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ELECTROMAGNETIC RADIATION EXPOSURE OF A BASE STATION ANTENNA UNDER VARIOUS ATMOSPHERIC CONDITION OF SUPER CYCLONE STORM YAAS

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Abstract

The outcome of electromagnetic Radiated Emissions has risky result on human health. However, telecom service providers are bothered about quality of service of mobile services after fulfilment of firm rules about cell tower radiations. In this paper we have studied the electromagnetic radiation exposure under the super cyclone storm yaas and also we have observed electric field strength, magnetic field strength, power density and also some atmospheric parameters. Analyses has been captured by using Electromagnetic field strength Meter- KM 195. Electromagnetic radiation is produced primarily by GSM (Global System for Mobile Communication) technology of wireless communication built on the electromagnetic emitters (GSM antennas) necessary for encompassing wider territorial areas. Base Transceiver Stations (BTS) generate non-ionizing Radio Frequency (RF) energy that is radiated across its antennas into space.

Keywords:

Electromagnetic Radiation, RF-EMF, Exposure Assessment, Mobile Phone Handset

1. INTRODUCTION

Very Dangerous Cyclonic Storm Yaas was a pretty strong and very destructive tropical cyclone that made landfall in Odisha and carried substantial influences to West Bengal during late May 2021. The second cyclonic storm, second severe cyclonic storm, and second very severe cyclonic storm of the 2021 North Indian Ocean cyclone season, Yaas arisen from a tropical distress that the Indian Meteorological Department first checked on May 23. The system further strengthened as it twisted to the northeast, becoming a dangerous cyclonic storm on May 24 in spite of moderate wind shear. Slightly favourable conditions further continued as Yaas accelerated north-eastward, strengthening to a Category 1-equivalent tropical cyclone and to a very severe cyclonic storm on May 25. In arrangements for the storm, many electrical companies in West Bengal and Odisha equipped supplementary generators and transformers for possible electrical problems. Evacuations were also methodical, beginning on May 24 on sea-level areas in East Midnapore and West Midnapore and Jhargram. Hooghly, Kolkata and North 24 Parganas and South 24 Parganas were positioned on high alert [1]. 20 people across India and Bangladesh died due to Yaas [2]. The total reimbursements in West Bengal, the most heavily impacted Indian state from Yaas, were projected to be around ₹20 thousand crores (US$2.76 billion) [3].

The EMF emitted from mobile base station is moreover insignificant to crash the bonds between molecules in human cells and, hence, cannot create ionization not like the ionizing radiation (such as cosmic rays and X-rays). So, EMF of mobile base station is called ‘non-ionizing radiations’ (NIR). As a result of the persistently increasing need for mobile communications and the continuously increasing necessity for ability, mobile operators have to position a huge quantity of base stations. The power density depends on three factors: the transmitted power of base station, the distance of the people between the base station, and the obstacles of the surrounded. Cell phone technology has fully-fledged exponentially in the last decade. Some researchers theoretically confirmed that existence of big number of antennas on single tower with several carriers from each antenna may reason changing of safe zone greatly away from the tower and overall community exposure area approaches in risk zone where power density is desperately greater than the recommended value. An investigation has been also ended to assess radiation level at several spans for various sets of BTS /mobile towers [4].

Currently metropolises are confronting big amount electromagnetic pollution due to GSM technology for wireless communication. In this regard, metropolises meet the utmost intense electromagnetic pollution in terms of non-ionizing radiation due to the attendance of transmitters for mobile communication in congested spaces. This type of sources registered continuously increasing in last years because of the large number of mobile services providers and antennas sites. Mobile phone technology has entirely altered the telecommunication industry in India. Owing to its great paybacks, mobile phone technology has grown exponentially in the last 10 years. The Global System of Mobile (GSM) communication has ascertained to be of incredible advantage to the civilization specially in a rising country like India, where other arrangements of communication happen to a very poor level. GSM technology of wireless communication supplies continuous pulsed microwave radiation [5]. Maximum nations have accepted the radiation standards as proposed by the International Commission on Nonionizing Radiation Protection (ICNIRP). As per the ICNIRP, the rate of power density at overall public exposure zone should be less then f/200 Watt/m2 for 400-2000 MHz band. Here f is the frequency used by the mobile operator in MHz [6]. The cellular base stations are transmitting nonstop even when nobody is with the phone. The amount of cell towers is tremendously growing without taking into attention its difficulties. A BTS is an element of a wireless communication setup that accommodates the radio that describes a cell and coordinates the radio link protocols with mobile devices such as GSM phones. Telecommunication masts or towers are big arrangements considered to support antennas or aerials liable for the transmission of telecommunication signal. These masts make use of electromagnetic radiation in transmission of this signal [7]. It has been stated that we are now virtually living within a microwave oven [8]. While the effects of the radiation that mobile phone towers produce are risky, there are increasingly towers being sanctioned by the municipal governments [8]. A typical BTS comprises of radios, amplifiers, combiners, duplexers, splitters, power supplies, an antenna system, and the software that runs the base station [9]. Scientifically, there were a number of reports that the electromagnetic radiation released by mobile telecommunications, has now become the foremost artificial cause of environmental radiation [8]-[11]. Mobile phone is not advanced scientifically significant, but it of the most imperative systems of twenty-first century is anticipated to improve its use of a tool for audio only to become a multipurpose tool with the capacity to send and receive audio, image, and receive information, which releases a new period of schemes of personal contact. Mobile phone base stations are also identified as base Transceiver stations or telecommunications assemblies. They are low-power, multi-channel two-way radios. Antennas, which create RF radiation, are attached on either transmission towers or roof mounted structures. These structures essential to be of an accurate height appropriate to have an extensive coverage. When mobile consumers interconnect on a mobile phone, they are associated to a nearby base station. From that base station their phone call goes into the regular fixed-line phone system. As the mobile phones and their base stations are two-way radios, they create RF radiation to communicate and therefore expose the people near them to RF radiation [12]-[16].

2. METHODOLOGY

The intensity of EM field and power density is measured in some parts in the vicinity of base station antenna situated at Burdwan city of West Bengal state in India under different time of two days during yaas by showing different atmospheric parameters. Taking into account the standard height of the Indian people the EM field exposure was measured at height 1.5 m by means of a three-axis electromagnetic field meter model KM-195 by KUSAM-MECO® brand. This meter can directly measure the electric field strength and then converts the measurement values to the equivalent magnetic field strength units and power density units by means of regular far-field formulate for electromagnetic radiation. The meter has an electrical field (E) sensor type. Electric field was measured in mV/m, magnetic field in mA/m and power density in μW/m^2. The Fig.1 shows the proposed base station antenna site of Burdwan city. While Table.1 shows the base station antenna parameters of this site.

Fig.1. Cellular Base Transceiver Station (BTS) in Burdwan, West Bengal

Table 1. Parameters of used Base Trans – Receiver Station (BTS) Burdwan

Parameters	Value
Latitude / Longitude	23° 15' 17.3628 N/ 87° 51' 29.3976 E
Type	Ground Level Antenna
Antenna Height	60 m
MCC / MNC / LAC	405 / 51 / 8108
CID	45161

3. RESULTS AND DISCUSSION

The Table.2 shows the Variation in EM radiation of base station antenna in Burdwan, India (Coordinates vs. Power Density, Electric Field and Magnetic Field at different time of the day of yaas during the rain time) along with different atmospheric parameters. From Table.2 it is seen that power density is high during afternoon time when temperature, humidity and wind speed and precipitation become high and pressure becomes low and power density reaches its maximum value of 41.42 mW/m^2 at a time of 2:30 pm. Power density is low during morning and evening time when temperature is low and humidity is high and also wind speed is low and pressure is high. Power density reaches its minimum value of 14.48 mW/ m^2 at a time of 3:30 pm.

The Table.2 shows the variation in EM radiation of base station antenna in Burdwan, India (Coordinates vs. Power Density, Electric Field and Magnetic Field at different time of the day of yaas after the rain time) along with different atmospheric parameters. From Table.3, it is seen that power density is high during mooring and afternoon time when temperature, humidity and wind speed become high and pressure becomes low and power density reaches its maximum value of 23.85 mW/m^2 at a time of 9 am. Power density is low during afternoon time when temperature is low and humidity is low and also wind speed is low and pressure is high. Power density reaches its minimum value of 3.829 mW/m^2 at a time of 11 am.

Now, Table.4 to Table.13 show the variation of electromagnetic radiation of base station antenna in Burdwan, India under the specific increase and decrease of separate atmospheric parameters. From Table.4, and also Table.5, it is seen that there are no significant changes of power density when temperature is high or low.

From Table.6, and also Table.7, it is seen that when humidity is high power density becomes high and when humidity is low power density becomes low. From Table.8, and also Table.9, it is seen that when wind speed is high at that time power density becomes high and when wind speed is low at that moment power density becomes low.

From Table.10, and also Table.11, it is seen that when precipitation is high then power density becomes high and when precipitation is low then power density becomes low. From Table.12, and also Table.13, it is seen that when pressure is high at that instance radiation becomes low and when pressure is low at that instance radiation becomes high.

Table.2. EMR During Rain

Time	Power Density (mW/m^2)	Electric Field (V/m)	Magnetic Field (mA/m)	Temperature (°C)	Humidity (%)	Wind Speed (km/h)	Precipitation (%)	Pressure (psi)
10:30 AM	25.99	3.941	10.455	24	94	26	43	14.649
11:30 AM	26.64	3.885	10.226	24	95	26	55	14.634
12:30 PM	37.17	4.407	11.69	23	95	19	58	14.634
1:30 PM	33.39	3.939	10.448	24	95	26	42	14.634
2:30 PM	41.42	4.665	12.373	24	94	24	61	14.591
3:30 PM	14.48	2.666	7.072	23	94	26	32	14.591
4:30 PM	23.37	3.574	9.479	23	94	26	48	14.605

Table.3. EMR After Rain

Time	Power Density (mW/m^2)	Electric Field (V/m)	Magnetic Field (mA/m)	Temperature (°C)	Humidity (%)	Wind Speed (km/h)	Precipitation (%)	Pressure (psi)
9:00 AM	23.85	3.176	8.424	24	89	23	0	14.649
10:00 AM	7.933	2.114	5.608	26	85	27	0	14.649
11:00 AM	3.829	1.575	4.18	27	78	21	0	14.649
12:00 PM	7.681	2.201	5.839	27	78	21	0	14.649
1:00 PM	4.012	1.616	4.287	27	79	24	0	14.634
2:00 PM	22.3	3.535	9.378	27	78	23	0	14.620

Table.4. EMR when Temperature High

Time	Power Density (mW/m^2)	Electric Field (V/m)	Magnetic Field (mA/m)	Temperature (°C)	Humidity (%)	Wind Speed (km/h)	Precipitation (%)	Pressure (psi)
11:00 AM	3.829	1.575	4.18	27	78	21	0	14.649
12:00 PM	7.681	2.201	5.839	27	78	21	0	14.649
1:00 PM	4.012	1.616	4.287	27	79	24	0	14.634
2:00 PM	22.3	3.535	9.378	27	78	23	0	14.620
10:00 AM	7.933	2.114	5.608	26	85	27	0	14.649
10:30 AM	25.99	3.941	10.455	24	94	26	43	14.649
11:30 AM	26.64	3.885	10.226	24	95	26	55	14.634

Table.5. EMR when Temperature Low

Time	Power Density (mW/m^2)	Electric Field (V/m)	Magnetic Field (mA/m)	Temperature (°C)	Humidity (%)	Wind Speed (km/h)	Precipitation (%)	Pressure (psi)
12:30 PM	37.17	4.407	11.69	23	95	19	58	14.634
3:30 PM	14.48	2.666	7.072	23	94	26	32	14.591
4:30 PM	23.37	3.574	9.479	23	94	26	48	14.605
10:30 AM	25.99	3.941	10.455	24	94	26	43	14.649
11:30 AM	26.64	3.885	10.226	24	95	26	55	14.634
1:30 PM	33.39	3.939	10.448	24	95	26	42	14.634
2:30 PM	41.42	4.665	12.373	24	94	24	61	14.591

Table.6. EMR when Humidity High

Time	Power Density (mW/m^2)	Electric Field (V/m)	Magnetic Field (mA/m)	Temperature (°C)	Humidity (%)	Wind Speed (km/h)	Precipitation (%)	Pressure (psi)
11:30 AM	26.64	3.885	10.226	24	95	26	55	14.634

12:30 PM	37.17	4.407	11.69	23	95	19	58	14.634
1:30 PM	33.39	3.939	10.448	24	95	26	42	14.634
10:30 AM	25.99	3.941	10.455	24	94	26	43	14.649
2:30 PM	41.42	4.665	12.373	24	94	24	61	14.591
3:30 PM	14.48	2.666	7.072	23	94	26	32	14.591
4:30 PM	23.37	3.574	9.479	23	94	26	48	14.605

Table.7. EMR when Humidity Low

Time	Power Density (mW/m²)	Electric Field (V/m)	Magnetic Field (mA/m)	Temperature (°C)	Humidity (%)	Wind Speed (km/h)	Precipitation (%)	Pressure (psi)
11:00 AM	3.829	1.575	4.18	27	78	21	0	14.649
12:00 PM	7.681	2.201	5.839	27	78	21	0	14.649
2:00 PM	22.3	3.535	9.378	27	78	23	0	14.620
1:00 PM	4.012	1.616	4.287	27	79	24	0	14.634
10:00 AM	7.933	2.114	5.608	26	85	27	0	14.649
9:00 AM	23.85	3.176	8.424	24	89	23	0	14.649

Table.8. EMR when Wind Speed High

Time	Power Density (mW/m²)	Electric Field (V/m)	Magnetic Field (mA/m)	Temperature (°C)	Humidity (%)	Wind Speed (km/h)	Precipitation (%)	Pressure (psi)
10:00 AM	7.933	2.114	5.608	26	85	27	0	14.649
10:30 AM	25.99	3.941	10.455	24	94	26	43	14.649
11:30 AM	26.64	3.885	10.226	24	95	26	55	14.634
1:30 PM	33.39	3.939	10.448	24	95	26	42	14.634
3:30 PM	14.48	2.666	7.072	23	94	26	32	14.591
4:30 PM	23.37	3.574	9.479	23	94	26	48	14.605

Table.9. EMR when Wind Speed Low

Time	Power Density (mW/m²)	Electric Field (V/m)	Magnetic Field (mA/m)	Temperature (°C)	Humidity (%)	Wind Speed (km/h)	Precipitation (%)	Pressure (psi)
12:30 PM	37.17	4.407	11.69	23	95	19	58	14.634
11:00 AM	3.829	1.575	4.18	27	78	21	0	14.649
12:00 PM	7.681	2.201	5.839	27	78	21	0	14.649
9:00 AM	23.85	3.176	8.424	24	89	23	0	14.649
2:00 PM	22.3	3.535	9.378	27	78	23	0	14.620
1:00 PM	4.012	1.616	4.287	27	79	24	0	14.634
2:30 PM	41.42	4.665	12.373	24	94	24	61	14.591

Table.10. EMR when Precipitation High

Time	Power Density (mW/m²)	Electric Field (V/m)	Magnetic Field (mA/m)	Temperature (°C)	Humidity (%)	Wind Speed (km/h)	Precipitation (%)	Pressure (psi)
2:30 PM	41.42	4.665	12.373	24	94	24	61	14.591
12:30 PM	37.17	4.407	11.69	23	95	19	58	14.634
11:30 AM	26.64	3.885	10.226	24	95	26	55	14.634
4:30 PM	23.37	3.574	9.479	23	94	26	48	14.605
10:30 AM	25.99	3.941	10.455	24	94	26	43	14.649
1:30 PM	33.39	3.939	10.448	24	95	26	42	14.634

3:30 PM	14.48	2.666	7.072	23	94	26	32	14.591

Table.11. EMR when Precipitation Low

Time	Power Density (mW/m²)	Electric Field (V/m)	Magnetic Field (mA/m)	Temperature (°C)	Humidity (%)	Wind Speed (km/h)	Precipitation (%)	Pressure (psi)
9:00 AM	23.85	3.176	8.424	24	89	23	0	14.649
10:00 AM	7.933	2.114	5.608	26	85	27	0	14.649
11:00 AM	3.829	1.575	4.18	27	78	21	0	14.649
12:00 PM	7.681	2.201	5.839	27	78	21	0	14.649
1:00 PM	4.012	1.616	4.287	27	79	24	0	14.634
2:00 PM	22.3	3.535	9.378	27	78	23	0	14.620

Table.12. EMR when Pressure High

Time	Power Density (mW/m²)	Electric Field (V/m)	Magnetic Field (mA/m)	Temperature (°C)	Humidity (%)	Wind Speed (km/h)	Precipitation (%)	Pressure (psi)
9:00 AM	23.85	3.176	8.424	24	89	23	0	14.649
10:00 AM	7.933	2.114	5.608	26	85	27	0	14.649
11:00 AM	3.829	1.575	4.18	27	78	21	0	14.649
12:00 PM	7.681	2.201	5.839	27	78	21	0	14.649
1:00 PM	4.012	1.616	4.287	27	79	24	0	14.634
2:00 PM	22.3	3.535	9.378	27	78	23	0	14.620

Table.13. EMR when Pressure Low

Time	Power Density (mW/m²)	Electric Field (V/m)	Magnetic Field (mA/m)	Temperature (°C)	Humidity (%)	Wind Speed (km/h)	Precipitation (%)	Pressure (psi)
2:30 PM	41.42	4.665	12.373	24	94	24	61	14.591
3:30 PM	14.48	2.666	7.072	23	94	26	32	14.591
4:30 PM	23.37	3.574	9.479	23	94	26	48	14.605
2:00 PM	22.3	3.535	9.378	27	78	23	0	14.620
11:30 AM	26.64	3.885	10.226	24	95	26	55	14.634
12:30 PM	37.17	4.407	11.69	23	95	19	58	14.634
1:00 PM	4.012	1.616	4.287	27	79	24	0	14.634
1:30 PM	33.39	3.939	10.448	24	95	26	42	14.634

4. CONCLUSION

From this paper we make a conclusion that EM exposures of this base station antenna are relatively very high in the case of rain times compare to the after the rain times. It is detected that radiations were higher when temperature, humidity, wind speed and precipitation become higher. It is also watched that radiations were reduced when pressure is higher. So, we can conclude that the pressure and precipitation take part in key position to manipulate this EM exposure level and on the other hand the temperature, humidity and wind speed take part in average character to direct this EM exposure level.

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