SPECIFICATION FOR LOW VOLTAGE OVERHEAD LINE DISTRIBUTION SYSTEM

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SPECIFICATION FOR LOW VOLTAGE OVERHEAD LINE DISTRIBUTION SYSTEM

1.0 GENERAL

This section of the Specification describes and specifies requirements for the supply, delivery, installation, testing and commissioning of a low voltage overhead line distribution system and handing over in approved working order and providing service and maintenance during the Defects Liability Period as specified thereafter for the period stated in the conditions of contract. Unless otherwise specified hereafter, the installation of the low voltage overhead line distribution system shall strictly comply to the Technical Instructions issued by TNB pertaining to the installation of the low voltage overhead line distribution system.

2.0 ROUTE

The routes shall be generally as shown on the drawing. The exact routes and locations of pole shall be pegged out by the Electrical Contractor on site for the approval of the Superintending Officer prior to installation.

The average span length shall be between 30 metre to 45 metre, and the maximum span length shall be 50 metre. For every 10 spans in the straight line formation, a section pole shall be introduced in between.

3.0 POLES

The pole shall be either wooden pole or prestressed spun concrete pole as specified in the drawings and/or Bills of Quantities.All poles shall be planted at a depth of 1524 mm. into the ground and shall be plump. All poles shall be labelled with stencilled lettering and painted. Lettering shall be of 50 mm. size and wordings shall be obtained from the S.O.

Wooden pole or prestressed spun concrete pole shall be manufactured in accordance to TNB Specifications.

3.1 WOODEN POLE

The wood poles shall be made from the following wood:-

(a) Chengal

(b) Balau

(c) Keruing (Chemically treated)

(d) Kempas (Chemically treated)

They are sawn square to size either 127 x 127 x 7620 (mm) or 152 x 152 x 9144 (mm) as specified. The weight of the 127 x 127 x 7620 (mm) shall range from 107 kg. to 120 kg. and that of 152 x 152 x 9144 (mm) shall range from 182 kg. to 209 kg. 6 holes of 17.46mm. diameter are drilled on the top for the fixing of accessories. The distance of the first hole from the pole top shall be 152.4mm and the subsequent holes shall be at 228.6 mm. apart. A square groove of side 4.76 mm. is cut on one side face of the pole for accommodating the entire earth wire.

3.2 **PRESTRESSES SPUN CONCRETE POLE**

The prestressed spun concrete pole shall be of 9000 mm. long with a circular top of 140 mm. diameter and the lower part of the pole has a diameter of 260 mm. tapered 1/75. The pole shall have additional reinforcement to a height of 1800 mm. above ground level to reduce the danger of collapse when exposed to vehicular impact.The design transverse load for the pole shall be 2.0 KN. 5 holes of 19 mm. diameter are provided on the top for fixing of accessories. The distance of the first hole from the pole top shall be 150 mm. and the subsequent holes shall be 230 mm. apart. Earth wire inlet and outlet shall be provided at a distance of 1200 mm. from the pole top and from the pole base respectively.

4.0 **EXCAVATION**

Excavation for pole holes shall be made so as to give the least disturbance to the surrounding earth. The earth at the bottom of the hole shall be well rammed and consolidated. Holes shall be back-filled and well rammed at 150 mm. layers. The Electrical Contractor shall be responsible for the removal of any surplus of earth.

5.0 **LINE CONDUCTORS**

Conductors shall be of hard drawn stranded aluminium, complying to BS 215. Conductors shall be bare unless otherwise specified and

the sizes shall be as specified and indicated in the Drawings and/or Bills of Quantities.

5.1 **ARRANGEMENT**

The conductors are arrange in vertical formation in the order of, starting from the pole top, Red phase, Yellow phase, Blue phase, Street Lighting, Neutral and Aerial earth. If two phase or single phase lines are run, the same sequence is to be maintained. For three phase lines if street lighting conductor is not provided for, then the fourth position is reserved for the installation of street lighting conductor in future, In the case of prestressed spun concrete pole, a metal clamp shall be provided to facilitate the installation of the aerial earth conductor.

5.2 **ERECTION**

Conductors must not be dragged on the ground while stringing to avoid damage to the conductor surface. Great care must also be taken to avoid kinks on the conductors. A wooden running block shall be placed between the insulator and `D' iron to run the conductor. Great care must also be taken to avoid kinks on the conductors. Conductors are erected and pre-tensioned and final adjustment is made for sag. The erection and killing tensions for the bare stranded aluminium conductors shall follow Table 1.

Table 1.

Size of conductor (sq. mm)	Erection Tension (KN)	Killing Tension (KN)
22	0.53	1.06
50	1.21	2.42
100	2.44	4.88

The sag of the conductor at erection tension and killing tension for various span length for 22 sq. mm., 50 sq. mm., 100 sq. mm. conductors shall follow Table 2.

Table 2.

Span length (M)	Erection Sag (mm)	Killing Sag (mm)

25	90	45
30	130	65
35	180	90
40	230	115
45	290	145
50	360	180

The spacing between conductors shall be 228.6 mm. `Binding in' of conductors to insulators shall be aluminium wire size 9 S.W.G. The method of making up binders shall comply to the standard practice by TNB. All jumpers shall be of the same size as the line conductors. Minimum clearance the jumper to the pole shall be 153 mm.

6.0 **JOINT**

Joints shall be made normally on supports and be free from tension. Mid span joints are not permitted unless otherwise prior approval is obtained from the S.O. Where approval is granted, mid span joint shall be made with approved connectors incorporating a clamping arrangement to ensure that the breaking load of the span is not less than that for the continuous conductor. Mid span connectors shall be of the same materials as the conductor.

No mid span joints shall be made where the conductors cross another aerial line, a telecommunication line, a public road, a railway line, or a navigable waterway.

7.0 **CLEARANCE AND CROSSINGS**

7.1 **GROUND CLEARANCE**

The height from the ground of any line conductor of aerial earth conductor in still air at a temperature of 60 degree Celsius shall not be less than:

(a) over roads : 5.49 metre

(b) other than over roads : 5.18 metre

(c) in positions

in accessible to vehicular traffic	:	4.57 metre

7.2 **CLEARANCE FROM BUILDINGS**

No line conductor unless effectively insulated shall come within 2134 mm. horizontally or 2743 mm. vertically of any building other than a substation. Only PVC insulated conductors may be terminated on buildings at a height not less than 2743 mm. from the ground level.

7.3 **CLEARANCE FROM TELECOMMUNICATION LINE**

The Electrical Inspectorate Regulations 1984 pertaining to the line conductors crossing the telecommunication line shall be strictly observed.

8.0 **CONNECTION OF CONDUCTORS**

Terminations of conductors shall be done by means of approved connectors. Aluminium saddle line taps shall be used when connecting aluminium conductor to aluminium conductor. However when connecting aluminium conductor to copper conductor, bi-metallic connector must be used. For copper conductor of sectional area less than 35 sq. mm. the aluminium grease-filled tube is allowed. When aluminium grease-filled tube is employed, this shall be used in conjunction with aluminium saddle tap. Minimum two conductors shall be used at every position of connection.

9.0 **INSULATORS**

Insulators shall be glazed porcelain and the shackle type. They shall be secured to the pole by suitable `D' iron or shackle straps and brackets, bolts, nuts and washers.`D' iron, shackle straps, brackets, `U' shackle, bolts, nuts and washers and other metal work used to support insulators shall be of hot dip galvanised mild steel.Bolts used for insulator supports shall have locknuts or spring washers.

All phase conductors and neutral shall be supported on the

porcelain shackle insulators. The aerial earth conductor shall be supported by either the porcelain shackle insulators or the `U' shackle. For aerial earth conductor supported on the porcelain shackle insulator, all metal work on the pole shall be effectively bonded to the aerial earth conductor.

10.0 **STAY AND STRUT**

10.1 **STAY**

Stays shall be used to counteract the forces that result from the tension on the conductor and the forces due to wind on the line. Stays of suitable number and size, be the type single stays, double stays, flying stays or out rigger-stays shall be installed where necessary and as shown in the Drawings. All stays shall be complete with stay plates, stay rods, stay bows and turnbuckles, thimbles stay wire, stay insulators and stay clamps. All stays shall be stranded galvanised steel wire of size 7/14 SWG, 7/12 SWG, 7/10 SWG and 7/8 SWG as specified. Stay plate, rod, bow and turnbuckle, thimble, clamp and bracket shall be of hot dip galvanised mild steel. Flying stay shall complete with either a wood pole or reinforced concrete pole of the same pole length as specified. The out rigger stay shall complete with the out rigger stay bracket. Where the ground conditions are good,1828 mm. stay rod shall be used with 7/14 SWG, 7/12 SWG, 7/10 SWG stay wire and 2438 mm. stay rod shall be used with 7/8 SWG stay wire. Where the ground is bad or doubtful, then 1234 mm. stay rods must be used.

The angle of rake of the stay to the pole shall not be less than 30 degree Celsius in good ground conditions, and shall not be less then 45 degree Celsius in doubtful or bad ground conditions. For two stays installed in line with each other, the stays shall not be less than 1828 mm. apart. At the wide angle deviations where two stays are used, the stays shall be installed so that one stay is in line with each branch of the deviation. Where one stay only is used, then it must be arranged to bisect the angle. Clamps shall always be used when fixing the stays to the pole tops. Stay insulator shall be provided at approximately 1828 mm. from the clamp along the stay wire and the portion between the clamp and the stay insulator must be effectively bonded to earth.

Stays shall be erected with the minimum disturbance to the ground in the direction of pull. The stay pit shall be back-filled and well rammed at 150 mm. layer.

10.2 **STRUT POLE**

Strut pole shall be wooden pole or galvanised steel pole as specified. Wooden strut pole shall be of the same type as stated para (3.1). They are sawn square to size 127 x 127 x 7620 (mm). Steel strut pole shall be Class B galvanised mild steel pipe of dimension 76 mm. x 90 mm. x 100 mm. and 7620 mm. long.

The strut pole shall be provided with 457 mm. x 457 mm. square steel base plate of 6.3 mm. thickness. The ground insertion shall be minimum 9144 mm.

Steel strut pole must be effectively bonded to earth.

11.0 **BONDING OF METAL WORK**

All metal work on the pole shall be effectively bonded to the aerial earth conductor. The bonding shall be carried out by the use of 7/18 SWG galvanised steel wire held between two washers under nut and spring washer of the D-iron through bolt and carried down to each D-iron and `U' shackle.

For wooden pole, the bonding wire shall be continued down the pole in the square groove and stapled to it to a point 457mm. below the ground level. It shall then be given five turns at 152mm. internal round the butt of the pole and finally stapled to the base. All these have to be done before erection of the pole.

On the prestressed spun concrete pole, the bonding wire shall run down to the earth through the earth wire inlet and outlet. At the lower part of the pole, a 7/18 SWG galvanised steel wire is given five turns at 152mm. internal round the butt of the pole and held loosely under the pole foot.

At section and terminal positions where a `U' shackle is not used at the aerial earth conductor position, all metal work on the pole must be effectively bonded to the aerial conductor by a 7/18 SWG galvanised steel wire.

12.0 **EARTHING**

The aerial earth conductor shall be effectively earth at the terminal poles and at not less than four points in every 1.61 kilometres. At each earthing point, it shall be effected by 25 sq. mm. PVC insulated green cable and 16 mm. diameter 7300 mm. length copper jacketed steel core rod.

The main earthing shall be provided at the pole where the main supply is connected. The main earthing to earth resistance not

exceeding one Ohm shall be effected by 3 mm. x 25 mm. copper strips and 16 mm. diameter copper jacketed steel core rods. This main earthing is in turn bonded effectively to the earthing system of the main supply.

Earth chamber and covers of reinforced concrete shall be provided for each earthing points. Those earthing loads from 3048 mm. high at the pole to the earthing point shall be enclosed by PVC conduit.

13.0 **LIGHTNING ARRESTOR**

Lightning arrestors incorporated in the low voltage overhead line distribution system shall be rated at 500 V line-to-earth, 50 Hz. The rated lightning discharge current for 8/20 microsecond waveshape shall be 5 KA and for 4/10 microsecond waveshape shall be 65 KA. The resistor block carrying non-linear resistive properties housed in a porcelain or cast resin casing shall offer very high resistance for powder frequency current and very low resistance for high lightning discharge current. The 100% impulse sparkover voltage shall be less than 2 kv.

Lightning arrestor mounted on the pole with a bracket of an approved design shall be provided and connected from each phase conductor, neutral conductor and street lighting conductor (if any) to ground as indicated on the Drawings. The earthing leads shall be PVC insulated green cable of cross sectional area not less than 6 sq. mm. and effectively connected to the earthing point. The earthing point using 15 mm. diameter steel core copper weld electrodes complete with earth chamber and covers of reinforced concrete type shall be positioned at not less than 3352 mm. from the pole. The earth resistance of the earthing point shall be less than 10 Ohms. That portion of the earthing leads from 3048 mm. high at the pole to the earthing point shall be protected by metal conduit.

14.0 **SERVICES TO BUILDINGS**

Unless otherwise specified service cables to the buildings shall be PVC insulated hard drawn aluminium conductors complying to BS 6485.

Service lines shall be taken off the distribution system by the use of line connectors. It shall be made off at buildings as indicated in the Drawings by means of porcelain insulators or porcelain insulators with coach screws (won-piece insulators) at a height not less than 2740 mm. from ground level.Where service

lines are made off at building consisting of several units, the service lines shall be continued with five-foot way mains.

The five-foot way mains shall be of PVC insulated hard drawn aluminium conductors and of the same size as the service lines, and shall be run along the face wall of the buildings. In cases where the walls are plaster, brickwork or metal, a hardwood batten will be firmly attached to the wall by the brass screws. The cable is then run on the wood batten and attached to it by saddled. The saddles shall be fixed by brass nails.

Tee off to main switch of each unit shall be by the use of junction box and the size of cable from the junction box to the main switch in each unit shall be the same as that of the service lines or five-foot way mains.

15.0 **POLE FUSE**

Pole fuse shall be provided as indicated on the Drawings. Pole fuse for rating less than 100A shall be of porcelain type. Rewirable fuse of tinned copper fuse wire shall be provided and rated accordingly as indicated on the Drawings. For those rating more than 100A, metalclad pole fuse box complete with HRC fuses shall be provided. HRC fuses shall be rated as indicated in the Drawings.

Pole fuse shall be mounted on hot dip galvanised mild steel bracket which is in turn mounted approximately 1067 mm. below the lowest conductor. The pole fuses shall be arranged in the horizontal plane and in the order Red phase, Yellow phase and Blue phase from left to right viewed from the front of the pole. The mild steel bracket shall be effectively earthed. PVC insulated hard drawn copper conductors used for connection between the two conductors through the pole fuse shall be of appropriate cross sectional area as to the fuse rating. The PVC insulated hard drawn copper conductors shall be properly arranged in accordance with phase sequence and secured to the pole by means of porcelain cleat in the case of wood pole. In the case of prestressed spun concrete pole, the conductors shall be secured by means of PVC binder.

16.0 **SERVICE AND MAINTENANCE**

During Defects Liability Period, the Electrical Contractor shall inspect the sagging of the overhead line conductors. Steps must be taken immediately to re-tension the lines if necessary. The tension in the conductors shall be observed and that not to increase to a point where the conductor may break or component

parts may shatter. All poles shall be in plumb, or otherwise shall be pulled up plumb by stays.

17.0 **AS INSTALLED DRAWING**

Within three calender months after the practical completion of the project, one set of true to scale negatives (110/115 gm/sq.m ISO AO or A1 size) and four sets of prints for each of the following drawings shall be submitted:-

(a) Site plan

(b) Schematic Wiring Diagram

(c) Layout plans of the low voltage overhead line distribution system and earthing wire.

These drawings shall be properly stencilled and shall have at the lower right hand corner the Electrical Contractor's name, and address, date of commissioning, scale, drawing number (the drawing number to be obtained from the S.O.), tittle and the following particulars :-

JABATAN KERJA RAYA
CAWANGAN ELEKTRIK
CONTRACT NO.
TENDER NO.

If the drawings submitted are not acceptable by the S.O. the Electrical Contractor shall amend and re-submit the drawings within two weeks from the date of return of the drawings.

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