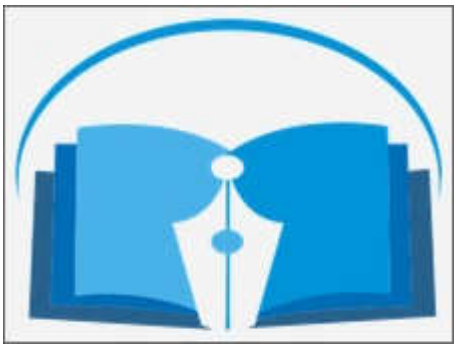

مجلة التربوي

مجلة علمية محكمة نصف سنوية تصدر عن

كلية التربية / الخمس

جامعة المرقب

العدد السابع والعشرون

يوليو 2025م

- المجلة ترحب بما يرد عليها من أبحاث وعلى استعداد لنشرها بعد التحكيم .
- المجلة تحترم كل الاحترام آراء المحكمين وتعمل بمقتضاها .
- كافة الآراء والأفكار المنشورة تعبر عن آراء أصحابها ولا تتحمل المجلة تبعاتها .
- يتحمل الباحث مسؤولية الأمانة العلمية وهو المسؤول عما ينشر له .
- البحوث المقدمة للنشر لا ترد لأصحابها نشرت أو لم تنشر .

ضوابط النشر:

يشترط في البحوث العلمية المقدمة للنشر أن يراعى فيها ما يأتي :

- أصول البحث العلمي وقواعده .
- ألا تكون المادة العلمية قد سبق نشرها أو كانت جزءا من رسالة علمية .
- يرفق بالبحث تزكية لغوية وفق أنموذج معد .
- تعدل البحوث المقبولة وتصحح وفق ما يراه المحكمون .
- التزام الباحث بالضوابط التي وضعتها المجلة من عدد الصفحات ، ونوع الخط ورقمه ، والفترات الزمنية الممنوحة للتعديل ، وما يستجد من ضوابط تضعها المجلة مستقبلا .

تنبيهات :

- للمجلة الحق في تعديل البحث أو طلب تعديله أو رفضه .
- يخضع البحث في النشر لأولويات المجلة وسياستها .
- البحوث المنشورة تعبر عن وجهة نظر أصحابها ، ولا تعبر عن وجهة نظر المجلة .

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Impact of EMFs waves on health

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Abstract

The expansion of telecommunication services in Libya has made mobile phones widely accessible across the population. To maintain coverage, cell towers emit electromagnetic fields (EMFs), raising public concerns about potential health risks. This study investigated EMF exposure levels at 11 cell tower sites in Tripoli, Libya. Measurements were compared with the exposure guidelines set by the International Commission on Non-Ionizing Radiation Protection (ICNIRP). The results demonstrate that EMF levels at the surveyed sites were generally within the recommended safety limits, suggesting no significant health risk from the measured emissions.

Keywords:

Electromagnetic fields (EMFs) – cell towers – exposure assessment – health risks – ICNIRP guidelines.

1. Introduction

In the last decade, mobile phone usage in Libya has increased substantially, leading to a rapid rise in the number of cell phone towers across the country. These towers operate with antennas that transmit and receive radio frequency (RF) electromagnetic signals to maintain communication with users. A Mobile Phone Company such as Libyana provides services to more than two million subscribers using the 900 MHz, 1800 MHz, and 2100 MHz frequency bands. To minimize potential health concerns, the power emitted by these antennas must remain within international safety limits. While no conclusive evidence

links RF emissions from cell towers to harmful health effects, the absence of proof does not guarantee complete safety.

The International Commission on Non-Ionizing Radiation Protection (ICNIRP), officially recognized by the World Health Organization (WHO), has issued widely adopted guidelines on safe exposure to electromagnetic fields (EMFs). These standards aim to protect both humans and the environment by defining acceptable exposure levels. In collaboration with a networking and IT company conducted an EMF survey of 10 cell phone towers to evaluate compliance with ICNIRP 2020 limits. The selected towers were chosen because they operate with multiple technologies (2G, 3G, LTE), include emissions from other providers such as Almadar and LTT, and are often located on schools and public buildings in densely populated areas.

No.	Site Number	Longitude	Latitude
1	TRI201	13.210845	32.902315
2	TRI314	13.128672	32.537480
3	TRI498	13.826452	32.518902
4	TRI167	13.194205	32.881640
5	TRI683	13.238950	32.912475
6	TRI079	13.175230	32.868905
7	TRI332	13.209150	32.890312
8	TRI025	13.121425	32.546230
9	TRI540	13.114980	32.872115
10	TRI752	13.217360	32.899824

2. EMF Survey Objective

The main objectives of this study

- Measuring the EMF radiation from 10 cell towers and compare that with ICNIRP guidelines
- Obtain better understanding of the behaviors of EMFs for different frequency bands.
- Ensure that the EMFs emissions from communication network follow international standards
- Protect networking costumers from potential health risks
- Support radio planning team for better coverage planning for new sites outdoor and indoor.
- Optimize transmitted power from networking cell towers to better serve the population

3. Scope of EMF Survey

- Setting up complete EMFs measurements Survey Plan
- Carrying out EMFs measures and the radiation around 10 cell phone towers to assure the public safety and compliance with international guidelines.
- Measuring EMFs for all frequency bands including 900 MHz, 1800 MHz, and 2100 MHz.
- Measuring the aggregated EMFs for the frequency range from 100 KHz to 8 GHz.
- Providing all the testing tools required to perform the job.
- Provide detailed Site Survey report including items described below.
- Provide the transportation to sites.
- Knowledge Transfer to networking Technical Staff

4.Methodology

The EMF exposure level at the selected cell phone towers is measured using SMP2 field strength meter equipped with an isotropic antenna that covers the frequency band from 100 KHz to 8 GHz. SMP2 is mounted on a tripod at a height of 1.5 m as shown in Fig. 1 and configured to measure the electrical field strength in V/m. The measured field strength level is automatically compared to ICNIRP 2020 reference level, and the results are displayed as percentage of the calculated reference value.

Three measurements scenario are conducted as follows:

Scenario A: at 30 m distance from the cell tower.

Conducting measurements at about 30 m away from the tower and with a clear line of sight with the targeted antennas will ensure that the measurements are conducted within the coverage zone of the sector antennas and at the far field region.

Scenario B: indoor

The measurements are conducted inside the closest building to the tower and if the antenna is located on multiple floors building, the measurements are conducted at the closest floor to the tower.

Scenario C: Under the cell phone tower at the closest point to the equipment room.

Measurements close to the equipment room is important to ensure that people who work on fixing air-conditioners and supply backup generators with gasoline are not exposed to high emissions.

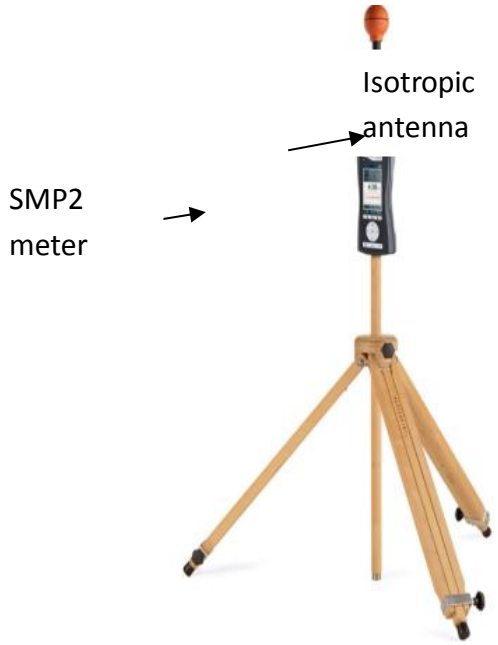

Fig. 1: SMP2 mounted on a tripod and connected to isotropic

For the three scenarios, the location of the tripod is chosen based on a survey with SMP2 configured in the broadband mode (100KHz-8GHz). The point with highest EMFs level is chosen to be the position of the tripod. For each scenario, four measurements are conducted as follows:

- Broadband exposure measurement for the frequency ranges from 100 KHz to 8GHz averaged over 6 min
- Selective measurement at 900 MHz averaged over 6 min
- Selective measurement at 1800 MHz averaged over 6 min
- Selective measurement at 2100 MHz averaged over 6 min

Therefore, the total number of measurements conducted for each cell tower site is 12.

SMP2 displays the EMFs results directly as percentage of the ICNIRP 2020 public whole body. Table 1 summarizes the reference exposure limits for ICNIRP 2020 at the required frequency bands.

Table 1: Reference exposure limits according to ICNIRP 2020.

Frequency band	Exposure limit in (V/m)
100KHz-8GHz	27.7
900 MHz	41.25
1800 MHz	58.34
2100 MHz	61.4

5.EMF Survey Tools

The tools that we utilize for EMF survey compliance with international standard. A networking company has adapted SMP2 EMF Meter included accessories:

- "SMP2 Reader" PC software: Compatible with Windows 7 or later versions.
- SMP2 probes carrying case.
- USB cable.
- Charger.
- SMP2 optional accessories:
- Non-reflective wooden tripod (including transport cover).
- Internal embedded GPS.
- Fiber optics interface.
- Vehicle DC charger.

- SMP2 protective pouch.
- SMP2 probe extension cable.

SMP2 BROADBAND

Portable field meter

to measure electromagnetic fields

(field probe required)

WPF8 broadband field probe

Frequency range 100 kHz - 8 GHz

(ENAC / EA / ILAC accredited calibration included)

Tripod SMP2 (basic)

6.Results

Measurements were conducted according to the above mentioned three scenarios. Fig 2 shows some photos taken during the measurement.

Fig.2: some photos taken during the measurements

The report prepared for each measurement is shown in Table 2. Description of each row in the table is presented in Table 3.

Table 2: survey report summary

Measurement information	Indoor
Measurement name	TRI997@1800 MHz
Software version	1.11.0.0
SMP2 serial	**21SN1596**
SMP2 firmware	1.79
Probe serial	**21WP041372**
Probe model	WPF8
Probe frequencies	100kHz-8GHz
Initial time	6/21/2021 12:53:08.0 PM
Final time	6/21/2021 12:59:08.0 PM

Measurement time	0:06:00
Coordinates	13.246478, 32.906641
Average interval	6m
Average type	Sliding
Limit	ICNIRP 2020-General public-whole body
Limit value	58.34 V/m
Limit calculated at	1.8 GHz
Units	**%E**
Last average	**0.2687**
Maximum	0.5435
Minimum	0
Result	Pass

Table 3: Explanation of the report

Item	Description
Measurement information	Contains information of measurement scenario which could be 30 m outdoor (Scenario A), indoor (Scenario B), under the tower (scenario C).
Measurement name	Includes information on the site number and the frequency band used for the measurement. For example, TRI997@1800 MHz means that the

	measurements are conducted for the site TRI997 at 1800 MHz
Probe model	WPF8is the model's name of the used probe
Probe frequencies	The frequency band within which the probe functions as expected
Initial time	Measurements start time
Final time	Measurements stop time
Measurement time	Measurement duration which is 6 min
Coordinates	Site location
Average interval	Total time for the measurement
Average type	Indicates the averaging technique used to calculate the measure electrical field which is sliding averages taken through sliding time window technique.
Limit	Indicates the type of reference guidelines that are used as reference measurement which is ICNIRP 2020-General public-whole body
Limit value	Limit value indicates the reference level calculated as per ICNIRP 2020 standard presented in Table 1
Limit calculated at	Indicates the frequency at which the measurements and the ICNIRP calculations are conducted
Units	Indicates the measured parameter in % which is in this case represents electrical field (E)

Last average	Represents the average percentage of the measured electrical field from the reference value
Maximum	Represent the maximum amount of the measured electrical field
Minimum	Represent the minimum amount of the measured electrical field
Result	Indicates if the test follows ICNIRP 2020 standards (pass) or not (fail).

The report also displays the same measurements in a screenshot as shown in Fig. 3

Fig.3: screenshot from the device screen after the measurements are taken

In addition, the report displays the average and the root mean square (RMS) value of the measured electrical field in percentage of ICNIRP 2020 over time span of 6 min as illustrated in Fig. 4

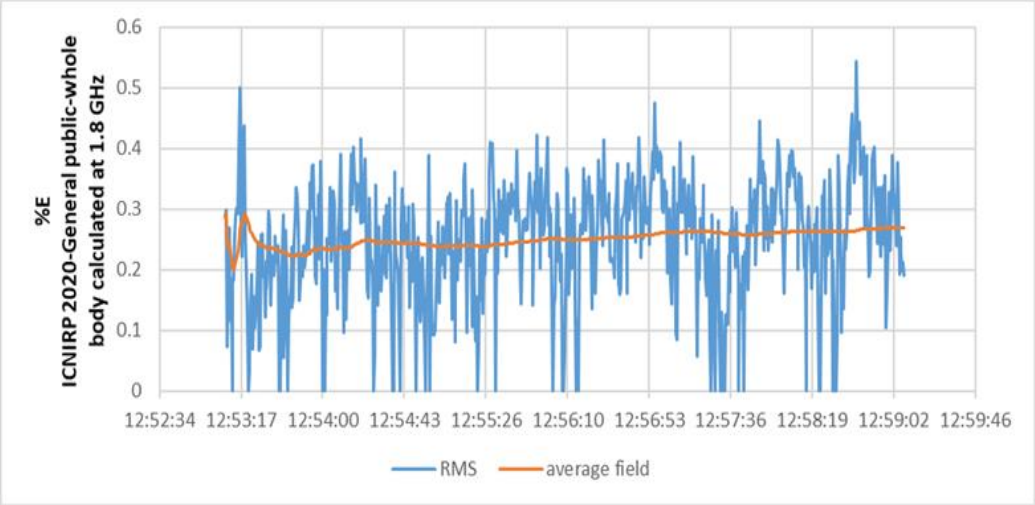

Fig.4: average and RMS %E versus measurement time

7.**Findings**

Some sites have shown higher radiation emission values than others as can be seen in Fig.5. The maximum emission value of 23.63 from ICNIRP 2020 has been measured at TRI027 cell site. High emission value of 20.15 % from the ICNIRP value was also measured at TRI 102.

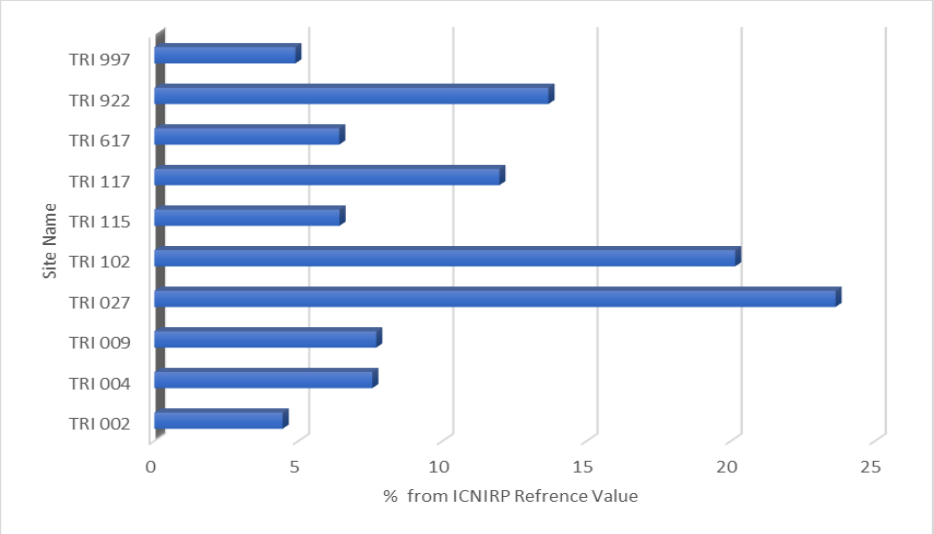

Fig. 5: % from ICNIRP value versus site name

These total Maximum values of emission were recorded for three aggregated bands (900MHz, 1800MHz & 2100MHz).

Overall, the EMFs measurements for the 10 sites show that the EMFs are within the limits defined by ICNIRP 2020 guidelines

8.Knowledge Transfer

A networking company team was accompanied by other teams during all the measurements. Libyana team had the opportunity to work with the SMP 2 device, conduct the measurements, store, and interpret the results. In addition, we have done our best to share knowledge and experiences to Libyana engineers which include technology background, international standards, measurements techniques as well as tools used for EMF measurements.

9.Challenges

We had some access challenges to one site located at Hatif Libya premises. This prevented us from conducting indoor measurements at this site. Another challenge was the severe heat wave which prevented us from conducting more than one measurement per day.

10.Recommendation

EMF measurement should be conducted on regular basis for all cell sites in communication network especially for the following:

- All sites located on the top of public places such as schools and hospitals
- All sites with indoor transceivers
- All sites located on the top of people property
- Microwave frequency band from 8 GHz to 60 GHz

We recommend that networking Mobile Phone coordinate with TRA for effort coordination and for sharing the data with public.

It is crucial to consider adapting long term EMF monitoring plan as per ITU Recommendation ITU-T K. 83. This recommendation gives guidance on how to make long-term measurements plan for monitoring EMFs in some selected areas that are under public concern, in order to show that EMFs are under control and within the limits.

11.References

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