Prediction of Possible Corona Occurrence in the Vicinity of Multi-Circuit Overhead Lines with Different Voltages

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Abstract **This paper deals with an analysis of the corona occurrence on the multi-circuit overhead lines with different voltages. The electric field is evaluated in the close vicinity of lower voltage conductors of the line. Various phase configurations have been calculated.**

Keywords **Corona occurrence, Multi-circuit overhead line, Partial capacitances, Electric charge, Phase configuration.**

I. Introduction

Building of new routes for the overhead lines is a big problem currently. The solution can be that the existing line is rebuilt to the multi-circuit overhead line often with different voltage levels located on the same tower. This fact brings some troubles which should be solved [1]. One of them is the corona occurrence. A new method for its investigation is presented in this paper.

II. Methods and Illustrative Examples

A. Design layout of transmission tower

Considered pylon carries two 3-phase 400 kV circuits and two 3-phase 110 kV circuits. Phase conductor of the 400 kV circuit is constructed as a bundle conductor.

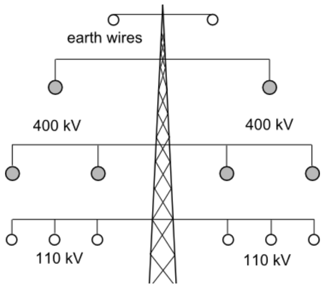

Fig. 1. Design layout of pylon

B. Evaluating of charges

For the calculation the harmonic steady state is supposed and maximal sag of conductors is considered. The charges have been calculated via method of partial capacitances which is based on the method of images [2].

$$\begin{bmatrix} Q_1 \\ Q_2 \\ Q_0 \end{bmatrix} = \begin{bmatrix} B_{11} & B_{12} & B_{10} \\ B_{21} & B_{22} & B_{20} \\ B_{01} & B_{02} & B_{00} \end{bmatrix} \begin{bmatrix} U_1 \\ U_2 \\ 0 \end{bmatrix} \quad (1)$$

Vector of conductor's charges can be divided into Q_1 (VHV level), Q_2 (HV level) and Q_0 (earth wires). U_1 and U_2 are vectors containing the phase voltages of VHV and HV system. The matrix of capacitance coefficient B consists of submatrices B_{ii} and B_{ij} that respect the self and mutual capacitive couplings.

C. Analysis of electric field strength

From (1) we can obtain the charges on all conductors. Resulting electric field strength at any point of space is given as a sum of particular electric field strengths caused by particular conductors. The superposition is made separately for *x* and *y* component. The electric field strength was evaluated at the surface of the 110 kV conductors. Results of various phase configurations are shown in table I.

TABLE I
Electric field strength and charge on 110 kV conductor's surface for different phase configurations

400 kV phase configuration				C C A B B A		
110 kV	a	c	b	b	c	a
E (kV/cm)	10.37	16.24	8.25	8.25	16.24	10.37
Q (μC)	0.719	1.083	0.547	0.547	1.083	0.719
400 kV phase configuration				C C A B B A		
110 kV	b	c	a	a	c	b
E (kV/cm)	11.66	16.21	13.75	13.75	16.21	11.66
Q (μC)	0.776	1.08	0.916	0.916	1.08	0.776
400 kV phase configuration				C A A B C B		
110 kV	c	b	a	b	a	c
E (kV/cm)	15.33	11.13	14.47	12.41	16.03	11.98
Q (μC)	1.023	0.741	0.964	0.829	1.069	0.799

III. Conclusion

Electric field strength in the close vicinity of the conductor is mainly affected by value of its electric charge. This phenomenon is shown by the values in table I. Possible occurrence of corona effect can be predicted via the electric charge value on specific conductor. Symmetrical phase layouts show one couple of conductors with increased value of electric field strength (over 16 kV/cm). Considered asymmetrical phase layout explores only one conductor with this stress.

IV. Acknowledgements

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V. References

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