



***ESWATINI
COMMUNICATIONS
COMMISSION***

REPORT

**Survey of Electromagnetic Fields (EMF)
around Mobile Network Base Stations
in Eswatini**

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1 INTRODUCTION

Mobile phones and their radio base stations transmit and receive signals using electromagnetic waves (often referred to as electromagnetic radiation or radio waves) which are in the form of electromagnetic fields. Electro Magnetic Fields (EMF) are static electric, static magnetic and time-varying electric and magnetic fields with frequencies up to 300 GHz. They are produced whenever a piece of electrical or electronic equipment is used. The electromagnetic radiation from mobile network base stations and handsets is called non-ionising radiation. Non-ionising radiation does not carry enough energy to change the structure of an atom while ionising radiation can change the structure of an atom. Examples of ionising radiation sources are X-RAY and Nuclear. Prolonged exposure to high levels of EMFs can give rise to effects that may be irritating or unpleasant. Consequently, the International Commission on Non-Ionizing Radiation Protection (ICNIRP) was established and its function is to investigate the hazards that may be associated with the different forms of Non-Ionizing Radiation (NIR), develop international guidelines on NIR exposure limits, and deal with all aspects of NIR protection.

Furthermore, the ITU-T Recommendation K52 (12/2016) provides guidance on how to comply with limits for human exposure to electromagnetic fields and also describes a procedure to be followed in order to determine compliance to the ICNIRP limits. The limits as determined by the ICNIRP prescribe the allowed levels of electromagnetic radiation which are safe for human beings to be exposed without any health effects.

According to section 15(h) of the Electronic Communications Act 2013 (ECA), all licensees shall “*comply with the radiation emission standards adopted and published by the International Commission for Non-Ionising Radiation Protect (ICNIRP) or such other appropriate standards as may be specified by law or by the Commission*”. Furthermore, section 7 of the Eswatini Communications Commission Act 2013 states that “*The Commission shall:*

- (o) *establish minimum quality and security standards for any of the communications services, products, operations and activities relating to any matter regulated by the Commission and regulate such measures as may be necessary to ensure public and private safety,*

(w) ensure end-user protection and privacy

(bb) determine complaints and carry out studies, research and investigations as required in relation to any matter within the remit of the Commission”

In a bid to ensure the protection and safety of the public around various communications network installations in the country and to ensure that all installations comply with the ICNIRP limits stipulated in the ICNIRP standards for non-ionizing emissions from the mobile network base stations, the Commission conducted a nationwide survey on EMF exposure around Mobile Network base stations in the country. The Commission used spectrum analysis tools and systems to carry out the measurements, and the results were analysed using procedures described in the International Telecommunications Union (ITU) Recommendations (ITU-T Recommendation K52).

This report presents the findings of this survey, including details of how the investigation was done as well as the final conclusions drawn from the results of the survey. Based on all the sites that were studied during this survey, the results indicate that all the sites are normally compliant to the ICNIRP limits and pose no health risk to people located around the sites.

2 METHODOLOGY

2.1 Data Collection

This survey, which was conducted between July 2019 and August 2019, 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, 34 sites from the four (4) regions of the country were assessed based on a multistage sampling approach to obtain representation at country level and regional level. and district level as well as the urban, suburb and rural mix. These included single sites and shared sites or collocated sites.

Measurements of power density were conducted at locations around the base stations which were identified as possible exposure zones / areas where there was a possibility of human presence. Seven (7) different points were identified around each site based on the possible accessibility and antenna directivity categories

defined in ITU-T Recommendation K52(12/2016) to obtain the data required for this assessment. An example of the points is shown in **Figure 2-1** for the MTN site at UNESWA. For this survey the antenna directivity category is category 1 which considers the transmission to be from a half wave dipole. The Commission used spectrum analysis tools and systems to carry out the measurements.



Figure 2-1 Assessment points for UNESWA site

2.2 Data Analysis

The data obtained from the measurements was analysed, guided by the procedure for determining compliance found in ITU-T Recommendation K52(12/2016). The procedure, which has pass and fail conditions at each step, can be summarized in the following steps:

Step 1: Mark out the different measurement points based on possible exposure.

Step 2: Measure the power density at each point selected in step 1 and calculate the exposure ratio for each point and for compliance, the highest exposure ratio must be less than 100%.

The criteria that is used to determine compliance requires that the power density limit is calculated for the measured frequency as follows, where f is in MHz:

$$S_{limit} = \begin{cases} f/200, & f = 400 - 2000\text{MHz} \\ 10, & f = 2000 - 3000\text{MHz} \end{cases} \quad (1)$$

The second stage is the calculation of the exposure ratio (ER) for the power density measured against the power density limit in (1) using (2) below. The maximum value of exposure ratio that should not be exceeded to ensure health compliance is 100%.

$$ER_{power\ density} = \frac{S_{measured}}{S_{limit}} \times 100\% \quad (2)$$

Where $S_{measured}$ is the measured value of power density and S_{limit} is the power density limit calculated using (1).

3 FINDINGS

At each selected site, from the seven measurement points, the highest power density readings were taken to calculate the exposure ratio. In cases where the site was shared between the two mobile network operators, the sum of the calculated values was used and **Table 1** provides a summary of the results obtained:

Table 1: Summary of results obtained for selected measurement points

REGION	SITE NAME	NO. OF OPERATORS	HIGHEST EXPOSURE RATIO (%)
Shiselweni	Nhlangano EPTC Exchange	2	91.79×10^{-6}
	Madulini	2	49.53×10^{-6}
	Mbangweni	1	63.02×10^{-6}
	Hlatikhulu	2	3.59×10^{-6}
	Hotela	1	5.89×10^{-4}
	Makhonza	1	6.84×10^{-5}
	Mathendele	1	5.19×10^{-5}
	Nkwene	1	8.89×10^{-8}
Manzini	Bhunu Mall	2	17.65×10^{-6}
	Matsapha EWSC	2	475.10×10^{-6}
	UNESWA Kwaluseni	1	9.64×10^{-6}
	Ntondozi	1	9.18×10^{-6}
	Lobamba Exchange	2	10.90×10^{-6}
	Mliba	1	42.10×10^{-6}
	Manzini EPTC Exchange	2	9.00×10^{-5}
	Masundvwini SML	1	1.20×10^{-5}
	Masundvwini MTN	1	2.49×10^{-6}
	Zakhele	1	7.39×10^{-6}
Lubombo	Siteki EPTC Exchange	2	75.22×10^{-6}
	Simunye EPTC Exchange	2	45.43×10^{-6}
	Tabankulu	1	906.50×10^{-9}
	Mhlume EPTC Exchange	1	32.55×10^{-6}
	Siphofaneni SML	1	1.31×10^{-5}
	Siphofaneni MTN	1	2.39×10^{-7}
	Duze	1	1.95×10^{-6}
	Phonjwane	1	5.53×10^{-5}
Hhohho	Nkwalini EPTC	2	103.46×10^{-6}
	Buhleni	2	991.24×10^{-6}
	Nkhaba Hill	2	82.67×10^{-6}
	Piggs Peak EPTC	1	14.11×10^{-6}
	Fonteyn	1	20.13×10^{-6}
	Mountain Drive	1	2.04×10^{-5}
	Piggs Peak Quarters	1	5.78×10^{-6}
	Mnyokane	1	2.32×10^{-9}

Generally, from the results it can be seen that the sites which are close to areas of high population recorded low values of exposure ratio than those in rural areas because of the configured output power of the sites.

Furthermore, the values for highest exposure ratio obtained for all the sites are very low when compared with the value of 100% which is the condition for compliance and therefore, any additional deployment of antennas in any area would not lead to exceeding the exposure limits.

4 CONCLUSION

This report presents the findings of a survey which was undertaken to determine the human exposure to EMF radiation from mobile network base stations. This was done by measurements which were taken around base station sites at distances from the antennas that allow far field 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 allowed public ICNIRP exposure reference levels and therefore are compliant to the ICNIRP standards.