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METHODS FOR DETECTING AND REDUCING THE INFLUENCE OF CORONA CHARGES ON HIGH-VOLTAGE EQUIPMENT

A corona discharge is a lightning discharge that occurs sharply in inhomogeneous electric fields of electrodes with a significant curvature of the surface (at sharp corners of connecting elements or thin wires). The high value of the intensity of the inhomogeneous electric field and the relatively high air pressure around the electrical equipment create a characteristic glow, in the form of a crown shape, which can be seen even with the naked eye. The described visual phenomenon of corona discharge is shown in Figure 1.

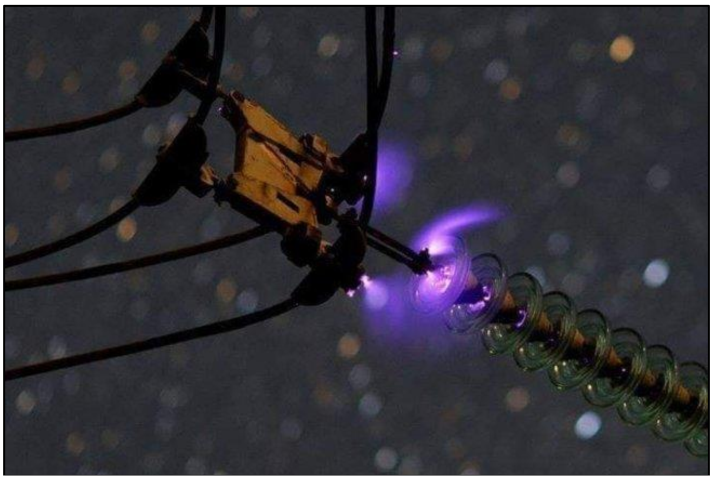

Figure. 1. Corona discharge occurring on an insulator in a high-voltage overhead power transmission line with a voltage of more than 500 kV

The causes of corona discharges are caused by several factors: air humidity, the state of insulation of the power line, the electric field strength exceeding the critical value [1].

When diagnosing the condition of high-voltage equipment without stopping its operation, a remote study is carried out, which allows implementing an electron-optical method of non-destructive testing. This method involves the use of highly sensitive measuring equipment that works effectively in day and night conditions, modern means of communication that carry out a quantitative assessment of processes to facilitate the operator's work during a full working day.

For this case, DayCorOfil electron-optical flaw detectors and CoroCAM 8 cameras are used, converting ultraviolet (UV) radiation into a visible image. The flaw detectors shown in Figure 2 differ in equipment, visualization and image registration tools, a set of additional functions, as well as a range of working distances.

а) б)

Figure. 2. UV flaw detectors
а) CoroCAM 8; б) DayCorOfil

The main disadvantage of corona cameras (flaw detectors) is the increased cost, since very complex and expensive optical systems are needed, which are based on electron-optical converters (EOP), as a result of which the operation of the photocathode is aimed at the ultraviolet range of optical radiation. The work plan of the optical ultraviolet flaw detector is based on the following algorithm.

The first thing the operator needs to do is to install the device at a specified distance from the object of control. When the device is started, the ultraviolet radiation emitted by the object is registered and converted into an electrical signal, which is processed taking into account the peculiarities of the appearance of corona discharges on high-voltage equipment. Signal processing leads to digitization, and its amplification due to the action of EOP, in order to transmit the received information directly to the operator or to data storage devices [2].

Based on the information received, the presence of corona discharges and defects in the considered section of the control object is revealed.

At the moment, it is not possible to completely eliminate and prevent the appearance of corona discharges in sections of power transmission circuits. However, there are ways to reduce the frequency and intensity of their manifestation. Let's look at some of them.

The use of expanded wires with an increase in diameter. Since the tension affects the formation of a corona discharge, then to reduce it, you should increase the diameter of the wire. This depends on the fact that the electric field strength on the surface of the wires is inversely proportional to the diameter of the wire, as a result of which they decrease with increasing diameter.

Using wires with a smooth outer surface. Rain, fog, frost can affect the appearance of additional irregularities on the wires in the form of a liquid droplet phase. At the same time, the non-smoothness coefficient decreases to 0.45-0.55, as a result of which the electric field strength E increases, forming a corona discharge.

Installation of anti-coronal rings on the lines. These devices, which are toroids made of conductive material, distribute an electric field to reduce the intensity values below the corona occurrence limit, so the discharge is transferred to the ring or completely absent.

Splitting of phase wires. Any of the phases, instead of a single wire of a large cross-section, usually of a special and sometimes complex design, is replaced by a small number of thin standard wires located at a specific distance from each other, but with a common cross-section that is equal to or slightly exceeds the cross-section of a single wire. With the use of split wires, the level of radio interference can be significantly reduced [3].

The methods of preventing corona discharges are being improved every year. At the moment, electron-optical control is characterized by high performance and accuracy of results, and also guarantees the safety of diagnostics.

Sources

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