3 phase high voltage overhead power line

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An overhead power line is a structure used in electric power transmission and distribution to transmit electrical energy along large distances. It consists of one or more conductors (commonly multiples of three) suspended by towers or poles. Since the surrounding air provides good cooling, insulation along long passages and allows optical inspection, overhead power lines are generally the lowest-cost method of power transmission for large quantities of electric energy.

Foundations for tower structures may be large and costly, particularly if the ground conditions are poor, such as in wetlands. Each structure may be stabilized considerably by the use of guy wires to counteract some of the forces applied by the conductors.

Power lines and supporting structures can be a form of visual pollution. In some cases the lines are buried to avoid this, but this "undergrounding" is more expensive and therefore not common.

A grounded wire is sometimes strung along the tops of the towers to provide lightning protection. An optical ground wire is a more advanced version with embedded optical fibers for communication. Overhead wire markers can be mounted on the ground wire to meet International Civil Aviation Organization recommendations.[6]Some markers include flashing lamps for night-time warning.

A single-circuit transmission line carries conductors for only one circuit. For a three-phase system, this implies that each tower supports three conductors.

A double-circuit transmission line has two circuits. For three-phase systems, each tower supports and insulates six conductors. Single phase AC-power lines as used for traction current have four conductors for two circuits. Usually both circuits operate at the same voltage.

In some countries like Germany most power lines with voltages above 100 kV are implemented as double, quadruple or in rare cases even hextuple power line as rights of way are rare. Sometimes all conductors are installed with the erection of the pylons; often some circuits are installed later. A disadvantage of double circuit transmission lines is that maintenance can be difficult, as either work in close proximity of high voltage or switch-off of two circuits is required. In case of failure, both systems can be affected.

Insulators must support the conductors and withstand both the normal operating voltage and surges due to switching and lightning. Insulators are broadly classified as either pin-type, which support the conductor above the structure, or suspension type, where the conductor hangs below the structure. The invention of the strain insulator was a critical factor in allowing higher voltages to be used.

At the end of the 19th century, the limited electrical strength of telegraph-style pin insulators limited the voltage to no more than 69,000 volts. Up to about 33 kV (69 kV in North America) both types are commonly used.[1] At higher voltages only suspension-type insulators are common for overhead conductors.

Insulators are usually made of wet-process porcelain or toughened glass, with increasing use of glass-reinforced polymer insulators. However, with rising voltage levels, polymer insulators (silicone rubber based) are seeing increasing usage.[7] China has already developed polymer insulators having a highest system voltage of 1100 kV and India is currently developing a 1200 kV (highest system voltage) line which will initially be charged with 400 kV to be upgraded to a 1200 kV line.[8]

Porcelain insulators may have a semi-conductive glaze finish, so that a small current (a few milliamperes) passes through the insulator. This warms the surface slightly and reduces the effect of fog and dirt accumulation. The semiconducting glaze also ensures a more even distribution of voltage along the length of the chain of insulator units.

Polymer insulators by nature have hydrophobic characteristics providing for improved wet performance. Also, studies have shown that the specific creepage distance required in polymer insulators is much lower than that required in porcelain or glass. Additionally, the mass of polymer insulators (especially in higher voltages) is approximately 50% to 30% less than that of a comparative porcelain or glass string. Better pollution and wet performance is leading to the increased use of such insulators.

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