Basic Engineering for Overhead Insulated Transmission Line

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ABSTRACT

The large urban centers almost always have high densities of load to be fed. Generally 40 MVA / km² have been a density that requires the distribution system to be directly buried and consequently the power substations of these centers of load must be made by insulated cables. For central districts, it is often necessary to have bulk substations 138kv / 13.8kv with power of the order of 100 MVA, requiring cables of about 400mm² or higher in 138kv for supplying these substations. Large cities present great difficulty in building underground lines due to the saturation of their sub soil with a wide variety of utilities. Looking for alternatives to this type of problem led to consider the wide corridors with some overhead transmission line system with insulated cables. This alternative has some attractiveness; (a) Eliminates excavations highly undesirable for municipal authorities; (b) Virtue (a) brings with it an effective reduction of implantation costs; (c) Screened and effectively grounded and yet with circulating currents reduces electromagnetic incompatibility, among others. Therefore, this technological challenge was placed to the utilities, and this work presents the progress made in the technological development of this new modality of electric power transmission.

KEYWORDS

Overhead Transmission Lines, Cables Insulated Sag and Tension, Elastic Line Vibration.

INTRODUCTION

An overhead line with insulated cables suspended between structures to be designed must pass on by criteria of a priori choices to save experimentation and unnecessary developments. These choices are mostly: (1) heuristic, (2) empirical, (3) experimental, or even (4) rational, heuristics, and when exercised they should be rehearsed in their real-scale form. The elastic line consisting of an insulated cable with the electric field fully confined within an electrostatic shield. This electrostatic shield shall be fully enclosed within an electromagnetic shielding that will arm each phase individually. The material of the electrostatic shield must have dielectric relaxation time close to zero. The material of the electromagnetic shield must have mechanical resistance to support the elastic line and provide condition of all current that will do the shielding of the phase. The electrostatic shield shall be mechanically decoupled from the electromagnetic shielding so as not to impart mechanical stresses to the dielectric.

Since the elastic line is a cable suspended between structures and the core an electrostatically shielded cable, must be free to move inside a shell. This assembly will provide support: (a) elastic line, (b) electromagnetic shielding, (c) core, cable splice splits shall also be free to move forward and backward within the metal housing or the assembly shall be fully locked at the point of suspension. Transition splices, between insulated cable and bare cable, should be rigidly anchored in header structures (stayed or not). In addition to these concepts and fundamentals, all other established theories for suspended cables and insulated cables should be invoked during the design.

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The following figure shows the cable core to its electrostatic shielding. The conductors will always be aluminum stranded in normal class A formation.

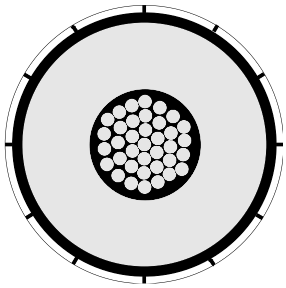

FIGURE (1)

HV CABLE 139 kV BIL 650 kV

A layer of semiconductor plastic is applied over the conductor in order to reduce the effects of recesses and protrusions in the electric field, which must be perfectly radial. On the inner semiconductor layer is applied the dielectric itself. Another layer of external plastic semiconductor is applied on the dielectric. This assembly will be tied with an aluminum (or aluminum alloy) tape covering providing the so-called insulated core of the cable with a confined electric field (since the outer layer of this core will be effectively grounded).

Over the core of the cable will be applied the shell that will play the role of mechanically resistant element and also the electromagnetic shielding of the cable. This shell consists of a corrugated aluminum tube of sufficient thickness to contain the core of the previous figure (1) and serves as a mechanical support tie which in this case was an AW (Alumoweld) messenger cable covered with a plastic PE sheath.

The two sets: Core and shell after mounted one inside the other will have the form shown in figure (2) forward, as the two elastic lines are in contact with each other, the set will be a mechanical system with two degrees of freedom joined by friction Coulombian.

The support of the insulated cable will be provided by a