

# Safe Distance to Extremely Low Frequency Radiation Associated with Power Transmission Lines Located in Ota, Southwest, Nigeria

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**Abstract--** The study investigates the level of extremely low frequency radiation from power line and to determine safe distance for dwellings and human activities. The study was bored out of the fact that people built houses and shops under power lines with the opinion that the place is free. The measurement were carried out during normal daily human activity 8:00 am to 4:00 pm between February and May, 2013 when the lines are supplying electricity in all locations with power lines in Ota, Ogun State, Nigeria. Extremely Low Frequency (ELF) associated with transmission power lines in some locations in Ota, Nigeria were measured using an ELF Detection meter manufactured by Action Electronics, USA. The lowest average ELF measured was 1.15 mG obtained at 200 ft (61 m) away from the transmission lines and the highest was 50 mG measured at the base of the power transmission line. It was observed that the ELF field decays rapidly with distance from source or hot spots. The study hereby suggests that erection of houses or human activities is not safe at any distance less than 200 ft (61 m) to power transmission lines. There is need for awareness on the need to avoid undue exposure to ELF radiation and strict adherence to standard regulation/policy to keep certain distance off from the power transmission lines in order to reduce the ELF exposure incurred and to avoid health challenges that can result from exposure to ELF radiation.

**Index Term--** ELF radiation, transmission power lines, resident, safe distance, Ota,

## INTRODUCTION

Throughout our nation and all across the world, in the rural areas and developing cities the demand for electricity is steadily rising. From the gadgets, to the appliances in our homes, to the complex computers and even down to the traffic system all rely on electricity. At the same time we rely on finite sources of energy, fossil fuel such as coal, oil and gas. Electricity is generated at power stations. The network of power transmission line supplies this electricity around the country to where it is needed. This transmission line is a system of conductors, such as wires, coaxial cables, appropriate for conducting electric power or signals between two or more terminals. Electric power generating stations are connected by a network of power transmission lines, mostly overhead lines [1]. Power transmitted is generally in the form of three-phase alternating current (ac) at 60 or 50 Hz (In Nigeria we use 50 Hz/220-240V). Overhead power lines are used in Nigeria. The electric power transmission lines are suspended by towers or utility poles and the insulation is provided by air. Overhead power lines are generally the

lowest-cost method of transmission for large quantities of electric energy. Towers for support of the lines are made of wood (as-grown or laminated), steel (either lattice structures or tubular poles), concrete, aluminium, and occasionally reinforced plastics [2]. Extremely low frequency (ELF) is a kind of Electromagnetic radiation EMR fields. They are created by high voltage power lines. ELF is made up of waves of electric and magnetic energy moving together (radiating) through space.

The environmental effects of power transmission lines have been under investigation; a great deal of uncertainty surrounds the question of possible health effects from EMF exposure. Nowadays, researchers are concerned about the effects of high voltage transmission lines on the populace health. Draper et al, (2005)<sup>[3]</sup>, IARC (2002)<sup>[4]</sup> and Neil (2001)<sup>[5]</sup> reported childhood leukaemia in relation with distance of home address at birth from the nearest high-voltage overhead power line and found increased risks for those living within 600 m compared with those living more than 600 m from a power line and double the risk of leukaemia and/or brain tumours in children living near power lines [6; 7]. Lowethal et al., (2007)<sup>[8]</sup> observed that there may be an increased risk of lymphoproliferative disorders (LPD) or myeloproliferative disorders (MPD) associated with prolonged residence close to high-voltage power lines, especially early in life, may increase the risk of the development of MPD and LPD later. However, [9] results showed that there is no serious concern for the people living near the transmission lines but for the individuals who are beneath those lines for long period of time. Therefore, the aim of this study is to measure the ELF radiation around electric power transmission lines in Ota, Ogun State and to deduce safe distance for residence as there are some houses and shops built directly under the transmission lines.

## MATERIAL AND METHOD

Thirty different locations were covered. Locations such as Adeyanje Street, Police Station, Goshen Street, Dominion stores, Obasanjo Farm, Eleidi Estate, Aduragbemi Street, Harvest Street etc., where there are power transmissions lines in Ota, Ogun State Nigeria were covered in the study. Ota is located in 6°41'N and 3°41'E. It is the local government headquarter of Ado-odo Ota and has an estimated 163,783 population. The power transmission lines run along Oloko and Obasanjo farm roads and cut across Idiroko road. This area is densely populated with shops and houses. People do carry out

their day to day activities under the transmission lines. Obasanjo farm settlement is adjacent to Oloko settlement while Idiroko road demarcate the two settlements. Oloko is moderately populated with houses and shops. This settlement has a poor road network and the road is directly under the power lines. Although few houses and shops are some distance away from the power lines.

Cell sensor (ELF detector meter) shown in Fig. 1, manufactured by Action Electronics, USA was used to measure the ELF radiation from the power transmission line at various directions since ELF is a three-dimensional in order to obtain a more accurate measurement of the field. It is done in the three axis, x, y, and z (horizontally, vertically and sideways) at distances ranging from 0-200 Ft (0 - 61 m) from the power lines. The measurement were carried out during normal daily human activity from the hours of 8:00 am to 4:00 pm between the months February and May, 2013 when the lines were supplying electricity.



Fig. 1. ELF Detection Meter (CellSensor)

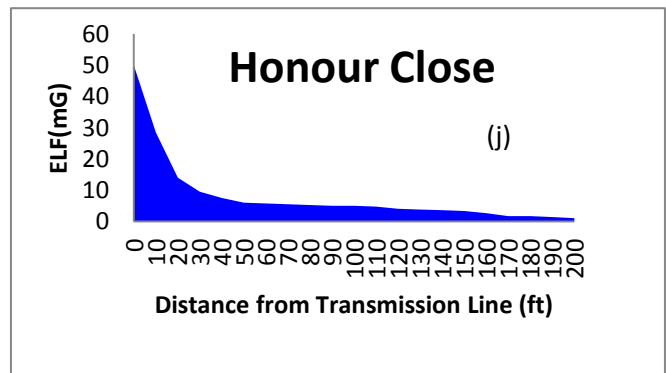
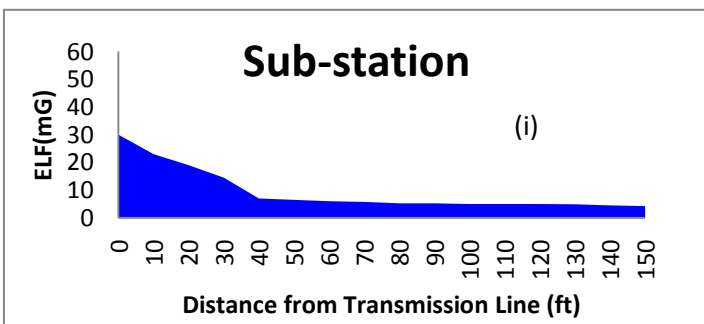
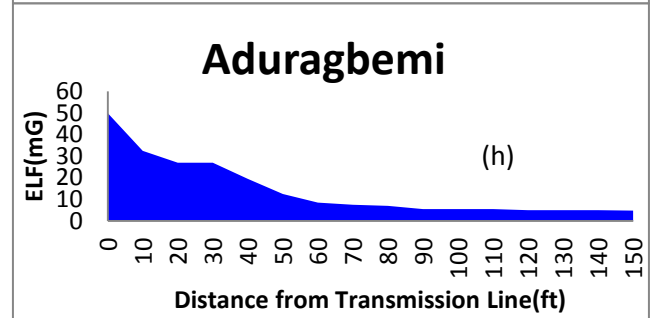
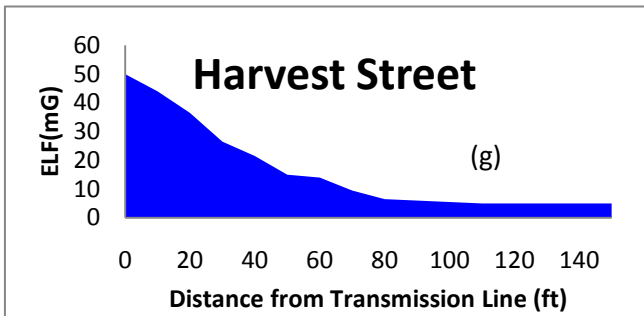
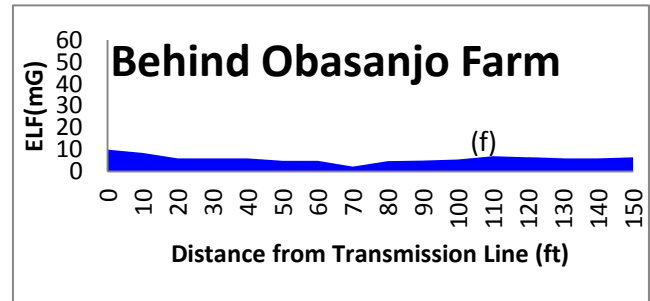
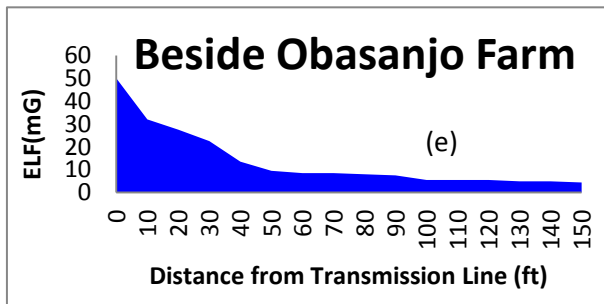
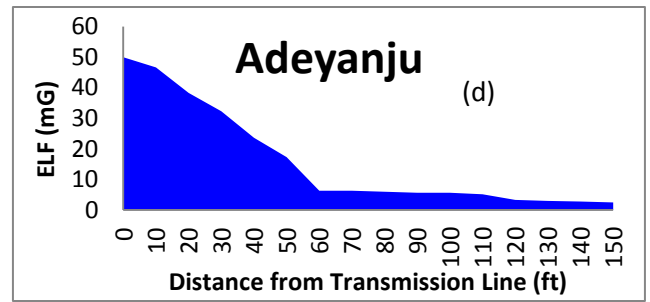
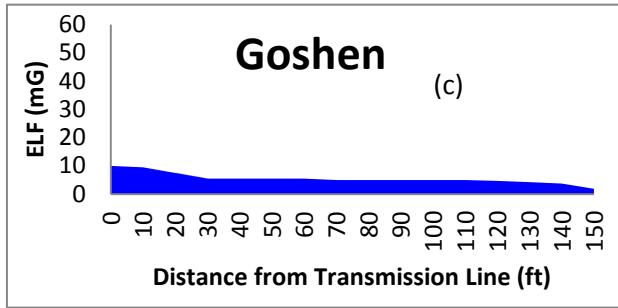
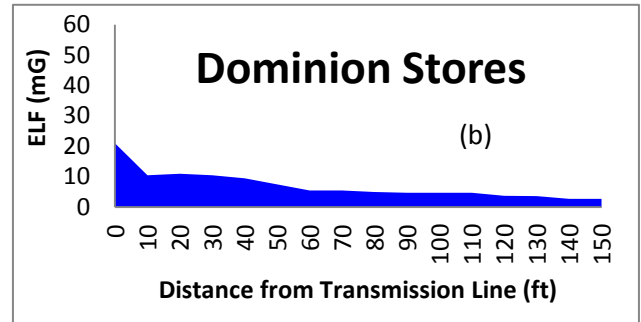
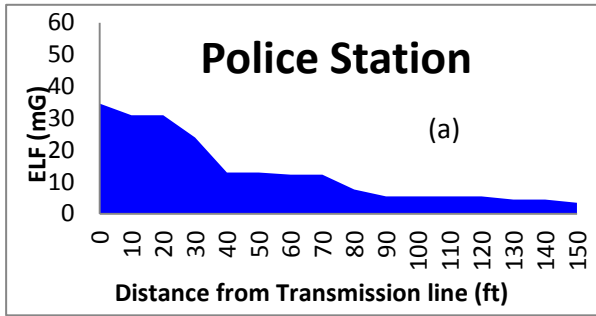
## RESULTS AND DISCUSSION

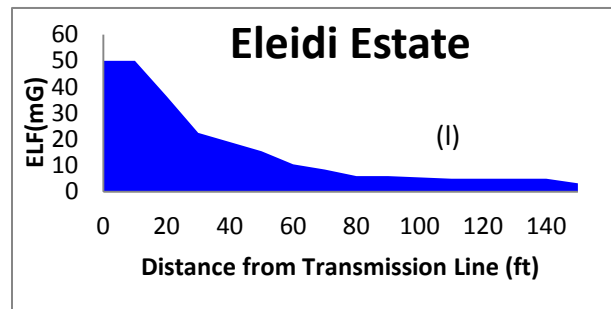
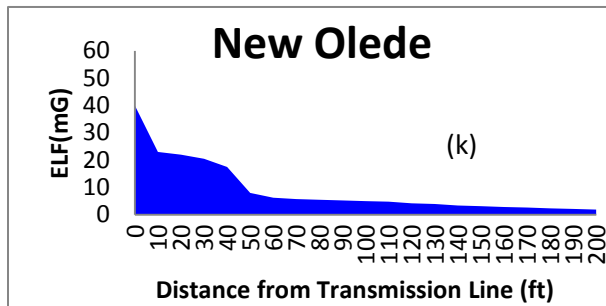
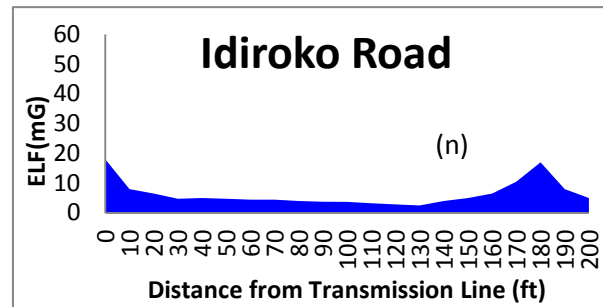
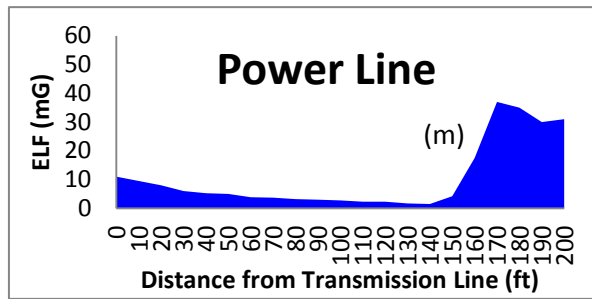
This study was conducted because of some houses are built very close to and shops erected under power transmission lines and the activities going on in the vicinity of the strong ELF radiation. The work assessed the ELF exposure levels arising from the power transmission lines in different locations in Ota Ogun State. The measured ELF is presented in Figures 2(a-n). At Police station (Fig. 2a) an average of 34.67 mG of extremely low frequency (ELF) would be incurred per day by sellers who sited their shops at 0ft that is directly under the transmission lines. While the occupants of the houses built 80-150ft away from the transmission lines incurred average of 7.67- 3.50 mG. Thus this area is not safe for business transactions and for residents. Fig. 2b presents result obtained at Adeyanju Street where we have group of sellers that sited their shops between 0-30ft from the transmission line. This group incur average of 10-5.5 mG per day. A Church is also cited between 60-150ft from transmission line would incur an average of 5.50-1.9 mG ELF on any service day. The

occupants of Shops and houses located within 0-50 ft from the power line would, take in average of 21-7.50 mG daily. Those in the range of 60-120 ft would incur 5.50-3.75 mG (Fig 2d). Fig 2e shows ELF measured at Obasanjo at distance between 0-150 ft to the transmission line is unsafe for neither sellers nor dwellers to erect shops or buildings because measured ELF even at 150ft is high. The location presented in Fig. 2g has a shop built directly under the transmission lines this suggest; that the occupants of this shop incur an average of 50.00 mG daily whenever they are in the shop. Fig 2h showed that as far as 150ft away from the transmission lines the ELF radiation level is still high for residents or business. In Fig 2(m-n) the irregularity in the plots occurs as a result of accumulated wires around the service drop lines erected at 150 ft from the transmission lines which increases the ELF at 150ft up to 200ft. There are a lot of shops and houses between 0-80 ft from the power lines which implies that the occupants in these areas are exposed to high level of ELF radiation. In general, it was observed that ELF just like other electromagnetic field decays rapidly with distance from the source (Fig 2a-n). According to Bioinitiative report<sup>[11]</sup> ELF limits should be between 1 mG planning limit for habitable space adjacent to all new or upgraded power lines and a 2 mG limit for all other new construction. It is also recommended that a 1 mG limit be established for existing habitable space for children and/or women who are pregnant (because of the possible link between childhood leukemia and in utero exposure to ELF). The recommendation is based on the assumption that a higher burden of protection is required for children who cannot protect themselves, that are at risk of childhood leukemia at rates that are traditionally high enough to trigger regulatory action. It was noted that the limits of exposures that are commonly associated with increased risk of child hood leukemia is between the 2 to 5 mG for all children and 1.4 mG for children age 6 and younger. 4 mG was reported to be the highest exposure to cause adult cancers and neurological diseases. From these results it can be deduced that houses located at 200 ft away from the power transmission line and above are safe for residence and any human activities, while those below 200 ft are not safe for residence. It also suggests that accumulation of wires on a single pole should be avoided in our environment.

## Conclusion

The ELF radiation around power transmission lines was assessed using cell sensor from Action Electronics (USA) in order to determine the safe distance for construction of houses for resident and human activities at different locations in Ota, Ogun State. It was deduced from this study that at 200 ft away from the power transmission line and above was considered safe for residence, while below 200 ft was not safe for residence since it was only from 200 ft from the power lines we are able to measure ELF 1.5 mG or less. The study also revealed that accumulation of wires on a service drop line increases the electromagnetic field (EMF), thereby increasing the ELF at that location.





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#### COMPETING INTERESTS

Authors declared that no competing interests exist.

#### Author's Contribution

MRU designed the study, performed the statistical analysis, and wrote the manuscript. ITI managed the literature searches and took the ELF measurement OCO managed the analyses of the study. All authors read and approved the final manuscript.