

TECHNICAL SPECIFICATIONS**II. Electrification Work (Street Lights)****A- General Instructions:**

- 1- The electrification work shall be carried out by licensed workmen authorized to undertake such works under the provisions of the Electricity Act 1910 and the Pakistan Electricity Rules 1937.
- 2- The installation work shall be carried out in conformity with the Pakistan Electricity Rules 1937 and the latest edition of the Regulations for the Electrical Equipment of Buildings by the Institution of Electrical Engineering, London (I.E.E.). However, in case of conflict between these specifications and the I.E.E. Regulations, then these specifications shall be followed.
- 3- Contractor shall be responsible for submitting the test certificates and getting the installation passed by the Electrical Inspector of the Region.
- 4- The Contractor shall set out the work himself and if any discrepancy is found he shall report the matter to the Consultants and shall act as directed. If any defective or modified setting is carried out by the Contractor on his own he shall rectify or make it good at his own cost.

The Contractor shall provide all material, equipment, labor, installation materials, jigs, tools, and instruments etc. for complete supply, installation, testing and commissioning of the electrical works specified herein and on drawings and Bill of Quantities.

- 5- The Contractor shall keep the Architect informed about the program and the progress of the work so that there is no hindrance in the progress of work at site due to site conditions or delayed supply of material equipment and labor by the Contractor.
- 6- The Contractor shall take care not to damage the structure during execution of work. If so done he shall repair and make good all loses at his own cost. All cut-away and chiseled works in the cement block walls or RCC structures or tiled /mosaic/plain CC flooring etc shall be made good and brought to the original state by the Contractor without any additional cost to the Owner. For any welding or drilling on steel structure, Engineer's approval is essential

- 7- The Contractor shall furnish all equipment and material at site, conforming fully to the specifications given herein and to the accepted standards and must comply with the standards listed in these specifications under the separate heading "Standards". All material and equipment supplied by the Contractor shall be new and in all respects conform to the high standard of engineering design and workmanship, perform and function as herein specified and fully meet the quality level and ruggedness requirements.
- 8- **Standards:**
The latest relevant Pakistan Standard Specifications shall be followed. The British Standard Specifications and codes, VDE, IEC Recommendations and Reports and I.E.E. recommendations shall be applicable and be followed for the equipment and installation specified herein provided these do not contradict the Pakistan Standard Specifications and Pakistan Electrical Rules and Act. In case of contradictions between these codes standards and recommendations the Engineer's ruling shall be final.
- 9- **Climatic Conditions:**
All equipment supplied shall withstand without developing any defect the climatic conditions in Sindh.

Maximum Ambient Temperature = 45 deg. Centigrade.

Minimum Ambient Temperature = 8 deg. Centigrade.

Maximum Relative Humidity = 60%
- 10- **As-Built Drawings:**
Upon completion of work the Contractor is required to prepare the As-Built Drawings showing the actually installed, fitted position and location of all equipment, material and fixture and submit to the Project In-charge for approval. Such drawings shall be in the form, size and scale equivalent to the construction drawings issued by the Consultants before and during the Contractor's work. After approval of As-Built drawings the Contractor shall submit 3 Nos. sets of ammonia prints and one reproducible set or CD of approved As-Built drawings to the Employer. The work of the Contractor will not be considered completed unless approved. As-Built drawings shall be received by Owner, duly checked and certified by the Architect.

B- EQUIPMENT & MATERIAL SPECIFICATIONS:**1- Conduit, Pipes & Accessories:**

1.1 **Steel Conduit:** The steel conduit shall be in standard length of heavy gauge 16 SWG accordance with BSS 31. The steel conduit shall be protected by two coats of first quality black enamel paint. The paint coating shall be of heavy enamel applied over two coats of red lead oxide primer. The black enamel coating shall also be given on the surface of conduit after fixing in position. The minimum size of conduit shall be 3/4" (20mm) outer diameter. Conduit accessories such as inspection boxes, junction boxes and pulling boxes etc., shall be of cast iron or of heavy gauge 16 SWG sheet steel having blank sheet steel covers. These shall be painted inside and outside with black enamel paint over two base coats of anti-rust red lead oxide paint. Soft metal bushes shall be used at conduit termination ends in order to save insulation from damage due to sharp conduit edges in cable pulling operation. The steel conduit shall be IIL make or approved equivalent.

1.2 **G.I. Pipes:** Galvanized iron pipes are to be provided for protection of cables when installed under Floor or for external installations. The Contractor shall supply and install within item rates all sizes of G.I. pipes including all G.I. accessories such as bends, sockets, reducers, bushes, couplers, check, nuts etc., as specified herein. The G.I. pipes shall be medium weight, galvanized inside and outside by hot dipped galvanizing process and made to BS 1387. The pipe shall be new free from stains, bare spots, burs or any other defect. All accessories, specials, fixing saddles and clamps to be used with G.I. pipes shall also be galvanized inside and outside. G.I. pipes shall be IIL or KPM make or approved equivalent.

2. L.T. Cables:

The L.T. cables shall be of voltage grade 600/1100, conforming to BSS 5467 and International Electrotechnical Commission Standards' publication 502-94 with latest revision.

The multi-core L.T. cables shall be circular, with shaped conductors, PVC insulated and PVC sheathed, or PVC/PVC single wire armoured and PVC served overall. The conductors shall be made of stranded, high conductivity electrolytic soft annealed copper wires, complying to BS6360. The PVC insulation on each conductor and the over sheath shall comply with British Standard Specifications BS 6346 for thickness and BS6746 for properties. It shall be flame retardant and shall meet the requirements of BS EN50265 Part-1

All multi-core cables shall have phase identification colour on each insulated core. The colour scheme shall be red, yellow, and blue for phases and black or grey for neutral. The manufacturer's name and the BS or IEC standard must be embossed on the outer PVC sheath of the cable. Cables manufactured by Pakistan Cables, Pioneer Cables and AGE will be acceptable.

3. **Earthing:**

3.1 The protective earth conductor shall be solid or stranded, high conductivity electrolytic 99.6 % and higher purity copper, PVC insulated only or solid hard drawn as specified and of sizes shown on the drawing. The minimum size of protective earth conductor (PEC) shall be 2.5sq.mm.and for motor body or switchboard body its size shall be 16 sq. mm. minimum or as shown on drawings.

3.2 **Earth Electrode:**

The vertical copper rod with drive end and clamp forming earth electrode shall be 25 mm dia round copper rod 2 meters in length, to be supplied in sections of one meter, having corrosion resistant couplings. The rod electrode shall be complete with driving head, pointed conical driven end, and copper clamp for fixing conductor. The copper rod shall be hardened to drive directly in ground by hammering. The rod electrode shall be as per detail shown on drawing.

4. **Feeder Pillar Board for Lighting :**

4.1 The main Feeder Pillar Board for lighting shall be sheet steel fabricated cubicle type floor mounting weather proof, factory fitted and ready wired complete with incoming and outgoing circuit breakers, bus bars, meters etc. as specified here. The switchboard shall be front operated weather proof and to be installed mounted on RCC Pedestal. Two earth terminals on the body of the switchboards shall be provided in addition to an earth bar of electrolytic copper. The body of the switchboard shall be powder coated as per manufacturer's standard colour. All incoming cables entries shall be in the bottom.

4.2 **Circuit Breakers :** The incoming and outgoing circuit breakers shall be moulded case triple 415 volts 50 Hz., having current ratings and short circuit capacity as indicated on drawing and in the items of bill of quantity of these documents. The circuit breakers shall be non draw-out type and shall have over current and short circuit protections. The earth fault protection shall be fixed or adjustable as per manufacturers' standard. Where 2 Nos. incoming circuit breakers are provided these shall have electrical and mechanical interlocking. The moulded case circuit breakers shall be Terasaki, Japan, Merlin Gerin, ABB & LS makes or approved by the Engineer.

4.3 **Bus Bars:**

The bus bars shall be high conductivity 99 % electrolytic copper bars fixed in full length of the switchboard and supported on insulators of infinity insulation resistance and with sufficient strength.

4.4 **Meters:**

Analogue volt meter and C.T. operated ammeters shall be provided with ammeter and volt meter ranges as shown on drawing. Where shown on drawings or bill of quantity panel type 3-phase or single phase KWH meter for balance and unbalance loads shall be provided.

5- Transformer (PMT):

General: The transformer shall be outdoor, oil immersed, self cooled, designed and built to give efficient service at full rated capacity in the climatic conditions prevalent at site. Transformer built to B.S.171, C.P.1-10, VDE 0532 and to latest IEC standards shall be acceptable.

Construction:

The transformer tank shall be constructed of welded boiler plates and provided with external radiator tubes. The tank and radiator tubes shall be designed to withstand, without developing any deformation, the pressure at least 25 % greater than the maximum operating pressure. Earth terminals shall be provided at the base of the tank.

The transformer core shall be built of high grade electrical steel laminations, each lamination insulated to reduce eddy current losses.

The winding coils shall be of high grade electrolytic copper conductor, flat or round, paper insulated. The high voltage leads shall be brought out to the porcelain insulators bushings for external connections to H.V. side as required. The low voltage three lines and neutral leads shall be brought out and terminated to glazed porcelain insulator bushings for external connections to LV side.

Off-load operated tap changer shall be provided on H.V. side, lockable selector switch mounted on the cover of the transformer tank. The tapings shall be as shown in the Technical Data Table-1 in these specifications. The clear marking illustrated by diagram and H.V. voltage figures for each tap position shall be provided prominently.

Accessories:

The transformer shall be provided with following accessories:

- i) Oil filling valve for vacuum filling of oil.
- ii) Oil drain valve and sampling plug
- iii) Bi-directional rollers fixed to the base steel channel for rolling in the direction of both centre lines of the transformer.
- iv) Lifting lugs for handling and un-tanking the transformer.
- v) Dial type thermometer with two hands ; one indicating present temperature and the other indicating the maximum temperature reached previously. A red marking for indication of maximum reading of allowable temperature shall also be provided.
- vi) Double float Buchholz relay as specified in the Technical Data Table-1 of these specifications shall be provided.

TABLE - 1: TRANSFORMER TECHNICAL DATA

Sr.No.	Particulars	Required Data
1	KVA Rating	100 KVA as per BOQ
2	No-Load Voltage Ratio	11000 V / 415 V
3	Phases	Three
4	Frequency	50 Hz
5	HV winding: Line to Line volts and connections	11000 V Delta
6	LV winding: Line to line volts and connections.	415 V Star. Neutral grounded.
7	Vector Group	DY11
8	Tapings on HV side	(-) 7% , (+)(-) 5% and (+)(-)2.5%,
9	HV & LV terminations	On Bushings
10	Impedance Voltage	5 % Approx.
11	Losses	Iron loss min. copper as per standard
12	Temperature rise over ambient of 45 °.C	40° C in oil 50° C on winding
13	Protection	Buchholz relay.

C- INSTALLATION INSTRUCTIONS**1. Installation of Cables:**

For installation of cables shall provide and install all installation material whether specified here or otherwise required. The BOQ item rates shall include all works such as transporting the cable to site, laying, installing, providing and fixing cable markers, cable identification tags, cable ties, mounting brackets, saddles, clamps, nuts bolts etc.

The Armoured power cables SWA shall be installed direct buried under ground as per given detail on drawing, complete with as per BSS standard. Each cable shall be provided with identification tag with circuit number printed or embossed. The PVC/PVC SWA cables shall not be bent to a radius less than 10 times the over-all diameter of cable.

The cable shall be terminated at floor mounting switchboards by using appropriate size cable gland. Direct entry of cable in the switchboard shall not be allowed. The cable cores inside the switchboard shall be neatly fanned out and clamped. Appropriate type of cable lug must be used for connecting the cable core to the circuit breaker or switch terminal.

2. Earthing Installation:

- 2.1 A complete earthing system as shown on drawing shall be installed by the Contractor. The system shall give earth resistance equal to or less than one ohm. The contractor shall supply all installation material, sockets, thimbles, saddles clamps, solder, nuts, washers, copper brazing, copper welding etc., without any additional cost. At all connections of PEC to body of switchboard, or any other metallic body, proper size copper or brass sockets, thimbles or lugs shall be used to which the copper wire shall be welded by copper brazing. Tin soldering of copper wire at joints or termination shall not be allowed. At main earth loop copper wires, all tee-off connections shall be by copper brazing. 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 to the bright metal surface before bolting the lug or socket.
- 2.2 Each switchboard body, motor body and all such conducting but non-current carrying metal bodies shall be connected at least at two points by two independent earth wires tapped from the earth loop or from the earth bar.
- 2.3 The rod type earth electrode shall be hammered down directly in the bare earth ground. The copper tape shall be installed at one meter depth measured from the general ground level and shall be fixed firmly at driving end's clamp from rod to rod and up to the connecting point.

3. Installation of Feeder Pillar Board:

- 3.1 The weather proof Feeder Pillar Board (FPB) / distribution boards shall be delivered & installed by the Contractor as shown on drawings. All installation material such as bolts brackets, support, cable glands, copper lugs, insulation material etc., shall be supplied and installed by Contractor within item rates. All test results of the tests carried out shall be recorded and submitted to the Engineer for his review and approval before energizing.
- 3.2 The FPB switchboard shall be installed on pedestal as shown on drawing. The switchboard shall be placed in position, leveled and bolted down on the foundation pad by means of 2-1/2" long 5/8" dia bolts. At least four bolts shall be used; one each corner of the switchboard or at provided location by the manufacturer. The switchboard shall be completely assembled, all loose parts dispatched by the manufacturers shall be fixed as per manufacturer's approved shop drawing.
- 3.3 The connections on incoming and outgoing cables shall be connected as per single line diagram and as to be directed at site. Appropriate sized cable glands of approved type shall be installed on each outgoing cable. No cables shall be brought-in directly to the circuit breaker of switchboard. Appropriate size cable lugs of copper and of required current rating shall be installed on each core of the cable. The lugs shall be bolted on the circuit breaker/switch terminals by copper bolts.

4. Transformer Installation (PMT):

- 4.1 The pole mounted transformer mounted on double pole plat form structure shall be prepared by WAPDA contractor including placing and grouting the steel channel rails. This contractor shall coordinate and supervise the work so that the rails are correctly spaced for the size of transformer.

The loose parts dispatched by the transformer manufacturer shall be assembled such as conservator tank and lugs etc. The transformer then placed in position and its wheels locked as directed at site.

- 4.2 The neutral of transformer shall be connected to the neutral earth connecting point directly by using insulated single core cables of sizes shown on drawing. The cable shall be clamped on pole. The body of transformer shall be connected to earth at two points provided by the manufacturer for this purpose, from the body earth's connecting point.
- 4.3 After the transformer is installed and connected up a thorough check shall be made for proper fixing of cable lugs and accessories, oil quality and level etc. before commissioning in the presence of the Engineer.

C- TESTING

1. General:

Upon completion of the installation the Contractor shall perform field tests on all equipment, materials and systems. All tests shall be conducted in the presence of the Engineer for the purpose of demonstrating equipment or systems in compliance with specifications.

The Contractor shall furnish, install and maintain all tools, instruments, test equipment, materials, connections, etc., and furnish all personnel including supervision and “standby” labour required for the testing, setting and adjustment of all electrical facilities and their component parts, including putting the same into operation.

All testing shall be made with proper regard for the protection of the equipment, and the Contractor shall be responsible for adequate protection to all personnel during such tests.

The Contractor shall record all test values of tests made by him on all equipment, giving both “as found” and “as left” conditions. Three copies of all tests data shall be given to the Engineer for record purposes.

2. Insulation Tests

Insulation resistance tests shall be made on all electrical equipment, using a self-contained instrument such as the direct indicating ohm-meter of the generator type. Direct current potentials shall be used in three tests and shall be as follows:

Circuits under 220 volts	-	500 volt test
Circuits 220 V to 440 V	-	1000 volt test

The minimum acceptable insulation resistance value will be 5 megohm. The Contractor will furnish the test equipment for insulation testing.

Before making connections at the ends of each cable, run the insulation resistance measurement test of each cable shall be made. Each conductor of a multi-core cable shall be tested individually with each other conductor of the group and also with earth. If insulation resistance test readings are found to be less than the specified minimum in any conductor, the entire cable shall be replaced and the new cable shall be tested.

3- Earth Resistance Test

Earth resistance tests shall be made by the 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 ECC, 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 earthing sets than one 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.

4- Switchgear

In addition to the insulation resistance test on the switchgear, polarity or phase rotation test shall also be made.

Each air circuit breaker shall be operated mechanically, ascertaining that handle mechanisms are operating. All interlock control circuits shall be checked out for proper connections in accordance with the wiring diagrams given by the manufacturers.

The Contractor shall identify the phases of all switchgears and power cables by stencilling the switchgear and tagging the cables so that the phases can be identified for connections to give phase sequence.

5. Operating Tests

Current load measurement shall be made on equipment and all feeders. The current reading shall be taken in each phases wire while the circuit or equipment is operating under actual load conditions. Clip-on ammeters may be used to take current readings.

6. Completed Test

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 such equipment for assurance that subsequent testing of other equipment or systems does not disturb the completed work.

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LIST OF APPROVED SUPPLIER**A- Steel / G.I. Pipes :**

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| 1. IIL | International Industries Ltd | 35680045- 54 |
| 2. Bashir Pipe | Industries Pvt Ltd. | 042-37635929-33 |

C- Multi-core & Single core Cables:

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|-------------------------------------|-------------|
| 1. Pakistan Cable Limited | 2561170-75 |
| 2. Pioneer Cable Limited | 2416511-14 |
| 3. A.G.E. Industries (Pvt.) Limited | 2414065- 66 |
| 4. Newage Cable Pvt. Limited | 4320005-06 |

D- Lighting Fixtures & Pole:

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| 1. Philips Electrical Industries of Pakistan Limited | 2560071- 78 |
| 2. Pierlite Pakistan (Pvt.) Limited | 53660972-73 |
| 3. Zain Lighting | 6669967-6692556 |
| 4. Mohsin Electric | |

F- Main & Sub-main switchboards

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| 1. Baber Brothers Engineering Company | 34583528- 34584615 |
| 2. A to Zee Engineering Services | 35121803-35121798 |
| 3. R.A. Engineering & Services Pvt. Ltd. | 35301838- 35290308 |