ELECTROMAGNETIC INTERFERENCE OF HIGH-VOLTAGE EQUIPMENT

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ABSTRACT

This work deals with electromagnetic interference high-voltage equipment. Are described sources of interference and their effects. Furthermore, there are practical ways to describe constraints HF noise.

KEYWORDS

Capacitive discharge, corona, electromagnetic emissions, HF noise, spark.

1. INTRODUCTION

When operating high voltage and high voltage devices are often problems with the disturbance applied to electronic devices in the vicinity. Electromagnetic emissions, caused mainly by high-voltage equipment fault conditions are also the subject of frequent disputes between the operator and the population.

2. SOURCES OF INTERFERENCE

Very powerful disruptive effects of power overhead lines show very high (VHV) and high (HV) voltage. This interference is caused mainly fought activities of various kinds. Are sources of interference, which are difficult to track down and even more difficult to remove.

2.1. Corona

If we increase the tension between the highly curved and relatively distant conductors (electrodes), the electric field intensity reaches the critical value of the conductors, which is sufficient to give rise to incomplete self-discharge, which is limited to a narrow layer around the conductors. This discharge is called *corona.* Manifestation of the corona is weakly luminescent layer, which leads the pack. This phenomenon is accompanied by characteristic noise and crackle.

The initial stages of the corona have a decisive influence surface condition of conductors. If the small wires on the surface of dirt or uneven surface, becoming the first area of small pockets of unstable pre-discharge. This phenomenon is called *corona Cat's-whisker,* occurs at a voltage of 0.3 U_0 (U_0 is the initial voltage on the corona completely smooth and clean lines). *Crossover corona* occurs at a voltage (0.5 to 0.6) U_0. Occur in larger surface roughness (on the damaged surface), water droplets and fatty stains. Reaches a size of the initial voltage corona voltage U_0 appears suddenly around the wires slightly shining packaging. This branch is called the *corona packaging.* It has been characterized by an increase in charging current and capacity management.

Corona can occur within the air gaps under the porcelain bodies grommets, mountings and cavities in the insulators. In the conquest are formed by ozone, which, together with moisture leads to the creation of acids that attack the said parts.

The positive influence of the corona occurs in a situation where the lines hit by lightning. The management created a wave of voltage, whose value far exceeds the voltage of the corona. Resulting

corona causes a decrease of peak value and the steepness of the waves and thereby reduce the risk of damage to the insulation of equipment in the stations.

Atmospheric and weather conditions greatly influence the emergence of the corona. The decrease in pressure and temperature increase respectively both can reduce the density of air and thus reduce the electrical strength of air. This has the effect of increasing the likelihood of corona on conductors. Rain and snow cause the most intense corona discharge. Level of HF noise may increase by more than 20 dB compared to dry conditions. Drops of water or snow that remains on the surface of conductors, produces a large electric field changes.

2.1.1. Effects of corona on conductors

Corona discharges are a source of radio noise. Spectral components ranging from a few kHz to 10 MHz. In this frequency band, the disturbance spreads leadership. Leadership is an effective radiator, since the wavelength is due to the large size wires.

2.1.2. Effects of corona on the fittings, insulators and equipment closets

Depending on the amount of voltage gradient in some areas (hanging clamps, protective circles and corners, bars and connectors) appear different stages of the corona in this order: a single cluster, and the glow breakthrough bunch of positive corona; Trichel’s or negative pulses, and the glow breakthrough cluster of negative corona. Only some produce HF noise, but all contributing to the corona losses. Highest level of HF noise produced breakthrough clusters. There are, however, only at high levels of stress gradient (the surge). This type of HF noise does not affect TV reception.

Most of the phenomena causing HF noise appears on the surface of the insulator, only in rare cases, the noise due to developments within the insulator (in tubes and spark cracks).

If the insulator surface dry and clean, the emergence of HF noise depends on the geometry and material and links to the insulator cap and gagged. When a insulator of several units, depending on the stress distribution along the chain. Shape of current pulses that cause HF noise, and consequently limit the frequency spectrum affects their capacity insulator and wave impedance. HF noise is limited to frequencies below 30 MHz. Poor or construction inappropriate involvement can cause higher levels of interference dating back to higher frequencies. This type of HF noise does not affect TV reception.

Slightly contaminated and relatively dry insulator (eg. weather permitting) in addition to producing the phenomenon of the previous HF noise from corona discharge caused by dirt on the surface of the insulator. Nevertheless, noise levels are substantially the same or only slightly higher.

If the situation arises where the insulator clean, but moist or wet, water droplets are the focus of the corona. These discharges produce higher levels of HF noise than the previous type of interference, but the frequency band is limited to several MHz.

If the surface of the insulator heavily polluted and wet, this is the totally different phenomenon. Leakage currents due to heating effects develop dry patches on the surface of the insulator. Sparks that jump the dry patches, create current pulses. These pulses are a source of HF noise. Limit frequency can reach up to several tens of MHz. Noise may also affect television reception.

2.2. Sparks the imperfect or interrupted connections

If unconnected conductive part of the line or substations, as well as objects such as metal fences, gutters, a strong electric field high-voltage lines may be electrically charged. This is also true of parts that are flying the potential (not connected to the ground conductor or lead). If the distance between the conductive parts is small, the field strength between these parts to reach the critical value at which

breakdown may occur gap. In the discharge potential difference drops two sections and there is the extinction curve and the process repeats. Repetition frequency depends on the time-constant charging and discharging, the intensity of electric field and sparking distance. Reaches values from hundreds to several thousands per second.

These discharges are characterized by short rise time, hence the wide range of emitted frequencies, which can amount to several hundred MHz. Valves and other components can oscillate in these discharges in a particular frequency. Then behave as antennas tuned to that frequency to emit an intense narrow-band interference. This type of interference affects the reception of AM radio signals and television video signal.

The band MF, LF and noise along the lines spread over distances of tens of kilometers. But when there are resonance conditions for fittings, noise can be radiated into space to distances of several kilometers.

2.2.1. Examples of sources of sparks

Among the sources of sparks are lightly loaded caps and gags as a result of inadequate weight insulator. There's a surface oxidation of metal parts. After crossing the dielectric strength of insulating layers or on a mechanical fault (movement of the insulator in the wind) there is a spark. Sparks may also occur in small tubes of porcelain insulators, cracked insulators, layers of paint etc.

Shocks in the gaps affects the weather. For the drought is more noise, wet can bridge the gap, water and noise completely disappears.

3. MEASUREMENT METHODS

There are two kinds of measurements. CISPR field measurements - the range of 0.15 MHz to 30 MHz and laboratory measurements CISPR. This issue deals with [2]. This standard specifies the procedure for measurement, place of measurement, the reference atmospheric conditions, the general procedure for determining the limits of HF noise from overhead lines and equipment. For laboratory measurements, there is the figure of the test circuit and its components.

The standard covers the frequency band from 0.15 MHz to 300MHz.

4. PRACTICAL WAYS TO REDUCE THE NOISE OF HF

4.1. Corona on conductors

The most important parameters in the design of management are the average number of cables and wires in the bundle phase. These parameters depend on whether the RF noise from corona on conductors exceeds the permitted level. The number and diameter of conductors per phase lines are mostly due to the calculation of the transmission line capacity or economic aspect. If the line designed with a high conductor surface gradients may be after completion of the construction line for noise reduction done very little. The remaining parameters such as the distance between phases, distance wires in the bundle and the height of conductors above the ground with only minor influence.

The basis for limiting the corona wires to the sound treatment of conductors in transportation and construction management so as to avoid infringement or breakage strands. It is necessary to choose the appropriate technology tension to avoid contact with the ground wire or other objects. To protect the steel the soul or inner layers against corrosion using special grease. Chosen should be such as fat, which even at the highest temperatures to penetrate the surface of the conductor.

4.2. Corona on metal armatures and insulators

Appropriate shapes and dimensions of metal fittings such as supporting clamps, hanging clamps, shackles, rings of protection, distance bars, etc. can be achieved already in the design. Edges and corners to be rounded, sharp edges and protrusions should not appear.

Noise levels can be reduced by reducing the voltage stress or insulators. the use of the special characteristics of insulators. Insulators coated with a layer of fat to prevent a continuous wet coating. Due to aging, however, this surface becomes a absorptive insulator ceases to be noiseless. Possibility is the use of special insulators with semi conducting glaze, which improves stress distribution. The spark arrester are not, because the heat produced by leakage current in the glaze keeps the dry strip wide enough.

4.3. Capacitive discharge (spark)

Preventive and remedial measures:

a) Conducting oil and pasta - Fast and economical, but the effect only temporary.

b) Contact brush - Lasts 2 to 3 years, ensuring contacts metal to metal in the pin and fork, and sticks and incense.

c) Contact terminals – At insulator pin - fork. Very important is to be installed on the insulator at the last wire.

d) Persistent connections - Connecting through each individual metal part insulator string made of stainless steel cable or copper cable.

e) Metal weights for the non-mechanically loaded insulator string - weights have anti corona adjustments.

f) Simple insulator

g) Gag insulators with conductive glaze - to avoid sparking a part of the surface of the insulator in place of contact with the conductor, must affix the conductive coating or plating. These measures are effective only when applied simultaneously with the production of glaze insulator.

5. LITERATURE AND REFERENCES

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