THE INTERNATIONAL JOURNAL OF SCIENCE & TECHNOLEDGE

Comparison Study for Theoretical EMF Radiation and Practical Realization of Cell Phone Towers

Sayak Banerjee
UG Student, Department of Physics, IGNOU, India
Ratan Kumar Das
Assistant Professor, Department of Physics, Charuchandra College, India

Abstract:
The use of microwave radiation is very wide in today's world. It is used widely in various appliances including cell phones. Microwave frequency is used by mobile towers as well as handsets for the medium of communication. The deviation of this microwave radiation from theoretical view point and practical way of life in long range (i.e. mostly cell phone tower radiation in public) is our subject of study in this article.

1. Introduction

Cell phones have become an integral part of our life. In India alone cell phone usage has risen exponentially over the years with various network providers satisfying their customers with various types of mobile technologies like GSM, UTMS, LTE. The cell phone towers are like relays where data is transmitted from previous tower to the next by microwave link. Microwave link is usually a microwave frequency of 300 MHz-300 GHz. But bandwidth used by the towers are 900 Mhz-2700Mhz. ICNIRP (International Commission on Non-Ionizing Radiation Protection) has laid down the levels of exposure for cell phone base stations which is around one-ten-thousandth of the guideline levels. Moreover, WHO (World Health Organization) through IARC (International Agency for Research on Cancer) has classified cell phone radiations under Group 2B which implies that it may be carcinogenic towards human. This has put a stricter binding on the telecom service providers and they are left pondering over the Qos (Quality of Service. As per the ICNIRP, the value of power density at general public exposure zone should be less then f/200 watt/m^2 for 400-2000 MHz band. Here f is the frequency used by the mobile operator in Mhz.

Many researchers [1,2,3,5,6,7] show doubt over the existing safe levels of radiations as on a single location there can be multiple towers whose accumulated radiation energy may cause shifting of a compliance zone towards the excedence zone where the power density is quite high than the levels of recommendation. In this article we show a deviation of the power density for an ideal single tower and the actual scenario where more than one towers are erected whose combined power density is observed [1,5,6].

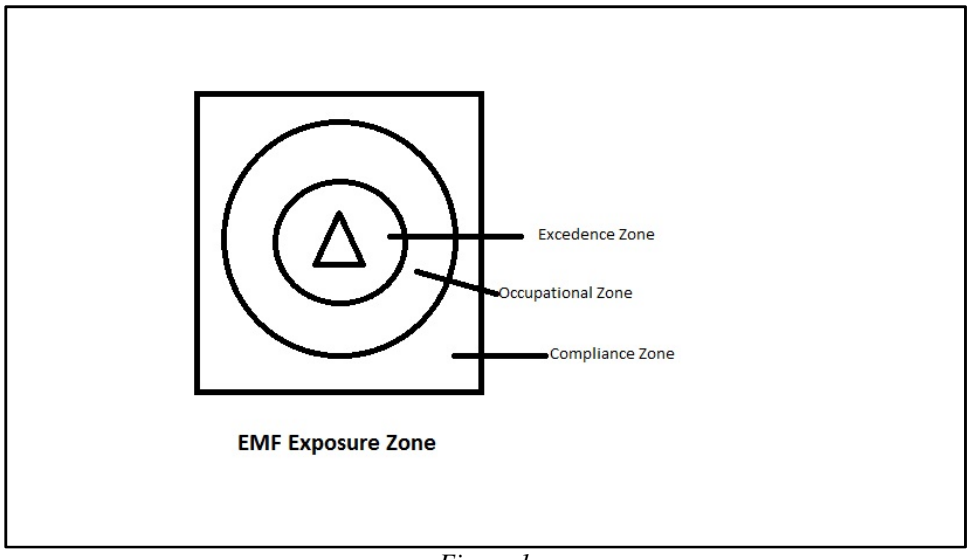

Figure 1

A. Excedence zone: This zone has restricted access to workers and the general public.
B. Occupational Zone: This zone is also restricted access one for general public. Physical barriers as well as various caution signs warn general public from accessing the zone. Workers only are permitted to the zone.
C. Compliance Zone: This zone has emf values within the safer limits and is accessible for general public.

1.1. Various Parameters and Comparison Study

POWER DENSITY AND RADIATION LEVEL: The power density at any distance from an isotropic antenna is simply the transmitter power divided by the surface area of a sphere at that distance. The surface area of the sphere increases by the square of the radius, therefore the power density, PD, (watts/square meter) decreases by the square of the radius.

The mathematical representation of the said definition is given by [1,5,6]-

$$S = \frac{PG}{4\pi R^2}$$

Where: S= Power density (Watt/m^2)
P= Power input to the antennae (W)
G= Power gain of the antennae
R= Distance to the centre of radiation of the antennae (m)

The compliance distance is actually a formula laid down by ICNIRP. We provide a table of the same here.

Radio Frequency Range	General Public Exposure	General Public Exposure
1-10 Mhz	r=0.10$\sqrt{eirp} \times f$	r=0.129$\sqrt{erp} \times f$
10-400Mhz	r=0.319$\sqrt{eirp}$	r=0.409$\sqrt{erp}$
400-2000 Mhz	r=6.38$\sqrt{eirp}/f$	r=8.16$\sqrt{erp}/f$
200-300000 Mhz	r=0.143$\sqrt{eirp}/f$	r=0.184$\sqrt{erp}$

Table 1

Where:
r= compliance distance in metres
f=frequency in Mhz
EIRP= equivalent isotropically radiated power in the direction of maximum antennae gain in watts
ERP=effective power in the direction of maximum antennae gain in watts

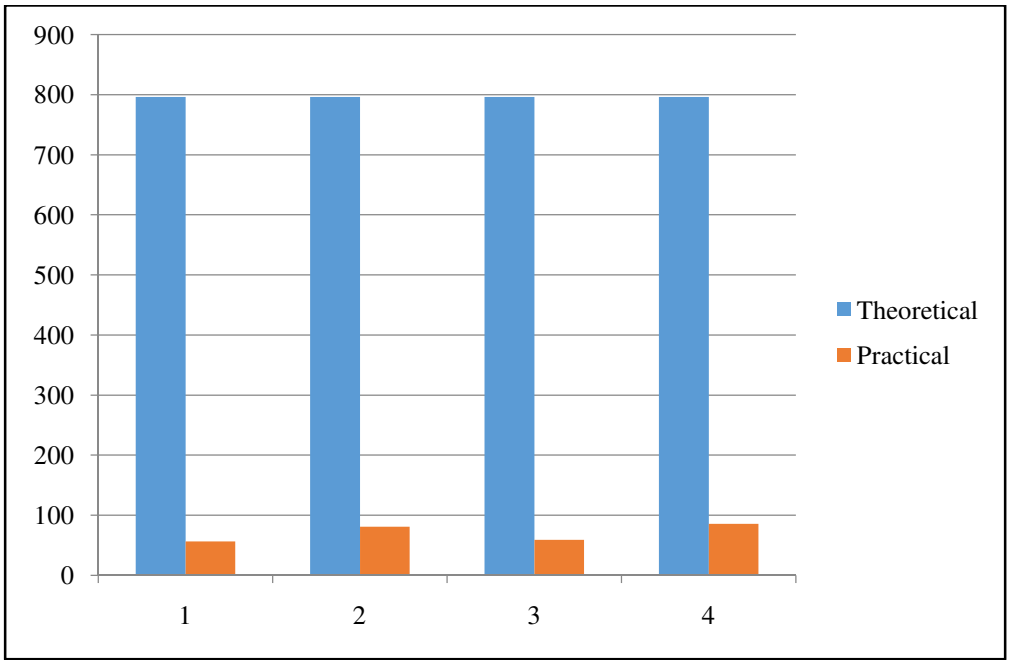

Figure 2

2. Conclusion

From the above discussions and study it can be seen that the practical and theoretical both the power density curves are quite similar to each other. Both shows an exponentially decay in power density with increase in distance. The nature of curve for both purpose is almost same. The values here show a slight deflection in the practical case as it is the conglomeration of many towers. But still it can be seen that it is well within the parameters of the compliance guidelines. Thus if the towers are situated at far reaches of human being and at greater height it is possible to tame the effect of radiation exposure on general public. And the present scenario shows that more or less we are residing in the compliance zone of the tower.

3. Acknowledgment

Authors would like to acknowledge *Mr. Shubham Roy*, Dept. of Physics, Asutosh College, Kolkata for his technical and theoretical guidance.

4. References

i. Comparison between the Level of Harm by Radiation Emitted from Cellphone Towers and Cellphones – Environment of Life, pp. 17, 3rd year, 7th issue(2015) by S. Roy et al.
ii. Monitoring and control system for tuneable high frequency microwave assisted chemistry -Journal of Physics: Conference Series76(2007) 012058 by G P Lewis et al.
iii. Biological Effects of Microwaves: thermal and Nonthermal Mechanisms* A Report by an Independent Investigator -by John Michael Williams-2009-08-13
iv. Telecommunications statistics in India-From Wikipedia, the free encyclopedia
v. "Mobile phone ebong manob shorire micro taronger protikriya"- "Jiboner poribesh" issue:1 ,17th august2014 by Pradip Kr. Datta (pg-7-12).
vi. Report on cell tower radiation by Prof. Girish Kumar- December 2010
vii. Estimation of Peak Power Density in the Vicinity of Cellular Base Stations, FM,UHF,WiMAX Antennas – IJET-IJENS; vol:11; no:2 by Bexhet Kamo et al.
viii. Health Physics 74 (4) 495 – 505 and in Radiation Research 162 (2) 219 – 225 by Foster et al.
ix. Analysis of cell tower radiations & practical realizations of compliance distance- IJSRP, vol:3; issue:5 by Richa Chitranshi et al.
x. Googleimages.
xi. Wikipedia- http://en.m.wikipedia.org/wiki/Blood%E2%80%93brain_barrier.