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Variation in the Electromagnetic Radiation Exposure Level from Cellular Mobile Base Station Antennas to its Vicinity- A Study

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***Abstract*—** Men made atmospheric exposure of Electromagnetic radiations (EMR) are now increasing almost exponentially in the last few decades. With rapid development in the field of communication, the mobile base station antenna and its associated health hazards are now led to growth of public concern for human exposure to Electromagnetic field (EMF) and its various health effects. The Electromagnetic Pollution (EMP) levels are now reaching alarming proportion for the whole biological system. The present study were aim to investigate the variation in the electromagnetic radiation exposure level from mobile base station antenna to its vicinity in terms of power density and electric field. Measurement was carried out with the help of three axis electromagnetic field strength meter. Three different cases were considered. The EM radiation exposure level from mobile Base Transceiver Station (BTS) was measured at a distance of 10m, 15m and 20m for the first, second and third cases respectively at different co-ordinate positions. Results are tabulated in terms of Power Density (PD) and Electric field. It has been observed that the electromagnetic radiation exposure level from mobile BTS varies with distance from BTS tower at different co-ordinate position. However the measured values of Power Density and electric field were well below the maximum permissible exposure level set by the International Commission on Non-ionizing Radiation Protection (ICNIRP) authority. The outcome of our study reveals that the EM radiation exposure level from BTS varies with distance and reached to its optimum value at a particular region (most sensitive zone) thereafter again the radiation level decrease gradually with distance from BTS at different co-ordinate positions.

***Keywords*—** Base Transceiver Station, Electromagnetic radiation, Power density, Electric field, Health Consequences.

I. INTRODUCTION

Cellular concept is deployed in modern telecommunication system. In last two decades the uses and applications of cell phones are drastically increased. To give radio coverage, large numbers of base transmitter stations (BTS) were erected in densely populated area. Due to continuous electromagnetic radiation from BTS, different types of health and atmospheric hazards are also increase gradually [1-4]. Access of area near BTS antennas is often restricted where radio frequency signal may exceed international exposure limits [5]. But most of the people are not aware of the effects of atmospheric exposure of electromagnetic radiation on our health. This present study was carried out to investigate the variation in the electromagnetic radiation exposure level from cellular mobile base station antennas to its vicinity in terms of power density and electric field.

II. METHODOLOGY

Power density and Electric field strength E are two basic physical parameters for observing the levels of atmospheric exposure to RF Energy. Electric field strength is described by the force exerted on a charged particle regardless of its motion in space. It is expressed in Volt per meter (V/m). In the far-field, the E-field and the H-field are mathematically interdependent. This implies that either E-field component or the H-field component has to be measured. In this study, EMR exposure level at vicinity of BTS has been observed in terms of power density ($\mu w/cm^2$) and electric field (v/m) with the help of three axis electromagnetic field strength

meter model KM-195. This meter covers the range of frequency band from 300 MHz to 3 GHz utilised for cellular mobile communication. This experiment has been carried out at Ramsagar, Bankura, in the state of West Bengal.

Figure-1: Cellular Base Transceiver Station (BTS)

The detail specifications of the Cellular Base Transceiver Station (BTS) used for the present study are given in Table 1.

Table 1: Specification of Cellular Base Transceiver Station

Sl. No.	Parameters	Types
1	Latitude / Longitude	23° 5' 57.48" N/ 87° 16' 23.52" E
2	Site ID	ROB/BTS/03755.
3	Type	Ground Level Antenna
4	Antenna Height	43 m
5	Equipment serial number	ABYUDOG / WBRAM-01
6	Model of Antenna	JUVAS B32 10000A
7	MCC / MNC / TAC	405 / 51 / 53
8	eNodeB ID / CID / PCI	63551 / 2 / 34

We have considered three different cases which are as follows:

Case 1: EMF exposure level was measured at a distance of 10 meter from the BTS in different coordinate's position.

***Case 2*:** EMF exposure level was measured at a distance of 15 meter from the BTS in different coordinate's position.

Case 3: The measurement of EMF exposure level was carried out at a distance of 20 meter from the BTS in different coordinates.

All the measurements were carried out under same atmospheric and physical conditions on the same day.

III. RESULTS AND DISCUSSION

The variation in the EM exposure level from BTS with distance at various co-ordinates position has been presented in this section. Table 2, 3 and 4 shows the measured values of EM exposure level in terms of power density (PD) and electric field for case1, case2 and case3 respectively. Figure 2, 3 and 4 illustrate the graphical representation for case 1, case 2 and case 3 respectively while figure5 shows the graphical representation of variation in electric field with distance from BTS. It has been observed that the Electromagnetic radiation exposure level reached at its optimum value at a distance of 15m from BTS (case 2) for this particular Base Transceiver station (BTS).

Table 2: EM exposure in terms of Power density and Electric field at a distance of 10 meter from BTS (case 1)

Distance from BTS (Meter)	Coordinates (Latitude, Longitude)	Power Density (μW/m²)	Electric Field (mV/m)
10	23°6'10.3968"N, 87°15'54.486"E	1436.6	948
10	23°6'10.35"N, 87°15'54.3456"E	1406.9	969
10	23°6'10.5192"N, 87°15'53.9568"E	1190.3	801.1
10	23°6'10.6596"N, 87°15'53.7336"E	1403.5	950.6
10	23°6'10.7856"N, 87°15'54.0468"E	1467.8	958.1
10	23°6'9.9648"N, 87°15'54.198"E	1581	941
10	23°6'9.9036"N, 87°15'54.5148"E	1797.6	890
10	23°6'9.8388"N, 87°15'54.6336"E	1766	758.4
10	23°6'10.35"N, 87°15'54.3492"E	1325.4	950.6

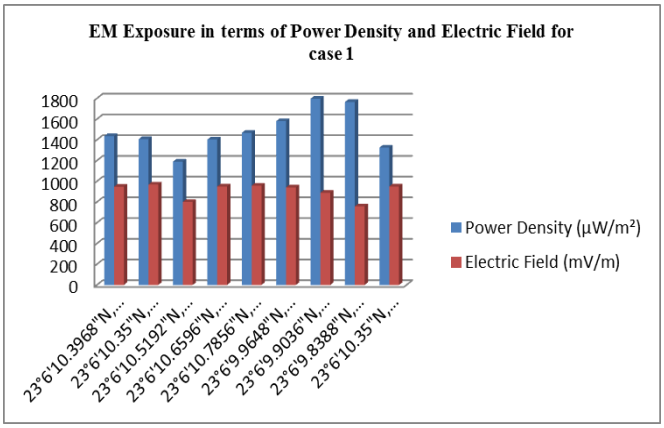

Figure-2: Graphical representation of EM exposure at a distance of 10 meter from BTS (case 1)

This region may be considered as most sensitive zone for the particular BTS associated with human exposure to EM radiation. It has also been observed that after this particular region the EM radiation level decrease gradually with distance from the BTS at different co-ordinates position.

Table 3: EM exposure in terms of Power density and Electric field at a distance of 15 meter from BTS (case 2)

Distance from BTS (Meter)	Coordinates (Latitude, Longitude)	Power Density (μW/m²)	Electric Field (mV/m)
15	23°6'9.9576"N, 87°15'54.6588"E	2831	1280.4
15	23°6'9.8856"N, 87°15'54.7416"E	2450	1237.3
15	23°6'10.6308"N, 87°15'54.666"E	2931	1365.6
15	23°6'11.358"N, 87°15'54.3204"E	2444	1227.2
15	23°6'10.7172"N, 87°15'53.64"E	2828	1327.6
15	23°6'10.98"N, 87°15'54.6732"E	2381	1223.5
15	23°6'41.8716"N, 87°15'14.0508"E	1600	1225

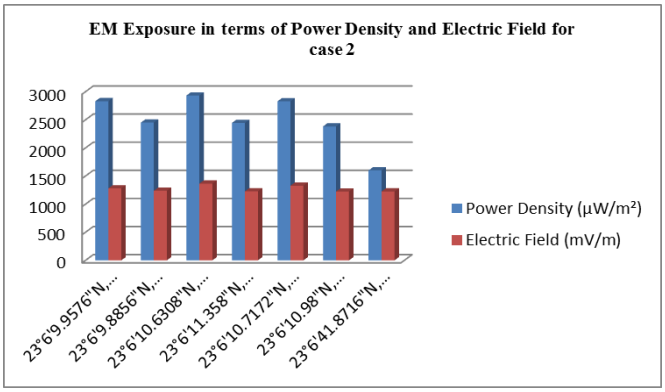

Figure-3: Graphical representation of EM exposure at a distance of 15 meter from BTS (case 2)

Table 4: EM exposure in terms of Power density and Electric field at a distance of 20 meter from BTS (case 3)

Distance from BTS (Meter)	Coordinates (Latitude, Longitude)	Power Density (μW/m²)	Electric Field (mV/m)
20	23°6'10.3536"N, 87°15'54.3888"E	2577	1168
20	23°6'3.9096"N, 87°16'4.422"E	2767	1195
20	23°6'9.9864"N, 87°15'54.8208"E	2639	1173.8
20	23°6'9.972"N, 87°15'54.8208"E	3591	1212.5
20	23°6'41.8716"N, 87°15'14.0508"E	3869	1198.5
20	23°6'10.3968"N, 87°15'54.6948"E	3068	1217.7
20	23°6'10.0656"N, 87°15'59.9976"E	2610	1235

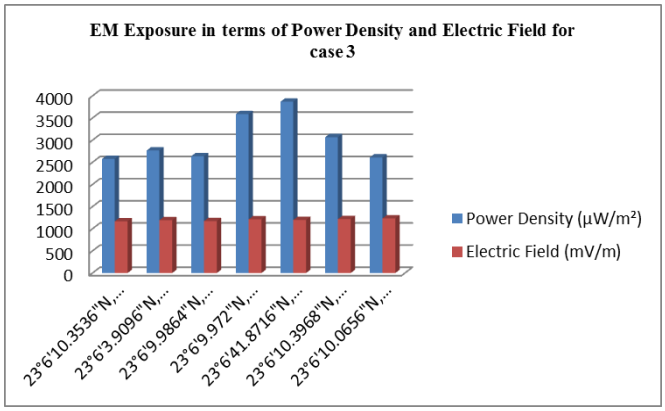

Figure-4: Graphical representation of EM exposure at a distance of 20 meter from BTS (case 3)

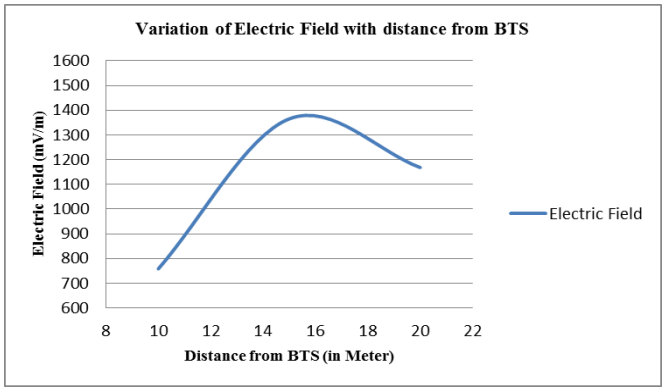

Figure-5: Graphical representation of variation of Electric Field with distance from BTS

IV. CONCLUSION

The variation in the Electromagnetic radiation exposure level from Cellular Base Transceiver Station (BTS) with distance has been investigated and presented in our present study. The finding of our study includes that the EM radiation exposure level varies with distance from BTS at different co-ordinate position and reached to its optimum value at a particular distance (region) from BTS, may be consider as most sensitive zone for public concern of human exposure to Electromagnetic field (EMF) and its associate health hazards, thereafter the EM radiation exposure level decreases gradually with distance from BTS as well. However it has also been observed that, human exposure over the investigated region situated in the close vicinity of Cellular Base Transceiver Station complies with DOT guidelines and standard exposure limits and guidelines set by ICNIRP/IEEE for RF exposure.

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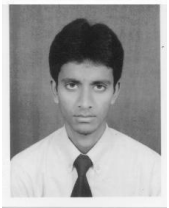

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