**SUBHASH & RUPESH CONSTRUCTION COMPANY PRIVATE LIMITED**

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# WORKING PROCEDURE

# INSTALLATION

# 1 SCOPE

The scope of this section is to give a detailed step by step description of the execution of this project.

# 2 PRELIMINARIES

## 2.1 SURVEY

A preliminary survey of the line shall be undertaken to determine the following:

2.1.1 Centerline span measurements – measurement of the center line distance of the transmission line from tower to tower. During this survey, tower types (whether tension or suspension) shall also be noted along with details of all obstructions, roads and transmission line crossings

2.1.2 Suitable locations for drum sites and engine sites (including facility for splicing) are noted to determine suitable locations for joints.

2.1.3 The height differences between the existing earthwire and the top conductor are measured in order to determine the specifics of the installation procedure.

2.1.4 Any damage to the earthwire (to the extent possible from ground/aerial survey) and other hindrances like aircraft warning spheres.

2.1.5 A reconnaissance of the area shall be carried out to determine the emergency facilities available in the area in case of accident or fire.

2.1.6 The above information shall be compiled in the form of a report that shall be submitted for each line separately to the Project Manager (ICT Department) for approval, prior to the commencement of work on the line.

## 2.2 SURVEY REPORT DOCUMENT

2.2.1 A survey report shall be prepared based on the survey carried out as above. The document shall consist of the following items:

i. Material schedule consisting of tower types (tension or suspension or further info wherever available), horizontal spans, fittings and accessories requirement and remarks regarding obstructions and crossings.
ii. Summary of materials required for the line.

iii. Single line diagram showing the spans and the joint positions, section lengths and the circuit on which the OPGW is to be installed.
iv. Clearances between earthwire and top conductors for the line.
v. Details of nearby emergency facilities.
vi. Staff details such as person in charge, contact numbers etc.

2.2.2 The above report shall be submitted separately for each line to the Project Manager (Department,) for approval prior to the commencement of installation of that line

# 3 PLANNING OF INSTALLATION

### 3.1 Installation plan

Following are the various factors to be borne in mind prior to the starting of installation works

- Preparation of installation machine and tools.
- Plan for safety awareness
- Plan for quality
- Plan for transportation
- Contingency plan in case of accident and tripping should be established before commencemen t of work to ensure lines of communication and actions are clearly established.
- Application for outages for removal of aircraft warning spheres and in case of damage to earthwire.

### 3.2 Management materials and fittings

#### 3.2.1 Inspection of material at site

All material shall be visually examined for any physical damage along with the documentation. Any material which is not as usual shall be closely examined to ensure its condition before use.

| Material | Inspection of items | |
|---|---|---|
| OPGW | Outer surface | • Packing condition<br>• Packing list (Object, Type, Length, Weight, Drum No. etc)<br>• Each ends waterproof treatment |
| | Attenuation | • Measure of attenuation by OTDR |

| | | |
|---|---|---|
| Fittings | Outer surface | • Free or scratches and kinks<br>• Type & Quantity |

### 3.2.2 Transportation and storage

- All material other than OPGW reels shall be stored off the ground or on wooden pallets.
- All OPGW reels shall be identified and shall be braced against accidental rolling.
- To storage complement packing condition.
- To storage each other use and type.
- Extreme care shall be exercised during the loading, transporting unloading and using of m aterials.
- A reel shall be lifted using a spreader bar protruded through the arbor hole it, or fork lift o r crane will be used.

## 3.3 Preparation of installation

**1) Establishment of communication network.(walkie-talkie, talk set, mobile phone etc.)**

Proper communication shall be available at site so as to enable rapid and affirmative liaison always within the stringing sectors. Communication shall be in the form of walkie talkies, with arrangement made for designated points to relay information (also called “centerman”) in the event that any of the walkie talkies are outside range due to terrain or distance.

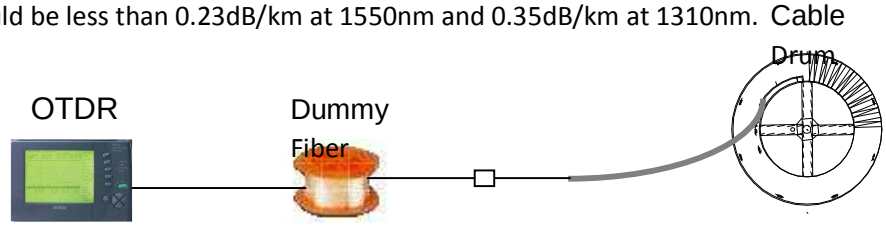
**2) Inspection on breakage of optical fibers (Drum Test)**

Inspection on breakage of optical fibers can be made before paying off the OPGW at site.

For precluding cable that may be damaged during shipment and transportation; every spooled FO cables segment shall be tested prior to installation.

- First of all, check the appearance and marking of the drums
- Check the sealing of the cable ends and spare cable caps
- Carry out the physical inspection of cable assembly and check the continuity and attenuatio n of optical fibers by OTDR
- The attenuation of the fibres shall be distributed uniformly throughout its length such that there are no point discontinuities in excess of 0.1dB. The overall optical fibres attenuation

should be less than 0.23dB/km at 1550nm and 0.35dB/km at 1310nm.




# 4 Preparation for stringing

## 4.1 Pre installation safety checks

- Weather condition has to be verified at the time of starting work - no work shall be undertaken in the following conditions:
  - Strong Winds
  - Rain (including light drizzle)
  - Fog
  - Lightning

- Ropes should be DRY.

- Red flags to indicate safe working route should be installed. Refer FIGURE 1 for details. Strict instructions should be given to the personnel to stay within the dedicated safe working route to reach the working area. The safe working route shall be established based on the 4.57m safety clearance to be maintained while climbing.

- Contractor's competent engineer shall ensure that AUTORECLOSE function on the line shall be switched off prior to commencement of the work.

- All personnel must be equipped with suitable PPE like Safety Belt, Safety Helmet, proper shoes, Walkie-talkies

- The towers in the section must be properly earthed. An additional earth should be installed if necessary.

- OPGW and all equipment that comes in to contact with it (such as rollers, pulling winch etc) shall be grounded. Please refer to Figure 2 for grounding arrangements.

- All tools and equipment must be checked for wear and tear before use.

- Lifting ropes must ONLY be laid WITHIN THE CENTER OF THE TOWER BODY. All lifting of material shall be done ONLY through the tower body..

- Swivel joints, rope connectors and socks joints should be marked with red cloth or warning tape to alert the position and to observe the free movement while they pass through rollers.

- Running out block of sufficient radius should be used to pull out OPGW through sections of tower and cross arm to avoid damage to aluminum strands and thus caging.

### 4.2 REQUIREMENT FOR OUTAGE

**Outage of the transmission line shall be required in the following case:**

- Removal of any hindrances eg aircraft warning spheres from the existing earthwire.
- Damage to existing earthwire such as damaged strands. In such cases, client shall be inform ed and outage shall be requested to take remedial action.
- Landing to substation Gantries.
- In the unlikely event that the traction machine gets stuck in mid-span, and it is not possible t o recover manually.
- Visual identification of any abnormal sag difference between earthwire and conductors.
- Abnormal deep valley in long span.

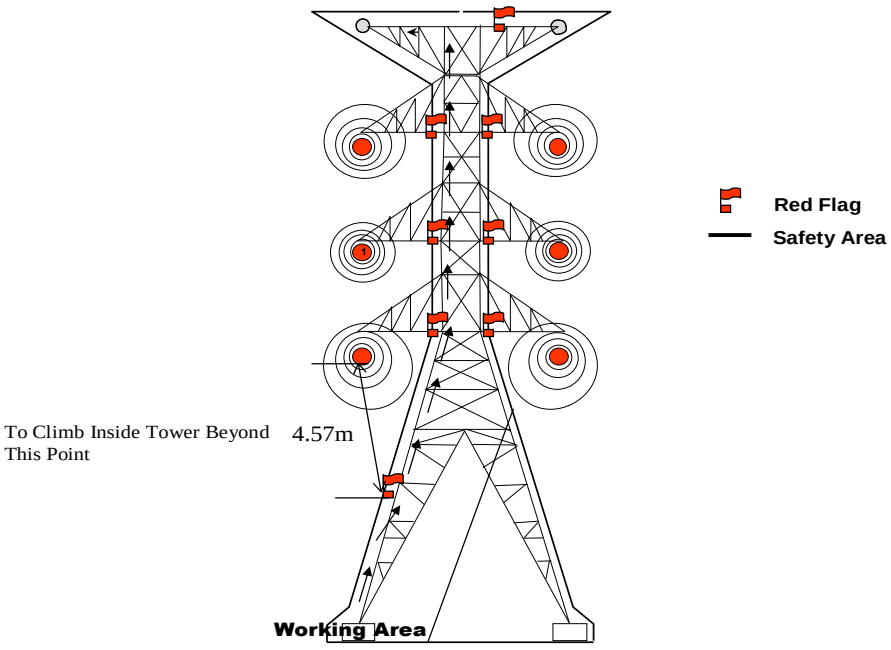



FIGURE 1 - Safe working area

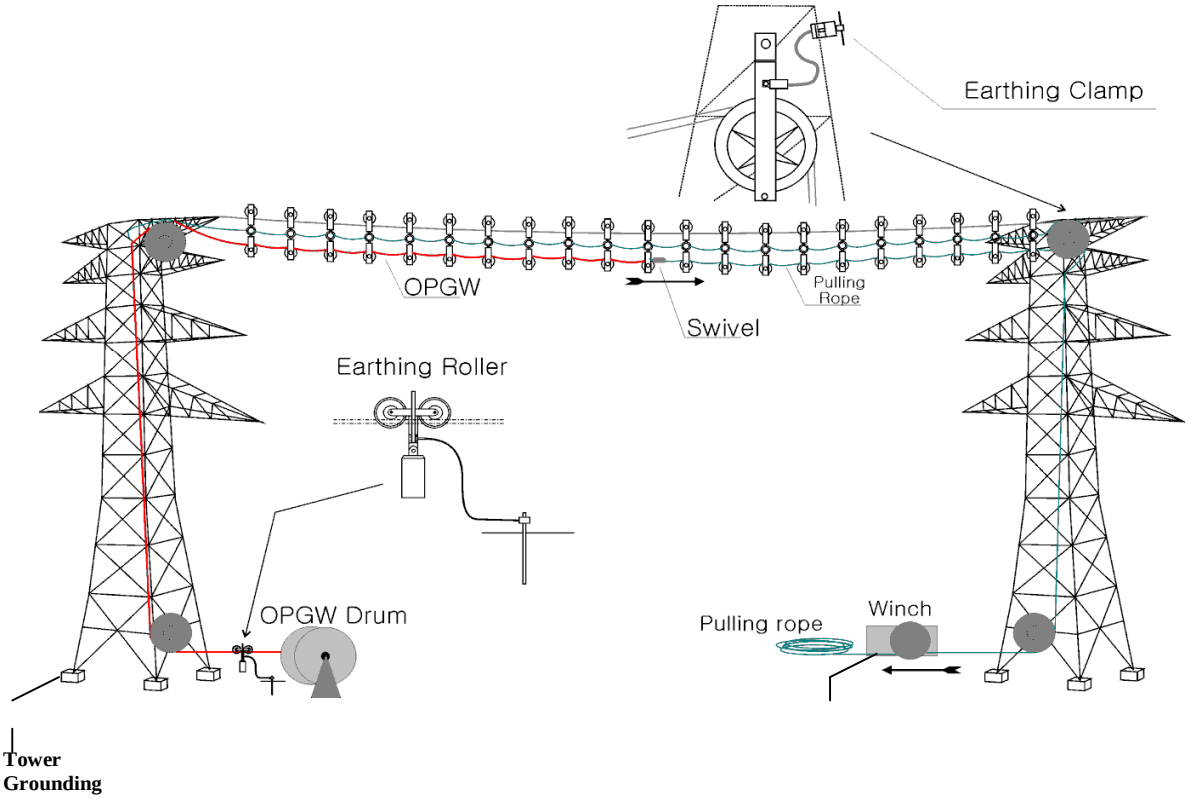



FIGURE 2 – Grounding Arrangements

### 4.3 Stringing plan

The stringing plan should be decided by taking into account the topography over which the transmission line shall pass through, suitable work area, stringing distance and situation of crossed objects.

- Condition of location of drum site and engine site.
- Stringing tension and the twist of block passing.
- Horizontal angle of steel tower and catenary angle of OPGW.
- Available manpower
- No. of tools and mobility.

### 4.4 Location of drum site.

Drum site should not deviate from the transmission line, and it should be decided by following.

- Transportation of drum and stringing equipment.
- Area for work.
- Block installation of tensioner, drum.
- The difficulty of OPGW pulling work due to the facilities near the drum site.
- Pulling angle of OPGW

### 4.5 Location of engine puller site.

Engine puller site should be decided near the transmission line by considering following.

- Transportation of engine
- Area for work.

### 4.6 Block attachment

The pulley block on each tower must be earthed and grounding roller to be used on drum site and winch site to ensure grounding of any induction current developed during installation.

### 4.7 Sagging Tension

While preparing a section for installation the sag of existing earthwire must be visibly checked in the case of following:

- In case the difference of height, in the sagging sector is large.
- In case there is extra ordinary span of height difference in supporting point, in the sagging se ctor.
- In case span length is extra ordinary different.

In case of excessive sag or difference in sag, then TNB shall be informed and outage shall be planned if necessary.

# 5 INSTALLATION PROCESS

## 5.1 STEP 1 - PREPARATION

- All towers in the pulling section shall be properly grounded. Put in additional earth for each tower as a precaution.
- Install OPGW drum with drum stand and tensioner at the drum field.
- Install reel winder and engine puller at the engine field.
- Install guide line using messenger wire or pulling rope and assistant block, if it is not easy to loca te engine field and drum field in the vicinity of tower.
- Preparative equipment, fittings along the situation of working field.
- The support roller be assembled on the pulling rope leave a space 10 m in each support roller.
- The stringing block (Dia.: Φ600 mm) be attached at the top and bottom part of tower in engine f ield and drum field.
- Visually check the clearance between existing ground wire and live-line before stringing.
- Visually check the condition of the earthwire for physical damage. In case it is observed that the ground wire has damages and is not suitable to take up the load of the installation equipments, the department must be informed for further action. Outage may be required in such cases.

Fig. 3

- Connect conductor on tower by wire grip or braid clamp, manipulating installed conductor at all stringing span.

## CHECK POINTS FOR STEP 1 - PREPARATION

| CHECKPOINTS | RESPONSIBILITY |
|---|---|
| Check earthwire visually for damages | Linesman |
| Check twisting and damaging of pulling rope | Preparation Foreman |
| Check Equipment | Installation Foreman & Storekeeper |
| Check tower footing earthing | Linesman for each tower |
| Check stability of equipment/drum at drum/puller site | Preparation foreman |
| Check grounding of rollers | Linesman for each tower |

### 5.2 STEP 2 - INSTALLATION OF SUPPORT ROLLERS

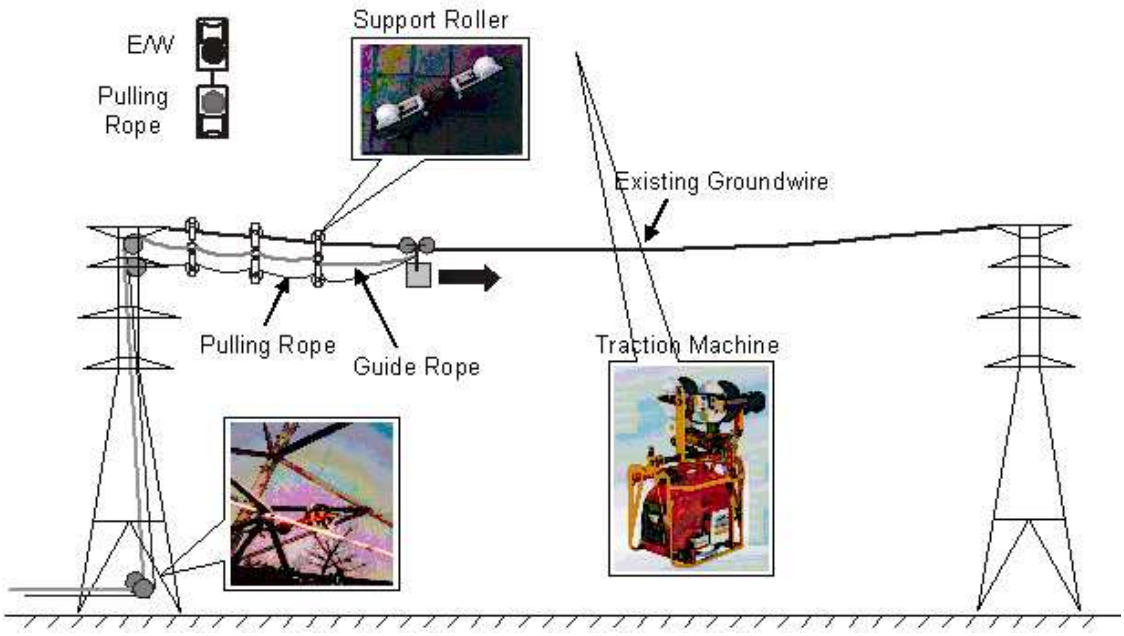



**Figure 4 - INSTALLATION OF SUPPORT ROLLERS**

- Install support rollers at intervals of 10m using a traction machine between spans. The traction machine be shifted from higher tower to lower tower.
- Install roller blocks on the upper part of tower when installing pulling rope.
- Install pulling rope for stringing for entire section.

- Install rollers at the point of contacting with angle of the tower when installing pulling rope.

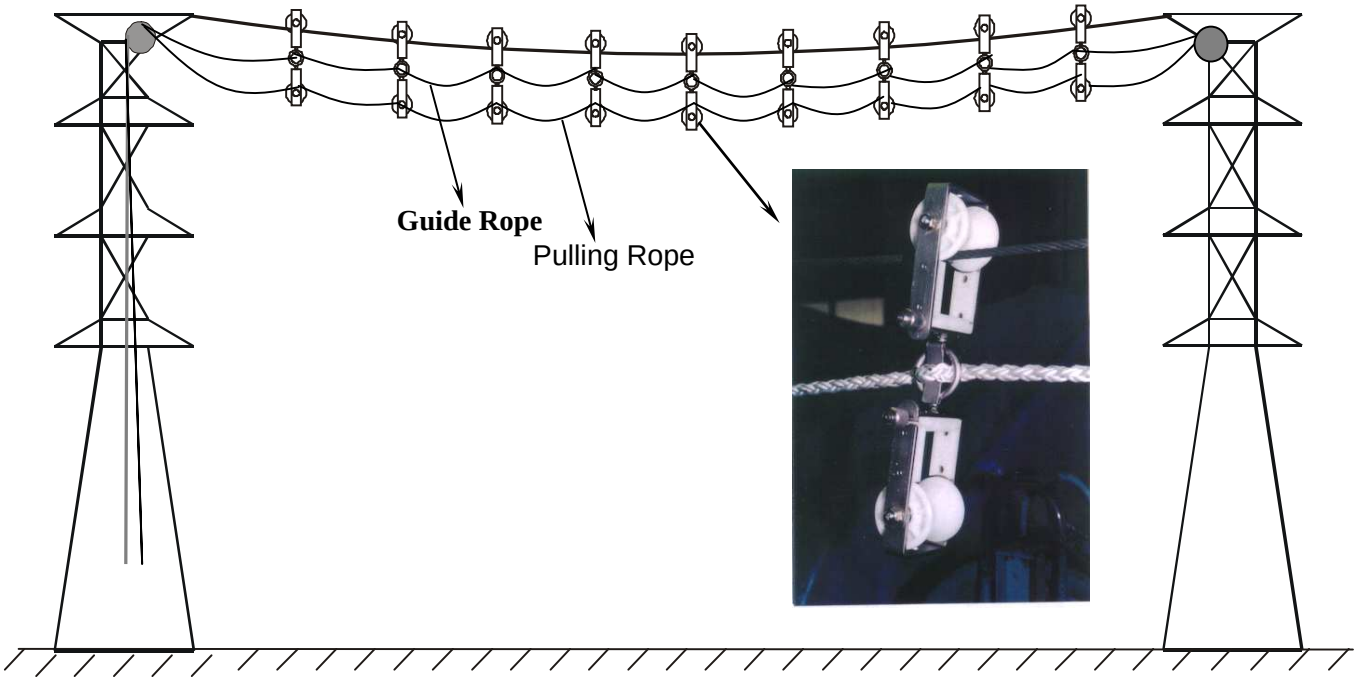



**Figure 5 – Completed Roller Installation**

## CHECK POINTS FOR STEP 2 – INSTALLATION OF SUPPORT ROLLERS

| CHECKPOINTS | RESPONSIBILITY |
|---|---|
| Do not pull before men at next tower are ready | Linesman on each tower |
| Monitor clearances and loop of pulling rope from top conductor | Authorized person & installation foreman |
| Check clamping status of roller | Linesman for each tower |
| Check if guide rope/pulling rope are securely fastened to tower body | Linesman for each tower |
| Pulling/guide rope to be held under tension at the ground by a skilled worker at all times during support roller installation | Installation foreman – Safety Clearance = 3.05m |

## 5.3 STEP 3 – OPGW STRINGING WORK

- Use wire clip and swivel(2Ton) for connecting OPGW and installed rope.
- Pull the installed conductor by using engine puller and reel winder.
- Put restrictions on stringing as follows.
  - Pulling Velocity : 20m/min (As per LG standard practice)
  - The allowable bending radius of the string block : 300mm (over block diameter 450mm or 600 mm)
  - Sag of OPGW: as per sag and tension calculation, however NEVER more than adjacent earth

wire.

- After stringing, the hang of OPGW to be maintained the vertical formation with the existing ground wire and not make it upset.

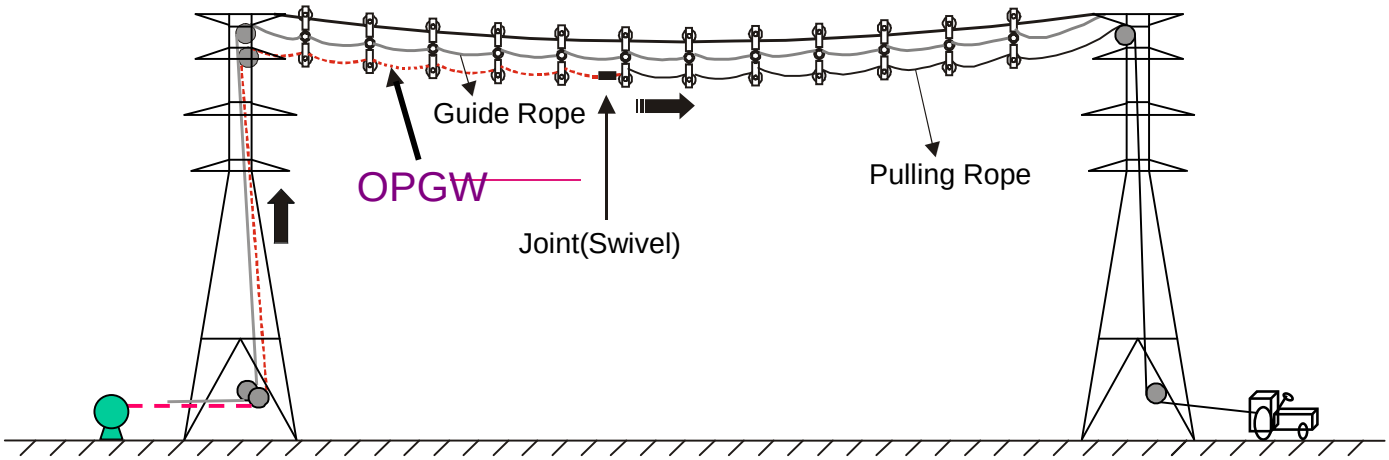
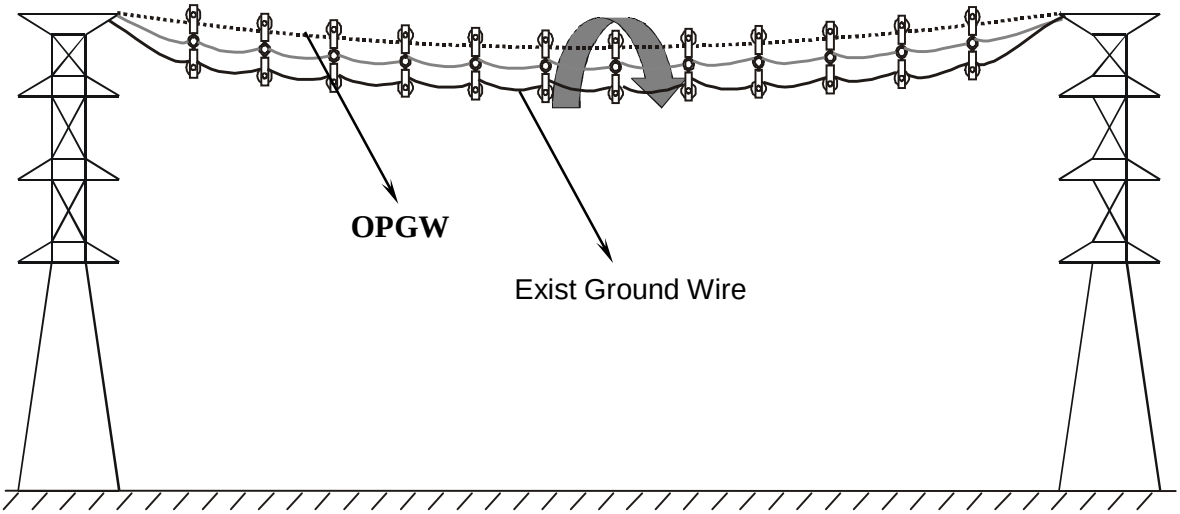



Figure 6 OPGW Pulling process

### 5.4 STEP 4 - Upsetting of OPGW

- Upset the pulling rope at the position of exist ground wire using chain block tension equipment.
- This is done by adjusting the tension of both conductors in order to reverse the two wires.



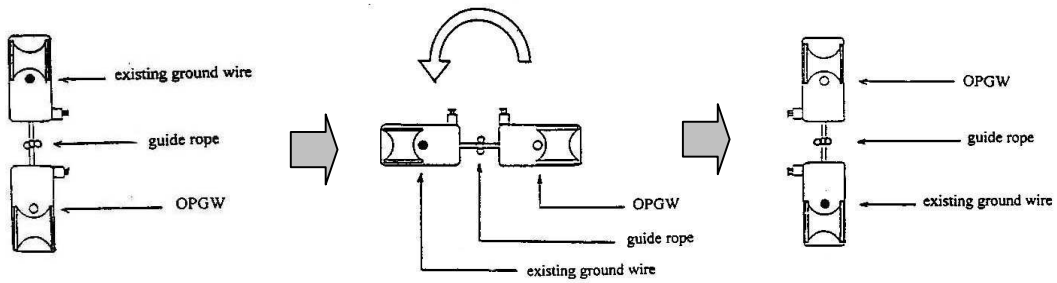



Figure 7 – Upsetting of OPGW

### 5.5 STEP 5 - Remove exist ground wire

- Connect new pulling rope to ground wire, and then withdraw ground wire.

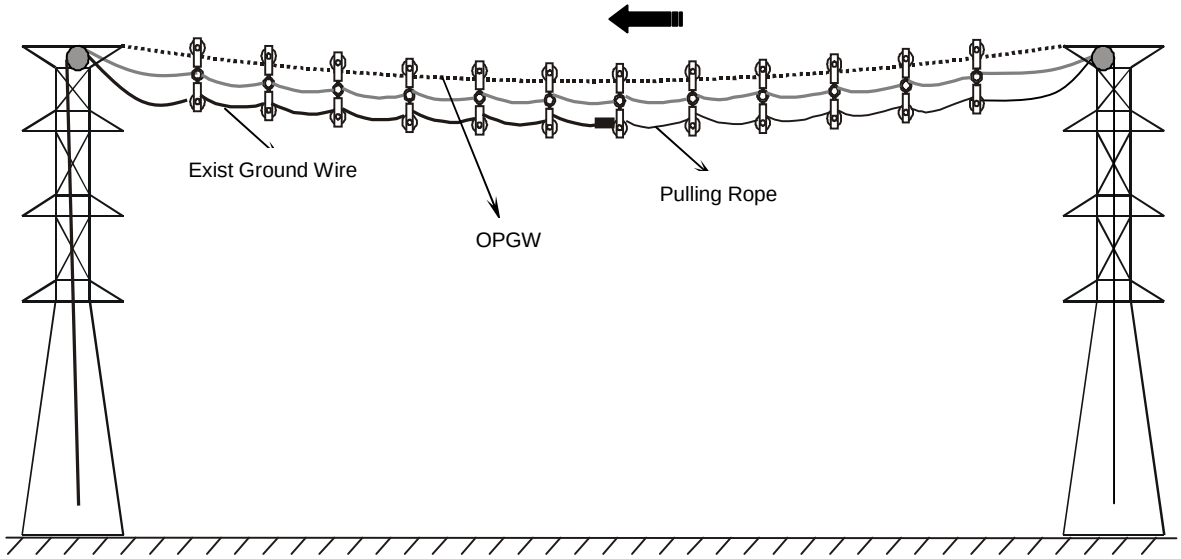



Fig. 8 – Removal of Existing Earthwire

### 5.6 STEP 6 - Retrieving support rollers

- Regain the pulling rope and support rollers to opposite direction between each span. Install retr ieving equipment at the end of guide, pulling rope after loosing the pulling rope a little.
- Retreat the pulling rope on ground by pulling the pulling rope with uniform speed by manpowe r. Retrieve support rollers at the upper part of tower. Reserve retrieving equipment in an own p lace.
- Ensure that the rope is taut at all times to maintain safety clearance of 3.05m at all times.

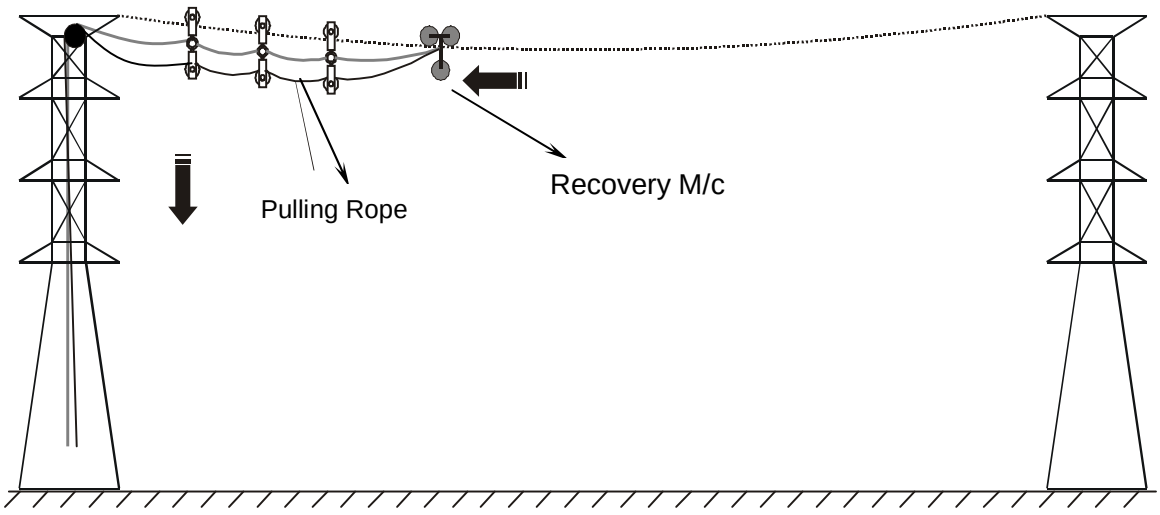



Figure 9 – Retrieval of Support rollers

**CHECKPOINTS FOR STEP 3 TO STEP 6**

| CHECKPOINTS | RESPONSIBILITY |
|---|---|
| Check condition of swivel joints and sock joints | Foreman for installation |
| Monitor clearances and loop of pulling rope and OPGW from top conductor – Figure 10 | Authorized person & installation foreman/linesman |
| Monitor Earthwire/Rope when passing through the roller. | Linesman for each tower |
| Ensure all ropes are securely tied to avoid accidentally touching the line | Linesman/foreman |
| Check retrieving equipment is clamped in the proper direction | Linesman |
| Ensure rope is tight at all times to maintain 3.05m safety clearance | Installation foreman/linesman |

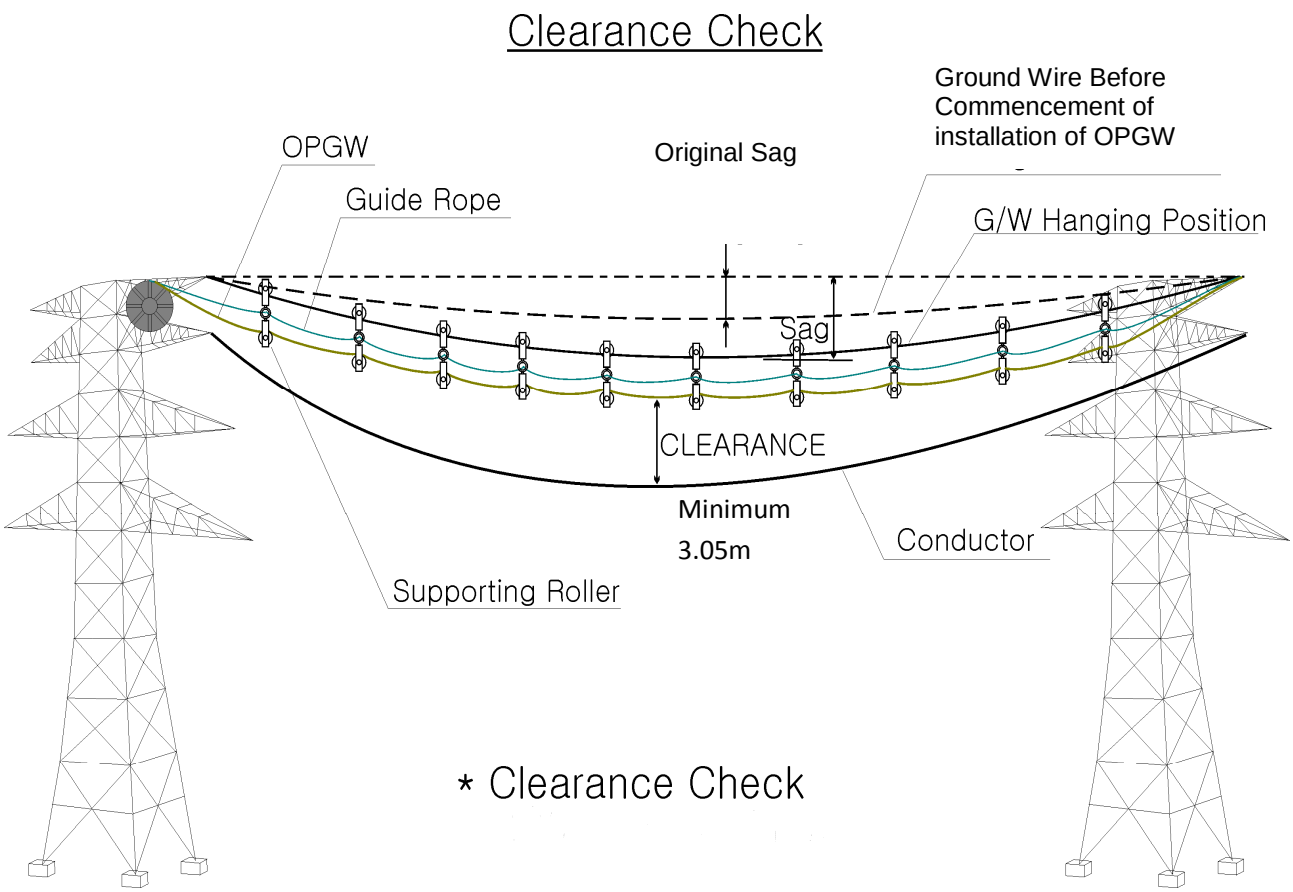



FIGURE 10 – CHECKING ON CLEARANCES FROM CONDUCTOR

## 5.7 STEP 7 – SAGGING AND RETENSIONING

Methods and procedures for sagging of OPGW are the same as those of normal overhead ground wire/OPGW.

1) After stringing the OPGW shall be sagged using information furnished on the sag and tension ch art. However, the sag of the OPGW should not exceed the existing ground-wire sag.

2) The sag shall be controlled with transits or scopes using calculated target, horizontal line of sigh t or calculated angle of sight method.

3) OPGW shall have tolerance as following unless otherwise specified on technical specification.

- At the time of sagging OPGW, the sag of any given phase should be within 6 inches of the theo retical value for existing temperature condition. The sag of all phase of a circuit shall have simi lar tolerances

4) OPGW tension between each sag section shall be equalized and this shall be determined by the vertical position of the suspension clamps on the last clipped structure of the preceding sag sect ion.

5) For pulling the OPGW with tension, the device of come-along is to be recommended.
6) After completion of sagging and clipping, the surplus OPGW is to be lain temporary in the towe r body in coil (Diameter of coil is approximately 1.0 - 1.5 m) and fixed on the tower. It is importa nt that precautions must be taken to prevent any damage of OPGW.
7) Waterproof caps shall be fixed at both ends of the OPGW cable.

**CHECKPOINTS FOR STEP 7**

| CHECKPOINTS | RESPONSIBILITY |
|---|---|
| Check condition of come along clamps | Foreman for installation |
| Sag and Tension chart to be available at site | Project Manager |
| Sag of the earthwire shall not exceed that of adjacent earthwire | Installation foreman, Linesman for each tower |

## 5.8 STEP 8 – CLAMPING WORK

1) Typical arrangements of accessories at the tension tower and the suspension tower are shown in figures. In order to lead down OPGW to the joint box, the arrangement of tension assemblies is different from that for conventional overhead ground wires, while the suspension assembly is almost similar to that for conventional ones.

2) The bending radius of OPGW is recommended to be more than 500mm at the corner position leading from the strain clamp to the arm of tower.

3) Surplus length of OPGW leading down from the strain clamp to the joint box shall be fixed to the tower along with arm and structures by down lead clamps.

4) The balanced length of OPGW should be coiled in a diameter more than 1.5 meter after completion of jointing, and then be firmly fixed to the tower.

5) Splicing shall be carried out as per approved splicing practice.

6) Joint box should be firmly attached to the tower as per approved drawings.
7) Vibration damper will be installed according to the placement chart approved by TNB

**CHECKPOINTS FOR STEP 8**

| CHECKPOINTS | RESPONSIBILITY |
|---|---|
| Proper and approved fittings drawings available at site | Foreman for installation |
| Materials to be checked before application | Foreman for installation |
| Vibration Damper to be placed based on span length | Foreman for installation |

### 5.9 STEP 9 - REMOVING EQUIPMENTS & TOOLS:

Once the stringing and recovery are completed, remove all rollers/pulleys, ropes and safety marks such as red flags & warning tapes from all towers in that section.

### 5.10 STEP 10 – SPLICING AND TESTING

Splicing and testing of the OPGW shall be carried out as per standard TNB practice and company work instructions. The job shall be carried out with proper PTW. The splicing and testing of OPGW do not involve interference in the live zone of the transmission line. However, the technician in charge of splicing shall ensure that at no stage, the working area is less than the required clearance of 3.05m away from the live parts of the line.