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Investigate and Analysis the Magnetic Field Intensity Generated Around Transmission Line Conductors (132KV)

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ABSTRACT

Along with the extended transmission lines arises a magnetic fields which its intensity depends on the amount of currents that flowing in the conductors and the distance from the conductors. In this research, the magnetic flux density generated by the 132 KV double vertical lines configuration has been investigated by using shadow method. The obtained results indicates that by changing the Standard dual vertical channel configuration into a new modified phase layout reduce the magnetic flux density on the ground surface in mid- channel to about (19.2 %). The obtained results also indicate that the strength of the magnetic field is far below the threshold of magnetic field levels set by the International Commission for Protection Against Ionizing Radiation Protection (ICNIRP).

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INTRODUCTION

The fast progress in the technology development led to establish a multi-line power system networks that extended for a long distances in our cities and villages to satisfy increasing needs for electric power consumption. To transfer power from the power plant to the load center it will be required a network starting from the transmission line until the consumer. So, in the vicinity of the transmission lines and distribution networks will rise a strong electromagnetic field caused by currents flows in the conductors. The using of overhead transmission lines networks with extra high voltage has some advantages, for example, by using high voltage ,a greater power supplied can be transmitted and the power losses can be suppressed. But in addition to advantages , there are also some disadvantages such as the generating of electromagnetic radiations that may cause a negative effects on the human health. So, With the increasing of HV transmission lines networks,the Study of the electromagnetic field intensity at operating frequency of HV transmission lines is very meaningful for transmission lines networks designers.

In order to evaluate the influence of the energy line, the calculation of coupling impedances and capacitances of the line it is not sufficient,but is necessary to analyze the generating fields . In recent years, Some laboratory experiments have found that under certain conditions and in some animals models, the magnetic fields can have some biological effects and different studies have been published in this area.The recommendation of the European Union in July 12 1999, sets the limits of tolerability in 100 μT, which taken into account the precautionary principle. This recommendation is endorsed by many agencies, institutions, scientific reports, and doctors (RG Olsen,1993) Some studies have been conducted in order to find a correlation mechanism between the field levels and their effects on the human beings were done but without significant success .The simulation of the line during planning has the advantage to study the possible risks and disturbing influences. One Way among others ways to minimize the magnet field strength, is by changing the channel configuration (WT Kaune and LE Zaffanella, 1992).

The main objective of this research is:

To investigate the magnetic field levels of a 132 KV high-voltage by using the imaging method , and compare the results obtained with practical measurements.

The second objective is to study and analyze the distribution of the magnetic flux density as a function of geometric configuration of the conductors of the line phase sequence and the current mismatch between circuits in order to determine which configurations produce less "magnetic pollution."

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Overhead three-phase power transmission lines consist of pylons that carry three or multiples of three conductors. The conductor layout depends on environment conditions and voltage provided (SELBY, A.—DAWALIBI, F. P ,1994). In the vertical configuration, the three phases arranged vertically with the same separation distance between the conductors as shown in Figure (1) (Gardiol, F. E.1986).

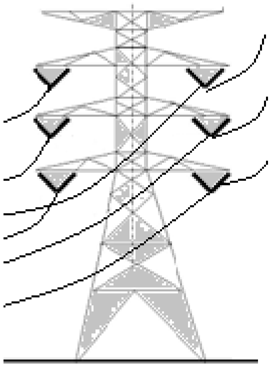

Fig. 1: Double circuit vertical configuration transmission line (132 KV).

High-voltage lines generate electric and magnetic fields in their neighborhood. The source of the magnetic fields are the currents in the phase conductors. The electric field is caused by the high potential of conductors. The electromagnetic field typically consists of two components, electric and magnetic fields. In general for time-varying fields, these two fields are coupled but in the limit of unchanging fields, they become independent (Floderus B *et al*, 1993).

The IRPA(International Radiation Protection Association) standards supply maximum values for the time allowed to stay of human beings exposed to electromagnetic fields at frequencies below 10 kHz. There are for the general public the allowed effective value of magnetic field strength with 50Hz (for the field of exposure (8 hours per day) at a magnetic field density of (B = 100 μT) and for the exposure (24 hours per day) for a magnetic field density (B = 40 μT) (International Commission on Non-ionizing Radiation Protection,1988).

The magnetic field produced from the transmission lines is our main concern and will be considered in this work. Designers of power lines are searching for technically and economically acceptable right-of-way (R.O.W.).

Previous studies:

The measurement of magnetic field and implementation of new techniques that enhance the reduction of exposure to this field have been the concern of many engineers in the past years. This led to conduct many studies , experiments and development researches in this area such as :

1- Calculations done by the (Commonwealth Associates Inc.) to observe the changes in the magnetic field due to changes in the power lines .These changes, include the rearrangement of phases in the power line system, provide an equilibrium in the phase and circuit loading, changing the structure of the line designs, switching from single-phase to three-phase distribution, increasing the voltages and finally using cancellation or shielding loops. After studying all the parameters that could determine whether the particular magnetic field reduction technique can be implemented or not, the (CAI) also performs a cost analysis to check for the feasibility of the EMF reduction technique due to cost considerations (Shafer, D. 2004)

2- The (Risk Assessment Program) project was conducted a survey that gathers information about the personal exposure to electromagnetic fields for around a thousand people, the activities that could increase or decrease the personal exposure (work and going to bed respectively), gender and age differences as well as sizes and mobility of residences differences Gailey, P. (April 1998) .

3- Guangwen Pan and Jilin Tan analyzed the radiation effect of micro strip transmission line While Floderus*et al*. (1993) investigated sets of electromagnetic field measurements made at 1015 different workplaces. This study covered 169 different job categories, and participants wore the dosimeters for a mean duration of (6-8 h).The most common measurement was (0.05 μT) and measurements above (1μT) were rare (Fei Wang , Weijie Wang , Zhichao Jiang , Xuezeng Zhao Issue Date:June (2010).

Practical part:

From the point of view of human exposure, the most critical points are those within or close to the right of way of the lines because the levels of electromagnetic fields is the highest close to power lines and decreases rapidly with increasing the distance from them.

The measurement will be conducted on open area in the free space and at equal distance from pylons to eliminate distortion due to influence of sag. In this research ,we will use the shadow method to determine the magnetic field density. If we assumed an imaginary conductor that identical to the original conductor and has a distance that the same as the original conductor above the ground but its location is opposite to the location of original conductor, then for calculation of magnetic field density around a transmission line, the earth can be replaced by this imaginary conductor which has a charge opposite to the original conductor charge.

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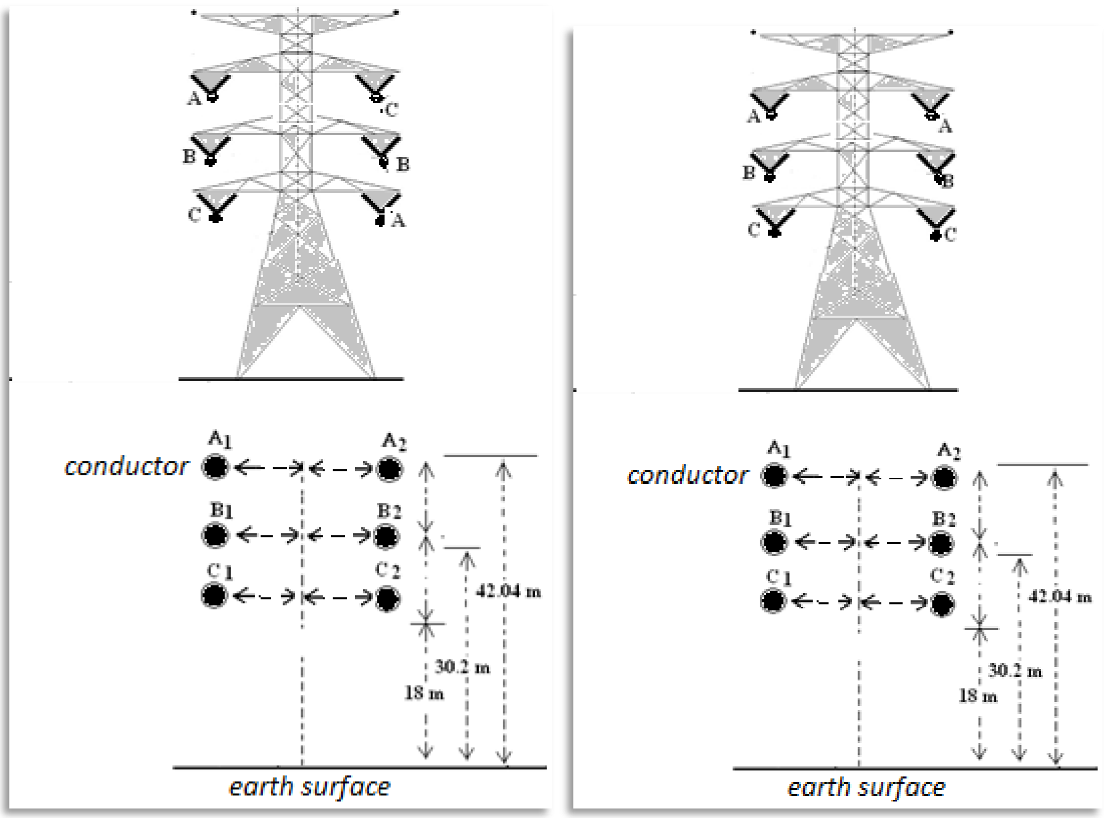

A B

Fig.2: Transmission line (132KV)with double vertical configuration.
A: Before changing the layout phase configuration.
B: Afterchanging the layout phase configuration.

The currents flows on each phase are as follows:
I_A = 710 (1 + j0) = 730A
I_B = 710 (-0.5 + j0, 866) A
I_C = 710 (-0.5 - j0, 866) A

Practical measurement of magnetic field:

For the measuring the magnetic field at a height of 1 m above the ground level, we will use the field meter (EMF –TESTER) model (EMF-872). We must note that the practical measurementof magnetic field cannot be accurately determined because of the impossibility to predict currents flowing through the conductors at a given moment.

RESULTS AND DISCUSSION

Mathematical calculations of magnetic flux density (B) are shown in table (2) while the practical measurements are shown in table (3). Table (2): Results of E (kv/m) measurements with and without fiber optic cable for the 132KV double vertical configuration in accordance to the range.

Figure (5) shows the level of the magnetic field density in (μT). The calculations and the practical measurements shows a good agreement.

Table1: Transmission line data for double vertical Configuration.

Conductor	Height in (m) (distance to ground surface)
A	42.
B	30.
C	18.

Table 2: Result of mathematical calculations of magnetic flux density (B) For dual vertical transmission line Configuring(132kv)before phases layout changing .

Range (m)	Magnetic field (μT)	
	Mathematical calculation	Practical Measurement
-20	2.76	2.62
-15	3.45	3.20
-10	4.23	4.12
-5	5.74	5.43
0	6.86	6.76
5	7.92	7.65

10	6.87	6.43
15	4.75	4.61
20	3.76	3.97

Table 3: Result of mathematical calculations of magnetic flux density (B) For dual vertical transmission line Configuring(132kv)after phases layout changing.

Range (m)	Mathematical calculation	Practical Measurement
	Magnetic field (µT)	Magnetic field (µT)
-20	1.85	1.91
-15	2.31	2.42
-10	3.20	3.25
-5	4.23	4.098
0	5.66	5.54
5	6.38	6.09
10	5.56	5.32
15	3.76	3.65
20	2.83	2.89

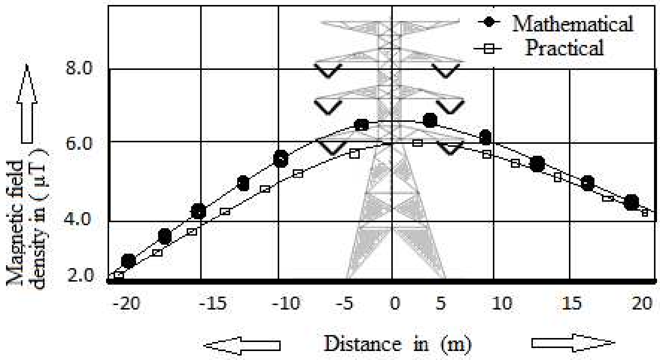

Fig. 5: The effective value of the magnetic field.

From the results obtained above, we can conclude the following:
1-The calculation result for (132 KV) double channel configuration without changing the layout phase (standard) flux density obtained in the earth surface level at (10 m) from the center position of the tower is about (6.87 µT). Whereas by changing the layout phase configuration , the calculation obtained of about (5.57) µT. This is because, with phase change the layout means there is a change in conductor distance closest to the ground surface. Originally Conductors closest to the ground surface is C1 and C2. By changing the layout phase Conductor C2 located in the top position and Conductor position A2 located at the bottom closest to the surface soil. So the position closest Conductor to ground surface are conductive C1 and A2. On the other side three-phase currents flowing through each Conductor phase unchanged. Consequently Conductor who originally had the closest distance to the ground (C2) will generate the magnetic field intensity smaller, because it is far above the ground surface. The results of this calculation means that the change of phase lies in the dual configuration can be used as one way to reduce the magnetic field intensity above ground.
2-In the case of comparison the results ,we can see that the results obtained by the mathematical calculation are approximately equal to the practical measurement . The difference between the practices measured values of field with those obtained by calculation, may be mainly due to the real currents in the measurement period, were slightly lower than calculated by the histogram of powers provided by the supply company and also the accuracy measuring instrument.
3-According to the above results of the measurements , it is found that the magnetic field produced by this transmission line configuration is far below the limits set by the international recommendation for exposure Limits (< 100 µT).

Conclusion:

High levels of electromagnetic fields can cause negative health effects on humans health, so there is a need and obligation according to WHO to calculate and measure these fields. In this research Different arrangements of phase conductors were analyzed to find the best solution for magnet field intensity reduction and a mathematical model and practical measurements of magnetic field density (B) in a high voltage power transmission line 132kv has been conducted . According to the results of the measurements, it is found that the magnetic field produced by (132kV) transmission line network are below the limit set by the international recommendations. The method presented in this paper allows comparisons between the "maps" of flux density magnetic generated by different types geometric configurations of conductors line, with or without change of phase sequences and / or the current mismatch between circuits. With proper redistribution of the phases is achieved an important way to reduce the value of the field for about (19.2 %). With decreasing the magnetic flux density, negative health effect of this field will be reduced.

List of abbreviations:
IRPA: International Radiation Protection Association
ROW: Right-Of-Way
RAPID: Research and Public Information Dissemination

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