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[1.]Yehia Sayed M. ALI, [2.]Adel A. EL-BASET, [3.]Amer Nasr A. ELGHAFFAR

MATHEMATICAL CALCULATION OF ELECTROMAGNETIC FIELD IN HIGH VOLTAGE SUBSTATIONS TO TREATMENT ITS EFFECT ON THE PROTECTIVE EQUIPMENTS

[1-3.] Electrical Engineering Department, Minia University, Minia, EGYPT

ABSTRACT: It's not economically to design and manufacture costly high voltage equipment's that is fail service at small fault or any abnormal condition in power system, so by using the protective equipment's will be restrict danger for human life and high voltage equipment's. In another hand the protective equipment's should be provide fast, reliable localizes faults, and selectivity. Electric and magnetic fields are much better to understood and documented despite the large number of studies and their increasing quality, researchers have been show that EMFs have effect on the protective equipment's, either in the high voltage substations. The purpose of study electric and magnetic fields in substations to treatment the affection of the field on the protective equipment's, overcome its impact on the protection devices. This paper presents a study of the electromagnetic fieldin high voltage substation 500kV overhead transmission line, and explicitly shows how the fields vary under high voltage lines by employing easily understood mathematical models, this methods use 2D free space case study results of a 500kV alternating current overhead transmission line and treatment to overcome the affection of the electromagnetic field on the protective equipment.
Keywords: High voltage, Protection Equipment's, Electromagnetic field and Grounding

1. INTRODUCTION

The electromagnetic fields generated around high-voltage lines in general have received many investigations concerning their intensities and their influence to human beings. In some places, especially where people live just under or nearby these lines, the awareness of the effects of the fields produced by these lines becomes a serious problem. [1]

Magnetic fields are produced by electric currents, which can be macroscopic currents in wires, or microscopic currents associated with electrons in atomic orbits. So, magnetic fields are produced wherever electricity or electrical equipment is in use, magnetic fields of power transmission lines cause electrical currents inside any equipment in zone of the field, so some people are concerned that daily exposure to magnetic fields may cause health problems or the affecting on the tools in field zone as the same of current transformer, voltage transformer, cables, or numerical relays in control room in high voltage substations or energy meters which will case error and low accuracy. This paper aims to explicitly showing a more practical approach on how the maximum charge values are obtained from the overhead line geometric dimensions and its highest rated system voltage. From the overhead line geometric dimensions and system current flows, the magnetic field intensity distribution on the ground is as well clearly obtained for both the lateral and longitudinal profiles. Hence, it is explained how electric fields arise from electric charges and how magnetic fields arise from the motion of these electric charges. This has been done by way of numerical simulations, in MATLAB, of a case study of a 500kV AC.

2. ELECTRIC AND MAGNETIC FIELD

Electric fields are caused by the voltage difference between electrodes while magnetic fields are caused by currents flowing in conductors. Electric fields are important in high voltage engineering due to the following effects the performance of electric insulating materials is adversely affected by excessive electric field magnitudes and the presence of electric fields causes induced voltages on non-earthed objects underneath energized high voltage conductors. Similarly, the charge at the base of a thundercloud causes an electric field near the earth surface that may induce charge on objects such as transmission lines.

Magnetic fields do not have a direct effect on the properties of insulating materials but they affect the power system indirectly in the following way, high AC currents cause time-varying magnetic fields that induce voltages in conducting loops. Similarly, high time-varying currents due to lightning may cause induced voltages. These over voltages cause high electric fields in power system components that may cause failure of the insulation systems. [2]

The mathematical modeling for electromagnetic radiation in a linear, homogeneous, isotropic, and time invariant medium can be solved using Maxwell's equations. To facilitate the solving of Maxwell's equations for the case of specified or known sources, vector and scalar potentials are used [3], Maxwell's equations are usually formulated in differential form (i.e., as relationships between quantities at the same point in space and at the same instant intime) or in integral form where, at a given instant, the relations of the fieldswith their sources are considered over an extensive region of space. The twoformulations are related by the divergence and Stokes' theorems [4,5].

Figure (1) illustrates the electric fields of several transmission lines where the intensity of the electric field produced depends on the following factors: [1, 6]

» The distance between the conductors and ground.
» The phase spacing if we have two circuits next to each other as well as the geometric configuration of conductors.
» By the surrounding environment (if we have tall object near-by such as trees, fences etc).
» The transmission center line tangential distance.
» The point of measurement elevation with respect to ground.
» The line voltage (the actual not the nominal).

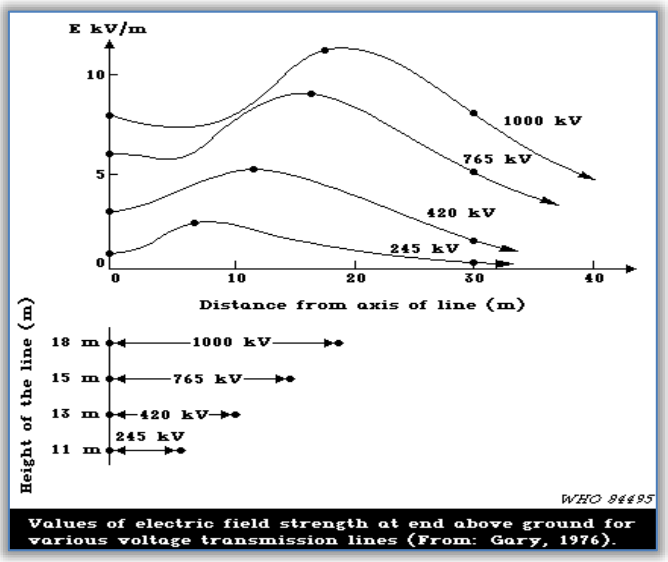

Figure 1.Illustrates the electric fields of several transmission lines

The magnetic field produced is affected by several factors:

» The ratings of the currents passing in the conductors typically lines have average currents of 2000 A, largest line existing supports a current of 4000 A.
» The clearance of the line. We can notice that the maximum fields occur underneath the conductors and falls rapidly with distance either side.
» The phasing of the conductors such as the conductor spacing, the phase positioning and the phase balancing affects the magnetic field. For example, for "un-transposed" phasing (where the phases on both sides of the line are in the same order from top to bottom) we have a magnetic field that decrease with the inverse square of distance from the line. While for "transposed" phasing (where the phases on one side are of opposite order to the others on the second side) the reduction in the magnetic field is inversely proportional to the cube of the distance, in figure (2) discussmagnetic field around single & double circuits 400kV transmission line, 1m above ground, Io=1000. [1]

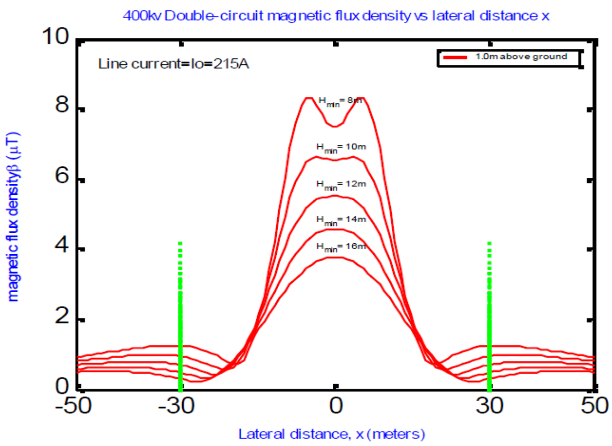

Figure 2. Discuss magnetic field around single & double circuits 400kV transmission line, 1m above ground, Io=1000A

3. MATHEMATICAL MODELS ELECTROMAGNETIC FIELD FOR HIGH VOLTAGE AMPERS LOW

High voltage 500 kV lines can carry large currents and as a result may produce relatively high magnetic fields, but primary distribution lines with voltages less than 63 kV can produce fields similar to those measured around a transmission line if they are carrying enough current.Magnetic fields become weaker rapidly with distance from the source. However, they do pass through most non-metallic materials and are therefore more difficult to shield. In the literature, magnetic field data are presented in either units of Gauss (G) or Tesla (T). A milli gauss (mG) is equal to one-thousandth of a Gauss (G). One Tesla is equal to 10,000 Gauss. A micro tesla (μT) is equal to one-millionth of a Tesla or 10 mG.[7, 8]

A useful law that relates the magnetic field along a closed loop to the electric current passing through the loop is Ampere's Law that first discovered by André-Marie Ampere in 1826. Ampere's Law is used to find the magnetic field generated by currents in highly symmetric geometries like the infinitely long wire and the solenoid. This law express that the integral of B around any closed mathematical path equals times the current intercepted by the area spanning the path. Equation (3.1) could describe the content of this concept. [7, 8]

$$\oint dL = \mu_0 I \tag{3.1}$$

where, the line integral is over any arbitrary loop, I is the current enclosed by that loop and r is the distance from the center of the wire.

The magnetic field of an infinitely long straight wire can be obtained by applying Ampere's law. The magnetic field generated by a single wire is equal to the following equation.

$$\vec{B} = \frac{\mu_0}{2\pi r}\vec{a}_\varphi \tag{3.2}$$

In Cartesian coordinate system $\vec{a}_\varphi$ and r can be rewritten as follows:

$$a_\varphi = -\frac{y-y_n}{R}\vec{a}_x + \frac{x-x_n}{R}\vec{a}_y \tag{3.3}$$

$$r = [(x_n - x)^2 + (y_n - y)^2]^{0.5} \tag{3.4}$$

So, equation (3.2) can be rewritten as follows

$$B = B_X.\vec{a}_x + B_y.\vec{a}_y \tag{3.5}$$

$$B = \frac{\mu_0}{2\pi r}\left(-\frac{y-y_n}{r}\right); \quad H = \frac{\mu_0}{2\pi r}\left(-\frac{x-x_n}{r}\right) \tag{3.6}$$

$$|B| = (B_x^2 + B_y^2)^{\frac{1}{2}}\ , \ \theta = \text{Arc}\tan\left(\frac{B_y}{B_x}\right) \tag{3.7}$$

Finally,

$$B = |B| \angle\theta \tag{3.8}$$

3.1. Magnetic field of power transmission line [7,8]

Based on Ampere's Law Magnetic field of power transmission line in any point can be calculated as following equations

$$B_{xa} = \frac{-\mu_0(I_{ra}+j\,I_{ia})(y_a-y_n)}{2\pi}\left[\frac{1}{(x_n-x_a)^2+(y_n-y_a)^2}\right] \tag{3.9}$$

$$B_{ya} = \frac{-\mu_0(I_{ra}+j\,I_{ia})(x_a-x_n)}{2\pi}\left[\frac{1}{(x_n-x_a)^2+(y_n-y_a)^2}\right] \tag{3.10}$$

Equations (3.9) and (3.10) can be rewritten as follows:

$$B_{xa} = B_{rxa} + j\,B_{ixa} \tag{3.11}$$

$$B_{ya} = B_{rya} + j\,B_{iya} \tag{3.12}$$

So,

$$B_{rx} = B_{rxa} + B_{rxb} + \cdots \tag{3.13}$$

$$B_{ix} = B_{ixa} + B_{ixb} + \cdots \tag{3.14}$$

$$B_{ry} = B_{rya} + B_{ryb} + \cdots \tag{3.15}$$

$$B_{iy} = B_{iya} + B_{iyb} + \cdots \tag{3.16}$$

Then, the real and imaginary values of the magnetic field can be calculated.

$$B_x = B_{rx} + j\,B_{ix} \tag{3.17}$$

$$B_y = B_{ry} + j\,B_{iy} \tag{3.18}$$

And finally, the amplitude of magnetic field can be calculated as follows:

$$|B| = \left(|B_x|^2 + |B_y|^2\right)^{0.5}$$

$$|B_x| = (|B_{rx}|^2 + |B_{ix}|^2)^{0.5} \tag{3.19}$$

$$|B_y| = \left(|B_{ry}|^2 + |B_{iy}|^2\right)^{0.5}$$

3.2. Magnetic field of three phase transmission line

Three-phase electric power is a common method of alternating-current electric power generation, transmission, and distribution. It is a type of poly phase system and is the most common method used by electrical grids worldwide to transfer power. Three-phase systems can produce a magnetic field that rotates in a specified direction. In a three-phase system, three circuit conductors carry three alternating currents (of the same frequency) which reach their instantaneous peak values at one third of a cycle from each other. Current of phases in these systems can be expressed as follows [7, 8]

$$I_a = I_m\cos(\omega t + \varphi_a);\quad I_b = I_m\cos(\omega t + \varphi_b); I_c = I_m\cos(\omega t + \varphi_c) \tag{3.20}$$
$$\varphi_b = \varphi_a - 120\,;\quad \varphi_c = \varphi_a + 120$$

The effective values of currents can be calculated using following equations.

$$I_{ra} = \frac{I_m}{\sqrt{2}}\cos(\varphi_a); I_{ia} = \frac{I_m}{\sqrt{2}}\mathrm{Sin}(\varphi_a); I_{rb} = \frac{I_m}{\sqrt{2}}\cos(\varphi_b);$$
$$I_{ib} = \frac{I_m}{\sqrt{2}}\mathrm{Sin}(\varphi_b); I_{rc} = \frac{I_m}{\sqrt{2}}\cos(\varphi_{ac})\ \ , I_{ic} = \frac{I_m}{\sqrt{2}}\mathrm{Sin}(\varphi_{ac}) \tag{3.21}$$

According the equations (3.9) and (3.10), magnetic field induced using phases a, b and c at an arbitrary point N (Xn ,yn)

$$H_x = H_{xa} + H_{xb} + H_{xc} \tag{3.22}$$
$$H_y = H_{ya} + H_{yb} + H_{yc} \tag{3.23}$$

where:

$$|H_x| = ((H_{rxa} + H_{rxb} + H_{rxc})^2 + (H_{ixa} + H_{ixb} + H_{ixc})^2)^{0.5} \tag{3.24}$$
$$|H_y| = \left((H_{rya} + H_{ryb} + H_{ryc})^2 + (H_{iya} + H_{iyb} + H_{iyc})^2\right)^{0.5} \tag{3.25}$$

and finally

$$|H_n| = \left(|H_x|^2 + |H_y|^2\right)^{0.5}, \theta = \mathrm{Arctg}\left(\frac{|H_y|}{|H_x|}\right), H_n = |H|\angle\theta \tag{3.26}$$

4. MATHEMATICAL MODELS ELECTROMAGNETIC FIELD FOR HIGH VOLTAGEOVER HEAD LINE EXTERNAL INSULATION [9]

The magnetic field from a power line can vary widely because the current in the wires depends upon the amount of power consumed, there are two basic 50Hz magnetic field, passive magnetic field and active magnetic field,and the magnetic field depends on the following factors rating current was passing in the conductors.

For example, typical lines- average current of 700A, largest line average current of 4000A. We observe that maximum field occur underneath the conductor, and falls rapidly with distance on either side. Phasing of the conductors like conductor spacing, phase positioning, and phase balancing affects the magnetic field. The phase positioning are of two types, un transposed phasing and transposed phasing, un transposed phasing is where the phases on both sides of the line are in the same order from top to bottom and we have a magnetic field which decreases with inverse-square of the distance. Transposed phasing is where the phases of one side are opposite order to the others on the second side. The magnetic field decreases inversely proportional to the cube of the distance.

Magnetic fields are the result of motion of electric charge or current when there is a current flowing through a power line. The magnetic field lines run in circles around the conductor.

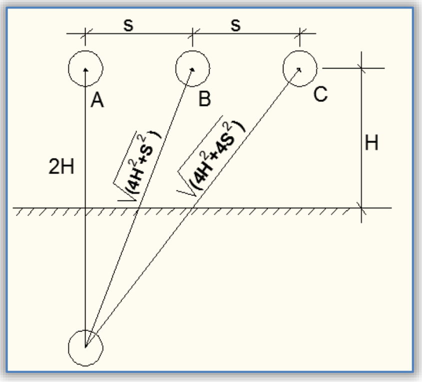

Figure 4. Three-phase horizontal configuration of an overhead transmission line

4.1. Conductor surface voltage gradient

To find the conductor surface voltage gradient, equation (4.1) is first used to derive the 3×3 inverse matrix [M] from the Maxwell's potential coefficients matrix [P], which is calculated from the overhead line geometric dimensions. This inverse matrix is then applied in equation (4.2) for the derivation of charges sustained on the three overhead line conductors. A horizontal three-phase configuration is assumed for the work in this paper as figure (4) shows.

$$[M] = [P]^{-1} \tag{4.1}$$

$$P_{11} = P_{22} = P_{33} = \ln\frac{2H}{r_{eq}}; \quad P_{13} = P_{31} = \ln[\frac{\sqrt{4H^2-4S^2}}{2S}]; \quad P_{12} = P_{21} = P_{23} = P_{32} = \ln[\frac{\sqrt{4H^2-S^2}}{S}]$$

Note that phases A, B, and C respectively refer to 1, 2, and 3 in these entries. H is the conductor height in meters, S is conductor spacing in meters,r_{eq} is given in equation (4.2) and is the equivalent radius of the conductor bundle in meters.

Equation (4.2) shows bundle radius R ($R = B/\sqrt{3}$ in this paper, B is bundle spacing), N number of conductors in a bundle, and radius of sub-conductor r.

$$r_{eq} = R * (N * r)^{-0.5} \tag{4.2}$$

When the three conductors experience a balanced positive-sequence voltage excitation understeady -state, a matrix of charges [Q] can be derived as shown in equation (4.3), where V is rms value of line-to-ground voltage and , i=1, 2, 3 for ith row.

$$\left[\frac{Q_i}{2\pi Q_i}\right] = \sqrt{2}V[{m_{i1}}^2 + {m_{i2}}^2 + {m_{i3}}^2 - (m_{i1}m_{i2} + m_{i2}m_{i3} + m_{i3}m_{i1})]^{0.5} \tag{4.3}$$

Equation (4.4) is then used to evaluate the electric field E on conductor surface

$$E = \frac{Q_i}{2\pi Q_i} * \frac{1}{N} * \frac{1}{r} * [1 + (n-1)\frac{r}{R}] \tag{4.4}$$

For respective maximum electric field expressions, $E_{OP}$and E_{CP}, for any point P on outer.
Conductor surface and on center conductor surface, equations (4.5) and (4.6) can be used.

$$E_{OP} = \frac{(1+\frac{(n-1)r}{R})}{N*r*\ln[\frac{2H}{r}*\frac{1}{[\left\{1+\left(\frac{2H}{s}\right)^2\right\}*\left\{1+\left(\frac{H}{s}\right)^2\right\}]^{0.25}}}V \tag{4.5}$$

$$E_{CP} = \frac{(1+\frac{(n-1)r}{R})}{N*r*\ln[\frac{2H}{r_{eq}}*\frac{1}{[1+\left(\frac{2H}{s}\right)^2]^{0.5}}}V \qquad 4.6)$$

Equations (4.1) through (4.6) stipulate that with only the knowledge of an overhead line geometric dimensions and the system's highest rated voltage, it is possible to determine the maximum conductor surface voltage gradient.

4.2. Ground level electric field distribution

The three-phase overhead line conductors can attract either (+q, +q, +q), (+q, 0, -q) or (+q, -2q, +q) charge conditions. These three representations respectively lead to the mathematical models for ground level electric field Ev distributions indicated by equations (4.7), (4.8) and (4.9).

$$E_V^1 = \frac{Q}{\pi e_0 H}[\frac{1}{1+\frac{(d+s)^2}{H^2}} + \frac{1}{1+\frac{d^2}{H^2}} + \frac{2}{1+\frac{(d-s)^2}{H^2}} \tag{4.7}$$

$$E_V^2 = \frac{Q}{\pi e_0 H}[\frac{1}{1+\frac{(d-s)^2}{H^2}} - \frac{1}{1+\frac{(d+s)^2}{H^2}} \tag{4.8}$$

$$E_V^3 = \frac{Q}{\pi e_0 H}[\frac{1}{1+\frac{(d+s)^2}{H^2}} + \frac{1}{1+\frac{(d-s)^2}{H^2}} - \frac{1}{1+\frac{(d)^2}{H^2}} \tag{4.9}$$

In equations (4.7) through (4.9), d is the lateral distance from the center phase towards corridor edge. The factor $Q/\pi\varepsilon_0$ is obtained from equation (4.3). Only the vertical component Ev is evaluated as its horizontal component is zero on an equipotential ground.

4.3. Ground level magnetic field distribution

The horizontal component of the magnetic field intensity HZ H in equation (4.10) is used. Since its vertical component is zero as the ground surface is assumed to be a flux line. In transmission circuits, currents are usually balanced. Hence, the phases A, B, and C respectively have$I_a = i\angle 0$ $I_b = i\angle 120$, and $I_c = i\angle 240$ currents flowing through them. The other parameters are as defined in equations (4.7) through (4.9).

$$E_{HZ} = \frac{HI_a}{\pi[(d+s)^2+H^2]} + \frac{HI_b}{\pi[d^2+H^2]} + \frac{HI_C}{\pi[(d-s)^2+H^2]} \tag{4.10}$$

Equations (4.1) through (4.10) can now be applied in electromagnetic field measurements for a real-life situation captured in the following section. These mathematical models can prove very handy even without the measuring instruments available on the market.

5. CALCULATION ELECTROMAGNETIC FIELD FOR BUSBAR 500 KV

The following data for bus bar in substation 500 kV, it is can be determine electromagnetic field, where, H= 17 m, s = 6.5 m, 12.55mm from point at surface ground,

$$R = \frac{21*10^{-2}}{\sqrt{3}} = 12.2435*10^{-2},$$

$$r_{eq} = 12.12435*10^{-2}*(2*12.55*10^{-3})^{1/2} = 1.9397*10^{-2}.$$

From the equation (4.1) determined the inverse matrix

$$P_{11} = P_{22} = P_{33} = \ln\frac{2H}{r_{eq}} = \ln\frac{17}{1.9397*10^{-2}} = 6.7758; \qquad P_{13} = P_{31} = \ln\left[\frac{\sqrt{4*17^2-4*6.5^2}}{2*6.5}\right] = 1.02963$$

$$P_{12} = P_{21} = P_{23} = P_{32} = \ln[\frac{\sqrt{(4*17^2)-6.5^2}}{6.5}].$$

From equation (4.3)

$$\left[\frac{Q_i}{2\pi Q_i}\right] = \sqrt{2}V[m_{i1}{}^2 + m_{i2}{}^2 + m_{i3}{}^2 - (m_{i1}m_{i2} + m_{i2}m_{i3} + m_{i3}m_{i1})]^{0.5}; \quad \frac{Q_i}{\pi Q_i} = 150.9807*10^3$$

Calculation at lateral distance from center phase towards corridor edge d=20m

As, charged on three phase (+q, +q, +q)

Calculation the electric fields from equation no (4.7).

$$E_V^1 = \frac{150.9807*10^3}{17}[\frac{1}{1+\frac{(20+6.5)^2}{17^2}} + \frac{1}{1+\frac{20^2}{17^2}} + \frac{2}{1+\frac{(20-6.5)^2}{17^2}}]; \quad E_V^1 = 17.2073\ kvm^{-1}.$$

Calculation the magnetic fields from equation no (4.10).

$$1\angle 0° = 1 + j0$$

$$1\angle -120° = -0.5 - j0.866$$

$$1\angle -240° = -0.5 + j0.866$$

$$E_{HZ} = -8.4185 + j6.2854\ T$$

Calculation at lateral distance from center phase towards corridor edge d=22.5 m

Electric field

$$E_V^1 = \frac{150.9807*10^3}{17}[\frac{1}{1+\frac{(22.5+6.5)^2}{17^2}} + \frac{1}{1+\frac{22.5^2}{12^2}} + \frac{2}{1+\frac{(22.5-6.5)^2}{17^2}}], \quad E_V^1 = 14.9179\ kvm^{-1}$$

Magnetic field

$$E_{HZ} = \frac{17*2000<0°}{\pi[(22.5+6.5)^2+17^2]} + \frac{17*2000<-120°}{\pi[22.5^2+17^2]} + \frac{17*2000<-240°}{\pi[(22.5-6.5)^2+17^2]}.$$

Calculation electric field and magnetic field for multipoint at ground surface in table (1) and table (2) which using to draw the relation between distances with the electric field in figure (5).

$$E_{HZ} = -7.156 + j5.4115\ \ T$$

Table (1). Calculation the electric field for a multi -point at ground surface

Dm	17	20	22.5	25	27.5	30	32.5	35
Ev	20.3491	17.2076	14.9179	12.9435	11.2638	9.8439	8.6455	7.6328

Table (2). Calculation magnetic field for a multi -point at ground surface

Dm	17	20	22.5	25	27.5	30	32.5	35
EHZ	-10.0508 +7.2597i	-8.4185 +6.2854i	-7.1560 +5.4115i	-6.0459 + 4.593 i	-5.1001 + 3.8722i	-4.3081 + 3.258 i	-3.6507 + 2.745 i	-3.1069 + 2.3202i

6. RESULT AND RECOMMENDATION

High voltage 500 kV lines can carry large currents and as a result produce relatively high magnetic fields; the research on electromagnetic and different mitigation technique discusses the different equations that allow us to calculate the magnetic fields. Magnetic fields become weaker rapidly with distance from the source. However, they do pass through most non-metallic materials and are therefore more difficult to shield. The grounding portion of substation design will be explored. In order to properly plan and design the grounding grid, calculations of the following will be done maximum fault current, grid resistance, grid current, safe touch and step voltages, ground potential rise, as well as expected touch and step voltage levels [11]. So the electromagnetic field effect on all tools in high voltage substation, and also effecting on the protection instrument, that's make error on the

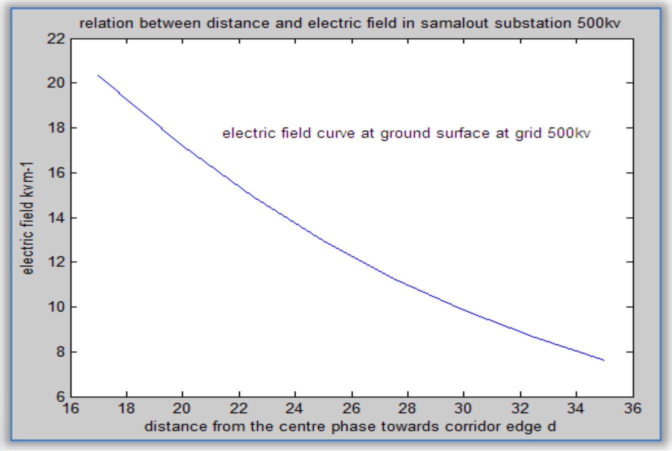

Figure 5. Relation curve between the distances coordinates with the electric field

fault location, the value of measuring and the value of fault current, To decrease the affection of the electromagnetic field:

1. The building for the control room should be after the value for the electromagnetic field at minimum value which discussed for the table (1) and (2)
2. For the cables by the selection of the type for isolation a cover and sheath earthed in two side, the sample cable in the Figure (6),
3. The instrument transformersshould beprotecting by a shield and it's earthed.
4. Cable tray should be throw underground cable tray where the ground voltage is zero and underground point which is small point affection by the electromagnetic field as in figure (7).
5. The protection panel which fix the equipment's can be decrease electromagnetic field direct by earthed as show in figure (8).
6. The selection of the measuring instrument (ammeter, voltmeter, wattmeter… etc) and the protection equipment's should be covered by metal (aluminum or cupper) to can be connect to earth and connected in steel panel which can be earthed also, as show in figure (9).

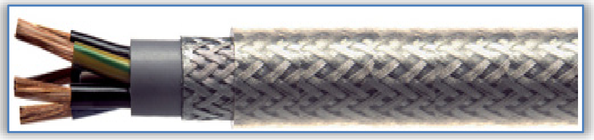
Figure 6. Sample control cable covered by a shell

Figure 7. Control cable trays in substation


Figure 8. Sample for protection panel earthed


Figure 9. Cover protection equipment earthed

7. CONCLUSIONS

The convection electric current is represented by the motion of electrically charged bodies with respect to a reference frame. Here, the electric current produced by the motion of a great number of electrically charged particles (for instance a flux of electrons or of protons) in empty space is included[12]. Overhead HV lines are sources of the electric and magnetic fields of low frequency (50/60 Hz). Near the ground surface, these fields cannot exceed values determined by ecological and health regulations or EMC standards. According to the above regulations, the considered fields should be estimated during the HV line designing [13]. Magnetic fields are the result of motion of electric charge or current when there is a current flowing through a power line. The magnetic field lines run in circles around the conductor, magnetic fields are usually measure in Tesla. So this field available in the space outer of the power line cable, if the field cut any equipment in this space this will generate magnetic field which can be induced current in this equipment which can be current transformer or voltage transformer or secondary connection cable or etc. The magnetic field from a power line can vary widely because the current in the wires depends upon the amount of power consumed. There are two basic 50Hz magnetic field, passive magnetic field and active magnetic field. The magnetic field depends on the following factors, the ratings of current passing in the conductors, Clearance of the line where maximum field occur underneath the conductor, and falls rapidly with distance on either side, Phasing of the conductors like conductor spacing. The induced current may be in the same main direction or opposite direction where this will do error in the protection relay or measurement equipment. In this paper part (6) discuss how can be overcome or reduce this affection which the main treatment for the induced electromagnetic field by grounding for all equipment's.

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