Guidelines For The Construction And Maintenance Of Transmission Lines

Edvard

Overhead transmission line

The purpose of this article is to give a general overview of the steps that are necessary in the ***planning and construction*** of a typical overhead transmission line, to give newcomers to the trade a general format to follow, and assist transmission design engineers in understanding how such lines are built.

Stringing overhead conductors in transmission is a very specialized type of construction requiring years of experience, as well as equipment and tools that have been designed, tried, and proven to do the work. Because transmission of electrical current is normally at ***higher voltages*** (*69 kV and above*), conductors must be larger in diameter and span lengths must be longer than in normal distribution.

Although proximity to other energized lines may be limited on the right-of-way, extra care must be exercised to protect the conductor so that when energized, power loss and corona are not a problem.

Medhods of installing

There are four methods that can be used to install overhead transmission conductors:

1. Slack stringing
2. Semi-tension stringing
3. Full-tension stringing
4. Helicopter stringing

Slack stringing

can only be utilized if it is not necessary to keep the conductor off of the ground, and if no energized lines lie beneath the line being strung. In this method the pulling lines are pulled out on the ground, threaded through the stringing blocks, and the conductor is pulled in with less tension than is required to keep it off the ground.

This is not considered to be an acceptable method ***when demands involve maximum utilization*** of transmissio requirements.

Semi-tension methods

are merely ***an upgrading of slack stringing***, but do not necessarily keep the conductor completely clear of the ground, or the lines used to pull.

Full-tension stringing

is a method of installing the conductors and overhead groundwire in which sufficient pulling capabilities on one end and tension capabilities on the other, keep the wires clear of any obstacles during the movement of the conductor from the reel to its final sag position.

This ensures that these current-carrying cables are “*clipped*” into the support clamps in the best possible condition, which is the ultimate goal of the work itself.

Stringing with helicopters

which is ***much more expensive per hour of work***, can be much less expensive when extremely arduous terrain exists along the right-of-way and when proper pre-planning is utilized.

Although pulling conductors themselves with a helicopter can be done, it is limited and normally not practical. Maximum efficiency can be achieved when structures are set and pilot lines are pulled with the helicopter, and then the conductor stringing is done in a conventional manner.

Special tools (*such as stringing blocks*) are needed if helicopters are used.

So that maximum protection of the conductor is realized and maximum safety of personnel is attained, properly designed and constructed tools and equipment are tantamount to a successful job. Because the initial cost of these tools and equipment represent such a small percentage of the overall cost of the project, the highest quality should be used, thus ***minimizing “down time”*** and possible failure during the course of construction.

Tools

Basic tools needed to construct overhead transmission lines are as follows:

1. Conductor blocks
2. Overhead groundwire blocks
3. Catch-off blocks
4. Sagging blocks
5. Pulling lines
6. Pulling grips
7. Catch-off grips
8. Swivels
9. Running boards
10. Conductor lifting hooks
11. Hold-down blocks

Conductor blocks are made in the following configurations:

1. Single conductor
2. Multiple conductor
3. Multiversal type (*can be converted from bundle to single, and vice versa*)

Guidelines For The Construction And Maintenance Of Transmission Lines (photo by Mike Lawrence: An S64F Erickson Air-crane flies off with a section of lattice tower that will be transported to a construction site on Henderson Island in the Ohio River for a power transmission line being built from the Big Rivers Power Complex in Henderson County to the A.B. Brown power plant in Posey County, Indiana.)

4. Helicopter

Conductor blocks should be large enough ***to properly accommodate the conductor*** and ***be lined with a resilient liner*** such as neoprene or polyurethane and constructed of lightweight, high-strength materials.

Sheaves should be mounted on anti-friction ball bearings to reduce the tension required in stringing and facilitate proper sagging. Conductor blocks are available for stringing single conductors or multiple conductors. Some are convertible, thus enhancing their versatility.

When stringing multiple conductors, it is desirable to pull all conductors with a single pulling line so that all conductors in the bundle have identical tension history. The running board makes this possible.

Pulling lines are divided into two categories:

1. Steel cable
2. Synthetic rope

Because of the ***extra high tension required in transmission line construction***, steel pulling lines and pilot lines are most practical to use.

Torque-resistant, stranded, and swagged cable are used so that ball bearing swivels can be utilized to prevent torque buildup from being transferred to the conductor.

Some braided or woven steel cables are also used. If ***synthetic ropes are utilized***, the most important features should include:

1. No torque
2. Very minimum elongation
3. No "*kinking*"
4. Easily spliced
5. High strength/small diameter
6. Excellent dielectric properties

Tesmec transmission line stringing equipment

A helicopter starts the process of stringing a high-voltage transmission line

Stringing overhead groundwires does not normally require the care of current-carrying conductors.

Most overhead groundwires are stranded steel construction and the use of steel wire with a fiber-optic core for communications has become a common practice. Special care should be taken to ensure that excessive bending does not occur when erecting overhead groundwires with fiber-optic centers, such as ***OPT-GW*** (*Optical Power Telecommunications — Ground Wire*) and ***ADSS*** (*All Dielectric Self-Supporting Cable*).

Special instructions are available from the manufacturer, which specify minimum sheave and bullwheel diameter for construction. OPT-GW should be strung using an antirotational device to prevent the cable from twisting.

Helicopter Makes Quick Work of Line Construction (VIDEO)

Cant see this video? Click here to watch it on Youtube.

Six Zebra Conductor stringing on 765kV Double Circuit Transmission Line (VIDEO)

Cant see this video? Click here to watch it on Youtube.

Skycrane Construction on McNary-John Day 500kV Transmission Line (VIDEO)

Cant see this video? Click here to watch it on Youtube.

Replacing Spacers

One of the first uses of helicopters in live-line work was ***the replacement of spacers in the early 1980s***. This method was a historic step in live-line work since it circumvented the need for hot sticks or insulated aerial lift devices.

Traditionally, ***the transmission line would have been de-energized***, ***grounded***, and either a line worker would have utilized a spacer cart to move out on the line to replace the spacer, or the line would have been lowered and the spacer replaced and the conductor strengthened.

The obvious ***safety dilemma*** was whether the conductor could support a line worker on a spacer cart or whether it was physically able to withstand the tensions of lowering it to the ground. By utilizing a helicopter and bare-hand work methods, the spacers were able to be replaced and the conductor strengthened where necessary with full-tension compression splices while providing total safety to the line workers and a continuous supply of energy over the transmission lines.

CES Blocks for Helicopter Stringing - suitable for stringing the pilot rope by a helicopter

Insulator Washing

Another common practice is ***to utilize helicopters for insulator washing***.

Heli Insulator washing (photo by pjhelicopters.com)

Again, this is a method that allows for the line to remain energized during the process.

The helicopter carries a water tank that is refilled at a staging area near the work location. A hose and nozzle are attached to a structure on the helicopter and are operated by a qualified line worker who directs the water spray and adequately cleans the insulator string.

Again, with the ease of access afforded by the helicopter, the speed of this operation can result in a typical three-phase tower being cleaned in a few minutes.

Reference: *The Electric Power Engineering Handbook – Wilford Caulkins and Kristine Buchholz*

Source: http://electrical-engineering-portal.com/guidelines-for-the-construction-and-maintenance-of-transmission-lines