

TECHNICAL SPECIFICATIONS

TECHNICAL SPECIFICATION - MECHANICAL

5.1 Scope of Work

This specification covers the technical requirements for Design, Fabrication, Supply, Erection, Testing & Commissioning of Edge Runner and related electrical works. The system shall be of proven design and capable of actual field operation for the desired materials without any difficulty or problem whatsoever. As such, the quality and performance guarantee for compliance with this specification shall be the prime responsibility of the successful tenderer.

The tenderer shall be thoroughly conversant with the specified requirements, standards, quality and workmanship for trouble free operation of the equipment.

5.2 Standards

The design, manufacture and testing of the equipment shall comply with the latest editions of appropriate standards.

Unless mentioned otherwise, all applicable codes and standards in their latest editions as published by the Bureau of Indian Standards shall govern in respect of design, workmanship and properties of materials and methods of testing. In case where suitable Indian Standards are not available, generally accepted codes and practices shall be adopted.

All equipment shall comply with the statutory requirements of the Govt. of India and Government of Kerala. The equipment constructions and installation shall conform to the provision of statutory and other regulations in force such as the Indian Boiler Regulations, Indian Factories Act, Indian Explosives Regulations, Kerala State Pollution Control Board, etc. Approval of drawings if required shall be arranged by the successful contractor at no extra cost to the Purchaser.

In cases where the offer deviates from the specified standards, the tenderer shall indicate clearly in his offer the reasons for deviation, standards proposed to be adopted by him and the details thereof.

5.3 Technical Requirements

8. Edge runner. 7 Numbers. With 100 kg wet materials.

All Contact Parts	: S.S. 304 & Granite
Pan Dia:	1200mm
Height : 550mm	Base: Granite Dia 1200mm X 150mm Thick
Granite Roller Dia: 450mm & Width 175mm	Heavy Duty Gear Housing covered by S.S. 304
Scraper – 3 Nos	Bottom Cover of Structure . S. S. 304.
Power Rating: 5 HP .Motor Heavy Duty Gear Box Safety devises : compulsorily limit switch for stoppage of machine while drawing the product.	S.S. 304 Side Discharge Door Heavy Duty M.S. 3 Channel Structured covered by SS .

Expected Value: Rs 46 Lakhs, 7 nos.

Note:

1. Tenderer should include the cost of all required accessories in the quoted rate.
2. Tenderer is free to quote the machine of their own design having the same capacity and quality specified above, subjected to the clause of Pre-qualification criteria.

5.4.Painting and Shipment

- 1 All external surfaces shall be cleaned of loose substance and foreign material, e.g. dirt, rust, scale, oil, grease, welding flux, etc. so that the zinc phosphate primer coat adheres to the original metal surface. The work shall be carried out generally in accordance with IS:1477 (Part I) amended up to Decemeber2010. The surface shall be cleaned either by sand blast to grade S.A.2.5 using graded sand or by acid pickling using dilute sulphuric or hydrochloric acid followed by thorough rinsing with fresh water. The prime coat shall be applied immediately after the surface preparation.
- 2 Paint shall be applied in accordance with manufacturer's recommendations as supplemented by this specification. The work shall generally follow IS: 1477 (Part II) amended up to December2010.
- 3 The prime coats shall consist of two coat of Zinc phosphate` primer.
- 4 Finish painting shall consist of three coats of epoxy paint as per manufacturer's specification.
- 5 Dry film thickness for each coat shall be about 25 microns and total dry film thickness shall not be lower than 125 microns.

6No shipment shall be made unless clear dispatch instructions are obtained from purchaser's representative .

7All projected parts shall be properly protected to avoid damage during transit.

8 *Touch up painting for damaged coats doing transit / erection should be done by the contractor .Prior painting proper cleaning of the damaged portions to be done*

9 Name Plate Details

Nameplate of the equipment shall be of Stainless Steel and attached by to the equipment of similar material and located for easy visibility.

The following data as a minimum shall be clearly stamped on the nameplate.

Name of the project

Name of the Client

Name of the Consultant

Manufacturer's name
PO No.

Year built
Name of the equipment
Equipment tag no
Capacity
Material Handled

Serial No.

5.5 Site Facilities

- 1 The bidder shall indicate clearly the work to be carried out at site and the procedure to be followed at Purchaser's site.
- 2 For the work to be executed at site, electricity will be made available near the work site. The Contractor shall ensure that the facilities are not misused or wasted.
- 3 The Contractor shall indicate approximate space requirements.
- 4 Accommodation/transport of workmen and supervisors of the Contractor shall be the responsibility of the Contractor.

5.6 Erection and Commissioning

The unit shall be erected by the Contractor on the locations given on the equipment layout drawing
Installation and commissioning of the complete system will be done by the supplier. He must ensure that the system shall be working properly.

5.7 Time of Completion

The period of the Contract shall commence from the date of receipt of Letter of Intent (LOI/Notification of Award). The whole work under this Contract including commissioning shall be completed in all respects within the time of completion specified in the notice inviting tender from the date of commencement of the contract.

5.8 Performance Guarantee and Warranty

- 1 Contractor shall guarantee that all materials used for the unit have been submitted to regular acceptance procedure and free from any defect regarding quality, form and appearance.
- 2 Any equipment, or its part not having been submitted to wrong operating service or faulty manipulation and found defective during erection, test or during operation, shall be repaired / replaced by the Contractor without delay and free of cost within the guarantee period.
- 3 In case of defective equipment Purchaser / Consultant shall have the option to repair/replace the equipment after intimating to the manufacturer, in order to avoid time delay. In such an event, Purchaser / Consultant shall be entitled to recover the cost of such repair / replacement from the Contractor.
- 4 The Contractor shall guarantee that upon completion of the satisfactory commissioning and acceptance of the equipment by the purchaser, all portions

thereof will be in accordance with requirement of the contract and will be perfect as to design, materials, workmanship etc. for a minimum period of one year from the date of provisional acceptance of the equipment as per general conditions of contract.

- 5 The Contractor shall further guarantee that during the guarantee period, he will repair all defective equipments and replace all defective materials furnished or installed under this contract, free of cost to the purchaser.
- 6 The performance of the systems as per the above requirement shall be guaranteed for a minimum period of 12 months from the date of commissioning or 18 months from the date of supply whichever is earlier.

5.9 Safety and Environmental Aspects:-

The total system should have adequate built-in precautions to prevent any fire or explosive hazards. Safety systems should be as per relevant IS codes.

5.10 Data to be furnished by The Tenderer

The tenderer shall submit all catalogues, leaflets, detailed technical specification, etc. for the equipment. Drawings showing all the design, operational and maintenance features, major dimensions shall be submitted along with the offer. The tenderer shall also submit a general arrangement drawing and approximate layout showing the space requirement etc.

Other Specifications and technical data to be furnished by the tenderer wherever applicable

- Data Sheets
- G.A drawings
- Drawings with dimensions of equipment
- Equipment Layout Drawings with elevations
- Equipment Specifications
- Empty Weight
- Safety devices provided.
- Service and spare parts availability
- Details of motors
- Manufacturing and delivery schedule
- List of customers to whom similar units have been supplied
- Erection, Operation & Maintenance manual with detail list of spare parts
- Compliance Statement

5.11 General

1. The system or equipment mentioned above is indicative only. The tenderers are advised to examine the feed materials and quote for a suitable equipment to meet the performance requirement.
1. The equipment supplied shall be complete in all respects with all necessary accessories required for operating.
2. The Purchaser reserves the right to procure all the items specified in the tender or part thereof without assigning any reason.

5.12 TECHNICAL SPECIFICATION - PLANT AND MACHINERY

5.13 SCOPE

5.14 This specification covers the technical requirements for manufacture, inspection, packing, forwarding, delivery, erection, testing and commissioning of various mechanical equipments.

5.15. STANDARDS

1. Unless otherwise mentioned all applicable codes and standards in their latest editions as published by the Bureau of Indian Standards and all such other as may be published by them during the tenure of the Contract shall govern in respect of design, workmanship and properties of material and methods of testing. In case where suitable Indian Standards are not available, generally accepted codes and practices shall be adopted.
2. In cases where the offer deviates from the specified standards, the tenderer shall indicate clearly in his offer the standards proposed to be adopted by him and the details thereof.

5.16. MATERIAL

Material not specified shall be as per standards for the specified operating conditions, subject to purchaser's approval.

5.17.ELECTRIC MOTORS

1 GENERAL

All electric motors required for the various equipment covered in the specification shall be capable of continuous operation at the rated speed without impairing performance and physical damage. All electric motors shall be capable of operating continuously under the voltage variation of +/- 10% and frequency variation of +/- 3%.

2 STANDARDS

The motors shall conform to the latest editions of Bureau of Indian Standard unless otherwise specified.

5.18. TECHNICAL DATA TO BE SUBMITTED WITH THE BID

1 Leaflets and Drawings

The bidder shall submit with his proposal all descriptive leaflets and technical brochure for the main and all auxiliary equipment quoted by him. Outline sectional drawings showing details of construction and materials, overall dimensions, weights and mounting and floating mechanism shall accompany each proposal.

5.19. DRAWINGS

General arrangement drawings indicating the mounting details, etc. shall be forwarded to Oushadhi approval prior to manufacture.

5.20. PAINTING AND SHIPMENT

5.21. All external surfaces of the equipment and motors shall be cleaned of loose substance and foreign material so that the prime coat adheres to the original metal surface. Prime coats and painting shall be done as directed by Oushadhi

5.22. LIST OF APPROVED MAKE

1	Motors	:	Crompton/BharathBijili/ NGEF/Jyothi
2	Mechanical seal	:	Sealol Hindustan/Dura Metallic
3	Valves	:	Uni Klinger, Spirax, L&T , BDK
4	Pressure/temperature gauge	:	General Instruments, H.Guru, Fiebig
5	Safety valve	:	Tyco Sanmar, Spirax

5.23. TECHNICAL SPECIFICATION - ELECTRICAL

5.24. GENERAL

5.27 The intent of this specification is to define the requirements for the design, manufacture, shop testing, supply, installation, testing and commissioning of the electrical system covering LT panel boards, motor control centers, Power & control cables, cabling, wiring and accessories, MCB distribution boards, earthing, lightning protection, control and monitoring system for turnkey completion for supply, installation, testing and commissioning of proposed equipments.

5.28

The suppliers should note that, it is the responsibility of the supplier to design, supply, install and commission the equipment and services required for the satisfactory performance of the installation according to the relevant codes and standards of Kerala State Electricity Board and Kerala State Electrical Inspectorate. The details given here are only indicative and are subject to changes and modifications to suit the requirements of the project and as directed by the Electrical Inspectorate during actual execution.

5.29 SCOPE OF WORK

Scope of work shall be includes but not limited to the following:

1. The Purchaser shall provide one number main LT power supply at 415 Volt, 3 phase & neutral, 50 Hz rating from Purchaser's main LT Power Control Center (PCC). The Supplier shall avail power supply from the outlets marked in the Purchaser's PCC by means of suitably rated aluminium bus ducts/cables to the Supplier's main LT Panel.
2. Supplier shall provide new Panel boards/Motor Control Center, VFD/Soft starter panel and sub switch boards for controlling the motors and other equipment.
3. Supply, installation, testing, commissioning and handing over of all electrical equipment and accessories to be supplied along with the machinery in satisfactory operating condition.
4. Supply and laying of cables, termination at ends, testing and commissioning of LT Power and Control Cables from Panels/ PCCs / MCCs to equipment/motors. Adequate size cables shall be provided to meet the continuous current rating and voltage drop limits in the cable as per electrical inspectorate standards.
5. Wherever buried cables are envisaged, scope of work includes digging of earth along the cable route, filling up of sand, protective covering as per specification, laying of cable, covering the cables with sand laying of bricks, back filling of earth etc., as per specification.

Installation of Hume pipes including excavation, erection, back filling etc. as required. Wherever drain/road crossings are required, hume pipe with manholes at both ends shall be provided. Hume pipe shall be suitably sized

and at least 20 percent spare space shall be provided for future insertion of cables.

6. Supply and installation of Cable markers as required.
7. Supply and installation of motors with local controlling ON/OFF switch unit. All the motors shall be provided local start/Emergency stop push button station in suitable metallic/cast aluminium enclosure with degree of protection is indoor/out door type as per the requirement.
8. Supply, installation and testing of earthing system complete with required number of earth pits, earth conductor of suitable rating as specified including interconnection between earth pits, earth bus and equipment earthing etc. MCCs/PCCs/panel boards, DBs etc, and building and other structures shall be connected to the earth bus. (The Main substation earthing and transformerearthing are excluded from Supplier's scope as the same will be covered by Purchaser separately).
9. Civil work includes grouting of equipment, Switch gear rooms, Foundations for LT panel boards, fixing of cable trays, cable trenches, pipes with all necessary supports.
10. Supply and installation of structural steel components for panel supports, cable supports, push button mounting pedestal etc.
11. Supply and installation of Galvanised Iron cable tray of ladder/perforated type with associated MS supports for cable supports etc
12. In addition to the electrical erection the Contractor shall provide safety items like the electrical danger boards, shock treatment charts, rubber mats, etc. on all the panel boards and other places where it is required. Fire extinguishers, fire buckets etc. required for electrical rooms shall be provided.
13. The price quoted for installation shall include the charges for cleaning and painting the conduits & supports and as directed by Engineer- In Charge.
14. Approval shall be obtained from Purchaser scheme, general arrangement, size and component rating of panel boards, design of lighting system and type of light fittings, cable sizing, lay out of switch gear room, earthing design and layout etc. All material shall be as per approved list.
15. Obtaining Approvals/Certificates like initial approval, scheme approval, final approval, safety certificates, etc from Kerala State Electrical Inspectorate, as per requirements, shall be in the scope of the Supplier. Any changes/modifications as directed by the Electrical Inspectorate after their inspection shall be carried out free of cost to the Purchaser.

16. Any item not specifically listed above, but required for safe and smooth operation of plant and for meeting the relevant codes, standards and KSEB & Electrical inspectorate regulations.
17. **The Supplier should submit all electrical equipment details with individual power requirement and total power consumption in terms of connected load and maximum demand along with the submission of tender document for review. Also the supplier should inform to purchaser about the requirement of Diesel generator back up for any critical equipment in the system.**

5.30 DETAILED SPECIFICATIONS

LT Panel Boards/ Motor control center

1 General

The switch boards are to be fabricated by a reputed firm.

2 Functional Requirement

The requirement of Panel board are to receive, control and distribute electrical power at 440V, 50 Hz, AC for all factory equipments supplied by the Supplier.

3 Design Requirement

4 Statutory Requirements

LT Panel Boards including motor control centre is to be manufactured/ assembled as per the latest BIS Specifications, Indian Electricity Rules, including special requirements of Kerala State Electrical Inspectorate and detailed specifications.

Switch Board / MCC Construction

The switch boards are to be manufactured/assembled as per the latest BIS specifications, IP42 classification, Indian electricity rules, including special requirements of state/ Central Electrical Inspectorate and the detailed specifications mentioned. This shall be floor mounted, free standing type, suitable for indoor installation in dust, vermin and weather proof construction. The control voltage for relay, contractors etc shall be 110V/230V AC by using suitable control transformers.

5 Housing Details

The SB shall be fabricated out of minimum 14 SWG sheet steel. It shall be provided with hinged doors on the front with necessary handles and earthed using flexible copper conductor. The doors shall be provided with neoprene gaskets. Suitable channel base frame should be provided for the panel board. Maximum length of a shipping section of PCC/MCC shall be 2500 mm.

Detachable gland plates of 3mm thick shall be provided at the bottom and top of the cable chamber, suitable for the termination of cables with compression type glands to the sizes as specified. Adequate space should be provided in the cable chamber for safe bending and termination of cables.

The enclosure shall be provided with lifting hooks, supporting legs and double earth terminals with double washers.

The switch board shall be in cubicle design (each feeder components are housed in individual cubicle) and fully compartmentalized having total segregation between each cubicle. Suitable cable and busbar alleys as well as separate metering and relaying compartments shall be provided. All components of the switch board shall be approachable from front. The Busbar chamber cover should be bolted type. The maximum operating handle/push button height of any feeder shall not be more than 1800 mm with reference to panel bottom. Supporting arrangement for dressing of power and control cables in cable alleys also shall be provided. The front openable/lockable door shall act as a cover for the switch boards. The busbar should be extendable at both ends. No busbar should be protruded in the cable alley.

6. Powder coating

All metal sheets shall undergo 7 tank metal treatment, thorough derusting-rinsing-degreasing-rinsing- phosphating-rinsing and then passivation. All metal surfaces shall be thoroughly cleaned and degreased to remove all scales, rust, grease and dirt. Fabricated structures shall be pickled and treated to remove any trace of acid. The undersurface shall be made free from all imperfections before undertaking powder coating.

Contractor shall obtain details of approved colour from the Engineer-in-charge before powder coating.

Panel finish shall be free from imperfections like pin holes, orange peels, run-off paint, etc.

All unpainted steel parts shall be cadmium plated or suitably treated to prevent rust, corrosion, etc.

7. Insulation resistance to earth:

This is to be measured with all fuse links in place, all switches, all lamps and appliance in position by applying a voltage not less than twice the working voltage (subject to a limit of 500V). Insulation resistance of the whole or any part of the installation to earth must not be less than 50 Megaohms divided by the number of outlets. In any case it should not be less than 1 Megaohm for the whole installation.

8. Insulation resistance between conductors:

Test to be made between all the conductors connected to one pole or phase conductor of the supply and all the conductors connected to the middle wire or neutral or the other pole or phase conductors of the supply. For this test, all lamps shall be removed and all switches put on. The result of the test must be 50 Megaohms divided by the number of outlets (point and switch positions) .In any case it should not be less than 1 Megaohm for the whole installation.

9. Busbar sizing connection and supports:

The busbars shall be made from high conductivity electrolytic grade aluminium conductor conforming to IS 5082. The busbars and supports shall be capable of

withstanding the rated and short circuit current as per the single line diagram/ feeder details. Minimum size of main power bus bars shall be of incomer switch rating and interconnecting busbar to feeders should be rated to switch rating. Maximum current density permissible for Aluminium bus bars shall be 0.8 Amps/Sq.mm without considering derating factors. Maximum current density permissible for Copper bus bars shall be 1.2 Amps/Sq.mm without considering derating factors. An earthing busbar of minimum 150 sq.mm section copper shall be provided outside panel at bottom throughout the length of the panel.

The busbars shall be provided with heat shrinkable PVC insulating sleeve. Supports for busbars shall be made of suitable size cast resin ribbed insulators and these should be adequate in number so as to avoid any sag in the busbars. (Hylam supports may not be used)

Minimum clearance between phase to phase shall be 32mm and that between phase to neutral/ earth shall be 26 mm.

10. Power Connection

10(A) For power interconnections within the panel board

Rigid Aluminium conductor, with PVC insulation, of adequate cross section i.e., current carrying capacity not less than the outgoing switch rating shall be used. Cable lugs/ sockets of suitable size and type shall be used for all interconnections.

For incoming and outgoing feeders of the switch boards, Aluminium conductor cable will be used and hence the panel has to be designed for receiving these and wherever required cable boxes shall be provided in panel by removable gland plates and shall be provided on top/bottom of panel, for cable entries.

In case of panel boards having bus duct as incomer, the panel board should be designed to accommodate proper connection/termination of the bus duct.

To prevent accidental contacts, all interconnecting cables/ bus bars and all terminals also shall be shrouded.

Provision for clamping the cables inside the cable alley should be provided.

Standard colour codes (red, yellow and blue for phases and black for Neutral shall be followed for all bus bars/conductors.

10(B) Auxiliary wiring and Terminals

Wiring for all controls, protection, metering, signaling, etc. inside the switchboard shall be done with 1100 volts grey colour HFFR (Halogen free fire retardant) copper conductor cables. Minimum size of these conductors shall be 2.5 sq.mm. Control wiring to components fixed on doors shall be flexible type.

The complete panel would be sub-divided into different sections and each section shall have its own control circuit with fuse and indication.

All control wiring should be provided with necessary cable sockets/ lugs at both ends. Conductors shall be terminated using compression type lugs. Each termination shall be identified at both the ends by PVC ferrules.

The identification termination numbers should match with those on the drawings.

5.31 Component of switch boards/MCC

The panel shall be provided with ACBs, MCCBs, SDFUs, fuses, meters, relays and instruments, etc. of size, capacity as per specification. The switch gears should be positioned inside the panel board as per manufacturers standards. The components (Over Load Relays and Contactors) inside the motor feeder shall be selected to meet Type-2 Co-Ordination and the contactors shall be used of AC-3 duty type. For incoming feeder of rating higher than 630 Amps., ACB shall be provided unless otherwise stated in the feeder details. Whenever remote control is to be provided for motor feeders, only Red Push Button for 'OFF' shall be provided on the MCC. Motor starters shall be suitable for AC 3 phase, heavy duty, unless specified otherwise.

5.32 Moulded Case Circuit Breakers

General

Moulded case circuit breakers (MCCBs) shall be incorporated wherever required and shall be of current limiting type and preferably double break. MCCBs shall conform to IS 13947-1/IEC 60947-1 for general rules and IS 13947-2/IEC 60947-2 for circuit breakers in all respects. MCCB shall be suitable for isolation as per standard, single phase 240V or three phase 415 V, 50Hz, AC and shall have a rated insulation voltage of 750 V AC. The MCCBs shall have thermal memory and shall have no Line-Load restriction. All the breakers shall have tropicalisation as a standard feature.

Construction

The MCCB case & cover shall be made of high strength heat resistant and flame retardant thermosetting insulating material.

The operating handle shall be quick make, quick break trip free type. The operating handle shall have suitable 'ON', 'OFF', 'TRIPPED' indicators.

In order to ensure suitability for isolation complying with IS13947-2/IEC 60947-2, the operating mechanism shall be designed such that the toggle or handle can only be in 'OFF' position.

Accessories

MCCBs shall be provided with the following accessories and all these devices shall be fittable at site. The accessories shall be separated from Power circuit. Preferably the Shunt trip release and undervoltage release shall be snap-in type and fitted with terminal blocks.

Shunt trip

Auxiliary switch

Extended rotary Handle.

Interlocking

MCCBs shall be provided with the following interlocking devices for interlocking the door of the switchboard.

Handle interlock to prevent unnecessary manipulations of the breaker.

Door interlock to prevent door being opened when breaker is in ON position. Door-interlock defeat to open the door even if the breaker is in ON position. Front operated rotary handle should have OFF-position pad-locking facility.

5.33 Switch Disconnecter Fuse Units (SDFUs)

Heavy duty switch disconnecter fuse unit to be incorporated in the cubicle switch boards shall comply fully with the requirements of IS: 13947 (part 3) and IEC 947-3, and all switch fuse units shall comply with the requirement of IS: 4064. The fuse switch units shall be of the double break type, suitable for load break (AC 23 A) duty with quick make and quick break action shall be capable of making and breaking 300% of the rated current. The unit shall be suitable for accommodating HRC cartridge fuse links and should have phase barriers and terminal shrouds. Each SDFU should have an auxiliary switch having 1NO+1 NC contacts, which shall be site fittable with out SDFU being removed from the panel board. All switch contacts shall be silver plated. The door of the unit shall be interlocked with the operating mechanism so as to prevent opening of the door when the switch is in 'ON' position and also to prevent closing of the switch with the door not properly secured. However by releasing interlock, switch shall be able to operate in any door position. The length of handle operating shaft shall be adjustable at site. The interior arrangement of the switch shall be such that all live metal is shrouded. The moving contacts shall be mounted on their own operating shaft so that they can be removed as a complete sub-assembly to facilitate inspection and maintenance. The terminal connections of the unit shall be capable of taking the appropriate sizes of cables with Aluminium conductors. For heavy duty fuse switch units, the connections to the units from the busbars and cables shall be terminated in pressure bolted joints inside the switch contacts, enabling readily removal of individual switch fuse unit from the front of the Board, if required. All normal duty switch fuse units shall have an external earthing terminal to enable the enclosure to be earthed.

a) HRC cartridge fuse links

The high rupturing capacity cartridge fuse links to be used in the switch disconnecter fuse units shall comply fully with the requirement of IS 2205. The fuse links shall have a certified rupturing capacity of not less than 35 kA. Fuses should have failure indication so that during fuse failure the operator can easily identify fuse failure.

HRC fuse shall be DIN/Blade type.

Motor Starters/Contactors

All motors are to be provided with suitably rated starters with over-load protection. Motor power cables shall be rated to withstand starting current of the motors. Direct on line (DOL) starters may be provided for motors upto 20 HP. Motors above 20 HP upto 75 Hp shall be provided with star delta starters. Motors above 75 HP shall be provided with soft starters with cooling system. Where ever VFD drivers are required the same shall be provided irrespective of the rating of motors. Bimetal overload relays are to be totally enclosed and sealed so that the sensitive

mechanism within is not tampered with during maintenance. Relays should be ambient temperature compensated and should be kept independent of the push buttons. All starters, relays, contactors, MCCB' etc. shall be selected based on type 2 coordination. All motor starters shall meet the required category of duty Contactors should conform to IS : 2959. Contactor coils shall be suitable for 110/230 volts, 50 Hz. unless otherwise specified. All contactors shall be supplied with minimum 2 NO + 2 NC auxiliary contacts. Additional contacts if required, for interlocking etc. shall also be provided. Suitable protection relays shall be provided as per Indian Electricity Rules, including Kerala State Electrical Inspectorate specifications. DOL connecting motor shall be rated for DOL operation and connecting cable should be rated for the starting current.

All starter shall be capable to monitor and control by PLC control and monitor system.

5.34 Indicating Lamps

Type	: Panel mounting wide band LED type with in built surge suppressor to protect LED against switching surges and built-in low voltage glow protection of 25V.
Standards applicable	: IEC 947-5-1
Diameter	: 22mm
Operating voltage	: 110/240V AC
Illumination Level	: Minimum 100 lux on the front face of the lens.
Colour of lamps	: as per standards

5.35 Measuring instruments

These shall be of square pattern having dimensions of 96x96 mm flush mounting type. Instruments like ammeter, Voltmeter, frequency meter etc. and instrumental transformers/ transducers etc. are also included in the scope of supply.

All AC meters shall be of class 1 accuracy.

Voltmeter shall be suitable for direct line connection. Voltmeters shall be connected through MCBs only.

All voltmeters shall be provided with selector switches.

Ammeters shall be CT operated.

Current Transformers (CTs)

CTs shall be cast resin insulated type. Primary and secondary terminals shall be marked indelibly. CTs shall preferably be mounted on stationery parts. CT rating and ratios shall be as per feeder ratings. These shall be capable of withstanding momentary short circuit and symmetrical short circuit current for 1 second. Neutral side of CTs shall be earthed. Protection CTs shall have low reactance, accuracy class "5P" and an accuracy limit factor greater than "10". Instrument CTs shall be of accuracy class "1.0" and accuracy limit factor less than "5.0".

5.36 Connection

Connections to the busbars shall be made by drilling holes. However, no holes shall be left in the busbars except at the both ends of the main busbar for panel extension. The bolts & nuts used for connections to busbars shall be of Aluminium alloy or tinned forged brass. For tapping of connections from busbars suitable size PVC sleeved copper conductor (minimum size 4.0 Sq.mm) shall be used with suitable size and type of crimped lugs/cable sockets. For connection of feeder above 63 Amps only busbar links with heat shrinkable PVC shall be used. Suitable size cable boxes shall be provided for incoming/outgoing cables. For all outgoing cables, cable alleys of suitable sizes in sides and tops, as required for proper cable connections/laying inside the panel, shall be provided. Switch board shall be suitable for Aluminium conductor PVC insulated incoming and outgoing cables. Removable gland plates shall be provided for cable entries.

5.37 Earthing

Purchaser will provide main earthing system bus at transformer room. These shall be inter-connected with Cu earthing busbars of size 25 x 6 mm (minimum) to the supplier earth bus. All earthing points inside the panel board / MCC , building structure , distribution board and equipments shall be interconnected to these earthing bus with suitable size copper conductor.

5.38 Name plates

Switch board/distribution board shall be provided with danger plate and name plates for all incoming and outgoing feeders. These name plates shall be of PVC (black colour base & white letters engraved) screwed to panel. PVC identification ferrule numbers shall be used for all internal wiring. The name plate shall contain the following information.

- Panel Board /MCC Identification number
- Feeder name.
- Switch/ fuse rating.
- Cable size.
- Feeder Cable from/ to.....

5.39 Supports

Busbars shall be rigidly fixed to the supports, of SMC/DMC solid block type base. Busbars shall be firmly held within the slots in sheet type supports, which in turn shall be rigidly fixed to the chamber.

5.40 Clearances

The minimum clearances to be maintained for enclosed indoor air insulated busbars for medium voltage applications shall be as follows:

Between	Min. clearances
Phase to earth	26 mm
Phase to phase	32 mm

Arrangement of busbars and main connections

Busbars and main connections, which are substantially in one plane, shall be arranged in the order given below:

- i) AC System
 - a) The order of phase connections shall be red, yellow and blue.
 - b) When the run of the conductors is horizontal, the red shall be on the top or farthest away as viewed from the front.
 - c) When the run of the conductors is vertical, the red shall be on the left, or farthest away as viewed from the front.
 - d) When the system has a neutral connection in the same plane as the phase connections, the neutral shall occupy the bottom position if horizontal and extreme right if vertical, or nearest position when viewed from the front.
 - e) Unless the neutral connections can be readily distinguished from the phase connections, the order shall be red, yellow, blue and black.

5.41 Push Buttons

- 1 Type : Manually operated spring return type.
- 2 Standard applicable : IEC947-5-1
- 3 Electric Shock protection : Class 2 (IEC 536)
- 4 degree of protection : IP54 (IEC529)
- 5 Diameter : 22mm
- 6 Type of mounting : snap type
- 7 Color of actuator : Start PB - Green
Stop PB - Red
Test/Reset PB - Black
- 8 Contact configuration : 2NO+2NC
- 9 Emergency stop push button: push and hold type

Approvals

The drawing showing general arrangements and detailed wiring diagram for the Panels shall be submitted to the Engineer-in-charge for approval, prior to manufacture and the same shall be got inspected, prior to despatch to project site. The complete switch board and its component shall conform to Indian Electricity Rules & Relevant IS.

5.42 Cables & Cabling

5.43 Scope

The scope under this section covers the following:

- 5.40 Power cables
- 5.41 Control cables

5.44 Standards

The following standards shall be applicable:

1. IS : 1753 : Specification for Aluminium conductors for insulated cables.
2. IS : 2982 : Specification for copper conductors in insulated cables.
3. IS : 5831 : Specification for XLPE insulated and PVC sheath of electric cables.
4. IS : 6474 : Polythene insulation and sheath of electric cables.
5. IS:3975 : Specification for mild steel wires, strips and tapes for armouring of cables.
8. IS : 694 : PVC insulated cables.
7. IS : 7098 : Specification for XLPE insulated PVC sheathed cables.
8. IS : 3961 : Recommended current ratings of cables.
9. IS : 5819 : Recommended short circuit ratings for high voltage PVC cables.

5.45 Power cables (LV) 1.1kV grade XLPE insulated cable

Power cables for use on 415 V system shall be of 1100 volt grade, Aluminium conductor, XLPE insulated, PVC sheathed, armoured and overall PVC sheathed cable, strictly as per relevant IS specification. Unarmoured cable to be used only if specifically mentioned in schedule of requirements. Bi-metallic plate washers should be provided wherever cables, lugs, and switch terminals are of different materials. Cables and cable lugs should be of same material where ever possible. No Aluminium conductor cable of size less than 4 sq.mm shall be used.

5.46 Control Cables

Control cables for use on 415 V system shall be HFFR (halogen free Fire retardent) type 1100 volts grade, copper conductor, PVC/XLPE insulated, PVC sheathed, armoured/ steel braided and overall PVC sheathed, strictly as per IS : 1554 (Part I) - 1978. Unarmoured cables to be used only if specifically mentioned in schedule of requirements. Control cable carrying current should be black colour and voltage circuit shall be of grey colour and shall be segregated.

The size of these cables shall be as specified in schedule of requirements or as per erection drawing. No cable of size less than 2.5 sq.mm. shall be used.

5.47 Cable Glands

Cable glands shall be of heavy duty single/double compression type of brass, chrome plated. These shall have a screwed nipple with conduit electrical thread and checknut. These shall be suitable for armoured/unarmoured cables, which is being used. All cable glands shall be properly earthed.

5.48 Cable Connectors

Cable connectors, lugs/sockets, shall be of copper/aluminium alloy, suitably tinned, solderless, crimping type. These shall be suitable for the cable being connected and type of function (such as power, control or connection to instruments, etc.)

5.49 Cable Indicators

These shall be self-sticking type and of 2 mm thick lead strap for overall cable. PVC identification numbers, ferrule shall be used for each wire.

5.50 Cable Route Markers

These shall be galvanised Cast Iron plate with marking (LT/HT) diameter 150 mm with 600 mm long 25x25 mm MS. angle riveted/bolted with this plate.

5.51 G.I. Pipes for Cables

For laying of cables under floor, ground etc. G.I. class 'B' pipes shall be used. MS. conduits is not acceptable for this purpose. All accessories of pipes shall be threaded types. Size of pipe shall depend upon the overall outer diameter of cable to be drawn through pipe. No G.I pipe less than 40 mm dia. shall be used for this purpose. To determine the size of pipe, assume that 40% area of pipe shall be free after drawing of cable.

Storage and handling

1. Storage:

- (i) The cable drums shall be stored on a well drained, hard surface, so that the drums do not sink in the ground causing rot and damage to the cable drums. Paved surface is preferred, particularly for long term storage.
- (ii) The drums shall always be stored on their flanges, and not on their flat sides.
- (iii) Both ends of the cables should be properly sealed to prevent ingress/absorption of moisture by the insulation during storage.
- (iv) Protection from rain and sun is preferable for long-term storage for all types of cables. There should be enough ventilation between cable drums.
- (v) Damaged battens of drums etc. should be replaced, as may be necessary.

2. Handling:

- (i) When the cable drums have to be moved over short distances, they should be rolled in the direction of the arrow marked on the drum.
- (ii) For manual transportation over long distances, the drum should be mounted on cable drum wheels, strong enough to carry the weight of the drum, and pulled by means of ropes. Alternatively, they may be mounted on a trailer or on a suitable mechanical transport.
- (iii) For loading into and unloading from vehicles, a crane or a suitable lifting tackle should be used. Small sized cable drums can also be rolled down carefully on a suitable ramp or rails, for unloading, provided no damage is likely to be caused to the cable or to the drum.

5.52 Motors

All motors are to be totally enclosed fan cooled (TEFC), IP55 type unless otherwise specified. The motor along with the fan is to be dynamically balanced to a high degree of accuracy. The rotor surface and the inside surface of the stator are to be suitably protected against corrosion. The motor shall be energy efficient, Squirrel Cage Induction motor (type eff-2) as per IS 12615. All motors should comply with IS:325, IEC:34. Push button control station shall be provided for all motors. Special

purpose motors with special characteristics and makes can be used after taken prior approval from purchaser/consultant. All motor shall be sufficient rated as per permitted temperature rise, running time according to the Indian Electricity Rules, including special requirements of Kerala State Electrical Inspectorate and detailed specifications

5.53 Technical Parameters

System voltage	- 415V +/- 10% 3 phase, 3 wire effectively earthed.
Frequency	- 50 Hz +/- 5%.
Enclosure	- IP 55 indoor/out door/flame proof as per as per requirement
Operation	- Continuous
Winding Insulation	- Class-F with temperature rise limited to class - B(average winding temp. 120oC on full load And hot spot temperature of 130 deg C)
Mounting	- As per Supplier's design and requirement at site.
Terminal boxes	- Large enough for Aluminium conductor cable, six terminal to be brought and shorted with heavy gauge tinned copper plate for DOL or star/delta starting, 2 Nos. brass cable glands for star/delta motors and 1No.brass cable gland for DOL motors.
Rotation	- Bi directional use.

5.54 Construction

The motors shall be so selected that efficient cooling is achieved to keep the temp. rise within permissible limits, as well as withstand the effect of abnormal operating conditions for a short period on in-frequent basis without any damage on the life and performance.

The design and manufacture shall be coordinated and appropriately matched with the requirements of the driven equipment both mechanically and electrically. The motor frame shall be either fabricated or casting of approved quality. The motors shall be cage type and the design shall provide a rigid cage construction with base firmly wedged in slots and solidly bonded to the end rings. The motors shall be capable of operation on full over speed which may be imposed by the driven equipment in both direction of rotation. The winding shall be use copper only.

The main base frame shall have two ground terminals for earthing the motor with ground network by 4/0 or 2/0 SWG copper conductor. The terminals shall be fitted with tinned copper serrated short barrel lugs.

For belt driven motors or directly coupled machine, protective covers/guards shall be supplied for the whole assembled unit.

Motor push button control station

These shall be provided in Aluminium cast/powder coated sheet steel housing, completely dust, vermin and weather proof, suitable for 415 volts, 50 Hz, complete with cable glands for incoming and outgoing cables. ON/OFF push button shall be provided for local isolation and testing purpose. Push button starting shall be based on PLC controlled Locking with out mechanical key system.

5.55 Motor Junction Box

These shall be in Aluminium cast/sheet steel housing, completely dust, vermin and weather proof(IP 55), suitable for 415 volts, 50 Hz, with heavy duty bakelite connector, complete with cable/conduit gland. Sample is to be got approved before use. Motor Junction Box shall be capable to terminate motor cables.

5.56 Wiring System

The internal plant wiring for general lighting shall be provided by the purchaser. But if any special lighting requirement for individual machine required, the same shall be provided by the contractor(supplier).

5.57 IPFC Based Capacitor Bank System

The purchaser will provided an IPFC based power factor improvement capacitor bank systems to improve the power factor above 0.9 under actual loading condition. The contractor shall designed and selected the plant equipments accordingly.

5.58 Earthing

The earthing of each panels, motors, push button station etc. shall be double earthed by using suitable size CU/GI strip as per Kerala state electrical inspectorate standard. The size of the strip shall be selected based on the fault level of the equipment.

5.59 Lightning Protection

Lightning protection of the building shall be provided by the purchaser. But if any individual machine lightning protection required, the same shall be included in the scope of contractor.

NOTE: - The specifications indicated above are minimum requirement only. The contractor should supply, erect and commission the equipments/ system according to latest editions of IEC and EI/IS standards

5.60 Control and Monitor System

The system shall be controlled from a programmable logic controller (PLC) based system installed by Supplier for the smooth operation of plant, described as PROCESS AUTOMATION SYSTEM.

5.61 Installation

Scope

The intent of this specification is to define the requirements for the installation, testing and commissioning of the electrical items mentioned in the schedule of requirements. The work shall, however at all times carried out strictly as per the instructions of the Engineer-in-Charge.

The Contractor shall furnish all tools, welding equipment, rigging materials, testing equipment, test connections and kits etc. Required for complete installation, testing and commissioning of the items included in the Contract.

The Contractor shall carry out touch-up painting on any equipment indicated by the Engineer-in-Charge, if the finish paint on the equipment is soiled or marred during installation handling.

The interconnecting control cables between LT panel boards, local push button station, UPS etc. should be done by the contractor as required.

The installation shall conform in all respects with Indian Standard Code of Practice.

5.62 LT Panel Boards/MCCs

Switchgears shall be installed in accordance with specified code of practice and the Consultants instructions. The panels shall be delivered in convenient shipping section by the contractors. The Contractor shall be responsible for final assembly and inter-connection of busbars/wiring. Foundation channel shall be grouted in the flooring by the Contractor. Switchgear panels shall be aligned and levelled on their base channels and bolted or tack welded to them as per the instructions of the Engineer-in-charge. The earth bus shall be made continuous throughout the length. Loosely supplied relays and instruments shall be mounted and connected on the switchgear. Wherever the instruments and relays are supplied separately, they shall be mounted only after the associated control panel have been erected and aligned.

After erection the switchboard/DB shall be inspected for dust and vermin proofness. Any hole, which might allow dust or vermin etc. to enter the panel, shall be plugged suitably at no extra cost.

If the instrument transformers are supplied separately they shall be erected as per the direction of the Engineer-in-charge. The Contractor shall fix the cable glands after drilling the bottom top plates of all switch boards with suitable holes at no extra cost.

Range of overload relays/timers etc. shall be checked with requirement of purchaser actually to be connected at site and if the same is under-sized/over-sized, it shall be brought to the notice of Engineer-in-charge and shall arrange procurement of correct rated components. However, the Contractor shall not charge anything extra for cost/labour for such replacements.

5.63 Testing

The Contractor shall perform operating tests on all switchgear and panels to verify operation of switchgear/panels and correctness of the interconnections between various items of the equipment. This shall be done by applying normal ac or dc voltage to the circuits and operating the equipment for functional checking of all control circuits, eg. closing, tripping, control interlock, supervision and alarm circuits.

All connections in the switchgear shall be tested from point to point for possible grounds or short circuit.

All electrical equipment alarms shall be tested for proper operation by causing alarms to sound under simulated abnormal conditions.

The Contractor shall arrange testing and calibrations of relays. The testing equipment including primary and secondary injection sets (if required) etc. shall also have to be arranged by the Contractor. Payment for above work shall be deemed to have been included in the erection of switch boards/control panels.

Insulation resistance tests shall be carried out by following rating meggers:

- a) Control circuits upto 220 V : by 500 V megger
- b) Power circuits, busbars, connections Upto 11kV : by 1000V meggar

Before electrical panel is energised, the insulation resistance of each bus shall be measured from phase to ground. Measurement shall be repeated with circuit breakers in operating positions and contact open. Before switchgear is energised, the insulation resistance of all DC control circuits shall be measured from line to ground.

The following tests shall be performed on all circuit breakers during erection:

- i) Contact alignment and wipe shall be checked and adjusted where necessary in accordance with the breakers manufacture's instructions.
- ii) Each circuit breaker shall be closed manually and its insulation resistance measured from phase to phase and phase to ground before erection.
- iii) All adjustable direct acting trip devices shall be set using values given by the Engineer-in-charge/manufacturer.
- iv) The dielectric strength of insulating oil wherever applicable shall be checked

Before switchgear is energised the following tests shall be performed on each circuit breaker in its test position.

- i) Close and trip the circuit breaker from its local & remote control switch, push button or operating handle. Switchgear control bus may be energised to permit test operation of circuit breaker with AC closing with prior permission of the Engineer-in-charge.
- ii) Test operation of circuit breaker latch, check carriage limit switch if provided.
- iii) Test proper operation of lockout device in the closing circuit, wherever provided by simulating conditions, which would cause a lockout to occur.
- iv) Trip breaker either manually or by applying current or voltage to each of its associated protective relays.

Before switchgear is energised, the test covered above shall be repeated with each breaker in its normal operating position.

All electrical equipment alarms shall be tested for proper operation by causing alarms to sound under simulated abnormal conditions.

The Contractor shall arrange testing and calibrations of relays. The testing equipment including primary and secondary injection sets (if required) etc. shall also have to be arranged by the contractor. Payment for the above work shall be deemed to have been included in the erection of switch boards/control panels.

Performa for Panels

- a) Circuit (breaker or Supplier module designation/bus no.)
- b) Insulation resistance tests (contacts open, breaker racked in position).
 - a) Between each phase of bus : Mega ohm
 - b) Between each phase and earth : Mega ohm
 - c) DC and AC control & auxiliary circuits : Mega ohm
 - d) Between each phase of CT/PT and CT & PT circuit if any : Mega ohm
- c) CT checks:
 - i) CT ratio
 - ii) CT secondary resistance
 - iii) CT polarity check
- d) Check for contact alignment and wipe.
- e) Check/test all releases/relays.
- f) Check mechanical interlocks.
- g) Check switchgear/control panel wiring.
- h) Check electrical interlocks.
- i) Checking of breaker/control circuits for
 - i) Closing-local and remote (wherever applicable)
 - ii) Tripping-local and remote (wherever applicable)
- j) Opening time of breaker/contactors.
- k) Closing time of breaker/contactors.

(This Performa shall be jointly signed by the Engineer-in-charge and the Contractor.)

5.64 Completion tests

After supply and installation of complete project or a particular building/area, the contractor shall carry out following tests before switching on the power to installation and the results shall be recorded and submitted to the engineer-in-charge. If results are not satisfactory/as per the standard, the contractor shall identify the defects/short coming and shall rectify the same. Nothing extra shall be paid for carrying out these tests and contractor has to arrange all necessary instruments.

5.65 Insulation resistance to earth

This to be measured with all fuse links in place all switches on all lamps and appliance in position by applying a voltage not less than twice the working voltage (subject to a limit of 500V). Insulation resistance of the whole or any part of the installation to earth must not be less than 50 Megaohms divided by the number of outlets (points and switch positions) except that it need not exceed 1 Megaohm for the whole installation.

5.66 Insulation resistance between conductors

Test to be made between all the conductors connected to one pole or phase conductor of the supply and all the conductors connected to the middle wire or neutral or the other pole or phase conductors of the supply. For this test, all lamps shall be removed and all switches put on. The result of the test must be 50 Megaohms divided by the number of outlets (point and switch positions) but need not exceed one Megaohm for the whole installation.

5.67 Polarity of single pole switches

Test shall be made to verify that all non-linked single pole switches are on phase conductor (Live) and not on the neutral or earthed conductor.

5.68 Resistance of metal conduits/sheaths (Earth continuity test)

In case of cables encased in metal conduit or metallic sheathing, the total resistance of the conduit or sheathing from the earthing point to any other position in the completed installation shall not exceed 2 ohms.

5.69 Busbar chamber

Busbar chambers shall be installed on fixed type switch boards with GI bolts and nuts.

5.70 Connections

- 1 Connections to busbars shall be made either by clamping arrangement, or by bolts and nuts as required. Tapped holes with studs may be permitted only for copper busbars for tapping conductor size upto 16 sq.mm.
- 2 All connections shall be made such that there is a clear metal to metal area contact at the tappings so that the current density of the busbars at the point of connection does not exceed permissible limits, avoiding local heating.
- 3 For tap-off connections from busbars, PVC insulated wiring cables may be used for current capacity upto 100A. and for higher current capacities, solid conductors/strips suitably insulated with PVC sleeve/tape shall be used.
- 4 The bolts and nuts used for connections to busbars shall be of aluminium alloy, tinned forged brass or galvanised iron. Suitable precaution shall be taken against heating due to bi-metallic contact, spring washers and plate washers, shall be used with the studs/nuts to ensure proper contact pressure.

5.71 Cabling

Cable network shall include power, control and lighting cables, which shall be laid in underground trenches, Hume pipes, open trenches, cable trays, GI pipes, or on building structure surfaces as detailed in the relevant drawings. Cable schedules or as per the Engineer-in-charge's instructions. Supply and installation of cable trays, GI pipes/conduits, cable glades sockets at both ends, isolators, junction boxes, remote push buttons stations, etc. shall be under the scope of the Contractor.

5.72 General requirements for handling of cables

- a) Before laying cables, these shall be tested for physical damage, continuity absence of cross phasing, insulation resistance to earth and between conductors. Insulation resistance tests shall be carried out with 500/1000 volt Megger.

- b) The cables shall be supplied at site, wound on wooden drum as far as possible. For smaller length and sizes, cables in properly coiled form can be accepted.

The cables shall be laid by mounting the drum of the cable on drum carriage. Where the carriage is not available, the drum shall be mounted on a properly supported axle, and the cable laid out from the top of the drum. In no case the cable will be rolled on, as it produces kinks which may damage the conductor.

- c) Sharp bending and kinking of cables shall be avoided. The bending radius for PVC insulated and sheath armoured cable shall not be less than $10 D$ Where 'D' is overall diameter of the cable.
- d) While drawing cables through GI pipes, conduits, RCC pipe, ensure that size of pipe is such that, after drawing cables, 40 % area is free. After drawing cable, the end of pipe shall be sealed with cotton/bituminous compound.
- e) High voltage (11 kV and above), medium voltage (230 V and above) and other control cables shall be separated from each other by adequate spacing or running through independent pipes/trays.
- f) Armoured cables shall never be concealed in walls/floors / roads without GI pipes, conduits RCC pipes.
- g) Joints in the cable throughout its length of laying shall be avoided as far as possible and if unavoidable, prior approval of site engineer shall be taken. If allowed, proper straight through epoxy resin type joint shall be made, without any additional cost.
- h) A minimum loop of 3 M shall be provided on both ends of the cable, or after every 50 M of unjointed length of cable and on both ends of straight through cable joint. This additional length shall be used for fresh termination in future
- i) Cable shall be neatly arranged in the trenches/trays in such a manner so that criss-crossing is avoided and final take off to the motor/switchgear is facilitated. Arrangement of cables within the trenches/trays shall be the responsibility of the Contractor.
- j) All cable routes shall be carefully measured and cable cut to the required lengths and undue wastage of cables to be avoided.. While selecting cable routes, interference with structures, foundations, pipe line, future expansion of buildings, etc. should be avoided.
- k) All temporary ends of cables must be protected against dirt and moisture to prevent damage to the insulation. For this purpose, ends of all PVC insulated cables shall be taped with an approved PVC or rubber insulating tape. Use of friction type or other fabric type tape is not permitted. Lead sheathed cables shall be plumbed with lead alloy.
- l) Wherever cable rises from underground/concrete trenches to motors/switchgears/push buttons, these shall be taken in GI pipes of suitable size, for mechanical protection upto 300 mm distance of concerned cable gland or as instructed by the Engineer-in-charge.
- m) Where cables pass through foundation/walls of other underground structures, the necessary

ducts or openings will be provided in advance for the same. However, should it become necessary to cut holes in existing foundations or structures, the electrical Contractor shall determine their location and obtain approval of the Engineer-in-charge before cutting is done.

5.73 Installation of Cable

Wherever cables are taken through masonry works and road crossings etc., they shall be protected by running through GI pipes and Hume pipes respectively. Depth shall be 1200 mm from top of finished road surface and it shall extend for about 1070 mm on both sides of the roads.

Utmost care shall be taken to avoid scratches, kinks and cuts on the conductor while transporting the cables to site or during installation. Suitable inhibiting grease shall be liberally applied to bare conductors, wherever they exist.

The junction boxes, cable end boxes etc. wherever required to be provided shall have sufficient wiring spaces with regard to the sizes of cables indicated in the drawings. Wherever required, the items to be supplied for electrification shall be complete with requisite type of cable glands, cable boxes, termination etc. and other accessories which are necessary for the satisfactory installation/operation of the installations as per relevant statutory rules and regulations.

Installation of all cables should be as per E.I. Standards. Fuses should be graded properly and should be selected based on the rating of cables. The cables shall be laid in trenches/overhead racks wherever available. The cables from cable trenches to the switcher shall be buried (as per standard practices and or taken through GI pipes to 1.2 m above ground/racks floor level. The cables taken over racks/ walls/ columns/ trusses shall be properly clamped using aluminium clamps of 16 SWG 1/4 hard or 3/4 hard sheet, the width varying from 12.5 to 25 mm at intervals of 750 mm. 225 mm minimum horizontal interaxial spacing shall be maintained when more than one cable is laid in same trench. Suitable and permanent type of cable markers is to be provided indicating the route and position of joints of cable. Loops should be provided at either ends of the cable. Identification tags should be provided for each cable in the trench at a distance of 3 metres.

Supply and installation of danger notice boards, where required, and other provisions under the statutory rules and regulations shall be included in the scope of this work.

The Contractor has to provide materials and carry out the wiring work including earthing according to IS 3043 unless otherwise specified and get it approved before using for work, by the authorised engineer of the Purchaser.

The complete installation work shall be conforming to NEC-1985 and complying with the Indian Electricity Rules and to meet the approval of the State Electrical Inspector etc. Installation of all switch boards and distribution boards should be in conformity with Rule 51(1)(c) of I.E.R. 1958. MV installation should conform to I.S. 7732.

The cable terminations and earth terminations, wherever required, shall only be using compression type cable glands and suitable lugs.

All the materials to be supplied for this work shall be got approved by the concerned engineer at site.

be considered complete only if the following tests are conducted, by the contractor at his own cost, satisfactorily in the presence of the site Engineer and are:

- a) Insulation test
- b) Earth resistance test and
- c) Continuity test

5.74 A) Laying of Cables (underground system)

- a) Cables shall be so laid in ground that these will not interfere with other underground structures. All water pipes, sewage lines or other structures, which become exposed by excavation, shall be properly supported and protection from injury until the filling has been rammed solidly in places under and around them. Any telephone or other cables coming in the way are to be properly shielded diverted as directed by the Purchaser.
- b) Cables shall be laid at minimum depth of 750 mm in case of LT & 1200 mm in case of HT, from ground level. Excavation will be generally in ordinary alluvial soil. The width of the trench shall be sufficient for laying of required number of cables.
- c) Sand bedding 75 mm thick shall be made below and above the cables. A layer of bricks (full size) shall be laid on the edge, above sand bedding on the sides of cables and a flat brick to cover cable completely. More than one cable can be laid in the same trench by providing a brick on edge between two cables. However the relative location of cables in trench shall be maintained till termination. The surface of the ground after back filling the earth shall be made good so as to conform in all respects to the surrounding ground and to the entire satisfaction to the Engineer-in-charge.
- d) For all underground cables, route markers should be used.
- e) Separate cable route markers should be used for LT, HT and telephone cables.
- f) Route markers should be grounded in ground with with 1:2:4 cement concrete pedestal size 230 x 230 x 300 mm.
- g) Cable markers should be installed at an interval not exceeding 50 M along the straight routes of cables at a distance of 0.5 M away from centre of cable with the arrow marked on the cable markers plate indicating the location of cable. Cable markers should also be used to identify change in direction of cable route and for location of every joint in underground cable.
- h) RCC hume pipes for crossing road in cable laying shall be provided by Contractor. RCC hume pipe at the ends shall be sealed by bituminous compound after laying and testing of cable by electrical Contractor without any extra charge.

5.75 B) Laying of Cables under Floors

- a) GI class A pipe shall be used for laying of outgoing cables from distribution boards to various equipment. Preferably one cable shall be drawn through one pipe. Size of pipe shall be such that after drawing of cable 40 % area is free. If length of pipe is more than 30 M, free area may be increased to 50 %.

- b) Use of elbows is not allowed at all and number of bends shall be kept minimum. Instead of using bends with sockets, pipe bending machine shall be used for making long smooth bends at site.
- c) Ends of pipe shall be sealed temporarily while laying with cotton/jute/rubber stopper etc. to avoid entry of building material.
- d) Exact locations of equipment shall be ascertain prior to laying of pipe.

5.76 C) Laying of Cable in Masonry Trenches

- a) Masonry/concrete trenches of laying of cable shall be provided by Contractor. However steel members such as MS angles/flats etc. shall be provided & grouted by electrical Contractor to support the cables. Cables shall be clamped to these supports with aluminium saddles/damps. More than one tier of cables can be provided in the same trench if the number of cables is more.
- b) Entry of cables in trenches shall be sealed with bituminous MASTIC compound to stop entry of water in trenches.

5.77 D) Laying of Cables in Cable Racks

Cable Racks to be used for cables laid indoors except for single cables. The cable racks shall be of ladder type fabricated out of structural steel, MS, GI or aluminium perforated as indicated. The cable racks shall be of adequate strength to carry the weight of cables with out sagging. Structural bracket grouted in the build up trenches to support the cable such supports shall be at intervals of not less than 750 mm centres. All the structural steel work shall be finished with two coats of paint over primer.

- a) Cables shall be fixed in cable trays in single tier formation and shall be clamped with aluminium flat clamps and galvanised bolts/unit.
- b) Earthing flat/wire can also be laid in cable tray along with cables.
- c) After laying of cables minimum 20 % area shall be spare.
- d) Laying of Cables on Building Surface/Structure
- e) Such type of cable laying shall be avoided as far as possible and will be allowed only for individual cables or small group of cables which run along structure.
- f) Cables shall be rigidly supported on structural steel/masonry using individual cast/malleable iron galvanised saddles and these supports shall be approximately 400 to 500 mm for cables upto 25 mm overall diameter and maximum 1000 mm for cables larger than 25 mm. Unsightly sagging of cables shall be prevented. Only aluminium/GI clamps with GI bolts/nuts shall be used.
- g) If drilling of steel structure must be resorted to, approval must be secured from the Engineer-in-charge and steel must be drilled where the minimum weakening of the

structure will result.

5.78 Termination and Jointing of Cables

a) Use of Glands

All PVC cable upto 1.1 kV grade, armoured or unarmoured shall be terminated at the equipment/junction box/ isolators/push buttons/control accessories, etc. by means of suitable size compression type cable glands armour of cable shall be connected to earth point. The Contractor shall drill holes for fixing glands wherever necessary. Wherever threaded cable gland is to be screwed into threaded opening of different size, suitable galvanised threaded reducing bushing shall be used for approved type.

In case of termination of cables at the bottom of the panel over a cable trench having no access from the bottom, a close fit holes should be drilled in the bottom plate for all the cables in one line, then bottom plate should be split in two parts along the centre line of holes. After installation of bottom plate and cables with glands, it shall be sealed with cold sealing compound.

b) Use of Lugs/sockets

All cable leads shall be terminated at the equipment terminals, by means of crimped type solder less connectors unless the terminals at the equipment ends are suitable for direct jointing without lugs/sockets.

The following is the recommended procedure for crimped joints and the same shall be followed:

- i) Strip off the insulation of the cable end with every precaution, not to sever or damage any strand. All insulation to be removed from the stripped portion of the conductor and ends of the insulation should be clean and square.
- ii) The cable should be kept clean as far as possible before assembling it with the terminal/socket. For preventing the ingress of moisture and possibility of re-oxidation after crimping of the aluminium conductors, the socket should be fitted with corrosion inhibiting compound. This compound should also be applied over the stripped portion of the conductor and the palm surface of socket.
- iii) Correct size and type of socket/ferrule/lug should be selected depending on size of conductor and type of connection to be made.
- iv) Make the crimped joint by suitable crimping tool.
- v) If after crimping the conductor in socket/lug, same portion of the conductor remains without insulation the same should be covered sufficiently with PVC tape.

c) Dressing of Cable inside the Equipment

After fixing of cable glands, the individual cores of cable shall be dressed and taken along the cableways (if provided) or shall be fixed to the panels with polyethylene straps. Cable shall be dressed in such a manner that small loop of each core is available inside the panel.

For motors of 20 HP and above, terminal box if found not suitable for proper dressing of an aluminium cables, the Contractor shall modify the same without any additional cost.

- d) Cables inside the equipment shall be measured and paid for.
Identification of Cables/Wires/Cores

Power cables shall be identified with red, yellow & blue PVC tapes for trip circuits identification, additional red ferrules shall be used only in the particular cores of control cable at the termination points in the switchgear/control panels and control switches.

In case of control cables all cores shall be identified at both ends by their wire numbers by means of PVC ferrules or self sticking cable markers, wire numbers shall be as per schematic/connection drawing. For power circuit also wire numbers shall be provided if required as per the drawings of switchgear manufacturer.

5.79 Testing of Cables

- a) Before energising, the insulation resistance of every circuit shall be measured from phase to phase and from phase to ground. This requires 3 measurements if one side is grounded and 6 measurements for 3 phase circuits.
- b) Where splices or terminations are required in circuits rated above 650 volts, measure insulation resistance of each length of cable before splicing and/or terminating. Report measurements after splices and/or terminations are complete.
- c) DC High Voltage test shall be made after installation on the following:
 - i. All 1100 Volts grade cables in which straight through joints have been made.
 - ii. All cables above 1100 V grade.

For record purposes test data shall include the measured values of leakage current versus time.

Cables shall be installed in final position with the entire straight through joints complete. Terminations shall be kept unfinished so that motors, switchgear, transformer etc. are not subjected to test voltage.

The test voltage and duration shall be as per relevant codes and practices of Indian Standards Institution.

5.80 Proforma for Testing Cables

Proforma - A

Date of Test

- a) Drum No. from which cable taken
- b) Cable from _____ to _____

Signature of
Engineer-in-Charge

Signature of
Contract

Proforma - C

Cable Jointing
(To be shown for each cable separately, voltage wise)

Date(s) of Test:.....

Voltage of Megger used:.....

1

2 3

Number of Joint
Location
Type of cable(s)
Type of joint (Indoor/Outdoor, straight
through/termination, LV/MV/HV)

Insulation resistance (Mega ohm) before jointing

Cable I -	(a) Between	R & Y Y & B B & R
	(b) Between	R & N Y & N B & N
	(c) Between	R & E Y & E B & E N & E
Cable II -	(a) Between	R & Y Y & B B & R
	(b) Between	R & N Y & N B & N
	(c) Between	R & E Y & E B & E N & E

Insulation resistance (Mega ohm) of Jointed cable

Cable I -	(a) Between	R & Y
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Y & B
B & R

(b) Between R & N
Y & N
B & N

(c) Between R & E
Y & E
B & E
N & E

Signature of Engineer-in-Charge

Signature of Contractor

Proforma - D

Testing Before Commissioning

(a) Cable Work Date(s) of Test:.....

(i) Details of high Voltage test conducted

System of supply.....
Test Voltage applied.....kV.....Minutes
Result of test-Satisfactory/Unsatisfactory.

Voltage of Megger used:-
Result of Megger testing:-

Between R & Y
Y & B
B & R
Between R & N
Y & N
B & N
Between R & E
Y & E
B & E
N & E

b) FEEDER PILLAR:-

i) Pillar Number:

ii) Voltage of megger used:

iii) Result of megger testing:

5.81 APPROVED MAKES OF EQUIPMENT AND MATERIALS

5.82 Scope

The scope of this section covers the recommended makes of equipment, material components. The final choice of makes shall be indicated at the time of finalisation of order.

The makes of material offered by the contractor shall be indicated at the space provided for proper evaluation of the offer and shall be one of the recommended makes. In the absence of such indication, the decision rests with the Purchaser/consultant.

5.83 Makes recommended

The makes of material recommended are exhibited in respective section. The offers shall be strictly on the basis of the makes recommended.

Where specified make and model nos. are indicated in the schedule of requirements, the supplier should quote for the same items.

List of Approved Makes of Equipment and Materials

Sl.No.	Item	Make of Materials/Equipment
1	1.1 kV grade XLPE insulated PVC sheathed Al./ Cu. Cable	CCI, NICCO, Torrent, Universal, Havells, Gloster, Traco
2	LT Cable joining & Termination kit	Raychem, M seal, Denson.
3	Cable glands, lugs, End termination kits	Gripwel, HMI, Denson, Multipressings, Dowell, Comet, Lapp Kabel
4	Starters, Contactors, relays	Siemens, L&T, Schneider Electric, ABB, GE.
5	Current Transformer	AE, Intrans, Resitech, kappa, Intech
6	Timer	Legrand, GE, Siemens, EAPL
7	Intelligent meter	L& T, Socomec (Diris), Krykard/ Conzerv/ Schneider
8	SDFU, Isolator	L&T, Siemens, ABB, Schneider
9	Push Buttons	Tecnic, Schneider, Siemens, BCH
10	Indicating lamps (LED type)	Tecnic, Schneider, Siemens, BCH
11	Fuses/Fuse carriers	Siemens, L & T, GE
12	Indicating meters & Energy meter	AE, MECO, L&T, Conzerv, Schneider.
13	Selector switches	Reco, Essen, Kaycee, L&T.
14	MCB Distribution board	Legrand, ABB, Indoasian, MK, Siemens
15	MCB, RCBO, RCBO	Siemens, Legrand, Indoasian
16	660/1100 volt grade stranded pvc unsheathed wire with copper conductor	Finolex, RR Kabel, L&T, Lapp Kabel.
17	ACB, MCCB	L&T, Siemens, ABB, GE, Schneider
18	Motor	ABB, BHEL, Bharat Bijlee, Kirloskar Electric, Siemens, Crompton Greaves, Alstom

