

EXTREMELY LOW FREQUENCY MAGNETIC FIELD MEASUREMENTS NEAR OVERHEAD POWR LINES

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ABSTRACT

Nowadays, with increasing rate of power consumption, extremely low frequency magnetic fields (ELF-MFs) from power distribution lines as well as electric house-hold appliances are known as “electromagnetic pollution” is increased.

According to the concerns mentioned above, different studies have been carried out to determine the ELF-magnetic field flux densities in urban areas and other studies have been focused on inhabitants in close vicinity to overhead power lines.

Alexandria Electricity Distribution Company (AEDC) has about 577 km Medium Voltage (MV) overhead lines. AEDC enumerated three slums which locate under the medium overhead power lines and within the right of way The survey results show one of these slums suffering from high level exposure to ELF-MF reached above 10 μ T inside homes which is considered dangerous for long time exposure period especially for children

This survey will be a motive to the AEDC to study the feasibility of converting the MV overhead power lines in these slums to underground cables to ensure healthy environment for the inhabitants.

INTRODUCTION

A possible link between childhood cancer and electrical power lines was raised when epidemiologists Nancy Wertheimer and ED Leeper, published a paper on 1979, in which they reported a 2-3 fold increased risk for childhood cancers. Since then numerous studies have been conducted in different countries to assess the health effects of ELF-magnetic fields, reporting various impacts due to exposure to these fields including behavioral and neurophysiologic changes, and childhood leukemia.

However, results from other studies have shown that the relationship between human's health and exposure to ELF-magnetic field is often poor or non-existent.

In 2010, International Commission on Non-Ionizing Radiation Protection (ICNIRP) produced new guidelines. According to these guidelines, the reference levels for safe general public exposure and for the frequency of 50 Hz are reported[1-2] as follows:

- For electric field strength, $E < 5$ kV/ m
- For magnetic field strength, $H < 100$ A/ m
- For magnetic flux density, $B < 200$ μ T

The levels for safe occupational exposure are:

- For electric field strength, $E < 10$ kV/ m
- For magnetic field strength, $H < 800$ A/ m
- For magnetic flux density, $B < 1000$ μ T

But these do not automatically take effect in the European countries. Many countries policy remained as it is based on 1998 ICNIRP until Governments decide otherwise, and other countries applied more restricted guidelines to ELF-MFs reached 1 μ T as Swiss.

AEDC established its overhead power lines (OHPL) according to the specification standard taking into consideration the suitable route for the lines and its right of way. The majority of these areas are developed in contradiction to building laws and planning regulations, as residents build houses on state-owned land or on privately-owned agricultural land without getting permission to build or fit in with land use plans, if these exist for the area. They can be considered illegal or informal settlements but not slums. These unsafe areas are characterized by being subject to life threat, or having inappropriate housing, or exposed to health threat or tenure risks, while unplanned areas are principally characterized by its noncompliance to planning and building laws and regulations.

AEDC enumerate three unsafe areas where there are a fetal accidents happened due to the closeness of OHPL.

MAGNETIC FIELD MEASUREMENT

On site measurement of magnetic field in the two substations are done using the magnetic field meter, more precisely the PMM 8053 which works together with a PMM EHP-50 probe supplied by Italy, which are connected through fiber optics wire used to avoid interference shown in Figure1.[3]

The magnetic field was measured at a height of 1 m above ground level according to IEEE Std 644-1994. Measurements were carried out in three unsafe areas located within the MV power lines corridors. The unsafe areas located in three areas are:

- 1- Borg Al Arab (case study 1)
- 2- Abbis (case study 2)
- 3- Abd Elkader (case study 3)



Figure 1. View of the probe and meter

Case study I

In this unsafe area, houses located within the corridor of the OHPL as shown in Figure 2. The current was 72 A during the magnetic field measurement at noon. The lateral measurements for magnetic field were carried out under the power lines according to IEEE Std 644-1994 and the results were shown in Figure 3. The spot measurements were taken inside the home and the range of measurements were between 4.2 μ T -6.4 μ T. Also spot measurements were carried out on the roof and its range were 9.4 μ T - 12 μ T



Figure 2. The overhead power line location in case study I

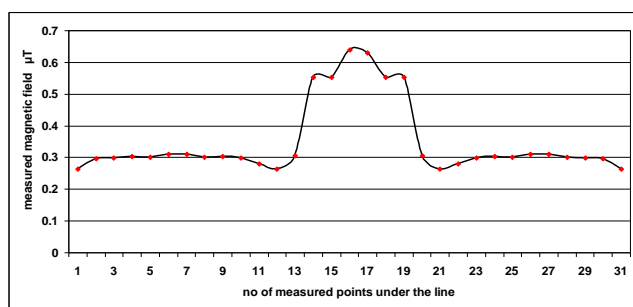


Figure3. Lateral Magnetic Field Measurement under power line

Case study II

The OHPL passes through an agricultural land and there are many buildings that have been built in front of the line so that the distance between the line and the buildings in some areas less than one meter as shown in Figure 4. The current was 148.38 A at noon while the sample was taken for one of these homes. The spot measurements have been taken at the first floor and the roof of the home at different places as shown in the plan Figure 5. These measurements were repeated at night when the current value was 212.46 A. Comparison between the spot measured values in home which cleared in Figure 5 was presented in Table 1. Also; the lateral measurements for magnetic field were carried out under the power lines at noon and night as shown in Figures 6-7.



Figure 4. The overhead power line location in Case study II

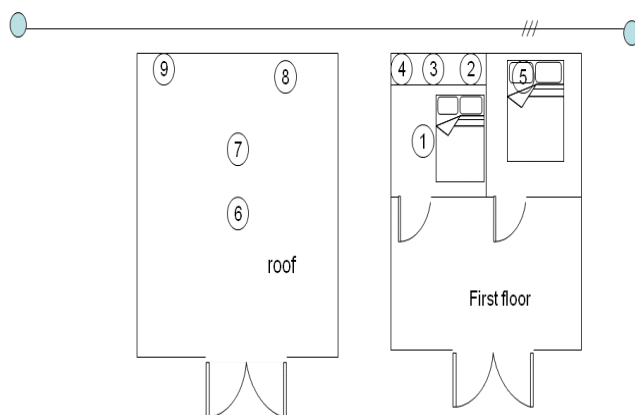


Figure 5. Home Plan for the spot measurements points inside the first floor and the roof

Table 1. Measured magnetic Field values in home

Measurement position	Measured magnetic Field (μT)	
	At noon	At night
1	0.36	0.512
2	0.37	1.6
3	0.58	1.9
4	0.411	2.3
5	0.566	2.5
6	0.516	2.1
7	0.725	3.5
8	0.67	2.7
9	0.68	3.1

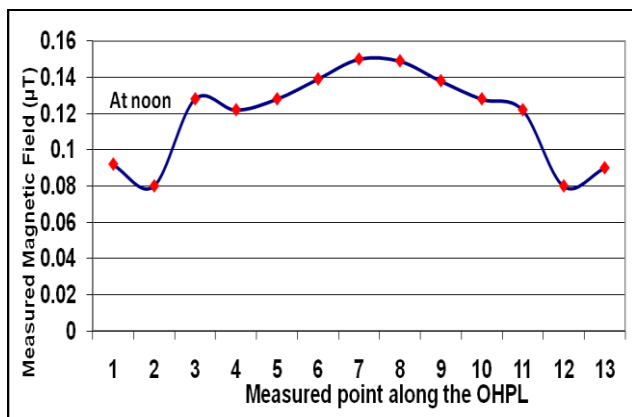


Figure 6. Lateral Magnetic Field Measurement under power line at noon

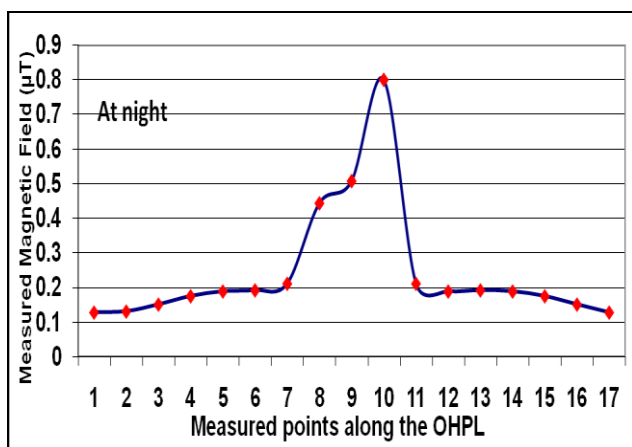


Figure 7. Lateral Magnetic Field Measurement under power line at night

Case study III

In this unsafe area there are two OHPL circuits, the houses located under and within the OHPLs corridors as shown in Figure 8. The magnetic field measurements were carried out inside one of the homes and one of the commercial stores in this area at night. The load currents were 17 A and 20A. The measured magnetic field values were presented in Table 2.



Figure 8. The Overhead power line location in Case study III

Table 2. Measured magnetic Field values

Measurement position	Measured magnetic Field (μT)	
	Inside the store In the 1 st floor	Inside the home Beside OHPL
1	0.128	0.228
2	0.122	0.133
3	0.11	0.266
4	0.139	0.516
5	0.15	0.67
6	0.149	0.725

CONCLUSIONS

It is noted from the results that all the measured magnetic field values are lower than the ICNIRP limits. The maximum magnetic field measured values were 12 μT at the roof and 6.2 μT inside the home room in case study I. These measured values will increase at night due to the load increase at peak time. For case study II, It is observed that the maximum magnetic field value was 3.5 μT inside the home. Also, it is noted that the measured magnetic field values under OHPL increased at night. For case study III, it is noted that the measured magnetic field

value was $0.725\mu\text{T}$. Although these values are lower ICNIRP limits but still there are elevated risk of cancer for children living in high-current-configuration for long period. Also there were many fatal accidents in these unsafe areas area due to the closeness of OHPL from people.

RECOMMENDATIONS

Children in developing countries sometimes live very close to OHPLs, because there are not any competent laws protecting them. They live, play, do schooling and grow up there because they have no other options. Occasionally children are admitted to the department of emergency with accidental electrical shock injuries, when playing in the vicinity of a power tower, or even trying to climb them as happened in case study I.

The authorities in developing countries should reassess the hazards and re-define the safe zones near the Medium and high voltage power lines. And the authorities must prevent any building to be established within 5 meters at least from the MV OHPLs.

This survey will encourage the AEDC to reroute the OHPLs in some spans along the line to increase the distance between homes and OHPL or to study the feasibility of converting the MV overhead power lines in these unsafe areas to underground cables to ensure healthy environment for the inhabitants [4-6].

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