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# BASIC METHODS FOR SOLVING THE REDUCTION OF CORONA LOSSES IN ULTRAHIGH VOLTAGE NETWORKS

**Abstract:** This thesis explores the relevance of work to reduce corona losses in a high-voltage electrical network and provides the most effective methods for reducing corona losses.

**Keywords:** Corona power loss, wire diameter increase, expanded wires, z-wires, ferromagnetic coating.

The existence of corona discharge on transmission line wires is facilitated by air ionization and discharge current flow near the wires, which is accompanied by glow near the surface of wires, formation of ozone and nitrogen oxides. Corona discharge causes not only power losses, but also corrosion of wires, which leads to deterioration of wire communication elements and high-frequency installations.

The following are the most effective methods for reducing corona losses:

1) **One of the means of corona control is to increase the wire diameter.** The main parameter in the construction of transmission lines is the selection of such design parameters of the line that the corona losses, at least in warm weather, are close to zero.

| **Standard cross-section, mm2** | **SA-70** | **SA-120** | **SA-240** | **SA-600*** |
|---|---|---|---|---|
| **Diameter, mm** | 11,4 | 15,5 | 21,4 | 33,3 |
| **Permissible current, A** | 265 | 390 | 610 | 1050 |
| **Active resistance, Ohm/km at 20°C** | 0,422 | 0,244 | 0,118 | 0,0498 |
| **Distance between wires, m** | 3,5-4 | 4,5-5 | 5-6 | 6-7 |

*SA-70, SA-120 – are uninsulated steel-aluminum wires with an aluminum core with a cross section of 70and 120 millimeters square; SA-240, SA-600 – are an uninsulated steel-aluminum wire with a lightweight steel core.

Table 1. Smallest permissible diameters of single conductors of overhead lines under conditions of corona losses

It is possible to increase the wire diameter by using different fillers inside the wires, such as aluminum tubes, sector frames supporting inner spirals of aluminum wires or fiberglass filled wire structures. Such constructions avoid excessive consumption of non-ferrous metal and increase the cost of overhead lines, while maintaining the original cross-section of the conductive part [1].

2) **Split wires** are most common in high and extra-high voltage transmission lines, in which the phase is replaced by several of the thinnest standard wires, instead of a single wire of larger cross-section [2]. They are placed at a certain distance from each other, but with the total cross-section equal to the cross-section of a single wire or slightly exceeding it. Split wires allow to reduce the level of radio interference. When splitting wires, the use of expensive wires loses its relevance, but the installation of split wires is the most complicated and requires a device for hanging wires of split phase with maintaining a certain step between the wires (40-50 cm). Line inductance is reduced when using split wires. The wave impedance is also reduced, which leads to an increase in transmission capacity.

3) **Shields are an important method of corona discharge control.** The shield is a casing or box made of thin sheet steel, which as if encloses all corona parts (bolts, nuts, sharp protruding parts, etc.) and is electrically connected with corona parts, i.e. it has the same potential as the corona parts of the installation. The use of screens improves the aesthetic appearance of the installation.

4) Among the more modern methods to combat corona losses (CL) is the **use of Z-type wires**. In this case, the PCL is reduced due to the smoother sheath of the wire. Compared to simple steel-aluminum wires, the field strength must be 15% higher for corona discharge to occur on z-wires (AERO-Z and AAAZC) [4].

5) Another effective method is to coat the surface of the wires with ferromagnetic materials with a low Curie temperature. This makes the wires self-protective against icing. When the wire temperature is below the Curie temperature, the wire coating is remagnetized and heat is generated in the coating, which prevents the formation of ice and frost deposits on the wires. Thus, the method makes it possible to eliminate the highest level of corona losses, which occurs with ice and frost deposits [1].

From the above methods contributing to the reduction of corona losses, it can be concluded that along with rather old methods of PC control, more modern methods exist and are being developed. This increases the number of competing design solutions when designing new overhead lines and modernizing existing ones.

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