Ain Shams University
Faculty of Engineering
Electric Power and Machines Engineering Department

"Mitigation of Electro-Magnetic Fields Near Over Head Transmission Lines"

A Thesis

Submitted By

Eng./ Abd El-Ghani Mahmoud Ibrahim

For
The M.Sc. Degree in Electrical Power Engineering

Supervised By

Prof.Dr./ Abd EL-Mohymen Mohamed Soliman
Faculty of Eng. Ain Shams University

Pof Ass. Dr. Salem Mahmoud El-Khodary
Faculty of Eng. Ain Shams University

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APPROVAL SHEET

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Presented By
Eng. Abd El-Ghani Mahmoud Ibrahim

Examiners committee

Name, Title and Affiliation Signature

١. Prof. Dr. ABDEL- SALAM HAFEZ HAMZA
Faculty of Engineering, Banha University

٢. Prof. Dr. SALIMAN MOHAMED EL- DYBAKI
Faculty of Engineering, Ain Shams University

٣. Prof. Dr. ABD EL-MOHAYMEN MOHAMED SOLIMAN
Faculty of Engineering, Ain Shams University

٤. Prof. Ass. SALEM MOHMOUD EL-KHODARY
Faculty of Engineering, Ain Shams University

Date ١٦th April ٢٠٠٨

STATEMENT

This dissertation is submitted to Ain Shams University for the degree of M.Sc. in Electrical Engineering (power).

The Work included in this thesis out by The author. The author works in the Hamza Associates Consultant Offes

No part of this study has been submitted for a degree Or a qualification at other University or institution

Date: ١٦ Th April ٢٠٠٨
Name: Abd El-Ghani Mahmoud Ibrahim

Signature:…….

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Ain Shams University
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Abstract
Thesis Submitted by
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Titled
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The increase of power demand has increased the need for transmitting huge amount of power over long distances.

Large transmission lines configurations with high voltage and current levels generate large values of electric and magnetic fields stresses which affect the human being and the nearby object located at ground surfaces. This has in turn prompted increased activity in the documentation of calculation techniques to accurately predict field strengths in isolated conducting bodies coupled to lines of all voltages and design configurations.

Overhead transmission systems required strips of land to be designed as right-of-ways (R.O.W.). These strips of land are usually evaluated according to same aspects; the most important one is the operating effects of the energized line including electric and magnetic field effects. Therefore determination of the maximum value of the electric and magnetic field stress at ground surface is very necessary and important. It is always required to minimize the amount of land set for high voltage (current) transmission facilities. This can be achieved by the reduction of the field stress at ground level which is also considered as the most object of efforts to minimize the field effects of such high voltage A.C. lines.

This thesis contains five chapters:

١. First chapter considered as introduction for the "Mitigation of Electro-Magnetic Fields Near Overhead Transmission Lines".

٢. Second chapter presents a review of previous work for the Electric and Magnetic field studies. This chapter also presents the biological effect from the electromagnetic fields.

٣. Third chapter review the different methods of electric and magnetic field computations. From which two flow charts were presented, one flow chart for the electric field calculation and the second for the magnetic field.

Third chapter also introduces the steps to build computer program to calculate the electric and magnetic field.

٤. Fourth chapter introduces proposed (built-up) programs. These programs were applied for a previously calculated overhead transmission line and for actual field measurements for the electric and magnetic fields under overhead transmission line.

Fourth chapter also presents a comparison between the actual field measurements and the output results from the proposed program. The error was within ١-٣%, this give the trust that this program is running okay. Then this program was applied for different types of mitigations were studied by the use of the computer program.

٥. Fifth chapter presents the final conclusion of this thesis presents different overhead transmission line module which will satisfy the electromagnetic field mitigation and reduce the right of way. This chapter also presents recommendations for future work.

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CHAPTER (١)

INTRODUCTION

CHAPTER (١)

INTRODUCTION

Electric and magnetic fields represent a phenomenon that is found in the area immediately surrounding all electric power transmission and distribution lines, electrical wiring in homes and such common everyday appliances [١].

i.e. The electromagnetic environment typically consists of two components, an electric field and a magnetic field.

In general for time-varying fields, these two fields are coupled but in the limit of unchanging fields, they become independent. For frequencies encountered in electric-power transmission and distribution, these two fields can be considered independent to an excellent approximation.

١. Electric fields (E) exist whenever a (+) or (-) electrical charge is present. They exert forces on other charges within the field. Any wire that is charged will produce an electric field. (i.e Electric field produces charging of bodies, discharge currents, biological effects and sparks). This field exists even when there is no current flowing. The increase of high voltage increase the electric field at any given distance from the wire.

٢. Magnetic fields (B) arise from the motion of electric charges. A magnetic field is only produced once the device is switched on and current flows, Magnetic field lines run in circles around the conductor. (i.e produces magnetic induction on objects and induced currents inside human and animal bodies causing possible health effects and a multitude of interference problems). The increase of high current produces increasing in strength of the magnetic field.

Overhead power lines have been in operation now for more than ١٠٠ years. However, it is only in the last ٤٠ years that health effects of their electric and magnetic fields have become a subject of interest.

Designers of power lines are searching for technically and economically acceptable right of way (R.O.W).

The biological and health effects of electric and magnetic fields have been studied since the ١٩٦٠'s. In the beginning the emphasis in these studies was mainly on the effects of electric fields, particularly those associated with high voltage transmission lines, because they were though to be the more likely to produce biological effects. [١]

In several post-١٩٧٩ epidemiological studies of childhood cancer, interest shifted from electric field to magnetic fields associated with high current utility wiring in the proximity of homes. Occupational studies have also dealt with increased risk to worker whose jobs expose them to higher – than – average field intensities.

This thesis contains five chapters:

١. First chapter considered as introduction for the "Mitigation of Electro-Magnetic Fields Near Overhead Transmission Lines".

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٣. Third chapter reviews the different methods of electric and magnetic field computations. From which two flow-chart were presented, one flow chart for the electric field calculation and the second for the magnetic field calculation.

٤. This chapter also introduces the steps to build a computer program to calculate the electric and magnetic field.

٥. Fourth chapter introduces developed (built-up) programs. These programs are applied for a previously calculated overhead transmission line and for actual field measurements for the electric and magnetic fields under overhead transmission line.

   This chapter also presents a comparison between the actual field measurements and the output results from the developed program. The error was within ١-٣%, this gives the trust that this program is running very well. Then this program is applied for different types of mitigation methods studies which were studied by the use of the computer program.

٦. Fifth chapter presents the final conclusion of this thesis for different overhead transmission line module which will satisfy the electromagnetic field mitigation and reduce the right of way. This chapter also presents recommendations for future work.