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Examining The Emf Exposure Effects Of Gsm Mast Antennas And The High Tension Electric Cables On The Environmnet Of Delta Park Of University Of Port Harcourt, Rivers State

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***Abstract*—The radiofrequency field strength measurement in this study was aimed at determining the level of non–ionizing radiation levels (emf) that may have impacted the Delta park environment and residence as a result of then cluster of GSM base station (mast) in the campus and the high tension overhead cables that crisscross the area. An in situ measurement of power density was conducted over the entire Delta Park using a radiofrequency (RF) field strength meter and the SARS values computed. The values obtained ranged between 0.31288μ/cm^2 (0.683 x 10^{-5}w/kg) to 0.29 μ/cm^2(6.64 x 10^{-5}w/kg) with a mean value of 0.13 x 10^{-5}mw/cm^2 (2.89 x 10^{-5}w/kg). These values recorded are well below values obtained in most of the developed countries of the world and are below the international guidelines of 0.20-1.20mw/cm^2 for the public. The obtained values will not constitute any significant biological, epidemiological or physiological effects to those residing in this environment. The Delta Part environment therefore meets all the international guidelines on non-ionizing radiation.**

Keywords—GSM mast antennas, High tension Cables, University of Port Harcourt.

Introduction

The rapid growth of the cellular communication (GSM) in the developed and developing countries like Nigeria has resulted in the installation of large network of base transceiver station (BSTs), which may be mounted on free standing towers, rooftops, or the side of buildings. Measurement near typical BTSs, have mostly shown that exposure level are well within the widely promulgated guidelines **[1][2][3]**.

Cooper et al.**[3]** measured power densities around cell phone based station on tower that ranged from 40 to 83 meters (120 to 250ft) in height. The maximum power density on the ground was 0.002% and the maximum was at 20 to 80meters (60-240ft) from the base of the tower.

In Vancouver Canada, the RF level in five schools, three of which have base stations on them or near them. All schools met Canadian, US and other International RF standards by a wide margin[4]. The UK National Radiological Protection Board **[5]** measured the radio frequency radiation level at 118 public –accessible sites around 17 cell phone base stations. The maximum exposure at any location was 0.083mw/cm^2. Typical power densities were less than 0.01% of the ICNIRP public exposure guideline. When radiofrequency radiation from all sources (GSM mast, cell phones, FM radio, television, high tension electric cables etc) was taken into account, the maximal power density at any site was less than 0.2%R of the ICNIRP public exposure guidelines.

Mann. et al. **[6]** studies the exposure to radio waves near mobile phone base station in 17 sites in UK and reported that the maximal exposure rate at any location was 0.023% of the NRPB investigation level or 0.018% of the ICNIRP reference level and concluded that the exposures are well within guidelines and not considered hazardous.

A number of authorities have conducted detail reviews of the potential health risk associated with exposure to RF fields. American Cancer Society conducted a review of the research on mobile phone technology and cancer and concluded that there is now considerable epidemiological evidence that shows no consistent between cellular phone use, tower mast and brain cancer **[7].**

The British Medical Association **[8]** published a report on mobile phones and health. The Report concluded that “The most recently published of the literature have concluded that while there are small physiological effects within the existing guidelines, there are no definite adverse health effects from mobile phones or their base stations. However, all the professional organization have called for more research to be conducted, since the possibility that RF radiation may cause adverse effects that cannot be ruled out on the currently available data. Some International Standards are presented in Table1. The Nigerian Communication Commission (NCC) set the closest distance of a GSM mast and base stations to

residential houses to be 10meters with no clear RF permissible standard for the public. This therefore necessitates the adoption of international bench mark for Nigeria for the evaluation impact of the exposure rate to the background Non- Ionizing Radiation from these sources.**[9]**

The Delta Park of the University of Port Harcourt is crisscrossed by a network of over-head high tension cables conveying electricity from the Independent Power Project (IPP) of the Rivers State Government located at Omoku to Port Harcourt. In addition, there are five GSM masts in the Delta Park with three located in Degema Street.

There are growing concern and fear by residents of Delta Park of the possible health implications of the radiation from these GSM mast stations and the high tension electric cables as they are directly above the roofs of living houses and the base stations are within 10 meters proximity to houses and offices within the Delta Park. This study is therefore aimed at measure the RF field and the power densities radiating from GSM masts and high tension electricity power lines, to measure the RF field and the power densities radiating from GSM masts and high tension electricity power lines and to ascertain the health side-effects of the GSM masts and electricity power lines on the residents in the Delta Park of the University. Make the appropriate recommendation to forestall any danger it may pose to the health of residents and to the environment.

Table 1: International Permissible levels for GSM base stations, Phones and GSM mast

Organization	GSM base station	GSM phone
Federal Communication Commission (FCC)**[10]**	0.57mw/cm^2 (0.13w/kg)	1.0mw/cm^2 (0.22w/kg)
International Commission of Non-ionizing Radiation Protection (ICNIRP)**[11]**	0.40mw/cm^2 (0.09w/kg)	0.90 mw/cm^2 (1.98w/kg)
National Radiological Protection Board (NRPB)**[12]**	0.57mw/cm^2 (0.13w/kg)	0/10mw/cm^2 (0.22w/kg)
International Standard RF Range	0.20 to 1.20mw/cm^2	NA

Materials and Methods

This study was conducted in one of the main campus (Delta Park) of the University of Port Harcourt where there growing anxiety of the possible health hazard from the number of the GSM masts that are situated in the campus and the network of 132KVA high voltage transmission lines passing through it. The campus is lies within latitudes N04^0 53'55.2" and N04^0 54'06.4" and longitudes E006^0 54'13.1" and E006^0 54.14.1". The survey work measured the BnIR levels of the combined sources since both emit RF radiation, using a Radiofrequency meter and a Geographical Positioning System (GPS). The RF survey meter measures the power density of radio waves from 0.5MHz to 3000MHz. Its

accuracy in the cell towers and high tension cables range (500MHz-1700MHz) is ±20% of the readings.

Twenty potential areas were identified within the campus where the effects of the GSM base stations and the high tension cables may be felt more. Measurements were made between 20 to 60meters and 5 to 20meters from the sources of RF radiation which represent the range for minimum radiation levels for GSM masts **[3]** and the electromagnetic field of high voltage lines. Readings were obtained along the triangular configuration since omninidirectional antennas are used to provide full 360^0 coverage while the direct reading was used for the high voltage cables. During measurement, the RF meter is held with sensor at the top and facing the radiating source and held stretched away from the body and above the head. This is to avoid some ambiguities in readings arising from bodies reflecting radio waves.

To obtain the average frequency of the transmitting frequency of each mast antenna, wide and narrow band readings were obtained. The transmitting frequency is estimated using the expression (RF meter manual).

$$F=\frac{100}{R-1} \quad (1)$$

Where; R is the ratio of the wide band to that of the narrow band readings.

The Specific Absorption Rate (SAR) is computed from the measured effective power density, using the conversion factor **[13][14]**

$$1x10^{-3}Wcm^{-2}=0.22Wkg^{-1} \quad (2)$$

Results

The results of the radiofrequency power density measurement and the computed specific absorption rate are presented in Table 2

Table 2*:* Results of Radiation measurements

S/N	LOCATION ADDRESSES	GEOGRAPHICAL LOCATION	RE FIELD STRENGHT μw/cm^2	SAR W/KG × 10^{-5}
1.	1 Degema Street near lawn tennis court.	N04^{0}53'55.2" E006^0 54'13.1"	0.22	4.73
2.	13 Degema Street.	N04^0 53'54.2" E006^0 54'11.0"	0.11	2.35
3.	18 Degema Street.	N04^0 53'57.2" E006^0 54'08.5"	0.08	1.72
4.	Front of block D Hostel	N04^0 53'57.7" E006^0 54'24.4"	0.23	5.17
5.	Basket ball Court behind Hostel A.	N04^0 53'57.1" 006^0 54'24.4"	0.25	5.54
6.	Delta park main gate.	N04^0 54'00.6" E006^0 54'24.4"	0.08	1.74
7.	Front Of King Jaja Hall C Hostel	N04^0 54'00.3" E006^0 54'17.3"	0.29	6.34
8.	Path way to Pro-Chancellor's lodge	N04^0 54'00.4" E006^0 54'17.3"	0.26	5.76
9.	Front of Pro-Chancellor lodge/pathway to Degema Street.	N04^0 54'00.4" E006^0 54'13.4"	0.11	2.44
10.	Pro-Chancellor's Lodge	N04^0 54'00.1" E006^0 54'09.1"	0.11	2.33
11.	Theatre Art (Crab)	N04^0 54'04.7" E006^0 54'23.1"	0.12	2.71
12.	Lawn tennis court near the Crab	N04^0 54'05.2" E006^0 54'21.1"	0.12	2.40
13.	IPS Entrance Gate	N04^0 54'06.2" E006^0 54'22.8"	0.11	2.40
14.	IPS building (right fence)	N04^{0}54'08.9" E006^0 54'23.4"	0.06	1.25
15.	IPS building (left fence)	N04^0 54'07.9" E006^0 54'21.5"	0.10	2.267
16.	Back of Senior Staff club	N04^0 54'06.6" E006^0 54'20.9"	0.10	2.267
17.	1 Isiokpo Street.	N04^0 54'06.3" E006^0 54'19.3"	0.09	2.067
18.	2 Isiokpo Street.	N04^0 54'06.3" E006^0 54'18.0"	0.09	1.94
19.	3 Isiokpo Street.	N04^0 54'06.6" E006^0 54'06.6"	0.06	1.37
20.	4 Isiokpo Street.	N04^{0}54'06.4" E006^0 54.14.1"	0.11	2.38
	MEAN		**0.13±0.02**	**2.89±0.40**

Discussion

The result of the measured power density show that RF radiation level ranges between 0.03 μw/cm^2 (0.68 x 10^{-5} w/kg) to 0.29 μw/cm^2 (6.34x10^{-5}w/kg) with a mean value of 0.13 μw/cm^2(2.89 x10^{-3}w/kg) in the campus. The entrance of block C Hostel area in Delta Park recorded the highest RF radiation level while the lowest RF radiation was recorded at the IPS building, extreme left fence. The general high level obtained along Degema Street and the hostel area, may be attributed to the RF radiation from the clusters of GSM masts and the high tension electrical cables combined. The low RF radiation level recorded within the IPS area may be as a result of the direction of the configuration of the base station antennas. The moderate values obtained within the Pro-chancellor lodge area may be as a result of the attenuation of the radiation from the surrounding mast which is about 65meters proximity to the lodge.

The result presented indicates that the mean RF radiation power density obtained for Delta Park is 0.023% of the FCC guidelines, 0.015% of the NRPB permissible limit and 0.019% of ICNISRP standard and international public exposure maximum permissible limit, thus they are well below all known international standard and permissible limits for the public. These values obtained at Delta Park are also below the values reported by Cooper et al, **[3]**, and are also below those reviewed by RSC **[15]**. The comparison of the obtained value within the different guidelines shows that the RF values measured are below the public permissible exposure level. Hence the RF level in the campus may have no impact or cause biological, epidemiological effects on the resident of Degema and the Delta Park, but physiological effects are not totally ruled out.

CONCLUSION

The impact of the radio frequency (RF) radiation from GSM masts and high tension cables on the residents of Delta Park, University of Port Harcourt has been conducted. The following conclusions can be reached.

(i).The investigation revealed that the radiation level of the GSM mast and the high tension cables combined is low and well below international permissible limit for the public.

(ii).These values of radiation obtained will not cause any significant biological or physiological health side effects on the resident of Delta Park. But caution must be taken against further installation of more GSM mast as this may result in RF field radiation build-up, which may have some further (long term) biological and physiological effects on the public and the residents of the area.

(iii).The Delta Park's environment therefore meets all the international guidelines on non-ionizing radiation.

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