# EXTERNAL LIGHTING SYSTEM
## TECHNICAL SPECIFICATIONS



# FEDERAL GOVERNMENT EMPLOYEES HOUSING AUTHORITY, GULZAR-E-HIJRI, KDA SCHEME-33, KARACHI

# TECHNICAL SPECIFICATION

## TENDER

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## SECTION – E - 1
## GENERAL SPECIFICATIONS

**FOREWORD**

This document is to describe the minimum requirements for the equipment and installations and to ensure that the Contractor is fully aware of his duties to perform the required works, in accordance with the terms of the Contract. As per K-Electric scope.

**1. SCOPE OF WORK**

The works related to the electrical system which are included in the scope of this Contract are shown on the Drawings, stated in the Particular Specifications, Bill of Quantities and explained in these specifications. The works shall broadly include but not limited to the following:

| | | |
|---|---|---|
| a. | Low Voltage Switch Board /Distribution Boards | (Section - E - 2) |
| b. | Low Voltage Cable and Wires | (Section – E- 3) |
| c. | Conduits and Pipes | (Section – E- 4) |
| d. | Wiring Accessories | (Section – E - 5) |
| e. | Lighting Fixtures | (Section – E - 6) |
| f. | Cable Tray, Ladder and Trunking | (Section – E - 7) |
| g. | Earthing System | (Section – E – 8) |
| h. | Transformer | (Section – E – 9) |
| i. | Light Poles | (Section – E – 10) |

All material and equipment supplied by the Contractor shall be new and in all respects conform to the high standards of Engineering design, workmanship, performance and function as here in specified and fully meet the quality level and rugged requirements of the specifications.

The Contractor shall also be responsible to supply any other equipment not specifically mentioned in these documents but which is necessary for proper operation of the works / system, shall be considered to have been so specified and accordingly shall be provided by the Contractor as part of the Contract.

The Contractor shall be solely responsible for ensuring proper functional requirements of various equipment and shall also be responsible for furnishing any additional piece of equipment and for making modification in the equipment as desired and / or approved by the Owner or his representative, to achieve proper coordination with various equipment offered in the bid and also those installed by others.

Approval of the Contractor's supplied equipment / installation works shall not relieve the Contractor of any of his obligations or liabilities under the Contract, except insofar as provided under the conditions of the Contract.

**2. RULES AND REGULATIONS**

The entire electrical installation / work shall be carried out by licensed contractor, authorized to undertake such work under the provisions of Electricity Act 1910 and The Electricity Rules 1937 as adopted and modified up to date by the Government of Pakistan.

All works shall be carried out in accordance with the latest edition of the Regulations of the Electrical Equipment of Buildings issued by the Institute of Electrical Engineers - London, the Contract documents, the Electricity Rules 1937 and bye-laws that are in force from time to time. Any discrepancy between these specifications and any other rules and regulations shall be brought to the notice of Owner or his representative, and his decision shall be final and conclusive.

The Contractor shall be responsible for completing all formalities and submitting the test certificates as per prevailing rules and regulations and shall have the installation passed by the Government Electric Inspector of that region. All requirements of the Electric Inspector and the Electric Company shall be complied with.

## 3. STANDARDS

All works, equipment and materials shall conform to:

On the one hand:
The specification recommended practices, official standards and codes the non - restrictive list of which is given below.

International Electro-technical Commission (IEC)
British Standards (BS)
National Electric Code (NEC)
Local Regulations

In the event of conflict between standards, the most stringent shall prevail.

Whenever the electrical equipment to be installed, does not hold national standards, the Contractor shall take into account the specific standards chosen by the Owner and make sure that the equipment he has to install, meets these standards.
In addition, even if no mention is stipulated in this specification, it is implied that the equipment be tropicalized, if required, by the conditions of the site of installation.

In any case, the standards and codes to be taken into consideration are those in force at the date of delivery.

## 4. INSTALLATION AND SERVICE CONDITIONS

### 4.1 Site Conditions

All material and equipment supplied and installed shall be designed, manufactured and tested to meet the following ambient conditions unless specifically stated otherwise for any material / equipment:

a. Maximum outdoor ambient temperature : 45 degree C
b. Minimum Indoor ambient temperature : 0 degree C
c. Maximum relative humidity : 90 %
d. Minimum relative humidity : 26 %



### 4.2 Service Conditions

Equipment shall be designed and built for continuous service with a minimum of supervision and maintenance.

## 5. MAIN ELECTRICAL CHARACTERISTICS

### 5.1 Power Supply System

Unless otherwise specified elsewhere, all equipment and material shall be designed to operate and function satisfactorily with the following minimum requirements without any de-rating:

- Voltage 400 ± 10%
- Phase 3, 4 wire system
- Frequency 50 Hz. ±2 Hz.

### 5.2 Degree of Protection of Enclosures

For indoors, IP42 minimum degree of ingress protection of the enclosures against contact with line or moving parts and against ingress of solid foreign bodies or liquids, shall be selected, in accordance with IEC 60529. For outdoor, IP 55 minimum degree of ingress protection of the enclosures shall be provided.

## 6. GUARANTEE

The Contractor shall furnish written grantee which should clearly state that the works he will carry out as well as the materials he will supply, meet with this specification and that compliance thereto constitutes an official clause, added by implication to the general conditions of his offer when signing the Contract.

Guarantee shall also be for replacement and repair of part or whole of the equipment which may be found defective in material or workmanship. The grantee shall cover the duration of Maintenance Period as defined in the conditions of the Contract. This guarantee shall not relieve the Contractor of his obligations and he will fully be responsible for the repair or replacement of any defective material in time, so as not to cause any undue delay in carrying out the repairs and/ or replacements.

The Contractor shall acquaint himself fully with the existing conditions and limitations at site and all works necessary to complete the project under the Contract, to be carried out by the Contractor.

## 7. EXCEPTIONS TO SPECIFICATION

Any exception or deviation from this specification or the codes and standards shall be listed separately in the Contractor's "List of Deviations". Any exception, which shall not be listed, shall not be considered later.

## 8. AVAILABILITY OF SPECIFICATIONS, DRAWINGS AT SITE

The Contractor shall assume at his own cost the permanent availability of this specification and drawings on site where applicable.

## 9. DISCREPANCIES IN TENDER DOCUMENTS AND DRAWINGS

The Contractor shall carefully examine the documents and drawings and if he finds any discrepancies or omissions from the specifications, bill of quantities or drawings, or is in doubt as to the meaning, he shall at once notify the Owner or his representative for receiving his instructions before proceeding with the works. If such defective or modified work is carried out by the Contractor on his own, he shall rectify the same at his own cost.

## 10. MEASUREMENT OF WORKS

The quantities set out in the bill of quantities are the estimated quantities and they shall not be taken as actual and correct quantities of work to be executed by the Contractor. The Contractor shall carry out actual measurement of works at the site.

## 11. INSTALLATIONS DETAILS

The locations, routings, installation heights, detail etc. for electrical equipment are indicated on the drawings. If any information is not stated on the drawings or wherever modifications are required the Contractor shall obtain prior instructions from the Owner or his representative.

## 12. DRAWINGS AND DATA

The Contractor shall provide dimensional outline drawings, arrangement drawings and technical data for the equipment offered, for the approval of Owner or his representative.

## 13. PRIOR APPROVAL OF SHOP DRAWINGS, MATERIALS AND EQUIPMENT

The Contractor shall provide shop drawings for the electrical installations showing the exact routes of all underground cables and ducts, the exact run of all conduits and trunking, draw-in and junction boxes, the number and size of wires in each conduit, the final connection arrangements at distribution boards and the details of ducts for the approval of consultant / Owner's representative before commencing any portion of the works. All such working drawings shall be submitted in suitable number of copies as indicated in the particular conditions and within the periods stipulated below:

a. **Cable entry ducts into buildings**:
Working drawings shall be submitted within two weeks of handing over the site.

b. All other working drawings shall be submitted to the Engineer against signed receipt and dated within two months of signing the Contract. Should however the Contractor be obliged to install electrical conduits prior to this period then he shall submit the relevant working drawings at least two weeks prior to the proposed date of commencement of the work. The Contractor shall submit the program indicating the dates on which coordination in different sections will take place, together with the submission of the working drawings. The Engineer shall arrange to return to the Contractor at least one week prior to the commencement of concreting of the section, his comments or approval of the working drawings.

The Contractor shall supply detailed specifications, dimensional drawings, etc., of equipment that he proposes to supply and install.

Where this Contract requires the approval of Engineer to material and goods, the Contractor must seek to obtain this approval within eight weeks after signing of the Contract. No extension of time shall be granted for non-availability of material or goods if this clause is not complied with. Approval of the Engineer does not relieve the Contractor of placing his orders in due time for the materials he needs to complete the Contract on time. The approved samples shall be retained on site for comparison with commodities used in works and removed



when no longer required.

## 14. MATERIAL ORIGIN AND QUALITY

The material and equipment shall be purchased from Consultant / Owner's agreed suppliers.

The consultant / owner shall retain the right to demand, at any time, the indication of origin of the materials, and to eventually refuse products, the origin of manufacturing of which have not been previously agreed to without consideration of quality.
On specific agreement of the Owner, the materials may be delivered progressively to the field, but in such a manner as to allow sufficient time for their reception.

When choice of manufacturer is allowed for any particular commodity the Contractor shall obtain the whole quality required to complete the work from one manufacturer or obtain approval of any change in source of supply. He shall produce written evidence of sources of supply when requested to do so by the Engineer.

## 15. IDENTIFICATION OF EQUIPMENT

For each piece of equipment, identification label shall be fitted in front of the casing. The label shall have block letter 7mm high, black on white back ground of trifoliate and fixed with screws.

## 16. MARKINGS

The contractor shall provide "Danger Boards "and" Shock Charts "wherever required to comply with the requirements of local Electricity Rules and according to normal practice.

## 17. FACTORY TESTS

All equipment supplied by and installed as part of the Contract such as distribution boards and like shall be fully tested at the manufacturer's works to the requirements of appropriate standards called for later in the particular specification.
The Contractor shall inform the Engineer in writing about the date and time of test of each equipment at least two weeks in advance. The witnessing of test by the Owner or his representative shall not absolve the Contractor from his responsibility for the proper functioning of the equipment and for furnishing the guarantees referred to in Clause 6.0. All test results in the form of certificate of test / test record certificates, signed by all the witnesses, for each item in the scope of Contractor's supply shall be supplied to the Engineer within seven days of the test date, and in any event before delivery to the site.

All expenses for carrying out the tests and witness by the Owner or his representative shall be borne by the Contractor and deemed to have been included in the tender bid.

## 18. STORAGE

The Contractor shall store the equipment in such conditions that it cannot be damaged, i.e., in a dry warehouse. As particular concerns; fragile components, these shall be stored on shelves in their original packing, fitted with identification labels so as to avoid unnecessary manipulation or handling.

The Contractor shall handle, store and fix each commodity in accordance with the manufacturer's recommendations. He shall inform the Engineer if these conflicts with any other specified requirement and submit copies of manufacturer's recommendations to the Engineer when requested to do so.

**19. LABOR AND STAFF OF CONTRACTOR**

The Contractor shall provide / furnish and arrange for:

- Skilled and unskilled labor required for performing the works in accordance with the technical specifications and drawings within the agreed time schedule.
- Supervisory technical staff with appropriate experience and requisite expertise to ensure quality of work performed.
- Supervisory administration and clerical staff to ensure smooth functioning of the activities at site.
- Construction equipment, meggers, tools, etc.

The Contractor shall supply all labor, materials and equipment necessary for the installation of low voltage distribution boards, cables, lighting and power equipment, together with all other apparatus shown on the drawings and as detailed in the Particular specification.

**20. SMALL INSTALLATION MATERIAL**

The Contractor shall supply all small installation and consumable materials such as nuts, bolts, washers, shims, angles, leveling materials, insulation tape, solder, PVC strap-on or heat shrinkable type cable tags, cable ties, bushes, sealing compound, Avometer, electrical testing and measuring instruments, etc., and all such other material not listed in BOQ, required for complete installation as intended by the specification and scope of works.

**21. INSTALLATION INSTRUCTIONS - GENERAL**

The Contractor shall set out the works himself as per specifications and drawings and shall properly position the equipment on specified foundation / location. In general, the manufacturer's instructions for installation shall be followed. Any defect or faulty operation of equipment due to Contractor not following the manufacturer's instructions shall be corrected and repaired by the Contractor at his own cost.

**22. ASSOCIATED CIVIL WORKS**

The expression `Associated Civil Works' shall mean civil work to be carried out by the Contractor under the direction of the Engineer in connection with the Electrical Service.

The Contractor shall prepare accurate drawings giving details of all holes, fixings, bases and other civil work requirements and shall be responsible for their accuracy. The cost of preparing shop drawings shall be considered to have been so specified in the tender price.

The following is a summary of the work to be carried out by the Contractor:

a. The cutting and forming of holes for conduits or pipes, or conduit or pipe fixings through walls, floors, ceilings, partitions, roofs, etc., and making good after the work is sufficiently advanced.
b. The building of concrete and / or brick ducts in floors, walls, etc.

c. The formation of concrete bases, etc., for equipment
d. Excavation forming for underground services of ducts and courses and then covers it.
e. The cutting or forming of chases, recesses, etc., in floors, walls, etc., for conduits and fittings in and making good.
f. Excavation for and laying of cable carrying pipes.
g. The building in of brackets and supporting bars or other form of conduit or pipe suspensions.
h. The painting of all pipes, tube and conduits etc. after fixing unless specified to the contrary.
i. The providing and building in of sleeves through slabs and walls.

In general all required holes through walls, floors and beams for pipes and ducts will be left out by the Contractor during the process of building.

Where conduits, pipes or fittings are fixed to concrete or woodwork by means of saddles or clips, the Contractor shall himself execute the work necessary and the cost of such work shall be considered to have been so specified in the price.

Cutting, fitting, repairing, patching or plastering and finishing of carpentry work shall be done by craftsmen skilled in their respective trades, when cutting is required it shall be done in such a manner as not to weaken structure, partitions or floors. The holes required to be cut must be directed without breaking out around the holes. Where patching is necessary in finished areas of building, the Engineer shall determine the extent of such patching or refinishing.

## 23. TESTING - GENERAL

Upon completion of installation, at least seven days notice is to be given of intention to perform any test. The Contractor shall perform all static, semi-dynamic (by simulation), and dynamic field testing on all the equipment and systems.

All tests shall be conducted in the presence of the Engineer for the purpose of demonstrating equipment or system compliance with specifications. The Contractor shall submit for Engineer's approval complete details of tests to be performed describing the test procedure, test observations and expected results.

The Contractor shall furnish all tools, instruments, test equipment, materials, etc., and all qualified personnel required for the testing, setting and adjustment of all electrical equipment and material including putting the same into operation.

All tests shall be made with proper regard for the protection of the personnel and equipment and the Contractor shall be responsible for adequate protection of all personnel and equipment during such tests. The cost of any damages or rectification work due to any accident during the tests shall be the sole responsibility of Contractor.

The Contractor shall record all test values of the tests made by him on all equipment. Four copies of all test data and results certified by the Engineer shall be given to the Engineer for record purposes. These shall also include details of testing method, testing equipment, diagrams, etc.

The witnessing of any tests by the Engineer does not relieve the Contractor of his guarantees for materials, equipment and workmanship, or as any obligations of Contract.

In addition to installation testing, the Contractor is to carry out operation testing of all sections and is to clean, set, calibrate and fully commission, demonstrate and hand over to the Owner the entire Contract works in a thoroughly complete and operational state to the satisfaction of the Engineer.

The acceptance - provisional or final- shall be made by the Owner. This reserves him the right to be represented or assisted by a representative or an organization ( whether official or not) of his choice, which may decide on his behalf any repairs deemed necessary resulting from lack of observations of this specification, or of the rules and standards. In addition, he may judge the quality of the works and the materials supplied.

This remains in force in case of sub-contracting.

The Contractor shall formally engage his direct responsibilities to the Owner or his representative, and likewise, shall assume all responsibility for work performed by sub-contractors and materials he has supplied and installed.

### 23.1 Insulation Resistance Test

Insulation resistance test shall be made on electrical equipment by using a megger of 1000 volts for circuits between 250 and 500 volts. The insulation resistance of distribution boards, cables, etc., shall be as per IEC, IEEE, BSS and Pakistan Electricity Rules.

The distribution boards shall be given an insulation resistance measurement test after installation, but before any wiring is connected. Insulation tests shall be made between open contacts of circuit breakers, switches and between each phase and earth.

If the insulation resistance of the circuit under test is less than specified value, the cause of the low reading shall be determined and removed. Corrective measures shall include dry-out procedure by means of heaters, if equipment is found to contain moisture. Where corrective measures are carried out, the insulation resistance readings shall be taken after the correction has been made and repeated twice at 12 hours interval. The maximum range for each reading in the three successive tests shall not exceed 20% of the average value. After all tests have been made, the equipment shall be reconnected as required.

### 23.2 Earth Resistance Test

Earth resistance tests shall be made by contractor on the earthing system, separating and reconnecting each earth connection as may be required by the Engineer. If it is indicated that soil treatment or other corrective measures are required to lower the ground resistance values, the Engineer will determine the extent of such corrective measures.

The electrical resistance of the E.C.C. together with the resistance of the earthing lead measured from the connection with earth electrode to any other position in the completed installation shall not exceed one

ohm.

Earth resistance test shall be performed as per Electrical Inspector's requirements. Where more than one earthing sets are installed, the earth resistance test between two sets shall be measured by means of Resistance Bridge Instrument. The earth resistance between two sets shall not exceed one ohm.

### 23.3 Switchgear

Each circuit breaker shall be operated electrically and mechanically. All interlocks and control circuits shall be checked for proper connections in accordance with the wiring diagrams given by the manufacturer.

The Contractor shall properly identify the phases of all switchgear and cables for connections to give proper phase sequence.
Trip circuits shall be checked for correct operation and rating of equipment served. The correct size and function of fuses, disconnect switches, number of interlocks, indicating lights and alarms shall be in accordance with approved manufacturer drawings. Nameplates shall be checked for proper designation of equipment served. Protective relays shall be tested and set at site prior to commissioning of the equipment.

### 23.4 Special Systems Tests

The special systems such as telephone, intercom, etc., shall be tested according to the procedures laid down in the respective sections of the technical specifications. However, any specific tests recommended by the manufacturer shall also be carried out as approved by the Engineer.

### 23.5 Complete Tests

After any equipment has been tested, checked for operation, etc., and is accepted by the Engineer, the Contractor shall be responsible for the proper protection of that equipment so that subsequent testing of other equipment do not cause any damage to the already tested equipment.

## 24. ELECTRICAL CONNECTION

Electrical connection for each building shall be supplied by other but necessary arrangement coordination to be done by this Contractor.

## 25. AS BUILT DRAWINGS AND SERVICE MANUALS

A record shall be kept as the work proceeds of any work not in accordance with the working drawings, and upon completion of the work, the Contractor shall prepare the following drawings and forward them to the Engineer for approval:

a. Duplicate prints of as built single line diagram of the main and sub main distribution network, indicating all cables, their size and type, and the rating of all protection devices such as circuit breakers, fuses, etc.

b. Duplicate prints of as built drawings of lighting, power, telephone, fire alarm, as applicable.

c. Duplicate prints of as fixed control and wiring diagrams for the equipment installed as part of the Electrical Contractor works.

After these drawings have been approved, the Contractor shall supply two prints on paper of each and insert these in the operating and maintenance manual specified below.

The Contractor shall submit to Engineer for approval a sample of manufacturer instructions for installation, testing, commissioning, operation and maintenance manuals including manuals of spare parts and tools of the equipment. Upon acceptance, the Contractor shall supply three copies to the Engineer for forwarding to the Owner. These manuals should be in properly bound form. At least two copies of the documents shall be submitted in original. The installation instruction shall be submitted two weeks prior to commencement of installation of each equipment, and operation and maintenance instruction at the time of commissioning. If the Contractor fails to provide the documents, the Engineer shall withhold issuance of requisite certificates and deduct suitable amount from the payments to the Contractor.

## 26. WORK COMPLETION

The Contractor shall further make good, repair, replace all defective works and clear away on completion and leave all installations in perfect working order and to the satisfaction of the Owner or his representative.

## 27. PAYMENT

No separate payment shall be made for work involved within the scope of this section unless specifically stated in the Bill of Quantities or herein.



## SECTION - E - 2
## LOW VOLTAGE SWITCHBOARDS / DISTRIBUTION BOARDS

### 1. GENERAL

#### 1.1 Purpose

This section together with its appending document covers the minimum requirement for the design, construction and performance of factory built assemblies of LV switchboard.

#### 1.2 Scope of Work

The work under this scope consists of supplying, installation, testing, connecting and commissioning of all material and services of the complete switchboard as specified herein and/ or shown on the Drawings and given in the Bill of Quantities.

The Contractor shall discuss the electrical layout with the Engineer and coordinate at site with others for exact route, location and positions of electrical lines and equipment.

#### 1.3 Standards

Switchboards shall comply with Section - E - 1, Clause 3.
Particular reference shall be made to:

| | |
|---|---|
| IEC 60027 | Letter symbols to be used in Electrical technology. |
| IEC 60051 | Direct setting electrical measuring instruments. |
| IEC 60073 | Colour for indicator lights and push bottoms |
| IEC 60158 | LV Switch gear and control gear. |
| IEC 60185 | Current Transformers. |
| IEC 60186 | Voltage Transformers. |
| IEC 60269 | LV fuses. |
| IEC 60439 | Factory built assemblies of LV switch gear and control gear. |
| IEC 60529 | Degree of protection provided by enclosures. |
| IEC 60617 | Graphic symbols for diagrams. |
| IEC 60947-2 | LV Switch gear and Control gear. |
| BS 951 | Earthing Clamps |
| BS 1433 | Hard drawn bare copper conductor for earthing. |
| BS 2874 | Nuts, Bolts, Washers and Rivets for use on copper. |
| BS 6346 | PVC Insulated Cables. |
| CP 1013 | Earthing |

Any other standard referred to in above standards or these specifications.

#### 1.4 Installation and Service Conditions

For general site conditions refer to Section - E- 1, Clause 4.

Switchboard shall be installed indoor. The equipment shall be capable of operation under the prevailing ambient conditions without any deleterious effect of any kind. Switchboard shall be suitable for continuous operation at full load rating under combined variation of both voltage and frequency as stated in Section - E-1, Clause 5.1.



Transient voltage depression down to 80% of rated voltage shall not affect the performance of the equipment and dip voltage must be within permissible limit.

## 2.0 MAIN ELECTRICAL CHARACTERISTICS

### 2.1 Power Supply System

Main characteristics of power supply system applicable to all switchboards are:

- Voltage 415 V $\pm$ 10%
- Phase 3 $\phi$, 4 Wire.
- Frequency 50 Hz. $\pm$ 2 Hz.
- Neutral system Solidly grounded.
- Peak asymmetrical SCC To be specified by the bidders.
- RMS symmetrical SCC To be specified by the bidders.

Main characteristics of auxiliary supply system are:

- Control / Command system 24 VDC.
- Space heater system 230 VAC.

### 2.2 Ratings

The equipment shall be capable of carrying the specified current on a continuous basis of 24 hours. Per day, without exceeding the permitted temperature.

The current ratings of all equipment must be guaranteed at the specified design temperature. Equipment shall be fully rated and constructed for withstanding, making and breaking the specified short circuit duty.

Pins of auxiliary circuits shall be sized for a rated circuit of 10 Amp Minimum.

## 3. GENERAL REQUIREMENTS

### 3.1 Concept

The Switchboard shall be of standard, prefabricated metal clad cubicle(s), floor mounting type/wall mounted, totally enclosed, dead front, dust tight and vermin proof requiring front access only. It shall complete in all respects with material and accessories, factory assembled, tested and finished all according to the specifications and to normal requirements. For indoor installations the international classification shall be IP42.

The Switchboard with all components and accessories shall be suitable for front operation only and shall:

- have a rated service short service breaking capacity, Ics at 400 VAC, conforming to IEC 60947-2 unless otherwise stated on the drawings.
- be provided with adequate clearance from live parts so that flash over cannot be caused by switching, vermin, pests, etc.
- have all components rated for insulation class 600-volt minimum.
- be designed for flush mounting of all instruments on the front side.
- have all incoming or outgoing connections from the top or bottom as required. Have the components mounted so as to facilitate ease of maintenance from the front. Have common

lamp test facility for all lamps.
- have wiring diagram on the inside of door of the switchboard. Be labeled with nameplate on the front side of door.
- have arrangements for extension of switchboard in future.

### 3.2 Accessibility

Switchboard shall preferably be arranged for bottom cable entries. Adequate space must be provided for cable entries and termination. It shall be possible to work easily and safely on cable of a main or control outgoing circuit in OFF position with the remainder of the board alive.

Adequate system shall be provided for installation and clamping of cables inside the cable compartment. Position of terminals and cables shall allow use of clamp ammeter.

Power and Control cable termination shall avoid obstruction to other cable termination and provide easy access for terminating cables. Cable supports shall be provided to avoid undue strain on cable termination. Easily accessible locations shall be reserved in the compartment for measuring transformers.

### 3.3 Heaters

Space heaters shall be provided for prevention of moisture in each cubicle. Heaters shall be wired together and shall be automatically controlled to avoid over heating the equipment. Heater shall be suitable for operation on 230 VAC supply from an external source (to be provide in main Distribution Board)

### 3.4 Name plates

On the front side, a name plate shall be provided at the top to indicate the name of manufacturer, system voltage and frequency and the current carrying capacity of switchboard.

Each breaker shall have a circuit identification label fitted below the breaker aperture or as suitable.

Drawing indicating the branch circuit names, breaker elements, cable sizes and connecting services shall be placed in a clear plastic pocket provided at the back of the front access.

Labels described shall have block letters 7 mm high on a white back ground, to be made from traffolite and be fixed with screws.

Each incoming and outgoing circuit shall also be labeled with name plate 75 mm x 15 mm, as described above on the front side of door.

## 4.0 MECHANICAL DESIGN

### 4.1 General Construction

The switchboard shall be fabricated, welded; grinded, finished with angle iron framework and cladded with 14 SWG MS sheet, to form a rigid, free standing, flush mounting fronted assembly.

It shall be suitably divided into panels and compartments for

accommodating the required number of circuit components, instruments and accessories. Each compartment shall be fully partitioned from its neighbor both horizontally and vertically, allowing safe cable routing / termination without shutting the switchboard down.

All live parts within cubicles, compartments or modules, which have to accessible during normal maintenance operations, shall be adequately protected and / or barried to ensure protection of works and to avoid accidental contact. Barriers may be rigid, transparent, insulating material fitted with warning labels.

The doors shall be provided with hinges on the left-hand side and locking handles on the right hand side for fastening the door. The front assembly shall be fastened to the enclosure by means of self locating fasteners for quick and easy fixing.

All holes, cutouts shall be tool or jib manufactured and free from burrs and rough edges. All structural components shall be of standardized design to provide complete uniformity and inter change ability of common parts. Removable gland plated shall be provided at top and / or bottom as required.

The switchboard shall be supplied complete with foundation bolts and other installation materials as recommended by the manufacturer. Proper size cable clamping channels with galvanized steel clamps and brass cable clamps respectively for unarmoured and armoured cables shall be provided.

The cabling inside the Switchboard shall be suitably numbered and harnessed by means of straps or cords. Wiring to door mounted components shall be in flexible PVC conduit. All indicating, control and selecting equipment shall be suitably arranged and clearly labeled with indelible labels indicating the rating of fuses, switches, etc.

All metal work of the switchboard shall be cleaned down to bare shining metal, phosphate and the surfaces chemically prepared for powder coating. Then these shall be coated with powder of colour RAL 7032 and then baked in oven. The thickness of powder coating shall not be less than 120 microns.

### 4.2 Bus Bars

Bus bars and droppers supported on non - hygroscopic material are to be high conductivity electrolytic tinned copper, completely isolated and mechanically braced and rated to withstand the specified short circuit currents for one second duration.

Bus bars and droppers shall be housed in a separate compartment and shall be clearly marked with their respective colors. Bus bars shall be provided for three phases, neutral and multi - terminal earth. The temperature rise shall not exceed 50 degree centigrade at rated current. Neutral bus assembly shall consist of outgoing screw terminals with one terminal for every MCCB / MCB.
Neutral Bus bar should be of same ampere rating as phase bar.



Removable metal covers on the bus bar chamber shall be provided with suitably sized labels at regular intervals, fixed with self tapping screws and warning of live metal work.

All bus connectors shall be tinned plated connections and joints. Horizontal bus bars shall be of the same current rating throughout their length.

### 4.3 Earthing

A copper earth bar of suitable section for the specified fault level shall extend the entire length of the Switchboard. Provisions shall be made for possible future extensions at both ends.

Earthing facilities shall be provided on each incoming and outgoing unit to permit earthing of the connections.

All metallic non-current carrying parts of the Switchboard shall be bonded together and connected to the Switchboard's earth bar.

Each circuit wiring shall be green / yellow colour. Earthing mass continuity between withdrawable parts and fixed frame shall be correctly ensured whatever the withdrawable part position.

Provision shall be made adjacent to cable termination for earthing cable armour to the earth bus bar.

Earthing switch shall be provided wherever mandatory as per rules and regulations / codes and standards and shall be manually operated. An interlocking system shall provide the following locking and safety functions :

- impossibility of closing the earth switch if the switching device is closed.
- visual check of earthing switch positions to be possible.
- possibility of locking the earthing switch operating handle in open and closed position.
- the earthing of the bus bar shall be done manually by the operator without provision of general earthing system.

## 5.0 DISTRIBUTION BOARDS

The enclosure of the LV Distribution Board shall be fabricated from electro-galvanized / zinc coated sheet steel.

The LV Distribution Board shall be fabricated with 16 SWG sheet steel recess mounting. All components shall be installed on a common component mounting plate made of 14 SWG sheet steel inside the enclosure and protected from the front with screwed sheet steel front plate. The door and dead front covers shall be made of 14 SWG sheet steel. The door shall be fully gasket with hinges on the left hand side and locking handle on the right hand side for fastening the door. The locking handle should be detachable. The dead / front assembly shall be fastened to the enclosure by means of self - locating fasteners for quick and easy fixing.



The distribution board shall be supplied complete with all installation materials as recommended by the manufacturer. The incoming and outgoing cable connections shall be according to the wiring requirements. If required, an adapter box for accommodating the cables and conduits may be provided. The box shall be of the same material and finish as the Distribution Boards.
An earth bar or terminal strips shall be provided for connection of incoming and outgoing earth conductors. The earth bar or terminals shall be permanently connected to the body of Distribution Boards at two points. Flexible copper strip shall be provided for earthing of the door of Distribution Board.

Neutral bus assembly shall consist of outgoing screw terminals with one terminal for each MCB. All holes, cutouts, etc., shall be tool or jib manufactured and free from burrs and rough edges. Removable gland plates shall be provided at both the top and / or bottom, as required.

The cabling inside the distribution board shall be suitably numbered and harnessed by means of straps or cords. Wiring to door mounted components shall be in flexible PVC conduit. All indicating, control and selecting equipment shall be suitably arranged and clearly labeled with indelible labels indicating the rating of fuses, switches, etc.

All metal work of the distribution board shall be cleaned down to bare shining metal, phosphate and the surfaces chemically prepared for powder coating. Then these shall be coated with powder of colour RAL 7032 and then baked in oven. The thickness of powder coating shall not be less than 120 microns.

## 6.0 COMPONENTS

The switchboards shall be provided with all components as specified or shown on the Drawings and as necessary for the satisfactory operation of the Switchboard and of the electrical system. Typical specifications are given here under :

### 6.1 Moulded Case Circuit Breaker

These shall be three pole 400 / 500 volts rating shown on the drawings. The breakers shall have both time delay over current and instantaneous short circuit protection.

The MCCBs shall be installed such that their switching levers are accessible through the dead front plate for operation. Circuit numbers / designation on all circuits shall be conspicuously marked to facilitate connection and maintenance.

The breaker shall have quick make - quick break toggle mechanism with positive 'ON', 'OFF' and intermediate ' Tripped ' positions.

Trip mechanism shall be trip free on overload or short circuit ensuring that the breaker will not close / remain close even if the close command is given while the circuit breaker has tripped due to short circuit or continuing overload.



### 6.2 Miniature Circuit Breaker (MCB)

The MCBs with current rating from 3 to 100 Amps. shall be conforming to BS EN 60-898 or IEC 60947-2. The circuit breakers shall be suitable for DIN-rail mounting, maintenance-free and fully tropicalized.
The MCBs shall be designed for horizontal or vertical mounting, or reverse feeding, without any adverse effect on electrical performance.

The operating mechanism shall be quick make, quick break type, trip free, with all poles opening and closing simultaneously (except for the neutral pole, which if required shall be of the advance-closing and late-opening type). The operating toggle shall clearly indicate the ON and OFF/TRIP positions.

The individual operating mechanism of each pole of a multiple MCB shall be directly linked within the MCB casing and not by the operating handle.

Each pole of the MCBs shall be provided with bimetallic thermal element for overload protection and a magnetic element for short circuit protection.

### 6.3 Earth Leakage Circuit Breakers (ELCB)

ELCBs shall be four pole, current operated type with tripping current of 0.3A and tripping time not more than 0. I seconds.

### 6.4 Load Break Switch and Contactor

Load Break Switches and contactors shall be of AC3 type for motor loads. Air circuit breakers above 630A shall be housed in separate cubicles. Aluminium plate shall be provided for cable entry to ACBs / MCCBs cubicles of 630A and above rating.

## 7. PARTICULAR COMPONENT REQUIREMENTS

### 7.1 Ammeters and Voltmeters

Indicating instruments shall be semi-flush Switchboard type, moving Iron, spring controlled with standard scale having white background and black graduations and markings. The front dimensions shall be 144 x 144 mm for instruments on incoming side and 96 x 96 mm on all outgoing circuits.

Indicating instruments shall be 1.0 class percent of full scale basic accuracy class in accordance with IEC 60051.

The ammeter shall be suitable for connection to 5 Amp. Secondary of Current Transformer or directly through shunt as shown on the drawings. The instruments shall have measuring range indicated on the drawings. A red mark shall be provided at the working voltage on the scale of all voltmeters.



### 7.2 Selector Switches

Ammeter and voltmeter selector switches shall be complete with front plate, grip handle, R-Y-B and OFF position for ammeter and RY-YB-BR-RN and OFF positions for voltmeters.

The selector switches for controls shall be rotary cam type and shall be provided complete with knob and front plate, showing all positions as required.

### 7.3 Push Buttons

The push buttons shall be momentary make / break contact type (normally open / normally close) and suitable for flush mounting. The push button for ON and OFF switching shall be red and green respectively.

### 7.4 HRC Fuses

HRC Fuses shall be provided complete with fuse bases, fuse, etc. The fuses shall have a fusing factor as specified for class Ql in accordance with BS 88.

### 7.5 Pilot Lamps

Switchboard shall be provided with phase indicating pilot lamps. The lamps shall be rated for 250 volts supply and suitable for flush mounting. The front of the lamps shall have colored rosettes for identification of phases.

### 7.6 Line up Terminals

Line up terminals wherever provided for Control or Power circuits shall be suitable for voltage and size of conductors as indicated on drawings. The Line up terminals for controls shall be suitable for channel mounting. All necessary accessories such as end-plates, fixing clips, transparent label holder caps and label sheets with marking shall be provided.

### 7.7 Secondary Wiring

All wiring shall be copper conductor, thermoplastic insulated, at least 1.5 sq. mm flexible, neatly arranged and clipped in groups.

Each conductor and its termination are to be identified and marked with numbered ferrules. All live terminals are to be shrouded.

Secondary wiring for Current Transformers shall be carried out with not less than 2.5 sq. mm. Terminals shall be specially marked to avoid opening of the circuit by accident.

## 8. INSTALLATION

The LV Switchboard shall be installed at location shown on the drawing. The Contractor shall ensure coordination with civil works for providing any openings, holes, etc. to avoid any breakage to completed works. In case the provisions in civil works for the installation of electrical equipment are not made or made incorrect the same shall be rectified by the Contractor at his own cost and to the satisfaction of the Engineer. The Contractor shall provide foundation bolts and grout them in cement concrete floor using non-shrinkable material with the approval of Engineer.



All installation material for physically erecting the Switchboard, such as bolts, nuts, washers, supporting steel, etc., shall be provided and installed by the Contractor. The Switchboard shall be installed upright and in level and shall be firmly and rigidly bolted to the floor and concrete supports.

The switchboard shall be completely erected as per manufacturer's instructions and as approved by the Engineer. Loose parts dispatched by the manufacturer shall be installed and connected as per assembly drawing provided by the manufacturer. Any safety locking provided by the manufacturer for safe transportation shall be released only after the switchboard is erected in position.

The incoming and outgoing cables shall be connected as recommended by cable manufacturer. The cable armour shall be connected effectively to ground.

The Switchboard body shall be connected to earth as per instructions given in section "Earthing" of these specifications. The Switchboard shall be tested and commissioned in the presence of the Engineer. The tests to be carried out shall be tested before energizing as per instructions contained in the article " Testing " of General Specifications of Electrical Works, section E-1 of these specifications.



## SECTION - E - 3
## LOW VOLTAGE CABLES AND WIRES

### 1. SCOPE OF WORK

The work under this scope consists of supplying, installation, testing, connecting and commissioning of all material and services of low voltage cables and wires and the accessories as specified herein or shown on the Drawings and given in the Bill of Quantities.

The Contractor shall discuss the electrical layout with the Engineer and coordinate at site with others for exact route, location and positions of electrical lines and equipment.

The LV cables and wires with accessories shall also comply with the General Specifications for Electrical Works, Section E- I and with other relevant provisions of the Tender document.

### 2. GENERAL

All multicore and single core wires for light circuits, socket outlets and circuits operating upto 250 volts shall be 300 / 500 volts grade. All single core sheathed cables shall be of minimum 450 / 750 volt grade. Power cables for main feeders, main to submain feeders, power equipment, etc., armoured or unarmoured shall be of 600 / 1000 volts grade. Armouring of cables shall be done with appropriate size galvanized steel wire as per codes.

The conductors shall be stranded or solid, high conductivity, soft annealed copper. Conductor of single core cables shall be circular, whereas of multicore cables may be circular or shaped according to standard practices and codes. The PVC insulation shall be extruded with a PVC compound having good flexibility, resistance to aging and ability to withstand the ambient temperatures as given in General Specifications for Electrical Works, Section E-1 of these specifications. Cable should be capable of running 125% of full load current without any damage.

All power cabling used for external power distribution shall be armoured type.

### 3. STANDARDS

LV Cables and Wires shall comply with Section – E -1, Clause 3.

Particular reference shall be made to :

| | |
|---|---|
| BS 6004 / 6346 | PVC insulated cables for lighting and power. |
| BS 6746 | PVC insulation for electrical cables. |
| BS 6360 | Copper conductors |
| BS 6500 | Insulated flexible cords. |

Any other standard referred to in above standards or these specifications.

### 4. MATERIAL



#### 4.1 General

The power, lighting and control cables shall be furnished and installed in accordance with the routes and requirements shown on the drawings.

All cables shall have phase identification colours on insulation of each core. The colour code for three phase circuits shall be red, yellow and blue for phase conductors and black for neutral conductor. Where insulated earth conductor is installed, it shall have green colour insulation.

Single phase circuits shall have insulation of red colour for phase / line, black colour for neutral and green colour for earth conductor.

All DC circuits shall have insulation of red colour for positive, black colour for negative and green for earth conductor.

The ends of each length of multicore armoured or unarmoured cables shall be properly marked for clock-wise and anti clock-wise sequence of core colours.

### 4.2 Cables for Conduit Wiring

All cables / wiring in concealed or surface mounted PVC or steel conduits shall be single core PVC insulated of specified grade and size, unless specifically shown on the drawings or given in BOQ.

### 4.3 Cables on Surface / Concrete Trenches

Cables for distribution system to be installed on surface, in cable ducts, in concrete trenches or on trays shall be single or multicore PVC insulated and PVC sheathed of specified voltage grade and size, unless specifically shown on the drawings or given in BOQ.

### 4.4 Underground Installation

Cables for laying directly underground shall be PVC insulated, PVC sheathed and armoured with galvanized steel wire. Cables fully installed in underground ducts / pipes and mechanically protected from end to end shall be PVC insulated and PVC sheathed unless specifically shown on the drawings or given in BOQ. The installation work of underground cabling shall be done completely as per the prevailing standards or as per the drawings.

### 4.5 Cable Accessories

All cable accessories shall be provided for the complete cabling and wiring system without any additional cost unless specifically mentioned in BOQ. These shall include but not limited to the items such as saddles, clamps, fixing channels, connectors, cable joints (where necessary and approved by the Engineer), clips, lugs, tapes, solder, identification tags, bushes, glands, etc.

## 5. INSTALLATION

### 5.1 General

When the laying is effectuated by others, the contractor shall test the cable characteristics insulation and continuity, at all phases of these and communicate them in a report to the Engineer, as per recommendations of the standards according to which the cable is manufactured.



The cables shall be spaced by categories along their entire length as well as upon penetration into buildings and in their interiors, according to their following rated voltages:

- 30 cm at least between a cable carrying I KV - 30KV and other cables.

- 20 cm at least between a cable carrying voltages between 50V
- 500V, and any power or control 10 cm at least between a cable carrying voltages lower than 50V and telephone or these possible being grouped.

All installation material, labour, tools and accessories for cable installation shall be furnished by the Contractor. The cable and accessories shall be installed as described in accordance with these specifications, drawings and manufacturer's instructions.

## 5.2 Conduit Wiring

The wiring through conduit shall be started only after the conduit system is completely installed and all outlet boxes, junction boxes, etc., are fixed in position. The filling rate inside the conduits shall not exceed 50 %. Cables directly embedded in the masonry are not accepted.

The wires shall be pulled in conduit with care, preferably without the use of any lubricant. Where necessary and if approved by the Engineer, the cable manufacturer's recommended lubricant may be used. Where several wires are to be installed in the same conduit, they shall be pulled together along with the earth conductor. All wires of same circuit shall be run in one conduit.

The wires shall not be bent to a radius less than 10 times the overall diameter of the wire, or more if otherwise recommended by the manufacturer.

The wiring shall be continuous between terminations and looping-in system shall be followed throughout. Any joint in wires shall not be allowed. The use of connectors shall only be allowed at locations where looping-in is rendered difficult. The consent of the Engineer shall be required for using connectors. The connector shall be of suitable rating having porcelain body with sunk-in screw terminals. The connector shall be wrapped with PVC insulation tape after its installation. A minimum of 150 mm extra length of cable / wire shall be provided at each termination to facilitate repairs in future.

## 5.3 Cables on Surface / Trenches

All cables for installation on surface of wall, column, ceiling, trenches, etc., shall be fixed to the surface by means of galvanized steel clips, secured to a steel channel using suitable stud plate, nuts and washers.

The erection of cables and position of support shall be agreed by the Engineer on site, having taken into consideration the accessibility of all such routes. These shall be so arranged that cable crossing one another be minimized if cannot be avoided.



Cables shall be fixed throughout their length by means of approved saddles, clips, etc., at every 600 mm vertically and 900 mm horizontally.

Cables and equipment fixed to a building fabric, i.e., brickwork, concrete, etc., shall be fixed by means of appropriate fixing devices, i.e., Raw bolts, Hilti fixing devices, etc., or alternatively by means of suitable fixing devices cast at site, e.g., concrete inserts.
Contractor shall be responsible for all drilling of steel work, brick work and masonry where necessary for fixing clamps and brackets for supports.

Cables shall not be pulled into conduit until the conduit system has been completed, cleared and free from obstruction and sharp edges.

It shall be ensured that conduit system is clear before cable is drawn in. cables shall be put into conduits in such a manner that there will be no cuts or abrasions in the cable insulation, protective braid and jackets. There shall be no link in the conductors.

Distance of saddles shall be used for installation of cables in defined condition of the surface of wall etc.

Grease or other injurious lubricants shall not be used in pulling cables. The use of talc or non-injurious lubricants is permissible, if desirable.

The number of wires installed in any conduit shall be such that the resulting space factor does not exceed 50 %. Spliced wires shall not be pulled through conduits.

All conduit wiring shall be carried out in the loop - in principle from outlet box to outlet box and in no circumstances shall joints be used except in fixed base connection blocks housed in outlet boxes.
The vertical clearance between two adjacent cables at any point is 50 mm minimum. Common mounting, channels are to be furnished for cable along the same route. The Contractor can offer alternate cable fixing arrangement, which shall be approved by the Engineer before commencement of installation.

The wall crossings where the outdoor cables penetrate in the building shall be carefully obstructed by means of polyurethane foam. The Contractor shall be fully responsible for the perfect tightness of these cable penetrations.

## 5.4 Underground Cables

The Contractor shall plan and take special care to prevent any damage to existing underground facilities such as underground piping, cables, foundations, etc. The Contractor shall notify the Engineer of any obstruction encountered and shall provide protective support or removal of such obstructions as instructed by the Engineer. Excavation adjacent to existing facilities, such as foundations manholes, ducts, underground pipelines and paving shall be braced and / or shored properly to protect those facilities during excavation and construction.



Sufficient slack shall be left in cables for this purpose that cut lengths of cables shall allow about 3% more in the measured lengths between terminations.
The RCC chamber of appropriate size shall be provided at every joint of cables as per standards and actual site requirements. The details of RCC chamber shall be provided by contractor prior to commissioning of works.

Cables, whether installed underground or in concrete trenches, shall not be bent to a radius less than 10 times the diameter of the cable or as recommended by the cable manufacturer, whichever is higher.

All cables shall be marked at least at each end, switch gear and equipment termination, where cable enter or leave underground cable trenches or channels, where cable rises from one level to another, at 30M intervals with predetermined identification numbers, by means of proprietary non-deteriorating type, PVC, heat shrinkable, strap-on type or equivalent, for the identification of cable and circuit. These shall be indelibly marked with cable number and securely fixed to the cable. Where conductors are left to be terminated by another party or left to be connected later, they shall be identified. The earth continuity conductor shall be laid in the trench with the cables.

Cables entering the buildings shall also be laid in protective pipes. The protective pipe ends, after installation of cables, shall be plugged water tight by means of polyurethane foam / bituminized Hessian or equivalent method as approved by the Engineer.

## 5.5 Cable Termination and Joints

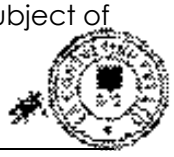
Cables shall be terminated in a safe, neat and approved manner at the associated equipment, included that erected by others.

Compression type connectors (lugs) shall be of the correct size and approved type for the conductors concerned. Compression tools shall be supplied for specific use and shall be maintained in good order. After compression the conductor and terminal shall form a solid mass ensuring good conducting properties and mechanical strength. The compression jointing system used throughout the installation must be approved by the Owner or his representative before use.

The Contractor shall be responsible for all drilling and if necessary, tapping entries where these have not been provided by others.

When preparing cables prior to fitting glands, the gland manufacturer's instructions for cable preparation shall be observed. In all cases where armored cables are used, care shall be taken to ensure that the lay of the armor is maintained after the gland is completely fitted.

Termination and joints shall be suitably insulated for the voltage of the circuits in which they are used.
Every compression joint shall be of a type, which has been the subject of a test certificate as described in BS 4579.



The RCC chamber of appropriate size shall be provided at every joint of cables as per standards and actual site requirements. The details of RCC chamber shall be provided by contractor prior to commissioning of works. Extra loops shall be left of cables at the end of every termination.

Cable ends, which are not terminated immediately after cutting, shall be sealed effectively to prevent ingress of moisture and shall be protected from damage until termination.

For all cables above 6 sq. mm in section, if a substantial mechanical clamp is not provided a compression type lug or socket shall be provided. At all equipment, cable shall be installed and terminated so that no strain is imposed on the cable or gland and due allowance made to counter the effect of vibration. At all termination an ample length of 'tail' shall be left.

Where joints in cable conductors and bare conductors are required, they shall be mechanically and electrically sound and they shall be accessible for inspection. Joints in non-flexible cables shall be made either by soldering or by means of mechanical clamps or compression type socket, which shall securely retain all the wires of the conductors.

Any joint in flexible cable shall be effected by means of cable coupler. Cable couplers and connectors shall be mechanically and electrically sound and shrouded in metal, which can be earthed. Where the apparatus to be connected require earthing every cable coupler shall have adequate provision for maintaining earth continuity.

Cables of AC circuits, installed in PVC or steel conduit shall always be so bunched that the cables of all phases and the neutral conductor (if any) are contained in the same circuit. The outdoor apparatus shall normally be connected by means of cables with conduit termination down to about 30 cm below ground level or concrete foundation. The conduit shall be firmly secured down to their penetration into the trench or channel.



## SECTION - E - 4
## CONDUITS AND PIPES

### 1. SCOPE OF WORK

The work under this scope consists of supplying, installation and commissioning of all material and services of the complete Conduits and Pipes as specified herein and / or shown on the Drawings and given in the Bill of Quantities.

The Contractor shall discuss the electrical layout with the Engineer and coordinate at site with others for exact route, location and positions of electrical lines and equipment.

The Conduit and Pipes with accessories shall also comply with the General Specifications for Electrical Works, Section E- I and with other relevant provisions of the Tender document.

### 2. GENERAL

The extent of works shown on the drawing does not indicate the exact position of conduit and pipes. The Contractor shall ensure exact location and route of conduit and pipes in coordination with other services drawings, as per site requirements and as directed by the Engineer.

The quality and material for the accessories of conduits and pipes such as sockets, elbows, bushings, bends, inspection / pull boxes, round boxes, etc., necessary for the completion shall be similar to that of conduit or pipes. All the accessories shall be supplied by the Contractor without any extra cost and deemed to have been included in the price of conduits / pipes.

### 3. STANDARDS

Pipes and Conduits shall comply with Section - E-1, Clause 3.
Particular reference shall be made to:

| | |
|---|---|
| BS 31 | Steel Conduit and accessories |
| BS 1378 | Galvanized Iron Pipes and accessories. |
| BS 3595 | PVC Pipes and accessories. |
| BS 4607 | PVC Conduits and accessories. |

Any other standard referred to in above standards or these specifications.

### 4. MATERIAL

#### 4.1 PVC Conduits, Pipes and Accessories

The PVC conduits and accessories for lighting and power circuits shall be furnished by the Contractor as shown in the drawings or given in BOQ. The PVC bends shall have enlarged ends to receive conduit without any reduction in the internal diameter at joint. Manufactured smooth bends shall be used where conduit changes direction. Bending of conduits by heating or otherwise will be allowed in special situations only, for which the consent of the Engineer shall be required. The use of sharp 90 degree bends and tees will not be allowed for concealed wiring.



The round PVC junction boxes for ceiling light or fan points shall have minimum dimensions of 64 mm diameter and 64 mm depth. The junction boxes for wall light points shall have minimum dimensions of 57 mm diameter and 40 mm depth. Round junction boxes shall be provided with one piece bakelite cover plate fixed to the box by means of galvanized screws.

The PVC pipe shall be rigid and shall be minimum B-Class (working pressure - 12 Kg / cm), unless otherwise stated on Drawings or Bill of Quantities. Where pipe changes direction, manufactured smooth bends shall be used. For jointing of pipe, all precautions and procedures recommended by manufacturer shall be followed.

### 4.2 Steel Conduit and Accessories

All conduits shall be of heavy gauge 16 SWG steel, manufactured and tested in accordance with latest relevant standards.

The conduit shall be protected by two base coats of red oxide anti-rust paint and finished in first quality black enamel paint. The coating shall be of heavy enamel, which shall not flake or crack during installation and handling. Each conduit length shall be furnished with threaded ends and a threaded coupling at one end. Soft metal bushes shall be provided at conduit termination to prevent damage to cable during pulling operation.

Junction boxes shall be 100 mm square, having minimum depths of 38 mm or 65 mm as required for accommodating the number of wires. The junction box shall be 16 SWG sheet steel provided with anti-rust paint and finished in heavy black enamel paint. The cast Iron outlet boxes for light points shall be round having 50 mm diameter and 63 mm depth. The above dimensions are given as minimum only, and the exact size shall be determined by the Contractor keeping in view the ease of Installation and maintenance. All outlet boxes and junction boxes shall be provided with one piece bakelite cover plate of suitable design.

### 4.3 Galvanized Iron Pipes and Accessories

For Surface run G.I. pipes shall be used and must be galvanized from inside and outside by hot dip galvanizing method. The pipes shall be free from stains, burrs or any other defect. The accessories for G.I. pipes shall be galvanized from inside and outside. The conduit shall be NPT threaded, with at least 5 complete threads and assembled with TEFLON tape.

### 4.4 Inspection Boxes / Pull Boxes

The rectangular inspection boxes or pull boxes shall be of 16 SWG heavy gauge, sheet steel having nipples welded to box at entry holes to receive PVC conduit with force fit. The box shall be painted inside and outside with black enamel paint over a base coat of red oxide primer paint. The minimum length of inspection box shall not be less than six times the cable manufacturer's recommended bending radius of the cable. All concealed type pull boxes shall have a white plastic sheet of appropriate size fixed to the box by means of galvanized screws.



### 4.5 Adaptable Boxes

Adaptable boxes shall be made of 16 SWG sheet steel box, painted and finished to the same quality as the light Distribution Board. The boxes shall be 50 mm in depth for conduits up to 25 mm diameter, 63 mm in depth for conduits up to 40 mm diameter and 87 mm in depth for conduits up to 50 mm in diameter. For conduits more than 50 mm in diameter, the minimum depth shall be two times the diameter.

### 4.6 Conduit / Pipe Accessories

Bushes, plugs, glands, etc., shall be of brass and all male bushes shall be of long thread pattern. Covers for boxes shall be screw fixed and finished as the boxes. Gaskets shall be fitted only when finish is galvanized unless otherwise specified.

### 4.7 Cable Trunking

Where required, wiring shall be run in hot-dipped galvanized (after fabrication) sheet steel cable trunking of the specified gauge complete with all fittings and accessories, manufactured and installed in accordance with BS 4678/NEMA. The trunking shall be constructed with return flanges. Trunking covers shall be secured by anchored turn-buttons and locking bars and minimum length of individual sections shall be 2.44-m. The trunking shall be suspended/supported from the structure at maximum 2-m intervals with straps and hangers fabricated from minimum 6-mm dia HDGI bars, or supported by angle-iron brackets.

Conduit drips from the trunking shall also be supported with hangers. Factory made connectors shall be used at joints.

Junctions (tee and 4-way) in multi-compartment trunking shall be double depth to avoid reduction in cabling space. Cable in vertical runs shall be supported by pin racks, prongs or bridging pieces. Fire barriers shall be provided at each floor level. Allowance for expansion shall be incorporated.

Bonding links shall be provided at each joint and secured by screws, nuts an shockproof washers. The bonding links shall make contact with the metal of the trunking of fitting, and continuity shall not depend on contact through the screws, nor on removal on site paint finish from ferrous metal.

## 5. INSTALLATION

### 5.1 PVC Conduits - Concealed

The conduit shall be installed concealed in roof, wall, column, etc.
At all joints and bends, PVC jointing solution as manufactured by Pakistan PVC Limited or approved equivalent must be used to strengthen and to seal the joint.

Manufactured smooth bends shall be used. Bending of conduits by heating or otherwise will be allowed in special situations only, for which the consent of the Engineer shall be required. The use of 90 degree bends and tees will not be allowed.



The conduit shall have a minimum of 38 mm cover of concrete. In the reinforced cement concrete (RCC) work, the conduit shall be laid before pouring of concrete. Under no circumstances shall chases be made in the RCC structure for concealing conduit and accessories, after pouring of concrete. The concrete shall be supported on top of bottom reinforcement of slab and shall be firmly secured by tieing to the reinforcing steel in order to avoid being disturbed during pouring of concrete.

All outlet boxes to be firmly supported and installed such that they finish flush with the soffit of slab of beam.

Where conduits have to be concealed in cement concrete (CC) work after concreting, or in block masonry, chases shall be made with appropriate tools and shall not be made deeper than required. The conduit shall than be fixed firmly in the recess and covered with cement concrete mixture to have to at least 32 mm cover before plastering. The work of curing in the cement concrete work or block masonry work shall be coordinated with the civil work. The Contractor shall obtain approval from Engineer for the route, to suit the site conditions before starting chasing and cutting.

The termination of conduits at or near the Switchboard / Distribution Board is shown diagrammatically on the drawing. The exact final locations of the termination shall be coordinated with the Switchboard / Distribution Board to be installed. Any extension of conduit near the Switchboard / Distribution Board to suit the site condition shall be made without any extra cost. Conduit ends pointing upwards or downwards shall be properly plugged in order to prevent the entry of foreign materials. All openings through which concrete may leak shall be carefully plugged and boxes shall be suitably protected against filling with concrete. At all termination of concrete, soft bushes shall be fixed to prevent sharp edges of conduit ends from cutting or damaging the wires or cables to be pulled through them.

The entire conduit system shall be installed and tested before wiring is carried out. Any obstruction found shall be cleared by use of cutting mandrel or other approved device and the conduit shall be cleaned out before the installation of cable.

Pull boxes / Adaptable boxes shall be provided in conduit runs wherever required to facilitate pulling operation. The drawings are diagrammatic and do not indicate the position and spacing of pull boxes or adaptable boxes. However, these shall meet the following requirements:

- Pull boxes.
  For straight runs the spacing shall not be more than 30 meters.
  For runs with one 90 degree bend, the spacing shall not be more than 15 meters.



- Adaptable boxes.
  For conduits up to 25 mm diameter, the boxes shall be 50 mm in depth.
  For conduits up to 40 mm diameter, the boxes shall be 63 mm in depth.
  For conduits up to 50 mm diameter, the boxes shall be 87 mm in depth.

Wherever the conduit lengths cross the expansion joint either along the column or slab, suitable arrangement shall be provided so that when the conduit lengths in the expansion joint are stressed, the conduit neither develops any cracks nor breaks down.

Bending, off setting and similar operations shall be performed through the help of proper bending tool to give a perfect bend of required angle without Desha ping of conduit to the least.

### 5.2 Steel and G.I Conduit

The minimum size of conduit shall be 20 mm.

The use of solid or inspection elbows, bends or tees will not be permitted and 120 degree bends shall be limited to one between any two drawn-in boxes.
Conduit coupling joint shall not be used where conduit enter spout entry boxes. Conduit running, joints shall not be used where conduit enter conduit boxes or spout entry boxes.

Equipment that is required to be removed for maintenance shall be provided with conduit unions in all conduits that enter such equipment. The use of conduit nipples shall be avoided as far as practicable.

All conduits shall be cut square and reamed at the end. All conduit ends and the inside of conduits shall be clean and free from burrs.
Where bushed spouts or tapped holes are not provided at conduit termination, the conduit shall be terminated in a flanged socket and a smooth bore brass hexagon bush, with a lead washer fitted between the flanged socket and the equipment or box.

All exposed threads and parts where the galvanizing has become damaged shall be thoroughly cleaned and painted with galvanized paint. The exposed conduit ends shall be capped to protect threads from being damaged before installing cables.

Repair painting shall take place before any making good on site or buildings is carried out. The entire conduit system shall be checked for continuity. Any observation found shall be removed without damaging the installation.

The conduit system shall be installed empty with an 16 SWG steel wire drawn through the conduits for pulling of cables. Joints in underground conduits shall be avoided or reduced to the absolute minimum.

Where adjustable dies are used they shall be so adjusted that threads cut with them shall be the same depths as machine made threads.

The use of manufactured bends shall be avoided and instead smooth bends shall be provided by using approved type of bending tools.
Flexible steel conduits shall be installed at all points locations where flexible connection is required, as directed by the Engineer. The flexible conduits when used, shall be protected by external PVC sheath, resistant to oil damages.

G.I. pipes for under ground installation shall be given bituminous paint coating and wrapped with suitable paper or cloth before installation.

### 5.3 Fixing of Conduits and Fittings

Conduits in process units and on steel work with "U" bolt type fixings.

Conduits in buildings shall be fixed with galvanized distance saddles. Where a number of conduits follow a single route they may be fixed to mild steel brackets.

Conduits shall be supported on both vertical and horizontal runs as follows:

- Conduits size 20 mm and 25 mm maximum spacing of fixing 1000 mm.
- Conduit sizes larger than 25 mm spacing of fixing 1500 mm.

All conduit boxes that support fittings shall be securely fixed. All conduits shall be fixed 150 mm before and after every right angle or off set. All conduit fittings and equipment shall be fixed true and line able.
All conduit bends shall be made with an approved conduit bending machine or hickory. The radius of curvature of the inner edge of any bend shall not be less than the following table:

| Conduit size | Radius |
|---|---|
| 20 mm (3/4") | Not less than 130 mm. |
| 25 mm( 1" ) | Not less than 150 mm. |
| 32 mm ( 1-1/4") | Not less than 200 mm. |
| 38 mm ( 1-1/2") | Not less than 255 mm. |
| 50 mm (2") | Not less than 305 mm. |
| 75 mm ( 2-1/2") | Not less than 380 mm. |
| 82 mm (3") | Not less than 460 mm. |
| 100 mm (4") | Not less than 610 mm. |
| 150 mm (6") | Not less than 750 mm. |

Under ground conduit stud-up or kick pipe through concrete envelope shall be extended a minimum of 150 mm above grade and adequately braced to prevent shifting during concrete pouring work. The concrete envelope shall extend at least 76 mm above grade.
Under floor conduit installation shall be at a minimum depth of 120 mm from finished floor level. The G.I. pipes / conduits shall be installed at a minimum depth of 1000 mm measured from the top of size to the finished road level.



### 5.4 Location of Conduits and Fittings

Before conduits are installed, confirmation shall be obtained that the conduit may be installed in that position.

Particular attention shall be given to the location of conduits to prevent the infringement of headroom and access ways.

Conduits shall be located to avoid obstructions, furnaces, hot lines and other places of high temperature.

Conduit shall not be located than 150 mm (6") where it runs parallel to or crosses hot surfaces. Underground conduit runs shall be kept to minimum in both number and length. Conduits shall not be recessed in fair brick work.

Draw boxes shall be so positioned to enable the cables to be drawn in easily. The boxes shall not be located in the comers or other such locations and shall be positioned to avoid tight bends, bending and cable kinks. Conduits shall not generally be installed having a greater length 12,000 mm (40 feet ) between draw-in boxes. Conduit entries shall wherever possible be located in the bottom of boxes and equipment etc.



## SECTION - E - 5
## WIRING ACCESSORIES

### 1. SCOPE OF WORK

The work under this scope consists of supplying, installation and commissioning of all material and services of the complete switches, switch sockets, etc., and miscellaneous items as specified herein and / or shown on the Drawings and given in the Bill of Quantities.

The Contractor shall discuss the electrical layout with the Engineer and coordinate at site with others for exact route, location and positions of electrical lines and equipment.

The wiring accessories shall also comply with the General Specifications for Electrical Works, Section – E - I and with other relevant provisions of the Tender document.

### 2. GENERAL

The locations of the wiring accessories such as sockets, switches etc. are tentatively shown on the drawings. The Contractor shall ensure exact positions and locations of wiring accessories in coordination with other services drawings, as per site requirements and as directed by the Engineer. The Contractor shall be responsible for proper functioning of wiring accessories after installation and Commissioning.

### 3. STANDARDS

Wiring accessories and miscellaneous items shall comply with Section - E-1, Clause 3.

Particular reference shall be made to:

- BS 67 Ceiling roses.
- BS 1363:1984 13A fused plugs and unswitched socket outlets
- BS 116 Two and three terminal ceiling roses.
- BS 2135 Capacitors for radio interference suppression
- BS 3676 Switch for domestic and similar purposes.
- BS 4934 Safety requirements for electric fans and regulators.
- BS 5060 Performance of circulating fans and their regulators.

Any other standard referred to in above standards or these specifications.

### 4. MATERIAL

#### 4.1 Switch Socket Outlets

Switch socket units shall be of flat pin type and conform to BS 1363, 13A for fused plugs and socket outlets. 2 and 3 Pin rated for 15 Amps. or 2 Pin rated for 10 Amps. Supply as specified in the bill of quantities.

3 Pin 15 Amps. Sockets shall be moulded type having white plastic face plate, suitable for mounting on a sheet steel box of appropriate dimensions. Switch sockets shall have shrouded live contacts such that the earth pin is engaged to socket earth before making with the live contacts. Where specified, the switch socket unit shall have spring loaded dust tight cover for mechanical protection.



### 4.2 Sheet Steel Boxes

The outlet boxes for installation of switches, fan speed regulators and socket outlets shall be 16 SWG sheet steel having appropriate dimensions. The boxes shall have suitable knockouts or welded nipples for receiving the conduits. An earth terminal shall be provided for connecting at least three earth wires of 4 sq. mm. The outlet boxes shall be given two coats of anti-rust red oxide and one coat of enamel before installation. The boxes shall be suitable for mounting flush with the surface of wall or on the surface of wall as may be required. The boxes shall not be less than 75 mm x 75 mm (3" x 3"). All boxes shall be water tight where installed in the vicinity of liquids.

### 4.3 Fans

#### 4.3.1 Bracket Type

The bracket type fans shall be suitable for mounting on the wall and suitable for operation semi-horizontally. These shall operate satisfactorily on 250 volts, single phase, 50 Hz, A.C. supply with + 10 % tolerance.

The sweep of the fan shall be as given in BOQ/drawings.

#### 4.3.2 Exhaust Fan

The exhaust fans shall be three blade types, mounted on the steel/plastic structure of its own, which will be fixed to the structure by means of suitable grouted foundation bolts. The fan shall be suitable for operation on 250 VAC with + 10 % tolerance.

The sweep of the fan shall be as given in Schedule of Quantities/drawings. Fans shall be direct driven and supplied complete with electric motor, back draft dampers and anti-vermin screen. The bearings shall be ball, roller or sleeve type of permanently lubricated and sealed type.
Wheels shall be heavily and rigidly constructed and accurately balanced both statically and dynamically and free from objectionable vibration or noises.

The fans shall comply with BS 380 as far as constructional requirements, range of fan speed, speed regulator starting, radio interference silent operation and temperature rise is concerned. For testing BS 848 as amended 1 960 shall be complied with.



## SECTION - E – 6
## LIGHTING FIXTURES

### 1.0 SCOPE OF WORK

The work under this scope consists of supplying, installation and commissioning of all material and services of the complete light fixtures as specified herein and / or shown on the Tender Drawings and given in the Bill of Quantities.

The Contractor shall discuss the electrical layout with the Engineer and coordinate at site with other services for exact route, location and positions of light fixtures.

### 2.0 GENERAL

The description of light fixtures in given Bill of Quantities, and stated on the drawings, and relevant material are described in this section. The determination of quality is based on certified photo-metric data covering the coefficient of utilization, light distribution curves, construction material, shape, finish, operation, etc.

The Contractor shall submit two samples of each and every light fixture specified and obtain approval of the Owner before purchasing. The quality and finishes of local make light fixtures (if mentioned in BOQ) shall be same as that of standard manufacturer. The accessories such as ballast, lamp / starter holders, starters, lamps, igniters, etc., for all type of light fixtures shall be of Philips make.

All fixtures shall be finished in standard color schemes as mentioned in the manufacturer's catalogue for respective fixtures, unless specifically stated in the Specifications, Drawings or Bill of Quantities or directed by the Engineer.

### 3.0 STANDARDS

Lighting fixtures shall comply with Section E-1, Clause 3.
Particular reference shall be made to:

- IEC 60598 Luminaries.
- IEC 62031 LED modules for general lighting-Safety requirements.
- IEC 62384 DC or AC supplied electronic control gear for LED modules performance requirements.
- BSEN 1838 Emergency Lighting

Any other standard referred to in above standards or these specifications.

### 4.0 LED Light Fixtures

The light fixture shall be as stated on drawings and bill of quantities. The light fixture shall be finished in standard colors unless otherwise stated on drawings or directed by Engineer. All LED light fixtures shall be of international standard and quality. The type of fixtures with manufacturer catalogue reference is given on the fixture schedule and in Bill of Quantities. Equivalent fixture may be acceptable provided that the Contractor submits for review all necessary data indicating photo-metric curves to show that the fixture proposed are of the same type, construction and quality.



The lamps for light fixtures shall be Light Emitting Diodes with driver and shall be supplied and installed according to the wattage as indicated on drawings.

Weather proof light fixture shall comprise of cast aluminum body and gasketed clear glass cover secured to the body by means of galvanized nuts / screws to give a weather proof and water tight fit. The gasket shall be weather resistance type.

The LED light fixtures shall be supplied complete with driver and all accessories as per light fixture schedule and shall be installed in accordance with manufacturer's recommendations and sound engineering practice.

## 5.0 INSTALLATION

### 5.1 General

The mounting heights of light fixtures are indicated on the drawings, and position of fixtures according to the mentioned scale.

The Contractor must ensure that the light fixtures are installed uniformly with respect to the dimensions of the area. Any modifications due to site conditions may be made with the approval of Engineer. All fixtures shall be carefully aligned before fixing in position. All fixing accessories such as ceiling rose, flexible cord, lamp holder, suspension rod; pipe or chain with suitable canopy, etc., shall be provided and installed.

The wiring between terminal box and the fixture shall be carried out with 3 core 0.75 sq. mm and I sq. mm copper conductor, PVC / PVC cable respectively for circuits protected by 10 amps and 15 / 20 amps MCBs. The wiring inside light fixture body shall be done with heat resistant cables or PVC insulated cable in heat resistant sleeves as approved by the Engineer.

Glasses, shades, reflectors, diffuses, etc., must be in a clear condition after installation.

All light fixtures shall be earthed by an earth wire connected to the earth terminal in the fitting.

### 5.2 LED Light Fixtures

The LED light fixture shall be installed on the surface of ceiling or wall by means of nylon plugs and galvanized steel screws, such that their back finish flush with the surface for exposed conduits and flush with outlet box for concealed conduit system. Wherever convenient, screws for fixing light fixtures shall be screwed into the holes of the outlet box. The light on false ceiling shall be installed in accordance with manufacturer's recommendations and in coordination with ceiling installation.



### 5.3 Outdoor Lighting

For illumination around buildings during dark hours, light fittings in various arrangements shall be provided in accordance with these specifications. The items not shown on drawings or called for, but which are necessary for a complete working system as required, these shall also be provided and deemed to have been considered as such.
The Contractor shall essentially use the standard products of a manufacturer, regularly engaged in the manufacturer of the product and shall meet the requirement of the specifications.

## TECHNICAL DATA SHEET FOR HIGH BAY LIGHTING

| DESCRIPTION : | SPECIFICATION |
|---|---|
| **Road light :** | |
| Light Source | LED light |
| lamp for LED light | As per BOQ |
| Heat dissipater | Air Convection radiator |
| LED luminous efficiency | >120 lm/w |
| LED Illumination flux | As per BOQ |
| Working Temperature | 55 $^{o}$ C |
| Lamp's Output Ratio/ Efficiency | >= 90% |
| P.F of LED Street/Flood Lighting | >= 0.99 |
| Colour Temperature(CCT) | As per engineers / consultant approval |
| Surge Protection | Min surge protection 10kV |
| Colour Index(CRI) | As per consultant / engineer approval |
| Beam Angle | Vertical Axis:70º, Horizontal Axis: 140º |
| Lifespan | 50,000hrs life, 3yrs warranty minimum |
| IP Rating | IP66 |
| Illumination time | 8~10 hours per day, |
| | |

The Contractor shall provide following certificates with LED Light Fixture Sample for the approval from Consultant/Client.

- LM 80 certificate for Chips
- LM 79
- LM 82 -12
- ENEC Certificate @ 50 C



Following manufacturer declaration and submission should be provided with the Tender submission.

| S. No. | Parameters. | Technical Specifications. | Documents to be provided. |
|---|---|---|---|
| 1 | System Voltage | 220V to 240V 50 Hz | Laboratory Test Report |
| 2 | Power Factor | Not less than 0.90 | Laboratory Test Report |
| 3 | Surge Protection. | 11KV | Laboratory Test Report |
| 4 | LED Driver | Programmable for Dimming with<br>1-10V DC<br>DALI<br>On board standalone program | Manufacturer's Declaration |
| 5 | Lumen Maintenance | L70 at 50000hours or better | LM80 test report & TM21 Projection |
| 6 | Color Temperature | Neutral White ~ 4000K ±275K | Manufacturer's Declaration<br>LM 79 Test report |
| 7 | Color Rendering index | 70 + / - 10 | Manufacturer's Declaration<br>LM 79 Test report |
| 8 | Ambient Temperature | 50 Degrees Celsius | Manufacturer's Declaration with Thermal report |
| 9 | IP Rating | ≥ IP66 without glue | IEC 60596-1 Test report |
| 10 | IK Rating | ≥ IK08 | IEC 60598-1 or IEC 62262 Test report |
| 11 | Cover | Transparent & weather resistant grade polycarbonate optic cover | Manufacturer's Declaration<br>Material Datasheet<br>Material UL94 rating of V2 (Minimum). |
| 12 | Housing | High Pressure Die Cast Aluminum with heat management system | Manufacturer's Declaration |
| 13 | Maintenance | Tool less Driver Cavity opening Tool less Gear Tray Change | Manufacturer's Declaration |
| 14 | Tel. management Controls. | Integrated Antenna or communication equipment in to luminaire housing | Manufacturer's Declaration and Evidence to show capability. |



| S. No. | Parameters. | Technical Specifications. | Documents to be provided. |
|---|---|---|---|
| 15 | 3rd Party Test Report | Laboratory facility must be accredited according to ISO 17025 & recognized by ILAC /APLAC for testing of LED products. | IEC60598 Report (IEC 60598-2-3) EMC Test Report (EN55015,EN61547,61000-3-2) Photo biological Safety Test Report (IEC62471) EMF Test Report (IEC 62493) SPD Test (IEC 61643-1-2005 & IEC 61347-2-11) Factory Certificates (ISO 14001, ISO9001,OHSAS18001) Certificates for Test Laboratory (ISO 17025) |
| 16 | 3rd Party Driver Test Report | Laboratory facility must be accredited according to ISO 17025. | IEC 61347-1,-2-13 Test Report. IEC 62384 Test Report. |
| 17 | Additional Test Report | Manufacturer's Test Report or from accredited lab. | Salt Spray Test Report (Minimum 500Hours Natural Salt Spray) as per ISO 9227 & ISO 10289 Vibration Test Report. Road Lighting simulations based on given configurations. |

## SECTION – E – 07
## CABLE TRAY, LADDER AND TRUNKING

### 1. RELATED DOCUMENTS
Drawings and general provisions of the Contract, including General and Supplementary Conditions and Division 1 Specification Sections, apply to this Section.

### 2. SUBMITTALS
General: Submit the following according to the Division 1 Specification Sections.
Product data for each component. Show tray types, dimensions, and finishes.
Determine the sizes of the cable trays based on the number and size of cables laid on the cable trays plus 20% space for future growth. Cables laid on cable trays shall be spaced twice their overall diameter (consider the largest cable as reference). In case of discrepancy with the contract documents this clause shall prevail, unless approved by the Engineer otherwise.
Shop drawings detailing fabrication and installation of cable tray, including plans, elevations, sections, details of components, and attachments to other construction elements. Designate components and accessories, including clamps, brackets, hanger rods, splice plate's connectors, expansion joint assemblies, straight lengths, and fittings.
Co-ordination drawings, including floor plans and sections drawn to accurate scale. Show accurately scaled cable tray layout and relationships between components and adjacent structural and mechanical elements.

### 3. QUALITY ASSURANCE
Manufacturer Qualifications: Select a firm experienced in manufacturing cable trays which has a record of successful in-service performance.
Comply with the relevant standards of BS, NEMA and NEC.
Single-Source Responsibility: All cable tray components shall be the product of a single manufacturer. For

### 4. SEQUENCING AND SCHEDULING
Co-ordination: Co-ordinate layout and installation of cable tray with other installations.
Revise locations and elevations from those indicated as required to suit field conditions and as approved by the Engineer.

### 5. CABLE TRAYS
The cable tray system shall be of one manufacturer and shall include factory made trays, tray fittings, connections and necessary accessories and supports to form a complete tray support system.
The cable tray system shall include the following factory made tray elements. Straight trays and ladders, fittings and horizontal and vertical bends of various angle crosses, tees, wyes, reducers, vertical riser elements, connectors and all necessary fixing accessories.
Cable trays shall be constructed from mild steel of minimum thickness 16 gauge (1.5 mm). Trays in excess of 300 mm width shall be of minimum thickness 14 gauge (2.0mm).



Insert elements, bolts, screws, pins etc., shall be mild steel cadmium plated.

a. Tray work shall have oval perforations. Ladder type trays shall be used as required and/or approved by the Engineer.
b. All trays (straight and fittings) to be heavy duty returned flanged type unless specified otherwise.
c. Tray component are to be accurately rolled or formed to close tolerance and all edges rounded. Flanges are to have full round smooth edges.
d. Ladder racks of widths up to and including 300mm shall be constructed from rolled steel sections of minimum thickness 16 gauge (1.5 mm). Ladders in excess of 300 mm width shall be C Section construction with a minimum thickness of 14 gauge (2.0mm). The rungs shall be spaced at a maximum 300 mm.
e. Unless indicated otherwise on drawings, cable trays shall be used in the range 150 mm to 900 mm wide, in fire preferred standard sizes: 150, 300, 450, 600 and 900 mm.
f. Other sizes shall be used where specified or previously agreed with the Engineer.
g. Flanges shall be a minimum of 50 mm deep.
h. Minimum radius at side rails, horizontal and vertical tees and crosses shall be in accordance with the Manufacturer's standard.

Perforated, heavy duty, return flange type, in 2.5m nominal lengths Hot dip galvanized after completion of bending and drilling, complete with all necessary purpose made bends, tees, supports and the like. Width shall be such as to permit adequate access for installation and maintenance of cables and per the requirements of WAPDA regulations.

## 6. CABLE TRUNKING

Where required, wiring shall be run in hot-dipped galvanized (after fabrication) sheet steel cable trucking of the specified gauge complete with all fittings and accessories, manufactured and installed in accordance with BS 4678/NEMA. The trunking shall be constructed with return flanges. Trunking covers shall be secured by anchored turn-buttons and locking bars and minimum length of individual sections shall be 2.44-m. The trunking shall be suspended/supported from the structure at maximum 2-m intervals with straps and hangers fabricated from minimum 6-mm dia HDGF bars, or supported by angle-iron brackets.

Conduit drips from the trunking shall also be supported with hangers. Factory made connectors shall be used at joints.

Junctions (tee and 4-way) in multi-compartment trunking shall be double depth to avoid reduction in cabling space. Cable in vertical runs shall be supported by pin racks, prongs or bridging pieces. Fire barriers shall be provided at each floor level. Allowance for expansion shall be incorporated.

Bonding links shall be provided at each joint and secured by screws, nuts an shockproof washers. The bonding links shall make contact with the metal of the trunking of fitting, and continuity shall not depend on contact through the screws, nor on removal on site paint finish from ferrous metal.

## 7. EXAMINATION

Examine surfaces to receive cable tray, cable trunking and cable ladder for compliance with installation tolerances and other required conditions. Do not proceed with installation until unsatisfactory conditions have been corrected.

## 8. WIRING METHODS

Use cable tray of complete with manufacturer's recommended covers, barrier strips, dropouts, fittings, conduit adapters, hold-down devices, grommets, and blind ends.

## 9. INSTALLATION

a. Install cable tray, cable trunking and cable ladder level and plumb according to manufacturer's written instructions, rough-in drawings, the original design, and referenced standards.
b. Remove burrs and sharp edges of cable trays.
c. Make changes in direction and elevation using standard fittings.
d. Make cable tray connections using standard fittings.
e. Locate cable tray above piping except as required for tray accessibility and as otherwise indicated.
f. Fire stop penetrations through fire and smoke barriers, including walls, partitions, floors, and ceilings, after cables are installed.
g. Working Space: Install cable trays with sufficient space to permit access for installing cables.

## 10. GROUNDING

Connect cable trays, cable trunking and cable ladder to ground as instructed by manufacturer. Tighten connectors and terminals, including screws and bolts, according to equipment manufacturer's published torque-tightening values for equipment connectors.

## 11. CLEANING

Upon completion of installation of system, including fittings, inspect exposed finish. Remove burrs, dirt, and construction debris and repair damaged finishes, including chips, scratches, and abrasions.



## SECTION – E – 8
## EARTHING SYSTEM

### 1. GENERAL

The work covered under this section of the specifications consist of furnishing all labour, equipment, appliances and materials and in performing of all operations in connection with providing, installing, connecting, testing the earthing system complete in accordance with this section of specifications and drawings. The earth pits on the drawings are only indicative and these will be located as directed by the Engineer.

### 2. APPLICABLE STANDARDS AND CODES

- BS 951 - EARTHING CLAMPS
- BS 7430 - EARTHING
- BS 2874 - NUTS,BOLT,WASHER,SCREW & RIVETS FOR USE ON COPPER
- BS 1433 - HARD DRAWN BARE COPPER CONDUCTOR FOR EATHING.
- BS 6346 - PVC INSULATED CABLES.

The maximum values of resistance of equipment earthing systems to the body of earth shall be as follow**:**

- General Electrical Earthing 1'Ω
- Earthing For Static Discharge 1000'Ω
- Earthing For Lightning Protection 10'Ω
- Instrument Clean Earth 1'Ω

### 3. EARTHING ACCESSORIES

The Earthing system shall be consist of Earth electrodes, Earthing leads, Earth connecting point, Earth continuity conductor and all accessories necessary for the satisfactory operation of the associated electrical system.

#### a. Earthing by Earth Copper Plate

The earth electrode Copper plate shall consist of 600mm x 600mm x 3mm thick 99.9% high conductivity electrolytic tinned copper plate. The plate shall have four terminals for connecting the earthing leads as shown on the drawings.

#### b. Earthing by Earth Copper Rods

The earth copper rod shall be installed for lighting poles as indicated in drawings. The copper rods shall be of 3m length and 20mm dia with high conductivity electrolytic copper. This shall be driven into the ground to the full length as shown in drawing.

#### c. Earthing Lead

The earthing lead shall connect the earth electrode to earth connecting point or equipment. It shall be round hard drawn bare electrolytic copper of size shown on the drawings. The cost of earthing leads deemed to have been included in the price of earth electrode & no separate pavement shall be made for it.

**d. Earth Continuity Conductor**

Earth continuity conductor (E.C.C) shall be hard drawn bare copper wire or single core PVC insulated copper conductor cable of sizes indicated on the drawings or BOQ. All thimbles, lugs, sockets, nuts, washers and other accessories necessary for the complete installation of ECC shall be provided by the Contractor without any extra cost. PVC insulated cables when used as E.C.C. shall be green or green yellow.

**e. Earth Connecting Points**

When copper plates or copper rods are used as earth electrodes, the earthing leads from the plate or rod shall terminate at the earth connecting points which shall be of tinned copper bar, rectangular in shape, having dimensional 500mm x 50mm x 10mm, installed in the wall of the inspection chamber at the ground level. Further connections to respective locations shall be made from this bar by earth conductors of various sizes as shown on the drawings.

**f. Inspection Chamber**

At the ground level an inspection chamber shall be provided size shown on the drawing. The inspection chamber shall have 50mm x 50mm angle iron frame at the top to accommodate an approved quality heavy duty cast iron or concrete cover with handle. The cover shall have "EARTH BELOW" inscribed on its top. The Contractor shall provide and install the cover flush with the ground level.

## 4. EARTH INSTALLATION

Complete earthing systems as shown on the drawing shall be installed by the Contractor. The earthing system shall give earth resistance, including resistance of soil, earth leads and E.C.C. equal to less than one ohm, this without ground pits water spraying.

The earthing system shall be loop connected with earthing cables at least 300 mm away from telephone cables. The concept of the main loops and the way they are connected shall be such that equipment / apparatus can be easily removed without requiring a complex disconnection operation nor risking interruption of / or damage to the loop itself. The fastening of the earthing conductors shall be made on a sufficient length so as to prevent crushing or cross section weakening. The parts on which they are connected shall be conveniently cleansed and surface.

Leads sheaths or steel tape armours are not permitted as grounding conductors. The earthing system shall be installed to ensure that when any part of the earthing system is disconnected for the purpose of carrying out periodic testing an alternative path to earth is available.

At all connections of earth continuity conductor to MV/LV Switchboard, LV Distribution Board or any other metallic body, proper size or brass sockets, thimbles or lugs shall be used to which the copper wire shall be connected by copper brazing. The soldering of copper wire at joints or termination shall not be allowed. All tee-off connections shall be by copper brazing using suitable socket and clamps. After brazing, the jointed surface shall be protected by oxide inhibiting compound of low electrical resistance. For connections to metallic body, the surface shall be thoroughly cleaned before bolting the lug or socket. The earth continuity conductor shall be in general run in cable trench or in conduits / pipes as shown on the drawings.Where laid along underground cables these shall be laid directly under ground in unpaved areas and in pipes under paved areas.

The earth connecting point shall be installed at locations shown on the drawings. It shall be fixed on wall surface by means of brass screws with nuts,



washers and other insulating material as instructed by the Engineer.
The earth continuity conductor of sizes shown on the drawing shall be installed all along the cable runs and connected to the earthing bar / terminals provided in the equipment. The body of all Switchboards shall be connected to earth by specified size of E.C.C. All metal work shall also be connected to earth by specified size of E.C.C.
At any joint or termination, the E.C.C. shall be connected using proper accessories. No connection shall be made by twisting of earth conductors.

- **Installation of Earth Electrode (Copper Plate)**

The installation of earth electrode (copper plate), a pit of appropriate diameter and up to the depth of 4 m or (as directed at site) shall be first excavated in the bare ground. The earth electrode shall be installed upright in the pit and shall be surrounded by **mixture of lime and charcoal** around the electrode as shown on the drawings and packed hard. From the plate earthing leads of 2x70mm² bare Cu. Conductor shall be taken to the bus bar in the inspection chamber through 50mm G.I pipe for watering purpose.

- **Installation of Earth Electrode (Copper Rod)**

The earthing system by copper rod shall consist of 20mm dia and 3 meter long copper rods. These shall be of 99.9% purity copper. These shall have screw able head to accommodate other rods in series with the help of dowel as is shown in the drawings. The driven head shall consist of a hardened tip. These rods shall be connected to the earthing lead whose other end shall be connected to the earth connecting points to be provided in the inspection chamber. From the earth connecting point's earth connection shall be made to individual point as marked in drawing.

- **Installation of Earth Electrode where the condition not suitable for Earthing**

Where the rock lie just below the surface or water table are very deep then earth electrode shall be installed through drilling or digging method. Due to certain ground conditions make it difficult to obtain a reliable earth resistance, whilst particular installations may require a very low resistance. In such cases, **Marconite concrete** shall be used as backfill for a conventional earth rod achieve a lower earth electrode resistance.

## 5. Equipment Grounding

**a.** Non-current carrying metal parts:

Bond and ground non-current carrying metal parts of electrical apparatus and equipment provided under work of any section of specifications.

**b.** Grounding of Fence:

All metallic fences shall be grounded by driving earth rods at a distance of 50 meter.

## 6. Inspection and Test

Earth resistance test shall be made by the Contractor on the complete earthing system in the presence of the Engineer. The test result shall conform to BS 7430 (formerly CP 1013) and BS 6651 (Formerly CP 326). To obtain the desired result more earth rods shall be provided.

## SECTION – E – 9
## TRANSFORMER

### 1. GENERAL

The work covered under this section of the specifications consist of furnishing all labour, equipment, appliances and materials and in performing of all operations in connection with providing, installing, connecting, testing the Step down transformer for medium voltage to low voltage.

1- Primary Voltage = 11000 volt
2- Secondary Voltage = 420 volt
3- Tap changer = 6 Position
4- Impedance = 6 percent
5- Winding = Copper
6- Oil = Mineral Oil
7- Standard = **IEC 60076**



## SECTION – E – 10
## LIGHTING POLE

### 1. 1GENERAL

The work covered under this section of the specifications consist of furnishing all labour, equipment, appliances and materials and in performing of all operations in connection with providing, installing, connecting, testing the Street light poles in accordance Hot dip galvanized with 100 microns weather proof. These will be located as directed by the Engineer.

| | |
|---|---|
| Material: | steel, Q235,Q345,S235,S355,SS400 |
| Yield strength of Material: | Minimum yield strength>=235n/mm2 for Q235, S235 and SS400<br>Minimum yield strength>=345n/mm2 for Q345 S355 and Gr 50 |
| Pole height: | 8m |
| Length of one part | without joint |
| Wall thickness: | 4mm |
| Pole's Shape Can be made: | Polygonal, Round, Taper Octagonal, Taper round, Round conical, Taper Square, Square. |
| Arm type can be made: | Single arm, Double arm, Tri-arm, Four-arm |
| Arm Diameter: | Diameter as 42mm, 48mm, 60mm, 76mm and etc, can fit to any diameter's lamps. |
| | |
| Welding | Advanced CNC welding equipment. flaw testing, internal and external double welding makes the welding beautiful in shape. The international welding standards are applied. |
| Galvanization: | Hot dip galvanization with thickness of 80-100μm average in accordance with Turkish TSE standards or European standards. |
| Manufactury Capacity Per Day: | 250 |
| Wall thickness Tolerance: | +- 0.1mm from 2.3mm to 4mm. +- 0.2mm from 5mm to 20mm. +- 0.5mm from 22mm to 30mm |
| Painting color: | (RAL)Color card or Refer to client's requirement |
| Surface treatment 1: | Rough pole |
| Surface treatment 2: | Hot dip Galvanizing antirust. |
| Surface treatment 3: | Hot dip galvanizing with powder coating |
| Temperature range | -35 °C~+65 °C |
| Wind Speed: | Aganist wind pressure of 120Km/h to 180Km/h, or according to client design. |
| Base plate mounted | Base plate is square, octagonal or round in shape with slotted holes for anchor bolt and dimension as per customer's requirement. |
| Ground mounted: | The length buried underground as per customer's requirement. |
| Quality Control | According to ISO9001-2020 requirements. |
| Certificates | ISO9001-2020, Audited Supplier |
| Other | Less land occupation & easy maintenance. |



## SECTION – E – 11
## LIST OF APPROVED MANUFACTURERS/SOURCES OF ELECTRICALEQUIPMENT

* All Equipment shall be procured from Principal Authorized agent distributors/resellers

The Bidder shall fill the name of only one manufacturer for each equipment/material on which the tender is based. He shall be bound to supply the equipment from the same manufacturer. In case, the Bidder gives names of more than one manufacturer against any equipment, the Engineer / Owner can ask the Bidder supply the equipment from any one of them.
At the evaluation stage if it is noted that any material offered by the bidder does not meet the specification requirements, the Engineer / Owner reserves the right to ask the bidder to replace his choice of equipment supplier meeting the required quality and specification requirement.

During the execution stage if the material from any supplier is found defective / substandard the Engineer / Owner reserves the right to ask the successful bidder to replace his choice of manufacturer / supplier for that particular equipment.

Any change in manufacturer / supplier shall only be entertained if there is sufficient reason that adhering to the original choice of manufacturer / supplier shall be detrimental to either the project quality or project timeline. Proper approval shall have to be sought for change in the choice manufacturer / supplier at least 1 month before the equipment is to be procured.

**Bidder is required to mark the proposed Manufacturer / supplier and country of origin for each item below.**

| S.No | Equipment | Manufacturer | Country of Origin | ✓ |
|---|---|---|---|---|
| 1. | MV Cables | Pakistan Cables | Pakistan | |
| | | Newage Cables | Pakistan | |
| | | Fast Cables | Pakistan | |
| 2. | MV Cables Accessories (Jointing & Termination Kits) | 3M | USA | |
| | | Raychem | USA | |
| 3. | HT – CT / PT | Revalco | Italy | |
| | | Schneider Electric | France | |
| | | ABB | Italy | |
| | | Siemens | Germany | |
| 4. | LV Switchgear, PFI Panels | Pak Elektron Limited (PEL) | Pakistan | |
| | | Premier Engineering | Pakistan | |
| | | Schneider Electric | Pakistan | |
| | | ABB | Pakistan | |
| | | Siemens | Pakistan | |
| 5. | Power Factor Plant, Capacitor, Relay, controller | Nokian | Finland | |
| | | Schneider | France | |
| | | Circutor | Italy | |
| | | Technologic | Italy | |
| 6. | LV Circuit Breakers | Schneider Electric | France | |
| | | Terasaki | Japan | |
| | | Siemens | Germany | |

| S.No | Equipment | Manufacturer | Country of Origin | ✓ |
|---|---|---|---|---|
| | | ABB | Italy | |
| 7. | C.T, Relays & instruments | Schneider Electric. | France | |
| | | Siemens | Germany | |
| | | Revalco | Italy | |
| | | ABB | Italy | |
| 8. | LV Cables and Wires/ Earthing Cable | Pakistan Cables | Pakistan | |
| | | Universal Cables | Pakistan | |
| | | Newage Cables | Pakistan | |
| | | Fast Cables | Pakistan | |
| 9. | Load Break Switches, Isolator, Change Over Switches | Gewiss | Italy | |
| | | Clipsal | Australia | |
| | | Legrand | Italy | |
| | | Kraus & Naimer | New Zealand | |
| 10 | uPVC Conduits / Pipes and Accessories | Civic | Pakistan | |
| | | Dadex | Pakistan | |
| | | Jeddah Polymer | Pakistan | |
| | | Beta | Pakistan | |
| | | Galco | Pakistan | |
| 11 | Back Box / Pull Boxes / Junction Boxes | Hussain & Co. | Pakistan | |
| | | Hensel | Germany | |
| | | Jeddah Polymer | Pakistan | |
| | | Premier Engineering | Pakistan | |
| 12 | Switch & Socket Outlets / Floor Boxes | Clipsal (Schneider Electric) | Australia | |
| | | MK Electric | UK | |
| | | ABB | Italy | |
| 13 | Cable Glands, Lugs, Terminals and Accessories | Cembre | UK | |
| | | Hubbell / Hawke | UK | |
| | | Hensel | Germany | |
| 14 | Cable Tray / Trunking | Premier Engineering | Pakistan | |
| | | Ezzi Engineering | Pakistan | |
| | | GIS | Pakistan | |
| | | M-Tech | Pakistan | |
| 15 | Contactors | Telemechanique | France | |
| | | National | Japan | |
| | | ABB | Italy | |
| 16 | Fans and Accessories | Pak Fan | Pakistan | |
| | | GFC Fan | Pakistan | |
| | | Millat Fan | Pakistan | |
| | | Royal Fan | Pakistan | |



| S.No | Equipment | Manufacturer | Country of Origin | ✓ |
|---|---|---|---|---|
| 17 | Light Fixture | Philips / Signify | Netherlands | |
| | | Osram | Germany | |
| | | GE | USA | |
| | | Thorn | UK | |
| 18 | Lightning Protection & Earthing | Erico | UK/USA | |
| | | Furse | UK | |
| | | Dehn | Germany | |
| | | Indelec | France | |
| | | Ingesco | Spain | |
| 19 | Lighting Pole | Jamal Pipes | Pakistan | |
| | | Ferhan Mech. Works | Pakistan | |
| | | Mitas | Turkey | |
| | | Al-Babtain | Saudi Arabia | |
| 20 | Transformer | PEL | Pakistan | |
| | | Transfo-Power | Pakistan | |
| | | Siemens | Germany | |
| | | Mitsubishi Electric | Japan | |



# KE ELECTRIFICATION WORKS

## TECHNICAL SPECIFICATIONS



# SPECIFICATIONS AND GUIDELINES FOR 11 KV SUBSTATIONS CONSTRUCTION

**Planning and Engineering (P&E)**

Technical Process Re-Engineering (TPRE) |
Distribution Network Academy (DNA)

## ISSUE & CHANGE HISTORY

| Sr. No. | Rev. # | Issue Date | Author | Amendment Details / Remarks |
|---|---|---|---|---|
| 1 | 04 | 02-03-2020 | Refer to Prepared by Section Below | - |
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## ISSUE AUTHORITY

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## REVIEW PERIOD

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## 1 PURPOSE:

The specifications and Guidelines are developed for the standardization of New 11 kv Substations across KE Distribution network

## 2 SCOPE:

This SOP shall be applicable to entire BU Distribution.

For Substations in coastal areas (within 2 km of seashore) in addition to this Specifications, the specs for Coastal Substation **"KDTP-S421-19-00-COASTAL SUBSTATION"** shall also to be followed.

If the location of the proposed substation is in Basement or First floor, **KE SOP "KDTP-P634-19-00**" to be followed for construction of substations as it has special requirements regarding Basement and first floor.

## 3 OBJECTIVE:

Following are the intended objectives to be achieved:

- To standardize the construction of new 11 kv substations
- To serve as a quality assurance and control reference document.

## 4 ABBREVIATIONS:

| | |
|---|---|
| **CM** | Corrective Maintenance |
| **DGM** | Deputy General Manager |
| **DM** | Deputy Manager |
| **GM** | General Manager |
| **HSEQ** | Health Safety Environment & Quality |
| **IBC** | Integrated Business Centre |
| **KDTP** | KE Distribution Technical Process Re-Engineering |
| **LT** | Low Tension |
| **PPE** | Personal Protective Equipment |
| **PM** | Preventive Maintenance |
| **PMT** | Pole Mounted Transformer |
| **RMU** | Ring Main Unit |
| **SD** | Shutdown |
| **SE** | Shift Engineer |
| **SI** | Shift In charge |
| **SOP** | Standard Operating Procedure |
| **SPE** | Special Protective Equipment |



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| | |
|---|---|
| **SS** | Sub-Station |
| **TBT** | Toolbox Talk |
| **TPRE** | Technical Process Re-engineering |

# 5 RESPONSIBILITIES:

The roles and responsibilities have been defined against respective tasks / activities as covered in the procedure section.

# 6 Substation design

## 6.1 Substation types

Various types of Substations layouts are used within KE as per the requirement of the system. Following is the details of overall size:

| Type of Substation | No of rooms | Size of Substations |
|---|---|---|
| **HT Bulk Supply** | **1 Room** | **15 ft x 15 ft** |
| **Distribution Substation with Transformer** | **2 Room** | **30 ft x 20 ft** |

### 6.1.1 Single Room Sub-Station (HT Switch Room):

6.1.1.1 These types of single room substation shall be constructed for the applicants requiring 11 KV bulk supply or for switching purpose of 11 KV feeders / network.

6.1.1.2 A typical Single room substation shall consist of maximum 04 Nos. of HT Switches. Size of the substation shall be 15’ x 15’ (225 Sq ft) with min clear height of 12 ft , with placement/orientation of equipment and trenches as per enclosed Drawing.

6.1.1.3 **Additional panels in HT Switch Room**

6.1.1.3.1 If the required switches are more than 4, then the proposed HT room size should be increased accordingly (additional 2’-2” for every switch), maintaining the necessary clearances as per the drawing.

### 6.1.2 Two Rooms Sub-Station (HT Switch and Transformer Rooms):

6.1.2.1 These types of substation shall be constructed for the applicants applying for load requiring Transformer **rated up to 1000 kVA** & will be constructed in the premises of applicant.

6.1.2.2 It shall consist of 2 separate rooms with separate gates, one with the transformer placed along with LT panel and the other room containing HT switches.

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6.1.2.3 In case, the number of transformer increases, then the applicant shall provide / construct additional room for transformer equal to the size of transformer room specified in the Drawing. The additional room shall have a separate gate for Entry/Exit. (see attached drawing in Annexure).

6.1.2.4 In case additional HT switches are required as per 11KV network necessities the additional space equivalent to the size of HT switch i.e. 2'-2" must be considered for each type of substation, maintaining the necessary clearances as per the drawing.

## 6.2 Substation Structure

**6.2.1 Raised design (Hollow type)**

6.2.1.1 The substation shall have a raised floor, casted as a slab with hollow space below for cable management etc. (Refer drawing)

6.2.1.2 Separate entry to be provided for the lower level with MS gate and anti-theft lock as per the details mentioned in the drawing.

6.2.1.3 Any decision to change the structure type of the substation, to be jointly taken by Substation Technical committee ( TPRE/Operation/NC etc).

## 6.3 Check Meter Installation

**6.3.1** Check Meter for monitoring losses of local transformer shall be provided in LT panel. (polymer type).

## 6.4 Material / Equipment's:

**6.4.1** All equipment's as HT Switches / Transformer / LT panels / HT and LT cables and hardware material used in substation shall be confirming to relevant (Latest) KE Standard Specifications.

**6.4.2** Proper tagging on HT- switches, as well as route and destination of in-comings, out-goings & local transformer cables plus LT circuit destination should be clearly mentioned.

## 6.5 Ventilation requirement

**6.5.1** Proper ventilation shall be provided in trafo room to dissipate heat from the electrical Equipment.

**6.5.2** Only **CC type ventilators** to be installed, with maximum width of 1 ft. (refer Picture ). No metallic ventilators to be used as these are prone to corrosion and can be a reason of theft.

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**6.5.3** The openings (slits) of the CC ventilators shall not be more than 1 inch in width.

**6.5.4** All the ventilators to be placed on the top portion of walls as per the drawing.

**6.5.5** Minimum Natural air ventilation to be provided as per below criteria as per NFPA-70 NEC Article 450, shall be atleast 3 inch sq per kVa of transformer rating. E.g 1000 kVa to have at least 3000 inch sq (approx. 21 sq ft) ventilation in trafo room.

**6.5.6** Natural airflow directly from outside of the building is preferred, position of ventilator should be such as to provide cross ventilation.

# 7 Substations Construction

## 7.1 Site selection for Substation Construction:

**7.1.1** Applicant shall provide the undertaking / legal document as per attached format for ownership of Sub-Station. (Annexure - A ).

**7.1.2** Following points to be considered for selecting the site/location of the substation.

7.1.2.1 Access to the substation shall be clear and easy to avoid any hindrance while maintenance/ operation. The access should be from the main road with no lockable gate up to the substation. If access from the front road is not possible, then it may be on the side road at **least 18 ft wide** for easy movement of crane/loader.

7.1.2.2 The main gate of the substation shall be accessible from Open area for the crane movement.

7.1.2.3 There shall be provision of free movement of cranes, loader or lifter for handling of the heavy equipment's placed inside the substation

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7.1.2.4 The sub-station area should be free from the risk of sewerage/rain/flood and storm water damages.

7.1.2.5 The personnel access to Sub-station for authorized field staff must be safe.

7.1.2.6 The services such as drains, sewers, HVAC Ducts, piping or wiring are not permitted to pass through the sub-station area (Minimum clearance to be maintained 3 ft)

7.1.2.7 For HT/LT cables, the entry and exit of the cables into the trench/lower level must be from the front side of the substation and as per enclosed drawings.

## 7.2 Substation Drawing / Layout

**7.2.1** The Applicant shall be given an Approved Schematic layout as well as detailed structural drawings of the substation prior to start of construction works. NC department will be responsible for the issuance of all the drawings. The Schematic layout shall be vetted from the Concerned User/Cluster before the issuance. This Schematic layout shall be prepared by NC showing the placement of the different equipment and trench position. Schematic layout shall be signed off by GM of both NC and User/Cluster.

**7.2.2** Detailed drawings of substation are attached in Annexure-B of this document.

**7.2.3** The Schematic layout shall contain all the necessary information regarding the size/orientation and equipment placement, including but not limited to the following.

7.2.3.1 Exact size of the substation along with clear height and height from road level.

7.2.3.2 Equipment placement

7.2.3.3 Location and dimensions of trenches (if present).

7.2.3.4 Cable entry and exit points (Sealing arrangements)

7.2.3.5 Gates location

7.2.3.6 Position and size of Ventilators

7.2.3.7 Fire extinguisher placement

7.2.3.8 Lighting arrangements etc

## 7.3 Construction Activity

**7.3.1** The applicant shall start the construction works after the approved Drawing is issued to them by KE.

**7.3.2** The applicant is required to notify the KE on different stages of the construction of Substation. The KE team will visit and check the Construction as per the Checklists (attached in Annexure-C), after the go ahead the applicant may continue the construction till the next inspection stage.

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## 7.4 Construction requirements

**7.4.1** Substation to be constructed by the applicant following all the construction requirements defined in this document. All the construction work to be done as per the structural and dimensional drawings issued.

**7.4.2** Materials to be used for the substation construction should be of the best quality available.

**7.4.3** Excavation to be done as per the footing size.

**7.4.4** Stone soling to be provided and compacted properly, min thickness to be provided 6", It is recommended to use 3 inch and 4 inch down stones for 6 inches and 8 inches thickness of stone soling respectively. The stones should be laid in two layers and proper compaction should be done.

**7.4.5** Lean concrete with ratio 1:4:8 to be done as per the drawing, thickness to be maintained 4"

**7.4.6** Proper concrete spacers to be used for maintaining concrete cover as per the ACI. The compressive strength of the spacers shall be same or greater than the concrete.

**7.4.7** Concrete to be used for all structural members shall be of minimum strength of 3000 psi.

**7.4.8** Steel reinforcement shall have minimum tensile strength of 60 ksi

**7.4.9** Proper curing to be done for all structural concrete members as per the required curing times.

**7.4.10** RCC slab to be provided as per the structural drawing with enough strength to bear the weight and the normal wear and tear during placement and shifting of equipment.

**7.4.11** All the concrete up to Plinth level to be done using Modified OPC cement to prevent the risk of sulfate and chloride attack, modified OPC to be used as per the following criteria:

*C3A should be more than 5% and should be less than 8%.*
*C4AF + 2C3A should be less than 25%.*
*AL2O3 should be less than or equal to 6%.*

Ordinary Portland Cement (OPC) meeting the above chemical composition can be used in lieu of modified cement and above plinth level OPC should be used.

**7.4.12** The plinth level of substation shall be atleast 5.5 feet above the road level/Ground level.

**7.4.13** Internal walls plaster to be ½'' and the external walls plaster to be ¾" thick.

**7.4.14** PCC SITU wall to be provided below the plinth beam, with ratio of 1:3:6. As per the details shown in the drawing



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**7.4.15** Machine made blocks of best quality to be used for construction, with the compressive strength of minimum 1000 psi. Blocks shall be non load bearing type, and shall conform to **ASTM C129.**

**7.4.16** Block masonry to be at least 6 inches thick for walls construction.

**7.4.17** Slope to be given in the RCC roof slab as per the drawing, for avoiding rain water ingress inside structure.

**7.4.18** Slab projection to be provided on all four sides, of at least 2 ft.

**7.4.19** Drip course shall be provided all over the projection (Chajja).

**7.4.20** Floor openings for cables, to be provided as per the approved drawing handed over by NC department. Details regarding the construction of the openings in floor, to be followed as per the structural drawing and the typical section provided.

**7.4.21** The floor of the substation shall be perfectly levelled, and cured before handing over.

**7.4.22** The ceiling shall be of RCC Cement Concrete construction as per the drawing.

**7.4.23** The finish of internal wall and ceiling must be clean, smooth and must be painted.

**7.4.24** The sub-station floor, including openings conduits etc. is to be formed in accordance with the position and details shown on KE drawing/specifications

**7.4.25** The floor must have a level steel troweled finish.

**7.4.26** The sub-station shall be constructed using approved water proofing materials. All sub-structure to be applied with waterproofing to avoid contact with sub soil water. Example are any bituminous waterproofing membranes etc.

**7.4.27** To protect the Sub-Station equipment, expose to dampness / water throughout its life requires proper site drainage and water proofing

**7.4.28** Sub-station requires special attention to ventilation in order to dissipate heat from electrical equipment, wherever possible natural air flow to the outside of the building will be used.

**7.4.29** Forced ventilation should be used where natural ventilation is not practicable. Forced ventilation by mean of industrial fan (s) with timer switch must be designed, supplied and installed by the owner as per KE's requirements (The power supply to meter shall be on account of KE) The air flow through the ventilation will be checked by KE before the final approval.

**7.4.30** The position of the vent must be directly to outside air, if this is not achievable then forced ventilation is required



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**7.4.31** A buried earthing/ grounding system is necessary for sub-station and installed equipment, the earthing system shall be provided as per KE's design/specification

**7.4.32** Opening in floor will be made as per the Equipment placement. With a drop beam below for extra clamps for HT cable.

**7.4.33** The owner will supply and install the light & power distribution board and the necessary light fittings and power outlets in the sub-station including all wiring. KE will connect the distribution board to the supply point on the low voltage board.

**7.4.34 Requirements for Anti-Theft type door**

7.4.34.1 The doors for the substation will be Antitheft type door, louvers should be provided as enclosed Drawing # K-TPRE-SS-05.

7.4.34.2 The door to be painted with EPOXY paint, with a minimum thickness of 240 Microns, including epoxy primer.

7.4.34.3 Steel surface of the door to be cleaned by sandblasting and cleaned before applying Primer.

7.4.34.4 Gate delivered at site shall be painted at least with a coat of primer. (unpainted/bare steel gate not allowed at site).

7.4.34.5 Small gate of same specifications to be fixed at lower level of the substation , and to be fixed with Antitheft type lock. Size of the gate to be 5'x3'.

## 7.5 Earthing Requirement

**7.5.1** Earthing shall be done as per **KE Standard SOP # KDTP-P619-19-02** (Earthing for HT/LT Equipment and Poles) for Grounding (Latest Applicable).

**7.5.2** After completion of civil works & installation of equipment's, the substation shall be handed over to KE. (Agreement / Undertaking / Deed for Handing/ Taking over of Sub-Station)

## 7.6 Provision of Fire Extinguisher

**7.6.1** For each room of Sub Station 2 units of the fire extinguisher shall be provided/ installed by the applicant as per below specification. This unit shall be used only for minor fire especially during and switching & preventive maintenance, and to be mounted on celling with Hooks.



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| | | |
|---|---|---|
| 7.6.1.1 | Capacity: | 6 kg |
| 7.6.1.2 | Make: | Imported |
| 7.6.1.3 | Extinguishing Agent: | ABC Dry Chemical Powder |
| 7.6.1.4 | Propellent: | Nitrogen |
| 7.6.1.5 | Area of Coverage: | Approx 130 sq feet |
| 7.6.1.6 | Duration of discharge: | 14-16 seconds |
| 7.6.1.7 | Installation: | Ceiling mounted above fire risk |
| 7.6.1.8 | Operating Mechanism; | Automatic Sprinkler Head |
| 7.6.1.9 | Operating Temperature: | 68 C |
| 7.6.1.10 | Shelf life: | 6 years |




## 7.7 Marking

**7.7.1** The following permanent marking to be provided:

7.7.1.1 SLD (laminated) to be displayed in HT room.

7.7.1.2 Name with Logo & code/ID in front /elevation side of Substation

7.7.1.3 11KV/.4KV & Danger sign on HT/LT Room of Substation

7.7.1.4 Year of Construction of Substation to be written inside the substation.

7.7.1.5 Destination of HT/LT incoming & outgoing cables should be marked/ paint on HT/LT panel.

7.7.1.6 Marking to be done on HT Switches using stencil.

7.7.1.7 Emergency Contact Numbers to be displayed outside the substation

7.7.1.8 Danger Signs to be pasted outside the substation.

# 8 Documentations (Agreement /Undertaking):

## 8.1 Documentation requirement:

**8.1.1** The agreement/ Undertaking shall draft as per Annexure "A" (appended below) on Rs. 1000 Stamp Paper and will be duly signed & stamped by concerned GM (NC) & 2nd Party (Applicant).

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**8.1.2** The Original Stamp paper (duly filled & stamped as per above) will be forwarded to KE Share department to kept in safe custody and two set of copies shall be forwarded to concerned GM Operation & GM (NC) KE for their record. A copy may also be provided to applicant, if required.

**8.1.3** The other required documentations or formalities other than agreement/undertaking shall be fulfill/done as per existing NC practice/policy.

# 9 Appendix

Annexure-A (Agreement/Undertaking)
Annexure-B (Drawings)
Annexure-C (Checklists)



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**Annexure-A**

**(Agreement/Undertaking)**

## This Handing/Taking Over Agreement ("Agreement") of Land along with Sub-Station Situated at Plot No……..is made on this day of , 2020.

**"K-ELECTRIC LIMITED",** being a public company duly incorporated and existing under the Companies Ordinance, 1984 and having its registered office at KE House, 39-B, Sunset Boulevard, Phase-II, Defense Housing Authority, Karachi, Pakistan (hereinafter referred to as **"KE",** which expression shall, wherever the context so permits, mean and include its successors-in-interest and assigns) of the ONE PART;

**AND**

Mr./Ms …… or M/s ……..through its authorized officer Mr./Ms …… resident of at……Karachi and running his/her/their/its business in the name and style of ……. , having its registered office at ……..Karachi hereinafter referred to as ***("Applicant")*** which expression shall whenever the context so permits, means and include his/her legal heirs, executors, legal representatives, successors-in- interest and assigns of the other part;
(KE and the Applicant are hereinafter individually referred to as a "Party" and collectively as the "Parties");

**RECITALS:**

WHEREAS KE is a privately managed and controlled vertically integrated utility company which generates, transmits and distributes electricity in Karachi and its adjoining areas in Sindh and Balochistan and has an exclusive Distribution License granted by NEPRA for the said service territory clearly delineated in its Distribution License.
WHEREAS the Applicant is desirous of obtaining supply of energy at its premises/Society/Multi-Storied Building/ Housing Scheme/Factory/Project and has further agreed to pay KE for the installation, erection and laying of electricity supply lines underground cable on Full Paid basis Scheme of KE within the area of the project, housing scheme, factory and/or premises etc to self or its member(s)/successor(s)/consumer(s), by providing the place/land along with the Sub- Station (space & completed substation structure/construction/civil works), where size and location should be as per KE standards and part of duly approved site plan from the competent authority hereinafter referred as *Substation*.



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**NOW THEREFORE, THIS AGREEMENT WITNESSETH AND IT IS HEREBY MUTUALLY AGREED BY AND BETWEEN THE PARTIES AS UNDER:**

1. That Applicant under this Agreement is providing suitable place/land along with freshly constructed Single/Double Room Sub-Station on perpetual basis for 11 KV bulk supply or for switching purpose of 11 KV feeders/network within the project/scheme/premises as per requirements of KE & the Applicant shall ensure the same is Approved by the competent authority and reflected in the Site plan indicating the actual size and location of the Substation, within a period of sixty (60) days from the date of execution of this Agreement and shall provide a certified copy of the approved site plan to KE.

2. That the Applicant shall ensure that provided place/land along with freshly constructed Substation is as per type "A" or type "B" in line with the Agreement with KE for providing Electric Connection on Full Paid basis.

Further, it is duly acknowledged here that the Applicant has duly handed over the possession of space/land along with the Sub-Station consisting upon one/two rooms and size of area is/are …… feet for ……..( ) KW to ……..( ) KW through this Agreement to KE as per the terms and conditions of this Agreement.

3. In case, the load of the Applicant increases from…… ( 800 ) KW, than the Applicant shall provide/construct an additional room for transformer equal to the above specified size of transformer room within a period of thirty (30) days form the date of such demand being raised by KE and same principals to apply as enumerated in Clause 1 & 2 above.

4. That KE has duly taken over the possession of the provided Sub-Station being responsible for its operations on the following conditions:

i) Applicant undertakes that it is the rightful owner of the land/property on which the Substation is constructed which for all purposes is in line with the existing New Connection Policy of KE.

ii) Substation has been constructed as per KE specification / drawing by the Applicant at its own cost, according to KE's New Connection prevailing policy.

Iii) The Substation is situated on main road (main road facing) in such a way that there is no ramp, underground/overhead water tanks and pillars etc. in the way of Substation with provision of free movement of inter alia cranes & lifter for handling of the heavy equipment/materials placed inside the Substation and KE personnel/representatives will have easy access to substation.



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iv. The Substation is free from the risk of sewerage / rain / flood and storm water damages. The drain provided is in working order and shall always be kept by the Applicant in working order.

v. Applicant shall protect the Substation from equipment being exposed to inter alia dampness / water / fire throughout its life vide proper site drainage water proofing. However, in case of any damage to the Substation the repair shall be done by KE on the Applicant's cost.

vi. The substation is fully equipped with all infrastructures as per requirement of KE under the existing New Connection policy & Eligibility Criteria, 2003 prescribed by the NEPRA.

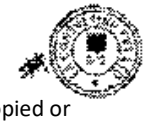
vii. That in future if the Substation is required to be used as Common Distribution System (CDS) then after its conversion from SDS KE will carry out operations & maintenance along with replacement of any parts at its own cost.

viii. That this Agreement shall be deemed as consent by the Applicant for the usage of the Substation by KE on perpetual basis under Section 12(2) of the Electricity Act, 1910 for all purposes and intents.

ix. At any time before or after the handing/taking over of the Substation, if any deviation is found pertaining to the construction of the Substation or if the Substation is not in conformance with the KE requirement and policies, then the Applicant shall make necessary alteration at its own cost including any reconstruction (wholly or partially) of the Substation according to proposed drawing and sketch vide reference No……dt…… as per prevailing policy of New Connection.

5. In case the Substation is at any time converted into CDS in the sole discretion of KE, then the Applicant shall not be entitled to claim possession of said Land/Substation and the handing over of the physical possession of the said Land/Substation shall be treated as irrevocable under this Agreement and transfer of title of the Substation to KE shall become mandatory on the Applicant. The Applicant shall also take all steps necessary to legally and formally transfer ownership of the Substation to KE for a full and final consideration of Pak Rupees One Hundred (PKR 100) vide a separate legally binding instrument within a period of thirty (30) days from the date of conversion to CDS.

6. That in case of shifting of Substation due to reason, the Applicant shall provide new space as per the terms and conditions agreed under this Agreement within the same area/surrounding of premises/Society/Multi-Storied Building/ Housing Scheme/Factory/Project and shall also bear the whole cost/expenses as per prevailing policy of New Connection.



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7. That in case of any modification, alteration, addition and renovation at the Substation, then there would be no need to revise this Agreement and the same shall be done by the Applicant when required by KE in writing. If the Applicant with or without any written intimation to KE has sold the property/premises on which the Substation is built and operating then the terms and conditions of this Agreement shall automatically become lawfully binding on the new owner without requiring to change this Agreement or enter into any new agreement.

8. Any increase or decrease of load shall be subject to KE policies, the Agreement shall not be amended, and the change of load shall be agreed through separate writing correspondence by KE we shall be deemed to form an integral part of this Agreement.

9. The Applicant agrees and acknowledges that KE has the right to extend HT & LT lines, modify and/or alter any equipment installed from Substation (if converted into GDS) without the Applicant's approval for distribution/supply of electricity.

10. The Applicant agrees not to hold KE responsible and indemnify KE and will keep KE indemnified (including third party claims), at all times from and against any and all loss (including any direct, indirect or consequential loss and loss of profit), loss of reputation and all interest, penalties, damage or liability (whether criminal or civil) suffered, legal fees (calculated on a full indemnity basis) and all other costs and expenses incurred by KE (whether directly or indirectly) as a result of KE's reliance on this Agreement.

11. This Agreement is in addition to and not in derogation or substitution of any other rights or remedies that KE may be entitled to under the law.

12. The Applicant agrees that this Agreement is purely voluntary in nature and the Applicant have not received any inducements, threats or coercive demands of whatsoever nature in relation to the execution and/or implementation of this Agreement and neither would be entitled to any compensation against the usage of the Substation by KE being handed over by the Applicant of perpetual basis and if converted to CDS shall become the property of KE.

13. This Agreement may be terminated by KE at any time and supply discontinued with immediate effect in case of breach by the Applicant of any clause mentioned hereunder including but not limited to the Substation not being constructed in accordance with requirements and as per approved specification of KE. This Agreement shall be exclusively governed by and construed in



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accordance with the substantive and procedural laws of the Islamic Republic of Pakistan and the Parties hereto irrevocably submit to the exclusive civil jurisdiction of the competent courts of Karachi. Nothing herein contained shall derogate from any rights available to KE under the Electricity Act 1910 read together with the Consumer Service Manual (CSM) issued by NEPRA as well as the NEPRA Act 1997 read with NEPRA Amendment Act 2018. In the event of any disputes between the Parties, both Parties shall cooperate to amicably resolve the dispute within thirty (30) days and incase of failure to amicably resolve the dispute, such dispute shall be referred to the senior management of both Parties for amicable resolution. In case of any dispute cannot be settled amicably, the same shall be referred to the joint equitable decision by way of arbitration under the Arbitration Act, 1940 and any applicable rules made there under by two (02) arbitrators, one (01) to be appointed by each Party to this Agreement and in the event of no such equitable decision being reached within sixty (60) days of the commencement of the arbitration, to the final decision of the umpire, to be jointly appointed by both the arbitrators which shall be final and binding on the Parties. The venue of arbitration
shall be Karachi. The arbitration shall be conducted in the English Language. Arbitration shall be a prerequisite and a condition precedent to any other action under the law. Each Party shall bear its own costs under the Arbitration. The arbitrators and the umpire shall be professionals preferably from the Power Industry.

IN WITNESS WHEREOF the parties above named set and subscribed their hands at Karachi, the day……month……and the year ..... first above written.

| | |
|---|---|
| ……. | ……. |
| K-ELECTRIC | Applicant(s)/consumer(s) |
| Witnesses of K-ELECTRIC: | Witnesses of Applicant: |
| 1. …….. | 1. ……. |
| 2. …….. | 2. …… |

NOTARIZE BY NOTARY PUBLIC



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**Annexure – B**

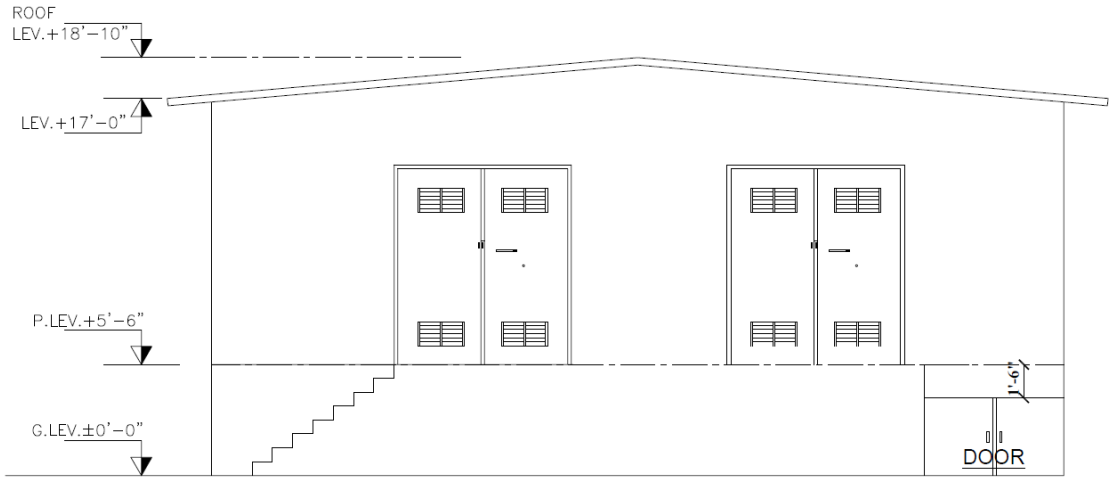
**Drawings showing Equipment layout, sizes and structural details are appended in the following pages:**

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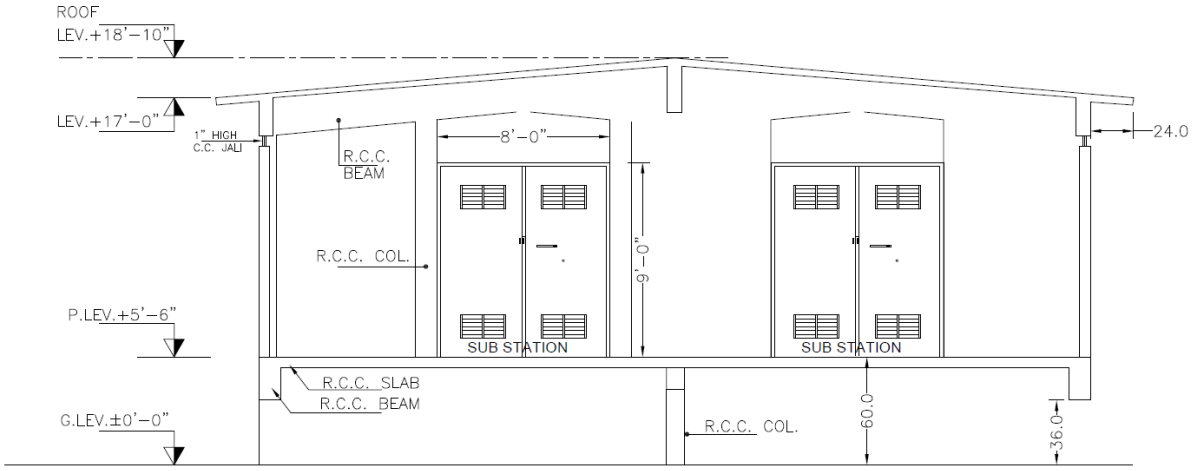
**Structural Drawings**

# Raised Hollow Design

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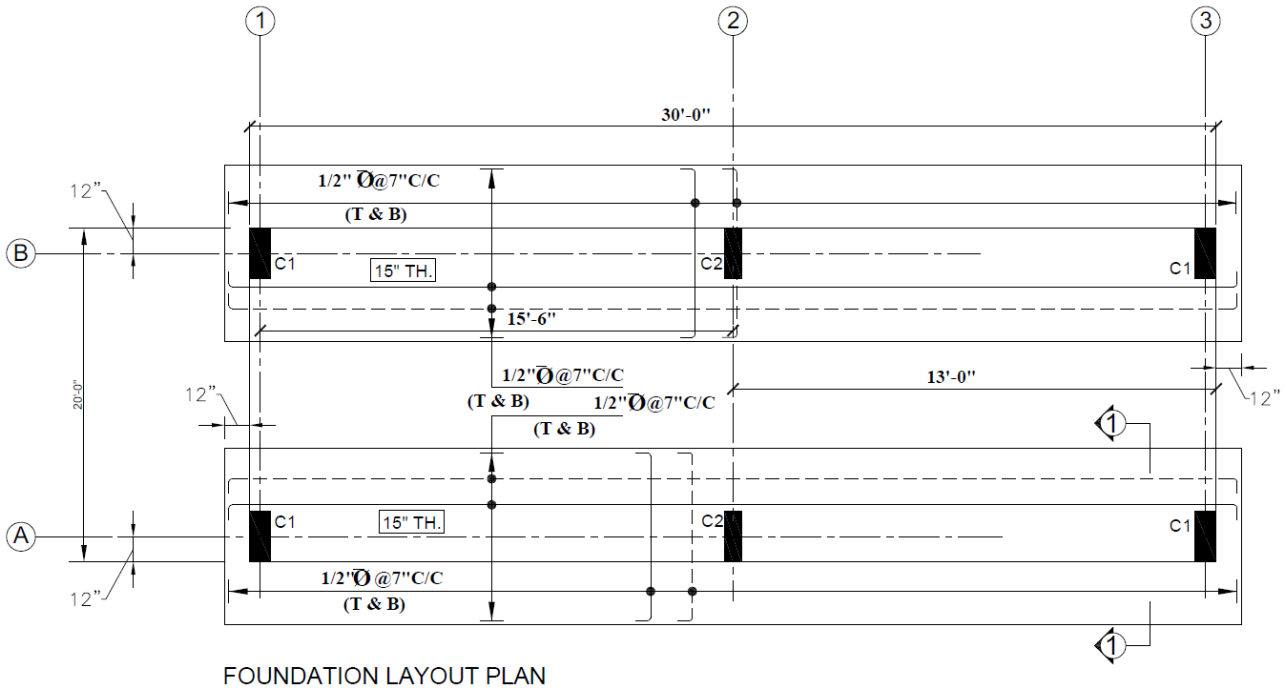



FRONT ELEVATION



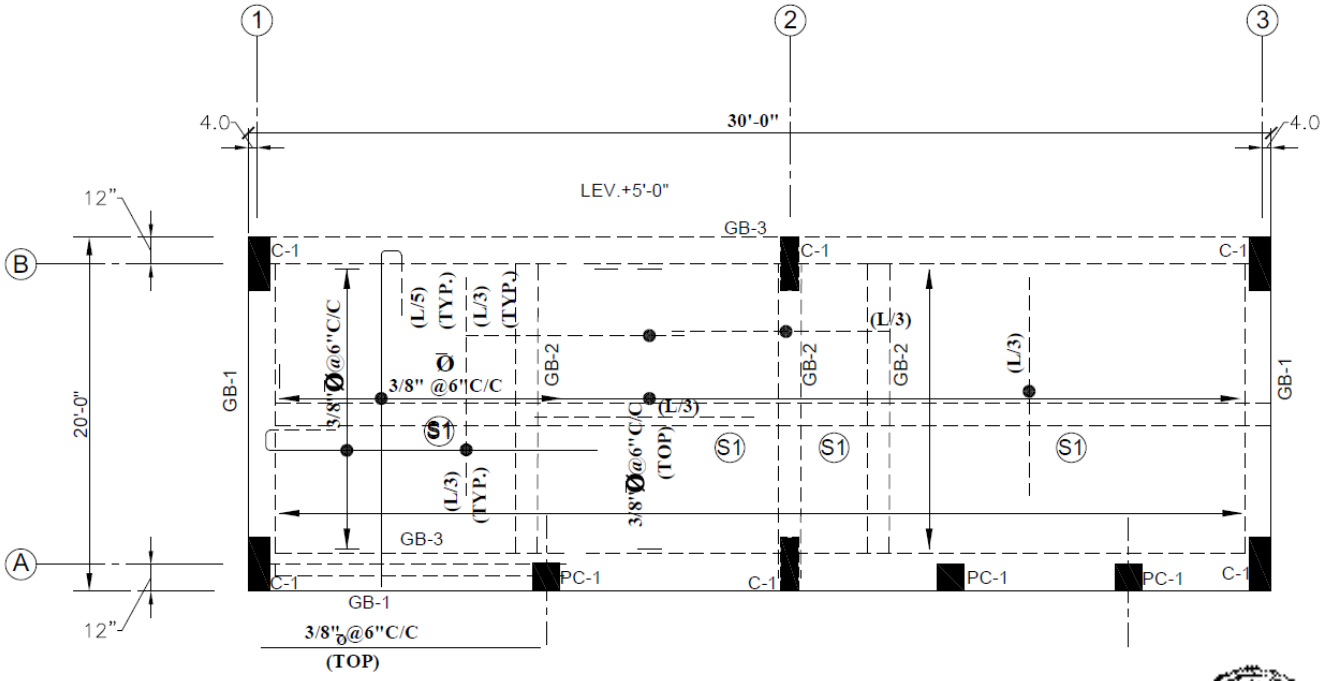

SECTION AT A-A

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FOUNDATION LAYOUT PLAN

**SCALE :-3/16"=1'-0"**

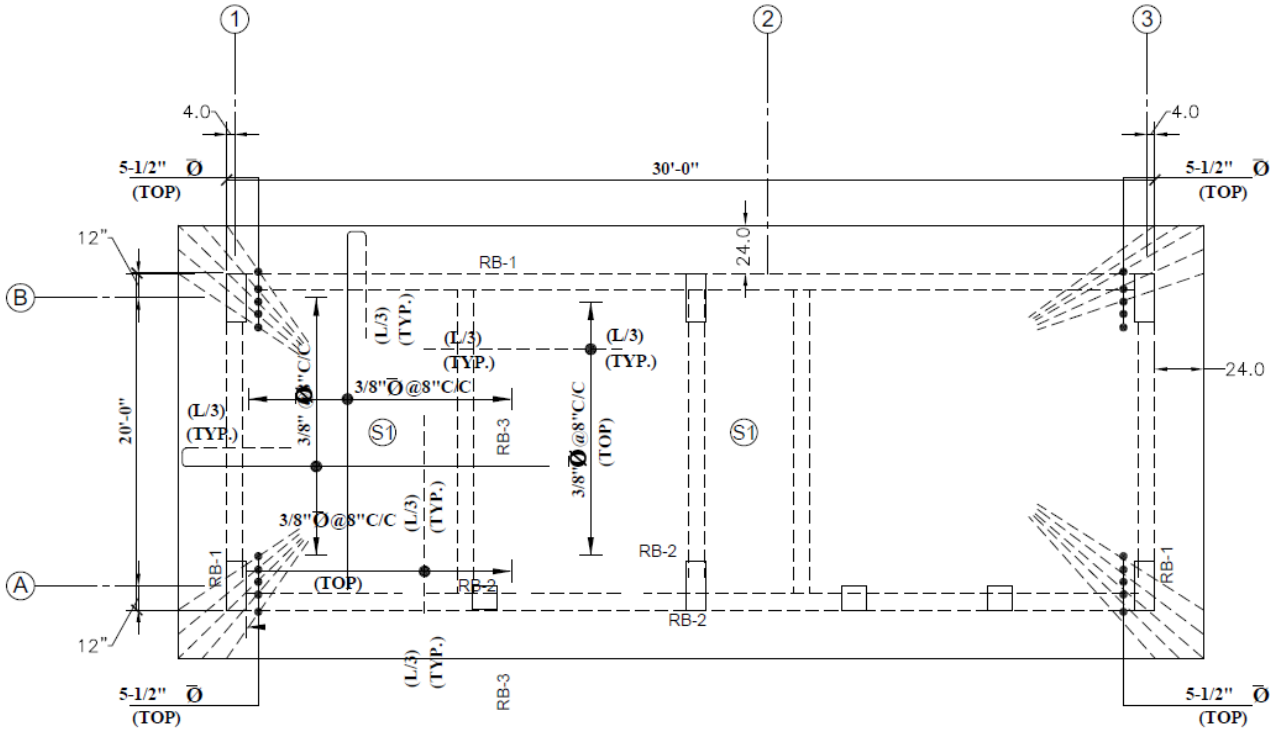



GROUND FLOOR FRAMING/REINFORCEMENT PLAN @ LEV.+5'-0"

NOTE:- ALL SLABS ARE 6" TH. U.N.O.

**SCALE :-3/16"=1'-0"**

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ROOF FRAMING/REINFORCEMENT PLAN @ LEV.+18'-10"

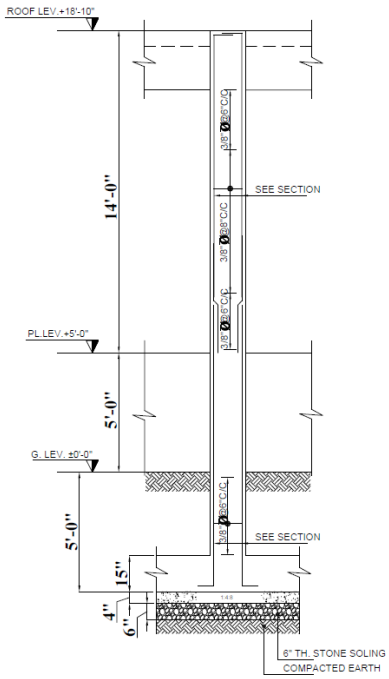
NOTE:- ALL SLABS ARE 4" TH. U.N.O.

**SCALE :-3/16"=1'-0"**

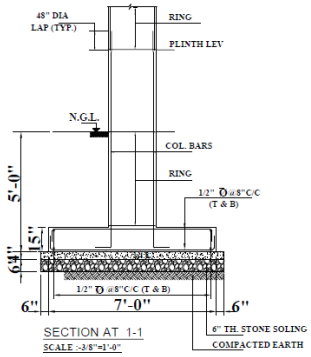
| SCHEDULE OF GROUND FLOOR BEAMS @ LEV.+5'-6" | | | | | | | | |
|---|---|---|---|---|---|---|---|---|
| | | BOTTOM STEEL | | TOP STEEL | | | STIRRUPS | |
| NOTATION | BEAM SIZE (WXD) | B1 | B2 | T1 | T2 | T3 | END STIRRUPS | MID STIRRUPS |
| GB-1 | 12"X24" | 4-5/8" Ø | - | 3-5/8" Ø | 2-1/2" Ø | 2-1/2" Ø | 3/8" Ø @4"C/C | 3/8" Ø @6"C/C |
| GB-2 | 10"X18" | 2-5/8" Ø | - | 2-1/2" Ø | - | - | 3/8" Ø @4"C/C | 3/8" Ø @6"C/C |
| GB-3 | 12"X24" | 5-3/4" Ø | - | 2-5/8" Ø | 3-5/8" Ø | - | 3/8" Ø @4"C/C | 3/8" Ø @6"C/C |

| SCHEDULE OF ROOF BEAMS @ LEV.+18'-10" | | | | | | | | |
|---|---|---|---|---|---|---|---|---|
| | | BOTTOM STEEL | | TOP STEEL | | | STIRRUPS | |
| NOTATION | BEAM SIZE (WXD) | B1 | B2 | T1 | T2 | T3 | END STIRRUPS | MID STIRRUPS |
| RB-1 | 8"X24" | 2-5/8" Ø | - | 2-1/2" Ø | 1-1/2" Ø | - | 3/8" Ø @4"C/C | 3/8" Ø @6"C/C |
| RB-2 | 8"X24" | 2-1/2" Ø | - | 2-1/2" Ø | - | - | 3/8" Ø @4"C/C | 3/8" Ø @6"C/C |
| RB-3 | 8"X24" | 2+2-5/8" Ø | - | 2-5/8" Ø | - | - | 3/8" Ø @4"C/C | 3/8" Ø @6"C/C |

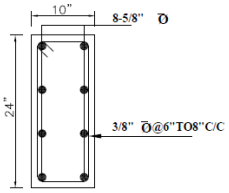
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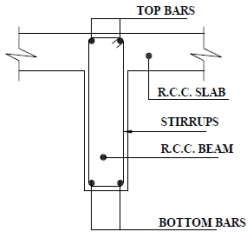

TYP. ELEVATION OF COLUMN
SCALE : 1/4"=1'-0"



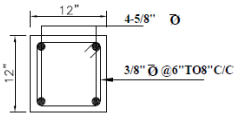

SECTION AT 1-1
SCALE :-3/8"=1'-0"




COLUMN C1
(10"X24")
SCALE:- 3/4"=1'-0"

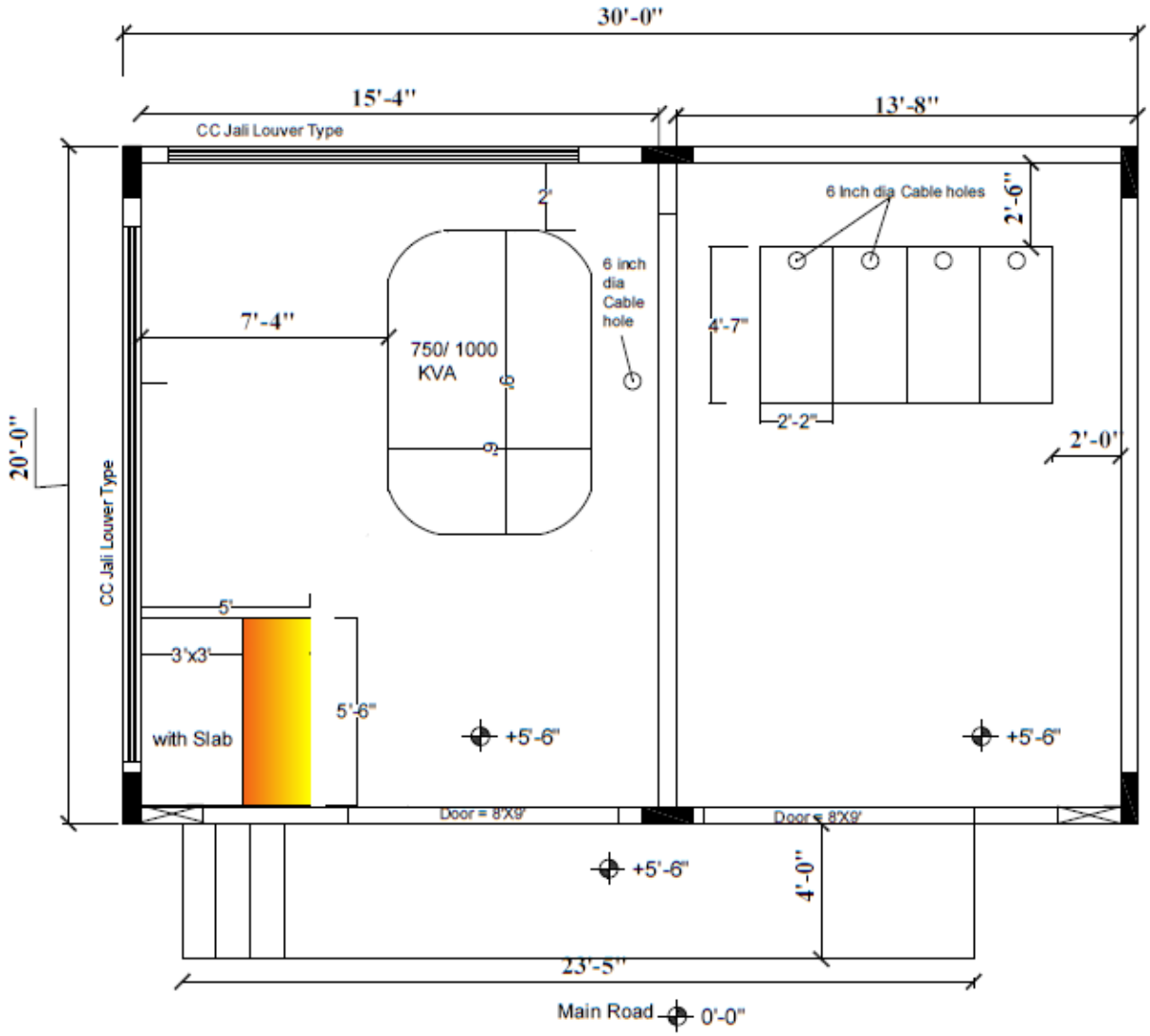



TYP. SEC. OF BEAM




COLUMN PC-1
(12"X12")
SCALE:- 3/4"=1'-0"

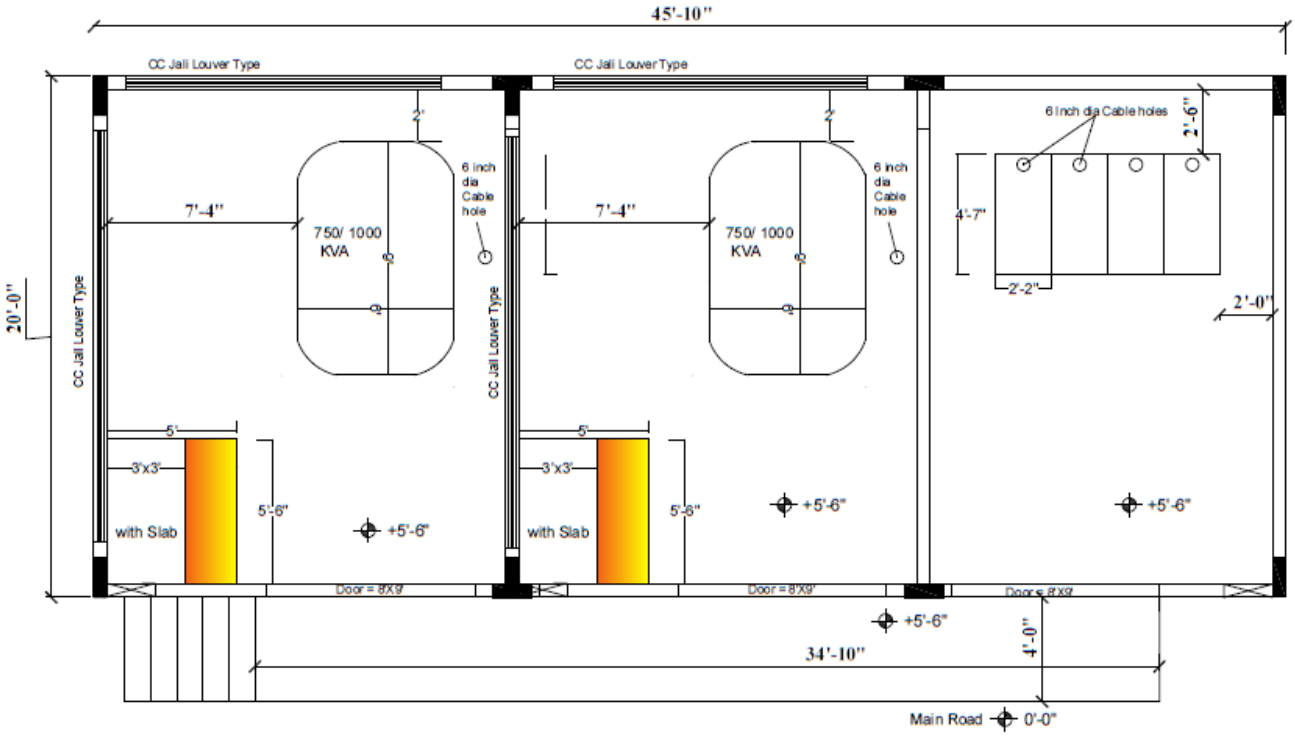
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Substation Layout Plan

**Equipment layout Drawing**

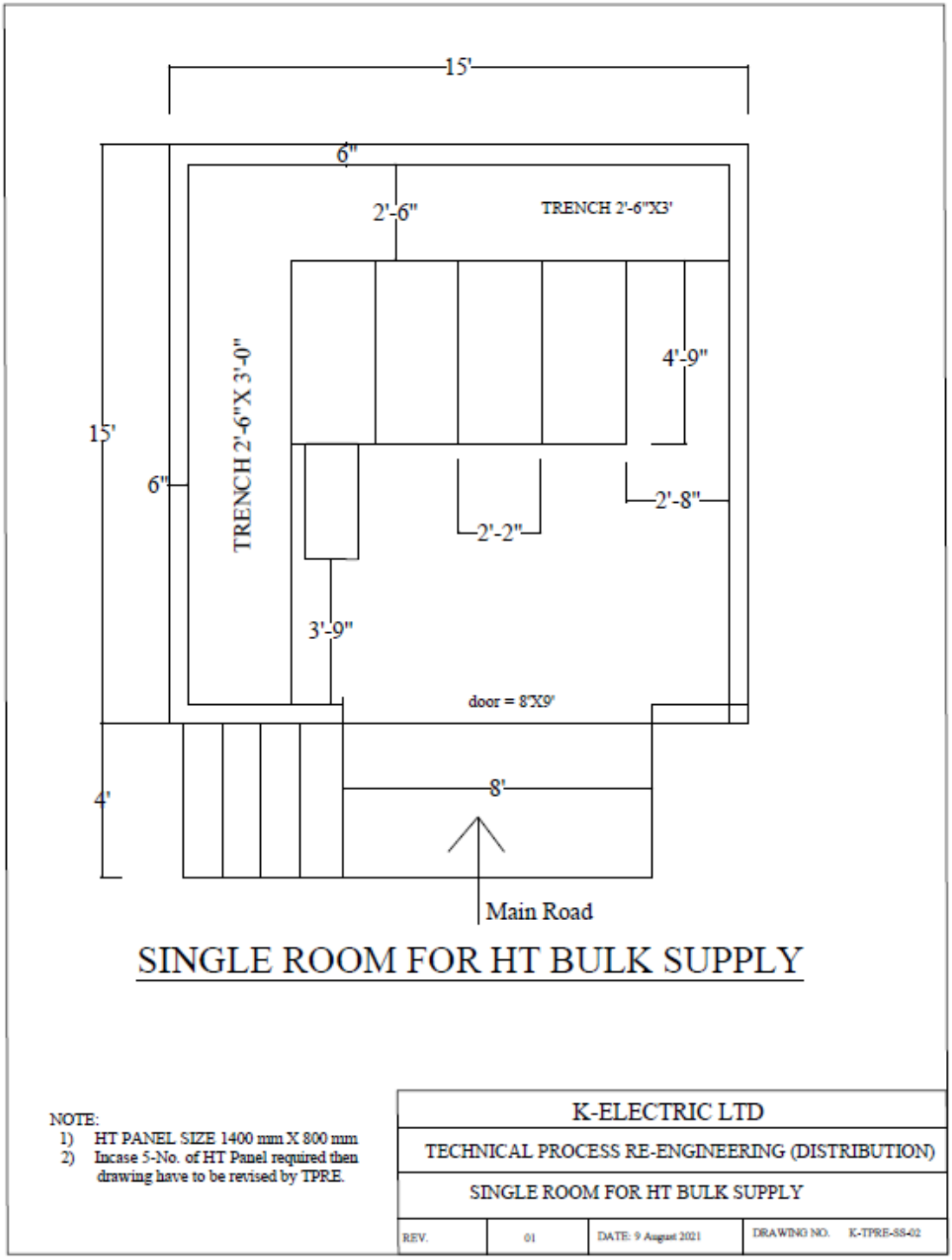
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Substation Layout Plan

**Equipment Layout Drawing (2 trafos)**

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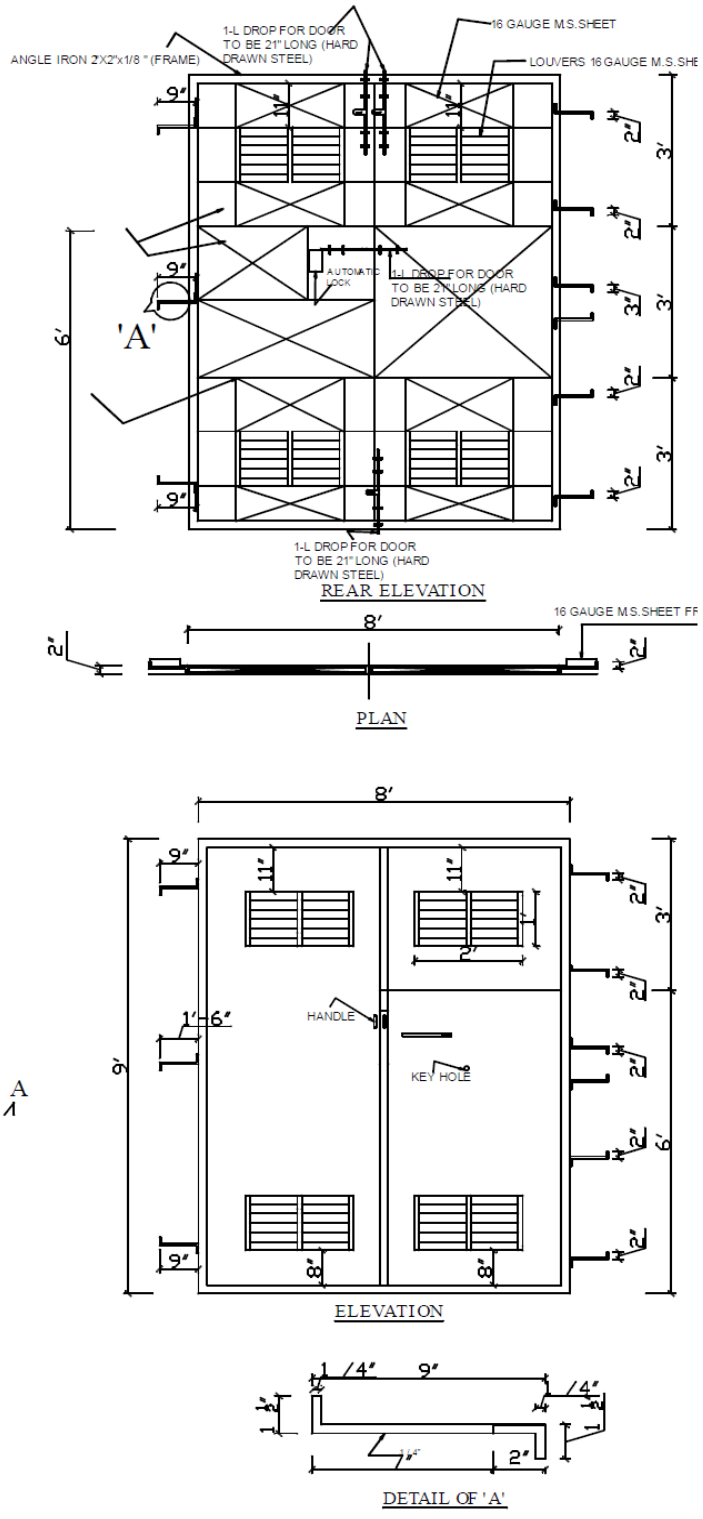



SINGLE ROOM FOR HT BULK SUPPLY

NOTE:
1) HT PANEL SIZE 1400 mm X 800 mm
2) Incase 5-No. of HT Panel required then drawing have to be revised by TPRE.

| K-ELECTRIC LTD | | | |
|---|---|---|---|
| TECHNICAL PROCESS RE-ENGINEERING (DISTRIBUTION) | | | |
| SINGLE ROOM FOR HT BULK SUPPLY | | | |
| REV. | 01 | DATE: 9 August 2021 | DRAWING NO. K-TPRE-SS-02 |

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**Anti-Theft Door Details**

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**Annexure – C**

**Following checklists are to be used for inspection at various stages:**

## CHECK LIST AT SUBSTATION LAYOUT STAGE

| S.NO | Description | YES | NO | REMARKS |
|---|---|---|---|---|
| 1 | Approved drawing is available at site? | | | |
| 2 | Layout of the substation site is done as per drawing. | | | |
| 3 | Any additional comments | | | |

## CHECK LIST AT FOUNDATION POURING STAGE

| S.NO | Description | YES | NO | REMARKS |
|---|---|---|---|---|
| 1 | Approved drawing is available at site? | | | |
| 3 | Steel reinforcement of footing is as per structural Drawing? | | | |
| 4 | Shuttering used is in sound condition | | | |
| 5 | Modified OPC Cement is being used | | | |
| 6 | Machine Mixer is being used for concrete | | | |

_____ _____

NC Supervisor NC Manager

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## CHECK LIST AT FIRST SLAB POURING STAGE

| S.NO | Description | YES | NO | REMARKS |
|---|---|---|---|---|
| 1 | Approved drawing is available at site? | | | |
| 2 | Construction till Roof is done as per the approved layout? | | | |
| 3 | Steel reinforcement of Roof Slab is as per structural Drawing? | | | |
| 4 | Shuttering used for Slab roof is in sound condition | | | |
| 5 | Props used for slab shuttering are in one piece | | | |
| 6 | Level marks are present at site? | | | |
| 7 | Cable holes/slits are made as per the approved equipment layout | | | |
| 8 | Machine Mixer is being used for concrete | | | |

## CHECK LIST AT SUBSTATION ROOF SLAB STAGE

| S.NO | Description | YES | NO | REMARKS |
|---|---|---|---|---|
| 1 | Approved drawing is available at site? | | | |
| 2 | Construction is done as per the approved layout? | | | |
| 3 | Proper slope is given in roof? | | | |
| 4 | Required shuttering is fixed | | | |
| 5 | Level marks are provided ? | | | |
| 6 | Steel Reinforcement is provided as per drawing | | | |
| 7 | Machine Mixer is being used for concrete | | | |

_____ _____

NC Supervisor NC Manager

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