

# Environment condition around transmission towers not fit for livelihood

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## Abstract

Influence of radio frequency (RF) and microwave radiation on human body is studied. According to Rai (1992) radio and T.V. transmission towers of Varanasi, which are located in thickly populated area, are causing health hazards problems to the people. Theoretical analysis shows that a transmission tower of 10 kW is expected to cause harmful effects on the people living upto about 300 m. For low power transmitters the distance is smaller. The radiation is more hazardous if a high voltage power transmission line is also passing over the area, as the combined effect of the two radiations may cause cancer risk to the people (Tenferde 1996).

**Key Words:** *Radio frequency, transmission, transmitter*

## Introduction

In addition to many types of air pollution produced by man an invisible pollution is also coming up. This is electromagnetic pollution which is at its peak near radio and T.V. transmission towers, various military and medical appliances, electrical appliances used in homes, power transmission lines and mobile cellphones. Rai (1992) has given a statistical observation of many diseases occurring to the people living around the T.V. transmission tower of Varanasi. He has also stated that the occurring diseases reduces with increasing of distance from the tower. Here we try to explore the mechanism responsible for this effect on human. Variation of the effect with distance is also explored.

**The Mechanism**

Radio and T.V. transmission towers transmit R.F. radiation i.e. electric and magnetic fields of radio frequency propagating in the atmosphere. Intensity of these fields is very high near the source (i.e. tower) and reduces as inverse square of the distance. This electric field induces potential difference across the tissues of human body. Higher is the environmental electric field, higher would be the potential difference induced across the tissues. This induced potential difference disturbs the normal functioning of the body and results in many diseases.

**Variation of Electric Field with Distance**

The value of electric field  $E_0$  at a distance of  $r$  from a transmitter of power  $P$  is given by the eqn. (Griffths 1999)

$$\frac{P}{4\pi r^2} = \frac{1}{2} \epsilon_0 E^2 c \quad \text{or} \quad E = \frac{1}{r} \sqrt{\frac{P}{2\pi \epsilon_0 c}} = \frac{7.746}{r} \sqrt{P}$$

where  $\epsilon_0$  is permittivity of free space and  $c$  is speed of light (or radiation). For 10 kW transmitter we get  $E_0=774.6/r$ . Thus the field value varies inversely as distance. Table 1 gives the field values at different distances from the transmitter. Table 2 gives the values of potential difference created across a body tissue for these distances, given by  $\Delta U=1.5a E_0$ , where  $a$  is radius of tissue (Bery 1988).

**Table:- 1 Field values at different distances from the transmitter**

Distance from the tower (m)	100	200	300	400	500	600	700	800	900	1000
Electric Field (V/m)	7.746	3.873	2.582	1.936	1.549	1.291	1.106	0.968	0.860	0.774

Table:-2 The variation of Potential difference across the tissue from the transmission tower of Varanasi.

Distance from the tower (m)	100	200	300	400	500	600	700	800	900	1000
Potential difference (V) X 10 <sup>-6</sup>	43.57	21.785	14.253	10.89	8.713	7.261	6.221	5.445	4.837	4.353

Variation of electric field with distance from transmitter is given in table 1. The tissues inside the body would come across somewhat less field as the penetration of the field depends upon frequency of radiation and depth inside the skin. Field at a distance  $z$  inside the boundary of the body is given by  $E_z = E_0 e^{-z/\delta}$  where  $\delta$  is the skin depth (the distance at which the field is reduced to  $1/e$  of its value at the boundary) which again depends on frequency of radiation. For biological materials it is given by  $\delta = 1/\omega q$  where  $q = [\mu \epsilon (\sqrt{1+p^2}-1)/2]^{1/2}$ ,  $p = \sigma/\omega \epsilon$   $\omega$  is radian frequency of radiation,  $\epsilon$  is permittivity,  $\mu$  the permeabilily and  $\sigma$  is the conductivity of tissue material.

The variation of electric field with distance inside the body for two frequencies of transmission of Varanasi T.V. is given in Table 3 for tissues of high water content. Table 4 gives these variation for tissues of low water content.

Table:-3 The variation of electric field when it penetrate inside muscle, skin and tissue high water content.

Frequency of E.M. Wave (MHz)	Skin depth (m) x 10 <sup>-2</sup>	Distance (m)	External electric field $E_0$ (V/m)	Induced Electric Field inside the muscles, skin and tissues				
				1mm (V/m)	2mm (V/m)	3mm (V/m)	4mm (V/m)	5mm (V/m)
41	11.2	100	7.746	7.677	7.608	7.541	7.474	7.407
	11.2	500	1.549	1.535	1.521	1.508	1.494	1.481
	11.2	1000	0.774	0.767	0.760	0.753	0.746	0.740
202	4.79	100	7.746	7.586	7.429	7.275	7.125	6.978
	4.79	500	1.549	1.517	1.485	1.455	7.424	1.395
	4.79	1000	0.774	0.758	0.742	0.727	0.712	0.697

**Table:- 4 The variation of electric field when it penetrate inside the bone, fat and tissue with low water content.**

Frequency of E.M. Wave (MHz)	Skin depth (m) x 10 <sub>2</sub>	Distance from tower (m)	External electric field $E_0$ (V/m)	Induced Electric Field inside the bone, fat and tissues				
				1mm (V/m)	2mm (V/m)	3mm (V/m)	4mm (V/m)	5mm (V/m)
41	118	100	7.746	7.739	7.732	7.726	7.719	7.713
	118	500	1.549	1.547	1.546	1.545	1.543	1.542
	118	100	0.774	0.773	0.7727	0.7721	0.771	0.770
202	39.2	100	7.746	7.726	7.706	7.275686	7.667	7.647
	39.2	500	1.549	1.545	1.541	1.537	7.533	7.529
	39.2	100	0.774	0.772	0.770	0.768	0.766	0.764

**Discussion**

The analysis shows that a permanent potential difference is created across the tissues of the body because of the radiation. This results in many types of diseases. If the potential difference is higher, it is more hazardous, which is more evident nearer to the transmitter.

**References**

Berg, H., 1988. Electrofusion of cells, in **Modern Bioelectricity**, A.A. Marino, ed., Marcel Dekker Inc. New York.

Griffiths, D.J., 1999. **Introduction to Electrodynamics**, Printice Hall of India Private Limited, 2<sup>nd</sup> Edition, New Delhi.

Tenforde, T.S., 1996. Interaction of ELF magnetic fields with living systems, in **Handbook of Biological effects of electromagnetic fields**, C.Polk and E. Postow eds., CRC Press, Boca Raton USA.