Understanding Cell Tower Radiation

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What is radiation?

Radiation is a form of energy on the move. Radiation is electromagnetic in nature, i.e., it consistsof waves of electric and magnetic energy moving together through space at the speed of light.

There are two types of radiation:

- ***Ionizing radiation***

It contains enough energy to cause ionization. Ionization is a process by which electrons are stripped from atoms and molecules. Its interaction with matter can change chemical reactions inthe body that leads to damage in biological tissues

- ***Non-ionizing radiation (NIR)***

It does not have sufficient energy to cause ionization in living matter. It causes some heating effect, but usually not enough to cause any kind of long-term damage to tissues. Radiofrequencyenergy, visible light and microwave radiation are considered non-ionizing.

What is radiofrequency (RF)?

A radio signal can be thought of as a wave that spreads out from its source (the antenna). It is often referred to as an *electromagnetic wav*e that is made up of linked electric and magnetic components. The radiofrequency (3kHz to 300GHz) part of the electromagnetic spectrum includes electromagnetic waves produced by television and radio transmitters (including base stations) and microwaves.

What are mobile phone base stations and how do they work?

Mobile phone base stations are also known as base transceiver stations or telecommunications structures. They are low-power, multi-channel two-way radios. Antennas, which produce RF radiation, are mounted on either transmission towers or roof-mounted structures. These structures need to be of a certain height in order to have a wider coverage. As the mobile phonesand their base stations are two way radios, they produce RF radiation to communicate and therefore expose the people near them to RF radiation.

What is the amount of exposure to RF Radiation?

Shadow zones near mobile phone towers:

A mobile phone antenna has a radiating pattern. It transmits higher energy in the blue shaded lobes. This emission intensity falls with distance. It also falls if you are not directly in any of the radiation lobes. The shadow zone is an area which falls out of the radiation lobe of an antenna. Alternatively, the highest radiation exposure is at the primary lobe at about 50 metres from the radiating antenna.

Cell tower radiation intensity is the highest in the primary lobe (Dark green shade portion) whenan area at 50 to 300 metre distance at an angular placement of 5 to 10 degree from the plane ofradiation. Any area not in the primary lobe falls in the shadow zone, which does not receive highradiation.

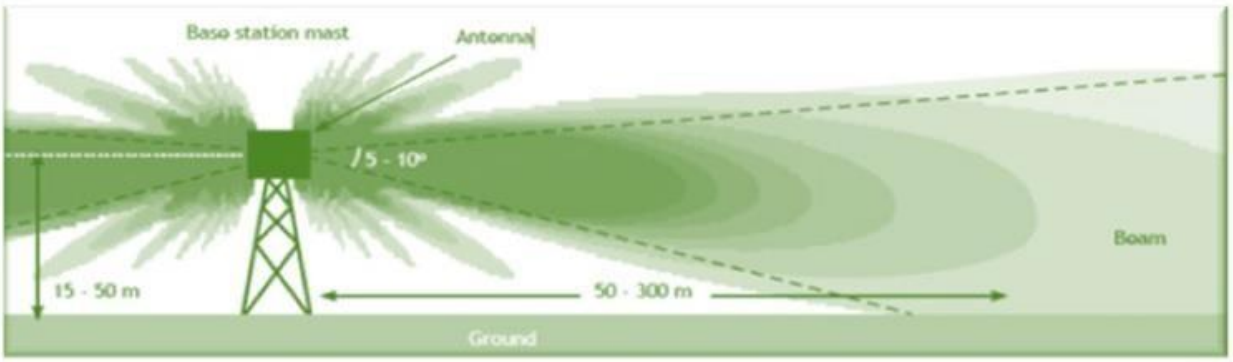

Fig. 2. Radiation from Towers.

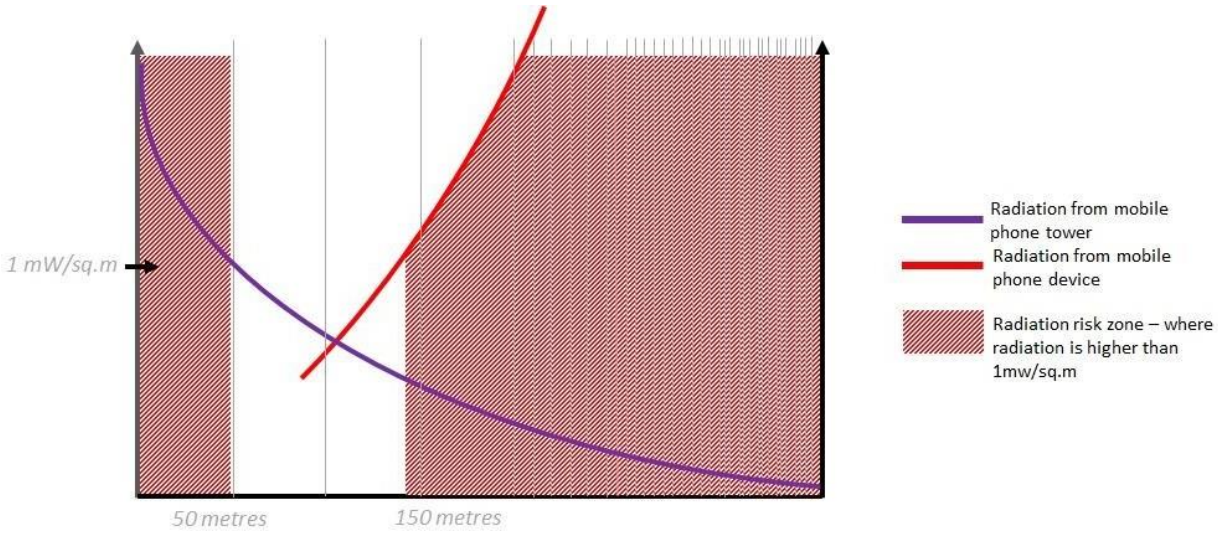

Fig. 3. Radiation from Towers and Mobile devices.

Radiation from mobile phone tower (Purple Line) reduces exponentially with distance. Within 50metres, it is higher than the exposure limiting value. This area around a cell phone tower could be dangerous in terms of high radiation from the tower. However, as we start going further awayfrom the tower, and the tower signal (Purple line) drops, the Phone radiation levels (Red line) start increasing. At around the 150 metre mark, phone radiation levels go beyond the exposure limiting value. For the rest of the distance, phone radiation remains pretty high.

Specific Absorption Rate (SAR):

The SAR is a measure of the rate that RF energy is absorbed by the body. For exposure to RF energy from wireless devices, the allowable FCC SAR limit is 1.6 watts per kilogram (W/kg), as averaged over one gram of tissue. The threshold level is a Specific Absorption Rate (SAR) value for the whole body of 4 watts per kilogram (4 W/kg).

Table 2. Basic restrictions for time varying electric and magnetic fields for frequencies up to10 GHz.[a]

Exposure characteristics	Frequency range	Current density for head and trunk (mA m^{-2}) (rms)	Whole-body average SAR (W kg^{-1})	Localized SAR (head and trunk) (W kg^{-1})	Localized SAR (limbs) (W kg^{-1})
Occupational exposure	up to 1 Hz	40	—	—	—
	1–4 Hz	40/*f*	—	—	—
	4 Hz–1 kHz	10	—	—	—
	1–100 kHz	*f*/100	—	—	—
	100 kHz–10 MHz	*f*/100	0.4	10	20
	10 MHz–10 GHz	—	0.4	10	20
General public exposure	up to 1 Hz	8	—	—	—
	1–4 Hz	8/*f*	—	—	—
	4 Hz–1 kHz	2	—	—	—
	1–100 kHz	*f*/500	—	—	—
	100 kHz–10 MHz	*f*/500	0.08	2	4
	10 MHz–10 GHz	—	0.08	2	4

[a] Note:
1. f is the frequency in hertz.
2. Because of electrical inhomogeneity of the body, current densities should be averaged over across-section of 1 cm2 perpendicular to the current direction.
3. All SAR values are to be averaged over any 6-minute period.

Radiation norms adopted in different countries:

Bio-Initiative Report in 2007

Some of the proposed maximum exposure values through various reports are given below:

- Building Biology Institute, Germany, provided following guidelines for exposure:
  a. <0.1 µW/m² (0.00001 µW/cm²) – no concern
  b. 0.1 - 10 µW/m² (0.00001 to 0.001 µW/cm²) - slight concern
  c. 10 - 1000 µW/m² (0.001 to 0.1 µW/cm²) - severe concern
  d. > 1000 µW/m² (> 0.1 µW/cm²) - extreme concern
- EU Parliament (STOA 2001) recommends - 100 µW/m²

In India, we have adopted radiation norms given by ICNIRP guidelines for safe power density of f/200, where frequency (f) is in MHz. Hence, for GSM900, power density is 4.7W/m² and for GSM1800, it is 9.2W/m². Many countries in the world have adopted much stricter maximum radiation density values of 0.001 to 0.24 W/ m² (1/100th to 1/1000th of ICNIRP guidelines).

Table 4: Revised EMF radiation norms for mobile towers (BTS) in India

Frequency	ICNIRP Radiation norms	Revised DoT Norms effective from 01.09.2012
900 MHz	4.5 Watt/ sq.m	0.45 Watt/sq.m
1800 MHz	9 Watt/ sq.m	0.9 Watt/sq.m
2100 MHz	10.5 Watt/ sq.m	1.05 Watt/sq.m

Safer distance from RF radiations

Power levels near towers are higher and reduce with distance. It is reduced to 1/4 when the distance from antenna doubles, and 1/9 when distance is tripled and so on. In addition, the safe distance from the tower also depends on the number of antennas served by the tower. The relation between antennas and distance is as given in the below table.

Table. 3: Safe distance in case of multiple antennas.

S.No.	Number of Multiple antennas	Building/Structure distance from the antenna (safe distance) (in mtrs)
1	2	35
2	4	45
3	6	55

How to mitigate RF radiations?

Since antennas are used for transmitting and receiving signals. A "**Radiation Shield**" consisting ofmultiple orthogonally polarized broadband monopole antennas, has been developed. The antennas are broadband planar circular monopole antennas and are designed to cover the frequency range from 800 to 4000 MHz. The antennas are terminated in matched load to absorbthe harmful radiation to produce a safe radiation free environment.

Other ways of protection from exposure to RF radiation:

- **Shielding Your Bedroom:**

You can effectively shield your bed with a Faraday bed canopy. The EMF Faraday canopy is an ultra-fine metal composite mesh which works along the same principles as a mosquito net. Instead of keeping out the mosquitoes it keeps out RF radiation. This kind of shielding can offer over 99% shielding performance.

Fig. 5. Faraday Bed Canopy.

- **Shielding Your Windows:**

Windows are a weak spot and generally provide the least protection from EMFs. Precious-metalcoated and self-adhesive film for shielding of windows and glass surfaces from Radio-frequency radiation (RF) can be used.

- **Shielding Paint:**

Stop cell tower radiation penetrating through an outside wall with a high frequency EMF shieldingpaint. It can be used on walls, ceilings, doors. It adheres well to cement, plaster, polystyrene andmost building materials. It can be used inside as well as out but generally you're better using it on your interior where it'll not be exposed to the elements.

- **EMF Shielding:**

Insulating aluminum foil is a cheaper solution. For internal walls, which unlike external walls don'tneed to breathe, insulating aluminum foil as used in the building industry, can be used.

- **Barriers:**

Physical Barriers and Natural barriers such as trees & plants can be used to hinder the RF radiation. These are effective to some extent only when there in the direct line with the source of the RF Radiation.

- **Shielding Devices:**

EnviroGlobe safeguards the human body from harmful radiations emanating from electrical gadgets, server rooms, wi-fi routers, mobile transmission towers, mobile boosters, etc. EnviroGlobe can be used in cars, hotel rooms, homes and offices. EnviroGlobe installed, pulse rate is reduced by 4-7 percent in those who have a high pulse rate (> 82). Lower pulse rate indicates lower stress and better health. EnviroGlobe corrects 250-300 sqft of area depending onthe proximity to various devices and gadgets mentioned above.

Conclusion:

If the site or building is in the line of sight of Towers (Antennas) and is located within 300 m distance, Radiation Audit has to conducted and necessary mitigation measures has to be taken. The radiation exposure levels from tower reduces as the distance from the tower increases. After 50m, the radiation levels reduce below the limiting values. The number of antennas facing the site/building also decides the safety distance. So, it is important to know the number of antennas and their properties. The Site or Buildings which falls in the shadow area does not have serious threat but precautionary measures should be taken. According to Indian Norms, the exposure levels (in terms of power density) should not exceed 9.2 watt/sq. m. But it would be preferable if it is lesser than 0.1 µW/m2 according to Bio-Initiative report (2007). Even if the site does not fall under this range, it is preferable to make measures to reduce the exposure levels to the desired range at least in the maximum occupied areas.