400 kV Double-Circuit Transmission Lines

Subjects: Engineering, Electrical & Electronic

Contributor: Ramunas Deltuva

A high-voltage AC double-circuit 400 kV overhead power transmission line runs from the city of Elk (Poland) to the city of Alytus (Lithuania). This international 400 kV power transmission line is potentially one of the strongest magnetic field-generating sources in the area. This 400 kV voltage double-circuit overhead transmission line and its surroundings were analyzed using the mathematical analytical methods of superposition and reflections. This research paper includes the calculation of the numerical values of the magnetic field and its distribution. The research showed that the values of the magnetic field strength near the international 400 kV power transmission line exceed the threshold values permitted by relevant standards. This overhead power line is connected to the general (50 Hz) power system and generates a highly intense magnetic field. It is suggested that experimental trials should be undertaken in order to determine the maximum values of the magnetic field strength. For the purpose of mitigating these values, it is suggested that the height of the support bars should be increased or that any individual and commercial activities near the object under investigation should be restricted.

Keywords: magneticfieldstrength ; magneticfluxdensity ; magneticpotential ; currentdensity ; power transmission line

1. Introduction

The institutions involved in electric power transmission in Lithuania and Poland have decided to implement the electricity link “LitPol Link”. This link is designed to connect the power systems of the Baltic States to those in Western Europe and also contributes to the development of the general European electricity market as well as boosting the reliability of the power supply. In pursuit of increasing the capacities of electric power transmission, the decision was made to supplement the LitPol Link by installing an extra 400 kV high-voltage AC double-circuit transmission line.

Recently, there has been increasingly widespread concern over the influence of the electromagnetic field (50 Hz) on the health of residents. One of the fundamental challenges is ensuring safe conditions for those living in locations where such an electromagnetic field is present.

The recently adopted Hygiene Standard HN 104:2011 “Human protection against electromagnetic fields caused by overhead power lines” is currently valid in the European Union (EU) and states that the effective values of the magnetic field strength must never exceed exceed 32 A/m or 40 μT (magnetic flux density) in residential environments, or 16 A/m or 20 μT (magnetic flux density) within residential and public service buildings. These values should never be exceeded irrespective of the duration of a person’s exposure to an electromagnetic field.

The double-circuit 400 kV power transmission line is one of the most powerful electrical installations in the entire power system; at a frequency of 50 Hz, it generates an intense magnetic field. Therefore, it is necessary to focus on the installation and safe operation of the 400 kV double-circuit overhead transmission line in order to prevent the magnetic field generated by this power transmission line from exceeding the requirements set by the European Union (EU) Hygiene Standard HN 104:2011.

2. Conclusions

The magnetic field strength of this power line was found to exceed the numerical values permitted by the Hygiene Standard HN 104:2011 HN, revealing that any person living or working in these areas was in serious danger. Any individual or commercial activities performed by the residents closer than 15 m to the double-circuit 400 kV overhead power line must be restricted.

For these reasons, the magnetic field in these locations must be reduced by installing higher support bars, and persons must wear appropriate personal protective equipment to protect them from exposure to electromagnetic field. For the purpose of more comprehensive analysis, it is recommended that experimental measurements should be made.

The distribution of the magnetic field strength at the high-voltage, double-circuit transmission line could be calculated using the methods of the magnetostatic field or by simulation using the finite element method (FEM). The difference is less than 5% between the results of the mathematical calculation and FEM simulation.

This paper has studied the magnetic field distribution resulting from all six groups with six types of long-distance distributing transposition. As a result, we can see how the impact of the calculation of the six groups' long-distance distribution transposition changes the magnetic field surrounding the transmission line.

The developed mathematical model for the calculation of the magnetic field generated by the conductors in the double-circuit 400 kV overhead power line can be used for the identification of hazardous areas and cases of electromagnetic pollution.
