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BIOLOGICAL HAZARDS OF ELECTROMAGNETIC FIELDS GENERATED BY ELECTRIC HIGH VOLTAGE TOWER KHARTOUM STATE - SUDAN

[1]Sami Abdalla Elbadawi , [2]Mubarak Dirar Abd-Alla , [3]Sawsan Ahmed Elhouri Ahmed

[1,2] Sudan University of Science & Technology – College of Science- Dept. of Physics-Khartoum-Sudan

[3]University of Bahri - College of Applied & Industrial Sciences- Dept. of Physics-Khartoum-Sudan

ABSTRACT

Different attempts were made to account the power emitted by mobile phone towers stations. However, no intensive research was made to determine the magnetic field strength generated by these towers. Also there is no sufficient work done to account the effect of electromagnetic field and magnetic field produced by electric transmission lines.

This work is concerned in studying electromagnetic field generated by transmission lines at Khartoum State – Sudan.

Keywords: transmission lines, EMF, electric domain, magnetic domain, Exposure

INTRODUCTION

Electromagnetic waves are electric and magnetic waves oscillating perpendicular to each other and to direction of propagation.

Exposure to electromagnetic fields is one of the main heath issues facing those who are living with the advancements of modern technology. The increased use of cellular and wireless technology, electronics, and household appliances cause continuous and intensive exposure to electromagnetic field (EMF) from a variety of sources. Governments have began to legislate and stipulate regulatory policies regarding the allowable limits of (EMF), but the over whelming majority of such legislation is concerned only with (EMF) from higher frequency and radio-frequency sources such as telecommunications and microwave ovens[1,2]

However, power transmission lines, and other sources which relate to the transmission and generation of electrical energy, emit extremely low frequencies between 0-300 Hz. The (EMF) Research and public information dissemination program (EMF RAPID) of the National Institute for Environmental Health Sciences in the US determined that exposure to extremely low frequency (EMF) is a "possible" cancer hazard; however, in 2001, the International Agency for Research on Cancer issued a monograph announcing that as a possible carcinogen, extremely low frequency magnetic field have statistically been linked to childhood leukemia. Although not conclusively linked at this time, higher incidents of cancer development have been documents not just among children, but also among adult residents who live or work near high voltage power lines[3,4,5]

MATERIALS AND METHODS

In this work the instrument used is (SPECTAN NF) device shown in figures (1) and (2) the device can measure magnetic field strengths down to ranges of nana teals.

The device measures the exposure limit from (117.7 nT to 804.6 nT[6].

This device is used to measure magnetic strengths and determine the electromagnetic power for different electric transmission lines in selected areas at Fig (1): spectra NF (5020) device

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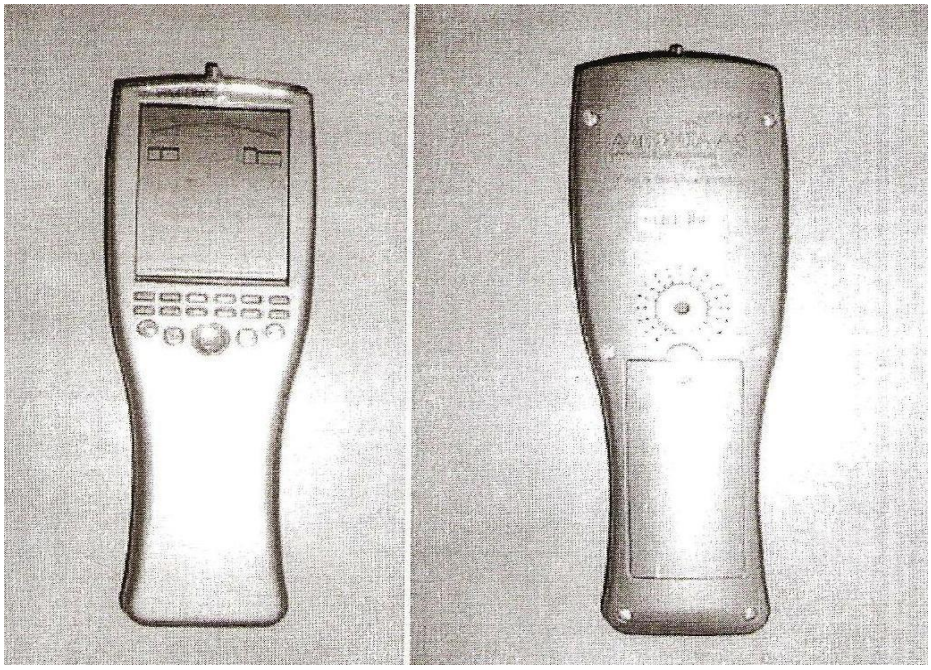
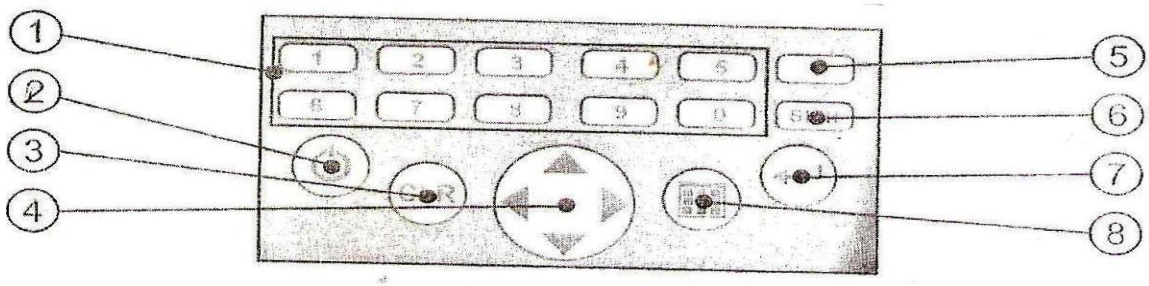


(2-1) Instrumentation

The device used here is spectrum NF (5020) device. It is used to magnetic flux density B down to a range of nana teals. It also measures the frequency of the oscillating field. A visual image of it is shown fig (1), while fig(2) [8,9,1



fig(2) : Details of measurement type.

(1) Numeric Block (Hotkeys).

①≡scan 0-1 GHz

②≡scan1-2 GHz

③≡scan2-3 GHz

④≡scan3-4 GHz

⑤≡scan4-3 GHz

⑥≡scanWLan(2.4GHz).

⑦≡scanGSM900 (D1&D2 Cell towers, no cell phones).

⑧≡scan GHz GSMI800 (E-Plus Cell towers, no cell phones).

⑨≡scanUMTS (UMTS cell towers, no cell phones).

⓪≡DECT-Analyzer (Measure DECT phones).

❶ On/Off button:

Turn the unit on/off.

❷ Clear/Reset Key:

1. ESCAPE Key: Reset all hotkeys to default settings.
2. with main menu active: Delete input.

❸Arrow Keys:

1. with main menu active: Selection of menu entries.
2. In Spectrum analysis mode:
- Right/Left Keys: Move frequency range by one SPAN.
- Up/Down Keys: Move reference-level by 10 dB.
3. In exposure limit calculation mode:
Right/Left Keys: Select exposure limits or W/m-Display.
4. In Audio Mode:
- Right/Left Key: Increase/decrease Center frequency by one RBVV.
- Up/Down Key: Increase/decrease RBW (band width).
❹Dot-Key:
1. In spectrum & exposure limit calculation modes (HOLD, on/off).
2. In audio mode: Switch between AM/FM.
❺Shift-Key:
In spectrum & exposure limit calculation modes (PULSE, on/off).
❻Enter-Key:
1. Switches between the operation modes spectrum analysis, audio, exposure limit calculation and broadband detector (power-meter).
2. With main menu active: confirms clirrent input (ENTER-Key).
❼ Menu-Key:
Call/Dismiss: main menu for changing various setting.
(8)Spectrum Device:
The device receives measure the electric and magnetic fields strengths near high-voltage transmission lines. Respective frequencies and signal strengths, in complete sense.
GPS Device:
The abbreviation GPS stands for the Global positioning system this system reties on set of-satellites. The GPS function is to identity the position of these satellites as well as calculating the distances between them and the earth in order to deduce the site of the receiver hence identifying their subordinates on the surface of the earth.

(2-2) Methodology

All power lines give off radiation called electric domain and magnetic domain. Both domains must have, maximum limit to which workers exposed securely. The standard maximum permissible limit is shown in table (1).
In this work 6 different readings were taken from 3 different planes
Exposure limit and frequency are measured for each high-voltage towers for different distance.
Table (1) show the data obtained by screening seven high-voltage towers in Khartoum. Readings were taken at different distances.
The column titled GPS shows the measured value of longitude and latitude lines by each tower length and width lines have been measured by using GPS device.
Then some areas across Khartoum State were investigated and analyzed.
1\ Some industrial countries standards for EMF radiation from high voltage towers.

Table (1)

Country "reference)	Distance (m)	Exposure-limit (nT)
Germany	35	10.000
Russia	50	1.000
Italy	40	500.00

Tesla (T): the unit of magnetic flux density (1 Tesla = 10^4 Gauss)

2\ The measurements slowed that the radiation emitted in high voltage lines in Khartoum State.

Table (2)

Data from Alamarat area: The measurements were taken at the ground land.

Position	Distance ($\pm 10^{-2}$m)	Exposure–limit ($\pm 10^{-9}$nT)	Frequency 1(±Hz)	GPS
1	10	627.7	50.0	N: 15.34657
2	15	540.5	49.0	E: 32.32504
3	18	459.7	49.5	
4	20	450.7	50.0	
5	21	384.8	49.5	N: 15.34541
6	22	358.5	48.5	E: 32.32523

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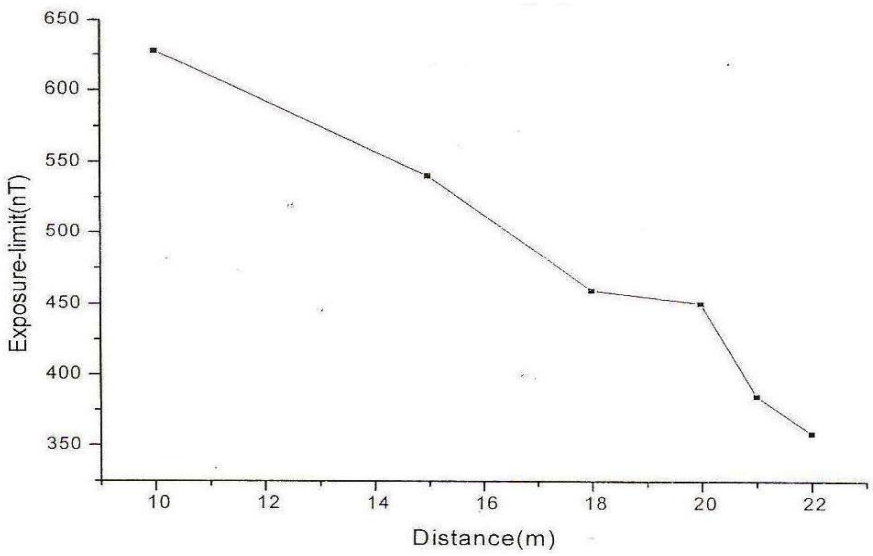

FIG (2-a)
Exposure limit versus distance at Alamarat Towers

The exposure limit against distance for two different high-voltage towers. Results show the fluctuations of Exposure limit with distance.

Table (3)
Data from Alamarat area: The measurements were taken at the top of the building

Position	Distance ($\pm 10^{-2}$m)	Exposure–limit ($\pm 10^{-9}$nT)	Frequency 1(±Hz)	GPS
1	41	662.5	50.0	N: 15.34657
2	42	593.6	48.5	E: 32.32524
3	61	579.3	49.5	
4	71	523.6	49.0	
5	80	409.2	50.0	N: 15.34541
6	100	321.9	48.0	E: 33.32610

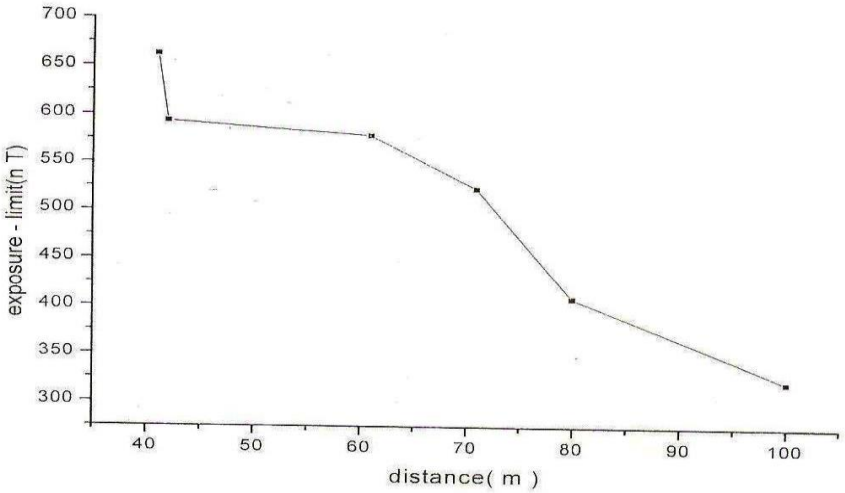

Fig (3-a):Exposure limit versus distance at Alamart towers

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Table (4)
Data from Arkaweet area: The measurements were taken at the ground land

Position	Distance ($\pm 10^{-2}$m)	Exposure–limit ($\pm 10^{-9}$nT)	Frequency 1(±Hz)	GPS
1	10	346.3	49.0	N: 15.34660
2	15	336.4	48.5	E: 32.33761
3	20	273.1	50.0	
4	22	245.1	50.0	
5	30	232.3	49.0	
6	36	147.7	49.5	N: 15.33904
7	40	117.3	48.5	E: 32.33775

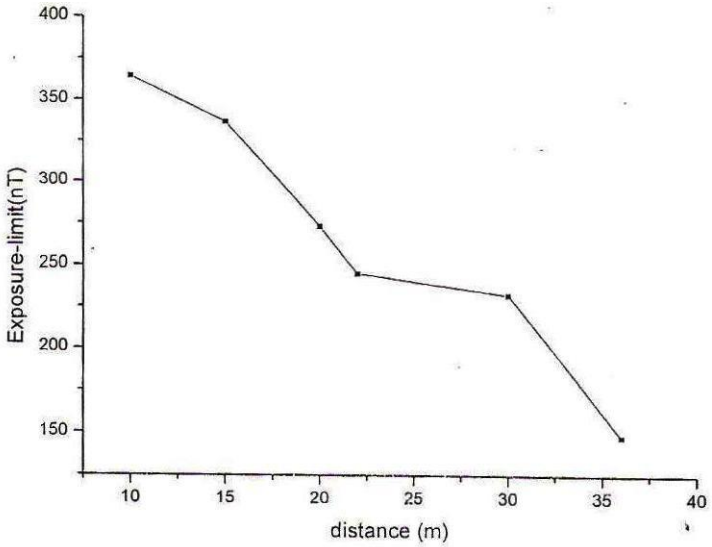

Fig (4-a):Exposure limit versus distance at Arkaweet towers

Table (5)
Data from Arkaweet area: The measurements were taken at the top of building

Position	Distance ($\pm 10^{-2}$m)	Exposure–limit ($\pm 10^{-9}$nT)	Frequency 1(±Hz)	GPS
1	36	626.6	49.0	N: 15.33703
2	40	612.9	50.0	E: 32.33621
3	42	601.2	48.5	
4	43	597.0	49.5	
5	71	560.2	48.5	
6	72	529.3	48.0	
7	81	433.6	49.0	
8	100	410.5	48.0	N: 15.343142
9	120	301.9	49.0	E: 32.33622

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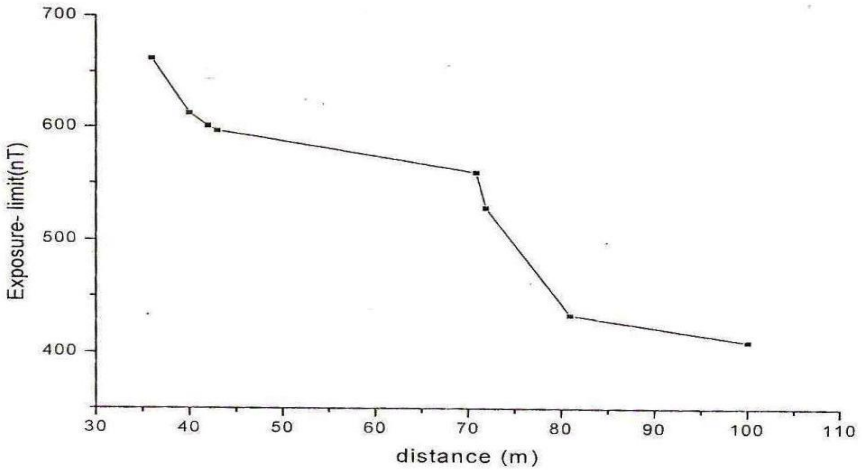

Fig (5-a): Exposure limit versus distance at Arkaweet Towers

Table (6)
Data from Abdullah El-tayeb Street area: The measurements were taken at the top of building

Position	Distance ($\pm 10^{-2}$m)	Exposure–limit ($\pm 10^{-9}$nT)	Frequency 1(±Hz)	GPS
1	10	738.4	49.0	N: 15.34248
2	15	735.5	49.5	E: 32.33872
3	20	729.1	49.0	
4	25	723.1	49.5	
5	40	603.2	49.5	
6	42	501.2	49.5	
7	43	475.9	49.0	N: 15.34293
8	50	433.5	48.5	E: 32.34140

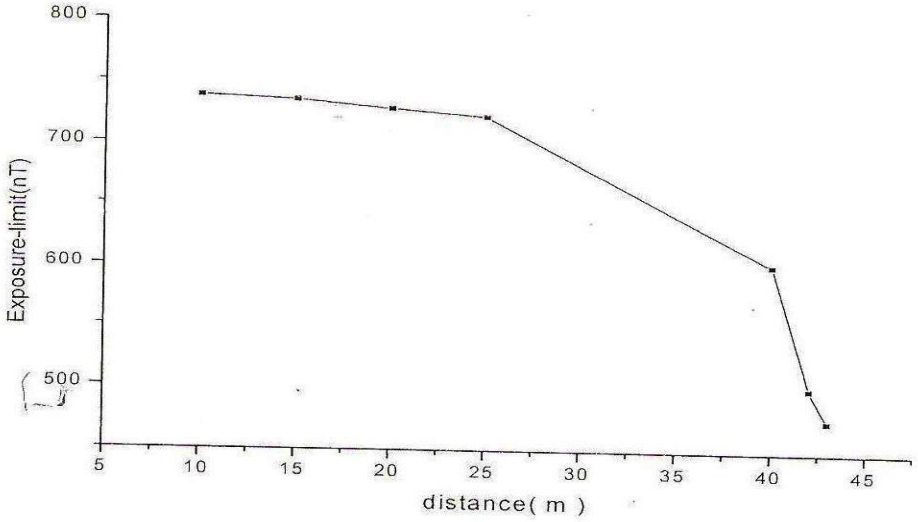

Fig (6-a):Exposure limit versus distance of Abdellah El-tayeb Street

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Table (7)
Data from Abdellah El-tayeb Street area: The measurements were taken at the ground land

Position	Distance ($\pm 10^{-2}$m)	Exposure–limit ($\pm 10^{-9}$nT)	Frequency 1(±Hz)	GPS
1	71	672.9	49.0	N: 15.34215
2	72	653.3	49.0	E: 32.33657
3	100	633.3	49.5	
4	150	628.5	49.0	
5	160	608.2	49.5	
6	180	602.1	49.0	N: 15.34750
7	200	510.5	49.0	E: 32.31260

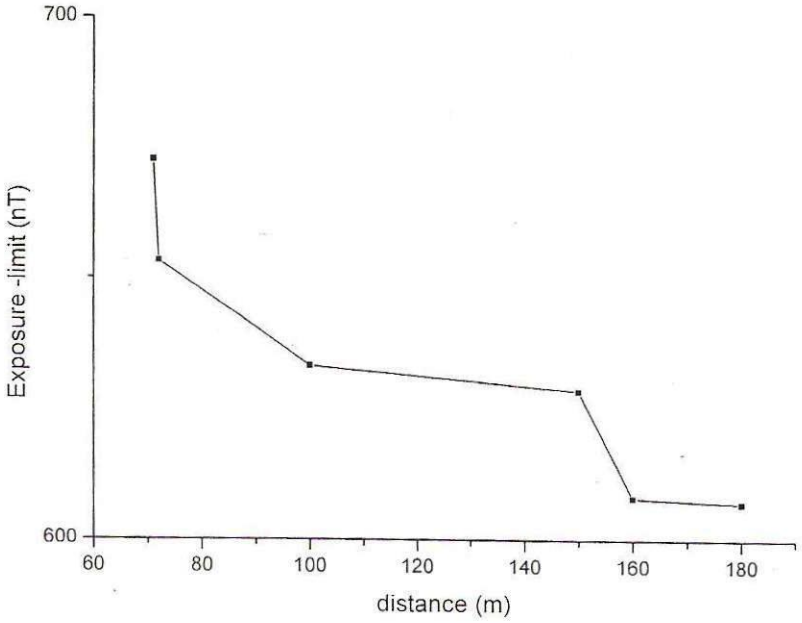

Fig (7-a):Exposure limit versus distance of Abdellah El-tayeb Street

THEORETICAL INTERPRETATION

Consider along wire in which current through it. According to
Biota- savant law the magnetic flux density B at a distance r is given by

$$B = \frac{\mu_\circ i}{2r} \quad (1)$$

The flux lines are in the form of concentric circles centered at points lying on the wire axis. For alternating current

$$i_{a=i_\circ} \sin wt \quad (2)$$

The vale of i stands for the effective value i_a , which is given by

$$i_{a=i_\circ} = \frac{i_\circ}{\sqrt{2}} \quad (3)$$

Where $i_\circ$ is the maximum current value. Thus inserting equation (3) in equation (1) yields

$$B_\circ = \frac{\mu_\circ i_\circ}{2\sqrt{2}\, r} \quad (4)$$

Considering three parallel power transmission lines the field flux density
Of the upper and lower one in given by

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$$B_1 = \frac{\mu_\circ i_\circ}{2\sqrt{2}\, r_2} \quad (5)$$

Where

$$r_1 = (r^2 + l^2)^{\frac{1}{2}} \qquad r_2 = (r^2 + l^2)^{\frac{1}{2}} \quad (7)$$

$$\sin\theta_1 = \frac{l}{r_1} \qquad \sin\theta_2 = \frac{l}{r_2} \quad (8)$$

Since: $r \gg l$ it follows that

$$r_1 \approx r_2$$

$$\theta_1 = \sin\theta_1 \approx 0 \quad \theta_2 = \sin\theta_2 \approx 0 \quad (9)$$

Thus the total magnetic flux density in the algebraic sum of the three fields resulting from the three wires.

$$B = B_0 + B_1 + B_2 = \frac{3 i_\circ \mu_\circ}{2\sqrt{2}\, r} \quad (10)$$

There for the electromagnetic radiation intensity I_2 is given by

$$I = \mu_\circ H^2 = \frac{B^2}{\mu_\circ} = \frac{9 {i_\circ}^2 \mu_\circ}{8 r^2}$$

$$I = \frac{9 {i_\circ}^2 \mu_\circ}{8 r^2} \quad (11)$$

CONCLUSION

The survey made and magnetic field intensity and electromagnetic field intensity is safe. It shows that electric transmission power line does not cause any biological hazards for human.

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