

SPECIFICATION FOR ELECTRICAL, AND ALLIED WORKS

I. General Condition of Contract:

1 General:

The following specifications will apply under all circumstance to the equipment and fittings to be supplied and installed against this contract and it is to be ensured that the contractor shall obtain at his own expense and on his own responsibility for the purpose of making the bid and for entering into a contract keeping in view the specifications hereunder, design drawings of the electrical installation, bill of quantities (BOQ) and inspection of site etc.

2 Standards:

Where not specified within this Specification, all materials and workmanship used in the installation works shall be in accordance to the latest edition of the related IS Standards / NS or equivalent.

Notwithstanding the stipulation of above standards, local electrical codes for electrical serves in buildings, where such exist, shall also be followed. Adequate consideration shall also be given to compliance of the equipment and works with local environmental conditions such as temperature, altitude, humidity, dust, vermin, attitude of personnel who will occupy the premises etc.

3 Scope of Work:

For detail scope of the work, the contractor shall consult in detail the drawings, the conditions of contract, all related specifications, related standards, bill of quantity (BOQ) and inspection of the proposed site.

The scope of works generally includes the followings.

- a. The supply, delivery, fixing, installation, testing and commissioning of all required materials, fixtures, all electrical appliances as mentioned in BOQ.
- b. Conducting and electrical wiring for light fixtures, fans, AC's, power points etc., (whichever applicable as per technical specifications, drawings, site conditions and bill of quantity)
- c. Testing and Commissioning of the entire electrical and HVAC installations.
- d. And other following related works:

The works undertaken shall be fully coordinated with the civil works so that all electrical and HVAC and allied works are set and finished in conformity with the building structural and architectural works. The work schedule shall also be coordinated so that no components of work schedules are interrupted owing to defective programming. Works to be undertaken are categorized under the following major sections:

- i. Laying of HDP/PVC conduits, PVC sleeves, outlet boxes, pull boxes and accessories required for the electrical wiring of the system.
- ii. Wiring in concealed installed conduit to achieve desired electrical sub-circuits for the given electrical and HVAC layout.
- iii. Installation of and termination of wiring to light fixtures, power outlets, ceiling fans, exhaust fans, switches, dimmers, regulators, AC out-lets, geysers etc (whichever applicable as per technical specifications, drawings, site conditions and bill of quantity).
- iv. Installation of mains power cables from utility LV/HV take-off terminals of electricity authority (or the sub-station) to the main panel/distribution board.
- v. Fabrication and fixing of cable trays if applicable.

- vi. Installation of sub-mains power cables form utility main panel/distribution board to sub-distribution boards.
- vii. Installation of main panel/distribution boards and sub distribution panels.
- viii. Rectification and cabling of earth continuity conductor.
- ix. Installation of diesel generator (if mentioned in BOQ).
- x. And all other works required including testing and commissioning.

Works indicated shall include all civil, electrical and HVAC works required to achieve a satisfactory installation, whether or not such are specified outlined in these specifications.

4 Rates:

The rate quoted in the tender shall include all charges of materials, installations, testing and commissioning, labor, tools and equipments, shed for material store, transferring all materials from place of availability to the site, all applicable taxes and duties, contingencies, breakage, wastage and maintenance of installation for one year. The rate in the original contract shall determine the values of the extra works where such extra work is of a similar nature and has been executed under similar conditions. Wherever the extra work is not of a similar nature, the rate for the same shall be determined prior to the execution of work and approved by the Engineer / Client / Consultant.

5 Quantities:

All quantities mentioned in the Priced Bill Of Quantity are true within $\pm 2\%$ and the contractor will get payment according to measurement of the actual work quantities. The schedule of quantities is liable to alteration by deletion or addition partially or wholly as required.

6 Materials:

The contractor must supply all the materials (Electrical and HVAC systems) from authorized distributor/ supplier / manufacturer. Prior to installation of the electrical and allied goods, the contractor should provide all the samples with relevant catalogues, dealer / agent authorization certificates for conformation of the quality of the materials. The contractor shall test all materials to be supplied before and after the installation in presence of the consultant.

Good appearance and workmanship of the installation shall be of equal importance with its electrical and mechanical efficiency. All portions of the work shall be so laid and installed that the work as a whole would be uniform and shall present a neat and aesthetically pleasant appearance in a manner meeting the approval of the engineer. The Contractor shall verify in the field all measurements necessary for the electrical works and shall assume the responsibility for their accuracy.

Materials defective or damaged during the execution works shall be promptly replaced at the expense of the contractor. The Works shall be carried out in a manner so as to conform to the progress of the other trades and shall be completed as soon as the conditions of the building will permit.

7 Drawings:

- a. Design drawings:

The drawings provided are design drawings and generally are diagrammatic. They do not show offsets, bends, pull box, which may be required for the installation.

- b. **Shop drawings:**
Prior to commencing procurement, the contractor shall submit for approval, detailed shop drawings showing actual layout, dimensions, materials used, standards, cable / conduit / cable trunk route, single line diagrams showing the feeders / circuits to be connected, cable ratings, circuit breakers ratings, panel boards fabrication details of electrical and HVAC and Allied items. The detailed shop drawings shall be prepared by the electrical experts with minimum 2 years experience in similar activities employed by the contractor. The contractor shall submit the CV of the electrical engineer to the consultant for approval.
- c. **As built drawings:**
3 sets of fully computerized “As Built Drawings” (soft and hard copy) indicating actual route runs of conduits / cables, actual electrical layouts shall also be submitted at the completion of entire electrical and HVAC installations.
All as built drawings shall be prepared by well experienced experts in relevant fields employed by the contractor.

8 Samples:

Prior to commencing procurement, the contractor shall submit for approval, technical description, related catalog/brochures and a sample item each of all electrical and HVAC items which are to be procured and installed.

9 Contractors Experts / Supervisor:

Contractor should have a full-time electrical engineer and a full-time electrical supervisor (well-experienced electrician), part/full time HVAC engineer etc, throughout the construction period for executing the work as per drawings, specifications and instructions of consultant. Also the contractor shall submit the bio-data of all relevant experts and supervisor with this offer.

10 Cutting and Patching:

Cutting and patching required for the proper installation and completion of works including plastering, masonry work, concrete work and patching should be done by the contractor himself using skilled labor.

11 Storage and Protection:

Particular care shall be taken to protect materials, equipment and fixtures against dampness and mechanical damage during period of storage and progress of construction and cleaning operations.

12 Quality of Work:

The work shall be carried out in the best workman like the contractor without any extra charge shall carry out defect or minor changes in the design etc. if pointed out.

Workmanship and good appearance of the installation shall be of equal importance with its electrical and mechanical efficiency, and all portions of the work shall be so laid out and installed that the work as a whole is of uniform quality and shall present a neat appearance in a manner meeting the approval of the Consultant. The contractor shall verify in the field all measurements necessary for the electrical work and shall assume responsibility for their accuracy.

13 Progress and Completion of Works:

The work shall be commenced immediately after the contractor receives instructions to proceed.

The contractor shall submit work schedule for execution of the project. The contractor shall employ adequate labors to complete the work within the schedule time and shall make his own arrangement for housing labor and materials etc.

Materials, which are defective or damaged during the progress of work, shall be replaced or repaired in an approved manner at the expense of the contractor. The progress of electrical and allied works shall be carried out so as to conform to the progress of the work of the other trade and the entire installation shall be completed as soon as the condition of the building will permit.

Upon completion of the installation of the lighting fixtures and lighting equipment they must be in first class operations order and in perfect conditions as to finish, etc. At the times of final inspection all fixtures and equipment must be complete with lamps and required glassware or reflector, which must be clean and free from defects. Any fixtures, reflectors or glassware broken prior to the time of final inspection and acceptance shall be replaced at the contractor's expense.

14 Performance of Works:

All cutting, drilling, channeling, patching, etc. required for installation of electrical and allied work shall be carried out in a manner approved by the Consultants. Any defecting of finish, plaster, woodwork, metalwork, masonry, concrete or other material, resulting from the performance of the work shall be replaced or repaired at no expense to the owner and to the approval of the Consultant.

15 Inspection, Testing and Commissioning:

The contractor shall notify in writing to the consultant about the completion of the work. Within the notified time, the consultant shall send his representative to remain present at the time of carrying out the tests by the contractor. The contractor shall fix up the date in consultation with the consultants for such test.

The contractor shall be responsible for providing all the necessary instruments for carrying out the tests without any extra charge.

Prior to test, feeders and branches shall be continuous from service contact point to each outlet; all panel feeders and devices connected and fuse in place. The contractor shall test the electrical and allied system for short circuits, earth fault, full load test, Insulation resistance test measured in mega ohm, earth resistance test and other related electrical tests. Test shall be carried out in accordance with the requirements of the Indian codes or equivalent and shall be conducted in the presence of the consultant. Any defect or damage during testing and commissioning shall be corrected or replaced by the contractor at his own cost.

16 Maintenance and Guarantee:

The contractor guarantees by his acceptance of the contract that all work installed will be free from any and all defects and that if during a period of one year from date of acceptance of work any such defects on workmanship material or performance replace, repair or otherwise correct the defects of deficiency, without any cost to the owner, within a reasonable time fixed by the consultant.

In the event of default on this guarantee by the contractor, the owner may have works done as required and recover the cost from the contractor.

17 As-Installed Drawings

After all tests on the completed installation have been approved, the contractor shall submit three copies along with the original set of as-installed Electrical and HVAC Drawings in spiral-bound covers for subsequent maintenance and operation. These shall clearly indicate:

- a. Conduit runs / route and sizes with the number and size of cables enclosed in the conduit accessories such as pull boxes, outlets etc.;
- b. Distribution patterns and circuits in main and sub-main and distribution boards/boxes;
- c. Location of earth stations and conductors;
- d. Location of all electrical and HVAC appliances, equipment and components; underground and over ground cable routes, sizes, cable trays and ducts provided.

18 Operation & Maintenance Instructions Manual

The contractor shall also provide three copies in a durable plastic case of operating and maintenance instruction manuals in English and with clear and readable text. The manuals shall comprise of the following in given order:

SECTION A	Index
SECTION B	Description of the Installations (Electrical, HVAC and Allied Works).
SECTION C	Test Reports
SECTION D	As Built Drawings (Electrical, HVAC and allied installations)
SECTION E	Routine maintenance instructions including those of the manufacturer's and dates for ordering replacements.
SECTION F	Manufacturer's names, addresses etc. Including those of Local Agents.
SECTION G	All relevant original catalogues from Manufacturer.
SECTION H	List of recommended spare parts

One copy of Manual shall be made available at the time of commissioning of the works. Until the record drawings, prints, transparencies are approved by the Engineer, the contract shall not be considered as complete and final payment including the release of retention monies will be withheld until such drawings, etc., have been submitted to and approved the Engineer

- 19. Sub-Contract:** Prior to sub-let any part of the work, the contractor shall submit the detail company profile / CV of the company/ person for approval.

20 Relevant Standards:

Unless otherwise specified, electrical equipments, materials and workmanship shall conform to the applicable current standards rules and IS specifications. All products shall bear the mark of Indian Standard Institutions. The following Indian Standards specifications will apply to the equipments to be used under this contract.

- I. Electrical Wirings Installations - IS 732-1989

II. Electrical Safety	-	IS 5216(Part 1)1982
III. Switch Fuse Units on cubical switches boards-		IS 4047-1967
IV. Distribution Boards	-	IS 2675-1966
V. Switch Gear Bus bars	-	IS 375-1963
VI. HRC Fuse Links	-	IS 2208-1963
VII. Enclosure for low voltage switchgear	-	IS 2147-1962
VIII. PVC Power Cables	-	IS 1554-1988
IX. Flexible Cables	-	IS 4289 –1984
X. Conduits for electrical installations	-	IS 9537-1980
XI. Flexible conduits non metallic	-	IS 6946-1973
XII. Safety for luminaries	-	IS 1913-1978
XIII. Danger notice plate	-	IS 2551-1982
XIV. Switch Socket and outlets	-	IS 4615-1968
XV. Recessed Luminaries	-	IEC Certified
XVI. Earthing	-	IS 3043-1966
XVII. Current Transformers	-	IS 2705-1981
XVIII. Lightning Arrestor	-	IS 3070-1985
XIX. LV Isolators	-	IS 2607-1967
XX. MCB	-	IS 8828-1978
XXI. MCCB	-	IS 2516-1985

21 Abbreviations Used:

NEA	-	Nepal Electricity Authority
LT	-	Low Tension
HT	-	High Tension
AC	-	Alternating Current
MPB	-	Main Panel Board
MDB	-	Main Distribution Board
FDB	-	Floor Distribution Board
SDB	-	Sub Distribution Board
KV	-	Kilo Volt
KA	-	Kilo Ampere
PVC	-	Poly Vinyl Chloride
SWG	-	Standard Wire Gauge (British)
IS	-	Indian Standard
TP	-	Three Pole
DP	-	Double Pole
SP	-	Single Pole
TPN	-	Three Pole Neutral
MCB	-	Miniature Circuit Breaker
MCCB	-	Moulded Case Circuit Breaker
CT	-	Current Transformer

22 Test:

The contractor shall submit for rechecking, re-testing and approval, a technical description of the method applied to test the electrical integrity of the entire installation including the measurement of obtained earthing resistance and the insulation resistance of the installation. Tests shall be conducted on the completed installation to check the following:

- (a) Polarity: to verify that all terminals are correctly connected with regard to line, neutral and earth.
- (b) Insulation test between live and neutral conductors: to verify the Megger reading between line and neutral conductors is not below 1 Mega ohm with all switches and fuses on but fixtures and lamps out.
- (c) Insulation test between all non-earthed conductors and the earth a live system is not below 1 Mega ohm from Megger reading.
- (d) Earth resistance test including the earth-loop test; and
- (e) Other tests to verify safety and integrity of the installation.

Routine Tests

Routine tests, in general, shall be carried out as summarized below, in accordance with this specification and relevant standard/specification to which the equipment has been made.

COMPONENTS

Circuit breakers
 Current transformer
 Indicating instruments and meters
 Voltage transformers
 Control switches
 Protection relays
 Fuse switches, switches and Isolators

COMPLETE SWITCH BOARDS

Distribution Boards
 High voltage power frequency tests on main and auxiliary circuits
 Insulation resistance tests
 Electrical operation of circuit -breakers, control circuits at the appropriate voltage limits.
 Mechanical operations tests and tests to certify correct functioning of interlocks
 Adequacy operation tests and tests to certify correct functioning of interlocks
 Measures of spacing between components, enclosure box thickness and cable entry and exit openings.
 Any other tests required by the Engineer or his appointed representatives.

Test at Site

General

At least two months before the equipment is due to be delivered to site two copies of a site test schedule shall be submitted for approval which shall include details of methods of carrying out and recording the performance acceptance tests and any other tests which are considered necessary to ensure that equipment is ready for service.

Switch Gear

The following tests are to be carried out after the equipment has been completely erected and connected up on site. The tests shall be made in the presence and to the satisfaction of the Engineer. Before testing, testing procedure shall be prepared and submitted to Engineer for approval.

- a) Panels
 - 1. Physical checks
 - 2. Duct or test on all bus bars
 - 3. Insulation resistance test
- b) Earthing
 - 1. Physical checks
 - 2. Earth values and various earth points
- c) Relays
 - 1. Physical checks
 - 2. Current sensitivity test
 - 3. Final setting test
 - 4. Final wiring check
- d) Current Transformer
 - 1. Physical checks
 - 2. Insulation resistance test
 - 3. Polarity test
 - 4. Magnetization curve test
 - 5. Ratio test
- e) Cables
 - 1. Physical checks
 - 2. Insulation resistance test

Building Service

- a) A visual inspection of the whole of the installation, covering equipment and section in subways, walkways, crossways and false ceilings where accessible.
- b) The operation of all accessories and items of equipment and a check for proper function, including such items as may have been supplied by others but wired under this contract. These tests shall be made under normal operating conditions and the results noted.
- c) Insulation tests which shall cover all circuits and shall be made between phases, phase to neutral, phase to earth and neutral to earth.
- d) Loop impedance tests shall cover every socket outlet, fixed appliance, switch, all switch/fuse gear and exposed metal work that is specified to be bonded to earth.
- e) A test to ensure a safe measure of earth bonding shall be carried out before any line/earth loop impedance test is undertaken. Where a circuit is shown to be badly or insufficient earthed, all earth continuity connections shall be remade to the satisfaction of the Engineer.
- f) For correct polarity of socket outlets, lighting switches and all other items where correctness of polarity is essential.

Method of Tests

- a) The tests shall be carried out by the contractor in the presence of the Engineer at the completion of the installation or in any other sequence the Engineer may decide.

- b) Recorded by the contractor on the form of test certificate and shall be forwarded to the Engineer within fourteen days of the tests being made.

23 Finishes of Equipment on Completion:

The contractor shall be responsible for ensuring that the finish of all equipment and light fittings is clean and in "as New" condition upon completion of the contract and at the time of handing over. The contractor shall take whatever steps as necessary to accomplish this during the course of the contract.

Any scratched switch plate shall be replaced and any splashed paint on the electrical equipment shall be carefully removed. Switch and main panels and distribution boards shall receive special attention and any scratches etc. shall be made good.

All light fittings, glasses and diffusers shall be left in a clean condition upon completion of the contract. The interiors of all electrical equipment, distribution boards etc. shall be cleaned.

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II. Specification for Internal Electrification Works

1 LT Distribution Panels/ Boards:

- a. The Main Distribution Board shall be indoor type, totally enclosed made from 14 SWG heavy gauge mild steel, powder coated, dust and vermin proof suitable for wall mounting. The steel sheet shall be supplied with 2 coats of red oxide primer and then two final coats of grey enamel.
- b. The bus bar shall be tinned and made from high conductive electrolytically pure copper bar strips of sufficient cross sectional area so that maximum current density of 1.2 amps per sq. mm shall not be exceeded. The neutral bus bars shall not be less than 50% of the phase bus cross section. The bus bars shall be sufficiently supported by insulator so that insulation resistance shall not be less than 20 mega ohm.
- c. Arrangement shall be made at the bottom of the control panel for receiving incoming cables. Space for outgoing cables shall be properly designed as per requirement of individual buildings.
- d. The interconnections of cables to the busbars, circuit breakers shall be done with heavy-duty crimping type chromium plated brass double compression cable shoe of suitable size.
- e. The connections from busbars to the incoming as well as outgoing circuit breakers shall be done by copper strips of suitable size.
- f. All the contact surfaces in copper bus bars and trips shall have coating of silver by brazing.
- g. Provision shall be made for removable blanking plates for possible additional breakers
- h. The distribution shall have sufficient space for different electrical equipments like ammeter, voltmeters, energy meters, bus bars, CT, and other required accessories as per design.
- i. The panels indoors shall be dust and vermin proof.
- j. All the panel and distribution boards shall have double cover.
- k. All the major panel or distribution boards shall have automatic lighting arrangements inside the board when its door will open.
- l. All required materials and accessories for cable trench should be supplied and installed for panel board installations.

2 Moulded Case Circuit Breaker – MCCB

MCCBs shall be of approved make and shall be fitted with suitable release. The MCCB mechanism shall be quick break and trip free. The position of on/off and trip should be clearly indicated. The MCCBs shall be of robust and compact design and shall comply with the requirements of IS-2516 with a rupturing capacity of not less than 35MVA at 415Volts. The basic unit shall consist of a horizontal, with drawable pattern, triple/ four pole fully interlocked, independent manual spring operated MCCB. The operating mechanism should be such that the circuit breaker is at all times free to open immediately the trip coil in energized. The current breaking capacity of MCCBs shall be as per BOQ and single line diagrams.

3. Miniature Circuit Breaker – MCB

MCBs shall have a breaking capacity not less than 10000 Amps and shall conform to IS:8828. The contacts shall be made of silver tungsten. The MCB shall have terminal, magnetic tripping characteristics. The body shall be out of heat resisting moldings with knockouts for bus bar mounting.

4. Earthing

Non current carrying parts with conducting surfaces such as the tank of the transformer structural steel work and armored cable armoring shall be effectively grounded for protection of equipments and operating personnel.

Earthing works shall be provided as required by ISS Code of practice as specified herein.

It may be anyone of the following types as may be specified in the schedule of works.

(a) G.I. Pipe Earth: It shall not be less than 75mm or 3 inch in diameter and 3.0 meter in length. In case of dry or rocky soil a delta shaped of the said length of the GI pipe shall be used.

(b) Copper Plate Earth: It shall not be less than 600mm x 600mm x 3.18mm. It shall be buried in the earth with the face vertical and the top not less than 3.0 meter below the finished ground level.

(c) Distance from Building: Normally an earth shall not be situated less than 2M from any building. Care shall be taken that the excavations for earthing may not affect the footing of the foundation of the building in such cases the distance being suitably increased. Location of earth shall be such that the soil has reasonable chance of remaining moist as far as possible.

(d) Main earthing lead shall be of galvanized iron wire in the case of G.I. pipe and it shall be of copper wire or copper strip in the case of copper plate. Minimum cross sectional area of G.I. shall be 8 SWG for general earthing and 25x5 copper strip in case of copper plate earthing.

(e) Protection of Earth Leads: The earthing lead (G.I. or copper wire) shall be suitably protected from mechanical injury by a galvanized iron pipe recessed in wall and floor up to the switchboard. In ground it shall be buried at least 60cm deep.

(f) The earthing shall be securely bolted and soldered to the plate or pipe as the case maybe. In the case of the plate, the lead shall be connected by means of cable socket with 2 bots and nuts. All bolts nuts and washers shall be of the same materials as the plate or pipes. All earthing lead shall be securely connected at the other end to the main board and all its mounting looped to all other iron clad switches

and distribution boards. In case of GI strips its joints shall be included and protected with anti-corrosion paint.

(h) Method of Installation: Alternate layers of charcoal and salt shall surround the earth plate or pipe to a thickness of 6" (150mm) around the electrodes. There shall be 19.05mm (3/4") G.I. pipe running from the top to the plate or pipe.

The top of this pipe shall be provided with a funnel and mesh for watering the earth. This will be housed in a masonry enclosure not less than 30x30x30cm deep. A cast iron frame with cover shall be suitably embedded in the masonry. Pipe earth maybe installed by boring a suitable sized hole in the ground into required depth.

The plate earth is to be installed by digging a 10-ft deep pit approved by the Engineer prior to their lowering into pits and refill.

(i) The earth resistance the resistance of the earth system shall not exceeded the following limits:

- | | | | |
|----|--------------------|---|--------------------------|
| a. | Major sub-stations | - | less than 2 OHMS |
| b. | Other sub stations | - | less or equal to 5 OHMS. |

Lightning Earthing:

The lightning conductor system shall have a separate set of plate connectors and shall be completely separate from the electrical installation systems set out here in. Earth plate electrode as per above shall be installed as directed by the consultant at the designated places and all aspects of the work and installation shall be as set out and governed by the terms of this contract. No extra payments shall be made for these installations. Lightning electrodes of an approved manufacture shall be installed on the building roof to provide protection to the premises in case of lightning strikes. The electrodes shall be effectively interconnected with 3 x 25 mm copper strip to form a mesh and this to be grounded by means of a copper strip not less than 75 sq.mm in cross-section to earthing

5 Armored and Unarmoured Cabling

Lying of cables between two points shall follow the following methods:

- i) Laying of cables directly in the ground in outdoor applications; and
- ii) Laying or supporting of cables in cable trays, trenches and ducts, or clipped on to the walls or structural members of the building.

Where cables are to be laid direct in ground these shall be laid in cable trenches at least 0.6 m below ground surface. The cable laid shall be covered with 100 mm finely sifted sand and protected by bricks, stone tiles on the top with transverse bricks across the trench cross-section. The trench shall then be back-filled and compacted.

Where cable routes run under hard surfaces, or where cables have to be run inside masonry or structural components inside buildings, such cables shall be run through rigid PVC conduit /GI pipe. The diameter of the conduit/pipe shall ensure that the cables occupy less than half of the cross-sectional area of the conduit.

6 Conduit and Battens

Electrical conduit and battens used in the final sub-circuits of the electrical services shall be rigid, non-metallic (PVC) conduit of an approved manufacturer conforming to the relevant IS/NS and shall be used only with corresponding approved accessories.

The size of the conduit and battens shall be in accordance with the number and size of electrical cables to be drawing into the conduit. The number of cables that may be drawn in a conduit shall be as specified in the table below or as stipulated in the appropriate section of the IS /NS Code or equivalent.

Accessories such as ceiling outlets, junction boxes, bends, and circulars shall be of approved quality. The physical integrity of the conduit/battens and accessories as an integral electrical component shall be ensured by approved means such as the use of water-resistant cement bonding on all unscrewed joints and termination, and use of rubber gaskets in entry points to junction boxes or outlets or other approved means.

7 Wirings

- (a) All final sub circuit shall be single core (preferably single stranded) with high conductivity copper conductor and 660 Volt insulation in strict accordance with NBC).
- (b) All cables and wires shall be delivered to the site with the Maker's Seals and Labels intact.
- (c) All wire and cable for feeders, sub-feeders, control and branch circuit shall be color-coded. If coding is not possible such as short run of heavy feed cables, painting the ends of the cables for color coding or tagging will be permitted.
- (d) The following color code shall be maintained for all final sub-circuit, sub-circuit, sub-mains and mains:

Phase	R	Red
Phase	Y	Yellow
Phase	B	Blue
Neutral	N	Black
Earth	E	Green

Switch runs from the light fittings shall be given a distinctive color White.

- (e) Wiring to light points, fan point and call bell points shall be done with multi stranded copper wire of specified size or specified in BOQ. The wiring of light and fan points shall be done form each points to switch to junction box to nominated DB.
- (f) The light, fan and power points wirings work includes all the required materials (wires, metal boxes for switches, junction boxes, conduits, circulars, screws, jointing and insulating materials, fan hooks, earthing materials, ceiling rose, blank plates and all required accessories) , labors, upto testing and commissioning.
- (g) No splices or joints shall be permitted in either feeders or branches except at outlets or accessible junction boxes. All splices in wire .01 sq. in and smaller may be stranded pigtail, mechanically tight, then cleaned, soldered and insulated with proper layers and thickness of rubber or approved electrical tape providing insulation not less than that of the conductor.
- (h) Each power sub-circuit should normally be restricted to 2000 watts. There shall not be more than two outlets on each sub circuit in any case. A single outlet of capacity 3000 watts shall be in each kitchen unit of each block.

- (i) Outlets shall be flush mounted by means of recessed junction boxes, which have been fabricated precisely for the fixture dimensions. Such boxes shall be constructed of sturdy galvanized sheet steel and shall feature conduit knockouts on all sides. Rubber gaskets shall be provided along the knockouts through which conduit will enter so that a watertight continuity of electrical installation is maintained.
- (j) Concealed wiring of power points shall be done by multi-strand copper cables or as per BOQ of specified size in high quality 20/25mm high quality HDP pipe in floor or brickwork as shown on drawing and terminated in 18 SWG thick G.I. sheet metal boxes, conforming to relevant British or Indian standards. The wiring of power points shall be done from each power point to nominated DB.

8 Cable Carriers, Conduit, Trunking Laying Works

Cable Trays:

- a. Contractor shall submit the detailed shop drawings indicating the actual route of cable trays, fabrication details and related detail for approval by the consultant prior to installation.
- b. Cable trays shall be fabricated from mild steel angles and bracket of appropriate sizes.
- c. Prior to fabrication the contractor shall submit shop / fabrication drawings for approval.
- d. The cable tray (three sides – bottom, and two sides) shall be covered with ply board. The cover shall be painted with approved color.
- e. Necessary cable trays hangers shall be provided at every 500mm interval.
- f. Necessary metal angles, channels, fixing accessories shall be provided for installation of cable trays.

Cable Ladders:

- a. Contractor shall submit the detailed shop drawings indicating the actual route of cable ladders, fabrication details and related detail for approval by the consultant prior to installation.
- b. Cable ladders shall be fabricated from mild steel and have side rails and rungs at least 3 mm thick.
- c. Necessaries bends, tees, four-ways cross piece, reducers, cable drop out and risers. Where cut sections are used for sets they shall free from sharp edges and jointed by means of fish plates bolted to each section. Where long runs of cable ladder are necessary or temperature fluctuations are present expansions joint fish plates shall be used throughout the entire length of the straight ladder section.

Installation of Cable Trays and Ladders:

- a. Where cable trays and ladders details are not detailed on the drawings then the tray / ladder shall be adequately sized to support the cables without bunching and a 25% spare margin shall be allowed in size and weight to be loaded.
- b. Earth continuity conductors shall be provided across gaps in all cable trays runs and bolted connections.
- c. All routes must be chosen to allow ease of access to all cables when installed.
- d. Supports shall be by means of steel brackets installed at intervals necessary to provide a rigid fixing and to ensure that maximum sag does not exceed 3 mm mid span of supports when fully loaded.

9 Light Fixtures:

Major types of fixtures are as briefly described below. All fixtures described shall be of an approved manufacture indicated in the drawings or the Bill of Quantities.

All luminaries shall be assembled and installed in accordance with the respective manufacturer's instructions / recommendations. All luminaries shall be fitted with power factor correction capacitors to achieve a 0.95 lagging power factor.

The offered rate of luminaries must be inclusive of lamps, lamp holders, control gears, capacitors, glass wares, diffusers, internal cables, energy efficient ballasts, starters, light dimmers, connection box, fuses, tube lights, stators and necessary mounting accessories and all necessary accessories.

All light fixtures with good color rendering qualities with sturdy, corrosion free metal body and mounting channel with required type of reflectors, diffusers or optical assemblies. High quality, low loss, high accuracy current set ballast chokes shall feature copper windings. High quality starters shall be of an approved manufacturer capable of generating adequate voltage to quickly ignite the type of tube used. A glow switch and a radio interference suppresser capacitor shall be built into the starter assembly, which shall be moulded from high quality white polycarbonate canister with good insulation characteristics.

The contractor shall provide all detail shop drawings, samples and catalogue of all luminaries for approval prior to installation.

Energy efficient lamps complete with their holder and ballast of the type specified in the drawings shall be either mounted independently or mounted inside luminaries as specified in the drawings and all LED fixtures IEC Certified.

All necessary mounting metal frames shall be provided and installed by the contractor for installation of out door light fixtures (flood Light fixtures, post lamps etc.)

10 Switches / Light Dimmers / Power Socket / Plug and Tops / Speed Regulators:

Switches used in the electrical services for the control of lights and low power appliances shall be single / double pole, modular type switches rated at not less than 6-10 A or as indicated in the drawings or boq. One way or two-way switches shall be used as indicated in drawings. Switches used in the installation shall generally conform to IS 3854.1966 or equivalent and shall have high current capacity silver and silver cadmium oxide contacts, bouncier snap action, wiping action and making and breaking mechanism with minimum arcing.

The outlets shall be flush mounted by means of recessed junction boxes, which have been fabricated precisely for the fixture dimensions. Such boxes shall be constructed of sturdy galvanized sheet steel and shall feature conduit knockouts on all sides. Rubber gaskets shall be provided along the knockouts through which conduit will enter so that a watertight continuity of electrical installation is maintained.

At specific location indicated in drawing, light switches shall be fitted into a recessed switch panel to centralize switching in circulation areas and to discourage tampering with the control of these appliances. Such switch panels shall be constructed sheet steel and shall house the light switches, dimmers, speed regulators, power out-lets and other accessories as specified herein or in the related drawings. Dimensions of the panels shall be maintained to the minimum required. The panels shall feature a robust hinged lockable cover flush with the finished surface of the room wall. The exterior shall be painted to conform to interior decor.

11 Pull / Junction Boxes:

All Junction Boxes shall be indoor type, totally enclosed made from 14 SWG heavy gauge mild steel, enamel coated, dust and vermin proof suitable for wall mounting. The steel sheet shall be supplied with 2 coats of red oxide primer and then two final coats of gray enamel.

Prior to installation, the contractor shall submit detail drawings and sample for approval.

12 Recommended Make:

- HT Switch Gear - Siemens, ABB, C&S, Legrand
- MCCB / MCB - Siemens, ABB, C&S, Legrand
- Cables / Wires - NS + ISO standard
- HDPE Conduits - NS standard
- Switches / Sockets - Northwest, Clipsal, ABB, Legrand, Philips
- Light Fixture - Hippo LED, NC LED, Philips, Decon, Homdec