ANNEXURE-2

TECHNICAL SPECIFICATION

SCOPE:-
These specifications cover the technical requirements of the outdoor/indoor equipment to be installed, there in up to and also including but not limited to L.T. (Main Panel), Cables, Wires, Floor Manager, Conduits, DG Sets, earthing etc if necessary. The equipment to be installed are for a temporary time, however all safety measures shall be taken and the installation shall be totally safe.

CODES & STANDARDS:-
The design, supply, installation and performance of the equipment shall comply with latest ISI standards, code of practices, I.E. regulations, and safety codes in the locality where the equipment will be installed & as per the regulations of the Electrical Inspectorate. Nothing in this specification shall be construed to relieve the contractor of its responsibility in any manner whatsoever.

The insulators shall be designed to avoid excessive concentration of electrical stresses in any section or across leakage surfaces. They shall have adequate strength against puncture.

- EARTH STATION:- Earth station is to be made as per I.S. 3043 with G.I. Pipe/ Plate in the ground to a depth of 3.0mtrs. With alternate layers of Salt & Charcoal. A funnel for watering & G.I. chambers is to be provided on the top. The scope includes all civil work, supply of all materials & labour. Two number of G.I. flats are to be connected to the plate & taken out of the ground. A separate Earth stations shall be provided for lightning protection of Cu plate and Cu Strip. The Contractor shall ensure that the system earth resistance value shall be as per I.S. wherever is necessary.

- EARTH CONDUCTOR:- The earth conductor flat shall be connected with brass nut & bolts with washers. The conductor shall not be kept lose & shall be clamped on spacers at regular intervals. In ground the conductor shall be at a depth of 600 mm from ground surface. All the backfilling & other civil works shall be done by the Electrical contractor.

- POWER /CONTROL CABLES:

CODES & STANDARDS
The Agent is required to follow all relevant IS and IEC codes as per latest amendments, however in particular following codes may be applied in addition.

- IS 7098-Part 1- Specifications for XLPE insulated thermoplastic sheathed cables, for working voltage up to 1.1kV (including 1.1kV)
- IS-1255 - Code of practice for installation and maintenance of power cable up to 33KV rating
- IEC 60502-1- Standard for cables for rated voltage from 1KV up to 6kV (Um=1.2kV)
- IEC-60050-461- Definitions for cables.
- IEC-60811 - Common test methods for cable insulation.
- IS: 3961- Part 2: Recommended current ratings for cables.
- IS: 8130 Conductors for insulated cables.

- IS: 583 XLPE Insulation and outer sheath of electric cables.
- IS: 10418 Specification for drums for electric cables.
- NEC- 2008 - National electrical code.
- NBC-2016 - National building code.
- IER-1956: Indian electricity rules.
- IEA-2007: Indian electricity act 2007
- Any other local bye-law or supply company norm as applicable.
- Supplying, laying, testing and commissioning of 1.1kV grade power cables and control cables suitable for 400V, 3Phase, 50Hz AC supply and also for 230V, 1Phase, 50Hz AC supply.
- Handling, loading, unloading, and storage of AC cables.
- Civil works, piping works and ducting works required for cable laying as per the tender document.
- Cable termination using double compression brass glands and lugs (cu lugs for cu cables and Al lugs for Al cables) as specified
- All the L.V. power cables used in this job shall be confirmed to I.S. 1554, IS 7098-Part 1, IEC 60050-461 and IEC 60502-2 with XLPE Insulation, PVC sheathed, 1100 V grade steel armored with stranded aluminum conductor above 6 mm^2 and heavy duty type.
- All the cables used for supplying power to the stall is XLPE Insulation, PVC sheathed PVC insulated, 1100V grade flat cable and shall be Fire Resistant.
- The cable supplied by the Contractor shall be of specified make having ISI mark.
- No cable joints are allowed, unless it is absolutely essential and will be carried out only after written approval.
- All the cables distributed within the building shall be laid on cable trays/trench.
- The cable to be laid in the Ground shall be laid at 750 mm Depth from ground level and sand of 75 mm shall be provided.
- Bricks are to be laid on the cables and then the Backfilling with screened soil.
- Trench excavation, supply of sand bricks, back filling and Rein statement is within the scope of electrical contractors work.
- Spacers, Saddles for clamping or cables shall be of G.I. only.
- For cable laid in the ground, cable markers are to be provided on the cable route. At every bend and at every 15 meters for a straight run.
- Cables supplied laid and installed will be paid on per meter basis. The exact cable run will be measured on-site from the terminal lug to the terminal lug at the other end.
- The cable bends shall not exceed the limits specified in Indian Standard for various sizes and sections.
- The cable crossing through floors, walls etc. should be through G.I. pipe and sealed with fire barrier material and bushes.
- Where group of H.V., L.V. control & telephone cables are to be laid along the same route, suitable barrier to segregate them physically shall be employed.
- The communication cable shall be at least 600 mm distant from power cable and shall be always laid above Power Cable.
- Where cable crosses roads, pavements etc., they shall be laid in RC.C. Hume pipe berried not less than 1 meter depth.
- Cables laid, installed on tree tops shall be properly tied and shall be totally safe.
- Cables shall be XLPE insulated PVC sheathed, Al or Copper conductor as specified.
- Cable shall be heavy duty type.

- Stranded Aluminum/Copper conductor shall be used.
- All Aluminum/Copper XLPE cables insulation shall be of high grade Cross- linked Polyethylene for insulation for extrusion process. Cores laid up.
- The inner sheath shall be bonded over with thermoplastic material for protection against mechanical and electrical damage.
- Armoring should be provided over the inner sheath to guard against mechanical damage.
- Armoring should be Galvanized steel wires or galvanized steel strips as specified.
- In single core cables used in A.C. wires/strips, round steel wires should be used; where diameter over the inner sheath does not exceed 13 mm, flat steel armor should be used.
- Insulation shall be of XLPE type as per latest IS general-purpose insulation for maximum rated conductor temp 90 degree C.
- The Conductor shall be stranded Aluminum/Copper circular/sector shaped and compacted.
- In multi core cables the core shall be identified by red, yellow, blue and black coloring of insulation.
- Conductor shall be of electrolytic Aluminum/Copper conforming to IS: 8130 and are compact circular or compact shaped. I
- In Inner sheath laid up cores shall be bonded over with thermo-plastic material for protection against mechanical and electrical damage.
- Insulation, inner sheath and outer sheath shall be applied by extrusion and lapping up process only. The outer sheath shall have FRLS properties.
- Repaired cables or cables made up of re-used copper / aluminum shall not be used.
- The cables shall be suitable for laying in racks, ducts, trenches, conduits and underground buried installations with uncontrolled back fill and chances of flooding by water.
- Progressive automatic in line sequential marking of the length of cables in meters at every one meter shall be provided on the outer sheath of all cables.
- Both ends of the cables shall be properly sealed with PVC/Rubber caps so as to eliminate ingress of water during transportation, storage and erection.
- Embossing of outer sheet: the following details on the other sheet of cable at a regular interval of 1(one) meter:
  a. Conductor size, type of insulation and voltage grade.
  b. Manufacturer's name along with ISI mark
- Typical parameters for AC cables shall be as follows :
  a. Rated Maximum Voltage: 1.1 kV (rms)
  b. Rated Frequency: 50 Hz
  c. Rated Power Frequency Withstand Voltage (1 min): 3 kV (rms)
  d. Rated short time withstand current for 1 sec: as per fault level
  e. Conductor material: Aluminum / Cu. As per cable schedule.
- Typical parameters for DC cables shall be as follows :
  a. Rated Maximum Voltage: 1.5 kV
  b. Maximum permissible DC voltage: 1.8 kV
  c. Voltage withstand for 5 minutes: 6.5kV
  d. Rated short time withstand current for 1 sec: as per fault level
  e. Conductor material: Aluminum / Cu. as per cable schedule.

LT cable termination:

- All cable glands shall be made out of brass and of good quality as approved.
- All cable glands shall be of double compressions type.
- Termination/ Joining of power and control cables shall be done by means of compression methods using solder less tinned copper or Aluminum terminal lugs.
- For control cables terminations, ring tongue or reducer pin type lugs shall be used to suit the purpose.
- Proper crimping tools with crimping paste shall be used to maintain proper conductivity and avoid any air gap.

Cable Tags:

- Following information shall be engraved in the cable with good quality material and the lettering height shall be 4.5mm
  a. Source of the Cable from where it is supplied power.
  b. Destination where the cable is terminated.
  c. No of cores of cables.
  d. Cross sectional area of the cable
  e. Complete notation as described under definition part of cable specification.

- TERMINALS:-
  - PVC insulation steel armored, 1100 V grade, cables are to be terminated with the help of glands for large size cables and glands (Brass) for 2.5 mm° cables. Crimping lugs are to be followed and anti-corrosive inhibiting flux is to be used. Brass nut bolts with plain and spring washers are to be used.
  - The crimping machine shall be of hydraulic or otherwise. The same should be approved by the KINEXIN before the work commencement.
  - Criss — Crossing of individual cores while connecting the respective phase terminal shall be avoided.
  - Spliced ends of the cable should be immediately crimped with lugs. The base conductor should not be left open to the atmosphere.
  - All the strands of a conductor must be fitted in the lugs and No cutting of strands will be allowed under any circumstances.
  - The appropriate size of holes shall be drilled (after KINEXIN permit) on the cable gland plate so that the gland after tightening is firmly secured with the gland plate. Any additional holes in the gland plate should be plugged in to make it vermin-proof.
  - Lugs of proper size should be selected to match the busbar holes or terminal holes with holes of lugs.
  - Where the diameter of the hole in the lug exceeds 1/4th the width of the busbar, the busbar shall be made wider. The width of the busbar shall be increased by connecting to the busbar an end piece similar to the busbar but wider. The lug shall be connected to the wider extension piece.
  - Raychem/ equivalent termination kits shall be provided for 11KV cable & shall be outdoor & indoor both types.

- MILD STEEL SUPPORT: The scope shall include supply & installation of Mild Steel sections including, cutting, bending, welding etc., to fabricate any structure required at the site shall be informed to KINEXIN for the necessary permission. It shall include necessary fabrication, removing of all sharp edges, & Painting. The painting shall be

consist of 2 coats of primer after cleaning & 2 coats of final finish paint. Minor civil work is included.

- DISTRIBUTION BOARD:
  - The Distribution board circuitry shall be as per the schematic given in Drawing or details given in the BOQ.
  - The sheet steel used for fabrication shall be of CRCA of minimum 2mm thickness. The board shall be suitable for wall mounting. It shall be totally enclosed, dust proof and vermin proof. The fabrication shall be as per relevant IS specifications for degree of protection provided by enclosure for low voltage switchgear-IP 54. The equipment such as MCB/RCB0, ELCB, Insulators, Busbars shall be as per relevant IS specifications with latest amendments.
  - The sheet steel shall be smoothly finished, leveled and free from flaws. All doors, removable covers shall be gasketed all-round the perimeter.
  - The service voltage is 440 Volts & busbar will be electrolytic copper. The copper busbar shall be tinned through out the length.
  - The door interlock shall be provided so that it shall not be possible to open the door with breaker in close position.
  - Enough space shall be provided for termination. A minimum two earth terminals shall be provided for each D.B. The board shall be factory wired with proper ferruling.
  - Adequate shrouds shall be provided for avoiding accidental contact with live terminals, busbar etc.
  - The conduits knockout shall be provided for conduit entry.
  - The guaranteed technical particulars shall be provided for the MCB/RCB0 & ELCB etc.
  - The engraved technical particulars shall be provided on all feeders.
  - All steel works shall undergo a process of degreasing, pickling in acid bath, phosphating.
  - This shall be followed by two coats of primer and two coats of final finish paint, both applied with spray. The colour shall be light battleship gray & power coated.
  - The distribution board shall have hinged door.
  - The busbar supports shall be non-hygroscopic, anti-tracking material.
  - The Distribution board shipping pieces & Loose equipment's shall be assembled by the contractor.
  - The Distribution on delivery at site shall be unloaded by the contractor & stored in a proper place.
  - The Contractor shall inspect the D.B. & in case of any defect, he shall inform the KINEXIN immediately.
  - Once the distribution Board is handed over to the contractor, he shall be responsible for the same.
  - The Distribution Board shipping pieces & loose equipment's shall be assembled by the contractor.
  - The D.B. shall be tested after proper cleaning & bus connections with a 1000V megger & proper functional checks.

- INDUSTRIAL 20A SWITCH SOCKET: The scope includes supply & installation of 20A MCB/RCB0 & 20A metal clad socket & plug in sheet steel box. The box shall be made

of 16 SWG sheet steel & shall have earth terminals & cable knockouts. It shall be painted & wired at the factory. The painting shall include proper cleaning & painting with degreasing, picking, primer etc.

Internal Electrical Works

- SCOPE of Work
  - Technical Specifications in this section cover the Internal Wiring Installations comprising for wiring of light /fan/exhaust/power point.
  - Wiring for lights and convenience socket outlets etc. in concealed/surface conduit/raceways.
  - Wiring for telephone outlets.
  - Wiring for fire detection system
  - Sub main wiring.

- Codes & Standards as per BIS (https://www.bis.gov.in/)

660/1100 V grade PVC insulated wires.	IS 694: 1990
Rigid steel conduits for electrical wiring.	IS 9537: Part 11980 IS 9537: Part 111981
Accessories for rigid steel conduits	IS 3837: 1990
Flexible steel conduits for electrical wiring	IS 3480 :1990
. Switch socket outlets	IS 4615: 1990
Switches for domestic and similar purposes	IS 3854 : 1997
Boxes for the enclosure of electrical accessories	IS 5133: Parts I &11 1969
Code of practice for personal hazard fire safety of buildingsCode of practice for electrical installation fire safety of buildings 1997	IS 1644: 1998 IS 1646
Code of practice for electrical wiring installations	IS 732: 1989

- Specifications
  - The wire pulling in conduits shall be in accordance with standard practices. All the wires in a particular section of conduit shall be bunched together and pulled at a time.
  - The wires used shall be colour coded with Red wires for R phase, Yellow wire for Y phase, Blue wire for B phase and Black wire for neutral. All the wires shall be 1100V grade, PVC insulated copper conductor.
  - All the wires shall be purchased directly from the manufacturers and approved by the consultant.
  - All the wire, shall be insulated with adequate thickness of extruded PVC.
  - All the wire ends shall be ferruled with colour codes & number.
  - All the circuits shall be identified at both ends of the circuit.
  - A maximum of 3 lights max. up-to 80W in total to be switched on one switch of 5A.
  - Balancing of circuits in three phase installation shall be planned before the commencement of wiring and shall be strictly adhered to.

- Insulation shall be shaved off for a length of 15 mm at the end of wire like sharpening of a pencil and it shall not be removed by cutting it square or wiring.
- Switches controlling lights, fans or socket outlets shall be connected in the phase
- wire of the final sub circuit only. Switches shall never be connected in the neutral wire.

- LIGHTING SWITCHES (Outdoor area)-Modular Type: Light & Fan control switches shall be of Industrial/Commercial type of maximum 5A. 240V rating at normal conditions. Decorative type shall be used in offices. In manufacturing area the cover plates shall be of stainless steel.

- LIGHT POINT WIRING :
  - The bidders are advised to study the Electrical layout & single line diagram.
  - The point wiring includes supply of all materials, accessories and labour.
  - The point wiring includes the G.I. switchboard with switches & further wiring from switchboards to individual light point & main circuit wiring from DB to switch Board with 3 x 2.5mm2 wire, 1100V grade in G.I. conduit. The point wiring shall be done with 3 x 1.5mm2 copper wire, 1100V grade, PVC insulated wire in
  - G.I. conduit. All conduit & accessories are included. A maximum of 2/3 lights up-to 80W in total shall be controlled on one switch of SA ratings.

- FAN POINT WIRING: Fan point wiring for ceiling/standing & exhaust fan (Single Phase) shall be similar to light point wiring. However, electronic type regulator shall be provided for fans. All the fans shall be provided with Individual control ceiling roses.

  Ceiling/stand Fans (BEE 5 star rated), to be provided in non-air-conditioned office/control room area. Further tentatively one (1) no. ceiling fan shall be provided for 10 sq.m area, at suitable mountingheight

- EXHAUST FANS :
  - Exhaust fans shall be of approved make and pertaining to relevant IS
  - Exhaust fans shall be suitable for 230V supply & shall be 230 mm sweep
  - Exhaust fans fixing shall be in the scope of the Electrical Contractor.
  - The Exhaust fan shall be suitable for Commercial/Industrial use as per the location..
  - 3/5 pin 6 amp socket outlet near the fan and a 6 amp control switch at convenient location near the room entry

- SWITCH BOARD: The switchboard shall be made of 16 SWG sheet steel and galvanized. It shall undergo a process of degreasing, pickling in acid bath, & phosphating. This shall be followed by two coats of primer. It shall be provided with earth terminal & gasket & manufacturers plate & switches. In case of manufacturing area the alternate quote for switchboard with stainless steel top plate to be given.

- 6/16 AMPS, SWITCH, SOCKET OUTLET – The point wiring for 6 Amps switch socket outlet includes running's of 3 x 2.5mm2 copper conductor, PVC insulated, 1100V grade wires in minimum 20mm G.I. conduit.

A maximum of 4/5 Nos. sockets in a room are to be looped in & controlled from the nearest Distribution board. The 6/16A switch shall be provided with a built in Fuse.
Primary Controlled circuit to have minimum 2.5sqmm Cu conductor for lighting and minimum 4 sqmm Cu conductor for Power.

- 16 AMPS, SWITCH, SOCKET OUTLET WIRING :
  - The point wiring for l6Amp switch socket outlet includes running of 3 x 4.0 Sq. mm PVC insulated stranded copper wire through GI conduit from the distribution panel board to the individual S/S/O
  - A maximum of 2 Nos. of 16 S/5/0 are to be controlled by MCB/RCB0 of 20 Amps in the distribution board. The circuit length shall not exceed a length of 70 meters.
  - All the wires for the S/S/0 shall be pulled through a separate conduit system. (not to be mixed with light, 6 Amp S/S/0 etc.) The 16A switch shall be provided with a built-in Fuse.
  - All Switches in Manufacturing area/ Laboratory quote alternately with steel plates suitable for clean room applications i.e. dust should not collect/stick on it.
  - The switches/ Sockets/ Plates shall be flush with the wall.

- CONDUITS & RACEWAYS

  - Conduit shall be of PVC. All accessories/fittings including ordinary & inspection tees; bushings, reducers, junction boxes, terminal boxes, saddles and steel supporting materials shall be the same as of the conduit.
  - The conduit shall be field bent as far as possible with reasonable long radii.
  - The conduit bends shall be free from cracks/ other damage to the pipe or its coating and shall not have pipe section unduly flattened.
  - The conduit joint shall provide structural rigidity and low electrical resistance.
  - The conduit shall be supported with saddles at regular intervals of l000mm.
  - The saddles shall be fixed with Raw plugs and G.I. screws of 3mm size.
  - The No. of wires through a given diameter of conduit shall be as per IS specification.
  - All the supporting holes are to be drilled by electric drill machine.
  - The Conduit shall be of 16 gauge confirming IS specification.
  - Conduit length exceeding 8 meter length shall be provided with junction boxes.
  - Conduit & accessories shall be securely fixed before any operations like concrete pouring, plastering etc.
  - The conduit be fixed by clipped which shall not cause deformation of conduit.
  - The conduit fixing shall be at regular intervals not exceeding 1.5 meter.
  - At the bends the fixings shall be secured by fixing clips at l50mm.
  - PVC conduits shall be high impact, rigid, FRLS PVC, heavy-duty type and shall comply to relevant Indian Standard.
  - Conduits up to 32mm dia shall be 2mm thick and above that shall be 2.5mm thick

- Wiring for power convenience socket outlets over work tables in laboratories shall be carried out in 100 mm x 50m PVC raceways in surface on wall as directed by KINEXIN.
- Conduits for LV systems shall be at least 150mm away from the electrical conduits.
- The saddles shall be of 3mm x 19mm galvanized M.S. flat properly treated, primed and painted securely fixed to support by means of nuts & bolts / raw plugs and brass machine screws.
- If so specified, surface conduits shall be provided with 20 mm wide and 100 mm long colour coding strips as below

Use Code	**colour**
Low voltage	Grey
Fire alarm	Red
Telephone	Black
PA system	Brown
Earthing system -	Green
Control system lighting	Purple

- Separate conduits shall be laid for the following systems:
  a) Normal light, Fan, and 6 A socket outlets.
  b) Power points.
  c) TV outlets.
  d) PA system.
  e) Telephone points
  f) Fire alarm system
  g) CCTV System
  h) Emergency Lighting

➢ Junction Boxes

Conduit fittings and accessories such as inspection boxes, draw boxes and junction boxes shall be of heavy duty rigid PVC installed in such a manner that they can remain accessible for existing wires or for the installation of the additional wires.

➢ **LT Power/Control Cable and Termination**

Scope of Work

- Supplying, laying, testing and commissioning of 1.1kV grade power cables and control cables suitable for 400V, 3Phase, 50Hz AC supply and also for 230V, 1Phase, 50Hz AC supply.
- Handling, loading, unloading and storage of AC cables.
- Civil works, piping works and ducting works required for cable laying as per tender document.
- Cable termination using double compression brass glands and lugs (cu lugs for cu cables and Al lugs for Al cables) as specified

Codes & Standards: The contractor is required to follow all relevant IS and IEC codes as per latest amendments, however in particular following codes may be applied in addition.

- IS 7098-Part 1- Specifications for XLPE insulated thermoplastic sheathed cables, for working voltage up to 1.1kV (including 1.1kV)

- IS-1255 - Code of practice for installation and maintenance of power cable up to 33KV rating
- IEC 60502-1- Standard for cables for rated voltage from 1KV up to 6kV (Um=1.2kV)
- IEC-60050-461- Definitions for cables.
- IEC-60811 - Common test methods for cable insulation.
- IS: 3961- Part 2: Recommended current ratings for cables.
- IS: 8130 Conductors for insulated cables.
- IS: 583 XLPE Insulation and outer sheath of electric cables.
- IS: 10418 Specification for drums for electric cables.
- NEC- 2008 - National electrical code.
- NBC-2016 - National building code.
- IER-1956: Indian electricity rules.
- IEA-2007: Indian electricity act 2007
- Any other local bye-law or supply company norm as applicable.

SPECIFICATIONS

LT Cables (AC & DC):

- Cables shall be XLPE insulated PVC sheathed, Al or Copper conductor as specified.
- Cable shall be heavy duty type.
- Stranded Aluminum/Copper conductor shall be used.
- All Aluminum/Copper XLPE cables insulation shall be of high grade Cross- linked Polyethylene for insulation for extrusion process. Cores laid up.
- The inner sheath shall be bonded over with thermoplastic material for protection against mechanical and electrical damage.
- Armoring should be provided over the inner sheath to guard against mechanical damage.
- Armoring should be Galvanized steel wires or galvanized steel strips as specified.
- In single core cables used in A.C. wires/strips, round steel wires should be used; where diameter over the inner sheath does not exceed 13 mm, flat steel armor should be used.
- Insulation shall be of XLPE type as per latest IS general-purpose insulation for maximum rated conductor temp 90 degree C.
- The Conductor shall be stranded Aluminum/Copper circular/sector shaped and compacted.
- In multi core cables the core shall be identified by red, yellow, blue and black coloring of insulation.
- Conductor shall be of electrolytic Aluminum/Copper conforming to IS: 8130 and are compact circular or compact shaped. I
- In Inner sheath laid up cores shall be bonded over with thermo-plastic material for protection against mechanical and electrical damage.
- Insulation, inner sheath and outer sheath shall be applied by extrusion and lapping up process only. The outer sheath shall have FRLS properties.
- Repaired cables or cables made up of re-used copper / aluminum shall not be used.
- The cables shall be suitable for laying in racks, ducts, trenches, conduits and underground buried installations with uncontrolled back fill and chances of flooding by water.

- Progressive automatic in line sequential marking of the length of cables in meters at every one meter shall be provided on the outer sheath of all cables.
- Both ends of the cables shall be properly sealed with PVC/Rubber caps so as to eliminate ingress of water during transportation, storage and erection.
- Embossing of outer sheet: the following details on the other sheet of cable at a regular interval of 1(one) meter:
  c. Conductor size, type of insulation and voltage grade.
  d. Manufacturer's name along with ISI mark
- Typical parameters for AC cables shall be as follows :
  a. Rated Maximum Voltage: 1.1 kV (rms)
  b. Rated Frequency: 50 Hz
  c. Rated Power Frequency Withstand Voltage (1 min): 3 kV (rms)
  d. Rated short time withstand current for 1 sec: as per fault level
  e. Conductor material: Aluminum / Cu. As per cable schedule.
- Typical parameters for DC cables shall be as follows :
  a. Rated Maximum Voltage: 1.5 kV
  b. Maximum permissible DC voltage: 1.8 kV
  c. Voltage withstand for 5 minutes: 6.5kV
  d. Rated short time withstand current for 1 sec: as per fault level
  e. Conductor material: Aluminum / Cu. as per cable schedule.

LT cable termination:

- All cable glands shall be made out of brass and of good quality as approved.
- All cable glands shall be of double compressions type.
- Termination/ Joining of power and control cables shall be done by means of compression methods using solder less tinned copper or Aluminum terminal lugs.
- For control cables terminations, ring tongue or reducer pin type lugs shall be used to suit the purpose.
- Proper crimping tools with crimping paste shall be used to maintain proper conductivity and avoid any air gap.

Cable Tags:

- Cable tag shall be made out of stainless steel minimum 1.2 mm thick and 25 mm x 100 mm size with holes provided to tag the cable.
- Following information shall be engraved in the cable with good quality material and the lettering height shall be 4.5mm
  a. Source of the Cable from where it is supplied power.
  b. Destination where the cable is terminated.
  c. No of cores of cables.
  d. Cross sectional area of the cable
  e. Complete notation as described under definition part of cable specification.

INSTALLATION, TESTING AND COMMISSIONING

- Cables shall be stored in a dry covered place to prevent exposure to climate conditions and wear and tear of wooden drums and it should be preferably concrete surface.
- All drums should be stored in such a manner as to leave sufficient space between them for air circulation. It is desirable for drums to stand on battens directly placed under the flange.
- In no case should the drums be stored "on the flat" i.e. flange horizontal.

- Both ends of the cables shall be properly sealed with PVC/Rubber caps so as to prevent ingress of water, miniaturization of cores and armors during transportation, storage and erection.
- On receipt of cable drums visual inspection of drums should be carried out for any damages to these cables.
- While unloading the cables certain precautions are to be taken to ensure the safety of cables. The cable end to be opened on one side and tested for its insulation and continuity.
- The cable drums should not be dropped or thrown from the trucks/railway wagons etc. during unloading operations as shock may cause serious damage to cable layers.
- A crane may be used for unloading cable drums. While lifting the cable drums with crane, it is recommended that the lagging should be left in place to prevent the flanges from crushing on the cables.
- If crane is not available a ramp should be prepared with approximate inclination of 1: 3 or 1: 4.
- The cable drums should be rolled over the ramp by means of ropes and winches. Additionally a sand bed at the foot of the ramp may be prepared to brake the rolling of the cable drum.
- Cable should not be dragged along the earth surface. Drums should be rolled in the direction of arrow only.
- For laying of cables special care is to be taken to prevent sharp bending, kinking, and twisting.
- Cable should be unwound from drum by proper mounting the cable drum on a cable wheel making sure the spindle is strong enough to carry the weight without bending and that it is lying horizontally in the bearings, so as to prevent the drum creeping to one side or the other, while it is rotating.
- The maximum safe pulling force (when pulled by pulling eye) proper and safe method of pulling of cable should be used depending upon the site conditions to avoid any kind of damage to the cables. Following pulling forces to be noted.
  a. Aluminum Conductor cables: 3.0 Kg/mm2
  b. Copper conductor cables: 5 Kg/mm2
- Special care is to be taken while laying cable at bends. Following are the recommended bending radius for power and control cables.

Sr. No.	Voltage rating (kV)	PVC / XLPE cables	
		Multi core	Single core
1	Up to 1.1 kV	12D	15D
2	Above 1.1 kV to 33 kV	15D	15D

D = D is over all diameter of cable.

- Armored cables are to be laid on cable trays/ underground as per relevant design drawing and specifications.
- All flexible cables shall be laid inside exposed / canceled conduits (rigid / flexible)/ raceways or as per relevant design drawing and specifications.
- After the cable trench has been properly excavated and straightened, it shall be covered with 100 mm thick layer of sand, the cable shall then be lifted and placed over the sand cushion.
- It may be planned to lay down the cables in stacks under the trench and under

such circumstances, cables shall be laid with the help of angular supports or cable trays suitable to take the load of the cable.

- In case the cable is laid with the help of angular supports inside the trench, such supports shall be provided at regular intervals so that the cable does not sag due to its weight.
- After laying the cable the complete trench shall be filled with sand / earth up to 200 mm depth from the ground level.
- A layer of silver sand along with a good quality caution tape with warning written in Hindi and regional language shall be laid throughout along the length of the trench at this level to indicate that electrical cables are running below and the area shall not be further excavated without suitable precautions and permissions.
- The complete trench may then be backfilled with earth up to ground level.
- Riggers shall ensure that while laying, the cable should not be subjected to any form of damage. Cables shall be laid by skilled and experienced workmen using adequate rollers to minimize stretching of the cable.
- The cables shall not be laid in such a fashion that one cable crosses over the other. Proper spacing shall be left between two cables as mentioned in the GFC or as specified or directed by engineer-in-charge.
- Drain points shall be ensured inside these trenches so that in case of water logging, the water ejects out through these drain points as a result of natural gradient provided.
- Man-holes shall be provided at strategic locations so as to ease the pulling of cables and maintenance. The manhole shall be covered with suitable covers of mentioned material and dimensions as per GFC.
- When laid in cable trays above ground, power cables to be placed at the bottom most layer and control cables at the top most layer. In case of multi core power cables, cables shall be laid side by side with spacing not less than half the diameter of larger cable.
- Multi-core cables shall be clamped by means of mild steel galvanized saddles. All cables below 1.1 KV single core cables if any should be clamped by means of non-magnetic saddles.
- The saddles / clamps shall not be placed at the intervals more than 1500 mm for horizontal and 1200 mm for vertical runs.
- Multi core control cables can be laid touching each other in cable racks and wherever required may be taken in two layers. These cables should be clamped by means of PVC straps for horizontal and vertical runs. Fabricated aluminum clamps may be used at regular intervals.
- All the cable shall be properly identified at regular intervals and care shall be exercised in laying cables to avoid forming kinks.
- The relative position of the cables, laid on the cable tray shall be preserved and the cables shall not cross each other.
- At all changes in direction in horizontal and vertical planes, the cable shall be bent smooth with a radius as recommended by the manufacturers.
- All cables shall be laid with minimum half diameter gap and shall be clamped at every meter to the cable tray and shall be tagged for identification with cable tag and clamped properly.
- Tags shall be provided at both ends and all changes in directions both sides of wall and floor crossings.
- All cable shall be identified by embossing on the tag the information as laid down

under this specification.

- If there is a need to join the cable due to the finishing of cable in the cable drum such joints shall be made through the approved straight-through joints and jointing kits as directed by and approved by the engineer-in-charge at site.

- Cables shall be fully tested (both type and routine test) as per the specification laid under Indian standards. In particular following test shall be done at site.
  a. Insulation resistance test.
  b. Continuity test.
  Cables shall be tested at factory as per requirement of IS: 7098 Part-I. The tests shall incorporate routine tests, type tests and acceptance tests. Prior to laying of cables, following tests shall be carried out. MTC shall be submitted for the same.

  i) Insulation test between phases and phase to earth for each length of cable before and after jointing. On completion of cable laying work, the following test shall be conducted in the presence of Owner.
  ii) Insulation resistance test (Sectional and overall) 1000/5000V depending upon the voltage grade of cable.

APPROVAL / INSPECTION : The method of installation, Drawing for construction shall be approved by the consultant prior to commencement of work. The consultant shall be given sufficient advance notice for approval of Drawing/ method of Installation etc. KINEXIN's electrical / technical consultant has a right to Inspect the materials, Quality, Quantity method of Installation at any stage of the project. The routine Inspection shall be carried out by KINEXIN / IICC for work in progress.

LABLES : The contractor shall provide all the danger labels, safety Code labels in approved manner wherever necessary.

TESTING & COMMISSIONING : The contractor shall carry out functional, routine tests specified in this specifications & relevant ISI for the routine checks, tabulate the test result in approved manner in the presence of KINEXIN.

CIVIL WORKS: The contractor (Electrical) shall be responsible for all the civil works pertaining to the scope described above, this need to be pre-approved by KINEXIN / IICC. The excavation for Cables shall be done to the minimum dimension as required for safety & workmanship facility. The backfilling shall be free of rocks, boulders etc. The concreting for the foundation of poles etc. shall be carried out in an approved manner & the method size etc. shall be approved prior to work.

VENTILATION: Roof extraction Fans/ Exhaust fans must be installed in adequate number to provide comfort Similarly Wall /pedestal fans in adequate number must be provided to cover the entire area of the Hall.

LIGHTING IN EXISTING STRUCTURES: Adequate general lighting for the hall to be included. Separate electrical power at one point for lighting of the podium to facilitate the conferences & seminars and different cultural programmes must be made available. Signage at the entrance to the Hall to be provided. Adequate number of emergency

entrances/ existing along the length of the structure, at least 3 in number must be provided.

MISCELLANEOUS:

- The rates must include over-all responsibility of erection and dismantling. Each of the structure for the conference will be separate, put up at different locations as per the plan to be provided by the KINEXIN.
- There must be adequate openings for ventilation with required number of fans. Adequate gaps between the roof and the walls to be provided for better ventilation
- Adequate road lighting and lighting up of trees are also included in scope of service (As per the layout drawing.)
- The layout drawing enclosed is for general guidance only actual quantities may vary depending on the site condition.
- For the main outdoor stage electrical power for lighting and sound to be provided at one point only. Necessary distribution will be done by the stage contractor.
- Arrangement of D.G. as shown in the SLD and its distribution is also included in the scope of service. The Contractor will quote separately for stand bye and hourly running cost.
- Breakage, Damage of any item whether supplied or given on hire will be to bidders account.
- The Contractor will depute its competent engineer and superior for the full duration of the function to take absolute responsibility of operating faultless electrical system during the exhibition. He will do all preventive maintainance from time to time to prevent all faults / breakdowns / accidents (to men & equipments) from happening.

MAKES OF MATERIAL:

- All material shall be of IS make
- Contractor to take approval of the Consultant Prior to Commencement of Work.
- The makes shall be standard makes

➢ LT PANELS

SCOPE - The scope of work shall include:

1. Supplying, installation testing and commissioning of LT Panels
2. Panel handling, loading unloading and storage.
3. Associated inter panel and intra panel wirings including both ac and dc wirings as well as control cabling, from panel to panel and from panel to DB.

CODES & STANDARDS

The definitions shall be as per IEC-60439-1 & 2 and other relevant IEC standards. The contractor is required to follow all relevant IS and IEC codes as per latest amendments, however in particular following codes may be applied in addition.

1. IEC-60439 - Standard for low voltage switchgear and assemblies.
2. IEC-60044 - Standard for instrument transformer.
3. IEC-60099- Standard for surge arrester.
4. IEC: 60255- Measuring relays and protection equipment.
5. IEC -60947 - Low voltage switchgear and control gear.
6. IS 2147 - Degrees of protection provided and enclosures for low voltage switchgear and control gear
7. IS 375 - Marking and arrangement of bus bars.
8. IS 13703-1993- HRC Fuse Links

9. IS 2705- Current Transformer
10. IS 3231- Relay
11. IS 1248- Indicating Instruments
12. IS 722- Integrating Instruments
13. IS 6875- Control Switches & Push Buttons.
14. NEC- 2008 - National electrical code.
15. NBC-2016 - National building code.
16. IER-1956: Indian electricity rules.
17. IEA-2007: Indian electricity act 2007
18. Any other local bye-law or supply company norm as applicable.

SPECIFICATIONS

Panel Cubical Construction

- The complete panel assembly shall be as per IEC-60439 - 1 & 2
- Panel fabricated out of 2mm CRCA sheet steel throughout and shall have undergone 7 tank process or better.
- Undrilled gland plates shall be 3mm thick. The gland plates shall have knock able type holes of suitable diameter of cable glands. Minimum 30% extra knock able holes shall be provided on each gland plate. Non-magnetic gland plates shall be used where single core cables are used for three-phase supply.
- The panel shall be self-supporting, free standing or wall mounted.
- The enclosure shall confirm to IP55 protection for outdoor panels and IP42 for indoor panels.
- The panel shall have appropriate protection against mechanical impact as per IK09.
- The enclosure system shall be Modular in nature with bolted on construction. Enclosure parts/kits shall be interchangeable to reduce downtime during modification or maintenance work.
- The Panel shall be dust, vermin, corrosion proof and shall be mechanically stable to take the mechanical load of complete assembly with all fixed and moving components.
- The panel shall have appropriate protection against mechanical impact.
- The panel shall be extendable from both sides.
- The terminal blocks shall be provided at convenient location for cable termination. The distance between the terminal strip and gland plate shall be kept in such away that the cables can be properly dressed & no cable tension is transferred on the terminal strip/or equipment.
- Proper grouting arrangement shall be made in panel for installation of panel in accordance with seismic requirement.
- Complete panel assembly shall be fixed on ISMC-100.
- The design shall ensure generous availability of space for ease of installation and maintenance of cabling, and adequate safety for working in one vertical section without coming into accidental contact with live parts.
- Front and rear doors should be fitted with synthetic rubber or neoprene gaskets with fasteners designed to ensure proper compression of gaskets.
- All sheet steel work forming the exterior of switch boards shall be smoothly finished, leveled and free from flaws. The corners should be rounded. The apparatus and circuits in the panels shall be so arranged as to facilitate their operation and maintenance and at the same time to ensure the necessary degree

of safety.

- Panel shall be constructed in form-3b methodology.
- All sheet steel work used in construction of panels shall be given for proper shot blasting/surface finish to make it free from all rusts/impurities/deposits.
- It shall be then provided with two primer coat and then/powder coated (electro-statically) with final paint shade RAL7032 as per IS – 5.
- It shall be the process of Powder Coating with suitable primer and having total coating thickness of 85-100 micron. The M.S Sheet Steel shall be given for proper shot blasting / surface finish to make it free from all impurities.
- Mix and match of ACB or MCCB series shall not be allowed for same manufacturer also.
- All sheet steel work used in construction of panels should have undergone a rigorous metal treatment 7 tank process or better as mentioned below.
  a. All sheet steel work shall be phosphate in accordance with the procedure in accordance with relevant standards for phosphatizing iron and steel. Oil, grease and dirt shall be thoroughly removed by emulsion cleaning.
  b. Rust and scale shall be removed by pickling with dilute acid followed by washing with running water, rinsing with slightly alkaline hot water and drying.
  c. A recognized phosphate process to facilitate durable coating of the paint on the metal surface and also to prevent the speared of rustling in the event of the paint film being mechanically damaged. This again, shall be followed by hot water rinsing to remove traces of phosphate solution.
  d. After phosphatizing through rinsing shall be carried out with clean water followed by final rinsing with dilute dichromate solution and oven drying.
  e. Passivation in de-oxalate solution to retain and augment the effects of phosphatizing.

Bus bars and internal connections

- The selection, design and construction of bus bars shall conform to IS/IEC specifications and the latest amendments.
- Bus bars shall be designed to carry rated currents during both steady state and transient conditions.
- The bus bars shall be air insulated and made of high conductivity, high Strength electrolytic grade aluminum.
- Bus bars shall be located in air-insulated enclosures and segregated from all other compartments of the cubicle.
- Direct access or accidental contact with bus bars andprimary connections shall not be possible.
- Bus bars shall be rated in accordance with service conditions and the rated for continuous and short time current ratings specified in SLD / data sheets.
- Busbars shall be design for a temperature rise of 40 degree celsius above the ambient temperature, while for all bolted connections of bus it shall be 45 degree celsius.
- The busbar shall be designed for a temperature of 190 degree during transient conditions.
- Bus bars shall be adequately supported on SMC/DMC insulator supports to with stand electro dynamic stresses due to short circuit currents.
- Bus bar support insulators shall be of non-hygroscopic material and shall confirm

to relevant IS standards.

- The current density of the bus bars shall not be less than 0.8 Amp / sq mm.
- Bus bars should be color coded for easy identification of individual phases and neutral.
- All the bus bars should be provided with color coded heat shrink sleeves.
- A main horizontal aluminum grounding bus, rated to carry maximum fault current, extending along the entire of the panel shall be provided.
- The ground bus shall be provided with two-bolt drilling with GI bolts and nuts at each end to receive the main Earthing grid.
- The size of the earth bus shall be as mentioned in drawings and schedules
- Important parameters for complete panel assembly shall be as follows :
  a. Voltage - 433V ± 6%
  b. Frequency - 50hz ± 3%
  c. No. of Phases - 3 + 100% Neutral + Earth bus
  d. Peak Impulse Voltage - 8KV
  e. Power frequency withstand capability – 2.5KV (power circuit) and 2KV (control circuit)
  f. Short circuit withstand capacity - 50kA for 1 second
  g. Type of discrimination required among switchgears - Total discrimination
  h. Min clearance and creepage distance - As per IEC-60439
  i. Dimensions : As per approved type tested design.

- Control wiring for all control circuit shall be done as follows :
  a. Each control circuit shall be protected with the help of DP MCB .
  b. Control wiring shall be done with 1.1kV grade FRLS type control cables tested for power frequency withstand of 2kV.
  c. All voltage circuits shall be wired with 1.5sqmm cu control cables.
  d. All current circuits shall be wired with 2.5sqmm cu control cables.
  e. Control wiring shall be done neatly with proper dressing and ferruling done.
  f. Control wiring shall be color coded appropriately.
  g. Terminal links used for control wiring shall be of good quality and shall withstand the temperature.
  h. All connections must be be tight.

- Power wiring for main circuit shall be done as follows :
  a. Switchgears of 100A rating and above shall be connected by the means of suitable busbars only.
  b. Cable terminal blocks used for power cable termination shall be suitable to withstand the temperature rise due to steady state and transient currents.
  c. All connections must be be tight.

Safety features and Interlocks

- The safety shutter shall be provided in breaker panels, which shall prevent in advertent contact with isolating contacts when breaker is withdrawn from the Cradle.
- Door interlocking shall be provided in each switchgear compartment with a provision of defeat interlock.
- All panel doors shall have provision of padlocking.
- Insulating barriers shall be provided in all live sections of the panel.
- There shall be provision of positive earth connection between fixed and moving

portion of the ACB either through connector plug or sliding solid earth mechanism.

- Earthing bolts shall be provided on the cradle or body of fixed ACB.
- Arc chute covers shall be provided wherever necessary.
- In case of draw out type switchgears safety shutters shall be provided to fully cover the live section automatically once the switchgear is being draw out
- It shall be possible to bolt the draw-out frame not only in connected position but also in TEST and DISCONNECTED position to prevent dislocation due to vibration.
- There shall be provision for locking the breaker in all three positions.
- The breaker shall be provided with interlock to prevent the breaker from being withdrawn or replaced except in the fully isolated position.
- Interlock shall also be provided to prevent the breaker from closing Without in service position.
- Space heaters triggered by thermostat shall be provided in cable compartments to avoid moisture.
- Lamp operated with a door limit switch and a toggle switch shall also be provided in panel compartments along with 6/16A witch socket for ease of maintenance

Air Circuit Breaker (ACB)

- ACB shall be mechanically rugged and shall be designed to carry steady state current and also transient current up to the time arc gets quenched.
- The moving parts of 4 pole circuit breaker shall have operating mechanism, primary and secondary isolating devices, auxiliary switches, mechanical position indicators, all mounted on a rigid sturdy steel frame work.
- Primary and secondary disconnecting devices shall be self-aligning type of fully isolating.
- On/Off push buttons shall be provided in ACB in such a way that ACB can be switched ON or OFF without opening the switchgear compartment. Breaker shall also trip without opening switchgear compartment.
- ACB shall be mounted on a cradle and shall be withdraw able type.
- The cradle shall be so designed and constructed as to permit the smooth withdrawal and insertion of the breaker into it.
- The movement shall be free from jerks, easy to operate and shall be on steel balls/rollers and not on flat surfaces.
- There shall be 3 distinct and separate positions of the circuit breaker on the cradle.
  a. Service: Both main and secondary isolating contacts in service.
  b. Test: Main isolating contacts separate and secondary isolating contacts in service.
  c. Isolated: Both main and secondary isolating contacts in isolated.
- Both mechanical and electrical indications shall be provided for TEST and SERVICE position.
- ACB maintenance trolley shall be provided by the contractor to rack out ACB
- ACB shall have following parameters / features :
  a. Rated voltage – 400 +/-6% V
  b. Rated frequency - 50Hz
  c. P.I.V - 12kV
  d. Rated short circuit capacity - 50kA for 1 sec.
  e. Poles - Four pole

f. Temperature deration: No deration up to 50 degree Celsius (In case deration is applicable, higher rating switchgear shall be provided)
g. Self-watt loss: As per IEC-60947
h. Total breaking time: less than 70ms
i. Closing coil: suitable for 230V AC
j. Shunt coil: suitable for 230V AC
k. Draw out type: Electrical
l. Spring charge operation: Through 230V AC motor as well as through handle.
m. Anti-pumping feature: Required and shall be inbuilt.
n. Ics = Icu = Icw = 100%
o. Spare contacts required: 4NO + 4NC
p. Indications: On, Off, Trip, Spring Charge, Ready to close
q. Under voltage coil : As per design requirement.
r. Time delay (td) - 0-400 m sec
s. Inbuilt thermal memory

- Release of ACB shall have following parameters / features :
  a. Protections: L,S,I,G
  b. Setting options: L - 40%-100% In (nominal current rating) = Ir
  S - 2 x Ir to 10 x Ir OR In
  I - 6 x In to 12 x In
  G - 10%, 20%, 50%, 100%
  c. Release type: microprocessor based.
  d. Zone selective interlocking - required.
  e. Communication: Fully communicable and shall be equipped with RS-485 port. And additional 24V DC auxiliary supply must be provided to access the data in case of trip condition of the breaker.
  f. Memory: Nonvolatile memory to record 10 trip histories with interrupted fault current value and Real Date & Time stamping and 10 alarm history.
  g. Alarm and indications: Visual indications for % loading in each phase, L, S, I, G fault, release failure
  h. Release shall be capable to generate remote alarm in case of any internal fault and Spare contacts shall be provided with release to do so.

Moulded Case Circuit Breaker (MCCB)

- MCCB shall be mechanically rugged and shall be designed to carry steady state current and also transient current up to the time arc gets quenched.
- MCCB shall be provided with door operating mechanism having interlock, defeat and padlocking facility.
- MCCB should trip free, quick make and quick break type and should be equipped with a current limiting feature.
- MCCB shall have spreader links and terminal shroud as a feature for safety and proper heat dissipation.
- MCCBs shall have double break mechanism.
- MCCB shall have following parameters / features :
  a. Rated voltage - 690V
  b. Rated frequency - 50Hz

c. P.I.V - 8kV
d. Rated short circuit capacity - As per SLD
e. Poles - Four pole
f. Temperature deration: No deration up to 50 degree Celsius (In case deration is applicable, higher rating switchgear shall be provided)
g. Self-watt loss: As per IEC-60947
h. Total breaking time: less than 40ms
i. Shunt coil: suitable for 230V AC
j. Draw out type: Non withdraw able (fixed type)
k. Ics = Icu = 100%
o. Spare contacts required: 2NO + 2NC
p. Indications: On, Off, Trip
q. Under voltage coil : As per design requirement

- Release of MCCB (in case of microprocessor based release) shall have following parameters / features :
  a. Overload setting (L) 0.4-1 x In
  b. Short circuit setting (with time delay)(S) 2 –10 x Ir OR In
  c. Time delay (td) 0-400 m sec
  d. Short circuit setting (Instantaneous) (I) 11 x In
  (Where In = nominal current of MCCB &Ir = rated current to which it is set.)
  e. Ground Fault Setting with time delay (0-300ms) (G) : 0.1-1 x In
  f. Neutral setting (N) (where ever required): 0.5-1 x In
  g. Release type: microprocessor based
  h. Communication: Fully communicable and shall be equipped with RS-485 port.
  i. Memory: Inbuilt thermal memory.
  g. Alarm and indications: Visual indications for L,S,I,G fault
  h. Release shall be capable to generate remote alarm in case of any internal fault and Spare contacts shall be provided with release to do so.
  i. All microprocessor based MCCB shall have individual fault LED indication for O/L (L),S/C (S&I) and E/F (G) protection.

- Release of MCCB shall be thermal magnetic up to 160A (with external earth fault protection wherever required).MCCBs above 160A shall have microprocessor based release.

Contactors

- All contactors and bi-metal relays should conform to IS - 13947 - 4/IEC - 947-4 standards.
- Contactors should be suitable for requisite duty and the contactor shall be designed to operate even in severe operating conditions.
- The Contactors shall be suitable for switching and controlling squirrel cage and slipping motors as well as other AC loads such as solenoids, capacitors, lighting loads, heating loads and transformer loads.
- The contactors shall be suitable for operation in service temperature up to 50 degree C without de rating.
- The contactors and bimetal relays shall have been tested for type-2 co-ordination at 50KA, 400 V 50 Hz as per IS 13947 for both fuse protected as well as fuse-less motor feeders.
- The contactor shall have coil of 220/240 V AC or as may be specifically asked for.
- The design of the current carrying parts, contact system and the magnet system

should be such that it should increase reliability of electrical and mechanical endurance.

- Auxiliary contact should have double break parallel bridge contact mechanism. For operator safety the contactors above 45 Amp should have arc-chamber. The construction of the arc chamber should be such that there is no emission of arc by-products on the surrounding equipment.
- The contactor shall have funnel shaped cable entries, cable end stops and predetermined insertion depths.
- Contactor below 63 Amp shall have captive screws preventing the screws from falling.
- Main contacts should be of silver alloy to have long contact life; it should withstand to keep the contact bounce to minimum and should be shrouded with an arc chute.
- Both moving and fix contacts should be accessible for inspection or replacement without disturbing terminal wiring.
- The magnet system should have laminated, construction to minimize the losses.
- Coils should withstand high temperature and ensure low power consumption. Coil should be resin cast/encapsulated. It should have inter layer insulation.
- Contactor should have facility to mount add-on auxiliary contact block. Mechanical interlocks should be provided for sequential operations if required.
- Contactor should be comfortably mounted in any position on a vertical plane. Contactor should be capable of handling high transient currents.
- It's Insulation voltage level should be – 1000 v. Contactor shall be designed to have mechanical endurance of the order of minimum 15 million operations or better.
- Contactor should operate without deration from - 30° C to +50°C

Current Transformer

- Current transformers shall comply with the requirements of IS. 2705.
- The current transformers shall be core type with cast resin/encapsulated secondary winding.
- CTs shall be mounted on the switchboard stationary part.
- The secondary CT leads from all panels should be terminated on the front of the board on easily accessible shorting type terminal connectors so that operation and maintenance can be carried out when the panels are in service.
- CT's shall be given heat run test.
- CT shall have following parameters / features :
  a. Rated voltage - 400V
  b. Rated frequency - 50Hz
  c. Class : 0.5 (for metering) / 5P10 for protection / PS for unit protection
  d. Rated short circuit capacity - As per fault level
  e. Construction - Ring / wound type
  f. Burden - As per SLD
  g. Rated secondary current : 5A

Control switches

- Control Switches shall be of the heavy-duty rotary type with escutcheon plates clearly marked to show the operating position.
- They shall be semi-flush mounting with only the front plate and operating handle projecting.

- Circuit breaker control switches shall be of the spring return to neutral type, while instrument selector switches shall be of the stay-put type.

Push Buttons

- Push buttons should be of the momentary contact, push to actuate type.
- Push Buttons should be panel mounted, flush type having 22.5 mm Ø.
- Push Buttons should be spring returns type.
- Lock and key head with Push turn facility.
- Modular blocks should contain NO-NC contact.
- It should be snap-fit type for easy assembly.
- Double break self-cleaning contacts for prolong life.
- NO-NC contact block should be colour coded for easy identification.
- Push Buttons should have transparent shroud and rubber shroud to enhance protection against ingress as per IP- 67.
- It should withstand operating voltage as well as frequent operation.
- It should have finger proof shrouded terminals.

Terminal Blocks

- Insulating barriers shall be provided between adjacent terminals. CT Terminal blocks shall be shorting type.
- Terminal blocks shall have a minimum current rating of 10 Amps & 650 volt grade rating complete with insulated barriers. Provisions shall be made for label inscriptions.
- It should have snap fit action.
- It should have captive-screws and self-lifting washers.
- Withstand temp range from –30° C to 100° C.
- Terminal Connectors should have flame retardant property confirming to UL-94, V-2.
- Terminal Block should be suitable for commonly used DIN Rail – 35 X7.5 mm and mounting channel 'C' shaped Std.32 mm.
- Terminal Block should be suitable for commonly used DIN Rail – 35 X7.5 mm and mounting channel 'C' shaped Std.32 mm.
- The construction material should be of high quality like polyamide 6/6 and contacts of Nickel plated brass. Labels shall be of anodized aluminum, with white engraving on black background.
- They shall be properly secured with fasteners.

Digital Energy Meter

- The load manager shall be micro-controller based unit capable to measures a host of electrical parameters and display them on a 128 x 64 backlit LCD.
- It shall have load management feature and shall have six numbers of output relay contacts apart from CT/PT contacts.
- These outputs shall be individually field programmable for both the parameter on which to generate alarm as well as the values on which to activate alarm and deactivate it.
- In addition to this flexibility in terms of load management, the load manager shall also have RS485 port. RS485 supports MODBUS RTU protocol for connections to EMS/SCADA.
- The unit shall be made for three phase four wire system. The installation type, CT

ratios and PT ratios shall be site selectable.

- The Load Manager with its six relay contacts shall be capable to be used as a Demand Controller. The method of Demand calculation i.e. sliding window, fixed window shall be selected at site. The device shall have all the features needed to implement a robust electrical load management system.
- It shall be programmable / configurable to suit most control and communication needs. The load manager shall be capable to measure following parameters:
  1. Voltage (Volts L-N & L-L) VL-N Accuracy: 0.5% of Reading VL-L Accuracy: 1.0% of Reading.
  2. Current (Amps IR, IY, IB) Accuracy: 0.25% of Reading.
  3. Line Frequency 45 to 55 Hz, Accuracy: 0.3% of Reading.
  4. Active Power (P) Accuracy: 0.5% of Reading (For IPFI>0.5).
  5. Reactive Power (Q) Accuracy: 1.5% of Reading (Between 0.5 Lag to 0.8 Lead).
  6. Apparent Power (S) Accuracy: 0.5% of Reading.
  7. Power Factor For Individual phases and System. Accuracy: 0.5% of Reading (IPFI≥0.5) Range of Reading: 0.05 to 1.000 Lag/Lead.
  8. Total Active Energy (KWh) Range of Reading: 0 to 9999999.9 KWh Accuracy: Class 0.5 as per IS14697.
  9. Total Apparent Energy (KVAh) Range of Reading: 0 to 9999999.9 KVAh Accuracy: Class0.5 as per IS14697.
  10. Total Reactive Energy (KVARh) Range of Reading: 0 to 9999999.9 KVARh Accuracy: Class0.5
  11. 3 rd to 15 th Harmonics (Odd) for all Voltages with THD.
  12. 3 rd to 15 th Harmonics (Odd) for all Currents with THD.
  13. Active Power (KW) Demand - Sliding & Fixed, Selectable.
  14. Apparent Power (KVA) Demand - Sliding & Fixed, Selectable
- The device shall also have following features:
  1. Display 128 X 64 Graphical LCD with Operating temp 10°C to 50°C.
  2. Data Logging Buffer 2 MB, Non-volatile memory, capable of holding 19691 records Logging Duration Site selectable.
  3. RS485 Modbus-RTU protocol
  4. Communication USB 8.0 Pen-drive For downloading logged data

INSTALLATION TESTING AND COMMISSIONING

- The complete Panel assembly shall be installed in accordance with the manufacturer's installation drawing duly approved by "The consultant "
- The panels needs to be grouted considering the seismic zone requirement.
- Panels shall be properly aligned and the leveled within tolerance of +/- 2mm and shall be ensured with a water level indicator or a laser gun whichever available. No shim shall be allowed to make a panel level suitably.
- All live sections and compartments shall be covered with insulation barriers.
- All the components of the panel shall be easily accessible.
- The location of installation shall be cleaned and co-ordination shall be made with other disciplines.
- Grouting holes shall be provided from inside and the panel shall be suitably and tightly bolted. No tuck welding with base channel is allowed.
- Panels shall have peel-able poly layer on the cover for protection from cement, plaster, paints etc. during the construction period.
- The holes made in enclosure for cable termination or anything else shall be made only through drill machine or approved cutting tool with marking of dia done

prior to cutting or drilling. Extra left out holes shall be filled neatly with fire retardant sealant.

- The Panel shall be tightly grouted. No spare nuts-bolts shall be left out un-tightened / open inside the DB enclosure in any case.
- Gland plates where ever used for cable termination shall be tightly fixed and shall be earthed.
- Size of Horizontal and vertical bus bars shall be equal.
- Switchgears above 63A shall be mounted on bus bars tightly and accurately.
- Termination lugs shall be tightly fixed and connected and there shall not be any bare wire strand jetting out of the lugs. Suitable crimping tool shall be used and terminal wires shall be covered with heat shrinkable sleeves whose color coding has to match with the color of the wire used.
- Color coding shall be followed for internal wiring also in a similar pattern as described. Bus bar shall be tagged for phase indication.
- Panel compartments shall be provided with space heaters and lights operated by door limit switches.
- The door of panel shall be aligned properly and there shall be no air gap left after closing the DB door. Gaskets shall be used to make DB free from moisture.
- Panel shall have Padlocking arrangement and shall be pad locked after complete installation.
- Panel board shall be fully tested (both type and routine test) for its components as per the specification laid under Indian standards. In particular following test shall be done :
  (a) Continuity test (both earth continuity and loop continuity)
  (b) Insulation resistance test.
  (c) Contact resistance test.
  (d) Primary injection test.
  (e) Temperature rise test
  (f) CT testing (Polarity, Knee voltage)
  (g) Phase rotation test.
  (h) HV test on bus bar
  (i) Space heater Testing
  (j) Control wiring check

NAME PLATES & LABELS

- Panel and all modules shall be provided with prominent engraved identification plates.
- The module identification designation. For single front switchboards, similar panel and board identification labels shall be provided at the rear also.
- All nameplates shall be of non-rusting metal or 3-ply lamicold, with white engraved lettering on black background. Inscription and lettering sizes shall be subject to Owner's approval.
- Suitable stenticilled paint marks shall be provided inside the panel/module identification of all equipments in addition to the plastic sticker labels. These labels shall be partitioned so as to be clearly visible and shall have the device number, as mentioned in the module wiring design.

PAINTING - All steel work shall be pretreated in tanks and finally powder coated of approved shade.

WIRING

- Control and protective wiring shall be done with copper conductor PVC insulated 1100 volts grade multi-stranded flexible wire of 2.5sq.mm cross section. The colour coding shall be as per latest edition of IS: 375.
- Each wire shall be identified by plastic ferrule. All wire termination shall be made with type connection. Wire shall not be taped or splied between terminal points.
- Terminal blocks shall preferably by grouped according to circuit function and each terminal block group shall have at least 20% spare capacity.
- Not more than one wire shall be connected to any terminal block. All doorframe of L.T. switchboard shall be earthed with bare braided copper wire.

TESTING & INSPECTION - After completion of all work at the manufacturer's works the switchboards shall be inspected and tested in the presence of Purchaser's representative. However, stage inspection may be carried out from time to time to check progress of work and workmanship. The following tests shall be carried out:

- All routine tests specified in relevant Indian/British Standards shall be carried out on all circuit breakers.
- Test for protective relay operation by primary or secondary injection method.
- Operation of all meters.
- Secondary wiring continuity test.
- Insulation test with 1000 Volts megger, before and after voltage test.
- Vendor shall provide all facilities such as power supply, testing instruments and apparatus required for carrying out the tests. Required copies of test certificates for all the tests carried out alongwith copies of type test certificates and certificates from Sub-Vendor for the components procured from them are to be submitted before despatch of switchboards.

DRAWINGS AND INFORMATION - The Vendor shall furnish following drawings/documents in accordance with enclosed requirements:

- General Arrangement drawing of the Switchboard, showing front view, plan, foundation plan, floor cutouts/trenches for external cables and elevations, transport sections and weights.
- Sectional drawings of the circuit breaker panels, showing general constructional features, mounting details of various devices, bus bars, current transformers, cable boxes, terminal boxes for control cables etc.
- Schematic and control wiring diagram for circuit breaker and protection including indicating devices, metering instruments, alarms, space heaters etc.
- Terminal plans showing terminal numbers, ferrules markings, device terminal numbers, function etc.