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Computation and Analysis of the Extremely Low Frequency Electric and Magnetic Fields Generated by Two Designs of 400 kV Overhead Transmission Lines

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Highlights

- Novel software for 2D simulation of ELF electric and magnetic fields is developed.
- The software is mainly intended for human exposure assessments.
- Analysis of two recent designs of 400 kV overhead transmission lines is performed.
- A very good agreement with finite element computations can be observed.

Abstract – The overhead transmission lines are considered one of the major sources of electric and magnetic fields, which can induce electrical currents within the human body. In this study, the electric and magnetic fields generated by two recent designs of 400 kV transmission lines used in the Romanian power system are computed and compared to the exposure limits established by the International Commission on Non-Ionizing Radiation Protection for the general public. The computations are carried out with two dedicated software tools, called PowerMag and PowerELT, which have been developed based on a 2D quasi-static analytical approach. This approach, as well as the electric and magnetic field distributions obtained for the considered 400 kV overhead transmission lines, will be discussed in detail. To confirm the validity of the results, some comparisons to finite element computations will also be presented.

Keywords – *electric field, magnetic field, extremely low frequency, 400 kV transmission line, 2D computation*

1. INTRODUCTION

Over the past 35 years, extensive research has been conducted to determine if the extremely low frequency (ELF) electric and magnetic fields like those emitted by

power lines, in-house installations and household appliances can affect the human health. Researchers from different scientific disciplines conducted numerous studies regarding the potential effects of ELF fields, such as cancer in children and in adults, reproductive effects, neurological effects, cardiovascular disorders, immunological modifications, etc. Most notably, a weak statistical association was reported between childhood leukemia and chronic exposure to average ELF magnetic fields above 0.3 to 0.4 μT [1-3].

Aiming to provide protection against ELF electric and magnetic fields, a number of national and international organizations have formulated exposure guidelines. However, these guidelines are not based on a consideration of risks related to cancer or other health problems. Rather, the point of the guidelines is to make sure that the electric currents induced in the human body by such fields are not stronger than those naturally produced by the brain, nerves and heart [4].

The current consensus among various national and international scientific organizations is that there are no known adverse health consequences of exposure to ELF fields at the levels generally found in residential and occupational environments, including proximity to electric transmission and distribution facilities. Despite this fact, the public frequently expresses concern about

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