SURVEY OF THE PROPOSED ROUTE OF LINE

The first step to be taken prior to the design or construction of any line is to conduct survey of the country over which the line is to pass. Topo sheet map of the area which would indicate towns, roads, streams/river, hills, railway lines, bridges, forest areas, telephones, telegraph and power lines may be taken and the approximate route of the line marked on it. Before finalizing the route, the following parameters should be kept in mind:

1. The shortest route practicable.
2. As close as possible to the road for easy maintenance and approach during the construction.
3. Route in direction of possible future load.
4. Angle points should be less.

THE AREAS TO BE AVOIDED AS FAR AS POSSIBLE ARE:

(a) Rough and difficult country side.
(b) Urban Development area.
(c) Restricted access for transport vehicles.
(d) Abrupt changes in line routes.
(e) Difficult crossing – river, railway.
(f) Proximity to aerodromes.
(g) Natural hazards like steep valleys, hills, lakes, gardens, forests, playgrounds, etc.

The route selected for a distribution line shall be such that it will give the lowest cost considered over a period of years, consistent with accessibility for easy maintenance, etc. This includes many considerations such as original cost, tree trimming and compensation, freedom from vehicular damages future development and availability for services.

The lines should be routed wherever possible to avoid natural obstacle such as steep hills or valley’s, swamps, lakes, thick forests, rivers, etc. Lines should be so located at a safe distance from buildings and from possible fire, proximity to traffic and other hazards. Line shall not cross school play grounds, cemetery, except under special circumstances. Lines should be away from the buildings containing explosives.

Transportation contributes a major portion of construction cost. As such while finalizing the route alignment, it may be ensured that due to transportation cost should be as low as possible.

Transport of RCC/PCC poles pose greater problem as they are generally heavier than other types of supports for same duty. The RCC/PCC poles are generally stronger on the longer axis than on shorter axis. Care should be taken on this aspect while handling, to prevent excessive stressing of the pole at the time of transporting. The unloading of poles from truck or trailer should also be done carefully. Suitable skid boards must be used and on no account, the poles be dropped. Several utilities have special trucks made with side loading arrangement for pole transportation or use trailers. It is preferably to provide a chain pulley block with a beam arrangement in the middle of the truck body to facilitate unloading/loading of the poles. The poles should not be dragged on rough surface, but transported I small hand – cart.

WALK OVER SURVEY

Having provisionally fixed the route, on the survey map, a preliminary Walk Over survey is carried out, before conducting the survey with ranging rods. As far as possible, the line route is taken through areas with minimum tree growth. If there are alternative routes, all such routes are investigated for final evaluation of the most economic route.
It may be mentioned here that the detailed survey can be carried out by theodolite and angle points can be fixed and marked with survey stones. A route may to a scale of 1 cm – 0.5 km can be prepared showing the various angles approach roads, near the line, routes detail of railways, communication lines, EHT line crossing, river crossing, etc. But this is not necessary in case of small lines as the local staff usually is conversant with the topography and thereafter marking of locations aligning the line with ranging rods is found to be satisfactory.

RIGHT OF WAY

(a) Once the route of the lines is fixed approval has to be obtained.
(b) From the railway authorities for Railway Crossings.
(c) From the competent Forest Authorities for routing of the line in Forest areas.
(d) From the State level Power Tele – communication Coordination Committee (PTCC).

(b) In addition if there are urban development Airport and similar other areas falling in the route of the line, permission has to be obtained.
(c) Sometimes private gardens/orchards may fall on the route and require free cutting. The details of trees are to be marked. Compensation be got fixed from Revenue Authorities and paid to the owner.

POLE LOCATIONS:

In locating poles on lines, the following general principles are to be kept in mind :-

1. Keep spans uniform in length as far as possible.
2. Locate to have horizontal grade.
3. By locating the poles on high places short poles can be used and will maintain proper ground clearance at the middle of the span. In extremely hilly or mountainous country, poles are located on ridges hereby increasing the spans without greatly increasing the poll on the conductor. This is possible because the sag can be made very large maintaining the required ground clearance.
4. Poles should not be placed along the edges of cuts or embankment or along the banks of creeks of streams.
5. Cut – point for a section could be at 1.6 km length (except in special cases), where Double-pole structures are to be provided to take tension of the conductors.

It may have been already estimated that 10 supports (locations) are mostly required in one km. length of H.T. lines and 15 supports for L.T. line.

CONSTRUCTION

The construction activity of H.T. lines may be divided as follows :

1. Pit marking, pit digging.
2. Errection of supports and concreting.
3. Providing of guys to supports.
4. Mounting cross-arms, pin and insulators, and pin binding.
5. Paying and stringing of the conductor.
7. Sagging and tensioning of conductors.
8. Crossings.
10. Earthing.

For low tension lines the activities could be followed, with simplified procedure.
PIT MARKING AND DIGGING PROCEDURE

After surveying, the pole location should be marked with the peg. The pits should not be too large than necessary, as otherwise, after erection of the pole and filing there remains a possibility of tilting of pole. For marking the pits, the dimensions of the pit and the centre to centre distance of pits are required. Pits having a dimension of about 1.2 m x 0.6 m should be excavated with its longer axis in the direction of the line. The planting depth should be about 1/6 length of the support (1500 mm).

Excavation is generally done by using pickaxe crow bars, and shovel, very hard or rocky soil may require blasting of rock by small charges of gun power, etc.

ERRECTION OF POLES AND CONCRETING :

After excavation of pits is completed, the supports/ poles to be erected may be brought to the pit location by manual labour or by cart. Then the pole may be erected inside the pit.

Errection of poles can be done by using Bipod/wooden horse made of15 cm G.I. pipe and 6 m long. The spread of the legs should be 10 m. The tie wire for attachment of bipod to the pole is about 6 m long and is made of 7/10 SWG. (3.15 mm) Stay wire and this wire should be attached the pole at 8 m. The pole is slid along the line route. The pole is tied with3 ropes. The rope at the bottom prevents the pole from being dragged in the direction of the pull. To prevent the support from moving side in raising, two guy ropes are fixed on both sides and attached to temporary anchor.

For smooth sliding and perfect placement of pole in the pit, an inclined trench having 15.2 cm (6 in) width and 10.2 cm (4 in) length may be dug adjacent to the pit as shown below. A piece of M.S. channel may be placed in the inclined position at the other end of the pit for enabling the pole to slip smooth inside the pit.

ERRECTION OF DP STRUCTURE :

For angles of deviations more than 10°, DP structure may be erected. The pit digging should be done along the bisection of angle of deviation.

After the poles are erected, the horizontal/cross bracing should be fitted and the supports held in a vertical position with the help of temporary guys of Manila rope 20/25 mm dia.

Ensuring that the poles are held in vertical position (by spirit level) the concreting of poles with 1:3:6 Ratio may be done from bottom of the support to the ground level. Before lifting the pole in the pit, concrete padding of not less than 75 mm thickness may be put up for the distribution of the lads of the support on the soil or anchor plate could be used.

CONCRETING

The concreting mixture 1:3:6 ratio, would mean 4.15 bags of cement 0.88 Cubic Mtr of 1 ½ size gitti and 0.44 cubic Mtr of sand. It may be noted that while preparing the concrete mixture large quantities of water should not be used as this would wash away cement and sand.
33 KV LINE

(i) Provision at D.P. locations is for 6 guy – sets (20 mm Rod of turn – buckle x 7/4 stay-wire, 8.5 kg in wt for each location). The quantity of concrete at the rate of 0.5 cum for D.P. locations and 0.3 cum for stay sets is 2.8 cum, irrespective whether D.P. locations are of P.C.C. poles or Rail pole.

(ii) Provision for 8 tangent locations in a section of 1 km is for 3 Guy-sets. These will require 0.9 cmt of concrete @ 0.3 cum per Guy-sets. A prefabricated base plate is to be provided at the bottom of the P.C.C. support for uniform distribution of load. If this is not provided then provision at the rate OX)5.cm_ of concrete per location for 8 locations should be made for casting the base-pad before erection of the P.C.C. support. Thus the total quantity of concrete required is 1.3 cum. Tangent locations are not concreted in several states but boulder 1 filling is carried out to economies. If P.C.C. pole tangent locations are to be concreted additional provision for concrete quantity is to be made. However Rail Pole or joist tangent locations (if Rails or joist are used) should be concreted. Provision for tangent location’s concreting is to be at the rate of 0.5 cum per location.

11 KV LINE

- The guys are made with7/3.15 stay wire (5.5 kg) turnbuckle rod is of 16 mm dia. 6 Guy-sets are required at D.P. locations and 4 additional Guy-sets are required in a km for 8 tangent – locations. The quantity of concrete for Guy-sets is provided at the rate of 0.2 cum per Guy-set. D.P. locations of P.C.C. poles require 0.3 cum concrete per location. Boulder filling of tangent locations could be adopted. If concreting is done for tangent locations additional provision at the rate of 0.3 cum per location should be made. Base – pad is to be used if not additional provision for base – pad concreting should be made.

L.T. LINE

- 15 locations are there in 1 km. Provision for 9 guy – sets is made with 7/3.15 stay – wire (5.5 kg), the turn – buckle M.S. Rod is of 16 mm dia. Concrete quantity at the rate of 0.2 cmt per stay – set should be provided. Base pad should be used if not additional provision for base pad concreting is to be made.

PROVIDING OF GUYS TO SUPPORTS

In spite of careful planning and alignment of line route, certain situations arise where the conductor tries to tilt the pole from its normal position due to abnormal wind pressure and deviation of alignment, etc. When these cases of strain arise, the pole is strengthened and kept in position by guys. One or more guys will have to be provided for all support where there is unbalanced strain acting on the support, which may result in tilting/uprooting or breaking of the support.

Guy brackets or clamps are fastened to the pole. The most commonly used form of guy is anchor guy. These guys are provided at (i) angle locations (ii) dead end locations (iii) tee off points (iv) steep gradient locations and (v) where the wind pressure is more than 50 kg sq.m.

Te fixing of guys stays will involve (i) pit digging and fixing stay rod (ii) fastening guy wire to the support (iii) Tightening guy wire and fastening to the anchor. The marking of guy pit, digging and setting of anchor rod must be carefully carried out. The stay rod should be placed in a position so that the angle of rod with the vertical face of the pit is 30°/45° as the case may be.

G.I. stay wire of size 7/3.15 mm (10 swg) or 7/2.5 mm (SWG 12), and 16 mm 720 mm stay rods are to be provided. For double pole structure (DP), four stays along
the bisectional the each direction and two stays along the bisection of the angle of deviation or as required depending on the angle of deviation are to be provided.

After concreting back filling and ramming must be done well and allowed 7 days to set. The free end of the guy wire / stay wire is passed through the eye of the anchor rod, bent back parallel to the main portion of the stay / guy and bound after inserting, the G.T. thimble, where it bears on the anchor rod. If the guy wire proves to be hazardous, it should be protected with suitable asbestos pipe filled with concrete of about 2 m length above the ground level, painted with white and black strips so that, it may be visible at night. The turn buckle shall be mounted at the pole end of the stay guy wire so fixed that the turn buckle id half way in the working position, thus giving the maximum movement for tightening or loosening.

GUY STRAIN INSULATORS

Guy insulators are placed to prevent the lower part of the Guy from becoming electrically energized by a contact of the upper part of the guy when the conductor snaps and falls on them or due to leakage. No guy insulator shall be located less than 3.50 m (vertical distance) from the ground.

FIXING OF CROSS – ARMS & TOP BRACKETS :

After the erection of supports and providing guys, the cross – arms and top – brackets are to be mounted on the support with necessary clamps bolts and nuts. The practice of fixing the cross – arms brackets before the pole erection is also there. In case, these cross are to be mounted after the pole is erected, the lineman should climb the pole with necessary tools. The cross – arm is then tied to, a hand line and pulled up by the ground man through a pulley, till the cross – arm reaches the line man. The ground man should station himself on one side, so that if any material drops from the top of the pole, it may not strike him. All the materials should be lifted or lowered through the hand line, and should not be dropped.

CONDUCTOR ERECTION PAVING AND JOINTING

Conductor erection is the most important phase in construction. The main operations are :-
(a) Transportation of conductor to works site.
(b) Paying and stringing of conductor.
(c) Joining of conductor.
(d) Tensioning and sagging of conductor.

The conductor drums are transported to the tension location. While transportation precautions are to be taken so that the conductor does not get damaged/injured. The drum could be mounted on cable, drum support, which generally is made from crow-bar and wooden slippers for small size conductor drums. The direction of rotation of the drum has to e according to the mark in the drum so that the conductor could be drawn. While drawing the conductor, it should not rub causing damage. The conductor could be passed over poles on wooden or aluminum snatch block mounted on the poles for this purpose.

The mid span jointing is done through compression crimping or if helical fittings are used the jointing could be done manually. After completing the jointing, tensioning operation could be commenced. The conductor is pulled through come-along clamps to stringing the conductor between the tension locations. Sagging of conductor has to be in accordance to the sag tension chart. In order to achieve it, it is preferred to pull the conductor to a tension a little above the theoretical value so that while transferring it from the snatch blocks to the pit insulators and to take care of temperature variation proper sag could be achieved. Sagging for 33/11 kv line is mostly done by “Sighting”. A horizontal strip of wood is fixed below the cross-arm on the pole at the required sag. The lineman sees from the other end and the sag is adjusted by increasing or decreasing the tension. The tension clamps could then be finally fixed and conductor be fixed o pin insulators. All fittings, accessories like guys, cross-arms, etc. could be checked as they should not have deformalities.
SAGGING AND TENSION

The conductor length in a section increases or decreases with variation in atmospheric temperature. In summer when temperature is high the length increases due to expansion and in winter, when the temperature is low the length decreases due to contraction. With increase in length, the conductor becomes loose, sag increases and tension reduces, while in winter the sag decreases, tension increases. The conductor has to be properly kept at the strung atmospheric temperature.

If we design. The line of 75 kg/m² wind-zone then wind load on 1 m length of the conductor and 2/3 projected Dia (D in mm) of the conductor = [(2/3) x 75] x (D/100) x 1 kg.

The line has to be designed to withstand the above load as postulated by the I.E. regulations. Hence it becomes necessary to calculate the tension and sag under conditions occurring at the time of erection. In practice the conductors are hung over Aluminum rollers and pulled up through ropes transferred to the insulators. The tension is not measured as it requires elaborate arrangements and difficult to measure it accurately, the sag is only measured.

There are two important factors which vary the sag and tension :- (i) Elasticity of the conductor and (ii) Temperature. Sag is directly proportional to W and inversely proportional to T. If the length of the conductor increases due to temperature increase then sag will increase. This may be the case in summer, while it may be reverse in winter. The tension accordingly decreases or increases.

In order that the sag and tension values under varied working conditions may be kept according to the regulations, Sag- Tension charts are prepared for different spans and temperatures for ACSR, AAAC & AAC conductor.

SPECIAL CROSSINGS

(A) In case the lines cross over the other lines or buildings, safe minimum clearances are to be maintained as per IE Regulations. The clearances have been tabulated for this purpose under design aspects. These clearances should be maintained.

The crossings could be for :-

(i) Telephone/telegraph lines.
(ii) Buildings.
(iii) Lines of other voltages.
(iv) Roads, streets, other than Roads/Streets.

(B) River Crossing : Data for the highest flood-level should be obtained for previous years. For medium voltage minimum clearance of 3 m be kept over the highest floor level. Double pole or 4 pole structure would be required to be specially designed, depending upon the span and conductor size for the river crossing. The structures should be located at such places that they could be approached under flood condition, also. The foundation of structures should be sound so that it may not get eroded or damaged due to rain water.

GUARDING

Guarding is an arrangement provided for the lines, by which a live conductor, when accidentally broken, is prevented to come in contact with other electric lines, telephone or telegraph lines, railway lines, roads, and persons or animals and carriages moving along the railway line or road, by providing a sort of cradle below the main electric line. Immediately after a live conductor breaks it first touches this cradle guard of G.I. wires before going down further. This, in turn, trips the circuit breakers or H.T / L.T. fuses provided for the H.T. / L.T. lines, and the electric
power in the conductor or the line is cut off, and danger to any living object is averted.

Guarding is not required for crossings of 66 KV and higher voltage lines where the transmission line is protected by fast acting, relay operated circuit breaker of modern design with a tripping time of even less than the order of 0.25 sec. from occurrence of fault to its clearance. For all other crossing, nice Railway Telecommunication lines and major road crossing guarding is essential.

The minimum height between any guard wire and live crossing-conductor shall not be less than 1.5 m in case of a railway crossing.

The guarding consists of 2 G.I. bearer wires strung between the two line supports, and G.I. Cross-lacings connecting two-bearer wires at definite intervals. The bearer fixed to the guarding cross-arms on the line supports by means of threaded eyebolts for proper tightening. In minor L.T. lines, only two guard-stirrups 600 mm long on either side are normally used with single G.I. wire cross-lacing on either side, as a measure of economy. Due to electrification of railway-tracks nowadays, 11 KV & L.T. crossings have to be through under-ground cables.

**EARTHING**

Earthing shall generally be carried out in accordance with the requirements of Indian Electricity Rules, 1956 and the relevant regulations of the Electricity Supply Authority concerned and as indicated below:-

1. All metallic supports shall be earthed.
2. For RCC/PCC poles the metal cross-arms and insulator pins shall be bonded and earthed at every pole for HT lines and at every 5th pole for LT lines.
3. All special structures on which switches, transformers, fuses, etc., are mounted should be earthed.
4. The supports on either side of the road, railway or river crossing should be earthed.
5. All supports (metal, RCC/PCC) of “both Ht and LT lines passing through inhabited areas, road crossings and along such other places, where earthing of all poles is considered desirable from safety considerations should be earthed.

In special locations, railway and telegraph line crossings, special structures, etc. pipe/rod earthing should be done. At other locations the coil earthing may be adopted. The coil earthing consists of 10 m length of 8 swg G.I. wire compressed into a coil 450 mm length and 50 mm dia and buried 1500 mm deep.

**ANTI-CLIMBING DEVICES**

In order to prevent unauthorised persons from climbing any of the supports of HT & LT lines without the aid of the ladder or special appliances, certain anti-climbing devices are provided to the supports. Two methods generally adopted are (i) Barbed wire binding, for a distance of 30 to 40 cm a height of 3.5 to 4 m from round level, (ii) clamps with protruding spikes at a height of 3 to 4 m.

**TESTING AND COMMISSIONING**

When the line is ready for energisation, it should be thoroughly inspected in respect of all following:-

1. Poles- Proper alignment, concreting and muffing.
2. Cross-arms-proper alignment.
3. Binding, clamps and jumpers – To check whether these are in reach.
4. Conductor and ground wire – Proper sag and to check whether there are any cuts, etc.
5. Guys : To check whether the guy wire is tight and whether the guy insulators are high.
6. Earthing System – To check whether the earthing connections of supports and fittings are intact. Measure earth resistance with earth tester.
After the visual inspection is over and satisfied, the conductor is tested for continuity/ground, by means of megger. At the time of testing through megger person should not climb on the pole or touch the guarding, conductor, guy wire etc.

1. Before charging any new line, it should be ensured that the required inspection fee for the new line is paid to the Electrical Inspector and approval obtained from him for charging the line.

2. The line should be energised before the authorised officer.

3. Before energising any new line, the officer-in-charge of the line shall notify to the workmen that the line is being energised and that it will no longer be safe to work on line. Acknowledgement of all the workmen in writing should be taken in token of having intimated them.

4. Wide publicity by Tum-toming should be arranged in all the localities through which the line, that is to be energised passes, intimating the time and date of energizing and warning public against the risk in meddling with the line.

5. The Officer-in-Charge of the line shall personally satisfy himself that the same is in a fit state to be energised.

**THE MAIN FEATURES FOR O.H. LINES IN THE RULES ARE**

<table>
<thead>
<tr>
<th>Supports</th>
<th>Factor of safety 2 to 3.5</th>
</tr>
</thead>
<tbody>
<tr>
<td>Conductors</td>
<td>Factor of safety 2.0</td>
</tr>
<tr>
<td>Stay wires, Guard &amp; Bearer wires.</td>
<td>2.5</td>
</tr>
<tr>
<td>Wind load</td>
<td>50 to 100 Kgs/m2(150 Kg/m2)</td>
</tr>
</tbody>
</table>

(a) Ground clearances

<table>
<thead>
<tr>
<th></th>
<th>Across Street</th>
<th>Along Street</th>
<th>Else Where</th>
</tr>
</thead>
<tbody>
<tr>
<td>i) Up to 650 V</td>
<td>5.791 mt</td>
<td>5.486 mt</td>
<td>4.572 mt</td>
</tr>
<tr>
<td>ii) 650V to 33 KV</td>
<td>6.096 mt</td>
<td>5.791 mt</td>
<td>5.182 mt</td>
</tr>
</tbody>
</table>

<table>
<thead>
<tr>
<th></th>
<th>Vertical clearance above buildings</th>
<th>Horizontal clearances</th>
</tr>
</thead>
<tbody>
<tr>
<td>i) Up to 650 V</td>
<td>2.439 mt (8 ft)</td>
<td>1.219 mt (4 ft)</td>
</tr>
<tr>
<td>ii) 650V to 33 KV</td>
<td>3.64 mt (12ft)</td>
<td>1.82 mt (6 ft)</td>
</tr>
</tbody>
</table>

**Planning the 33/11 KV Sub Station**

Involves the following Steps :-

1. Tentative location based on available data of the 11 KV Network.
2. Capacity of the Sub Station.
3. Selection of site.
   - Orientation of the Sub Station
   - Planning of the Sub Station.

**Main equipments of Sub Station are :-**

1. Structures
2. Power Transformers
3. A) Circuit Breakers
   B) HT Fuse (HG Fuses)
4. Isolating Switches (Isolators)
5. Bus Bar arrangements.
6. Insulators.
7. Lightning Arrestors.
8. Instrument transformers.
   a) Current transformers
   b) Potential transformers
9. Control and relay panels with relays, meters etc.
10. Battery and Battery chargers.
11. Cables.
   i) Power cables.
   ii) Control cables.
12. Earthing arrangement
13. Station Transformer
14. Control room
15. Communication Equipment
16. Fencing, Retaining wall.
17. Illumination, fire fighting equipment, quarter.

BASIC CONCEPT OF PLANNING

Awareness of the causes and their effects itself would reduce the system irregularities to some extent. All these difficulties ultimately lead to a low voltage profile in the system.

The poor voltage profile causes loss of equipments and energy. Thus, maintenance of the voltage profile to keep the consumer voltage at the declared level allowing the deviation within the permissible limits would keep the losses at control. The consumer voltage may be kept at the desired level by controlling one or more of the following variable on which it is dependent.

1. The voltage received at the grid sub-station.
2. The range of tap changing gear available with the power transformers at the sub-station.
3. The percentage impedance of the power transformer at the grid sub-station.
4. The voltage drop in the sub-transmission line (33 KV or 66 KV lines).
5. Tap available with the transformer at the primary distribution sub-station (PDS).
6. The percentage impedance of the power transformer at the PDS.
7. The voltage drop in the primary transformers feeders.
8. The voltage drop in the joints.
9. Voltage regulators/boosters and/or capacitors installed in the system.

GUIDE LINES OF ERRECTION OF POWER TRANSFORMERS IN 33/11 KV SUB STATIONS-

The erection of Power Transformers comprises of following works :-

- Unloading of Transformer from Tractor Tailor/Lorry at the Sub-Station.
- Stacking aside wherever the Power Transformer plinth etc are not ready.
- Moving the transformer on to plinth.
- Assembly of all the mounting, accessories etc.
- Filling and topping up of transformer oil.
- Oil circulation through filter if required.
- Earthing.
- Jumpering.

Unloading of Transformer from Tractor Tailor/Lorry at the Sub-Station :

Generally the higher capacity Power Transformers are sent from the manufacturer duly dismantling, conservator tank radiators, piping etc. in either tractor trailer or lorry. For unloading the man tank from the vehicle we may use a suitable crane or do manually. When manual unloading is done, the following T & P and equipment are required :-.
Platform up to the height if tractor trailer/lorry is to be built up with wooden sleepers. By using hydraulic jacks, the main tank is to be lifted on all sides to a height so that the rail poles can be inserted at the bottom of main tank and main tank rests on rail poles. The other end of poles are to be on the wooden sleeper platform. Now with the help of winch or tirfur the transformer main tank will be dragged on rail poles up to wooden sleeper platform. When the main tank would be dragged correctly over the platform, with the help of hydraulic - jacks the transformer main tank is raised slightly and rails are removed, The main tank is lowered to one sleeper height by slowly removing the top sleepers one after another. During removal of sleepers following step by step operations are done.

1. Keep two jacks under jack pads of transformers along the top sleeper (Which is to be removed one jack each on either end of sleeper).

2. Operate the jacks so that lifting pad of jacks are tightly positioned under transformer jack pads.

3. Now slowly pressurize jacks equally on both sides simultaneously so that one side of the transformer tank is raised slightly to enable to draw out the sleeper.

4. Now place the wooden packing pieces one over the other by the sides of jacks up to jack height.

5. Now remove the sleeper slowly without hitting the jacks.

6. Slowly lower the transformer tank, by releasing pressure in jacks slowly (both simultaneously) and removing the packing pieces one after other.

7. Now remove the jacks, when the side of transformer is securely resting on the next bottom sleepers.

8. Now place the jacks on the other side of the power transformer tank and carry out above operation and remove other side sleeper also.

9. After the transformer tank lowered to the height of one sleeper height, then sleepers are to be placed along the route to the plinth on which PTR is to be erected.

10. On the sleepers rail poles are to be kept duly inserting under the tank and transformer tank is to be dragged close to the plinth.

11. After dragging the transformer tank nearer to plinth the transformer tank is to be raised to the level slightly above the plinth top level by using sleepers & Hydraulic jack.
12. Then the Power Transformer tank is to be dragged on to the plinth slowly with the help of rail poles and winch tirfur.

13. When the transformer tank is correctly positioned / placed on the plinth further work is to be taken up.

ASSEMBLING OF TRANSFORMER FITTINGS, MOUNTINGS

- The radiator dummy plates are to be removed and ensured that no foreign material, moisture is accumulated in the radiators, the radiators can be fitted by using sleepers, jacks / chain pulley block. The radiator valves shall be in closed position only.

- Conservator tank is to be fixed by lifting the same suitably.

- Breather with Silicagel, vent pipe, Buocholz relay, thermometers are to be fixed on to the power transformer.

- Filling / topping up of oil : Now new filtered tested transformer oil is to be filled in the transformer through suitable clean pump & pipes slowly through one of the top valves while filling oil slowly open bottom valve and air releasing dummy of one radiator. When oil is filled up to top of radiator then close the air releasing dummy immediately open top valve of radiator. In the same way all the radiators are to be filled and conservator tank is filled up to 50% level approximately.

- Then release the air once from all air releasing points.

- Checkup oil level in the OLTC unit.

- Then earthing and jumpering is to be done as per standards.

ERRECTION OF BREAKERS

- Before Errection of breaker, suitable plinths are to be constructed duly embedding the foundation bolts as per distances specified in the manual of the breaker.

- Once the curing period of plinth is completed and plinths are perfectly cured, first the mounting structures of the breaker is to be placed on plinth in position. Then the breaker is to be brought near to plinth on rail poles or MS Channels, lifted & erected with the help of chain pulley block & ropes. During errection of breaker for tying the breaker to ropes lifting ring ears provided on the breaker are to be used but not bushings or bushing collar frames.

- CT base channels are already fixed and CT’s are to be positioned on the channels already fixed.

- Jumpering from Bus Isolators to Breaker; Breaker to CT’s; CT’s to line Isolators is done with Panther Conductor through suitable clamps.

- Double earthing of breaker body & CT body is to be done.
ERRECTION OF PTs, L As, CTs

- Before erection of these equipments, base dimension and distances between mounting holes are to be noted.
- Suitable holes are to be drilled in seating structure on which the equipment is to be erected.
- The equipment is to be lifted by using lifting holes provided on the equipment with the help of chain pulley block and manila rope.
- After positioning on the channels, the base is to be fixed to base channel with suitable coated or GI bolts, Plain washers / spring washers and double nuts.
- Earthing & Jumpering is to be done as per the standards.

MATERIAL REQUIRED
Material required for Erection of 33 KV, 11 KV & LT Line.

33 KV LINE :- 01 KM

<table>
<thead>
<tr>
<th>S.NO.</th>
<th>NAME OF ITEM</th>
<th>UNIT</th>
<th>QUANTITY</th>
</tr>
</thead>
<tbody>
<tr>
<td>01</td>
<td>280 Kg. 9.1 mtr PCC pole</td>
<td>NO.</td>
<td>14</td>
</tr>
<tr>
<td>02</td>
<td>OR</td>
<td>NO.</td>
<td>14</td>
</tr>
<tr>
<td>03</td>
<td>33 Kv V Cross Arm with back clamp</td>
<td>NO.</td>
<td>14</td>
</tr>
<tr>
<td>04</td>
<td>33 Kv Top clamp</td>
<td>NO.</td>
<td>14</td>
</tr>
<tr>
<td>05</td>
<td>Earthing Set</td>
<td>NO.</td>
<td>14</td>
</tr>
<tr>
<td>06</td>
<td>33 KV Pin Insulator with GI Pins</td>
<td>NO.</td>
<td>2</td>
</tr>
<tr>
<td>07</td>
<td>Raccoon Eq. AAAC Conductor (8oSq.mm.Al. Eq with 3% Seg.)</td>
<td>KM.</td>
<td>3.09</td>
</tr>
<tr>
<td>08</td>
<td>Jointing Sleeves</td>
<td>NO.</td>
<td>14</td>
</tr>
<tr>
<td>09</td>
<td>Stay Set 20 mm</td>
<td>SET</td>
<td>3</td>
</tr>
<tr>
<td>10</td>
<td>Stay Wire 7/4 mm</td>
<td>KG.</td>
<td>25.5</td>
</tr>
<tr>
<td>11</td>
<td>Concreting of Rail @ 0.65 cmt.</td>
<td>CMT.</td>
<td>9.10</td>
</tr>
<tr>
<td>12</td>
<td>Concreting of Stay @ 0.3 cmt.</td>
<td>CMT.</td>
<td>0.90</td>
</tr>
<tr>
<td>13</td>
<td>Red Oxide Paint</td>
<td>LTR.</td>
<td>14</td>
</tr>
<tr>
<td>14</td>
<td>Aluminium Paint</td>
<td>LTR.</td>
<td>14</td>
</tr>
<tr>
<td>15</td>
<td>Anty Climbing Devices</td>
<td>NO.</td>
<td>14</td>
</tr>
<tr>
<td>16</td>
<td>Danger Board</td>
<td>NO.</td>
<td>14</td>
</tr>
<tr>
<td>17</td>
<td>Winding Wire &amp; Tape</td>
<td>KG.</td>
<td>4</td>
</tr>
<tr>
<td>18</td>
<td>M.S. Nuts &amp; Bolts</td>
<td>KG.</td>
<td>42</td>
</tr>
</tbody>
</table>

33KV DP STRUCTURE

<table>
<thead>
<tr>
<th>S.NO.</th>
<th>NAME OF ITEM</th>
<th>UNIT</th>
<th>QUANTITY</th>
</tr>
</thead>
<tbody>
<tr>
<td>01</td>
<td>280 Kg. 9.1 mtr PCC pole</td>
<td>NO.</td>
<td>2</td>
</tr>
<tr>
<td>02</td>
<td>OR</td>
<td>NO.</td>
<td>2</td>
</tr>
<tr>
<td>03</td>
<td>D.C. Cross arm 100x50x6mm channel suitable for 5 centre DP</td>
<td>SET.</td>
<td>1</td>
</tr>
<tr>
<td>04</td>
<td>33 KV Strain Set with H/W.</td>
<td>SET</td>
<td>6</td>
</tr>
<tr>
<td>05</td>
<td>Earthing Set</td>
<td>NO.</td>
<td>1</td>
</tr>
<tr>
<td>06</td>
<td>33 KV Pin Insulator with GI Pins</td>
<td>NO.</td>
<td>2</td>
</tr>
<tr>
<td>07</td>
<td>Horizontal &amp; cross bracing 5 feet centre with back clamp</td>
<td>SET.</td>
<td>1</td>
</tr>
<tr>
<td>08</td>
<td>Stay Set 20 mm</td>
<td>SET</td>
<td>6</td>
</tr>
<tr>
<td>09</td>
<td>Stay Wire 7/4 mm</td>
<td>KG.</td>
<td>51</td>
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<tr>
<td>10</td>
<td>Concreting of Rail @ 0.65 cmt.</td>
<td>CMT.</td>
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<td>Concreting of PCC Pole</td>
<td>CMT.</td>
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<tr>
<td>12</td>
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<td>CMT.</td>
<td>1.80</td>
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<tr>
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<td>LTR.</td>
<td>1.5</td>
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<tr>
<td>S.NO.</td>
<td>NAME OF ITEM</td>
<td>UNIT</td>
<td>QUANTITY</td>
</tr>
<tr>
<td>-------</td>
<td>--------------------------------------</td>
<td>------</td>
<td>----------</td>
</tr>
<tr>
<td>01</td>
<td>140 Kg. 8 mtr PCC pole</td>
<td>NO.</td>
<td>12</td>
</tr>
<tr>
<td>02</td>
<td>R.S. Joist 175 x 85 mm</td>
<td>NO.</td>
<td>14</td>
</tr>
<tr>
<td>03</td>
<td>D.C. Cross arm 100x50x6mm channel</td>
<td>SET.</td>
<td>1</td>
</tr>
<tr>
<td>04</td>
<td>11 KV V Cross Arm with back clamp</td>
<td>NO.</td>
<td>14</td>
</tr>
<tr>
<td>05</td>
<td>11 KV Top clamp 65 x 65 x 6 mm</td>
<td>NO.</td>
<td>14</td>
</tr>
<tr>
<td>06</td>
<td>Earthing Set</td>
<td>NO.</td>
<td>12</td>
</tr>
<tr>
<td>07</td>
<td>11 KV Pin Insulator with GI Pins</td>
<td>NO.</td>
<td>42</td>
</tr>
<tr>
<td>08</td>
<td>Raccoon Eq. AAAC Conductor (8oSq.mm.Al. Eq with 3% Seg.)</td>
<td>KM.</td>
<td>3.09</td>
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<tr>
<td>09</td>
<td>Jointing Sleeves</td>
<td>NO.</td>
<td>6</td>
</tr>
<tr>
<td>09</td>
<td>Stay Set 20 mm</td>
<td>SET.</td>
<td>4</td>
</tr>
<tr>
<td>12</td>
<td>Stay Wire 7/3.1 mm</td>
<td>KG.</td>
<td>33</td>
</tr>
<tr>
<td>13</td>
<td>Concreting of Rail @ 0.65 cmt.</td>
<td>CMT.</td>
<td>9.10</td>
</tr>
<tr>
<td>14</td>
<td>Concreting of Stay @ 0.2 cmt.</td>
<td>CMT.</td>
<td>0.80</td>
</tr>
<tr>
<td>15</td>
<td>Red Oxide Paint</td>
<td>LTR.</td>
<td>2</td>
</tr>
<tr>
<td>16</td>
<td>Alluminium Paint</td>
<td>LTR.</td>
<td>2</td>
</tr>
<tr>
<td>17</td>
<td>Anty Climbing Devices</td>
<td>NO.</td>
<td>14</td>
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<tr>
<td>18</td>
<td>Danger Board</td>
<td>NO.</td>
<td>14</td>
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<tr>
<td>19</td>
<td>Winding Wire &amp; Tape</td>
<td>KG.</td>
<td>3</td>
</tr>
<tr>
<td>20</td>
<td>M.S. Nuts &amp; Bolts</td>
<td>KG.</td>
<td>18</td>
</tr>
</tbody>
</table>

### 11 KV DP STRUCTURE

<table>
<thead>
<tr>
<th>S.NO.</th>
<th>NAME OF ITEM</th>
<th>UNIT</th>
<th>QUANTITY</th>
</tr>
</thead>
<tbody>
<tr>
<td>01</td>
<td>1400 Kg. 8 mtr PCC pole</td>
<td>NO.</td>
<td>2</td>
</tr>
<tr>
<td>02</td>
<td>R.S. Joist 175 x 85 mm</td>
<td>NO.</td>
<td>2</td>
</tr>
<tr>
<td>03</td>
<td>D.C. Cross arm 100x50x6mm channel</td>
<td>SET.</td>
<td>1</td>
</tr>
<tr>
<td>04</td>
<td>11 KV Strain Set with H/W.</td>
<td>SET.</td>
<td>6</td>
</tr>
<tr>
<td>05</td>
<td>Earthing Set</td>
<td>NO.</td>
<td>1</td>
</tr>
<tr>
<td>06</td>
<td>11 KV Pin Insulator with GI Pins</td>
<td>NO.</td>
<td>2</td>
</tr>
<tr>
<td>07</td>
<td>Horizontal &amp; cross bracing 4 feet centre with back clamp</td>
<td>SET.</td>
<td>1</td>
</tr>
<tr>
<td>09</td>
<td>Stay Wire 7/4 mm</td>
<td>KG.</td>
<td>33</td>
</tr>
<tr>
<td>10</td>
<td>Concreting of Rail @ 0.65 cmt.</td>
<td>CMT.</td>
<td>1.30</td>
</tr>
<tr>
<td>11</td>
<td>Concreting of PCC Pole @ 0.5 cmt.</td>
<td>CMT.</td>
<td>1.00</td>
</tr>
<tr>
<td>12</td>
<td>Concreting of Stay @ 0.2 cmt.</td>
<td>CMT.</td>
<td>1.80</td>
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<tr>
<td>13</td>
<td>Red Oxide Paint</td>
<td>LTR.</td>
<td>2.60</td>
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<td>Alluminium Paint</td>
<td>LTR.</td>
<td>1.60</td>
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<td>15</td>
<td>Anty Climbing Devices</td>
<td>NO.</td>
<td>2</td>
</tr>
<tr>
<td>16</td>
<td>Danger Board</td>
<td>NO.</td>
<td>1</td>
</tr>
<tr>
<td>17</td>
<td>M.S. Nuts &amp; Bolts</td>
<td>KG.</td>
<td>6</td>
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</tbody>
</table>

L.T. LINE :: 01 Km.

<table>
<thead>
<tr>
<th>S.NO.</th>
<th>NAME OF ITEM</th>
<th>UNIT</th>
<th>QUANTITY</th>
</tr>
</thead>
<tbody>
<tr>
<td>01</td>
<td>140 Kg. 8 mtr PCC or R.S. Joist 175 x 85 mm</td>
<td>No.</td>
<td>15</td>
</tr>
<tr>
<td>02</td>
<td>AB Cable Hanging Clamp/ Tension</td>
<td>No.</td>
<td>15</td>
</tr>
<tr>
<td>No.</td>
<td>Description</td>
<td>Unit</td>
<td>Quantity</td>
</tr>
<tr>
<td>-----</td>
<td>-------------</td>
<td>------</td>
<td>----------</td>
</tr>
<tr>
<td>03</td>
<td>Suspension Clamp</td>
<td>No.</td>
<td>15</td>
</tr>
<tr>
<td>04</td>
<td>Dead end clamp</td>
<td>No.</td>
<td>15</td>
</tr>
<tr>
<td>05</td>
<td>Clamp for neutral</td>
<td>No.</td>
<td>15</td>
</tr>
<tr>
<td>06</td>
<td>Piercing connector type I single phase</td>
<td>No.</td>
<td>66</td>
</tr>
<tr>
<td>07</td>
<td>Piercing connector type II single phase</td>
<td>No.</td>
<td>47</td>
</tr>
<tr>
<td>08</td>
<td>1100 Volt Grade Aerial Bunch XLPE Cable including 3 % sag. (i) 3x50 + 1x16 + 1x35 sq mm. (ii) 3x25 + 1x16 + 1x35 sq mm.</td>
<td>Km.</td>
<td>1.03, 1.03</td>
</tr>
<tr>
<td>09</td>
<td>Stay set 16 mm</td>
<td>Km.</td>
<td>9</td>
</tr>
<tr>
<td>10</td>
<td>Stay wire 7/3.15 mm.</td>
<td>Set</td>
<td>49.5</td>
</tr>
<tr>
<td>11</td>
<td>Concreting of R.S. Joist 125x70 mm @ 0.3 cmt.</td>
<td>Kg.</td>
<td>4.50</td>
</tr>
<tr>
<td>12</td>
<td>Concreting of Stay @ 0.2 cmt.</td>
<td>Cmt.</td>
<td>1.80</td>
</tr>
<tr>
<td>13</td>
<td>M.S. Nuts &amp; Bolts</td>
<td>Cmt.</td>
<td>58</td>
</tr>
<tr>
<td>14</td>
<td>Earthing Set</td>
<td>Set</td>
<td>4</td>
</tr>
<tr>
<td>15</td>
<td>Distr. Box for housing 5 No. Amp. MCCB including accessories for fixing suitable for ABXLPE cable</td>
<td>No.</td>
<td>15</td>
</tr>
</tbody>
</table>

**LT AB CABLING**

Now a days LT line is laid on 1100 Volts LT AB Cable.

Size used normally are :-

1). 3 x 50 + 1 x 16 + 1 x 35 sq mm. (Normally in urban area).

2). 3 x 25 + 1 x 16 + 1 x 35 sq mm. (Normally in rural area).

Phase 50/25 sq mm Neutral 16 sq mm and Bare messenger 35 sq mm

**Accessories involved in LT AB Cabling are:-**

1). Dead end clamp assembly (End clamp + hook + pole clamp).

2). Suspension clamp assembly (Suspension clamp + eye hook + pole clamp).

3). Piercing connector.

4). Clamp for neutral connection.

5). Pre insulated mid span joint.

6). End cap.

7). Distribution Box

   i. Single Phase 1 in 9 out.

   ii. Three Phase 1 in 3 out.

**MAXIMUM SPANS**

1). 3 phase 5 wire LT line on R.S. Joist / 140 Kg. PCC pole. (In urban area). – 50 mtr.