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ASSESMENT OF ELECTROMAGNETIC FIELD RADIATION EXPOSURE LEVELS AND ASSOCIATED HEALTH RISKS IN NYANGASANG AREA OF CALABAR, NIGERIA.

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Abstract

This study assessed the electromagnetic field radiation from high tension power lines at Nyangasang Calabar. The result shows that there's a major spike in EMF radiation exposure levels at areas where the high-tension power lines overlaps or where two or more terminals tend to meet at a point. The result also showed that the topography of an area also has an impact on the amount of EMF radiation that is exposed, this was clearly seeing in one of the sample locations (LAST TRANSFORMER), where even a peak value of 2.0m the exposure was 0.1944 V/m. The result also showed that while varying the distance higher from 0.0 m, 1.1 m, and 2.0 m, the EMF radiation is Exposure tends to increase respectively which implies that the ratio of exposure is directly proportional to the distance apart. Results from the study in comparison to Etido et al., (2018) is in agreement and the exposure limits are below the standards set by ICNIRP, the result is also in agreement to Jide et al., (2021) in research conducted on assessment of Extremely Low Frequency Electromagnetic Field (ELF-EMFs) emitted from High Voltage Power Transmission Line (HVPTLs) in Akure Nigeria.

Keywords: Electromagnetic Field Radiation, Ionizing Radiation and Non- ionizing Radiation.

1.0 Introduction

Electromagnetic fields (EMFs) are a fundamental aspect of the physical world, it is created whenever electrical current flows through a conductor. They are omnipresent in our modern society due to the extensive use of electricity Adewale et al. (2022). These fields comprise electric and magnetic components and have both natural and artificial origins.

According to International commission for Non-ionizing radiation protection (ICNIRP), EMFs can be broadly categorized into two types: low-frequency EMFs, such as those emitted by household appliances, and high-frequency EMFs, which encompass radio waves, microwaves, and ionizing radiation like X-rays and gamma rays. This project focuses primarily on the assessment of low-frequency EMFs emitted from high tension power lines and the potential health risks associated with long-term exposure to these fields. Understanding the sources, characteristics, and associated calculations of EMF radiation, particularly from power lines, have fuelled considerable research and debate, and is of paramount importance dueto growing concerns about its impact on human health Adewale et al. (2022).

Electricity delivery to residential or industrial consumers involves three main sections: power generation plants, transmission facilities and distributions. Transmission facilities act as a bridge between the power generation stations and the consumers, carrying high-voltage electric power over long distances through transmission lines. These lines can be either underground or overhead, depending on the location and the availability of right-of-way (ROW). Underground transmission lines are used for underwater and densely populated areas where overhead lines are not feasible, while overhead transmission lines can be used in both sparse and dense areas in urban, suburban and rural environments. However, underground transmission lines are less common than overhead ones because they have more heat losses, longer restoration times and higher costs.

Understanding and quantifying EMF radiation involves mathematical expressions that allow to measure and assess these fields. Below are key formulas for calculating EMF radiation.

The magnetic field generated by a long straight current-carrying conductor is given by Ampère circuital law as:

$$B = \frac{\mu^{\circ} * I}{2\pi r} \qquad (1)$$

Where, B is the magnetic field in teslas (T), μ° is the permeability of free space

($4\pi \times 10^{-7}$ T·m/A),

I is the current in amperes (A) and r is the distance from the wire in meters (m).

1.2 Electric Field (E) Calculation

The electric field near a high voltage power line is calculated as:

$$E = \frac{V}{d} \quad (2)$$

Where, E is the electric field intensity in volts per meter (V/m), V is the voltage in volts (V) and d is the distance from the power line in meters (m).

Nyang-asang area of Calabar, one of the leading clouded local settlements in Calabar, Cross River State, Nigeria, houses several infrastructures which is crucial for the inhabitants while these infrastructures are important, they also carry potential risks as most of properly are electric power lines. Understanding the Electromagnetic field radiation exposure levels and associated health risks in Nyang-asang area of Calabar is essential to ensure the safety of its inhabitants.

To assess Electromagnetic field radiation exposure levels, various measurements and monitoring techniques will be employed. This study will involve the use of a global positioning system (GPS), which is a device that helps determine the coordinates of the area, and also the use of an Electromagnetic meter which is a device used to measure and record Electromagnetic field radiation exposure over a specific period. Electromagnetic meter will be used at different locations, including students' walkways, shops, or stores built under the high-tension power cables and parking space, to capture a comprehensive picture of Electromagnetic field radiation exposure across Nyang-asang area of Calabar. The data from the Electromagnetic meter will be analyzed to determine the average radiation dose and identify areas or activities with higher Electromagnetic field radiation exposure levels. Once the radiation exposure levels are determined, the study will assess the associated health risks.

According to National Council on Radiation Protection (NCRP) (2009), the health risks of Electromagnetic field radiation exposure depend on factors such as the dose, duration of exposure, and type of radiation. The collected data will be compared with established EMF radiation safety guidelines and standards to evaluate potential health risks.

The assessment of Electromagnetic field radiation exposure levels and health risks in Nyang-asang area of Calabar carries several significant implications. Firstly, it will provide crucial information to the institution's management and relevant stakeholders regarding the safety of individuals working, studying, or doing business within the campus. This knowledge can be used to implement appropriate radiation protection measures, including training programs, awareness campaigns, and the establishment of safety protocols. Additionally, the study's findings can contribute to the development of comprehensive radiation safety guidelines and policies within the institution, fostering a culture of safety and responsible use of radiation-emitting technologies.

The assessment of Electromagnetic field radiation exposure level and health risks in Nyang-asang area of Calabar, with specific consideration to power cables and high-tension wires, is a critical issue that requires immediate attention and investigation.

While these electrical infrastructures are crucial for the efficient functioning of the area, their proximity to populated areas raises concerns about potential health risks.

The specific levels of Electromagnetic field radiation emitted from these power sources and the extent of exposure to students, faculty, staff, and visitors remain largely unknown.

The assessment of Electromagnetic field radiation exposure levels and health risks associated with power cables and high-tension wires at Nyang-asang area of Calabar is crucial to ensure the well-being and safety of the individuals within the community.

The identification of potential "hotspots" where Electromagnetic field radiation levels might exceed recommended safety limits is of utmost importance.
By pinpointing areas with elevated Electromagnetic field radiation levels, appropriate measures can be taken to minimize exposure and ensure the safety of individuals in those locations.

This information will enable the development and implementation of effective safety protocols and guidelines to minimize any potential health risks.

Additionally, the study will contribute to the existing scientific knowledge on the health effects of EMFs and provide valuable insights into the specific context of Nyang-asang area of Calabar.

The study was carried out at Nyang-asang area of Calabar, Cross River State. Measurements were taken at different locations within the campus to assess EMF radiation exposure and doses emitted from the high-tension power cables. The areas chosen for the measurements of the EMF radiation were selected based on human activities within the area. Below is a table showing GPS coordinates of the study area.

2.0 Materials and methods

Table 1. Showing GPS coordinates of the study area

S/N	LOCATIONS	LABEL	LATITUDE	LONGITUDE	ELEV.
1.	FIRST TRANSFORMER NYANGASANG	A_1	N 04° 58' 37′.21"	008° 21' 48.07"	58m
2.	APOSTOLIC CHURCH NYANGASANG	A_2	N 04° 58' 33.18"	008° 21' 27.13"	59m
3.	SECOND TRANSFORMER NYANGASANG	A_3	N 04° 58' 32.82"	008° 21' 32.36"	57m
4.	AKPANDEM NYANGASANG	A_4	N 04° 58' 34.9"	008° 21' 43.8"	58m

5.	LAST TRANSFORMER NYANGASANG	A_5	N 04° 58' 42.11"	008° 21' 57.37"	38m
6.	CONTROL	A_6	N 04° 58' 44.01"	008 21' 56.57"	42m

Measurement approach was adopted using factory-calibrated Electro smog Meter (ED78S) to measure the EMF radiation in the study area. The coordinates of the 6 locations were taken with a handheld geographical positioning system (GPS 76S) at an elevation of 1.0 m above ground level. While that of Electro smog Meter (ED78S) was taken at different intervals, with the aid of a measuring tape which was used to measure the distance apart. Distances of 0.0m, 1.0m, and 2.0m from the ground level under the high-tension power lines were considered when taking reading from Electro smog Meter.

3.0 Results

Table 2: Showing Sample location and the mean values of the EMF radiation exposed

S/N	SAMPLE LOCATION	EMF RADIATION EXPOSURE (V/m)		
		0.0 m	1.0 m	2.0 m
1	FIRST TRANSFORMER NYANGASANG	0.1239	0.2005	0.3855
2	APOSTOLIC CHURCH NYANGASANG	0.1658	0.3302	0.3785
3	SECOND TRANSFORMER NYANGASANG	0.1509	0.2761	0.3435
4	AKPANDEM NYANGASANG	0.1043	0.1614	0.1944
5	LAST TRNSFORMER NYANGASANG	0.2104	0.6665	0.7760
6	CONTROL POINTS UNICROSS (100m)	0.1095		

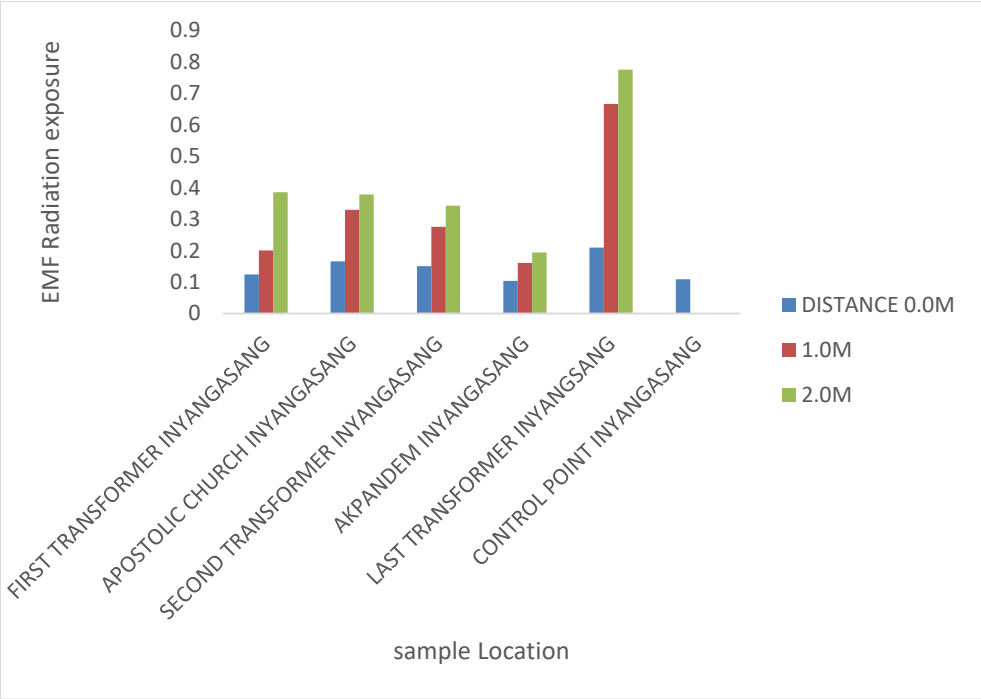

Figure 1 Showing EMF radiation exposure in Nyangasang

4.0 Discussion

The result after carrying out the experiment in chapter three shows that there's a major spike in EMF radiation exposure levels at areas where the high-tension power lines overlaps or where two or more terminals tend to meet at a point. The result also showed that the topography of an area also has an impact on the amount of EMF radiation that is exposed, this was clearly seeing in one of the sample locations (second transformer nyangasang), where even a peak values of 2.0m the exposure was 0.1944 V/m. The result also showed that while varying the distance higher from 0.0 m, 1.1 m, and 2.0 m, the EMF radiation is Exposure tends to increase respectively which implies that the ratio of exposure is directly proportional to the distance apart. Results from the study in comparison to Etido et al., (2018) is in agreement and the exposure limits are below the standards set by ICNIRP, the result is also in agreement to Jide et al., (2021) in a research conducted on assessment of Extremely Low Frequency Electromagnetic Field (ELF-EMFs) emitted from High Voltage Power Transmission Line (HVPTLs) in Akure Nigeria.

4.1 Health risk assessment

According to the World Health Organization (WHO), the exposure limits for EMF fields developed by the European and International Commission on Non-Ionizing Radiation Protection (ICNIRP) are based on reviews of all the peer-reviewed scientific literature, including thermal and non-thermal effects. The European and ICNIRP guidelines recommend the following exposure standard limits for the general public; A safe value of 5 v/m for public areas and 10 v/m for occupational areas.

Comparing the data in Table 4.1, With the ICNIRP guidelines, I can see that the EMF

radiation exposure levels at the various locations are below the standard levels. For example, at the CONTROL POINT location, the exposure level is 0.1095 V/m, which is much lower than the limit of 5 V/m for the frequency of 50 Hz. Similarly, at the other locations, the exposure levels are also below the standard limits.

However, this does not mean that there is no risk of adverse health effects from EMF exposure. Some studies have suggested that EMF exposure may be linked to cancer, reproductive problems, neurological disorders, and other health issues. However, the evidence is not conclusive and more research is needed to establish the causal relationships and the mechanisms of action.

Therefore, it is advisable to adopt the precautionary principle and reduce the exposure to EMF as much as possible, especially for children, pregnant women, and people with medical conditions.

5.0 Conclusion

This study aimed to evaluate the electromagnetic field (EMF) radiation emitted by high tension power lines within Nyangasang, Calabar, Cross River State. The primary objective was to assess the EMF exposure and associated health risks in the vicinity. A calibrated electro smog meter was used to measure EMF exposure emanating from the high tension power lines. Measurements were taken at different heights above the ground level, specifically at 0.0 m, 1.0 m, and 2.0 m. Subsequently, the collected data was analyzed and compared against the safety standards set by the International Commission on Non-Ionizing Radiation Protection (ICNIRP) guidelines.

The results of the study indicated that the measured EMF radiation levels were below the ICNIRP's established safety limits. The highest levels of EMF radiation were observed at a distance of 2.0 meters above the ground in all locations, with values ranging from 0.1095 V/m to 0.7770 V/m. These findings suggest that the EMF radiation from the high-tension power lines within Nyangasang Calabar does not pose a significant health risk to the general public, as it falls within internationally recognized safety thresholds.

However, despite the results showing compliance with safety standards, it is advisable for staff and students in the campus community to avoid prolonged exposure by refraining from staying, constructing buildings, or parking vehicles in close proximity to or underneath the high tension power lines. Long-term exposure to EMF radiation, even within permissible limits, may still carry potential health risks.

The assessment of EMF radiation in Nyangasang Calabar is of importance, because it creates awareness about the health risk of being exposed to EMF radiation daily. This study has clearly shown the health risk of EMF radiation which cannot be seen ordinarily without the aid of an instrument. In conclusion, the EMF radiation emitted at Nyangasang Calabar can be controlled with the help of the study.

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