# ASSESSMENT OF EMF RADIATION LEVELS IN TANZANIA

Presented by:

THE COMMITTEE TO ASSESS EMF RADIATION LEVELS IN TANZANIA

## PROGRES REPORT FOR 2011-2012

## JULY 2012

# LIST OF ABBREVIATION AND ACRONYM

| | |
|---|---|
| CENELEC | ComitéEuropéen de NormalisationÉlectrotechnique |
| EMF | Electromagnetic Fields |
| FM | Frequency Modulation |
| GSM | Global System for Mobile Communication |
| ICNIRP | International Commission on Non-Ionizing Radiation Protection |
| IEC | International Electrotechnical Commission |
| IEEE | Institute of Electric and Electronics Engineers |
| ITU | International Telecommunication Union |
| ITU-T | ITU-Telecommunication |
| MIT | Mbeya Institute of Technology |
| MoDANS | Ministry of Defense and National Service |
| MoU | Memorandum of Understanding |
| MW | Medium Wave |
| NEMC | National Environmental Management Council |
| RBW | Resolution Bandwidth |
| SRM | Selective Radiation Meter |
| TAEC | Tanzania Atomic Energy Commission |
| TCRA | Tanzania Communications Regulatory Authority |
| UDOM | University of Dodoma |
| UDSM | University of Dar es Salaam |
| UHF | Ultra High Frequency |
| UMTS | Universal Mobile Telecommunications System |
| VHF | Very High Frequency |
| ZBC | Zanzibar Broadcasting Cooperation |

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# EXECUTIVE SUMMARY

The Tanzania telecommunication sector has witnessed fast growth in the number of mobile telephone users now served by seven cellular operators. Until February 2012, there were about 26 million mobile phone subscribers served by more than 4,000 base stations spread all over the country. A considerable increase in the number of FM radio (82 stations) and TV (26) stations has also been observed. These are served by about 55 transmitting towers. Increase in other sources such as Radar was also noticed. Despite the many advantages brought by these systems, there is increased public concern over possible adverse health effects due to electromagnetic fields (EMF) radiated by these equipments.

In order to address the public concern, the Tanzania Atomic Energy Commission (TAEC) and the Tanzania Communications Regulatory Authority (TCRA) signed a Memorandum of Understanding (MoU) on October 4$^{th}$, 2011 to work on non-ionizing radiations issues in line with the ITU recommendation to continuously monitor EMF radiation levels and results be available in simple form for the public to understand.

Based on the above, a Committee was formed to assess public exposure to EMF radiation levels from communications masts and recommend remedial measures accordingly. The committee includes members from TCRA, TAEC, academia (UDSM and UDOM), Zanzibar Broadcasting Commission (ZBC), National Environment Management Council (NEMC) and Ministry of Defense and National Services (MoDANS). The main task of the Committee is to measure and assess EMF radiation levels from communication masts and to prepare report with relevant recommendations.

A subcommittee comprising of TCRA engineers from zonal offices and engineering research students from higher learning institutions situated in these zones was formed to work under the main Committee. The aim of involving academia is to facilitate the transfer of knowledge and enhance awareness on issues regarding EMF Radiation

safety and to forge research collaboration. The function of the subcommittee is to carry out EMF radiation levels measurements in all zones.

In carrying out the assignment, the Committee organized a workshop in which the recommendations of the previous Committee were reviewed and presentations on the basics of EMF, EMF measurement techniques as well as EMF exposure limits recommended by IEEE and ICNIRP and also measurement methods as proposed by ITU were made. Participants to the workshop also participated in field training on the EMF measurement which was conducted to enable participants to practice the operation and use of the measuring equipment.

Measurement has been done in 3 mainland regions of Dar es Salaam, Dodoma and Arusha and three regions in Zanzibar which include Urban West, South Unguja, and North Unguja. A total of sixty four (64) sites were covered. The measurement sites were chosen by considering areas with possibly high levels of exposure and areas considered to be sensitive such as schools and hospitals. The measurement covered all FM radio, VHF TV, UHF TV, 900 GSM cellular, 1800 GSM cellular and UMTS frequency bands using an average time between 2 to 6 minutes for each measurement.

For the FM frequency band (FM radio system), the highest measured EMF radiation level of 2.74 (V/m) was obtained in Dar es Salaam and for the VHF frequency band (VHF TV systems), the highest measured EMF radiation level of 0.63 (V/m) was obtained in Arusha. These measured values are very small compared to the ICNIRP safety limit of 28 (V/m) for these frequency bands.

For the UHF frequency band (UHF TV systems) the highest measured EMF radiation level of 2.14 (V/m) was obtained in Kisarawe which is well below the ICNIRP safety limit of 29.8 (V/m) for this frequency band.

For the GSM 900 frequency band, the highest measured EMF radiation level of 3.14 (V/m) was obtained in Arusha which is well below the ICNIRP safety limit of 41.9 (V/m). For the GSM 1800 frequency band the highest measured EMF radiation level of 3.74 was obtained in Dodoma which is below the ICNIRP safety limit of 58.4 (V/m).
For the UMTS frequency band, the highest measured EMF radiation level of 6.02 (V/m) was recorded in Arusha which is well below the ICNIRP safety limit of 61 (V/m).

Based on the measurements, it has been establish that radiation levels at the four zones (Costal, Central, Northern and Zanzibar) are well below the recommended ICNIRP guideline limits.

The Committee has planned to carry out the following in near future based on priority and availability of funds; Conduct public awareness to the members of Parliament and House of Representatives, conduct awareness and education to the public, publish the measurement results in the TCRA and TAEC websites, organize workshop to stake holders, prepare TV programmes and continue with EMF radiation levels measurement. The Committee has also planned to identify research agendas on EMF radiation in collaboration with the academia and to formulate of EMF regulations for Tanzania.

# 1.0 INTRODUCTION

In Tanzania, the use of mobile phones has increased considerably in recent years and it is as an essential means of communication in commerce and society. Currently there are seven cellular phones operators with more than 4,000 base stations distributed all over the country. The number of mobile phone users has increased from 10 million in 2008 to more than 26 million by February 2012. A high increase in the number of radio stations (82) and TV stations (26) served by 55 transmitting towers was also observed during the same period. The increase in these communication systems has resulted into increased public anxiety over possible adverse health effects due to electromagnetic fields (EMF) radiated by these equipment.

Although the safety guidelines recommended by the International Commission on Non-Ionizing Radiation Protection (ICNIRP) guideline [1] and the Institute of Electric and Electronics Engineers (IEEE) standards [2] are known to be conservative enough to prevent any established adverse health effects of electromagnetic fields and the fact that fields levels from mobile phone base stations and other systems are much lower than safety limits, the public worry on the EMF radiation exposure still persists.

As one of the possible solutions to minimize public anxiety, the International Telecommunications Union (ITU) recommendation K.83 [3] has proposed that continuous monitoring of EMF should be performed and results be available to general public in simple form for the public to understand.

In order to address the above proposed solution, the Tanzania Atomic Energy Commission (TAEC) and the Tanzania Communications Regulatory Authority (TCRA), both being regulatory bodies in EMF issues, signed a Memorandum of Understanding (MoU) on October 4$^{th}$ 2011 to cooperate/collaborate in the non-ionizing radiations issues especially in regulatory control; inspections; standards; enforcement; research; training/workshops/seminars; public awareness; complains handling; public and

environmental protection as well as in consultation/consultancy. After signing of the MoU, a Committee was formed to assess public exposure to EMF radiation levels from communications masts and recommend remedial measures accordingly.

This progress report mentions what the Committee has achieved since the MoU came into force. It further recommends future activities for the Committee as well as prioritizing future research agenda.

## 2.0 FORMATION OF THE COMMITTEE

Tanzania Atomic Energy Commission (TAEC) is mandated with all issues regarding Electromagnetic Fields (EMF) exposure and safety in the United Republic of Tanzania. However, the Tanzania Communications Regulatory Authority (TCRA) regulates services and equipment which are the sources of EMF exposure. With this background, EMF radiation levels assessment Committee, to be spearheaded by TCRA and TAEC, was formed to carry out EMF radiation levels assessment in collaboration with Research Institutes/Universities.

### 2.1 Committee Members

The Committee includes members from TCRA, TAEC, academia (University of Dar es Salaam - UDSM and University of Dodoma - UDOM), Zanzibar Broadcasting Commission (ZBC), National Environment Management Council (NEMC) and Ministry of Defense and National Services (MoDANS). The committee was given a mandate to co-opt members from other institutions with interests and expertise in the subject matter.

A subcommittee, to work under the supervision and direction of the main Committee was also formed. The subcommittee comprises of the TCRA engineers from zonal offices and engineering research students from Academic Institutions situated in these zones. Inclusion of students from higher learning institutions will facilitate the transfer

of knowledge and enhance awareness on issues regarding EMF Radiation safety, which is one of the duties for both TCRA and TAEC. It will also open a new venue for collaboration in researches with these Institutions. The idea of using engineers from TCRA zone offices will in the long run reduce the cost for this continuous activity as there will be no need for staff from the Head Quarter or the committee members to travel to the zone offices for measurement purpose.

It was suggested that the sub-committee comprise of two (2) engineers from each of the six TCRA zones and 2 research students from higher learning institutions/universities in the respective zone totaling 24 persons. The Institutions identified so far are: Eastern Zone (UDMS), Central Zone (UDOM), Southern Zone (MIT), Zanzibar (Karume Technical College). Efforts to identify institutions in Lake Zone could not bear fruit.

**Table I:** List of Committee members

| S/N | Name | Institution | Position |
|---|---|---|---|
| 1 | Dr. Joseph S. Kilongola | TCRA | Chairman |
| 2 | Dr. Mwijarubi. M. Nyaruba | TAEC | Vice-Chairman |
| 3 | Mr. Simon Mdoe | TAEC | Member |
| 4 | Eng. Lawi Odiero | TCRA | Member |
| 5 | Mr. Justice Kamote | TCRA | Member |
| 6 | Eng. Johannes Magesa | TCRA | Member |
| 7 | Eng. Andrew Kisaka | TCRA | Member |
| 8 | Mr. Victor Nkya | TCRA | Member |
| 9 | Prof. Justinian Anatory | UDOM | Member |
| 10 | Dr. Mussa Kissaka | UDSM | Member |
| 11 | Mr. Kamugenyi Luteganya | NEMC | Member |

| | | | |
|---|---|---|---|
| 12 | Mr. Ali H. Ayoub | ZBC | Member |
| 13 | Brig. Gen. Eng. Stephen Ndazi | MoDANS | Member |
| 14 | Dr. Ally Y. Simba | TCRA | Secretary |

## 2.2 Terms of Reference

The committee was given the following Terms of Reference:

(i) To review the recommendations put forward by the previous committee

(ii) To measure and assess EMF radiation levels from communications masts

(iii) To write a report on the measurements and make relevant recommendations

# 3.0 METHODOLOGY AND MATERIALS

## 3.1 Workshop

The Committee organised a workshop in which the implementation of the recommendations given by the previous committee was reviewed [4]. Furthermore, several presentations on the basics of EMF, EMF measurement techniques as well as related radiation safety and environmental issues were discussed. The aim of the workshop was to impart knowledge on EMF matters and also to gain practical knowledge on how to measure EMF radiation levels from different sources. The discussions were extended to EMF exposure limits recommended by IEEE and ICNIRP and also measurement methods as proposed by ITU.

### 3.1.1 Review of the Previous Committee's Report

The Committee reviewed the Recommendations put forward by the previous committee. The recommendations were divided into three categories, that is, recommendations to government, regulatory authorities and operators. The detailed recommendations are attached as **APPENDIX I.**

### 3.1.2 Presentation

The following presentations were made by members of the Committee:

(i) Radiation issues concerning mobile phones and base stations

(ii) Environmental issues associated with projects involving construction and installation of communication masts

(iii) The basics of EMC and spectrum analyzer

(iv) Radiation hazards caused by high power radar transmitters around the position proximity

(v) EMF measurement techniques and application of the Narda SRM 3006 radiation meter

### 3.1.3 Field Training

#### 3.1.3.1 Assessment of EMF Levels

Field training on the EMF measurement was conducted to enable the workshop participants to practice the operation of the measuring equipment, i.e., Narda SRM 3006. The training was conducted at Undali Street, Upanga in Dar e Salaam, where TCRA had received complaint from one individual that TIGO base station might be causing health effects to individual living in the area.

#### 3.1.3.2 Environmental Issues

During the field work, physical inspection and visual observations as well as interviews with people living close to the base stations were done to facilitate environmental impacts assessment.

## 3.2 Measurement and Assessment of EMF Radiation

A rapid increase in the use of mobile phones, resulting into massive deployment of mobile base station antennas needed to support capacity and coverage, has increased public concern on the possibility of adverse health effects due to exposure to electromagnetic radiation. However, it should be noted that, these base stations are installed such that their RF exposures comply with appropriate safety standards and regulations currently available [1, 2]. In order to asses if EMF exposure from base stations and other communications equipment complies with the exposure safety limits, electromagnetic fields measurements have been carried out. Several international standards for evaluation of human exposure in the vicinity of communication towers have been developed. These standards include IEC 62232 [5], ITU-T standard K.61 [6] and ITU-T standard K.91 [7], which has been recently approved. The measured values of EMF fields are then compared to the level provided in the safety standards.

### 3.2.1 Frequency and Measuring Equipment

State of the art Narda SRM 3006 equipment (6 kHz – 6 GHz) was used for measurements as shown in figure 1. This equipment is connected with isotropic (probe) antenna, which is capable of receiving signal in all directions. The antenna used has a range of 27 MHz to 2.9 GHz. The Narda equipment and the antenna are connected by a 5 m long coaxial cable, with the antenna fixed at the height of 1.5 m from the ground using a wooden stand as shown in Figure 1.

(a)

(b)

Figure 1: (a) Narda probe fixed on the wooden stand, (b) Narda 3006 Radiation Meter

In this work, measurements were divided into several frequency bands based on application as shown in Table II. The total sum of EMF radiation level from all operators in a given frequency band was measured. Figure 2 shows a frequency spectrum of E-filed in [V/m] for all GSM 1800 operators. Therefore the total EMF radiation level at a particular location is obtained by summing all the radiations from the individual operators. The results discussed in this report considered total exposure from all operators. The measured total radiation levels were then compared with the ICNIRP EMF safety limits as per ICNIRP guideline for the frequency band assessed as listed in Table II.

**Table II:** ICNIRP EMF safety limits for different frequency bands

| Frequency Band (MHz) | Application | E-Field[V/m] |
|---|---|---|
| 87 - 108 | FM RADIO | 28 |
| 174 - 230 | VHF BAND TV | 28 |
| 470 -790 | UHF BAND TV | 29.8 |
| 930 - 960 | GSM 900 Down link | 41.9 |
| 1805 - 1880 | GSM 1800 Down Link | 58.4 |
| 2110 - 2170 | WCDMA | 61 |

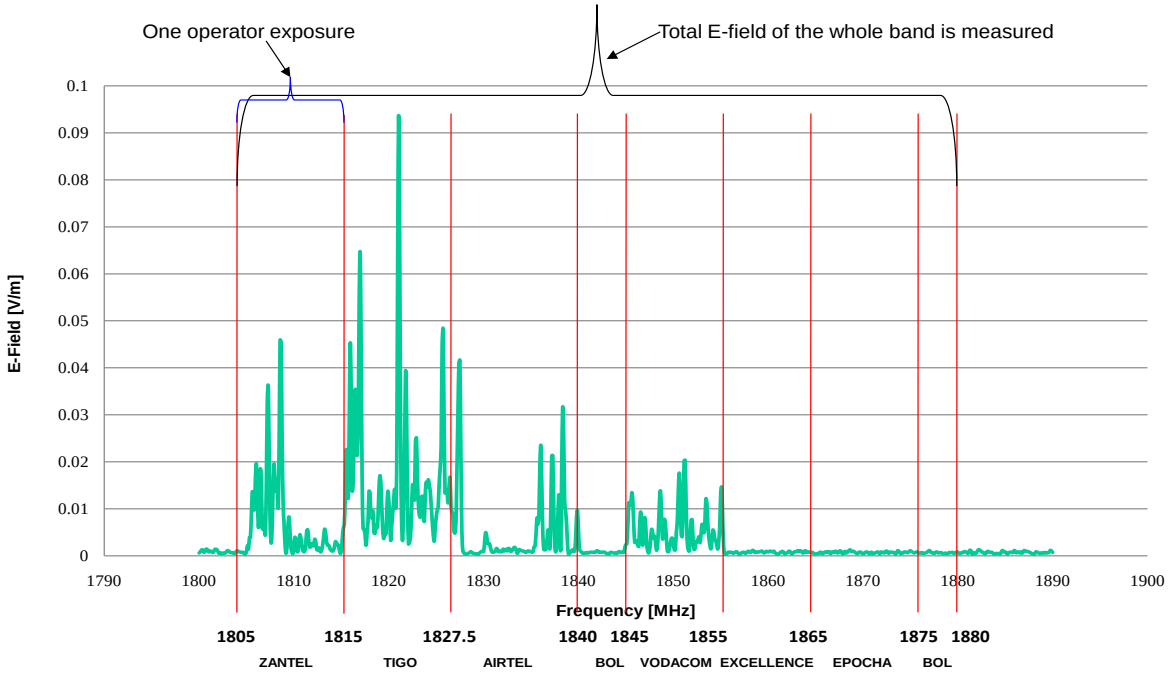



Figure 2: RF exposure from different operators at GSM 1800 frequency band.

### 3.2.2 Measurements Conditions

During measurement the following equipment settings were used. Resolution bandwidth (RBW) of 200 kHz for FM, GSM, and UMTS and RBW of 1 MHz was used for VHF and UHF. Measurement was set to maximum and data were recorded manually for a measurement time between 2 and 6 minutes.

### 3.2.3 Measured Locations

The sites for measurements were chosen by considering areas with possibility of high levels of radiation, areas considered to be sensitive such as schools and hospitals. Measurements results presented in this report were obtained from 3 mainland regions, i.e., Dar es Salaam, Dodoma and Arusha, and three regions in Zanzibar, i.e., Mjini Magharibi, Kusini Unguja, and Kaskazini Unguja. In each region visited, all districts were considered.

Measurements in fifteen locations in Dar es Salaam, twenty in Arusha, fourteen in Dodoma, and fifteen in Unguja were carried out.

# 4.0 FINDINGS

## 4.1. Review of the Report of the Previous Committee

In the review of the report of the previous committee, the concentration was given on its recommendations and status of implementation of those recommendations. It was observed that after submission of the committee's report to the TCRA management, other stake holders were not informed of the recommendations. The status of implementation is given in Table III.

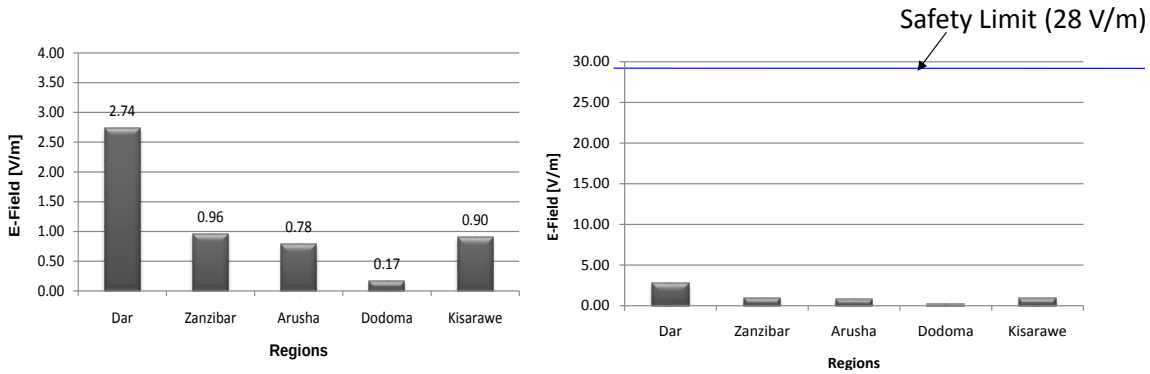
**Table III:** Status of the implementation of the recommendations of the previous Committee

| Recommendation Category | Observation |
|---|---|
| **7.1: Recommendation to Government** | |
| 7.1.1 Amendment of Acts Cap 378 and Cap 101 to include current developments in the sector. | Not sure whether stake holders were informed |
| 7.1.2 Issuance of building permits by Local government authorities after applicants receive clearance from regulatory authorities. | Not sure whether stake holders were informed |
| 7.1.3 Harmonization of laws governing the regulatory authorities on issues related to communication | Not sure whether stake holders were informed |
| **7.2: Recommendation to Regulatory Authorities** | |
| 7.2.1 Responsible Regulatory Authorities (TCRA, TAEC, and NEMC) should come up with regulations and guidelines on issues related to communication | Somehow implemented. See EPOCA Act and regulations on mast sharing. |
| 7.2.2 Compliance to the regulations for all telecommunication installations. | Partially implemented, see EMA Cap 191. |

| | |
|---|---|
| 7.2.3 Public education on issues pertaining to the communications matters such as radiation, etc. | This is being done occasionally. |
| 7.2.4 Research collaboration with higher learning universities | Not implemented |
| 7.2.5 Procurement of Test Laboratory to be used to measure SAR for phones which enter the domestic markets. | TCRA has started the process of building TAL |
| **7.3 Recommendations to Operators** | |
| 7.3.2 Disguise antennas and equipment as part of building to be an integral part of a building, structure, or landscape | Not sure whether stake holders were informed |
| 7.3.3 Sharing of existing sites, masts and other infrastructure | Not sure whether stake holders were informed |
| 7.3.5 Consultation with local communities before new installations is done. | Implemented |

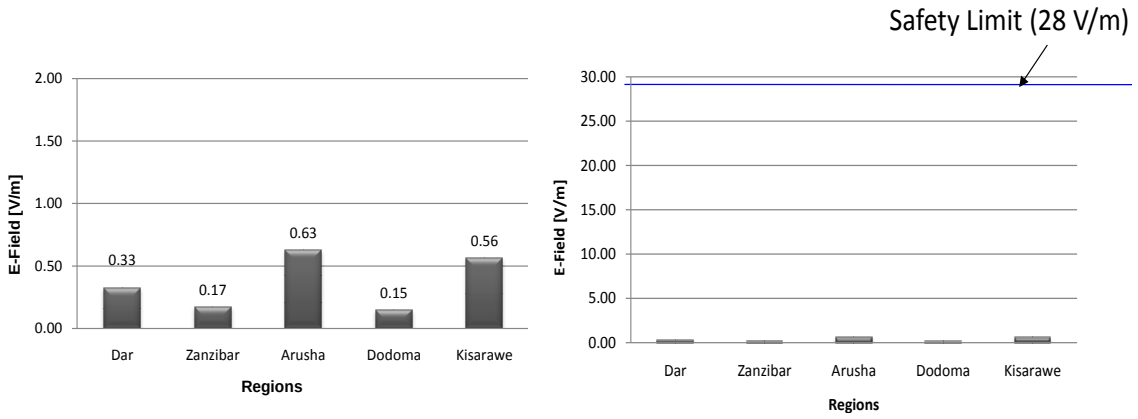
## 4.2 Assessment of the EMF levels

Figures 3 (a) and (b) show the measured EMF levels for FM frequency band. In Figure 3(a), maximum E-field levels obtained in regions were measurements were carried out are compared whereas in Figure 3(b) these measured maximum values are compared



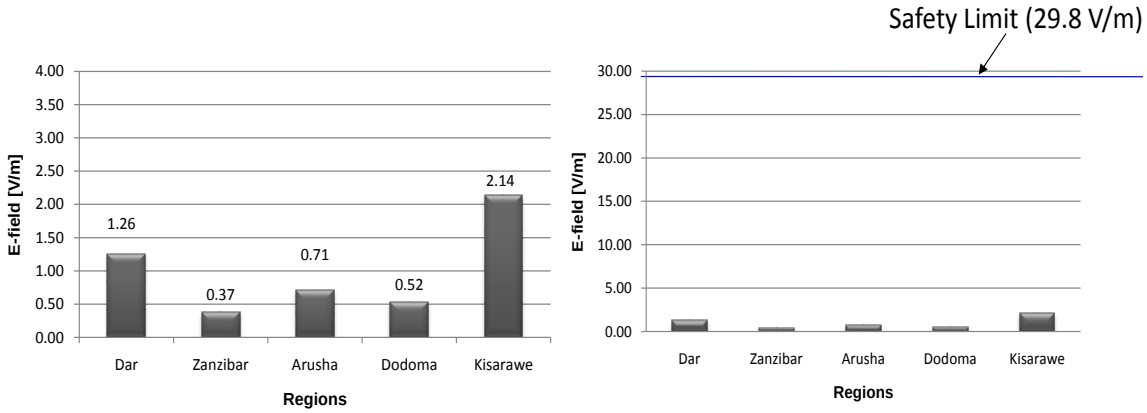

(a) (b)

Figure.3 (a) Maximum E-field measured in different regions at FM frequency band, (b) Comparison between E-fields in (a) with the ICNIRP safety limit.



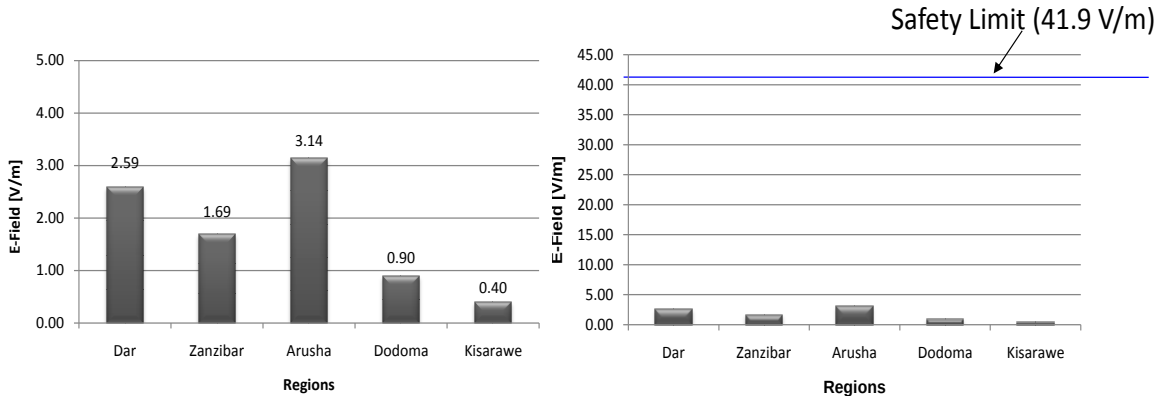

(b) (b)

Figure.4 (a) Maximum E-field measured in different regions at VHF frequency band, (b) Comparison between E-fields in (a) with the ICNIRP safety limit.



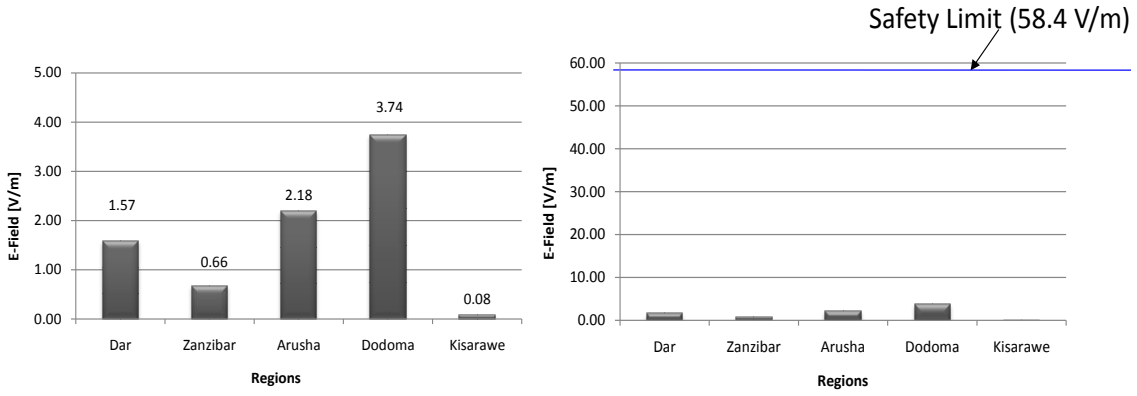

(a) (b)

Figure.5 (a) Maximum E-field measured in different regions at UHF frequency band, (b) Comparison between E-fields in (a) with the ICNIRP safety limit.



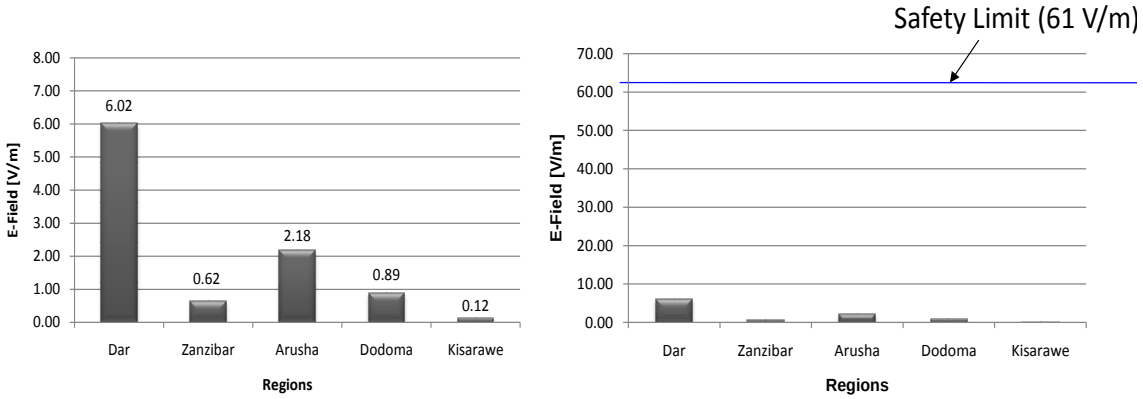

(a) (b)

Figure.6 (a) Maximum E-field measured in different regions at GSM 900 frequency band, (b) Comparison between E-fields in (a) with the ICNIRP safety limit.




(a) (b)

Figure.7 (a) Maximum E-field measured in different regions at GSM 1800 frequency band, (b) Comparison between E-fields in (a) with the ICNIRP safety limit.




(a) (b)

Figure.8 (a) Maximum E-field measured in different regions at UMTS frequency band, (b) Comparison of E-fields in (a) with the ICNIRP safety limit.

**Table IV:** Maximum exposure obtained during measurement exercise

| Frequency Band | Location of Maximum Exposure | Maximum Exposure [V/m] | ICNIRP Limit E-Field [V/m] |
|---|---|---|---|
| FM | Makongo (Dar) | 2.7 | 28 |
| VHF | TBL (Arusha) | 0.63 | 28 |
| UHF | Bus stand (Kisarawe) | 2.14 | 29.8 |
| GSM 900 | Unga Limited (Arusha) | 3.14 | 41.9 |
| GSM 1800 | Nyerere Square (Dodoma) | 3.74 | 58.4 |
| UMTS | Muhimbili (Dar) | 6.02 | 61 |

against the EMF safety limit. It is clearly observed that the measured values of EMF levels are by far smaller than the safety level recommended by the ICNIRP guideline.

Figures 4 to 8 are the results for VHF, UHF, GSM900, GSM1800, and UMTS, respectively. Similar argument as that of Figure 3 can be deduced regarding the measured EMF levels and the EMF safety limits. Table IV summarizes maximum values measured in each band from different locations and the safety limit values recommended by the ICNIRP for the particular frequency band. Detailed measurements from the measurement sites are attached as **APPENDIX II**

## 5.0 ACHIEVEMENTS

Through the organized workshop participants learnt about EMF radiation safety levels and standards by different national and international organizations such as ICNIRP, IEEE, CENELEC, etc. participants were also able to measure EMF radiation levels using state of the art NARDA equipment at different frequencies. Therefore it has been possible to build human capacity in measuring EMF radiation levels among staffs from participating institutions. It is now envisaged that in future the EMF measurements will be thoroughly conducted by the skilled personnel in respective zones.

On the other hand, the participating institutions (stakeholders) in the workshop shared experiences and identified areas in which they can collaborate among themselves (networking). Currently there are postgraduate students from UDSM carrying out research on EMF as part of their Master degree programs as a result of the conducted workshop.

Through the carried out EMF measurements it has been possible to establish that radiation levels at the four zones (Costal, Central, Northern and Zanzibar) are well below the recommended ICNIRP guideline limits. Hence, answering the concerns on the worry that the public is exposed to high levels of EMF radiation. The measurement data has been documented for future use.

# 6.0 FUTURE ACTIVITIES

The committee recommends the following activities be carried out. However, implementation should be priorities based on the availability of funds.

(a) Presentation to TAEC and TCRA management

(b) Public awareness and education

i. To publish results in the TCRA and TAEC websites

ii. to Members of Parliaments and House of Representative

iii. Exhibition to Nane-Nane and Saba Saba festivals

iv. Workshop to stake holders

v. TV programs

(c) Continuation of EMF measurement

(d) Purchase of antenna (probe) for measurement of radiations from MW radio band

(e) Conduct at least four working committee meetings per year to discuss measurements and other activities (such as workshop to enhance internal capacity of committee members on issues related to EMF) carried out in the period.

(f) Identification of research agendas on EMF. The students in Universities will be encouraged to carry out research in these areas. The research agendas may be drawn from issues related to environmental and EMF radiation.

(g) Formulation of EMF regulations. In this activity, the committee intends to form a sub-committee which will include a member from Tanzania Bureau of Standard and NEMC, two lawyers, two Engineers/Scientists. The subcommittee will be tasked to determine which should be the lead organization of the EMF regulations and approach to be used for Tanzania to adopt ICNIRP Guideline.

(h) Conduct mobile phone SAR measurement

# 7.0 REFERENCES


[1] ICNIRP Guidelines, "Guidelines for limiting exposure to time-varying electric, magnetic and electromagnetic fields (up to 300 GHz)," Health Phys. Soc., vol. 74, no. 4, pp. 494–522, Apr. 1998.

[2] IEEE Standard for Safety Levels With Respect to Exposure to Radio Frequency Electromagnetic Fields, 3 KHz to 300 GHz, IEEE Standard C95.1-2005, 2005.

[3] ITU-T Recommendation K. 83, "Monitoring field strength of the electromagnetic field," Mar. 2011.

[4] Study of Radiofrequency Radiation Levels From Mobile Phone Base Station and Radio Transmitter in Tanzania, TCRA Progress Report, 2008.

[5] IEC62232 Determination of RF Fields in the vicinity of Mobile Communication Base Stations for the Purpose of Evaluating Human Exposure, IEC62232 Ed. 2 CD, 2009

[6] ITU-T Recommendation K.61, "Guidance on measurement and numerical prediction of electromagnetic field for compliance with human exposure limits for telecommunication installations

[7] ITU-T Recommendation K.91,Guidance for assessment, evaluation and monitoring of human exposure to radio frequency electromagnetic fields, May 2012

## APPENDIX I

## RECOMMENDATIONS OF THE EMF COMMITTEE

### 7.1: Recommendation to Government

7.1.1 Amendment of Acts Cap 378 and Cap 101 they need to be amended to include current development in particular deployment of telecommunication infrastructure including masts.

7.1.2 Local government authorities should issue building permits after an applicant has been cleared by the regulatory authorities, and the procedures used to grant permits should be the same to all authorities.

7.1.3 The Government should harmonise laws governing the regulatory authorities on issues related to communication infrastructure installations and operations.

### 7.2: Recommendation to Regulatory Authorities

7.2.1 Responsible Regulatory Authorities (TCRA, TAEC, and NEMC) should come up with regulations and guidelines on radiofrequency radiation levels, sound levels from generators, mast sharing, warning signs on fences on areas with high exposures of radio frequency radiations, installations in sensitive areas like schools and hospitals and other related technical and environmental aspects.

7.2.2 The regulatory authorities should make follow up on the compliance to the regulations for all telecommunication installations.

7.2.3 The regulatory authorities should educate the public on issues pertaining to the communications matters such as radiation, best practices on the use of mobile phones, environmental issues, etc.

7.2.4 The regulatory authorities, in collaboration with higher learning institutions should develop capabilities to conduct research on possible health effects caused by telecommunications equipment.

7.2.5 The regulatory authorities should consider radiofrequency radiations in the type approval process by procuring Test Laboratory which should be used to measure SAR for phones which enter the domestic markets.

### 7.3 Recommendations to Operators

7.3.2 Disguise antennas and equipment, for example as part of building or installing antennas and equipment so that they appear to be an integral part of a building, structure, or landscape

7.3.3 Share existing sites, masts and other infrastructure

7.3.5 Consultation with local communities before new installations is done.

## APPENDIX II

## EMF EXPOSURE LEVELS IN EACH LOCATION

## Appendix II (a) Measured EMF Exposure Levels for Dar es Salaam Locations

| DISTRICT | SITE NAME | FREQ. BAND [MHz] | E [V/m] | ICNIRP [%] |
|---|---|---|---|---|
| KINONDONI | Tandale Magharibi | FM radio (87-108) | 0.06 | 0.2 |
| | | TV VHF (174-230) | 0.04 | 0.1 |
| | | TV UHF (470-790) | 0.05 | 0.2 |
| | | GSM900(930-960) | 0.71 | 1.7 |
| | | GSM 1800 (1805-1880) | 0.37 | 0.6 |
| | | UMTS (2110-2170) | 0.10 | 0.2 |
| | Mwanyamala Hospital | FM radio (87-108) | 0.05 | 0.2 |
| | | TV VHF (174-230) | 0.04 | 0.1 |
| | | TV UHF (470-790) | 0.05 | 0.2 |
| | | GSM900(930-960) | 0.97 | 2.3 |
| | | GSM 1800 (1805-1880) | 0.54 | 0.9 |
| | | UMTS (2110-2170) | 1.26 | 2.1 |
| | Kinondoni Muslim | FM radio (87-108) | 0.08 | 0.3 |
| | | TV VHF (174-230) | 0.07 | 0.2 |
| | | TV UHF (470-790) | 0.09 | 0.3 |
| | | GSM900(930-960) | 2.59 | 6.2 |
| | | GSM 1800 (1805-1880) | 1.13 | 1.9 |
| | | UMTS (2110-2170) | 1.03 | 1.7 |
| | Tegeta Sokoni | FM radio (87-108) | 0.15 | 0.5 |
| | | TV VHF (174-230) | 0.04 | 0.1 |
| | | TV UHF (470-790) | 0.05 | 0.2 |
| | | GSM900(930-960) | 1.01 | 2.4 |
| | | GSM 1800 (1805-1880) | 0.49 | 0.8 |
| | | UMTS (2110-2170) | 0.33 | 0.5 |
| | | FM radio (87-108) | | |
| | Makongo TX Site | FM radio (87-108) | 2.74 | 9.8 |
| | | TV VHF (174-230) | 0.33 | 1.2 |
| | | TV UHF (470-790) | 1.26 | 4.2 |
| | | GSM900(930-960) | 0.73 | 1.7 |
| | | GSM 1800 (1805-1880) | 0.49 | 0.8 |
| | | UMTS (2110-2170) | 1.37 | 2.2 |
| TEMEKE | Mbagala Zakheim | FM radio (87-108) | 0.07 | 0.2 |
| | | TV VHF (174-230) | 0.07 | 0.2 |

| | | | | |
|---|---|---|---|---|
| | | TV UHF (470-790) | 0.10 | 0.3 |
| | | GSM900(930-960) | 0.72 | 1.7 |
| | | GSM 1800 (1805-1880) | 0.44 | 0.8 |
| | | UMTS (2110-2170) | 0.17 | 0.3 |
| | Duce University | FM radio (87-108) | 0.50 | 1.8 |
| | | TV VHF (174-230) | 0.07 | 0.2 |
| | | TV UHF (470-790) | 0.09 | 0.3 |
| | | GSM900(930-960) | 0.74 | 1.8 |
| | | GSM 1800 (1805-1880) | 1.03 | 1.8 |
| | | UMTS (2110-2170) | 0.31 | 0.5 |
| | Tandika Magorofani | FM radio (87-108) | 0.07 | 0.3 |
| | | TV VHF (174-230) | 0.07 | 0.2 |
| | | TV UHF (470-790) | 0.09 | 0.3 |
| | | GSM900(930-960) | 0.38 | 0.9 |
| | | GSM 1800 (1805-1880) | 0.50 | 0.9 |
| | | UMTS (2110-2170) | 0.53 | 0.9 |
| | Buguruni Sokoni | FM radio (87-108) | 0.07 | 0.3 |
| | | TV VHF (174-230) | 0.07 | 0.2 |
| | | TV UHF (470-790) | 0.09 | 0.3 |
| | | GSM900(930-960) | 0.47 | 1.1 |
| | | GSM 1800 (1805-1880) | 1.34 | 2.3 |
| | | UMTS (2110-2170) | 0.38 | 0.6 |
| ILALA | Posta Mpya | FM radio (87-108) | 0.04 | 0.1 |
| | | TV VHF (174-230) | 0.04 | 0.1 |
| | | TV UHF (470-790) | 0.05 | 0.2 |
| | | GSM900(930-960) | 1.42 | 3.4 |
| | | GSM 1800 (1805-1880) | 1.57 | 2.7 |
| | | UMTS (2110-2170) | 2.12 | 3.5 |
| | Ferry | FM radio (87-108) | 0.04 | 0.1 |
| | | TV VHF (174-230) | 0.04 | 0.1 |
| | | TV UHF (470-790) | 0.05 | 0.2 |
| | | GSM900(930-960) | 0.37 | 0.9 |
| | | GSM 1800 (1805-1880) | 0.39 | 0.7 |
| | | UMTS (2110-2170) | 0.25 | 0.4 |
| | Uhuru Mchanganyiko | FM radio (87-108) | 0.04 | 0.1 |
| | | TV VHF (174-230) | 0.15 | 0.5 |
| | | TV UHF (470-790) | 0.51 | 1.7 |

| | | | | |
|---|---|---|---|---|
| | | GSM900(930-960) | 0.23 | 0.6 |
| | | GSM 1800 (1805-1880) | 0.36 | 0.6 |
| | | UMTS (2110-2170) | 0.48 | 0.8 |
| | Kariakoo | FM radio (87-108) | 0.41 | 1.5 |
| | | TV VHF (174-230) | 0.04 | 0.1 |
| | | TV UHF (470-790) | 0.05 | 0.2 |
| | | GSM900(930-960) | 0.95 | 2.3 |
| | | GSM 1800 (1805-1880) | 0.90 | 1.5 |
| | | UMTS (2110-2170) | 0.51 | 0.8 |
| | Muhimbili | FM radio (87-108) | 0.17 | 0.6 |
| | | TV VHF (174-230) | 0.17 | 0.6 |
| | | TV UHF (470-790) | 0.24 | 0.8 |
| | | GSM900(930-960) | 0.91 | 2.2 |
| | | GSM 1800 (1805-1880) | 0.42 | 0.7 |
| | | UMTS (2110-2170) | 6.02 | 9.9 |
| KISARAWE | Bus Stand | FM radio (87-108) | 0.90 | 3.2 |
| | | TV VHF (174-230) | 0.56 | 2.0 |
| | | TV UHF (470-790) | 2.14 | 7.2 |
| | | GSM900(930-960) | 0.40 | 1.0 |
| | | GSM 1800 (1805-1880) | 0.08 | 0.1 |
| | | UMTS (2110-2170) | 0.12 | 0.2 |

## Appendix II (b) Measured EMF Exposure Levels for Zanzibar Locations

| REGION | DISTRICT | SITE NAME | FREQ. BAND [MHz] | E [V/m] | ICNIRP [%] |
|---|---|---|---|---|---|
| URBAN WEST | WEST | CHUKWANI | FM radio (87-108) | 0.171 | 0.6 |
| | | | TV VHF (174-230) | 0.172 | 0.6 |
| | | | TV UHF (470-790) | 0.229 | 0.8 |
| | | | GSM900(930-960) | 1.058 | 2.5 |
| | | | GSM 1800 (1805-1880) | 0.596 | 1.0 |
| | | | UMTS (2110-2170) | 0.225 | 0.4 |
| | | DOLE | FM radio (87-108) | 0.235 | 0.8 |
| | | | TV VHF (174-230) | 0.037 | 0.1 |
| | | | TV UHF (470-790) | 0.046 | 0.2 |
| | | | GSM900(930-960) | 0.445 | 1.1 |
| | | | GSM 1800 (1805-1880) | 0.126 | 0.2 |
| | | | UMTS (2110-2170) | 0.131 | 0.2 |
| | | MIGOMBANI | FM radio (87-108) | 0.957 | 3.4 |
| | | | TV VHF (174-230) | 0.174 | 0.6 |
| | | | TV UHF (470-790) | 0.228 | 0.8 |
| | | | GSM900(930-960) | 1.444 | 3.4 |
| | | | GSM 1800 (1805-1880) | 0.660 | 1.1 |
| | | | UMTS (2110-2170) | 0.422 | 0.7 |
| | URBAN | FORODHANI | FM radio (87-108) | 0.175 | 0.6 |
| | | | TV VHF (174-230) | 0.176 | 0.6 |
| | | | TV UHF (470-790) | 0.227 | 0.8 |
| | | | GSM900(930-960) | 0.302 | 0.7 |
| | | | GSM 1800 (1805-1880) | 0.180 | 0.3 |
| | | | UMTS (2110-2170) | 0.253 | 0.4 |
| | | MLANDEGE | FM radio (87-108) | 0.175 | 0.6 |
| | | | TV VHF (174-230) | 0.173 | 0.6 |
| | | | TV UHF (470-790) | 0.230 | 0.8 |
| | | | GSM900(930-960) | 0.379 | 0.9 |
| | | | GSM 1800 (1805-1880) | 0.372 | 0.6 |
| | | | UMTS (2110-2170) | 0.186 | 0.3 |
| SOUTH UNGUJA | CENTRAL | DUNGA | FM radio (87-108) | 0.171 | 0.6 |
| | | | TV VHF (174-230) | 0.174 | 0.6 |
| | | | TV UHF (470-790) | 0.225 | 0.8 |
| | | | GSM900(930-960) | 0.389 | 0.9 |
| | | | GSM 1800 (1805-1880) | 0.286 | 0.5 |
| | | | UMTS (2110-2170) | 0.298 | 0.5 |

| | | | | | |
|---|---|---|---|---|---|
| | | | | | |
| | | CHWAKA | FM radio (87-108) | 0.166 | 0.6 |
| | | | TV VHF (174-230) | 0.167 | 0.6 |
| | | | TV UHF (470-790) | 0.221 | 0.7 |
| | | | GSM900(930-960) | 0.362 | 0.9 |
| | | | GSM 1800 (1805-1880) | 0.337 | 0.6 |
| | | | UMTS (2110-2170) | 0.234 | 0.4 |
| | | TUNGUU | FM radio (87-108) | 0.165 | 0.6 |
| | | | TV VHF (174-230) | 0.168 | 0.6 |
| | | | TV UHF (470-790) | 0.222 | 0.7 |
| | | | GSM900(930-960) | 0.222 | 0.5 |
| | | | GSM 1800 (1805-1880) | 0.134 | 0.2 |
| | | | UMTS (2110-2170) | 0.184 | 0.3 |
| | SOUTH | KITOGANI | FM radio (87-108) | 0.040 | 0.1 |
| | | | TV VHF (174-230) | 0.039 | 0.1 |
| | | | TV UHF (470-790) | 0.050 | 0.2 |
| | | | GSM900(930-960) | 0.292 | 0.7 |
| | | | GSM 1800 (1805-1880) | 0.175 | 0.3 |
| | | | UMTS (2110-2170) | 0.092 | 0.2 |
| | | BWEJUU | FM radio (87-108) | 0.038 | 0.1 |
| | | | TV VHF (174-230) | 0.039 | 0.1 |
| | | | TV UHF (470-790) | 0.051 | 0.2 |
| | | | GSM900(930-960) | 0.291 | 0.7 |
| | | | GSM 1800 (1805-1880) | 0.030 | 0.1 |
| | | | UMTS (2110-2170) | 0.038 | 0.1 |
| | | MAKUNDUCHI | FM radio (87-108) | 0.039 | 0.1 |
| | | | TV VHF (174-230) | 0.039 | 0.1 |
| | | | TV UHF (470-790) | 0.050 | 0.2 |
| | | | GSM900(930-960) | 0.750 | 1.8 |
| | | | GSM 1800 (1805-1880) | 0.471 | 0.8 |
| | | | UMTS (2110-2170) | 0.117 | 0.2 |
| NORTH UNGUJA | NORTH A | MASINGINI | FM radio (87-108) | 0.255 | 0.9 |
| | | | TV VHF (174-230) | 0.162 | 0.6 |
| | | | TV UHF (470-790) | 0.374 | 1.3 |
| | | | GSM900(930-960) | 1.685 | 4.0 |
| | | | GSM 1800 (1805-1880) | 0.464 | 0.8 |
| | | | UMTS (2110-2170) | 0.463 | 0.8 |

| | | | | | |
|---|---|---|---|---|---|
| | | NUNGWI | FM radio (87-108) | 0.038 | 0.1 |
| | | | TV VHF (174-230) | 0.037 | 0.1 |
| | | | TV UHF (470-790) | 0.047 | 0.2 |
| | | | GSM900(930-960) | 0.666 | 1.6 |
| | | | GSM 1800 (1805-1880) | 0.181 | 0.3 |
| | | | UMTS (2110-2170) | 0.623 | 1.0 |
| | NORTH B | KIWENGWA | FM radio (87-108) | 0.040 | 0.1 |
| | | | TV VHF (174-230) | 0.039 | 0.1 |
| | | | TV UHF (470-790) | 0.047 | 0.2 |
| | | | GSM900(930-960) | 0.126 | 0.3 |
| | | | GSM 1800 (1805-1880) | 0.031 | 0.1 |
| | | | UMTS (2110-2170) | 0.054 | 0.1 |
| | | MAHONDA | FM radio (87-108) | 0.039 | 0.1 |
| | | | TV VHF (174-230) | 0.039 | 0.1 |
| | | | TV UHF (470-790) | 0.050 | 0.2 |
| | | | GSM900(930-960) | 0.496 | 1.2 |
| | | | GSM 1800 (1805-1880) | 0.437 | 0.7 |
| | | | UMTS (2110-2170) | 0.206 | 0.3 |

## Appendix II (c) Measured EMF Exposure Levels for Arusha Locations

| DISTRICT | SITE NAME | FREQ. BAND [MHz] | E (V/m) | ICNIRP % |
|---|---|---|---|---|
| ARUMERU | KIMORI KIA | FM radio (87-108) | 0.037 | 0.13 |
| | | TV VHF (174-230) | 0.036 | 0.13 |
| | | TV UHF (470-790) | 0.047 | 0.16 |
| | | GSM900(930-960) | 0.922 | 2.20 |
| | | GSM 1800 (1805-1880) | 0.031 | 0.05 |
| | | UMTS (2110-2170) | 0.036 | 0.06 |
| | MORORONI KIKATITI | FM radio (87-108) | 0.144 | 0.51 |
| | | TV VHF (174-230) | 0.038 | 0.14 |
| | | TV UHF (470-790) | 0.049 | 0.16 |
| | | GSM900(930-960) | 0.663 | 1.58 |
| | | GSM 1800 (1805-1880) | 0.030 | 0.05 |
| | | UMTS (2110-2170) | 0.058 | 0.10 |
| | TENGERU | FM radio (87-108) | 0.057 | 0.20 |
| | | TV VHF (174-230) | 0.038 | 0.14 |
| | | TV UHF (470-790) | 0.057 | 0.19 |
| | | GSM900(930-960) | 0.601 | 1.43 |
| | | GSM 1800 (1805-1880) | 0.113 | 0.19 |
| | | UMTS (2110-2170) | 0.051 | 0.08 |
| KARATU | KARATU | FM radio (87-108) | 0.037 | 0.13 |
| | | TV VHF (174-230) | 0.036 | 0.13 |
| | | TV UHF (470-790) | 0.047 | 0.16 |
| | | GSM900(930-960) | 0.839 | 2.00 |
| | | GSM 1800 (1805-1880) | 0.850 | 1.46 |
| | | UMTS (2110-2170) | 0.362 | 0.59 |
| | KARATU - KILIMA TEMBO | FM radio (87-108) | 0.036 | 0.13 |
| | | TV VHF (174-230) | 0.036 | 0.13 |
| | | TV UHF (470-790) | 0.045 | 0.15 |
| | | GSM900(930-960) | 0.183 | 0.44 |
| | | GSM 1800 (1805-1880) | 0.034 | 0.06 |
| | | UMTS (2110-2170) | 0.037 | 0.06 |
| MONDULI | MAKUYUNI | FM radio (87-108) | 0.036 | 0.13 |
| | | TV VHF (174-230) | 0.036 | 0.13 |
| | | TV UHF (470-790) | 0.045 | 0.15 |
| | | GSM900(930-960) | 0.569 | 1.36 |
| | | GSM 1800 (1805-1880) | 0.028 | 0.05 |

| | | | | |
|---|---|---|---|---|
| | | UMTS (2110-2170) | 0.035 | 0.06 |
| | MONDULI | FM radio (87-108) | 0.038 | 0.14 |
| | | TV VHF (174-230) | 0.036 | 0.13 |
| | | TV UHF (470-790) | 0.047 | 0.16 |
| | | GSM900(930-960) | 0.406 | 0.97 |
| | | GSM 1800 (1805-1880) | 0.243 | 0.42 |
| | | UMTS (2110-2170) | 0.037 | 0.06 |
| LONGIDO | NAMANGA | FM radio (87-108) | 0.037 | 0.13 |
| | | TV VHF (174-230) | 0.036 | 0.13 |
| | | TV UHF (470-790) | 0.046 | 0.15 |
| | | GSM900(930-960) | 0.529 | 1.26 |
| | | GSM 1800 (1805-1880) | 0.160 | 0.27 |
| | | UMTS (2110-2170) | 0.405 | 0.66 |
| | OLDONYO SAMBU | FM radio (87-108) | 0.038 | 0.14 |
| | | TV VHF (174-230) | 0.037 | 0.13 |
| | | TV UHF (470-790) | 0.049 | 0.16 |
| | | GSM900(930-960) | 0.138 | 0.33 |
| | | GSM 1800 (1805-1880) | 0.041 | 0.07 |
| | | UMTS (2110-2170) | 0.038 | 0.06 |
| ARUSHA | NGARAMTONI | FM radio (87-108) | 0.043 | 0.15 |
| | | TV VHF (174-230) | 0.037 | 0.13 |
| | | TV UHF (470-790) | 0.046 | 0.15 |
| | | GSM900(930-960) | 1.215 | 2.90 |
| | | GSM 1800 (1805-1880) | 2.183 | 3.74 |
| | | UMTS (2110-2170) | 0.579 | 0.95 |
| | MAJENGO MBAUDA | FM radio (87-108) | 0.087 | 0.31 |
| | | TV VHF (174-230) | 0.038 | 0.14 |
| | | TV UHF (470-790) | 0.087 | 0.29 |
| | | GSM900(930-960) | 1.510 | 3.60 |
| | | GSM 1800 (1805-1880) | 0.307 | 0.53 |
| | | UMTS (2110-2170) | 0.758 | 1.24 |
| | SOMBETINI MBAUDA | FM radio (87-108) | 0.085 | 0.30 |
| | | TV VHF (174-230) | 0.038 | 0.14 |
| | | TV UHF (470-790) | 0.100 | 0.34 |
| | | GSM900(930-960) | 1.038 | 2.48 |
| | | GSM 1800 (1805-1880) | 0.403 | 0.69 |
| | | UMTS (2110-2170) | 0.052 | 0.09 |

| | | | |
|---|---|---|---|
| UNGA LIMITED | FM radio (87-108) | 0.215 | 0.77 |
| | TV VHF (174-230) | 0.079 | 0.28 |
| | TV UHF (470-790) | 0.235 | 0.79 |
| | GSM900(930-960) | 3.141 | 7.50 |
| | GSM 1800 (1805-1880) | 1.389 | 2.38 |
| | UMTS (2110-2170) | 0.844 | 1.38 |
| CLOCK TOWER | FM radio (87-108) | 0.096 | 0.34 |
| | TV VHF (174-230) | 0.042 | 0.15 |
| | TV UHF (470-790) | 0.141 | 0.47 |
| | GSM900(930-960) | 2.678 | 6.39 |
| | GSM 1800 (1805-1880) | 0.931 | 1.59 |
| | UMTS (2110-2170) | 2.685 | 4.40 |
| MUSHONO | FM radio (87-108) | 0.056 | 0.20 |
| | TV VHF (174-230) | 0.037 | 0.13 |
| | TV UHF (470-790) | 0.052 | 0.17 |
| | GSM900(930-960) | 0.131 | 0.31 |
| | GSM 1800 (1805-1880) | 0.130 | 0.22 |
| | UMTS (2110-2170) | 0.101 | 0.17 |
| SOWETO | FM radio (87-108) | 0.190 | 0.68 |
| | TV VHF (174-230) | 0.126 | 0.45 |
| | TV UHF (470-790) | 0.334 | 1.12 |
| | GSM900(930-960) | 1.249 | 2.98 |
| | GSM 1800 (1805-1880) | 0.959 | 1.64 |
| | UMTS (2110-2170) | 0.258 | 0.42 |
| NGARENARO | FM radio (87-108) | 0.120 | 0.43 |
| | TV VHF (174-230) | 0.038 | 0.14 |
| | TV UHF (470-790) | 0.142 | 0.48 |
| | GSM900(930-960) | 1.232 | 2.94 |
| | GSM 1800 (1805-1880) | 1.045 | 1.79 |
| | UMTS (2110-2170) | 0.653 | 1.07 |
| NJIRO 1 | FM radio (87-108) | 0.095 | 0.34 |
| | TV VHF (174-230) | 0.038 | 0.14 |
| | TV UHF (470-790) | 0.093 | 0.31 |
| | GSM900(930-960) | 0.225 | 0.54 |
| | GSM 1800 (1805-1880) | 0.116 | 0.20 |
| | UMTS (2110-2170) | 0.094 | 0.15 |

| | | | | |
|---|---|---|---|---|
| | NJIRO 2 | FM radio (87-108) | 0.171 | 0.61 |
| | | TV VHF (174-230) | 0.043 | 0.15 |
| | | TV UHF (470-790) | 0.706 | 2.37 |
| | | GSM900(930-960) | 0.765 | 1.83 |
| | | GSM 1800 (1805-1880) | 0.480 | 0.82 |
| | | UMTS (2110-2170) | 0.308 | 0.50 |
| | ARUSHA TBL | FM radio (87-108) | 0.781 | 2.79 |
| | | TV VHF (174-230) | 0.628 | 2.24 |
| | | TV UHF (470-790) | 0.628 | 2.11 |
| | | GSM900(930-960) | 1.173 | 2.80 |
| | | GSM 1800 (1805-1880) | 0.667 | 1.14 |
| | | UMTS (2110-2170) | 0.263 | 0.43 |

## Appendix II (d) Measured EMF Exposure Levels for Dodoma Locations

| DISTRICT | SITE NAME | FREQ. BAND [MHz] | E(V/m) | ICNIRP % |
|---|---|---|---|---|
| MPWAPWA | MPWAPWA TOWN | FM radio (87-108) | 0.07 | 0.23 |
| | | TV VHF (174-230) | 0.04 | 0.14 |
| | | TV UHF (470-790) | 0.05 | 0.17 |
| | | GSM900(930-960) | 0.65 | 1.55 |
| | | GSM 1800 (1805-1880) | 0.43 | 0.73 |
| | | UMTS (2110-2170) | 0.13 | 0.22 |
| | MPWAPWA TEACHERS COLLEGE | FM radio (87-108) | 0.04 | 0.13 |
| | | TV VHF (174-230) | 0.04 | 0.13 |
| | | TV UHF (470-790) | 0.05 | 0.16 |
| | | GSM900(930-960) | 0.64 | 1.52 |
| | | GSM 1800 (1805-1880) | 0.04 | 0.08 |
| | | UMTS (2110-2170) | 0.04 | 0.07 |
| KONGWA | KONGWA SOKONI | FM radio (87-108) | 0.04 | 0.14 |
| | | TV VHF (174-230) | 0.04 | 0.13 |
| | | TV UHF (470-790) | 0.05 | 0.17 |
| | | GSM900(930-960) | 0.02 | 0.06 |
| | | GSM 1800 (1805-1880) | 0.03 | 0.06 |
| | | UMTS (2110-2170) | 0.04 | 0.07 |
| | MBANDE | FM radio (87-108) | 0.04 | 0.14 |
| | | TV VHF (174-230) | 0.04 | 0.13 |
| | | TV UHF (470-790) | 0.05 | 0.17 |
| | | GSM900(930-960) | 0.03 | 0.08 |
| | | GSM 1800 (1805-1880) | 0.03 | 0.06 |
| | | UMTS (2110-2170) | 0.04 | 0.07 |
| MVUMI | MVUMI HOSPITAL | FM radio (87-108) | 0.04 | 0.13 |
| | | TV VHF (174-230) | 0.04 | 0.13 |
| | | TV UHF (470-790) | 0.05 | 0.17 |
| | | GSM900(930-960) | 0.46 | 1.09 |
| | | GSM 1800 (1805-1880) | 0.28 | 0.47 |
| | | UMTS (2110-2170) | 0.05 | 0.07 |
| | CHAMWINO STAND | FM radio (87-108) | 0.04 | 0.14 |
| | | TV VHF (174-230) | 0.04 | 0.13 |
| | | TV UHF (470-790) | 0.05 | 0.17 |
| | | GSM900(930-960) | 0.19 | 0.45 |

| | | | | |
|---|---|---|---|---|
| | | GSM 1800 (1805-1880) | 0.17 | 0.29 |
| | | UMTS (2110-2170) | 0.12 | 0.19 |
| KONDOA | KONDOA GROUND | FM radio (87-108) | 0.04 | 0.13 |
| | | TV VHF (174-230) | 0.04 | 0.13 |
| | | TV UHF (470-790) | 0.05 | 0.16 |
| | | GSM900(930-960) | 0.11 | 0.27 |
| | | GSM 1800 (1805-1880) | 0.10 | 0.16 |
| | | UMTS (2110-2170) | 0.04 | 0.07 |
| | IDARA YA MAJI | FM radio (87-108) | 0.04 | 0.14 |
| | | TV VHF (174-230) | 0.04 | 0.14 |
| | | TV UHF (470-790) | 0.05 | 0.17 |
| | | GSM900(930-960) | 0.52 | 1.24 |
| | | GSM 1800 (1805-1880) | 0.30 | 0.52 |
| | | UMTS (2110-2170) | 0.04 | 0.07 |
| BAHI | BAHI TOWN | FM radio (87-108) | 0.04 | 0.13 |
| | | TV VHF (174-230) | 0.04 | 0.13 |
| | | TV UHF (470-790) | 0.05 | 0.17 |
| | | GSM900(930-960) | 0.29 | 0.70 |
| | | GSM 1800 (1805-1880) | 0.16 | 0.28 |
| | | UMTS (2110-2170) | 0.04 | 0.07 |
| DODOMA TOWN | DODOMA HOSPITAL | FM radio (87-108) | 0.17 | 0.60 |
| | | TV VHF (174-230) | 0.15 | 0.53 |
| | | TV UHF (470-790) | 0.52 | 1.76 |
| | | GSM900(930-960) | 0.90 | 2.15 |
| | | GSM 1800 (1805-1880) | 0.63 | 1.08 |
| | | UMTS (2110-2170) | 0.76 | 1.25 |
| | NYERERE SQUARE | FM radio (87-108) | 0.11 | 0.38 |
| | | TV VHF (174-230) | 0.07 | 0.26 |
| | | TV UHF (470-790) | 0.31 | 1.04 |
| | | GSM900(930-960) | 0.51 | 1.22 |
| | | GSM 1800 (1805-1880) | 3.74 | 6.40 |
| | | UMTS (2110-2170) | 0.89 | 1.46 |
| | AREA D | FM radio (87-108) | 0.16 | 0.57 |
| | | TV VHF (174-230) | 0.09 | 0.33 |
| | | TV UHF (470-790) | 0.33 | 1.12 |
| | | GSM900(930-960) | 0.69 | 1.64 |
| | | GSM 1800 (1805-1880) | 0.37 | 0.64 |

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|---|---|---|---|---|
| | | UMTS (2110-2170) | 0.34 | 0.56 |
| | IHUMWA VILLAGE | FM radio (87-108) | 0.07 | 0.24 |
| | | TV VHF (174-230) | 0.07 | 0.24 |
| | | TV UHF (470-790) | 0.09 | 0.31 |
| | | GSM900(930-960) | 0.03 | 0.08 |
| | | GSM 1800 (1805-1880) | 0.07 | 0.12 |
| | | UMTS (2110-2170) | 0.08 | 0.13 |
| | UDOM | FM radio (87-108) | 0.07 | 0.24 |
| | | TV VHF (174-230) | 0.06 | 0.23 |
| | | TV UHF (470-790) | 0.09 | 0.30 |
| | | GSM900(930-960) | 0.19 | 0.46 |
| | | GSM 1800 (1805-1880) | 0.27 | 0.46 |
| | | UMTS (2110-2170) | 0.10 | 0.16 |