International Journal of
INTELLIGENT SYSTEMS AND APPLICATIONS IN ENGINEERING
ISSN:2147-6799 www.ijisae.org Original Research Paper

Mobile Tower Radiation-Safe Zone Analysis & Regulatory Compliance

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Submitted:12/03/2024 **Revised**: 27/04/2024 **Accepted**: 04/05/2024

Abstract: Radiations from Mobile towers is a common phenomenon. Spectacular growth in the Mobile technology and resultant increase in the population of Mobile towers gave raise to certain apprehensions and health concerns among public. Therefore, it is necessary to evaluate the EMF radiation from towers so as to ascertain their safety levels. Towards this direction a study has been undertaken to evaluate radiations from huge number of towers in Telangana State and their compliance to the regulations of Department of Telecom. Further study has been conducted on selected complaint/non-complaint sites and a comparison made with mathematical evolved values.

Keywords: Mobile Tower Radiations, Radiation zones, Regulatory Compliance, EIRP.

1. Introduction

Cell phones have become the basic need of today and there has been an unprecedented growth of mobile industry in India during the last two decades.To serve people in urban and remote areas, mobile towers are essential to establish the connectivity.The base stations constructed at these tower locations have transceivers (BTSs) that work using radio frequency waves. These BTSs produce varying intensities of electromagnetic radiation depending upon the distance from the mobile towers and are supposed to be in safe limits as prescribed by Department of Telecommunications (DoT), Ministry of Communications, Govt. of India.Now there is a growing concern on the exposure of these radiations. Many initiatives are taken by the Department of Telecom (DoT) to ensure that these EMF radiations are compliant to the norms. This paper deals with practically observed radiation level w.r.t calculated value. Regulatory compliance is also dealt with.

2. Literature Survey

Experiments have been performed and power levels were recorded at selected sites in IIT Roorkee Campus by Akanksha Jain (2014). It is observed that the radiation level is under permissible limits as per the guidelines adopted in India. This study restricted to GSM 1800 and GSM 900 signals only. Richa chitranshi & others (2014) practically measured cell tower radiation in Ghaziabad city and observed that the operators were able to manage radiation levels with in the recommended values while maintaining QoS. Srinivas R Jog, Payal M Paranjape (2015) expressed need for RF survey due to increased number of RF sources in India. Further, there are no long term studies based on exposure level, intensity variation with distance, etc. Radiation levels are assessed in the Craiova City of Romania by Ioan & Claudin (2016) and concluded that no location exceeded the official standard of ICNIRP recommendations but many locations have long term exposure to levels higher than 1mW/m^2. This study only limited to GSM bands.

Shashank Vijay (2017) measured radiation levels at different places of Kota city using EMF detector (mobile app), he found that almost 50% of the 40 observations are in the category of medium to high risk levels and mobile towers were found to be emitting radiation levels beyond the permissible limits. The study is carried out using 3rd Party mobile apps rather than standard equipment. A.Balmori (2022) has reviewed the effects of base stations antenne on humans especially in real urban condition and concluded that serious problems are being faced due to the effect of tower radiations.

All these studies show the need for tower radiation measurement, safety zone determination and numerical calculations of exposed levels of power density.

3. Objective

The present paper focuses on measurement of radiation levels around the 2G, 3G and 4G BTSs in Telangana State to monitor the compliance as per norms and to identify the zones of Excedence, Occupational and Compliance zones of cell tower radiation. Identifying zones located in the vicinity of base stations where the recorded EMF radiations were higher than the recommended values and assessment of radiation level based on numerical calculations for three selected sites have been presented.

4. Methodology

4.1 Types of Mobile Tower Radiation

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EMF radiations are divided into two categories. Ionizing radiation is electromagnetic radiation whose waves contain energy sufficient to overcome the binding energy of electrons in atoms or molecules, thus creating ions. e.g. UV rays, X-rays, gamma rays and cosmic rays. Non Ionizing radiation refers to any type of electromagnetic radiation that does not carry enough energy per quantum to ionize atoms or molecules. e.g. low frequency radiations like radio waves, microwaves and infrared radiations. The EMF radiation in mobile services is primarily from two sources: (i). Radiation from BTS, (ii). Radiation from mobile handset. The energy carried by both of the above are unable to break chemical bonds in molecules and thus, falls under non-ionizing radiation category.

4.2 EM Radiation and Standards

ICNIRP, provides scientific advice and guidance on the health and environmental effects of non-ionizing radiation (NIR) to protect people and the environment from detrimental NIR exposure, formally an official collaborating NGO of the World Health Organization (WHO) and the International Labour Organization (ILO).

Table No:1 : International EMF Radiation norms for mobile towers (BTS)

S.No.	International Exposure Limits for EMF (1800 MHz)		S.No.	International Exposure Limits for EMF (1800 MHz)	
1	12 W/m^2	USA, Canada and Japan	8	0.4 W/m^2	China
2	9.2 W/m^2	ICNIRP and EU	9	0.2 W/m^2	Russia. Bulgaria
3	9 W/m^2	Australia	10	0.1 W/m^2	Poland, Paros, Hungary
4	2.4 W/m^2	Belgium	11	0.1 W/m^2	Italy in sensitive areas
5	1.0 W/m^2	Italy, Israel	12	0.095 W/m^2	Switzerland
6	0.5 W/m^2	Auckland, New Zealand	13	0.09 W/m^2	ECOLOG 1998 (Germany)
7	0.45 W/m^2	Luxembourg	14	0.001 W/m^2	Austria

4.3 DoT Norms and System of Assurance

Studied various EMF radiation norms prescribed by WHO and ICNIRP and exposure limits being followed by various countries. Number of countries has specified their own radiation levels in view of environmental and physical factors. Power density limits vary from 0.001 Watt/Sq.m to 12 Watt/Sq.m. Indian standards are 10 times more stringent than many countries like USA, Canada, Japan and Australia as follows:

S. No	Frequency	ICNIRP Radiation Norms	DoT Norms
1	900 MHz	4.5 Watt/Sq.m	0.45 Watt / Sq.m
2	1800 MHz	9.0 Watt /Sq.m	0.9 Watt / Sq.m
3	2100 MHz	10.5 Watt /Sq.m	1.0 Watt / Sq.m

All BTSs should be safe-limits compliant and certification to this effect is submitted to respective Field unit of DoT. All new BTS sites start radiating commercially only after such certification is submitted to relevant Field unit of DoT in each State. Extensive audit of compliance of self-certificates being submitted by Telecom Service Providers and base transceiver station (BTS) sites is regularly being carried out by DoT. Additionally, the BTS sites against which there are public complaints are also tested by Field units of DoT. The testing is done as per procedures prescribed by Telecom Engineering Centre (TEC) from time to time.

4.4 Checking for Compliance

Field measurement approach was chosen to analyse cell tower radiations in various regions. For this purpose, survey of around 1000 mobile towers in Telangana state has been considered. Narda SRM 3006 meter will be used to measure the field strength. Signal power from all towers should not exceed the limit prescribed. This meter monitors high frequency radiation emissions from 700 MHz to 3 GHz

Fig1. NARDA SRM 3006 Meter

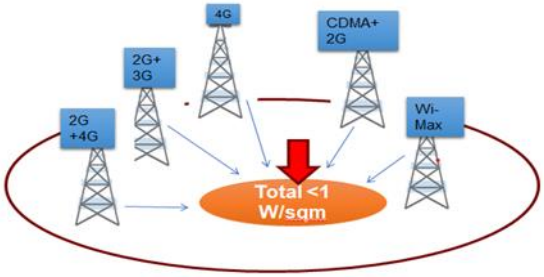
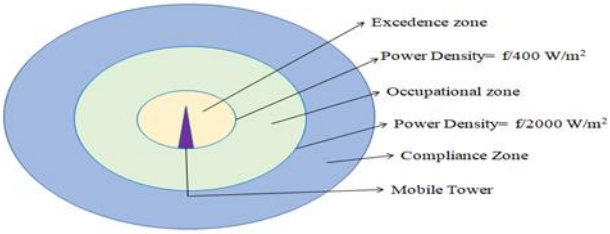


Fig 2. Broadband measurement technique

Further the measurements are taken using the technique of broadband measurement. In this technique the EMF signal available at a particular point, due to all the BTSs which are nearby to that point is measured by adding up of the signals emanating from all the nearby BTSs. The total or added value found at that point should not exceed 1 watt per square metre or the prescribed limit as the case may be.

The Fig 3 shows the zones of radiation around the mobile tower.



4.5 Radiation patterns

As per the ICNIRP, the value of power density at general public exposure zone i.e. Compliance Zone should be less than f/200 watt/m^2 for 400-2000 MHZ band where f is frequency (in MHZ). Whereas DoT-Govt. of India has adopted strict norms than ICNIRP recommendations, accordingly the Compliance Zone should be less than f/2000 watt/m^2

Excedence zone: (f is frequency in MHZ) this zone is identified as restricted access to workers and the general public. Power density is greater than f/400 watt/m^2 in this area.

Occupational zone: Restricted access to general public with suitable signage. Workers are permitted to enter the occupational zone. Power density is less than f/400 watt/m^2 but more than f/2000 watt/m^2. This zone is identified as f/400>Powerdensity>f/2000.

Compliance zone: EMF value below the applicable limits and treated as safer for general public. Powerdensity is below the f/2000 limit as per the DoT, Govt. of India norms.

5 Results and Discussions

5.1 EMF measurement findings in Telangana State

Normally, EMF testing for 10% of working sites has been carried by DOT field units every year. During the Study, around 5316 BTSs have been tested at 1113 Tower locations in Telangana State of all Telecom Service Providers and results are summarized below:

Table No 2: Details of BTSs audited

Details of BTS audited							
S. No	TSP	Total No. of BTSs tested	Technology			No. of BTSs compliant to EMF norms	Non-compliant
			2G	3G	4G		
1.	Airtel	1470	465	310	695	1470	0
2.	BSNL	522	272	231	19	522	0
3.	RJIL	2082	NA	NA	2082	2082	0
4.	VIL	1242	376	333	533	1239	3
TOTAL		**5316**	**1113**	**874**	**3329**	**5313**	**3**

Table No 3: Sample Data - Compliant sites

S. No	Site ID	Longitude	Latitude	TSP	Power density (W/m2)	Limit (W/m2)	Electric Field (V/m)
1	HYD659	78.44106E	17.40608N	AIRTEL-2G	0.1071	0.4701	6.355

2	UHYD659	78.44106E	17.40608N	AIRTEL-3G	0.1071	0.4701	6.355
3	LHYD659	78.44106E	17.40608N	AIRTEL-FDD	0.1071	0.4701	6.355
4	I-AP-HDBD-ENB-A147	78.34331E	17.46645N	RJIL-FDD	0.05999	0.4415	4.755
5	I-AP-HDBD-ENB-A147	78.34331E	17.46645N	RJIL-TDD	0.05999	0.4415	4.755
6	I-AP-HDBD-ENB-A147	78.34331E	17.46645N	RJIL-FDD (850)	0.05999	0.4415	4.755
7	HD2561	78.34331E	17.46645N	BSNL-2G	0.05999	0.4415	4.755
8	HD2561	78.34331E	17.46645N	BSNL-3G	0.05999	0.4415	4.755
9	HYD07006	78.34331E	17.46645N	VIL-3G	0.05999	0.4415	4.755
10	HYD07006	78.34331E	17.46645N	VIL-FDD (1800)	0.05999	0.4415	4.755
11	HYD07006	78.34331E	17.46645N	VIL-TDD (2600)	0.05999	0.4415	4.755

Table No. 4 Sample Data: Non-Compliant sites

S.No	Site ID	Longitude	Latitude	TSP	Power density (W/m^2)	Limit (W/m^2)	Electric field (V/m)
1	HYD04102	78.51995	17.42455	VIL-2G	1.048	0.4694	28.13
2	HYD04102	78.51995	17.42455	VIL-3G	1.048	0.4694	28.13
3	HYD04102	78.51995	17.42455	VIL-FDD	1.048	0.4694	28.13
4	HYD04102	78.51995	17.42455	VIL-TDD	1.048	0.4694	28.13
5	HY3844	78.51995	17.42455	AIRTEL-2G	1.048	0.4694	28.13
6	LHY3844	78.51995	17.42455	AIRTEL-FDD	1.048	0.4694	28.13

5.2 Theoretical Calculation of EMF levels and Measurements at three selected sites

Generally mobile towers are of two types:

GBT(Ground Based Towers which are erected directly on the earth surface)

RTT/RTP (Roof Top Towers/Roof Top Poles which are erected on an existing building)

BTS: Base Transceiver station or Base Station. It is the node which radiates EMF signals and receives the signal from mobiles.

Sector/Cell: Physical coverage area of an antenna. Normally a tower will have 3 sectors each covering 120 degrees of azimuth, but not all the towers and it depends on the coverage requirement.

EIRP: Effective Isotropic Radiated Power is the total amount of power radiated by sector (isotropic) antenna after deducting the loss of connecting waveguide.

EIRP= Total transmitted (output) power of BTS – Combiner Loss- Cable Loss+ Antenna gain

For Roof Top Pole Antenna (RTP) when Power Density is measured from the roof level, Power Density measured/observed will be from the side lobes of antenna. Hence, Side Lobe Attenuation factor is considered and EIRP calculation is modified accordingly as follows.

EIRP= Total transmitted (output) power of BTS –Side Lobe Attenuation-Loss of waveguide–Combiner Loss-Cable Loss + Antenna gain.

Total Power from number of radio frequency sources P= $P_1 + P_2 + P_3 + \ldots.. + P_n$ ... **Equation (1)**

Where n= Number of Radio frequency sources

According to Free Space Propagation loss

Power Density at a Distance (R) from the tower

(S) $= \frac{P}{4\pi R2}$ .... **Equation (2)**

Where S= Power Density ($Watts/m^2$), P= Total EMF Power (Watts), R= Distance from the radio source (meter)

The EMF levels are measured and calculations as described above are done for few towers are given below. These graphs of Measured versus Practical values are plotted using **OriginPro** software toolwhich is a proprietary computer program for interactive scientific graphing and data analysis by OriginLab Corporation.

Site ID: AP/06/5192/0020

Data of Site 1: The Site details are as follows

Site Address: 6-1-71, Beside HDFC Bank, Lakdi-kapul, Hyderabad (Lat, Long)=(17.40438, 78.46518)

RF Details of site are as follows:

S.No	System Type	Sector	Antenna Height (mts)	Azimuth (deg)	Base Chanel Frequency (MHz)	Carriers/Sector	Antenna Gain (dBi)	Total Tilt (deg)	Vertical Beamwidth (deg)	Side Lobe Attenuation (Db)	Transmission Power (dBm)	Combiner Loss (db)	RF Cable Length (mts)	Unit Loss (dB/100 m)
1	FDD LTE-1800	1	22	10	1841.5	1	16.8	2	7.3	18	43	2.5	5	5.41
2	FDD LTE-1800	2	22	180	1841.5	1	16.8	2	7.3	18	43	2.5	5	5.41
3	FDD LTE-1800	3	22	270	1841.5	1	16.8	2	7.3	18	43	2.5	5	5.41
4	GSM	1	22	30	940.8	2	17.1	2	7.5	15	43	2.5	26	5.41
5	TDD LTE	1	22	10	2640	1	18	2	7	15	40	2.5	5	18.2
6	TDD LTE	2	22	150	2640	1	18	2	7	15	40	2.5	5	18.2
7	TDD LTE	3	22	310	2640	1	18	2	7	15	40	2.5	5	18.2

EIRP Calculation:

EIRP for GSM system=(43-15-2.5)-(26*0.0541) + 17.1=41.2 dBm=13.18 Watts

Total EIRP= 13.18+[13.163*0.81*(2-1)] = 23.823 Watts/sector .....Radio frequency source (A)

EIRP for LTE system:

EIRP for FDD LTE-1800 system= (43-18-2.5)-(5*0.0541)+16.8 = 39.0295 dBm= 7.99 Watts

Total EIRP = 7.99 Watts/sector .....Radio frequency source (B)

EIRP for TDD LTE system = (40-15-2.5)-(5*0.182)+18

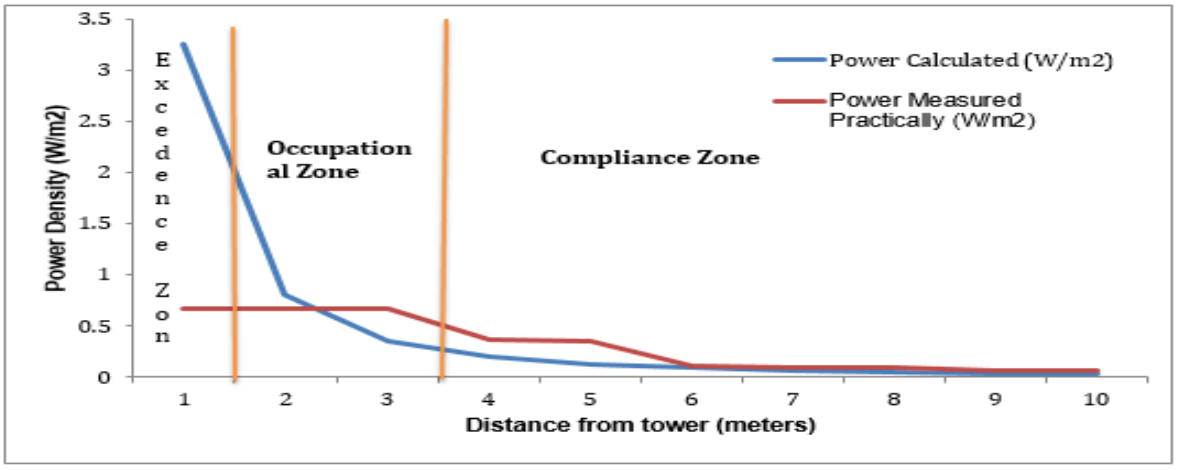
= 39.59 dBm= 9.1 Watts/sector .....Radio frequency source (C)

Total radiated power (P)= $P_A+P_B+P_C$ =23.823+7.99+9.1 Watts/m^2== 40.913 Watts/m^2

Distance (R) (meters)	1	2	3	4	5	6	7	8	9	10
Power Calculated (W/m^2)	3.257	0.814	0.361	0.203	0.13	0.09	0.066	0.05	0.04	0.032
Power Measured Practically(W/m^2)	NA	NA	0.67	0.37	0.35	0.11	0.09	0.1	0.07	0.06

As per the DoT-Govt. of India norms the safe horizontal/Compliance distance from the tower is at f (in MHZ)/2000 = 850/2000= 0.425 W/m^2 power levels.

From the above calculations and practical measurements, safe horizontal/Compliance distance is observed to be 3 mts for this site.



Data for Site 2: The Site details are as follows

Site Address: 6-1-506,Srinivas Colony,Kairatabad, Hyderabad-04, Lat-17.41244 & Long-78.46335

Site ID: AP/06/5177/0821

This site is of RTP type with 6 meters pole erected on the roof top of a 18 meters height building. The site is working with GSM and UMTS technologies.

RF Details of site are as follows:

S.No	Operator Name	System Type	Sector	Antenna Height (mts)	Azimuth (deg)	Base Chanel Frequency (MHz)	Carriers/Sector	Antenna Gain (dBi)	Vertical Beamwidth (deg)	Side Lobe Attenuation (Db)	Transmission Power (dBm)	Combiner Loss (db)	RF Cable Length (mts)	Unit Loss (dB/100m)
1	Airtel	FDD LTE-1800	1	21	160	1829	1	16.8	7.2	18	49	0.5	5	4
2	Airtel	FDD LTE-1800	2	21	200	1829	1	16.8	7.2	18	49	0.5	5	4
3	Airtel	FDD LTE-1800	3	21	300	1829	1	16.8	7.2	18	49	0.5	5	4
4	Airtel	FDD LTE-1800	4	21	160	944.6	1	18	7	15	49	1	5	4
5	Airtel	FDD LTE-1800	5	19	200	944.6	1	18	7	15	49	1	5	4
6	Airtel	FDD LTE-1800	6	19	300	944.6	1	18	7	15	49	1	5	4
7	Airtel	FDD LTE-1800	7	19	160	1829	1	18.3	7.2	18	49	1.3	5	4
8	Airtel	GSM	1	21	160	1815.8	2	16.5	7	15	49	5	13	4
9	Airtel	GSM	2	21	200	1816.4	3	16.5	7	15	49	5	13	4
10	Airtel	GSM	3	21	300	1816	3	16.5	7	15	49	5	13	4
11	Airtel	GSM	4	21	160	1816.2	3	18.3	7.2	18	49	5	13	4
12	Airtel	TDD LTE	1	21	160	2360	2	18.6	5.1	18	49	1.6	5	4
13	Airtel	TDD LTE	2	21	200	2360	2	18.6	5.1	18	49	1.6	5	4
14	Airtel	TDD LTE	3	21	300	2360	2	18.6	5.1	18	49	1.6	5	4
15	VI	FDD LTE-1800	1	19	30	1841.5	1	16.8	7.3	18	46	0.5	5	19
16	VI	FDD LTE-1800	2	19	190	1841.5	1	16.8	7.3	18	46	0.5	5	19
17	VI	FDD LTE-1800	3	19	300	1841.5	1	16.8	7.3	18	46	0.5	5	19
18	VI	FDD LTE-1800	4	19	30	2161.4	1	16.8	7.3	18	46	0.5	5	19
19	VI	FDD LTE-1800	5	19	190	2161.4	1	16.8	7.3	18	46	0.5	5	19
20	VI	FDD LTE-1800	6	19	300	2161.4	1	16.8	7.3	18	46	0.5	5	19
21	VI	GSM	1	19	20	938.2	2	17.6	7.2	17	43	2.5	5	5.41
22	VI	GSM	2	19	20	939	2	17.6	7.2	17	43	2.5	5	5.41
23	VI	GSM	3	19	20	939.8	2	17.6	7.2	17	43	2.5	5	5.41
24	VI	TDD LTE	1	22	30	2645	1	17.5	6.4	16	43	2.5	5	0
25	VI	TDD LTE	2	22	190	2645	1	17.5	6.4	16	43	2.5	5	0
26	VI	TDD LTE	3	22	300	2645	1	17.5	6.4	16	43	2.5	5	0

EIRP Calculation:

EIRP for Airtel FDD LTE-1800 system:

EIRP for BCCH (Broadcast Control Channel) Channel

= 49-18-0.51-(5*0.04)+16.8=47.1dBm=51.168Watts/sector ..... Radio frequency source-A

EIRP for Airtel GSM system:

EIRP for BCCH (Broadcast Control Channel) Channel

= 49-15-5-(13*0.04)+16.5=44.98 dBm=31.477Watts/sector

Total EIRP = 31.477+[31.477 *0.81*(2-1)] =56.947 Watts/sector …… .Radio frequency source-B

EIRP for Airtel TDD LTE system:

EIRP for BCCH (Broadcast Control Channel) Channel

= 49-18-1.6-(5*0.04)+18.6=47.8 dBm=60.256 Watts/sector

Total EIRP=60.256+[60.256*0.81*(2-1)] =109.06 Watts/secto ……. Radio frequency source-C

EIRP for VI FDD LTE-1800 system:

EIRP for BCCH (Broadcast Control Channel) Channel

` = 46-18-0.5-(5*0.19)+16.8=43.35 dBm=21.63Watts/sector ..... Radio frequency source-D

EIRP for VI GSM system:

EIRP for BCCH (Broadcast Control Channel) Channel

= 43-17-2.5-(5*0.054)+17.6=40.83 dBm=12.11 Watts/sector

Total EIRP= 21.11+[12.11*0.81*(2-1)]= 21.92 Watts/sector ……. Radio frequency source-E

EIRP for VI TDD LTE system:

EIRP for BCCH (Broadcast Control Channel) Channel

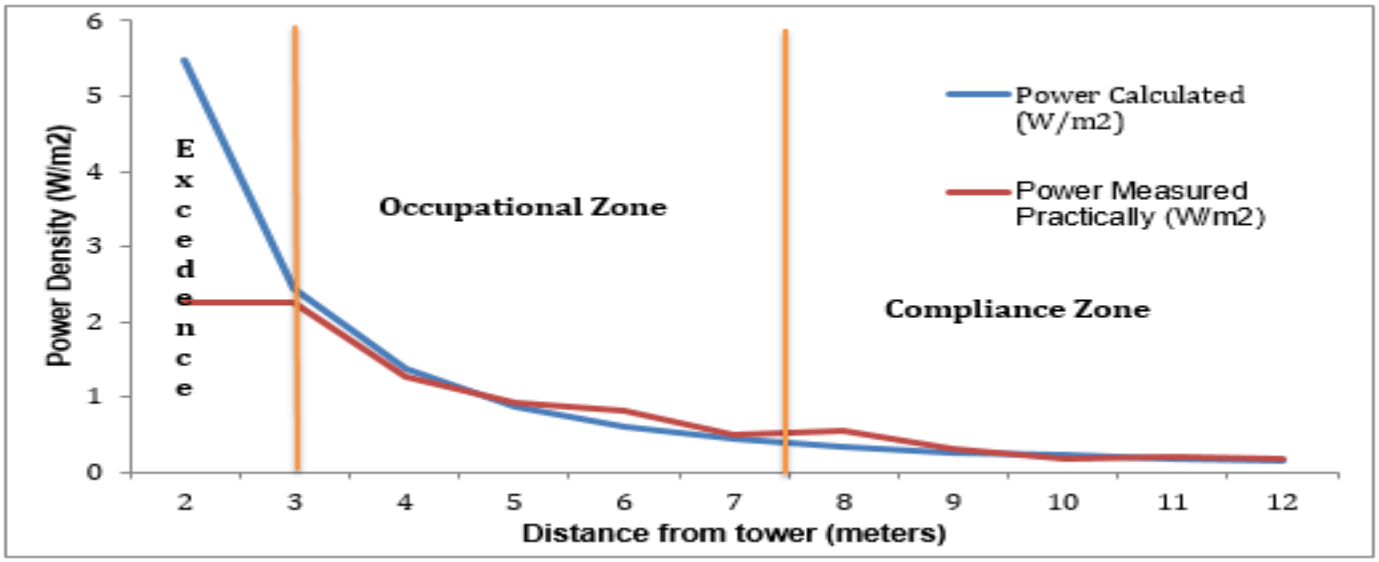
= 43-16-2.5-(5*0.05)+17.5= 41.75 dBm= 14.96 Watts/sector … .. Radio frequency source-F

Total radiated power = A+B+C+D+E+F= 275.69 Watts/m^2

Distance (R) (meters)	1	2	3	4	5	6	7	8	9	10	11	12
Power Calculated (W/m^2)	21.95	5.49	2.44	1.37	0.88	0.61	0.45	0.34	0.27	0.22	0.18	0.15
Power Measured Practically (W/m^2)	NA	NA	2.25	1.27	0.92	0.82	0.5	0.54	0.3	0.19	0.2	0.17

As per the DoT- Govt. of India norms the safe/Compliance distance from the tower is at f (in MHZ)/2000 = 939/2000= 0.46 W/m^2 power levels.

From the above calculations and practical measurements, safe/Compliance distance is observed to be 7 meters for this site.



Data for Site 3: The Site details are as follows

Site ID: AP/06/5126/0223

Site Address: New CBI quarter, Indranagar, Kairatabad, plot no 6-1-456/15c, Hyd -04 Lat - 17.412425 & Long - 78.4639625.

This site is of RTP type with 9 meters pole erected on the rooftop of a 10 meters height building. The site is working with GSM and UMTS technologies.

RF Details of site are as follows:

S. No	System Type	Sector	Antenna Height (mts)	Azimuth (deg)	Base Chanel Frequency (MHz)	Carriers/Sector	Antenna Gain (dBi)	Total Tilt (deg)	Vertical Beam width (deg)	Side Lobe Attenuation (Db)	Transmission Power (dBm)	Combiner Loss (db)	RF Cable Length (mts)	Unit Loss (dB/100 m)
1	GSM	1	19	0	955.4	4	17	2	9	18	43.02	4.7	15	4
2	GSM	2	19	45	955	4	17	2	9	18	42.83	4.7	15	4
3	GSM	3	19	160	954.8	4	17	2	9	18	42.83	4.7	15	4
4	UMTS-2100	1	19	0	2156.4	1	18	2	5.5	15.5	46	1	15	4
5	UMTS-2100	2	19	45	2156.4	1	18	2	5.5	15.5	46	1	15	4
6	UMTS-2100	3	19	160	2156.4	1	18	2	5.5	15.5	46	1	15	4

EIRP for GSM system:

EIRP for BCCH (Broadcast Control Channel) Channel

= 43-18-4.7-(15*0.04)+17= 36.7 dBm= 4.67 Watts/sector

No. of carriers per sector (N) =4

For other carriers= EIRP of BCCH*(0.9*0.9)*(N-1)= 4.67 *0.81*(4-1)= 11.34 Watts

Total EIRP = 4.67+11.34 = 16.01 Watts/sector .....Radio frequency source -A

EIRP for UMTS system:

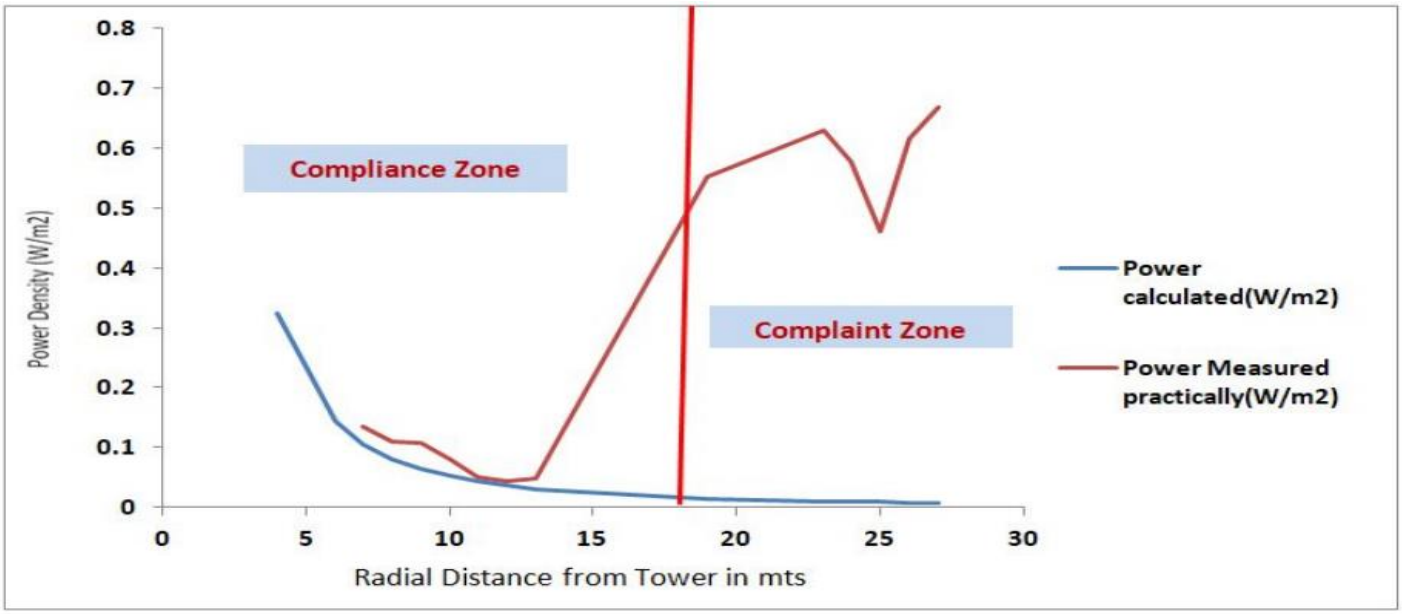
EIRP for BCCH (Broadcast Control Channel)= 46-15.5-1-(15*0.04)+18= 46.9 dBm= 48.97 Watts

No. of carriers per sector (N) =1

Total EIRP = 48.978 Watts/sector .....Radio frequency source -B

Total radiated power (P)=A+B= 16.01+48.978 = 64.98 Watts/m2

Distance (R) (meters)	2	4	6	7	8	9	10	11	12	13	19	23	24	25	26	27
Power Calculated (W/m^2)	1.293	0.323	0.143	0.105	0.080	0.063	0.051	0.042	0.035	0.030	0.014	0.009	0.008	0.008	0.007	0.007
Power Measured Practically (W/m^2)	NA			0.134	0.109	0.106	0.079	0.049	0.043	0.047	0.552	0.469	0.576	0.461	0.617	0.669



As per the DoT- Govt. of India norms the safe/Compliance distance from the tower is at f (in MHZ)/2000 = 955/2000= 0.47 W/m^2 power levels. From the above calculations and practical measurements, safe/Compliance distance has to be 18 meters for this site. Where as this is a non-compliant site as the power density is more after safe zone.

Conclusions

1.The radiation levels across the Telangana state were measured as per the DoT, Govt. of India norms. Results of this study indicate that EMF radiations in the Telangana State are within the official standard of DoT, Govt. of India recommendations except for 3 BTSs out of 5316 BTSs measured. This implies that the radiation levels in general are under permissible limits.

2. Power density levels were measured at three identified tower locations and different radiation zones were identified for first two sites. It was observed that Compliance distance varies from tower to tower depending upon the configurations like transmitted power, antenna gain, antenna height, frequency etc. The compliance/safe distance found to be 3mts for site1, 7mts for site2.

3. On the contrary, the radiation pattern from site 3 is in variance with other two in that the safe zone is not as per the laid down norms. This is non-complaint to EMF radiation norms issued by DoT, because power density is more than f/2000 W/m2 limit. So a suitable protection mechanism is suggested for those living in such locations.

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