1-12 or equivalent) Fire Suppression system designed to provide a uniform concentration within the electrical panels in accordance with NFPA 2001 and requirements of the contract documents).
- b) Provide all engineering design and materials for a complete agent suppression system including FK-5-1-12 storage cylinders with steel bracket, extinguishing agent, detection tube, cylinder valve and associated accessories including but not limit to; adaptors, pressure switch, tube fittings etc. required for complete operation of system.
- c) All necessary safety requirements such as warning signs, discharge alarm shall be part of system.
- d) The necessary nomenclature such as pressurization level, agent volume, and gross/net weight of cylinder shall be clearly marked on cylinder.

- e) Prior to supply of material at site. Contractor must submit following documents for approval of Engineer-in-charge.
- f) Drawing in A-3 size, clearly showing the panel, routing of tube inside the panel, location and fixing arrangement of cylinder & system components.
- g) All doors and holes in the enclosed/equipment's should be closed or sealed to maintain the tightness of enclosure.

14.10. System Description:-

- b) The detection tube shall be fixed with cylinder valve at top of cylinder. The tube shall be pressurized with dry nitrogen. In case of reach of pre-determined temperature (100-120 degree C), the tube shall rupture gas shall be released from tube over the protected area.
- c) Pressure Gauge with dual Pressure Switch points, one for leakage and another for discharge to be provided for automatic signals in case of system pressure falls at 9 bar (leakage) and 5bar(Discharge) .This system to give output to stand alone hooter cum flasher.
- d) The Extinguishing Agent shall be stored in cylinder as liquefied compressed gas, super Pressurized with dry nitrogen at 15 Bar.
- e) The stainless steel cylinder shall be equipped with brass valve, pressure gauge (to monitor agent pressure) and isolation valve for maintenance purposes. The cylinder bracket shall be of steel Construction with quick release clamp.
- f) The detection tube shall be installed throughout the compartments of panel. The location and spacing of tube shall be above the hazard, to be protected.
- g) In case of fire, the tube shall rupture at a point. The rupture of tube shall result in formation of discharge point and release the agent in uniform pattern.
- h) With system activation, a signal should be generated via Audio Visual Alarm installed at convenient location as per Engineer-in-Charge.
- i) The system must be service for minimum of 5 years.

14.11. System Components:-

The bidder shall provide an under taking from Principle Manufacturer of CE marked product they intent to install, that manufacturer will fully support the bidder for this specific project.

- a) Cylinder of stainless steel construction. Cylinders shall be accompanied by original manufacturers test certificate confirming the contents of the cylinder and must have CE and serial no punched on the cylinder body. Cylinders shall be super pressurized with dry nitrogen to an operating pressure and temperature as per manufacturer recommendations. Furnish a welded steel bracket with each cylinder assembly for holding the cylinders in a saddle with a front bracket piece that secures the cylinders. Cylinder shall be provided with a certificate provided by the company who charge with the FK-5-1-12 gas mixture. The certificate shall be secured around the cylinder with chain fastener.

- i). The cylinder should be manufactured as per TPED directives of EN 3 specifications and tested for
 - ii). Corrosion test as per BS EN 3-8
 - iii). Hydraulic Burst Strength BS EN3-7
- b) Pressure Monitoring Device - Each cylinder shall have pressure gauge integrated dual low-pressure switch to provide visual and electrical supervision of the cylinder pressure. The low-pressure switch shall be wired to the Audio Visual Alarm to provide audible and visual trouble alarming the event of drop of pressure. The pressure gauge shall be colour coded to provide an easy, visual indication of cylinder pressure.
- c) Detection Tube - LPCB/UL/CE approved to be Red Colour and pressurized at 15 Bar. The Detection Tube to rupture between (100-120oC). The Tube should pass following test as per ISO-62
- I. Moisture Absorption 23Deg Celsius at 50% Relative humidity = less than 1
 - II. Water absorption immersion at 23Deg Celsius= less than 2
 - III. Hydraulic Bust Strength of the Tube must be = 50 bar.
- d) Extinguishing Agent - FK-5-1-12 (Dedecafluoro-2-Methylpentan-3 One – CF₂CF₂C (O) CF (CF₃)₂)
- I. The agent shall not contain any Hydro fluorocarbons (HFC).
 - II. The ozone depletion potential should be zero.
 - III. The Global warming potential should be equal to or less than 1.
 - IV. The Extinguishing Agent should be UL Listed & FM approved
 - V. The extinguishing agent should be filled in an UL Listed or FM or PESO approved filling station.
 - VI. The extinguishing agent must not be in touch with any corrosive metal to avoid corrosion in long run.
- e) Valve - Valve must be brass forged or Stainless Steel. The valve must be approved from Pie/BAM Europe/UL/VDS/LPCB. It should have pressure relief device set at 30 bar, port for pressure gauge with dual pressure switch.

14.12 Installation:-

- a. The system shall be installed on basis of approved drawing with no more than 40 meters of tube in one system complying to no more than 10 meter of single largest length of tube end from valve.
- b. Maximum 4 Tee connections are allowed in one system.
- c. The installation / final connections shall carry out in direct supervision of representative of Manufacturer/authorized distributors.
- d. The installation contractor should be a proven source with minimum 5 years of installation of Trace Tube Systems in India.
- e. Cylinder shall be located so that they are not subjected to mechanical, chemical or other damage.
- f. All system components shall be capable of withstanding heat of fire and severe weather conditions.
- g. Detection Tube to be properly secured inside the panel by Clips/Tie etc.
- h. The Detection Tube outside the panel should be protected in flexible conduit.
- i. Inspection certificate should be pasted on cylinder clearly marking next due date of inspection.

MAKES: Firetrap, Trace fire, Safe fire.

15. LIFT MACHINES:-

Power supply to MRL Gearless Passenger lift M/c of required capacity is proposed to be tapped from the source LT PANEL of Ground floor through suitable size PVC insulated XLPE AL. Ar. Cable to lift's M/c Panel which is to be Located in Lift M/c room or as directed by E/I. . Lift M/c Panel is to provide with suitable rating of MCCB as incomer and MCCB as outgoing for Lift machine and MCB for Lift M/c Room Power , light points and lift duct/lift well.

MRL Gearless passenger lift having contract speed of 1.0 mps serving different floors in the lift shaft as per detailed specifications enclosed and as under:-

All elevators shall be equipped with automatic elevator retrieval system which shall, upon signal from the central fire alarm system or manually operated key switch shall, open their doors and remain at the ground floor. All floor and car buttons shall be rendered ineffective until the system is manually reset on all floors. A smoke, cause all elevators to be dispatched automatically to the ground floor. Elevators detector shall be placed in close proximity to each elevator bank on each floor. If this device senses smoke, system shall land elevators at a preselected, alternate, landing floor. A key operated switch shall be provided at the ground floor to activate and reset the retrieval system manually.

a. Emergency operation shall return the elevator/s to a designated floor, most commonly, the Lobby, by means of a signal from the automatic fire alarm system.

b. On initiation from the fire alarm system, all elevators travelling away from the lobby floors shall stop and reverse without opening their doors indicating fire mode-operation to passengers, ignoring all car and hall calls and express to the lobby or assigned floor.

c. Cars travelling toward lobby shall express to lobby ignoring all car and hall calls. Cars parked on intermediate floors shall close their doors and express to lobby. Cars parked at lobby shall open their doors ignoring car and hall calls. All hall and car buttons shall extinguish and shall accept no further hall or car registration.

d. All elevators shall, in addition and where allowed by code, be provided with a key operated switch where designated by the Architect, for use by in-house fire brigade

The elevator tendered shall coordinate and cooperate with the fire detection & alarm system supplier / installer for his system interfacing responsibilities.

15.1 AUTOMATIC RESCUE DEVICE:

The ARD shall have the following specifications.

ARD should move the elevator to the nearest landing in case of power failure during normal operation of elevator. ARD should monitor the normal power supply in the main controller and shall activate rescue operation within 10 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 operation as soon as normal power supply resumes.

In case the normal supply resumes 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. All the lift safeties shall remain active during the ARD mode of operation.

15.2 Codes and Regulations for Lifts:-

The latest edition of the following statutory codes, regulations and specifications will be complied with:

- A. Local authority requirement /Vertical transportation Department' recommendation.
- B. BS 5655 Part 1 to Part 13 safety rules for the construction and installation of electric lifts, and hydraulic lifts published by the British Standards Institution (BSI).
- C. N81 Part 1to Part13 safety rules for the construction and installation of electric lift sand hydraulic lifts, published by the European Committee for Standardization (CEN).
- D. BS 7255 Code of Practice for safe working on lifts, published by the British Standards Institution (BSI)
- E. IS: 3696 (Part I) -1966 Safety code for scaffolds and ladders: Part IS scaffolds.
- F. IS: 3696 (Part II) -1966 Safety code for scaffolds and ladders: Part IIL adders.
- G. Recommendations of CIBS guidebook.

Other Detail specification of Lift can be derived from CIVIL DBR.

16. EARTHING NETWORK:-

Earthing with Maintenance free Chemical Earthing system/GI Earthing System/Copper Earthing system, as required, shall be provided by the Contractor for earthing sub stations equipment, Electrical Panel boards, UPS and other Equipment/ installations in each building. Earthing shall be in conformity with provisions of rule 32, 61,67 &68 of Indian Electricity Rules 1956 & as per IS-3043 as amended up to date. Copper/GI earth strips shall be used for connecting the Electrical equipment with Earth pits as required. Earth Leakage circuit breakers shall be provided in the DBs for individual units. Separate and distinct earth station switch electrode shall be provided for the following:

Complete electrical installation shall be earthed as per IS –3043. All metallic bodies of electrical equipment/ fixtures shall be bounded to the normal earth mass through a network of earthing strips/ conductors. Neutral points of transformers and DG sets shall be earthed separately.

Considering the hazardous nature of electrical energy, safety measures in using this energy is of paramount importance, Earthing system shall be provided in accordance with Indian Standards IS: 3043-1987 & other statutory regulations. Earthing shall be in conformity with provisions of rule 32,61,61, 67 &68 of Indian Electricity Rules 1956 & as per IS-3043 as amended up to date. Copper/GI earth strips shall be used for connecting the Electrical equipment with Earth pits as required. Earth Leakage circuit breakers shall be provided in the DBs for individual units. All non-current carrying metal parts forming the Electrical System shall be connected to the Earthing System as per the requirements. The earthing system shall be so designed that resistance of the earthing network shall be less than 1.0 ohm at any point of the system. All the Bus-Ducts/ Cable Trays shall be provided with suitable size of 2 nos. G.I. strip in full length. Separate Earthing shall be provided for Computers/ UPS Network & entire earthing shall be insulated with PVC tape.

Separate earthing grid shall be provided for the earthing of Panels, &earthing of Data/ Telephone Systems and lightning protection system. EXTERNAL LIGHTNING PROTECTION SYSTEM

AS PER INTERNATIONAL & NATIONAL STANDARDS- IS IEC 62305-3 & NBC 2016 CODES.

The proposed Earthing System can be divided into three sections:

I. Sub Station Equipment Earthing:

A. Transformer Neutral Earthing:	Copper Earthing
B. Transformer Body Earthing:	G.I. Earthing
C. H.T. Switchgear Earthing:	G.I. Earthing
D. D.G. Set Earthing:	G.I. Earthing
E. D.G. Set Neutral Earthing:	Copper Earthing

II. Panel Earthing

a. LT Panel Earthing (Body):	G.I. Earthing
b. Distribution Board Earthing:	G.I. Earthing
c. Equipment Earthing:	G.I. Earthing
d. Lightning Protection:	Copper Earthing
e. UPS Earthing.	Copper Earthing
f. Any other equipment as required.	

III. Lighting/Power Circuit Earthing: Copper Wire Earthing.

IV. Copper Earthing for Server Rack & EPABX Machine. 2 nos. Each. T-N-S Earthing system will comply with IS3043, NBC and local Authority standards. All main plant rooms, electrical rooms, lift motor rooms and telecom rooms will be provided with dedicated earth bars where appropriate. All equipment within the vicinity will be connected to the earth bars through appropriately sized earth cables, which will be sized in detail design stage. The generator room will also be provided with earth bars.

17. LIGHTNING PROTECTION SYSTEM:

Lighting protection of Fire Training Academy At Bitha, Patna, Bihar shall be provided as per IS/IEC62305-1:2010 (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 lightning protection system will be provided in all the buildings as per NBC 2016 Standards, using single prone finials, horizontal and down comer earthing strips of suitable size, terminating in the Earth Pits. Aviation Obstruction Light (AOL) shall be provided in various buildings as per Civil Aviation regulations, NBC norms & CPWD Specifications as applicable.

All Aviation Obstruction Lights (as required) shall be fed with UPS supply only.

18.1. REFERENCE STANDARDS:

IS: 12834:1988(reaffirmed 2000)	Solar Photovoltaic Energy Systems – Terminology
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IEC : 61215 Ed 2 or Latest	Crystalline silicon terrestrial photovoltaic (PV) modules– Design qualification and type approval
IEC: 61730 Pt. 1 &2	Photovoltaic (PV) module safety’ qualification – Part 1: Requirements for construction Part 2: Requirements for testing
IEC: 61701	Salt mist corrosion testing of photovoltaic (PV) modules.
IEC:60904-1(2006)	Photovoltaic Devices- Part-IS: Measurement Of current-Voltage Characteristic.
IS: 9000	Basic environmental testing procedure for Electronic and electrical items.
IEC:60068	Environmental testing
IEC 61723 Ed1.0	Safety Guidelines for grid connected photovoltaic systems mounted on the buildings.

20.6 ACCESS CONTROL SYSTEM:-

Access control system for building security comprising of Magnetic controlled through Car Readers and biometrically controller, E&M Locks, Reader, Smart Cards, cabling, recording, display system, hardware and software support as required. All sensitive areas of all office buildings, Mess, Auditorium, Conference/Meeting Hall and as places as required by the client. IP based door controllers shall be provided as required. Each controller will control four nos. of magnetic locks which can be single or double door leaf. The centralized control will be managed through a Server to be installed in main server room. For overriding purpose Push Button will be provided inside the rooms.

Access control system for building security comprising of following:-

- a) Access intelligent Controller support 4 Weigh and interface or up to 8 serial interface on RS 485 bus technology, 8 input & Output port as per the specification with enclosure power supply, & Maintenance free Batteries with 30 minutes backup.
- b) E & M Locks, Reader, Smart Card, cabling, recording display system, hardware and software support as required.
- c) Access Control & Time Attendance software: Access Control system software Access Professional Edition- Basic License with 1 Clients, 300 Readers, 5000 Card holder license with features like:
 - 1) Integrated Video Verification-
 - 2) Integrated Offline Locking System (OLS)
 - 3) Multi-user system with definable user profiles
 - 4) Attendance tableau
 - 5) Attendance report in excel
 - 6) Includes Badge Designer for Photo ID Badge printing.

The system will be capable to record the biometric attendance of the authorized personnel and the records will be stored in server. Contractor shall calculate the quantity of Access Control as per scope of work and full coverage requirement. All Monitoring and backend system must be designed as per the min specification given here. For Access Control Monitoring shall be done in 55 inch Full HD Monitor of CCTV installed in work station.

20.7 MASTER ANTENNA TELEVISION SYSTEM (GUEST HOUSE)

- a) The master antenna television aerial (MATV) system shall be designed to provide in reception, all Rooms of Mess, Residential Blocks Common areas, and also as per site requirement
- b) Provide dish TV as per convenience.
- c) All type of Mess/guest house in all rooms, reception will have TV, 43" Full HD LED Panel for normal rooms and all Reception areas shall have 43" 4k LED Panel. But in all residential Building will TV out let wirings shall be provided as per CPWD norms or GPRA norms.

The system shall include supply and installation of Centralized MATV Common areas antenna TV system for entire the campus of FTA at Bihta, Patna, Bihar. The system comprises of a shared coaxial cable network that transmits analogue television signals to downstream. 43" LED Flat TV shall be provided in common reception/waiting areas etc of all Mess/Guest house.. MATV system shall be interconnected with Information Display system.

The master Antenna for TV shall be provided at the top most convenient point in any building with a suitable room on the top most floor or terrace for housing the amplifier unit. From the amplifier room, conduits should be laid in recess to facilitate drawing coaxial cable to individual areas. Suitable Tap Off boxes shall be provided in every room.

The specifications of the same are listed below:

- a) **Conducting**-Conducting for MATV system shall be carried out in PVC Conduit.
- b) **Outlets** - All MATV outlets shall be provided with modular range of cover plate, box and coaxial outlet. Cover plate shall match in shape & finish with other light and power accessories.
- c) **Junction Box**: Suitable size of GI box shall be provided for termination of conduit for MATV system.
- d) **MATV Line Amplifiers**: The MATV Amplifier shall be housed in a high frequency resistant Aluminium housing at the highest level (terrace level). The MATV Amplifier shall have an in built variable equalizer and Alternator for site signal condition adjustments.
- e) **Coaxial Cables**: The coaxial cable shall be of wideband type.
- f) **Tap Off / Splitter**: These shall be of ultra-wide bandwidth and of hybrid type. These shall have a flat frequency response over the entire operating range. These shall have aluminium cast housing for high frequency radiation resistance. The Tap offs shall be in one way, two way and four way configurations.

Contractor shall calculate the quantity of 43" LED Flat TV as per scope of work.

20.8 FIRE DETECTION/ALARM SYSTEM:-

Addressable Intelligent fire detection and Alarm system of latest technology with Fire alarm panels, multi Sensor detectors, smoke detectors, heat detectors, beam detectors, response indicators, manual call point and hooters, light strobe etc. shall be provided. It shall meet the requirement of NBC 2016/NFPA/CPWD Specifications/ State By laws. License/Approval of Local Fire Authorities shall be provided for the complex. There shall be the proper Zone of the building considering the Non Critical & Critical areas of buildings. Repeater panels shall be provided in various buildings as required.

There shall be Independent fire panel for (FTA) at Bihta, Patna, Bihar etc. and all fire control panels shall be interconnected with each other. Fire Detectors and devices of other buildings/ blocks i.e. Sub Station Building, Pump House, etc. shall be connected to Fire Control Panel of the main building through necessary cables in DWC HDPE pipes. The monitoring of whole complex

shall be in the Main Fire Control Room of Convention center. For Central Monitoring of all the Fire Panels, necessary devices like PC, Printer, modules & Software etc. of latest technology with minimum 1 TB hard disk shall be provided in the Control room. Fire Alarm control Panel shall not have more than 100 devices and 100 detectors in one loop.

The details of the system proposed shall be as follows:

- a. Addressable intelligent dual type Fire Detectors is suggested.
- b. Detectors should be with inbuilt short circuit isolator & automatic addressing. Detectors should be installed as per coverage defined in NFPA 72. It should include all rooms, halls, storage areas, basements, attics, lofts, and spaces above suspended ceilings including plenum areas utilized as part of the HVAC system. In addition, coverage should include all closets, elevator shafts, enclosed stairways (Directional Sounder), dumbwaiter shafts, chutes, and other subdivisions and accessible spaces.
- c. Each detector & devices shall have integrated short circuit isolator.
- d. Suitable numbers of input/ output (C/M) relay modules are suggested for connecting other equipment like Electrical Panels, lifts, fire fighting system, AHUs etc.
- e. Spacing between two detectors shall not be more than 8 Mtrs. or it shall be as per relevant code & manufacture standards.
- f. Cabling shall be with Fire Survival Armoured copper cable.
- g. Suitable addressable loop powered sounders/ hooters for 100db sound level are suggested.
- h. Addressable manual call boxes shall be provided near all exits, stair cases lift lobbies etc. As per relevant Norms.
- i. The Response Indicators shall be used in the waiting areas, Corridors, Common Area, Conference/Meeting Hall Control Room or in large rooms etc. Microprocessor IP based fire alarm control panel (fully redundant) for number of required loops with 24 hrs. Battery backup with LCD display, printer etc. shall be located in the fire control room.
- j. Fire Alarm Panels shall be integrated with PA system and with BMS also.
- k. Two Way communication Fire Fighters Telephone Jack & Handset with necessary accessories are to be provided in all the buildings as required.
- l. Addressable **Monitor Module** for Sprinklers, Panic Bars & other Third Party Inputs. The monitor module shall monitor potential free contacts. The device shall have an LED which shall blink in normal state & gets test action to monitor the health status of the device. Addressing shall be with user friendly rotary decimal switches. Module shall be supplied with mounting plate from OEM for ease of installation & maintenance.
- m. Addressable **Isolator Module** for isolating short/de-wired/loose circuits with automatic resetting arrangement. Isolator Base can also be proposed, however in that case needs to be considered with each detector & module. The device shall have an LED which shall be link in or mal state & get steady on activation to it or the health status of the device. Addressing shall be with user friendly rotary decimal switches. Module shall be supplied with mounting plate from OEM for ease of installation & maintenance.

20.9 PUBLIC ADDRESS SYSTEM (PA SYSTEM):-

PA system shall be provided in Fire Training Academy (FTA) at Bihta, Patna, Bihar as required. Speakers in the Ceiling/Wall shall be provided in corridors, lift lobbies and other common areas as per **NBC2016**/relevant IS codes.

- a. Box type speaker shall be provided in the entrance lobby.
- b. Horn type speaker are suggested in the Ground Floor Exit & Entrance.
- c. Recessed speakers in the false ceiling areas.

- d. Proper zoning are to be done considering the user requirement, critical areas & floor etc.
- e. Control console shall be located in the fire control room with pre amplifiers, amplifiers, CD, DVD/Pen-drive, FM Player & gooseneck microphone.
- f. System shall have the facility to make announcement on all floors simultaneously or on individual floors.
- g. Wiring shall be done with twin twisted tinned copper wire in the conduit.
- h. The system shall be integral with Fire alarm panel and with the BMS also as required.

20.10 SIGNAGE SYSTEM:-

LED Exit/Entrance sign board with concealed in false ceiling, complete in all respect as per drawings, & manufactures specifications with normal Illuminated signage for Toilets, common area, reception pre-function area etc. Illuminated Signage system in Convention Centre should be OEM standard shall be adopted in all FTA Office buildings, Lobby, stairs, fire Stairs, Toilets, common area, Auditorium Hall, Reception, Pre-Function Area, VIP Rooms, Green Rooms, Control Rooms projection rooms, Multifunction room, Conference Halls, etc. Along with Hotel Name plate illuminated signage. The Signage systems shall be electrically operated with minimum 2 hrs batteries backup

20.11 SECURITY SYSTEM:-

BOOMBARRIERS:-

Boom Barrier for car: Electro mechanical parking barrier with all accessories up to 6 meter length. 2 Nos. Boom Barriers up to 6 Mtrs. Length shall be provided at all Entry and Exit Gates of the All the Complex. Push Button Type Control for open & Close the Boom Barrier through high Torque motors operated through 230V AC Supply. In case of power failure the barrier can be raised/lower manually. The Boom length shall be as per the requirement of the road Width. The Opening time varies from 3 sec. to 6 sec. The Control Unit shall be IP 54 protected against rough weather. Auto Boom Barrier Gate to be integrated with UVSS with Barrier type: high speed, Rising speed: 1.3-2.0s Falling speed: 1.5-2.5s, Arm form: 3m, straight-arm, Colour: grey, Arm moving direction: leftward / rightward (adjustable) Input power supply: 220V±10% 50Hz, Anti-failing, IP54.

Anti Fall Radar 79GHZ, Beam width: Vertical 12°, Horizontal 34°, relay output; Preferred

20.21 CONFERENCE SYSTEM:-

An advance Audio Video Conferencing System with 75" LED Display, Digital Control Units, Digital Chairman Unit (wired), Digital Delegates Units (wired), Array Column Loudspeakers, Two-Way 4" Coaxial Ceiling Loudspeaker, Eight Channel Power Amplifier, 4x4 DSP with 4 inputs and 4 outputs, 12 Control Inputs and 6 Logic Outputs, Full HD PTZ Camera supporting 1080p at 60 Frames per Second, Wireless Handheld Microphone, required HDMI, Interconnects & Connectors consisting of XLR, S peakons, TRS, Speaker cable - 2 X 2.5 sq.mm & 2 x 4.0 sq. mm, CAT-6A Cable etc. shall be provided in Meeting Hall of ADMINISTRATIVE BLOCK, FTA, Bihta, Patna.

In addition to that one Wall LED, Wireless Handheld Microphone, Wired Gooseneck Microphone, Speakers, Amplifier, speakers cables, CAT6-A /cable all other required equipment, etc. as required shall be provided in Control Room of Administrative Block, FTA. Bihta, Patna. The conferencing system shall be complete with Audio-Video recording facility. The system shall have flush mounted with wired Chairman/delegate unit on the tables. Each delegate unit shall be shared by two delegates. Chairman unit shall have a priority unit to override the delegates.

For Conference Halls (Meeting Hall) facility of proceedings recording shall be provided with cameras, network recorders, microphones, LED TVS Networks switches etc. along with above mentioned video swathing system for providing video conferencing facilities

DIGITAL CONFERENCE SYSTEM IN MEETING HALL, ADMINISTRATIVE BLOCK, FTA, BITHA, PATNA.

(1 No.) Digital table top Chairman Unit with following specification

Should have microphone push button with integrated LED Must have Removable microphone connector: Digital signal processing, Shielded microphone, immune to mobile phone interference Microphone On/Off button, Loop-through, daisy-chain cabling Patented fail-safe redundancy feature, Concealed conference bus connections, Bi-color bar indicator, 2 digital bus connections (RJ 45 Cable Non Patent), Audio quality 16 bit digital, additional buttons- Priority and Next-in-line. The Priority button silences all delegate microphones and allows only the chairperson to speak. It is possible to precede this function by a chime. The Next-in-line button gives the floor to the next speaker in a waiting list of speakers who requested to speak. Frequency response 25 Hz-15,000 Hz (± 3 dB), The OEM, product and bidder shall not share the common borders with India and adhere to GFR 144 (xi) guidelines of purchase manual with gooseneck Microphone 400mm or better, Transducer principle Back electrets (condenser), Operating principle Pressure gradient, Polar pattern Unidirectional, cardioids, Nominal conditions Bias resistor = 1k2, Vdd = 3.3 V DC, 1 Pa = 94 dB SPL, Max SPL @ 1 kHz 110 dB SPL (1% THD+N), Signal to noise ratio > 67 dB(A), Free field sensitivity (-40.5 ± 2) dBV @ 1Pa, 1KHz included 2mtr shielded patch cord of the same OEM.

(20 Nos.) Digital Table Top Mount delegates unit with following specification

Should have, microphone push button with integrated LED Must have removable microphone connector: Digital signal processing, Shielded microphone, immune to mobile phone interference Microphone On/Off button, Loop-through, daisy-chain cabling Patented fail-safe redundancy feature, Concealed conference bus connections, Bi-color bar indicator, 2 digital bus connections (RJ 45 Cable Non Patent), Audio quality 16 bit digital, Frequency response 25 Hz-15,000 Hz (± 3 dB), The OEM, product and bidder shall not share the common borders with India and adhere to GFR 144 (xi) guidelines of purchase manual with gooseneck Microphone 400mm or better, Transducer principle Back electrets (condenser), Operating principle Pressure gradient, Polar pattern Unidirectional, cardioids, Nominal conditions Bias resistor = 1k2, Vdd = 3.3 V DC, 1 Pa = 94 dB SPL, Max SPL @ 1 kHz 110 dB SPL (1% THD+N), Signal to noise ratio > 67 dB(A), Free field sensitivity (-40.5 ± 2) dBV @ 1Pa, 1KHz included 2mtr shielded patch cord of the same OEM.

(1 Set) Digital Control units

Having following specification control upto 150 Nos. with the help of additional power supply /Master Slave Function, Touch sensor button technology, Digital signal processing, Integrated web server, Integrated Recording two USB connections located at the front of the unit to connect a USB storage device for direct recording of the meeting. If one device is full, the second device will automatically take over. Selectable voice activation (VOX), Fail-safe redundancy technology, Default digital acoustic feedback reduction, Menus and integrated LCD, System volume, On/Off button, Balanced XLR input, 1 Unbalanced RCA input, 2 Unbalanced RCA outputs, 4 Bus connections (4 branches or 2 loops) RJ 45 Connections, LAN connection, Audio quality 16 bit digital The OEM, product and bidder shall not share the common borders with India and adhere to GFR 144 (xi) guidelines of purchase manual.

21.6 GENERAL LIGHTING SYSTEM:-

LED Panel Light

Efficiency: Upto80lm/W or better

Aluminium Die-Cast housing

Beam Angle: 90⁰ or better

Colors: 2000K /4000K/ 6000K

Wattage: 20 Watts or better

Input voltage:100 Volts-265Volts Ac

Working Life: 50000 Hrs

LED COB Light

Efficiency: Upto80lm/W or better

Aluminium Die-Cast housing

Beam Angle: 90⁰ or better

Colors: 2000K /4000K/ 6000K

Wattage: 20 Watts or better

Input voltage:100 Volts-265Volts Ac

Working Life: 50000 Hrs

LED Strip Light

Efficiency: Upto80lm/W or better

Heavy copper PCB to ensure good heat dissipation

Material: PC White finish

LED Count: 40 per meter

Color: 4500K

Wattage: 20 Watts or better

Input Voltage: 12Volts DC

12V Non Dimmable Electronic Transformer.

Electrical Control Panel for General Lighting.

UPS back-up : - 3 phase in and 3 phase out minimum 30 min. back including battery bank.

In addition to above in Auditorium LED type lighting fixtures with DALI Dimmable drivers for all most areas except some exceptions as defined further in built harmonic suppression mechanism shall be provided along with occupancy sensors in corridors, toilets (Common Toilets and Rooms Toilets) etc.

22. GENERAL SPECIFICATION:-

22.1 Technical Requirement

The Agency shall submit 15 days after award of work an undertaking from the OEMs for Specialized Electrical works regarding:

- a) The OEM shall unconditionally support the lowest tendered technically throughout the execution of contract as well as for Maintenance / Comprehensive Maintenance Contract for the useful life of the system, and 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.
- b) The agency must study specifications and conditions carefully. The work shall be executed in close coordination with the progress of building

work.

- c) The work shall be carried out in the following order of preference.
 - i) Indian Electricity rules 2005 & Indian Electricity Act 2003 amended up to date.
 - ii) Technical specifications and list of acceptable makes attached.
 - iii) Relevant BIS standards as modified up to date.
 - iv) CPWD General Specifications for Electrical Works Part - I (Internal) - 2013 & Part-II (External) – 2012. Especially for Residential Blocks
Contractor should also follow the GPRA norms.
 - d) Electrical & LV Point matrix for residences shall be as per FTA Plinth Area Revised Norms. FINAL PAR SUBMITTED & APPROVED.
 - e) For all Buildings, the electrical & LV point detail shall be as per actual requirement and furniture layout as per direction of Engineer- In-charge.
CPWD General Specifications for Electrical Works Part - III (Lifts) - 2013. CPWD General Specifications for Electrical Works Part - IV (Sub-Stations) – 2013. National Electrical Code 2011. Relevant Sections of National Building Code 2016 with up-to-date amendments.
 - f) All equipment shall be delivered with
 - 1. Manufacturer's test certificate,
 - 2. Manufacturer's technical catalogues, and installation / instruction (O&M) manuals.
 - g) Statutory fees/ payments required to be deposited for processing the case, shall be reimbursed by the department

19" 12 U , 600mm X 600mm Equipment rack with complete fan, tray, rack rails, etc. (Approved Makes: Standard as per Direction of EIC)

22.2. Shop Drawings:-

- a) On the award of the work, the Contractor shall immediately proceed with the preparation of detailed working drawings showing the detail of each equipment that are to be installed and the ancillary works that are to be carried out. All the works are deemed to be included in various items of bill of quantities as applicable.
- b) Three sets of all such working drawings duly signed by the head of the planning design department of the tenderer shall be submitted to the Engineer-in-charge for approval to ensure that the works will be carried out in accordance with the specifications and drawings, including such changes as may have been mutually agreed upon.
- c) All the drawings shall be received by the Engineer-in-charge for approval within 04 (Four) weeks from the date of award of work. The approval of the drawings by the Departments / Engineer-in-charge shall in no way relieve the Contractor from his obligations to provide a complete and satisfactory plant installation, testing and commissioning as per intent and purpose as laid down in the specifications. It will be the responsibility of the contractor to ensure that laid down inside conditions are maintained at all times.
- d) Any omissions and/or errors shall be made good or rectified whether or not the drawings are approved. Contractor shall obtain written approval for samples (like grills/diffusers) and other materials before placing the order. Contractor shall guarantee the specified inside conditions at specified outside conditions. Prior to the erection of Equipment, the contractor shall furnish to the employer (2) two sets of a comprehensive manual for all equipment etc. describing all components furnishing a list of spare parts and setting forth in details the instructions for the operation and maintenance of the plant.

- e) The Contractor shall also fix in the Operating/Maintenance Room, neatly typed and framed instructions in details, for the starting and running of the plant.
- f) The Contractor for approval- shall prepare the shop drawings for approval.

22.3 As Built Drawings:-

The Contractor shall submit three sets of paper prints of the as-built drawings one soft copy, showing accurate record of the work as installed to the Client for his reference. The contractor shall also submit three copies of an Operating Manuals in ring binder describing the brief write up on the system installed, operating instruction for all equipments, catalogues, maintenance of equipments etc.

22.4 Instruction / Maintenance Manual:-

The Contractor shall prepare and produce instruction, operation and maintenance manuals in English for use, operation and the maintenance of the supplied equipment and installations, and submit to the Engineer-in-charge in three copies at the time of handing over. The manual shall generally consist of the following:

- a) Description of the Project.
- b) Operating instructions.
- c) Maintenance instructions including procedures for preventive maintenance.
- d) Manufacturers' catalogue.
- e) Spare parts list.
- f) Trouble shooting charts.
- g) Drawings.
- h) Type and routine test certificates of major items.
- i) Six sets of as built drawings along with soft copy of drawings in CD.

5. Repairs / Replacement of Parts during Guarantee

Any defects or other faults which may appear within defect liability / guarantee period of twelve months from the date of handing over the plant in a satisfactory working conditions to the Department (except for normal wear and tear) arising in the plant from material or workmanship not in accordance with the contract specification will be rectified by the contractors free of cost & nothing shall be paid extra on any account.

6. Testing

All testing instruments shall be arranged by contractor at his own cost.

All types of specified & routine tests of the equipments shall be carried out at the works of the EPC Contractor or the manufacturers of the components. The Department shall be free to witness any or all tests, if they so desired. The EPC Contractor has to inform to the Client before dispatch of any material /equipment.

On the completion of the installation, the Contractor shall arrange to carry out various initial tests as detailed below, in the presence of and to the complete satisfaction of the Department / Engineer-in-Charge / Departments, any defect or short-coming found during the tests shall be speedily rectified or made good by the EPC Contractor at his own expenses. The initial tests shall include, but not be limited to the following:

It is clarified that guarantee period shall start after successful completion of commissioning & handing over.

7. Inspections & Testing

All the major equipment may be got inspected & tested before dispatch if desired by the client at the manufacturers work.

The EPC Contractor shall intimate the client minimum 21 days in advance about the date of readiness of Contractor.

The manufacturer of these equipment must have a facility of testing the equipments at the test bed on full load at their works. All the test readings mutually taken shall be recorded & evaluated with the technical data furnished by the Contractor.

8. Quality of material and workmanship

All parts of the equipment shall be of such design, size and material to function satisfactorily under all rated conditions of operation. All components of the equipment shall have adequate factor of safety. The work of fabrication and assembly shall conform to sound engineering practice and based on "Fail Safe Design". The mechanical parts subject to wear and tear shall be easily replaceable type. The construction of the equipment shall be such as to facilitate effortless 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.

22.9 Inspection and testing at site

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

The completed installation shall be inspected and tested by the Engineer-in-charge in the manner as will be laid down by him, in consultation with the agency. All instruments and facilities necessary for the tests shall be provided by the agency.

10. 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 these specifications. Any discrepancy may be brought out in pre-bid meeting.

All electrical fittings/fixture/appliances, to be provided for the work, should have latest minimum 5-starrating (of BEE) as available in market.

22.11. MATERIAL SPECIFICATIONS:

- a) Wires for Internal work PVC insulated copper conductor single core multi Strained Wires as per
- b) Conduits for Internal works Medium grade PVC conduit as per IS-9537 (Part – III)

- c) Switches and socket outlets Plate type modular range of switches, sockets and Accessories.
- d) Distribution Boards (DB) Factory fabricated with copper bus bars and MCBs and ELCBs
- e) Meter Boards & LT Panels OEM/company System integrator fpr TTA Panel & Cubicle type, dust, o bars having degree of protection as per IS: 2147. (as per **IEC 61439-1 &**
- f) L.T. Cables 1.1 KV XLPE insulated, sheathed, armoured aluminium Conductor cabl

23. LIST OF APPROVED MAKE OF MATERIALS

Sl · N o	Description	Approved Makes D.G. SETS
1	DIESEL ENGINE	ENGINES: VOLVO, PERKINS/CUMMINS, GREAVES COTTON, KIRLOSKAR, RUSTON, KOHLAR.
2	ALTERNATOR	CROMPTON, JYOTI, KIRLOSKAR, NGEF, STAMFORD ,KOHLAR.
3	ANTI-VIBRATION MOUNTINGS	AS PER MANUFACTURER STANDARD PRACTICE
4	AMF/SYNCHRONIZATI ON PANEL	OEM OF DG SETS /AUTHORISED SYSTEM INTEGRATOR.
5	M S ANGLE/CHANNEL/ISMB	TATA/JINDAL/RATHI/SAIL
6	PLC (ALTERNATOR)	SIEMENS/L&T/SCHNEIDER/ ALLEN BRADLEY OR COMPANY SYSTEM INTEGRATOR..
7	BATTERY	EXIDE/ PRESTOLITE/AMARAJA/ LUMINOUS
8	OTHERS ITEM	AS PER SUB-STATION LIST

24. LIST OF RECOMMENDED MAKES

Sl. No	ITEM	MAKE

1	ACB (EDO/MDO)	L&T "U"-POWER OMEGA WITH MTX 3.5 AND ABOVE / LEGRAND DMX ³ /M-2 SERIES / SIEMENS - 3WL-ETU-45B/ SCHNEIDER- MASTER PACK NW-6 P.
2	MCCB	L&TD- SINE/LEGRANDDPX ³ /SCHNEIDERNSX/ SIMENS- 3VL-3WL.
3	MCB- C Series 10kA /RCCB- 30mA	LEGRAND- DX ³ /SCHNEIDER- ACTI-9/ SIEMENS- BETA GUARD/ L&T- AU VERSION.
4	DB (DOUBLE DOOR) SP & TPN DOUBLE DOOR VTPN/SDB DB WITH METER BOX	SIEMENS, LEGRAND, SCHNEIDER, L&T
5	CHANGE OVER SWITCH	SOCOMEK, LEGRAND, L&T
6	MULTIFUNCTION METER	SCCHEIDER/L&T/ RISHAV
7	SELECTOR SWITCH	AE, KAYCEE, L&T,
8	CURRENT TRANSFORMER	KAPPA, MATRIX, AE RISHLINE (L&T)
9	INDICATING LAMP	L&T, SIEMENS, KAYCEE
10	PVC INSULATED COPPER CONDUCTOR SINGLE CORE STRANDED WIRES OF 1.1 KV VOLT GRADE (FRLS)	HAVELLS, FINOLEX, LAP, RR CABLE
11	TELEPHONE WIRES (0.5 sq.mm FR PVC insulated copper)	RR KABLE, FINOLEX, HAVELLS, POLYCAB
12	TELEPHONE TAG BLOCKS	KRONE, MATRIX/ AVAYA/TVS/ALCATALE
13	TEL. UN ARMOURED & AR. CABLE	FINOLEX/ POLYCAB/ HAVELLS.)
14	CABLE GLAND & LUG	DOWELL, CAPITAL , STEPWELL _LUGS- CRIMPING TYPE) Confirming to IS : 7098:1988
15	PVC CONDUIT/MS-STEEL CONDUIT	AKG, CAP, BEC
16	PVC CONDUIT ACCESSORIES	AKG, CAP, BEC

17	MODULAR SWITCHES, SOCKETS,	SCHNEIDER-ZENCELO/LEGRAND- ARTIER /HAVELLS (CRABTREE- AMARE)/PANASONIC-/MK- BLENZ.
18	CEILING ROSE	ANCHOR/ KONA.
19	LED LIGHT FIXTURES	PHILIPS, WIPRO, TRILUX/HAVELLS/LIGHTING TECHNOLOGY
20	FAN (CEILILNG & WALL) (ISI.) (BLDC)& ENERGY EFFICIENT-2 Yrs. Warranty	HAVELLS/USHA/CROMPTON/ORIENT (CELING FAN 5 STAR ENERGY EFFICIENT-(BLDC motor BEE Five star)
21	EXHAUST FAN	CROMPTON, , HAVELLS, USHA
22	LAMINATED SHEET	HYLEM, FORMICA, GREEN
23	POWER CABLE XLPE PVCINSULATED (AL ARMOURED)	HAVELLS, FINOLEX, RR CABLE) Confirming IS: 7098:1988.
24	TRANSFORMER AS PER ECBC NORMS.	VOLTAMP TRANSFORMER LTD.BARODRA/ CROMPTON/KIRLOSKAR
25	VACUUM CIRCUIT BREAKER (VCB) (OEM MANUFACTURED)	SIEMENS, L & T/KIRLOSKAR./OEM OF COMPANY MAKE .
26	RELAY /CONTACTORS	BCH, L&T, SIEMENS /LEGRAND
27	CAPACITOR confirming IS:- 13341-1992 & 13340-1993	LEGRAND/EPCOS / SCHNEIDER / L&T / SIEMENS
28	ANCHOR FASTNER FOR CABLE TRAY	HILTI/ BOSS/ POWER
29	LT PANELS / SUB PANELS/ HVAC PANEL/ CAPACITOR PANEL/ PLUMBING & FIRE FIGHTING PANEL (TTA PANELS) ETC	SHIVALIC POWER CONTROL PVT LTD, SIEPAN- SIEMENS, MARINE ELECTRICALS-SCHNEIDER, ADLEC POWER PVT. LTD, LEGRAND, ELECTRO ALLIED PRODUCT- KOLKATA (L & T), OR OEM OR THEIR TTA MANUFACTURER OR AS APPROVED BY ARCHITECT/CONSULTANT
30	LIGHTNING PROTECTION	OBO/DEHN/ERICO / LPI

31	SIGNAGE	GLYPTIC/CALLAD/HONEYWELL/LG/SO NY/BAJAJ
32	LED TV	SONY/PANASONIC/SAMSANG/LG
33	CHEMICAL EARTHING	OBO/Truepower
34	CABLE TRAY WIRE MESH	LEGRAND/SIEMENS/SCHNEIDER/OBO/
35	CAT 6A CABLE	LEGRAND/ RIT/MOLEX/COMMSCOP.
36	PASSIVE COMPONENTS DATA NETWORKING	LEGRAND/RIT/MOLEX/COMMSCOP.
37	FIRE SURVIVAL CABLE	LAPP/TYCO/ FINOLEX/HAVELLS
38	FIRE SUPPRESSION SYSTEM	JANSON CONTROL/FIRETEX/SAVE FIRE./TRACE TREX
39	TEL. CABLE	HAVELLS/POLYCAB/MOLEX/FINOLEX.
40	FRLS (H) CABLE	POLYCAB/HAVELLS/FINOLEX/LAP
41	PVC FRLS COPPER WIRE	POLYCAB/FINOLEX/HAVELLS/KEI/STANDARD/ HPL
42	STEEL CONDUIT	B.E.C./AKG/MK.
43	PVC CONDUITS	AKG/PRECISIO/POLYCAB.
44	CABLE WIRING	FINOLEX/HAVELLS/LAP.
45	PVC INSULATED CABLE	FINOLEX/HAVELLS/LAP
46	SIGNAGE	GLOWLIGHT/LEGRAND/BAJAJ/OMNI/ PIERLTE.
47	ANY OTHER ITEM (NOT SPECIFIED)	ISI MARKED/ AS PER IS SPECIFICATION TO BE APPROVED BY ENGINEER IN CHARGE

25. EXECUTION AND COMPLETION PERIOD

25.1. Cables

M.V. cables shall be PVC insulated aluminum conductor armored cables suitable for laying in trenches, duct, and on cable trays as required.

25.2. Wires

650/1100 volts grade PVC insulated copper conductor wires in conduit shall be used.

25.3. Cable Laying

Easy access to all cables shall be provided to allow cable withdrawal/replacement in the future. Where more than one cable is running, proper spacing shall be provided to minimize the loss in current carrying capacity with necessary saddling/clamps.

25.4. CABLE WORK

This section covers detailed requirements for supply, laying, testing and commissioning of cables.

25.5. GENERAL

MV cable shall be supplied inspected, laid, tested and commissioned in accordance with drawings, specifications, relevant Indian Standards Specifications and cable manufacturer's instructions. The cable shall be delivered at site in original drums with manufacturer's name clearly written on the drum.

25.6. MATERIAL

- a) The MV power cable of 660/1100 V. grade shall be PVC insulated Aluminum conductor armored cable conforming to IS: 1554 (part - I). MV cable shall be 3.5/4 core of size and type as specified.
- b) The MV control cables shall be PVC insulated copper conductor armored cable.

25.7. STORAGE AND HANDLING

- 1) All cables shall be inspected upon receipt at site and checked for any damage during transit.
- 2) Cable drums shall be stored on a well-drained, hard surface, preferably of concrete, so that the drums do not sink in the ground causing rot and damage to the cable drums.
- 3) During storage periodical rolling of drums once in 3 months through 90o shall be done. Rolling shall be done in the direction of the arrow marked on the drum.
- 4) It should be ensured that both ends of the cable are properly sealed to prevent ingress/absorption of moisture by the insulation.
- 5) Protection from rain and sun shall be ensured. Sufficient ventilation between cable drums, should be ensured during storage.
- 6) The drums shall always be rested on the flanges and not on the flat sides.
- 7) Damaged battens of drums etc. should be replaced, if necessary.
- 8) When cable drums have to be moved over short distances, they should be rolled in the direction of the arrow, marked on the drum.
- 9) For transportation over long distances, the drum should be mounted on cable drum wheels strong enough to carry the weight of the drum and pulled by means of ropes. Alternatively, they may be mounted on a trailer or on a suitable mechanical transport.

- 10) When unloading cable drums from vehicles, a crane shall preferably be used. Otherwise the drum shall be rolled down carefully on a suitable ramp or rails, where necessary.
- 11) While transferring cable from one drum to another, the barrel of the new drum shall have a diameter not less than that of the original drum.
- 12) The cables shall not be bent sharp to a small radius. The minimum safe bending radius for all types of PVC cables shall be taken as 12 times the overall diameter of the cable. Wherever practicable, larger radius should be adopted. At joints and terminations, the bending radius of individual cores of a multi core cable shall not be less than 15 times its overall diameter.
- 13) Cable with kinks and straightened kinks or with similar apparent defects like defective armoring etc. shall be rejected.
- 14) Cables from the stores shall be supplied by the contractor as per the site requirement in pieces cut in the stores.

25.8. INSTALLATION

1) GENERAL

The cable installation including necessary joints shall be carried out in accordance with the specifications given herein. For details not covered in these specifications, I.S.:1255 shall be followed. No straight through joint shall be permitted in the system. The cables shall be supplied as per cable schedule submitted by the contractor & approved by Engineer-in-Charge.

2) ROUTE

- a) Before the cable laying work is undertaken, the route of the cable shall be decided by the Architect in consultation with Owner representative.
- b) While shortest practicable route shall be preferred, cable runs shall generally follow fixed developments such as roads, foot-paths etc. with proper offsets so that future maintenance, identification etc. are rendered easy. Cross country run to shorten the route length is not desirable as it would lead to route identification and maintenance problems, besides posing difficulties during later development of open areas etc.
- c) While selecting cable routes, corrosive soils, ground surrounding sewage and effluent etc. shall be avoided. Where this is not feasible, special precautions as approved by the Architect shall be taken.
- d) As far as possible, the alignment of the cable route shall be decided taking into consideration the present and future requirements of other agencies and utility services affected by it, the existence of any cable in the vicinity as may be indicated by cable markers or cable schedules or drawing maintained for that area, possibilities of widening of roads/lanes, storm water drains etc. Cable routes shall be planned away from the drains and should be within the property.
- e) Whenever cables are laid along well demarcated or established roads, the MV cables shall be laid further from the kerb line than HV cables.

- f) Cables of different voltages and also power and control cables shall be kept in different trenches with adequate separation. Where available space is restricted, MV cables shall be laid above HV cables.
- g) Where cables cross one another the cable of higher voltage shall be laid at a lower level than the cable of lower voltage.

3. WAY LEAVE

It may be necessary to obtain way leave for the cable route from the appropriate authorities some of whom are listed below:

- a) Drainage, Public Health and Water Works.
- b) Telephones and Telegraphs.
- c) Gas works.
- d) Other Undertakings.
- e) Owners of properties.

Where necessary, joint inspection with representatives of other authorities may be arranged so that mutual interests are safeguarded. In case of private property, Section 12/51 of the Indian Electricity Act shall be complied with.

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5. Laying on Cable Trays

- Cables, where indicated in approved shop drawings, shall be laid on overhead cable trays which are suspended from ceiling or supported from wall, by anchor fasteners as required.
- The Contractor shall provide for all accessories for the installation of the cable trays, such as bends, tees, reducers coupler plates, trefoil clamps and structural steel members (comprising of channels, angles, flats, rods) to be fabricated at site for structural supports for cable trays racks etc.
- Brass single compression glands shall be provided for MV cables termination

6. Testing

- A) All 650/1100 Volt grade cables before laying shall be tested with a 500 V mugger or with a 2,500/5,000 V mugger for cables of higher voltages. The cable cores shall be tested for continuity, absence of cross phasing, insulation resistance to earth/sheath/armor and insulation resistance between conductors.
- B) All cables shall be subject to above mentioned tests during laying, before covering the cables by protective covers and back filling and also before the jointing operations.

7. CABLE TRAYS

7.1 G.I. Cable trays of ladder type and associated accessories, tees, bends, elbows & reducers shall be fabricated from 12 gauge (2.6 mm thick) mild steel. Perforated cable trays and associated accessories tees, elbows, and reducers shall be fabricated from 14 gauge (2 mm thick) MS steel.

7.2 Cable trays and accessories and covers shall be painted with one shop coat of red oxide zinc chromate primer and two coats of Aluminum alkyd paint.

7.3 The Contractor shall provide for all accessories for the installation of the cable trays, such as bends, tees, reducers coupler plates, trefoils clamps and structural steel members (comprising of channels, angles, flats, rods) to be fabricated at site for structural supports for cable trays racks etc.

25.9. COMMISSIONING & GUARANTEE

25.9.1. SCOPE OF WORK

Work under this section shall be executed without any additional cost. The rates quoted in this tender shall be inclusive of the works given in this section.

Contractor shall provide all tools, equipment, metering and testing devices required for the purpose.

On award of work, Contractor shall submit a detailed proposal giving methods of testing and gauging the performance of the equipment to be supplied and installed under this contract.

All tests shall be made in the presence of the Architect or his representative or any inspecting authority. At least five working days' notice in writing shall be given to the inspecting parties before performing any test.

Water flow rates of all equipment and in pipe lines through valves shall be adjusted to design conditions. Complete results of adjustments shall be recorded and submitted.

Contractor shall ensure proper balancing of the hydraulic system and for the pipes / valves installed in his scope of work by regulating the flow rates in the pipe line by valve operation. The contractor shall also provide permanent Tee connection (with plug) in water supply lines for ease of installing pressure gauge, temperature gauge & rota meters. Contractor shall also supply all required pressure gauge, temperature gauge & rot meter for system commissioning and balancing. The balancing shall be to the satisfaction of Consultant / Project Manager. Three copies of all test results shall be submitted to the Engineer in A4 size sheet paper within two weeks after completion of the tests.

25.9.2. PRE-COMMISSIONING

On completion of the installation of all pumps, piping, valves, pipe connections, insulation etc. the Contractor shall proceed as follows:

Prior to start-up and hydraulic testing, the Contractor shall clean the entire installation including all fitments and pipe work and the like after installation and keep them in a new condition. All pumping systems shall be flushed and drained at least once through to get rid of contaminating materials. All pipes shall be riddled to ensure clearance of debris, cleaning and flushing shall be carried out in sections as the installation becomes completed.

- a) All strainers shall be inspected and cleaned out or replaced.
- b) Check all clamps, supports and hangers provided for the pipes.
- c) Check all the equipment, piping and valves coming under hot water system and operate each and every valve on the system to see if the valves are functioning properly. There after conduct & hydro test of the system as for (b) above.

d) Fill up pipes with water and apply hydrostatic pressure to the system as given in the relevant section of the specification. If any leakage is found, rectify the same and retest the pipes.

25.9.3. FINAL ACCEPTANCE TESTS

Following commissioning and inspection of the entire installation, and prior to issue of the Completion Certificate, the Contractor shall carry out final acceptance tests in accordance with a programme to be agreed with the Architect. Should the results of the acceptance tests show that plant, systems and/or equipment fail to perform to the efficiencies or other performance figures as given in this Specification, the Contractor shall adjust, modify and if necessary replace the equipment without further payment in order that the required performance is obtained. Where acceptance tests are required by the relevant Authorities having jurisdiction, these tests shall be carried out by the Contractor prior to the issue of Completion Certificate to the acceptance of the Authorities.

25.9.4. REJECTION OF INSTALLATION / PLANT

Any item of plant or system or component which fails to comply with the requirements of this Specification in any respect whatsoever at any stage of manufacture, test, erection or on completion at site may be rejected by the Architect either in whole or in part as he considers necessary/appropriate. Adjustment and/or modification work as required by the Architect so as to comply with the Authority's requirements and the intent of the Specification shall be carried out by the Contractor at his own expense and to the satisfaction of the Authority/Architect.

After works have been accepted, the Contractor may be required to carry out assist in carrying out additional performance tests as reasonably required by the Architect/Employer.

25.9.5. WARRANTY AND HANDOVER

The Contractor shall warrant that all plant, materials and equipment supplied and all workmanship performed by him to be free from defects of whatsoever nature before handover to the Owner.

25.9.6. HANDING OVER OF DOCUMENTS

All testing and commissioning shall be done by the Contractor to the entire satisfaction of the Owner's site representative and all testing and commissioning documents shall be handed over to the Owner's site representative.

The Contractor shall also hand over all maintenance and operation manuals, all certificates and all other documentation as per the terms of the contract to the Owner's site representative.

1. Wherever makes have not been specified for certain terms as equivalent makes referred, the same shall be as per BIS and as per approved by Engineer –in charge/Project consultant.
2. Contractor shall be required to get the finishing items/products approved by Project consultant in respect of their make, finish, texture. Color and such parameters, which are essential.
3. A necessary inspection is required for Approval by Project Consultant in their respective plants (India /abroad) of all Electrical Items before Procurement /Purchase.
4. All Electrical items like HT Panel, Transformer, Battery Charger, DG Sets, All LT Panels ,UPS etc. shall be inspected by the Consultant /Architect at manufacturer's factory and for the all arrangements are to made by the agency/contractor.

5. All necessary requirements have been taken in preparation of above DBR as per norms of STATE DISASTER RESPONSE FORCE (FTA) AT BIHTA, PATNA, BIHAR

25.9.7. HVAC

1. VRV System in training building as required.
2. Split AC system in guest house, SP/Principal residence, Hospital etc. as required.

Note:- In case make of any equipment or material is not specified in the DBR, the matter shall be referred to the DBR approving authority and obtain the approval. Thereafter the agency can proceed with the supply of material. Any doubt or mismatch shall be brought in to notice to Architect/Consultant.