UGANDA COMMUNICATIONS COMMISSION

NATIONAL SURVEY ON ELECTROMAGNETIC FIELDS (EMF) EXPOSURE AROUND GSM BASE STATIONS IN UGANDA

e - summary

SUMMARY REPORT

JULY 2015

UGANDA COMMUNICATIONS COMMISSION

communication for all

1. INTRODUCTION

In a bid to ensure the safety of the public around the various communication installations in the country, Uganda Communications Commission (UCC) conducted a nationwide survey on electromagnetic field (EMF) exposure around GSM[1] base stations in Uganda. This survey, which was conducted between February 2014 and May 2015, sought to assess the level of EMF exposure to the public in locations within the proximity of GSM mobile phone base stations across the country.

During the survey, 392 sites from 53 districts were assessed based on a multistage sampling approach to obtain representation at country level, regional level and district level as well as the urban, suburb and rural mix. These included single sites, shared sites and collocated sites.

Measurements of power density were conducted in the GSM 900 and GSM 1800 band at the selected sites to obtain the frequency selective data required for this assessment. This was done using a calibrated[2] omnidirectional antenna (Omni log 90200) coupled with an Aaronia AG spectrum analyzer (Spectran HF 60105, 700MHz -2.5GHz).

The measurements were conducted at a height of 1.5m above ground level based on the recommended height range for the trunk of the body at which most of the radiation is absorbed. Assessments for both rooftop and mast sites were conducted on ground level. Each measurement was taken for an average of 6 minutes to take into account the average time it takes the thermoregulatory mechanism of the human body to maintain thermal equilibrium.

[1] GSM – Global System for Mobile communications

[2] Daily calibration was done based on the downlink frequencies for both GSM 900MHz and 1800MHz

The benchmark for the assessment was the public reference level specified by the International Commission on Non-Ionising Radiation Protection (ICNIRP) guidelines using the formula below:

$$\frac{S}{\left(f/200\right)}\% \ ;$$

Where;

- S is the power density in W/m² received,
- f is the frequency in MHz, and
- f/200 is the equivalent plane wave power density in W/m² for the frequency range 400-2000MHz.

Based on this formula, a value exceeding the ICNIRP reference level provides a percentage of more than 100% or exposure quotient of 1.

At each selected location, the highest signal strength along with the respective frequency and power density readings were read off in each of the frequency bands. The ICNIRP maximum values for each reading from the two bands (*900MHz and 1800MHz*) at that location were then calculated and summated to obtain the cumulative exposure at that location.

2. FINDINGS

The ICNIRP maximum values obtained at the various sites across the country is illustrated in the graph below.

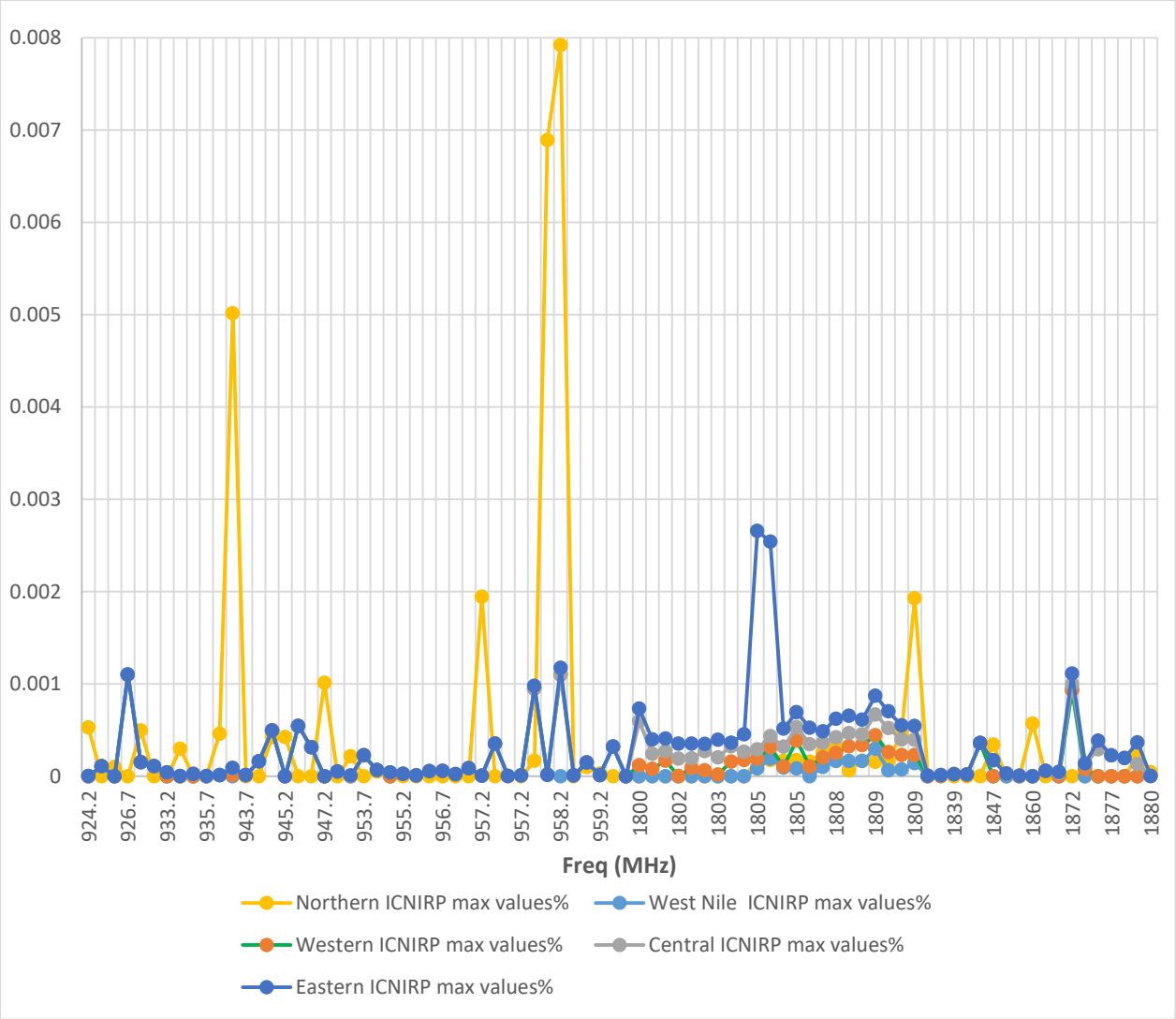

Figure 1: ICNIRP maximum values at various sites per region.

The table below reviews the highest ICNIRP maximum values obtained in each of the regions.

Table 1: Highest ICNIRP maximum values obtained in each of the regions

Region of the country	ICNIRP maximum value (%)	Remarks
Northern	0.007919015,	Assessment in this region was conducted on

		45 sites. The sites in this region are located largely in the country side (rural) and mounted on taller masts than those in the trading centers.
Western	0.001099871	Assessment in this region was conducted on 41 sites. The sites in this region are located in both the rural areas and near trading centers. Most of the ICNIRP maximum values in this region were found though to be below 0.0004%.
Eastern	0.002364898	Assessment in this region was conducted on 123 sites. The sites in this region are also located in both the rural areas and near trading centers. Most of the ICNIRP maximum values in this region were found to be below 0.0003%.
West Nile	0.001098737	Assessment in this region was conducted on 47 sites. The sites in this region are mainly located on hills and in the rural.
Central	0.000863545	Assessment in this region was conducted on 136 sites. Sites in the central region are typically located around human proximity (*on rooftops and in trading centers and towns*) with most being shared masts. Most of the ICNIRP maximum values in the central region were found to be below 0.0003%. Assessment done on

The findings presented lower ICNIRP values in areas with higher human activity, (*such as the urban setting, towns and up country trading centers)*

than the rural and sparsely populated areas. Notably, the ICNIRP maximum values in the central region were the lowest of all regions.

Comparatively, the base stations in the rural and up country areas are high powered to provide extended coverage and are usually mounted on taller masts with at higher heights from human settlements.

It was generally observed that the signal strength of GSM 1800 was stronger than GSM 900 at most measured locations. However the exposure due to GSM 900 was greater than the exposure due to GSM 1800 in the study area.

3. CONCLUSION

The findings reported in this survey have been obtained at measurements taken around base station sites at distances from the antennas that allow far field[3] assessments as expressed in power density. All results suggest that the exposure levels around the base stations in the country are a very small fraction of the public ICNIRP exposure reference levels.

By inference, an increase in deployment of antennas in one single area would not lead to exceeding the exposure limits.

i. Assessment of Spatial Exposure to RF Radiation due to GSM 900 and GSM1800 – A Case Study of UCH, Ibadan, Nigeria IOSR Journal of Applied Physics (IOSR-JAP) e-ISSN: 2278-4861. Volume 4, Issue 2 (Jul. - Aug. 2013), PP 44-48 *www.iosrjournals.org*
ii. ICNIRP guidelines 1998- Guidelines for limiting exposure to time- varying Electric, Magnetic and Electromagnetic fields (up to 300GHz) www.icnirp.de
iii. Revised ECC Recommendation(02)04 Measuring non-ionising electromagnetic radiation (9 kHz – 300 GHz)
iv. OFCOM Measurement report 27 June 2011
v. COST 244bis- Short Term Mission on Base Station Exposure (Mobile telecommunication base stations– exposure to electromagnetic fields Report)
vi. RF EME survey report in relation to the environmental radiofrequency electromagnetic energy levels around the Caloundra district, November 2005
vii. Study of levels of exposure to electromagnetic fields from mobile phones base-stations in Khartoum & Khartoum Nort (Dr. Kamal Eldin Eltayeb Yassin, Maha M khair and Shima K. Yasin)
viii. Why 900Mhz band is superior than 1800Mhz band: Thomas K. Thomas

[3] The area extending from an antenna where the electric fields and the magnetic fields are in phase with each other and are related by the characteristic impedance of free space

ix. ITU EMF guide www.itu.int
x. Users' Manual- Aaronia Spectran HF
xi. IEEE (Institute of Electrical and Electronics Engineers) standard for safety levels with respect to human exposure to radio frequency electromagnetic fields, 3 kHz to 300 GHz, IEEE Std C95.1, 2005.
xii. ITU-T (International Telecommunications Union- Standards Section) Recommendation; K52- Guidance on complying with limits for human exposure to EMF. www.itu.int
xiii. http://www.who.int/peh-emf/about/WhatisEMF/en/
xiv. Radiation, Mobile Phones, Base Stations and Your Health, Ng Kwan-Hoong, Ph.D thesis, September 2003 published for Malaysian Communications and Multimedia Commission
xv. RF safety at Base station sites (Mobile Manufacturers Forum –MMF)
xvi. Estimated and measured values of the Radio Frequency radiation power density around cellular base stations ,S Miclaus, P. Bechet September 12 2006