ELECTRICAL & ALLIED REPAIR WORK
FOR STAFF HOSTEL AT IIT BOMBAY

TECHNICAL SPECIFICATIONS

ELECTRICAL WORKS
SECTION – 1 INTRODUCTION:

1.0 GENERAL

1.1 This specification covers in brief the technical requirements for the supply of equipment, materials, installation, testing and commissioning of the electrical equipments / systems as described in SLD (Single Line Diagram) enclosed and BOQ for CEIL, Navi Mumbai.

1.2 The technical specifications made here under are applicable for the stated job and shall be rigidly adhered for the supply of equipment, materials, installation, testing and commissioning of the electrical equipment / systems as described in SLD (Single Line Diagram) enclosed and BOQ for CEIL, Navi Mumbai.

1.3 It is not the intent to specify all the details pertaining to design, selection of material / equipment, procurement, manufacturer, installation, testing and commissioning however the same shall be of high standard of engineering and shall comply to all currently applicable standards, regulations and safety codes.

1.4 The rates quoted should include the cost for load sanctioning for extra load from the local electrical body including all costs for application & installation of the meter in the designated area on the floor. The owner will be under no liability to bear any costs towards the same. The rates should also be inclusive for any other statutory approvals required for Electrical work.

2.0 CODES AND STANDARDS

2.1 For the supply of equipment, materials, installation, testing and commissioning of the electrical equipment / systems / materials / accessories etc. shall comply with the latest applicable standards and codes of practices.

2.2 For guidelines to the contractors few of the Indian Standards are indicated below:

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SECTION – 2 415 V PANELS / DISTRIBUTION BOARDS:

1.0 **SCOPE OF WORK**

1.1 The scope of work comprises of Designing, Obtaining Approval of the Consultants/Owner and Fabricating as per Approved Drawings, Testing at works, Packing and Forwarding, supplying, Storing at Site, Checking at site. Touching Up all damaged portions, Erection and testing and commissioning at site.

The equipment shall be designed for operation in highest of ambient temperature and high humidity tropical atmospheric conditions. Means shall be provided to facilitate ease of inspection, cleaning and in the installations where continuity of operation is of prime importance.

1.2 **STANDARDS**

1.2.1 The equipment shall be designed to confirm to the following requirements and to the latest amendments in the codes or relevant BS applicable standards & CPRI approved.

a. IS 8623 - Factory Builds Assemblies of switchgears and control gear.
b. IS 4237 – General requirements for switchgears are control gear for voltage not exceeding 1000 volts.
c. IS 2147 – Degrees of protection provided and enclosures for low voltage switchgear and control gear.
d. IS 375 – Marking and arrangement of bus bars.

1.3 **GENERAL**

1.3.1 The distribution boards shall be used to provide power to all sort 415V / 230V equipment / systems.
1.3.2 The distribution boards shall be suitable for 415V +/- 10%, 3 Phase, 4 wire, 50 Hz +/- 5% supply. All MCB shall have a short time rating of 9 KA (RMS) for 1 second.
1.3.3 The equipment shall be kept in a hot, humid and tropical atmosphere and shall be made dust and vermin proof.
1.3.4 The distribution boards shall confirm to the latest edition of applicable IS.

1.4 **CONSTRUCTION**

1.4.1 The distribution boards shall be Floor mounting, compartmentalized or wall mounted type (to be confirmed during detailed engineering), shall be made out of CRCA M.S. Steel of thickness not less than 2 mm. Thickness of all load bearing members should not be less than 3 mm. Color of the DB’s shall be as per the Architect’s specifications.
1.4.2 The enclosure shall confirm to IP55 protection for outdoor panels and IP52 for indoor panels.

1.4.3 The distribution boards shall be designed of the requisite vertical sections, which when coupled together shall form continuous switchboards. It should be readily extensible on both sides by addition of vertical sections after removal of the end covers or as otherwise called for in the bill of quantities.

1.4.4 The distribution boards shall be constructed only of materials capable of withstanding the mechanical, electrical and thermal stresses as well as the effects of humidity, which are likely, too be encountered in normal service.

1.4.5 The gland plate shall be of minimum 3 mm thick steel. The gland plates shall have knock out type holes of suitable diameter of cable glands. And minimum 30% extra knock out holes shall be provided on each gland plate.

1.4.6 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 a way that the cables can be properly dressed & no cable tension is transferred on the terminal strip / or equipment.

1.4.7 A main horizontal Copper 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 Stainless Steel bolts and nuts at each end to receive the main Earthling grid.

1.4.8 The structure shall be mounted on a rigid base frame fabricated using ISMC channel of minimum 100 mm height. The design shall ensure that weight of the components is adequately supported without deformation or loss of alignment during transit or during operation.

1.4.9 The design shall ensure generous availability of space for ease of installation and maintenance of cabling, and adequate safety for working in one vertical section without coming into accidental contact with live parts in an adjacent section.

1.4.10 Front and rear doors should be fitted with synthetic rubber or Neoprene gaskets with fasteners designed to ensure proper compression of gaskets. When covers are provided in place of doors, generous overlap shall be assured between sheet steel surfaces with closely spaced fasteners to preclude the entry of dust.

1.4.11 The height of the panel should not be more than 1800 mm. The
Total depth of the panel should be adequate to cater for proper cabling space and should not be less than 300 mm for MCCB sections or should be appropriate.

1.4.12 Doors and compartment partitions shall be fabricated using 14 Gauge thick sheet steel. Sheet steel shrouds and partitions shall be minimum 14 Gauge thickness. All sheet steel work forming the exterior of switchboards shall be smoothly finished, leveled and free from flaws. The corners should be rounded. All the boards/panels should be fabricated using 14 gauge CRCA MS sheets only.

1.4.13 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.

1.4.14 Apparatus-forming part of the panels shall have the recommended Minimum clearances for uninsulated bus bars or should be as per relevant IS Codes.

1.4.15 When, for any reason, the above clearances are not available, suitable insulation shall be provided. Clearances shall be maintained during normal service conditions. Creepage distances shall comply with those specified in relevant standards.

1.4.16 All insulating material used in the construction of the equipment shall be of non-hygroscopic material, duly treated to withstand the effects of high humidity, high temperature tropical ambient service conditions.

1.4.17 Metallic/insulated barriers shall be provided within vertical Sections and between adjacent sections to ensure prevention of accidental contact with main bus bars and vertical risers during operation, inspection or maintenance of functional units and front mounted accessories.

1.4.18 All doors/covers providing access to live power equipment circuit shall be provided with tool-operated fasteners to prevent unauthorized access.

1.5 CABLE ALLEY

1.5.1 Cable entries and terminals shall be provided in the switchboard to still the number; type and size of aluminium/copper conductor power cables and copper conductor control cable specified in the detailed specifications.

1.5.2 Provision shall be made for top entry of cables as required. Generous size of cabling chambers shall be provided, with the position of cable gland and terminate such that cables can be
easily and safely terminated. The minimum depth of the panel shall be restricted to suit for this purpose.

1.5.3 Barriers or shrouds shall be provided to permit safe working at the terminals of one circuit without accidentally touching that of another live circuit.

1.6 PAINTING

1.6.1 All sheet steel work used in construction of panels should have undergone a rigorous metal treatment 7-tank process as mentioned below.

1.6.2 All sheet steel work shall be phosphated in accordance with the procedure mentioned below and in accordance with relevant standard for phosphating iron and steel.

1.6.3 Oil, grease and dirt shall be thoroughly removed by emulsion cleaning.

1.6.4 After through and rigorous metal treatment the panel shall be duly powder coated with epoxy polyester powder. Unless otherwise specified all panels shall be powder coated in Structured Finish Siemens Grey shade.

1.7 BUS BARS

1.7.1 The selection, design and construction of bus bars shall confirm to IS specifications and the latest amendments.

1.7.2 The bus bars shall be air insulated and made of high conductivity, high strength 99.95% purity Tinned copper or electrolytic grade Aluminium of E91 grade as called for in the bill of materials.

1.7.3 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 and primary connections shall not be possible.

1.7.4 All bus bar joints and bus tap joints shall be provided with contact paste for low resistance. High tensile bolts Plain and spring washers shall be provided to ensure good contacts at the joints and taps. Wherever aluminium to copper connections is required suitable bimetallic connectors should be used. All hardware for Bus bars to be of Stainless Steel.

1.7.5 Bus bars shall be rated in accordance with service conditions and the rated for continuous and short time current rating specified, in SLD / data sheets. Maximum temperature of the bus bar and bus bar connections, under operating conditions, while carrying
rated normal current at rated frequency shall not exceed 85 degree C.

1.7.6 Bus bars shall be adequately supported on insulators to withstand dynamic stresses due to short circuit currents.

1.7.7 Bus bar support insulators shall be of non-hygroscopic material and shall confirm to relevant IS standards.

1.7.8 For all the switch fuse units more than 63Amps the connections should be done using Copper bus bars. The connections to switch fuse units having rating 63 Amps and below can be done using copper flexible wires.

1.7.9 The current density of the bus bars shall not be less than 1.6 Amp/sq.mm. The size of the bus bar thus arrived at shall be chosen in such a manner that the sizes of the terminals and sizes of the bus bars be matched with each other. The neutral as well as the earth bar should also be capable of withstanding the electrical and mechanical stresses equivalent to phase bus bars.

1.7.10 Appropriate clearances and creep age distance shall be provided for the bus bars system to minimize the possibility of a fault.

1.7.11 Connections from the main bus bars to functional circuit shall be arranged and supported so as to withstand without any damage or deformations the thermal and dynamic stresses due to short circuits currents.

1.7.12 All the bus bars should be provided with color-coded heat shrink sleeves. The size of the Earth shall be same as the size of the neutral bus bar.

1.8 CIRCUIT BREAKERS

1.8.1 Circuit breakers shall be triple pole or four poles, air break, horizontal draw out type, designed to be maintained. The breakers shall comply with the requirements of IS 516 (parts I & II/Sec. I)-1997- short circuit performance category p-2, and shall have, A short circuit breaking capacity of not less than as indicated on SLD at 415 Volts 50 Hz AC.

1.8.2 Mechanical endurance for 20000 operating cycles out of which 6000 cycles should be for electrical endurance, cooling and extinction of arc. Inter phase barriers shall be provided to prevent flame over between phases.

1.8.3 The operating mechanism shall be of robust design, with a minimum number of linkages to ensure maximum reliability. Manually operated circuit breakers shall be provided with spring operated closing mechanism.
1.8.4 The operating mechanism shall be such that the breaker is at all times free to open immediately when the trip coil is energized.

1.8.5 Circuit breakers shall be individually housed in sheet metal cassettes provided with hinged doors.

1.8.6 MCCB should be tripping free, quick make and quick break type.

1.8.7 MCCB should be suitable for interchangeable line/load connection

1.9 CURRENT TRANSFORMERS

1.9.1 Current transformers shall comply with the requirements of IS:2705. They shall have ratios, outputs and accuracies as specified/required.

1.10 INDICATING INSTRUMENTS

1.10.1 All-indicating instruments shall be of flush mounting industrial patterns, conforming to the requirements of I. S.

1.10.2 The instruments shall have non-reflecting bezels, clearly divided and indelibly marked scales and shall be provided with zero adjusting devices in the front.

1.10.3 Integrating instruments shall be of flush mounting switchboard pattern, complying with the requirements of I. S.

1.11 PUSH BUTTONS

1.11.1 Push buttons shall be of the momentary contact, push to actuate Type. All indicating lamps should be LED type.

1.12 CONTROL WIRING

1.12.1 All Control wiring shall be carried out with 1100/660 Volts grade Single core PVC cable conforming to IS 694/IS 813 – having stranded copper conductors of minimum 1.5 sqmm. Section for potential circuits and 2.5 sqmm sections for current transformer circuit.

1.12.2 Wiring shall be neatly bunched, adequately supported and properly routed to allow for easy access and maintenance.

1.12.3 Wires shall be identified by numbered ferrules at each end. The Ferrules shall be of the ring type and of non-deteriorating material. They shall be firmly located on each wire so as to prevent free movement.
1.12.4 All control circuits fuses shall be mounted in front of the panel and shall be easily accessible.

1.13 TERMINAL BLOCKS

1.13.1 Terminal Blocks shall be of Elmex/Connect well make of the suitable type. Insulating barriers shall be provided between adjacent terminals.

1.13.2 Terminal blocks shall have a minimum current rating of 10 Amps.

1.14 LABELS

1.14.1 Labels shall be of anodized aluminum, with white engraving on black background. They shall be properly secured with fasteners.

1.15 TESTS

1.15.1 Routine tests shall be conducted on all panels and Distribution Boards in accordance with relevant IS.

1.16 INSPECTION

1.16.1 Inspection of the panels shall include inspection of wiring and Electrical operational tests where necessary, Dimensional & Visual verification.

1.16.2 Checking of Protective Measures, Functional Testing and electrical continuity of the protective circuits.

1.16.3 High Voltage Test with 2-5 KV, 1 minute for checking insulation and megger tests before and after the installation.
SECTION – 3 ALUMINIUM/COPPER L. T. ARMoured CABLES:

1.0 SCOPE OF WORK

1.1 The scope of this section comprises of supply, delivery, store at site, laying of L. T. cables, fixing of Cable glands, cable dressing and termination in proper position.

2.0 CODES AND STANDARDS

2.1 The design, manufacture, testing and supply of the cables under this specification shall comply with the latest revisions including amendments of the following standards.

IS: 3961-II  Recommended current ratings for cables.

IS: 8130  Conductors for insulated cables.

IS: 7098-I  Test Procedures for cables.

IS: 39751  Mild steel wire, strips and tapes for armoring of cable.

IS: 1554  PVC insulated.

3.0 TECHNICAL REQUIREMENTS

3.1 Stranded Aluminium/Copper conductor in case of above 4 Sqmm and solid conductor in case of 10 Sqmm and below.

3.2 Cores laid up.

3.3 Armoring should be provided over the inner sheath to guard against mechanical damage. Armoring should be Galvanized steel wires or galvanized steel strips.

3.4 Conductor shall be of electrolytic Aluminum/Copper conforming to IS: 8130 and are compact circular or compact shaped.

3.5 In Inner laid up cores shall be bonded over with thermo-plastic Material for protection against mechanical and electrical damage.

3.6 Insulation, Inner sheath and outer sheath shall be applied by Extrusion and lapping up process only.

3.7 Armoring shall be of galvanized steel wire/flat.

3.8 Repaired cables shall not be used.

3.9 Current ratings of the cables shall be as per IS: 3961.
4.0 DRAWINGS AND DATA

The Contractor shall furnish technical particulars of cables, types, make and catalogue.

4.1 The product should be coded as per IS: 7098 Part – I and the codes should be as follows:
   Aluminium Conductor A
   Steel round wire armor W
   Steel strip armor F
   PVC outer sheath Y

4.2 1.1 KV Grade cables shall be PVC insulated PVC sheathed, A1 or Copper conductor Armour confirming to IS: 1554 with latest amendments.

4.3 TESTS
Routine tests shall be conducted on all cables in accordance with relevant IS codes before dispatch of cables from manufacturer works and certificate will be submitted to owner / consultant.

5.0 CABLE GLANDS

All cable glands shall be made out of brass of approved make.

6.0 CABLE LUGS

6.1 Termination/Jointing of power and control cables shall be done by means of compression methods using solder less tinned copper lugs of approved make.

6.2 For control cables terminations, ring tongue or reducer pin type lugs shall be used to suit the purpose.

7.0 CABLE LAYING

7.1 For laying of cables special care is to be taken to prevent sharp Bending, kinking and twisting.

7.2 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.

7.3 Special care is to be taken while laying cable at bends.

7.4 All cables below 1.1 KV single core cables if any should be clamped by means of non-magnetic saddles.

7.5 The saddles / clamps shall not be placed at the intervals more Than 750 mm for horizontal and 500 mm for vertical runs.

SECTION – 4 EARTHING
1.0 CODE AND STANDARD

1.1 Earthing shall confirm to the latest edition of IS 3043.

2.0 SCOPE

2.1 Earthing system to be provided shall comprise of copper earth electrode and bare copper earth wires as called for, for acting as earth continuity conductor.

3.0 SPECIFIC REQUIREMENT

3.1 Earthing Pits

3.1.1 Plate Electrode Earthing – Earthing electrode shall consist of a tinned copper plate not less than 600 x 600 x 3 mm thick. The plate electrode shall be buried as far as practicable below permanent moisture level but in any case not less than 3 mts. below ground level. Wherever possible earth electrode shall be located as near the water tap, water drain or a down fence. It shall be kept clear of the buildings foundations and in no case shall it be nearer than 1 meter from the outdoor face of the wall and surrounded with 150 mm thick layer of charcoal dust and salt mixture 20 mm G.I. pipe shall run from the top edge of the plate to the ground level. The top of the pipe shall be provided with a funnel and a mesh for watering the earth through the earth. The main earth conductors shall be connected to the electrode just below the funnel, with proper terminal lugs and checks nuts. The funnel over the G. I. pipe. The masonry chamber shall be provided with a cast iron cover resting over a G. I. frame embedded in masonry.

3.2 RESISTANCE OF EARTH

3.2.1 The contractor shall measure the resistance of the individual Earthing pit and report to the Consultants/Owner. The contractor will make after due consultation with Consultants/owner, for finalizing the number of Earth pits and its layout, such that, the overall resistance in the earth bus and at major electric equipment does not exceed 1.0 ohm.

3.3 EARTH CONTINUITY CONDUCTOR

3.3.1 Switchgears and Power Distribution Boards shall be earthed by a Copper Wire.

3.3.2 Panels shall be earthed by a continuity conductor, as specified.

SECTION – 5 POINT WIRING:
1.0 **SCOPE OF WORK**

The scope of this section comprises of supply, delivery, store at site, prepare the conduit assembly, fix and erect in proper position, rigid PVC conduits of minimum 2.0mm wall thickness and as per IS 2509 of 1973. Concealed work check before casting of slab, measure and tie the assembly to reinforcements, complete with providing GI pull wires.

1.1 **APPLICABLE STANDARDS**

The relevant sections of Indian Standard Specifications as more particularly stated herein and broadly to all the codes, status and regulations as applicable shall be strictly enforced and adhered to. More particularly following codes should be strictly followed.

IS 2509 OF 1973 Rigid non-metallic conduits for Electrical Work?

IS 732 Wiring Practice.

IS 3043 Code of Practice of Earthing.

IS 3202 Climate proofing of Electrical Work.

2.0 **RIGID PVC CONDUIT WORK**

2.1 **MATERIAL**

2.1.1 The minimum wall thickness of Rigid PVC Conduits permitted for concealed/open conduiting shall be 2.0 mm thick.

2.1.2 The tubing must be perfectly circular, without any burrs or kinks.

2.1.3 The conduits shall be of such type, so as to be capable of making light fitting joints.

2.1.4 The minimum size of Rigid PVC Conduits allowed in open/concealed work shall be of 20 mm and above.

2.2 **CONDUIT ACCESSORIES**

2.2.1 All conduit accessories that are to be used in the work shall be of Rigid PVC type conforming to latest and relevant IS codes.

2.2.2 Conduit Accessories shall be capable of clean and tight fittings.

2.2.3 All junction boxes of one way or above shall be of high dome type with a depth of minimum 65 mm and minimum 2 mm wall thickness.
2.2.4 In concealed work, inspection type of bends is not allowed; normal bends/elbows may be permitted after specific approval.

2.3 CONDUIT ASSEMBLY WORK

2.3.1 The Contractor shall submit to the Consultant/Owner detail layout plan of conduit network containing particulars regarding size and routes of conduits, number of wires carrying in each conduit, inspection and junction boxes provided along with the routes of the conduits. The number of wires in each conduit shall not exceed as specified in the table of conduit capacity.

2.3.2 Initially all drawings for conduit work shall be inspected. Any discrepancies of otherwise occurring due to site conditions or change in internal layouts or in walls shall be reported. After rectification of the same, then the measurements and marking shall be done for the conduit assembly, on the shuttering of the slab.

2.3.3 Wherever fluorescent light fixtures are shown in the layout, the conduit shall be terminated in a high dome junction box at the center of the fixture, unless otherwise specified or indicated in drawings.

2.3.4 In the concealed conduit work, all junction boxes, bends, elbows shall have PVC tapes on either side to ensure security of the accessories in its place. They shall also be PVC taped at all joints in order to prevent cement, water or slurry entering the Rigid PVC conduit assembly.

2.3.5 For all circuit wiring, i.e. from Lighting Distribution Boards to Individual Switchboards, minimum 2.0 mm wall thickness conduits shall be used.

2.3.6 Adequate numbers of PVC, pull boxes of suitable sizes shall be Provided in the PVC conduit assembly.

2.3.7 Where the conduit runs in brick walls it should be necessary Fixed by using MS clamps. In the straight run the distance between the two clamps shall not exceed 500 mm and additional clamps should be provided near end and junction box.

2.3.8 The entire jointing in PVC conduit assembly shall be done using PVC solvent cement only. Wherever the conduits are terminated in PVC switchboard boxes or PVC, Socket outlets boxes, the use of collars or male-female type of PVC adaptors shall be provided.

2.3.9 The maximum capacity of a conduit for drawing in wires shall be In accordance with IS 732 of 1963. The minimum size of conduit to be used shall not be less than 20 mm (approx) and not more

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than two circuits connected to same phase be bunched in one conduit. Two different phases are not allowed in one circuit.

2.4 **POINT WIRING**

The wiring shall be of looping in system as different from the tree system. Connectors should not be used without specific prior approval. Looping in on the phase side shall be at the switches and that on the phase side shall be at the switches and that on the neutral side at the ceiling roses. Every light point, fan point and plug point shall have individual control switch unless stated otherwise. Earthing shall be provided for all the points according to the statutory requirement wherever necessary. The number of points per circuit shall not exceed 8 in any case.

2.5 a) the point wiring in conduit consists of wiring from the Branch distribution board in conduit with its ancillary work, such as inspection bends, junction boxes and wires up to the fixed terminals depending upon the type of point.

b) For easy identification, wires with different colors shall be used for phase and neutral as far as practicable.

c) The control switches for lights, fans, wall sockets and fan regulators shall suitably be grouped on sheet steel boxes of all welded design fabricated out of 1.2 mm (approx). Control accessories for one circuit only shall be grouped on a sheet steel box. Suitable Earthing terminal shall be provided on the sheet steel box.

d) All the wires shall have a grade 650/1100 volt for lighting and power wiring.

e) Termination of PVC wires used for point wiring, but one end being terminated in DB shall be lugged type.

f) Telephone and Computer Networking cables shall be laid in separate PVC Conduit.

2.6 **MAINS AND SUB-MAINS WIRING**

This shall include the cost of all wires conduit accessories, clamps spacers, wires in battens depending upon the type of wiring, all masonry work, such as cutting, neat finishing of walls, floor openings etc.

3.0 **SWITCHES, SOCKETS**

3.1 **SOCKETS OUTLETS WITH PLUGS**
These shall be modular type, in 5-Pin design of best quality, suitable for single phase, 250 volts supply. The earth pin shall be effectively connected to the nearest conduit or earth connections in distribution board with copper wire. The socket outlet shall be complete unit shall be with ratings of 6 Amps, 250 volts or 16 Amps, 250 volts to suit individual requirement as stated in Schedule of Quantities and Rates. The socket-outlets shall begin flush mounting or on plate designs as called for in the Schedule.
SECTION – 6 PRE COMMISSIONING TESTS:

All Equipment / Panels / Distribution Boards / Networks & EPABX etc shall be tested at site before commissioning as per prevailing I.E. rules IS codes statutory requirements.

Following tests as minimum shall be carried out on electrical work, panels / DB etc.

1.0 Insulation resistance tests on all 415V panels.

2.0 Insulation resistance tests on lighting and power circuit at DB.

3.0 Earth resistance & continuity tests of main Grid.

4.0 Functional controls check for panels.

5.0 Any other tests as required or called for like functional testing.

6.0 Test reports for all such tests shall be prepared by contractor for owner / consultant records.