Buried Pipelines Influenced by Transmission Lines

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Abstract **This paper deals with the possibilities of suppressing influence of electrical and magnetic fields of three-phase overhead lines on buried pipelines using shielding band. There are considered various shapes of the shielding band.**

Keywords **buried pipeline, overhead line, electric and magnetic field, numerical analysis.**

I. INTRODUCTION

At present time, there is a tendency to build corridors common for transmission lines and buried linear pipelines. The current density and the magnetic flux density in a buried steel pipeline can be reduced by a placing of a pipeline in parallel or a shielding band along a pipeline [1]. Several methods have been developed to determine the influence of overhead lines on the buried pipelines [2] [3]. This paper deals with a reduction of the influence of such overhead lines on a buried pipeline using a shielding band of various shapes along the pipeline. The computations were performed by in-house application Agros2D [4] and supplemented with a number of own procedures.

II. MATHEMATICAL MODEL AND NUMERICAL SOLUTION

Fig. 1 depicts a typical arrangement of a buried pipeline in parallel with a power overhead line. The pipeline is accompanied by a copper shielding band.

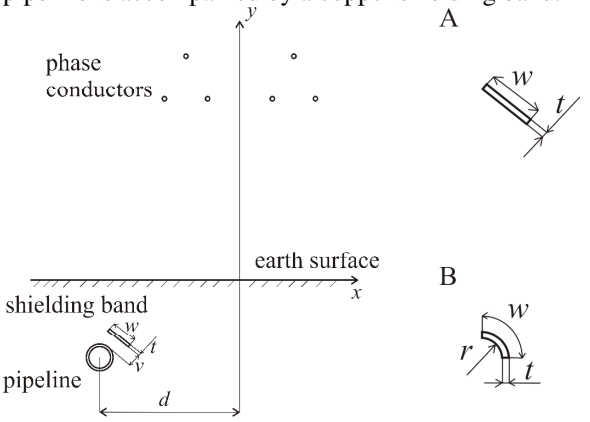

Fig. 1. The arrangement of a buried pipeline in parallel with a power overhead line

Fig. 2 The shielding band shapes

In each area, we assume a linear environment. Supposing sinusoidal steady state, i.e. the complex representation of time varying functions can be used. Distribution of the electromagnetic field can be described by the partial differential equation for the phasor of the magnetic vector potential $\boldsymbol{A}$ in the form:

$$\Delta \underline{\boldsymbol{A}} - j\omega\gamma\mu\,\underline{\boldsymbol{A}} = \mu \underline{\boldsymbol{J}}_{\text{ext}} \tag{1}$$

III. ILLUSTRATIVE EXAMPLE

The example shows only one buried pipeline in parallel with a power overhead line, with the Donau type towers carrying two parallel overhead lines. The subject of this study is the steel pipeline ($\gamma = 60000$ S/m, $\mu_r = 8000$). The pipeline (inner diameter 0.5 m, thickness is 0.02 m) is buried at a depth of 1 m in the soil ($\gamma = 0.01$ S/m) and is accompanied by a copper shielding band ($\gamma = 5.8 \cdot 10^7$ S/m). The considered shapes of copper shielding band are shown in Fig. 2. Fig. 3 depicts the dependence of current density on the distance between the pipeline and the axis of the tower.

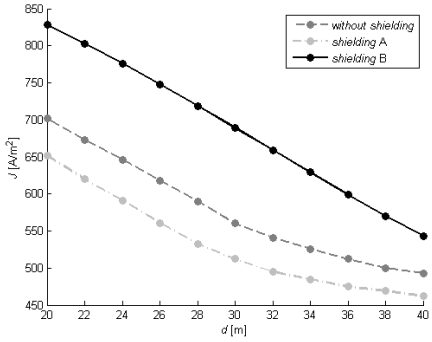

Fig. 3. The dependence of current density on the distance between the pipeline and the axis of the tower

IV. CONCLUSION

The values of current density and magnetic flux density in a pipeline are influenced by the distance of the pipeline from an overhead line, the arrangement of phases in two parallel lines, the conductors sag, and by conductivity of soil, which is variable both vertically and horizontally depending on the soil composition. Based on the obtained current density values, it is possible to determine the probability of pipe corrosion and to decide to lay the shielding band. In such a case, it is necessary to consider the economic point of view.

V. ACKNOWLEDGEMENTS

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VI. REFERENCES

[1] Šroubová, L., Hamar, R., Kropík, P. Reduction of Influence of Transmission Lines on Buried Pipelines. In *IC-SPETO 2015: XXXVIII miedzynarodowa konferencja z podstaw elektrotechniki i teorii obwodów*. Gliwice: Politechnika Slaska, 2015.

[2] Bortels, L., Deconinck, J., Munteanu, C., Topa, V.: A General Applicable Model for AC Predictive and Mitigation Techniques for Pipeline Networks Influenced by HV Power Lines, In *IEEE Transactions on Power Delivery*, Vol. 21, No. 1, January 2006, 210 – 217.

[3] Kopsidas, K., Cotton, I.: Induced Voltages on Long Aerial and Buried Pipelines Due to Transmission Line Transients, In *IEEE Transactions on Power Delivery*, Vol. 23, No. 3, July 2008, 1535 – 1543.

[4] http://agros2d.org