

PRE-FILED TESTIMONY
OF GIRISH KUMAR, B.Sc. Ph.D.
MPUC Docket No. 2011-00262

1 **Q. Please state your name and business address.**

2 A. My name is Girish Kumar. My business address is:

3 Professor, Department of Electrical Engineering

4 IIT Bombay

5 Powai, Mumbai - 400 076, India

6 **Q. Briefly state your occupation, educational background and current**
7 **employment.**

8 A. I am a faculty member in the Electrical Engineering Department, I.I.T. Bombay,
9 India (May 1991 – present).

10 Ph.D. (Electrical Engineering), I.I.T. Kanpur, India, 1983

11 B.Sc. (Electrical Engineering), A.M.U. Aligarh, India, 1978

12 Current employment is professor, Electrical Engineering Department, I.I.T.
13 Bombay

14 **Q. Briefly describe your professional experience.**

15 A. Professor, Elect. Engg. Dept., I.I.T. Bombay, India, Feb. 2001 - present

16 Associate Professor, Elect. Engg. Dept., I.I.T. Bombay, India, May 1991 –
17 Feb. 2001

18 Assistant Professor, Elect. Engg. Dept., Univ. of North Dakota, USA, Aug.1985 -
19 May 1991

20 Research Associate, Elect. Engg. Dept., Univ. of Manitoba, Canada, June 1983 –
21 July 1985

22 Research Engineer Elect. Engg. Dept., I.I.T. Kanpur, India, Nov. 1982 - May 1983

23 Senior Research Assist. Elect. Engg. Dept., I.I.T. Kanpur, India, July 1980 - Nov
24 1982

25 Research Assist. Elect. Engg. Dept., I.I.T. Kanpur, India, July 1979 - June 1980

26 I Have worked in the areas of microstrip antennas and arrays, microwave circuits
27 and systems, EMI/EMC, and radiation from cell phones and cell towers

1 **Q. Are you a member of any professional organizations? If so, please list.**

2 A. International Advisory Committee Member of International symposium On
3 Microwave and Optical Technology (ISMOT); USA Fellow, Institute of
4 Electronics and Telecommunication Engineers (IETE), India; Life Member, Indian
5 Society for Technical Education (ISTE), India

6 **Q. Have you authored any papers or journal articles?**

7 A. I have published more than 200 scientific studies in peer-reviewed scientific
8 journals and conference proceedings and also written a book on "Broadband
9 Microstrip Antennas" published by Artech House, USA, 2003. A full list is shown
10 on my *curriculum vitae* attached as Exhibit A.

11 **Q. Briefly describe your work and experience related to the study of**
12 **electromagnetic fields and radio frequency waves in the 30 MHz to 300 GHz**
13 **range ("RF"), and about their potential effects on biological systems. If you**
14 **have conducted any studies or published any writings on the subject, briefly**
15 **describe them.**

16 A. I have been doing research on electromagnetic fields and radio frequency waves in
17 the range of 90 MHz to 3 GHz range, and about their potential effects on
18 biological systems. I have written several papers and reports, details of these are
19 given in Exhibit A. I have also submitted a report on Cell Tower Radiation to
20 Secretary, DOT, India in Dec. 2010 attached as Exhibit B. It contains 30 pages of
21 report and nearly 200 scientific/technical references.

1 Q. Are you familiar with other research studies and writings on the subject?
2 Briefly describe the body of research and published literature on the subject
3 of which you are familiar.

4 A. I am familiar with other research studies and writings on the subject, including the
5 following, some of which offer recommended exposure guidelines.

6 Bio-Initiative Report in 2007 (610 pages long) has been prepared by a group of
7 independent scientists after thorough and very careful survey of the literature and
8 they concluded that the existing standards for public safety are inadequate to
9 protect public health and proposed $1000 \mu\text{W}/\text{m}^2$ for outdoor, cumulative RF
10 exposure and proposed $100 \mu\text{W}/\text{m}^2$ for indoor, cumulative RF exposure. Also,
11 Bio-Initiative Report 2012 has re-emphasized strong evidence of health hazards at
12 lower levels.

13 •Building Biology Institute, Germany, provided following guidelines for exposure:

- | | | |
|----|----|---|
| 14 | | |
| 15 | a. | $<0.1 \mu\text{W}/\text{m}^2$ ($0.00001 \mu\text{W}/\text{cm}^2$) - no concern |
| 16 | b. | $0.1 - 10 \mu\text{W}/\text{m}^2$ (0.00001 to $0.001 \mu\text{W}/\text{cm}^2$) - slight concern |
| 17 | c. | $10 - 1000 \mu\text{W}/\text{m}^2$ (0.001 to $0.1 \mu\text{W}/\text{cm}^2$) - severe concern |
| 18 | d. | $> 1000 \mu\text{W}/\text{m}^2$ ($> 0.1 \mu\text{W}/\text{cm}^2$) - extreme concern |

19 See attached Exhibit E.

20
21 Guidelines of the Austrian Medical Association are similar to the above. See
22 attached Exhibit E.

23 • Thomas S, Heinrich S, von Kries R, Radon K. Exposure to radio-frequency
24 electromagnetic fields and behavioural problems in Bavarian children and
25 adolescents. Eur J Epidemiol 2010 Feb; 25(2): 135-41(power densities should not
26 exceed $100 \mu\text{W}/\text{m}^2 = 0.01 \mu\text{W}/\text{cm}^2$).

27 •EU Parliament (STOA 2001) recommends - $100 \mu\text{W}/\text{m}^2 = 0.01 \mu\text{W}/\text{cm}^2$. See
28 attached Exhibit E.

1 •Prof. Girish Kumar, IIT Bombay, India recommends $100 \mu\text{W}/\text{m}^2 = 0.01 \mu\text{W}/\text{cm}^2$

2 See my presentation attached as Exhibit C especially:

3 Slide 23 - EMF Radiation Standards

4 Slide 25 - Health concerns with current Safety Guidelines Slide 31 - Effect of Cell
5 Towers

6 Slide 35 - Impacts of Communication Towers on Wildlife including Birds and
7 Bees

8 Slide 36 - Guideline of the Austrian Medical Association

9 Slide 37 - Energy = power x time

10 On May 31, 2011, International Agency for Research on Cancer (IARC), a part of
11 WHO designated cell phones as "possible human carcinogen" [Class 2B]. They
12 Found evidence of increase in glioma and acoustic neuroma brain cancer for
13 mobile phone users.

14 **Q. Based on your knowledge and review of relevant scientific studies do you**
15 **have an opinion about whether exposure to low-level RF (below the level at**
16 **which thermal effects are known to occur) can adversely affect biological**
17 **systems including the human body?**

18 **A.** In my opinion, the peer-reviewed literature supports the conclusion that exposure
19 to low-level RF (below the level at which thermal effects are known to occur) can
20 adversely affect biological systems including the human body.

21 **Q. What are some of the biological effects reported in the peer-reviewed**
22 **literature?**

1 A. As described on Exhibit B, the reported biological effects include sleep disorder,
2 headache, lack of concentration, memory loss, increased permeability of blood-
3 brain barrier, calcium ion efflux, infertility, miscarriage, cardiovascular problems,
4 cancer, etc.

5 **Q. Did some of these studies involve exposure to RF in or near the 2.4 GHz**
6 **range?**

7 A. Yes. A number of studies involving exposure to RF in that range have shown
8 positive results for non-thermal biological effects as identified on Exhibit C.

9

10 **Q. In your opinion, could a careful scientist familiar with the body of knowledge**
11 **on the subject reliably conclude that there are no risks of adverse health**
12 **effects from the exposure to RF in the 1-3 GHz range?**

13 A. In my opinion, a careful scientist familiar with the body of knowledge on the
14 subject cannot reliably conclude that there are no risks of adverse health effects
15 from the exposure to RF in the 1-3 GHz range. There are risks of adverse health
16 effects from the exposure to RF in the 1-3 GHz range depending upon the power
17 level and exposure time. If the exposed power is of low level or for short duration,
18 then there may not be risks of adverse health. Ultimately, total RF energy is
19 important, which is power multiplied by time. And total RF energy must be
20 derived from all sources of exposure, not just exposure from one RF device in
21 isolation. We are exposed to many sources of radiation which are additive in
22 nature. Also, when the whole body is exposed, total RF energy must be based on

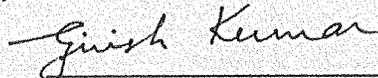
1 Q. Are there any plausible scientific explanations for a causal link between EHS
2 and exposure to electromagnetic radiation?

3 A. There are plausible scientific explanations for a causal link between EHS and
4 exposure to electromagnetic radiation. Please see Exhibits B and D.

5 Q. Are there any peer-reviewed studies that would support such a causal link or
6 mechanism?

7 A. There are many peer-reviewed studies that would support such a causal link or
8 mechanism, please see Exhibits B and D.

Dated this 31 day of January, 2013.


Girish Kumar

GIRISH KUMAR

EXHIBIT A

RESUME

Name : GIRISH KUMAR

Work Address

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I.I.T. Bombay, Powai
Mumbai – 400 076, India
Tel.: (022) 2576 7436
Fax: (022) 2572 3707
Email: gkumar@ee.iitb.ac.in

Residential Address

B – 288 Central Area
Building No. 24, I.I.T. Bombay
Powai, Mumbai – 400 076, India
Tel.: (022) 2572 2128
(022) 2576 8436

Areas of Interests

Microstrip Antennas and Arrays, Broadband Antennas, Microwave Integrated Circuits and Systems, EMI/ EMC, and Industrial Microwave Heating.

Educational Qualifications

Ph.D. (Electrical Engineering), I.I.T. Kanpur, India, 1983, C.P.I. = 9.0 / 10.0

Thesis: Broadband microstrip antennas using coupled resonators

B.Sc. (Electrical Engineering), A.M.U. Aligarh, India, 1978, C.P.I. = 9.5 / 10.0, 2nd Rank

Professional Experience

Chairman	Wilcom Technologies Pvt. Ltd. Vashi, Navi Mumbai, India	March 2006 - present
Professor	Elect. Engg. Dept., I.I.T. Bombay, India	Feb. 2001 - present
Associate Professor	Elect. Engg. Dept., I.I.T. Bombay, India	May 1991 – Feb. 2001
Assistant Professor	Elect. Engg. Dept., Univ. of North Dakota, USA	Aug. 1985 - May 1991
Research Associate	Elect. Engg. Dept., Univ. of Manitoba, Canada	June 1983 – July 1985
Research Engineer	Elect. Engg. Dept., I.I.T. Kanpur, India	Nov. 1982 – May 1983
Senior Research Assist.	Elect. Engg. Dept., I.I.T. Kanpur, India	July 1980 – Nov 1982
Research Assist.	Elect. Engg. Dept., I.I.T. Kanpur, India	July 1979 – June 1980

Research and Development Experience

Worked in the broad area of microwaves and antennas. More specifically, worked on the following:

- **Broadband Microstrip Antennas (MSA)** - Proposed and developed several new broadband MSA configurations, such as, gap coupled and directly coupled rectangular MSA, hybrid coupled circular, semi-circular, and triangular MSA, electromagnetic and aperture coupled multilayer MSA.
- **Circularly Polarized MSA** - Developed new circularly polarized MSA configurations using modified triangular MSA and off-centered stacked circular MSA.
- **Multi-frequency MSA** - Worked on several multi-frequency MSA, such as, stub loaded rectangular and circular MSA, hybrid coupled semi-circular and circular MSA.
- **Compact Microstrip Antennas** - Developed compact MSA configurations using shorted variations of rectangular, circular, and triangular MSA.
- **Microstrip Antenna Arrays** - Developed phased array MSA for land mobile satellite communication and defence applications.
- **HF Broadband antennas** - Designed HF broadband antennas using conical monopole, planar disc monopole, and log-periodic antenna arrays.
- **Educational Trainer Systems**- Designed various antennas, impedance matching networks, and microstrip components for Antenna, Transmission Line, and Microstrip Trainer Systems, respectively.
- **Microwave Industrial Applications** - worked on several microwave industrial applications, such as, moisture content measurement, microwave heating for food and pharmaceutical applications.

Professional Memberships

- Fellow, Institute of Electronics and Telecommunication Engineers (IETE), India
- Life Member, Indian Society for Technical Education (ISTE), India

Awards and Scholarships

- Merit scholarship, Aligarh Muslim University, Aligarh, India, 1973 – 1978
- Nominated for Outstanding faculty award for excellence in undergraduate teaching, University of North Dakota, Grand Forks, USA, 1987.
- Received Elwyn F. Chandler award for superior teaching and special commitment to and relationships with undergraduate and graduate students, University of North Dakota, Grand Forks, USA, 1989.
- My students won first, second, and third prizes in paper competition organised by IEEE Red River Valley Section, USA, in 1989 and 1990 and first and second prizes in 1991.
- My students won first and consolation prizes in the All India M.V. Chauhan student paper contest organised by IEEE, India Section 1994.
- Received best paper award in experimental category at National Communication Conference (NCC-2004), I.I.Sc. Bangalore, India.
- Awarded “Professor Extraordinario” of the Univ. of Navarra, San Sebastian, Spain, 2004.

Professional Activities

- Reviewer for various national and international journals and conference papers.
- International Advisory Committee Member of International symposium on Microwave and Optical Technology (ISMOT), since 2003.
- Chairman, IEEE AP/EDS Mumbai Chapter, 2001-2002.
- Counsellor, IEEE Student Branch at the University of North Dakota, USA, 1987 – 1991.
- Secretary and Treasurer, Vice - Chairman, Chairman, IEEE Red River Valley Section, USA, 1988 – 1990, respectively.
- Campus Representative and Executive Member, ASEE North - Midwest Section, USA, 1989 - 1991.

Sponsored Projects

- Development of microstrip antennas for land mobile satellite systems, Faculty Research Committee, Univ. of North Dakota, Grand Forks, USA, 1986 - 1987.
- Design and development of wideband gap-coupled rectangular microstrip antennas, Faculty Research Committee, Univ. of North Dakota, Grand Forks, USA, 1987 - 1988.
- Frame synchronisation for GOES series satellites, Centre for Atmospheric Sciences, Univ. of North Dakota, Grand Forks, USA, 1988 - 1989.
- Application of voice recognition and speech synthesis systems, Faculty Research Committee, Univ. of North Dakota, Grand Forks, USA, 1989 - 1990.
- HRPT frame synchroniser, Centre for Atmospheric Sciences, Univ. of North Dakota, Grand Forks, USA, 1989 - 1990.
- Computer controlled radiation pattern measurement system, MHRD Institute Project, I.I.T. Bombay, India, 1993 - 1995.
- Study of MIC tapered slot antenna and its arrays, DRDO, India, 1993 - 1997.
- Broadband microstrip antennas, AICTE, India, 1997 – 2000
- Microstrip antenna array for airborne steerable GPS system, Phase I, ARDB, India, 1999 - 2001.
- EMI / EMC investigations of lasers and pulsed power sources, BRNS, India, 1999 - 2003.
- Microstrip antenna array for airborne steerable GPS system, Phase II, ARDB, India, 2002 - 2003.
- Space Fed Microstrip Antenna Array, Indo Japan Collaboration Project, Japan, 2006-2009.
- Broadband Electromagnetic Energy Harvesting for Low Power Applications – Theory and development including design of CMOS AC to DC converter chip, DST, India, 2010-2013.
- Design of a wideband and low loss 250kW CW RF Coupler for RFQ cavity at 352.2 MHz, BRNS, India, 2011-2013.
- Disinfestation of Spices and Nuts using Microwave Energy, DST, India, 2012-2015.

Consultancy Projects

- Integrated voltage regulator for brushless synchronous generators, Electric Machinery, Minneapolis, USA, Summer 1989 and Summer 1990.
- Data acquisition system for measuring pH and conductivity of soil, Agvise, North Dakota, USA, 1990.
- Compact power supply for interactive display, North star, North Dakota, USA, 1991.
- Measurements of cable parameters, Procon Cables Pvt. Ltd., Bombay, India, 1993.
- Modelling and analysis of Polarimetric SAR antenna, Space Application Centre, Ahmedabad, India, 1994.
- Measurement of cable parameters, Airtech, Bombay, India, 1996.
- Non-ferromagnetic resonance type small isolator, Hitachi Metals, Japan, 1996 – 1997.
- Programmable Logic controller card, Messung Systems, Pune, India, 1997.
- Characterisation of surface mount capacitors, SIMIC Electronics, Bombay, India, 1998.
- HF broadband antennas, Aero-Marine, Bombay, India, 1998 – 1999.
- Microwave heating for pharmaceutical applications, Kleinzaid, Bombay, India, 1998 - 1999
- UHF microstrip antennas, ECIL, Hyderabad, India, 1998 - 1999.
- Microstrip antenna array for replacing paragridded antennas, ECIL, Hyderabad, India, 1998 – 2000.
- Microstrip antennas for WLL and GSM bands, Microqual Techno (P) Ltd., Mumbai, India, 2000.
- Design and development of hybrid coupler and scan converter, ECIL, Hyderabad, India, 2000.
- Software development and CAD data for microstrip antenna arrays at Ka-Band, DEAL, Dehradun, India, 2000-2002.
- Microstrip antenna arrays at X-band, BEL, Bangalore, India, 2001-2002.
- Design and testing of antennas for educational training systems, Signet, Mumbai, India, 2002.
- Design and development of planar microstrip antenna array for the UHF base radio links, CRL BEL, Bangalore, India, 2002-2003.
- Design of microstrip components for microstrip trainer system, Signet, Mumbai, India, 2003.
- Design of transmission line impedance matching devices for transmission line trainer system, Signet, Mumbai, India, 2003.
- Testing of patch panel antennas, BSNL, Mumbai, India, 2003.
- Design of microstrip circuits and antenna systems, Microwave & Antenna Systems (India) Pvt. Ltd., Navi Mumbai, India, 2003-2004.
- Development of S and C band printed antennas, DEAL, Dehradun, India, 2003-2005.
- Microwave components, equipment and software, RF Equipment (India) Pvt. Ltd., Navi Mumbai, India, 2004-2005.
- Design and development of RFID and WLAN systems, Microwave & Antenna Systems (India) Pvt. Ltd., Navi Mumbai, India, 2004-2005.
- Technical opinion on telecommunication transmission equipment, Etc Telecom Ltd., Mumbai, India, 2005.
- Antenna Design, Innoviti Embedded Solutions Pvt. Ltd., Bangalore, India, 2005.
- Technical advice for inlays for e-passport manufacturing, India Security Press, Nashik, 2007.
- Radio Frequency Radiation Study of TV Tower, Worli, I-Ven Realty Limited, Mumbai, 2007.
- Studies of the radiation impact of TV tower on residential building, Shree Ram Urban Infrastructure Limited, Worli, 2008.

- GPS based Locators for torpedo, NSTL, Visakhapatnam, 2008-2010.
- Cell tower radiation report, Telecom Users Group, Delhi, 2010.
- Solutions for Radiation emitted through cell phone towers and other devices, BMS Wellness Pvt. Ltd., 2011-2012.

Teaching Experience

In the last 27 years, taught the following under-graduate and post-graduate courses. Also, developed following software, laboratories and conducted short-term courses.

Under - Graduate Courses

Analog Electronics	Communication Electronics
Control Systems I	Electrical Engineering Fundamentals
Electromagnetic Fields	Electromagnetic Waves
Electronics I and II	Electronic Circuits
Linear Electric Circuits II	Network Theory

Post - Graduate Courses

Microwave Integrated Circuits	Radiating Systems
Semiconductor Circuits	Radar Systems
Solid State Microwave Devices and Applications	

Laboratory Development

Analog and Digital Electronics	Communication Electronics
Antennas	Microwave Circuits
Electromagnetic Waves	

Course / Software Development

- Lesson plan for Analog Electronics Course
- Software for Electromagnetic Waves Course
- Software for Radiating Systems Course

Short term courses organised / taught

Antennas	Communication Circuits
Digital Electronics	Fibre Optics
Satellite Communication	Microstrip antennas

Workshop Organised

Cell Phone/Tower radiation Hazards and Solutions

BOOKS PUBLISHED

G. Kumar and K.P. Ray, "Broadband Microstrip Antennas", Artech House, USA, 2003

LIST OF PATENTS APPLIED

1. M.S. Shojaei, G. Kumar, M. Arrawatia, and V. Diddi, "Self biased high efficiency fully differential RF rectifier", Indian Patent Application No 470/MUM/2012, Filed on 21 February 2012.
2. G. Kumar, M.S. Shojaei, and M. Arrawatia, "A Fully Differential Electromagnetically Coupled Microstrip Antenna", Indian Patent Application No 1258/MUM/2012, Filed on 20 April 2012.

LIST OF PUBLICATIONS

Papers in refereed journals

- [1] G. Kumar and K.C. Gupta, "Geometrical tolerance effects in branch - line and rat - race hybrids", *JIETE*, vol. 28, pp. 336 - 345, July 1982.
- [2] G. Kumar and L. Shafai, "Radiation characteristics and generation of higher order modes of circular microstrip antennas", *Electronic Letters*, vol. 20, pp. 681 - 683, Aug. 16, 1984.
- [3] G. Kumar and K.C. Gupta, "Broadband microstrip antennas using additional resonators gap - coupled to the radiating edges", *IEEE Trans. Antennas Propagat.*, vol. AP - 32, pp. 1375 - 1379, Dec. 1984.
- [4] G. Kumar and K.C. Gupta, "Non - radiating edges and four edges gap - coupled multiple resonator broadband microstrip antennas", *IEEE Trans. Antennas Propagat.*, vol. AP - 33, pp. 173 - 178, Feb. 1985.
- [5] G. Kumar and K.C. Gupta, "Directly - coupled multiple resonator wideband microstrip antennas", *IEEE Trans Antennas Propagat.*, vol. AP - 33, pp. 588 - 593, June 1985.
- [6] G. Kumar and L. Shafai, "Generation of conical patterns from circular patch antennas and their performances", *Canadian Electrical Engineering Journal*, vol. 10, pp. 108 - 112, July 1985.
- [7] K. Parasnis, L. Shafai and G. Kumar, "Performance of star microstrip as a linearly and circularly polarised TM_{21} mode radiator", *Electronic Letters*, vol. 22, pp. 463 - 464, April 24, 1986.
- [8] V. Rathi, G. Kumar and K.P. Ray, "Improved coupling for aperture coupled microstrip antennas", *IEEE Trans Antennas Propagat.*, vol. AP - 44, pp. 1196 - 1198, Aug. 1996.
- [9] K.P. Ray and G. Kumar, "Multi-frequency and broadband hybrid-coupled circular microstrip antennas", *Electronic Letters*, vol. 33, no. 6, pp. 437 - 438, March 13, 1997.
- [10] S.K. Satpathy, K.P. Ray, and G. Kumar, "Compact shorted variations of circular microstrip antennas", *Electronic Letters*, vol. 34, no. 2, pp. 137 - 138, Jan. 22, 1998.

- [11] N.P. Agrawall, G. Kumar, and K.P. Ray, "Wideband planar monopole antennas", *IEEE Trans Antennas Propagat.*, vol. AP - 46, pp. 249 - 251, Feb. 1998.
- [12] S.K. Satpathy, K.P. Ray, and G. Kumar, "Compact shorted variations of triangular microstrip antennas", *Electronics Letters*, vol. 34, no. 8, pp. 709-711, April 1998.
- [13] K.P. Ray and G. Kumar, "Hybrid coupled planar microstrip antennas", *IETE Technical Review*, vol. 16, no.1, pp. 81-84, Jan.-Feb. 1999.
- [14] G. Kumar and R.K. Kotapati, "Aperture coupled microstrip antennas", *IETE Technical Review*, vol. 16, no.1, pp. 85-88, Jan.-Feb. 1999.
- [15] S. Babu and G. Kumar, "Parametric study and temperature sensitivity of microstrip antennas using improved linear transmission line model", *IEEE Trans. Antennas Propagat.*, vol. 47, pp. 221-226, Feb. 1999.
- [16] R. Kapur and G. Kumar, "Hybrid-coupled shorted rectangular microstrip antennas", *Electronics Letters*, vol. 35, no. 18, pp. 1501-1502, Sep. 1999.
- [17] K.P. Ray and G. Kumar, "Determination of the resonant frequency of microstrip antennas", *Microwave and Optical Tech. Letters*, vol. 23, no. 2, pp. 114-117, Oct. 1999.
- [18] V. Srinivasan, S. Malhotra and G. Kumar, "Multiport network model for chip resistors loaded rectangular microstrip antennas", *Microwave and Optical Tech. Letters*, vol. 24, no. 1, pp. 11-13, Jan. 2000.
- [19] V. Srinivasan, K.T.V. Reddy and G. Kumar, "Multiport network model analysis of second and third order modes of rectangular microstrip antennas", *Microwave and Optical Tech. Letters*, vol. 26, no. 1, pp. 8-10, July 2000.
- [20] K.P. Ray and G. Kumar, "Tuneable and dual band circular microstrip antenna with stubs", *IEEE Trans Antennas Propagat.*, vol. AP - 48, pp. 1036-1039, July 2000.
- [21] K.P. Ray and G. Kumar, "Compact gap-coupled shorted 90° sectoral microstrip antennas for broadband and dual-band operations", *Microwave and Optical Tech. Letters*, vol. 26, no. 3, pp. 143-145, Aug. 2000.
- [22] K.T.V. Reddy and G. Kumar, "Dual feed gap-coupled square microstrip antennas for broadband circular polarization", *Microwave and Optical Tech. Letters*, vol. 26, no. 6, pp. 399-4025, Sep. 2000.
- [23] S. Pandav and G. Kumar, "Modeling of Yagi-Uda antenna using method of moments", *IETE Technical Review*, vol. 17, no. 5, pp. 283-291, Sep.-Oct. 2000.
- [24] K.P. Ray, P.V. Anob, R. Kapur and G. Kumar, "Broadband planar rectangular monopole antennas", *Microwave and Optical Tech. Letters*, vol. 28, no. 1, pp. 55-59, Jan. 2001.
- [25] S. Babu and G. Kumar, "Reliability studies of microstrip antennas using Monte Carlo Simulation", *IETE Technical Review*, vol. 18, no. 1, pp. 51-56, Jan.-Feb. 2001
- [26] K.P. Ray and G. Kumar, "Multiport network model for fundamental and higher order modes of semi-circular microstrip antennas", *Microwave and Optical Tech. Letters*, vol. 28, no. 4, pp. 237-241, Feb. 2001.
- [27] S.B. Ray and G. Kumar, "Three port rectangular microstrip unequal power divider and coupler", *Microwave and Optical Tech. Letters*, vol. 29, no. 4, pp. 219-223, May 2001.

- [28] K.P. Ray and G. Kumar, "Improved method for the prediction of resonance frequency of triangular microstrip antennas", *IETE Journal of Research*, vol. 47, nos. 3&4, pp. 161-164, May-Aug. 2001.
- [29] S. Pandav and G. Kumar, "Analysis of log periodic dipole array antennas using method of moments", *IETE Journal of Research*, vol. 47, no. 5, pp. 247-251, Sep.-Oct. 2001.
- [30] K.P. Ray and G. Kumar, "Correction to Tuneable and dual band circular microstrip antenna with stubs", *IEEE Trans Antennas Propagat.*, vol. AP - 50, p. 552, April 2002.
- [31] K.P. Ray, G. Kumar and H.C. Lodwal, "Hybrid-coupled broadband triangular microstrip antennas", *IEEE Trans Antennas Propagat.* vol. AP - 51, pp. 139-141, Jan. 2003.
- [32] G. Kumar, "Antennas for commercial applications", *Electrical & Electronics*, India, pp. 52-56, June 2004.
- [33] P. Sarkar, A. Agrawal, and G. Kumar, "Radio Frequency Identification", *Electrical & Electronics*, India, pp. 52-56, June 2004.
- [34] A. Deshmukh and G. Kumar, "Compact Broadband U-Slot Loaded Rectangular Microstrip Antenna", *Microwave and Optical Tech. Letters*, pp. 556-559, Sep. 2005.
- [35] A. Deshmukh and G. Kumar, "Compact Broadband E-shaped Microstrip Antennas", *Electronics Letters*, Vol. 41, No. 18, pp. 989 – 990, Sep. 2005.
- [36] A. Deshmukh and G. Kumar, "Broadband Pairs of Slots Loaded Rectangular Microstrip Antennas", *Microwave and Optical Tech. Letters*, pp. 223-226, Nov. 2005.
- [37] A. Deshmukh and G. Kumar, "Compact Broadband gap-coupled Shorted L-shaped Microstrip Antennas", *Microwave and Optical Technology Letters*, Vol. 47, No. 6, pp. 599 – 605, Dec. 2005.
- [38] A. Deshmukh and G. Kumar, "Compact Broadband stacked Microstrip Antennas", *Microwave and Optical Technology Letters*, Vol. 48, No. 1, pp. 93 – 96, Jan. 2006.
- [39] A. Deshmukh and G. Kumar, "Various slot loaded Broadband and Compact Circular Microstrip Antennas", *Microwave and Optical Technology letters*, Vol. 48, No. 3, pp. 435 – 439, March 2006.
- [40] A. Deshmukh and G. Kumar, "Compact Broadband S-shaped Microstrip Antennas", *Electronics Letters*, Vol. 42, No. 5, pp. 260-261, March 2006.
- [41] A. Deshmukh and G. Kumar, "Even mode Multi-port Network Model for slotted dual band Rectangular Microstrip Antennas", *Microwave and Optical Technology letters*, Vol. 48, No. 4, pp. 798 – 804, April 2006.
- [42] A. Deshmukh and G. Kumar, "Compact Broadband Rectangular Microstrip Antennas", *Microwave and Optical Technology letters*, Vol. 48, No. 6, pp. 1043 – 1046, June 2006.
- [43] G. Kumar, K. P. Ray, and A. Deshmukh, "Microstrip Antennas Integrated with Horn Antennas", *International Journal of Microwave and Optical Technology (IJMOT)*, www.ijmot.com, June 2006.
- [44] A. Deshmukh and G. Kumar, "Compact Broadband Gap-Coupled Shorted Square Microstrip Antennas", *Microwave and Optical Technology letters*, Vol. 48, No. 7, pp. 1261 – 1265, July 2006.

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REPORT
ON
CELL TOWER RADIATION

Submitted To

Secretary, DOT, Delhi



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CELL TOWER RADIATION REPORT

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1. Advantages and disadvantages of cell phone technology

Cell phone technology has revolutionized the telecommunication scenario in India. Due to its several advantages, cell phone technology has grown exponentially in the last decade. Currently, there are more than 50 crore cell phone users and nearly 4.4 lakh cell phone towers to meet the communication demand. The numbers of cell phones and cell towers are increasing without giving due respect to its disadvantages. All over the world, people have been debating about associated health risk due to radiation from cell phone and cell tower. Radiation effects are divided into thermal and non-thermal effects. Thermal effects are similar to that of cooking in the microwave oven. Non-thermal effects are not well defined but it has been reported that non-thermal effects are 3 to 4 times more harmful than thermal effects.

A cell phone transmits 1 to 2 Watt of power in the frequency range of 824 - 849 MHz (CDMA), 890 - 915 MHz (GSM900) and 1710 – 1780 MHz (GSM1800). A cell phone has a SAR (Specific Absorption Rate) rating. In USA, SAR limit for cell phones is 1.6W/Kg which is actually for 6 minutes per day usage. It has a safety margin of 3 to 4, so a person should not use cell phone for more than 18 to 24 minutes per day. This information is not commonly known to the people in India, so crores of people use cell phones for more than an hour per day without realizing its associated health hazards.

Cell tower antennas transmit in the frequency range of 869 - 894 MHz (CDMA), 935 - 960 MHz (GSM900) and 1810 – 1880 MHz (GSM1800). Also, 3G has been deployed in a few cities, in which base station antenna transmits in the frequency range of 2110 – 2170 MHz. Mobile phone operators divide a region in large number of cells, and each cell is divided into number of sectors. The base stations are normally configured to transmit different signals into each of these sectors. In general, there may be three sectors with equal angular coverage of 120 degrees in the horizontal direction as this is a convenient way to divide a hexagonal cell. If number of users is distributed unevenly in the surrounding area, then the sectors may be uneven. These base stations are normally connected to directional antennas that are mounted on the roofs of buildings or on free-standing masts. The antennas may have electrical or mechanical down-tilt, so that the signals are directed towards ground level.

A base station and its transmitting power are designed in such a way that mobile phone should be able to transmit and receive enough signal for proper communication up to a few kilometers. Majority of these towers are mounted near the residential and office buildings to provide good mobile phone coverage to the users. These cell towers transmit radiation 24x7, so people living within 10's of meters from the tower will receive 10,000 to 10,000,000 times stronger signal than required for mobile communication. In India, crores of people reside within these high radiation zones.

2. Radiation from the cell tower

A GSM900 base station antenna transmits in the frequency range of 935 - 960 MHz. This frequency band of 25 MHz is divided into twenty sub-bands of 1.2 MHz, which are allocated to various operators. There may be several carrier frequencies (1 to 5) allotted to one operator with upper limit of 6.2 MHz bandwidth. Each carrier frequency may transmit 10 to 20W of power. So,

one operator may transmit 50 to 100W of power and there may be 3-4 operators on the same roof top or tower, thereby total transmitted power may be 200 to 400W. In addition, directional antennas are used, which typically may have a gain of around 17 dB (numeric value is 50), so effectively, several KW of power may be transmitted in the main beam direction.

2.1 Radiated power density from the cell tower

Power density P_d at a distance R is given by

$$P_d = \left(\frac{P_t \times G_t}{4\pi R^2} \right) \text{ Watt/m}^2$$

where, P_t = Transmitter power in Watts
 G_t = Gain of transmitting antenna
 R = Distance from the antenna in meters

For $P_t = 20$ W, $G_t = 17$ dB = 50, P_d for various values of R is given in Table 1.

Table 1 – Power density at various distances from the transmitting tower

Distance R (m)	Power density P_d in W/m ²	Power density P_d in μ W/m ²
1	79.6	79,600,000
3	8.84	8,840,000
5	3.18	3,180,000
10	0.796	796,000
50	0.0318	31,800
100	0.008	7,960
500	0.000318	318

The power density values given in Table 1 are for a single carrier and a single operator. If multiple carriers are being used and multiple operators are present on the same roof top or tower, then the above values will increase manifold. However, radiation density will be much lower in the direction away from the main beam. One should know actual radiation pattern of the antenna (which unfortunately is not made public) to calculate exact radiation density at a point.

2.2 Radiation pattern of the antenna

The simulated radiation pattern of GSM900 antenna of approximately 17 dB gain at 950 MHz of size 2400 mm x 30 mm is shown in Fig. 1. Radiation pattern of the antenna is shown in two planes – horizontal and vertical. There is one main lobe and several side lobes. For the main lobe, half-power beam-width (HPBW – defined as angular range over which maximum power decreases to half of its value) in the horizontal direction is 65 degrees and HPBW in the vertical direction is 6 degrees. There are several side lobes, whose maximum levels are about -13 to -20 dB below the main level.

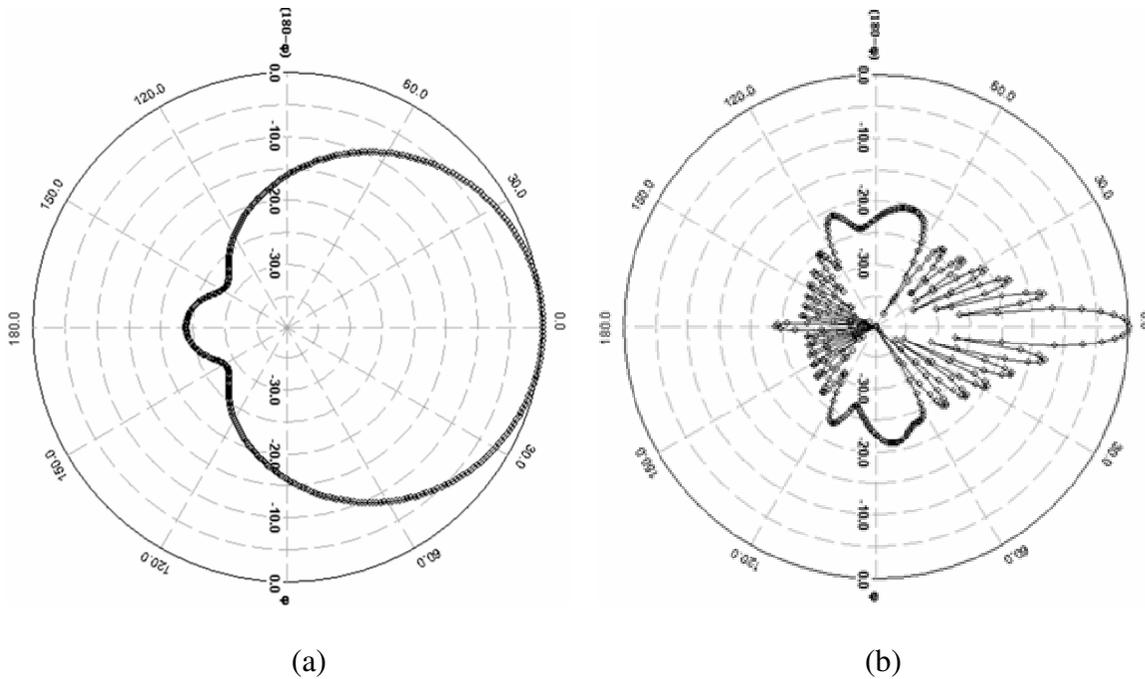


Fig. 1 – (a) Horizontal and (b) Vertical radiation pattern of a 17 dB gain antenna

2.3 Case study of Usha Kiran Building, Mumbai

Through the help of the above typical radiation pattern, let's analyze the news reported in Mid-day, Mumbai dated Jan. 3, 2010, which stated - "Mumbai's swanky Usha Kiran building says the four cancer cases there could be linked to mobile towers installed on the facing Vijay Apartments". The picture taken from the Usha Kiran building of the several antennas installed on the seventh floor of Vijay Apartments is shown in Fig. 2. People living in the 6th, 7th and 8th floor in the opposite building will get maximum radiation as they are in the main beam direction. People living on the other floors will receive lesser radiation as beam maxima is reduced considerably as can be observed from vertical radiation pattern. In the horizontal direction again, people living in the front side of the antenna will receive much higher radiation compared to people living in the back side of antenna.

<http://www.mid-day.com/news/2010/jan/030110-mobile-tower-cancer-cases-carmichael-road-posh-areas.htm>



Fig. 2 – Cell phone towers installed at the roof top of a building in Mumbai

From Table 1, it may be noted that for a single transmitter, power density at $R = 50\text{m}$ is equal to $0.0318\text{W/m}^2 = 31,800 \mu\text{W/m}^2$. Even for 3 transmitters in the same direction, it comes out to be approximately $0.1 \text{ W/m}^2 = 100,000 \mu\text{W/m}^2$, which has caused cancer to several people in a duration of 2 to 3 years.

3. Radiation norms adopted in different countries

In India, we have adopted radiation norms given by ICNIRP guidelines of 1998 for safe power density of $f/200$, where frequency (f) is in MHz. Hence, for GSM900 transmitting band (935-960 MHz), power density is 4.7W/m^2 and for GSM1800 transmitting band (1810-1880 MHz), it is 9.2W/m^2 . The ICNIRP guidelines clearly state that for simultaneous exposure to multiple frequency fields, the sum of all the radiation must be taken into consideration. However, in India, we have applied this limit to individual carrier, so the radiation level exceeds by several times than even prescribed by ICNIRP guidelines, depending upon the total number of transmitters in that area. Some of the people (especially older people, house wives, small children) living near the towers are exposed to this radiation 24 hours a day. Unfortunately, ICNIRP has considered only the thermal effects of radiation, whereas scientists all over the world have found non-thermal effects of these radiations to have significant health effects and these non-thermal health effects occur at levels much below these norms.

Bio-Initiative Report in 2007 (610 pages long) has been prepared by a group of independent scientists after thorough and very careful survey of the literature and they concluded that the existing standards for public safety are inadequate to protect public health and proposed $1000 \mu\text{W/m}^2$ for outdoor, cumulative RF exposure. Some of the proposed maximum exposure values through various reports are given below:

- Building Biology Institute, Germany, provided following guidelines for exposure:
 - a. $<0.1 \mu\text{W}/\text{m}^2$ ($0.00001 \mu\text{W}/\text{cm}^2$) - no concern
 - b. $0.1 - 10 \mu\text{W}/\text{m}^2$ (0.00001 to $0.001 \mu\text{W}/\text{cm}^2$) - slight concern
 - c. $10 - 1000 \mu\text{W}/\text{m}^2$ (0.001 to $0.1 \mu\text{W}/\text{cm}^2$) - severe concern
 - d. $> 1000 \mu\text{W}/\text{m}^2$ ($> 0.1 \mu\text{W}/\text{cm}^2$) - extreme concern
- H Thomas et al, Germany; power densities should not exceed $100 \mu\text{W}/\text{m}^2$
- EU Parliament (STOA 2001) recommends - $100 \mu\text{W}/\text{m}^2$

The current USA standard for radiation exposure from cell phone towers is 580-1,000 microwatts per sq. cm. ($\mu\text{W}/\text{cm}^2$), but they are now considering revising the norms. Over 100 physicians and scientists at Harvard and Boston University Schools of Public Health have called cellular towers a radiation hazard. And, 33 delegate physicians from 7 countries have declared cell phone towers a “public health emergency”. Many countries in the world have adopted much stricter maximum radiation density values of 0.001 to $0.24 \text{ W}/\text{m}^2$ ($1/100^{\text{th}}$ to $1/1000^{\text{th}}$ of ICNIRP guidelines) as shown in Table 2. The people in these countries have studied extensively the health hazards of cell tower radiation to adopt stricter radiation norms. As can be seen in the case described in Section 2.3, even $0.1 \text{ W}/\text{m}^2 = 100,000 \mu\text{W}/\text{m}^2$ has caused cancer to several people in a duration of 2 to 3 years.

Table 2 - International Radiation Density Limits for GSM1800

Power Density (W/m²)	International Exposure limits adopted by various countries
10	FCC (USA) OET-65, Public Exposure Guidelines at 1800 MHz
9.2	ICNIRP and EU recommendation 1998 – Adopted in India
3	Canada (Safety Code 6, 1997)
2	Australia
1.2	Belgium (ex Wallonia)
0.5	New Zealand
0.24	Exposure limit in CSSR, Belgium, Luxembourg
0.1	Exposure limit in Poland, China, Italy , Paris
0.095	Exposure limit in Italy in areas with duration > 4hours
0.095	Exposure limit in Switzerland
0.09	ECOLOG 1998 (Germany) <i>Precaution recommendation only</i>
0.025	Exposure limit in Italy in sensitive areas
0.02	Exposure limit in Russia (since 1970), Bulgaria, Hungary
0.001	"Precautionary limit" in Austria, Salzburg City only
0.0009	<i>BUND 1997 (Germany) Precaution recommendation only</i>
0.00001	New South Wales, Australia

At many places, cell phone towers are mounted on the roof top of residential /commercial buildings. Even though antenna radiates less power vertically down but the distance between the antenna and top floor is usually a few meters, so the radiation level in the top two floors remain very high. From Table 1, power density at $R = 3\text{m}$ is equal to $8,840,000 \mu\text{W}/\text{m}^2$ in the main beam. In the vertically down direction, radiation is approximately 20-22 dB less and the roof may provide attenuation of 6 to 10 dB depending on the construction (implying $1/1000^{\text{th}}$ power), implying radiation density of $8,840 \mu\text{W}/\text{m}^2$, which is still very high.

Let's do some simple calculation of how much microwave power will be absorbed by human body if exposed to the so called safe radiation level adopted in India of power density = $4.7 \text{W}/\text{m}^2$ for GSM900 band,. If we model human body as a cylinder, then its area will be 1.436 square meter (average height 5'6" = 1.67 m and waist 34" = 86 cm). So, power recd. by human body will be power density x area = 6.75 Watts. In one hour, microwave energy absorbed will be $6.75 \times 3600 = 24.3 \text{KW-sec}$. In one day, microwave energy absorbed will be $24.3 \times 24 = 583.2 \text{KW-sec}$. A typical microwave oven has a rating of 700 to 1000 W, and with say 60% efficiency, microwave power output is approximately 500 W. This implies that human body can be safely kept in a microwave oven for $583.2 \text{KW-sec} / 500 \text{W} = 1166 \text{seconds} = 19 \text{minutes}$ per day. How many people in the world are willing to put themselves, their family members, and their unborn children in an open microwave oven for 19 minutes/day? Telecom providers or policy makers can argue about body being adaptable to external threats and the radiation is spread over whole day. However, question remains, would we like to put our citizens in an open microwave oven for 19 minutes/day over the years. Also, this is only for a single source. For multiple sources, it will increase correspondingly. Thus, the safe limit adopted by India is extremely high and millions of people are suffering because of this.

Interphone study in 2010 mentions that excessive use of mobile phones has doubled to quadrupled brain tumor risk. However, they claim that for an average user, increase in cancer cases is not significant but they have taken an average user as a person who uses cell phone for 2 hours/month. In India, many people use cell phones for 1 to 2 hours per day. Re-evaluation of the Interphone study by a group of eminent scientist has found that the risk of affected people is significantly higher than reported. Interphone Study excluded children from the study. Children are at higher risk from exposures to carcinogens than adults and today very large population of children are using cell phones and also many of them sleep with the cell phones beneath their pillows every night without realizing the health hazards.

A number of adverse health effects have been documented at levels below the FCC guidelines, which include altered white blood cells in children; childhood leukemia; impaired motor function, reaction time, and memory; headaches, dizziness, fatigue, weakness, and insomnia etc. Figure 3 shows guidelines adopted by various countries in the top right corner and health effects of radio frequency radiation at various power densities at much lower level.

Guidelines for various countries

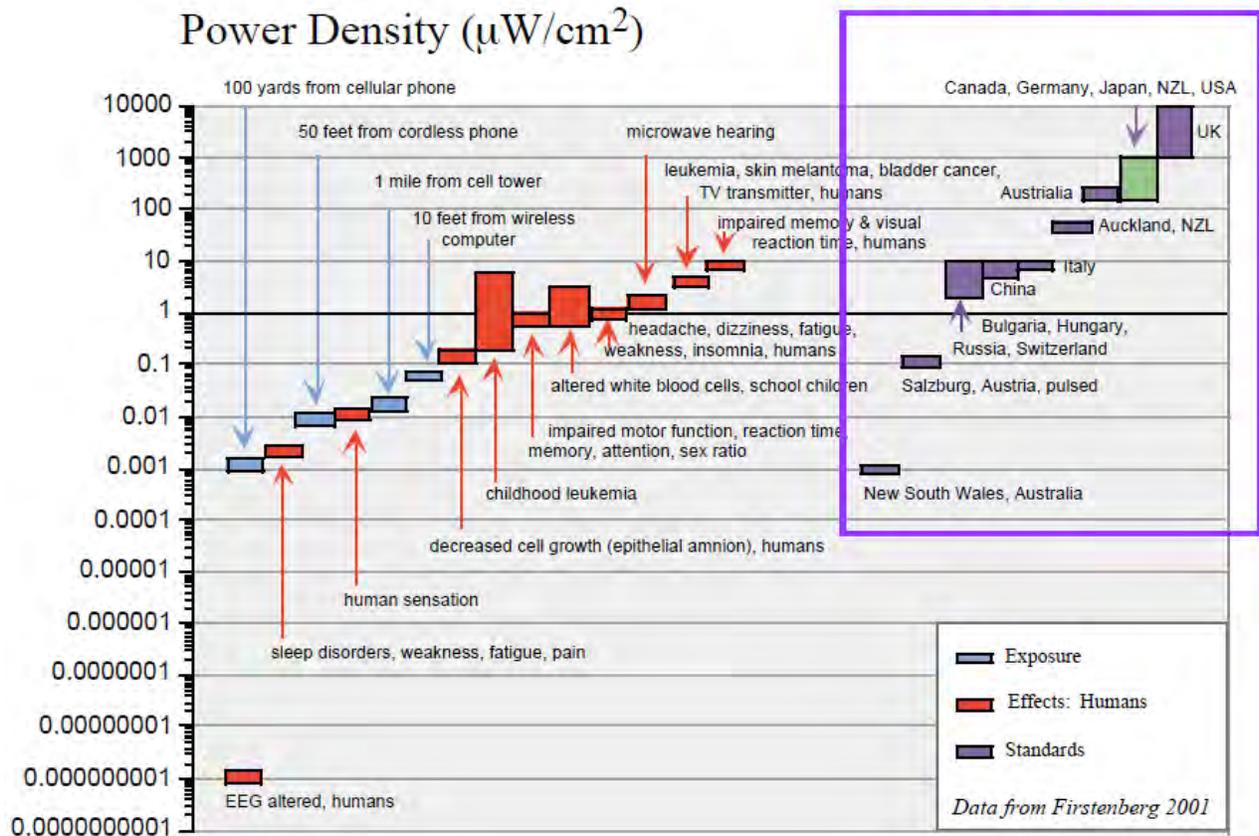


Figure 3: Guidelines, exposures and effects of radio frequency radiation at various power densities. Data from Firstenberg 2001.

4. Theoretical and Measured Radiated power

To measure the power at a distance R, an antenna is used to receive the power and a spectrum analyzer or power meter is used to measure received power.

Power Received P_r by an antenna at a distance R is given by:

$$P_r = P_t \times G_t \times G_r \times \left(\frac{\lambda}{4\pi R} \right)^2$$

Received power is directly proportional to the transmitted power, gain of transmitting and receiving antennas, and square of wavelength of the signal and it is inversely proportional to square of distance. For transmitter power $P_t = 20 \text{ W}$, transmitting antenna gain $G_t = 17 \text{ dB}$, receiving monopole antenna gain $G_r = 2 \text{ dB}$, the received power at $R = 50 \text{ m}$ is:

At 887 MHz (tower transmitting frequency in CDMA), $P_r = -3.2 \text{ dBm}$.

At 945 MHz (tower transmitting frequency in GSM900), $P_r = -3.8$ dBm.

At 1872 MHz (tower transmitting frequency in GSM1800), $P_r = -9.7$ dBm

The purpose of a cell tower is that mobile phone should receive adequate signal for its proper operation. A mobile phone shows full strength at -69 dBm input power and works satisfactorily in the received power range of -80 to -100 dBm. In comparison with -80 dBm level, the measured power level at $R = 50$ m is at least 50 to 60 dB higher, which translates to 100,000 to 1,000,000 times stronger signal than a mobile phone requires. There are millions of people who live within 50m distance from cell towers and absorbing this radiation 24x7.

4.1 Conversion from measured power to power density

These measured power levels are in dBm whereas international standards are in terms of power density. In Table 3, conversion from measured power in dBm using a monopole antenna of gain = 2 dB (radiation monitor consists of this antenna) to power density is given.

Table 3 - Conversion from Power received from a monopole antenna of gain = 2 dB to Power Density at different frequencies.

Power received	Power density for different frequencies (Micro Watt/sq. meter)		
	f = 900 MHz	f = 1800 MHz	f = 2450 MHz
10 dBm = 10 mW	706,860	2,827,440	5,238,180
3 dBm = 2.0 mW	141,372	565,488	1,047,636
0 dBm = 1.0 mW	70,686	282,744	523,818
-7 dBm = 200 μ W	14,137	56,549	104,764
-10 dBm = 100 μ W	7,068.6	28,274.4	52,382
-17 dBm = 20 μ W	1,414	5,655	10,476
-20 dBm = 10 μ W	706.9	2,827.4	5,238
-27 dBm = 2 μ W	141.4	565.5	1,048
-30 dBm = 1 μ W	70.7	282.7	523.8
-37 dBm = 0.2 μ W	14.1	56.6	104.8
-40 dBm = 0.1 μ W	7.1	28.3	52.4

where

f = 900 MHz is approximately the center frequency of CDMA tower (869 to 890 MHz) and GSM900 tower (935 to 960 MHz) transmit frequency bands

f = 1800 MHz corresponds to GSM1800 cell tower (1810 to 1880 MHz) transmit frequency band.

f = 2450 MHz is approximately the center frequency of WiFi, WLAN, Bluetooth, Microwave oven, etc.

4.2 Measurement at a cancer’s patient residence

Since the radiation effect on the human body is cumulative, a hand held broadband radiation monitor (Frequency range of 800 to 2500 MHz) has been developed to measure the total received power. Radiation measurements were carried out in a lady’s apartment, who had developed cancer within one year of installation of cell tower. The layout of the apartment and the measured readings are shown in Fig. 3. It may be noted that the radiation level is very high and it is between – 4 to -10 dBm. At 900 MHz, -10 dBm received power is equivalent to 7,068 $\mu\text{W}/\text{m}^2$, again implying that safe radiation norms must be reduced considerably than adopted by India, which is $4.7\text{W}/\text{m}^2 = 4,700,000 \mu\text{W}/\text{m}^2$.

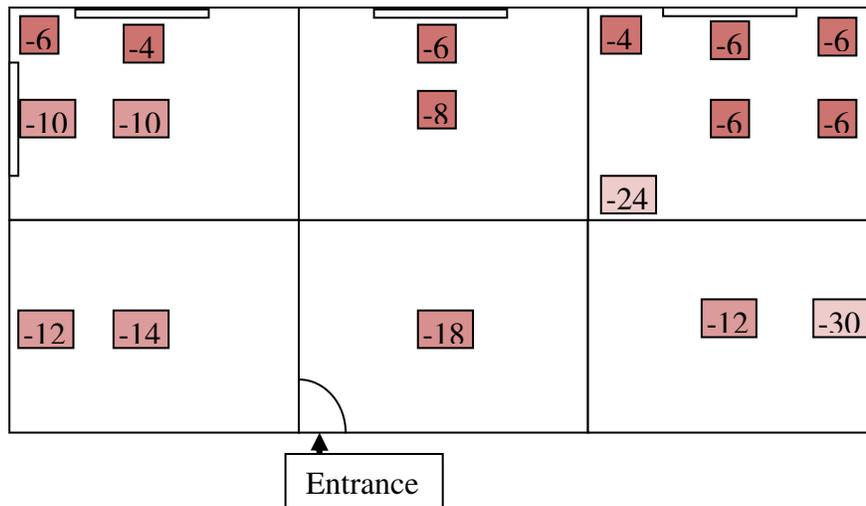


Fig. 3 – Measured power at a cancer patient’s residence

4.3 Radiation Measurement at various places

Radiation measurements were carried out at various places in Gurgaon, Delhi and Mumbai. Some of these readings are given in Table 4. It may be noted that on Delhi-Gurgaon Highway bridge after Toll Naka towards Delhi, the measured radiated power was as high as 0 dBm, which is equivalent to 70,686 $\mu\text{W}/\text{m}^2$ as there are 3 cell towers near the highway.

Table 4 – Measured Radiated power and power density at various locations

Location	Measured power in dBm	Power Density in W/m²	Power Density in μW/m²
Delhi-Gurgaon Highway near Toll (3 towers)	0	0.70686	70,686
Khar Bridge, Mumbai	0	0.70686	70,686
Bridge b/w Vashi and Sanpada, Navi Mumbai	-4	0.028274	28,274
Worli Naka	-4	0.028274	28,274
Tilak Bridge, Dadar	-4	0.028274	28,274
Resident 1, 4 th Fl. Sergeant House Lady w/cancer	-6	0.017756	17,756
Bandra Bridge	-6	0.017756	17,756
Airport Bridge	-6	0.017756	17,756
Resident 2, Rane Society, Powai	-10	0.007069	7,069
Near Hub mall, Goregaon	-10	0.007069	7,069
Mahalaxmi Temple, Bhulabhai Desai Road	-10	0.007069	7,069
Haji Ali, Juice Centre	-10	0.007069	7,069
IIT Bombay, Main Building	-10	0.007069	7,069
Gandhi Nagar-over railway bridge-near building	-12	0.00446	4,460
JK Cement group, Worli	-12	0.00446	4,460
Ustav Chowk, Kharghar	-12	0.00446	4,460
Siddhivinayak Temple	-14	0.002814	2,814
Vikroli - before Godrej	-14	0.002814	2,814
Govandi- Residential towers - near Indian Oil	-14	0.002814	2,814
Kemp's Corner	-14	0.002814	2,814
Race Course- Haji Ali	-14	0.002814	2,814
Powai Plaza	-14	0.002814	2,814
Belapur Flyover, near RBI- CIDCO	-16	0.001776	1,776
Vile Parle	-16	0.001776	1,776
Peddar Road (Punjab National Bank)	-16	0.001776	1,776
Dadar Plaza	-16	0.001776	1,776
Poddar Medical College	-16	0.001776	1,776
Vashi Highway – near Turbhe	-18	0.00112	1,120
Andheri Bridge- continuous high till Jogeshwari	-18	0.00112	1,120
Nerul Bridge	-20	0.00707	707
Vivero pre School (opposite powai lake)	-22	0.000446	446
Powai police station	-22	0.000446	446
L&T Bridge	-24	0.000446	281.4
Rajeev Gandhi nagar	-26	0.000177	177
On road near Evita (Hiranandani Building)	-28	0.000112	112
D-Mart, Hiranandani, Powai	-34	0.000028	28
Poddar Road opp. Mukesh Ambani Residence	-36	0.000028	17.8
IIT Bombay School of Management - Entrance	-46	0.00000178	1.78
Resident at Central Area, IIT Bombay	-56	0.000000178	0.178

5. Biological effects of microwave radiation

When a human body is exposed to the electromagnetic radiation, it absorbs radiation, because human body consists of 70% liquid. It is similar to that of cooking in the microwave oven where the water in the food content is heated first. Microwave absorption effect is much more significant by the body parts which contain more fluid (water, blood, etc.), like the brain which consists of about 90% water. Effect is more pronounced where the movement of the fluid is less, for example, eyes, brain, joints, heart, abdomen, etc. Also, human height is much greater than the wavelength of the cell tower transmitting frequencies, so there will be multiple resonances in the body, which creates localized heating inside the body. This results in boils, drying up of the fluids around eyes, brain, joints, heart, abdomen, etc.

There are several health hazards associated with cell phones and cell towers. Some of these are described in the following sub-sections.

5.1 The Blood Brain Barrier

The brain is protected by tight junctions between adjacent cells of capillary walls by the blood-brain barrier (BBB), which selectively lets nutrients pass through from the blood to the brain, but keeps toxic substances out. Experiments conducted on young laboratory rats found that RF from mobile phones can significantly open the BBB in animals and cause leakage of albumin from blood vessels in inappropriate locations (neurons and glial cells surrounding the capillaries) in the brain. This is shown in Fig. 4 as dark dots in the exposed brain on the right side. Control animals, in contrast, showed either no albumin leakage or occasional isolated spots, as seen on the left side. The presence of albumin in brain tissue is a sign that blood vessels have been damaged and that the brain has lost some of its protection.



Figure 4 - Comparison of brains from unexposed and exposed rats

A closer look at the cells within the brain also revealed that exposed animals had scattered and grouped dark neurons often shrunken with loss of internal cell structures. Neuronal damage of this kind may not have immediate consequences but in the long run, it may result in reduced brain reserve capacity that might be unveiled by other later neuronal diseases. It must be noted that the blood-brain barrier and neurons are the same in a rat and a human being.

In another research, a single two-hour exposure to a cell phone just once during its lifetime, permanently damaged the blood-brain barrier and, on autopsy 50 days later, was found to have damaged or destroyed up to 2 percent of an animal's brain cells, including cells in areas of the brain concerned with learning, memory and movement. It is known that this barrier is damaged in Alzheimers and Parkinsons disease. So there is a risk that disruption of this protection barrier may damage the brain.

5.2 Risk to Children and Pregnant Women

Children are more vulnerable to cell phone radiation as they:

- Absorb more energy than adults from the same phone owing to their smaller head and brain size, thinner cranial bones and skin, thinner, more elastic ears, lower blood cell volume, as well as greater conductivity of nerve cells and the energy penetrates more deeply. Tumors in the mid brain are more deadly than in the temporal lobe,
- Children's cells reproduce more quickly than adults which makes cancers more deadly,
- Their immune system is not as well developed as adults hence are less effective against fighting cancer growth,
- Children have longer life time exposure.

Absorption of electromagnetic radiation from a cell phone (Frequency - GSM 900 MHz) is shown in Fig. 5 by an adult, 10 year old and a 5 year old child. When radiation hits the head, it penetrates the skull. The yellow area at the bottom is the location of the cell phone by the ear. The radiation penetrates the skull of an adult (25%), 10 year old (50%) and a 5 year old (75%).



Fig. 5 - Absorption of electromagnetic radiation from a cell phone based on age (Frequency GSM 900 MHz)

The younger the child, the deeper is the penetration due to the fact that their skulls are thinner and still developing. For these reasons it is critical that children under the age of 16 use cell phones only for short essential calls as they have much bigger danger of getting a brain tumor. Brain tumors have now taken over leukemia as the biggest cause of death amongst children. Due to these reasons countries like Belgium, France, Finland, Germany, Russia and Israel have publicly discouraged use of cell phones by children. An Independent research in Sweden last year concluded there was an astonishing 420 percent increased chance of getting brain cancer for cell phone users who were teenagers or younger when they first started using their phones.

A pregnant woman and the fetus both are vulnerable because of the fact that these RF radiations continuously react with the developing embryo and increasing cells. Microwave radiation can damage the placental barrier; the membrane which prevents the passage of some materials between the maternal and fetal blood, protecting the fetus, implying that pregnant woman should avoid cell phone or use during emergency.

In a recent finding, an association was found between a mother's cell phone use during pregnancy and greater likelihood for spontaneous abortion, congenital malformations and behavioral problems in their children. It is believed that the eggs, which form the embryo, are affected and the damage will become apparent after the child reaches puberty.

The Russian National Committee on Non-Ionizing Radiation Protection says that use of the phones by both pregnant women and children should be "limited". It concludes that children who talk on the handsets are likely to suffer from "disruption of memory, decline of attention, diminishing learning and cognitive abilities, increased irritability" in the short term, and that long-term hazards include "depressive syndrome" and "degeneration of the nervous structures of the brain".

5.3 Irreversible infertility

Recent studies confirm that cell phone radiation can drastically affect male fertility. In 2006, the American Society for Reproductive Medicine reported that use of cell phones by men is associated with decrease in semen quality, sperm count, motility, viability and normal morphology and is related to the duration of cell phone use. Studies have found 30% sperm decrease in intensive mobile phone users, in addition to damage of sperms. The average sperm count was found to be at 59 million sperm per milliliter of seminal fluid compared to 83 million for men not continually exposed to mobile phone radiation. Similarly, the study found that motility - the power of the sperm to swim - was affected by mobile phone transmissions. Men who made lengthy calls had fewer rapidly motile sperm, 36.3 per cent compared with 51.3 per cent for men who made no calls.

It was found that not only does using a phone affect a man's sperm quality, but simply having it switched ON in a pocket was enough to do damage as mobile phones periodically but briefly transmit information to cell towers to establish contact. Radiation from cell phone can also produce DNA breaks in sperm cells that can mutate and cause cancer. Damage to sperm DNA increases the risk further and can pass on the genetic changes to subsequent generations.

Animal studies indicate that EMR may have a wide range of damaging effects on the testicular function and male germ. It has been reported that mice on exposure to cell phone signals from an antenna park become less reproductive. After five generations of exposure, the mice were not able to produce offspring, showing that the effect of Radio frequency radiation can pass from one generation to another.

Due to these reasons it is advisable to never wear or use any wireless device near reproductive organs. Men planning to father children are advised to make sure that they stop using wireless devices well in advance of fertilization to reduce the chance of procreation with damaged sperm.

5.4 Calcium ion release from cell membranes

Studies have shown that weak electromagnetic fields remove calcium ions bound to the membranes of living cells, making them more likely to tear, develop temporary pores and leak. Leakage of calcium ions into the cytosol (the fluid found inside cells) acts as a metabolic stimulant, which accelerates growth and healing, but it also promotes the growth of tumors. Leakage of calcium ions into brain cells generates spurious action potentials (nerve impulses) accounting for pain and other neurological symptoms in electro-sensitive individuals. It also degrades the signal to noise ratio of the brain making it less likely to respond adequately to weak stimuli.

5.5 DNA damage

Cellular telephone frequencies can lead to damaged DNA. Studies show that microwave exposure at levels below the current FCC exposure standard, produces single and double strand breaks in DNA. EMR causes membrane leakage due to loss of calcium ions. Leaks in the membranes of lysosomes (small bodies in living cells packed with digestive enzymes) release DNAase (an enzyme that destroys DNA), which explains the fragmentation of DNA seen in cells exposed to mobile phone signals.

Microwave radiation can also interfere with the natural processes involved in DNA replication and repair, by subtly altering molecular conformation (architecture). Another possibility of DNA damage is via free radical formation inside cells. Free radicals kill cells by damaging macromolecules, such as DNA, protein and membrane and are shown to be carcinogenic. Several reports have indicated that electromagnetic fields (EMF) enhance free radical activity in cells as shown in Figure 6. The Fenton reaction is a catalytic process of iron to convert hydrogen peroxides, a product of oxidative respiration in the mitochondria, into hydroxyl free radical, which is a very potent and toxic free radical. Thus EMF affects the DNA via an indirect secondary process.

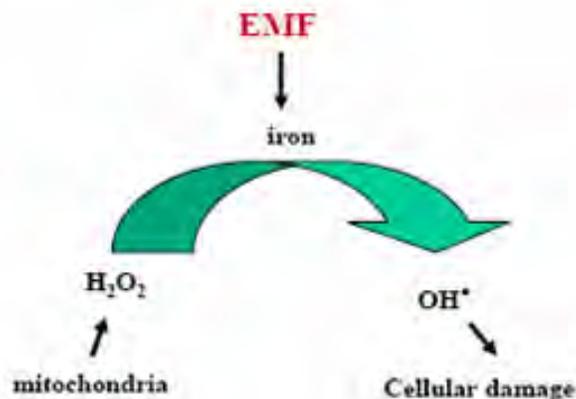


Figure 6 - The Fenton Reaction

Damage to DNA is a central mechanism for developing tumors and cancer. When the rate of damage to DNA exceeds the rate at which DNA can be repaired, there is the possibility of retaining mutations and initiating cancer. DNA damage in brain cells can affect neurological functions and also possibly lead to neurodegenerative diseases.

5.6 Interference with other gadgets including Pace Makers

Cell phone radiation interferes with navigational equipment; therefore its use is banned in airborne flights. Electromagnetic interference (EMI) from mobile phones can cause malfunctioning of life-line electronic gadgets in the hospitals thereby potentially endangering patients. It is also advisable to restrict mobile phone use in clinical areas like operating theatres and intensive care units.

Finally, hospital construction needs to take into account EMR from different areas within the hospital, as well as external sources, to limit interference with medical equipment. For example, allowing mobile phone use in a hospital corridor adjacent to a ward with sensitive medical equipment susceptible to EMR could be problematic.

RF exposure from mobile phones and cellular phone base antennas can also affect patients carrying Pace Maker, Implantable Cardiovascular Defibrillators (ICDs) and Impulse Generators. The signals generated by mobile phones cause electromagnetic interference with the device and interfere with its proper functioning. The signals produced by cell phone operating functions like, turning on, ringing, conversation and turning off, contain components of low frequencies that can interfere with the implanted pacemakers causing them to become arrhythmical which in adverse conditions can put the patient to death.

Due to these reasons government agencies have advised not to place mobile phones directly over pacemakers (such as in the chest pocket) and have issued recommendations to health care providers and patients with pacemakers. Also, the cellular phone should be used with the right ear if the pacemaker is implanted in the left side of the chest. As a safety measure, it is advisable to maintain a safe distance of about 50 cm between portable mobile phones from the patient.

5.7 Effects on Stress Proteins (Heat Shock Proteins)

Non-thermal effects of Radio frequency radiation accumulate over time and the risks are more pronounced after several years of exposure. The effects are not observed in the initial years of exposure as the body has certain defense mechanisms and the pressure is on the stress proteins of the body, namely the heat shock proteins (HSPs). The highly conserved HSPs accumulate in cells exposed to heat and a variety of other stressful stimuli like heavy metal poisoning and oxygen deprivation. HSPs, which function mainly as molecular chaperones, allow cells to adapt to gradual changes in their environment and to survive in otherwise lethal conditions.

It has been observed that GSM mobile phone exposure can activate the cellular stress response in both human and animal cells and cause the cells to produce stress proteins (heat shock proteins), in particular HSP27 and HSP70. This means that the body recognizes these electromagnetic radiations as a potential harm. Hence RF exposures add to the list of environmental stressors that

cause a physiological stress response. This further demonstrates that ELF and RF exposures can be harmful, and it happens at levels far below the existing public safety standards.

HSPs are known to inhibit natural programmed cell death (apoptosis), whereby cells that should have 'committed suicide' continue to live. Recent studies show that HSP27 and HSP70 inhibit apoptosis in cancer cells. Taken together, these various effects are, in turn, consistent with the 2 to 3 fold increase in the incidence of a rare form of cancers. If the stress goes on for too long, there is a reduced response, and the cells are less protected against the damage. This is why prolonged or chronic exposures may be quite harmful, even at very low intensities.

5.8 Effect on Skin

Radiation from cell towers and mobile phones affects human skin. People who talk often on cell phones have a higher concentration of the *transtyretin* protein than those who do not. *Transtyretin* is formed in the liver; it helps transport vitamin A in the body and plays an important role in nervous diseases such as Alzheimers.

The symptoms of *Morgellons* disease include those of electromagnetic hypersensitivity (EHS); may be based on how body uses electric currents to repair wounds to the skin. People who suffer from this condition report a range of skin symptoms including crawling, biting and stinging sensations; granules, threads or black speck-like materials on or beneath the skin and/or lesions (e.g., rashes or sores). EMFs degrade the immune system and stimulate various allergic and inflammatory responses. The high radiation from cell towers can result in an increase in mast cells, which explains the clinical symptoms of itch, pain, edema and erythema.

5.9 Tinnitus and Ear Damage

Tinnitus, popularly known as "Ringxiety"- is the psychological disease of hearing phantom sound and sensation of cell phone ring and it has been reported among millions of cell phone users in the world. People with severe tinnitus may have trouble hearing, working or even sleeping. The radiation emitted by mobile phones may damage the delicate workings of the inner ear, and long-term and intensive mobile phone use for more than four years and for longer periods than 30 minutes in a day are at a higher risk of developing hearing loss, which cannot be reversed.

This auditory perception has been shown to occur when a person's head is illuminated with microwave energy. The microwave pulse upon absorption in the head, launches a thermo-elastic wave of acoustic pressure that travels by bone conduction to the inner ear. There it activates the cochlear receptors via the same process involved for normal hearing, which explains the "clicks" heard by people exposed to microwave radiation.

Today, more and more young people between 18 and 25 years of age are suffering from hearing loss, which doctors say is due to excessive use of mobile phones and other gadgets. Good hearing depends on the health of some 16,000 hair cells present in each inner ear. But increasingly, doctors have been treating people whose hair cells have been damaged by the high radiation emitted from cell phones. Hearing problems occur because these cells do not regenerate. Anyone who spends two to three hours on the cell phone every day runs the risk of

partial deafness over three to five years. Most of the marketing and tele-consulting professionals are in their 20s, and their jobs demand long conversations on cell phones. The problem starts with a pain in the ear that gradually develops into tinnitus or a ringing sensation which finally leads to hearing loss.

5.10 Effect on Eye/ Uveal Melanoma

Frequent use of mobile phones can also damage the visual system in many ways and cause uveal melanoma i.e. tumor of the eye. Tumors involve the choroid (98%), iris (1%) and unknown parts of the uveal tract (1%). Computational modeling and experiments with several laboratory animals show that microwave radiation similar to mobile phone frequencies (900, 1800 MHz and 2450 MHz) can induce chromosomal breaks in the corneal epithelial cells and increase the intraocular temperature of the eye with prolonged exposure.

Increase in temperature close to the eye lens (as low as 3°C) can result in lens opacities and increase the risk of developing cataracts in humans, a condition characterized by clouding in the natural lens of the eye and lens opacities. When Bovine eye lenses were exposed to microwave radiation, it caused macroscopic damage and affected the optical function of the lens. The damage increased as the irradiation continued and reached a maximum level after a number of days. When the exposure stopped the optical damage began to heal gradually. A similar maximum level was observed when the irradiation intensity was reduced to one-half the original, except that it took twice the time. A lens of good optical quality is able to focus the laser beam from the various locations (green lines in the left frame of Fig. 7. When the lens is damaged due to exposure to microwave radiation, its ability to focus the laser beam at the various locations is altered, as clearly revealed in the right frame. The blue line connects the points of the back vertex distance for each ray passing through the lens. The pink line shows the relative intensity of each beam, that is, the transmitted intensity normalized to the incident one.

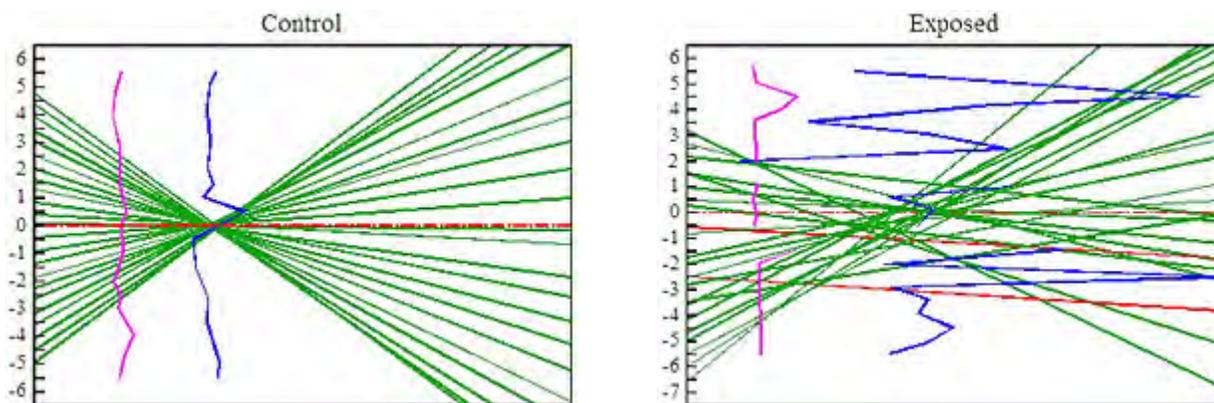


Fig. 7 – Left - Good quality lens - all rays passing through the lens have similar focal length. **Right** - Exposed lens, showing considerable variability in the focal length of the beams passing through the lens.

Prolonged exposure to microwave radiation similar to that used by cellular phones can lead to both macroscopic and microscopic damage to the lens and part of this damage seems to accumulate over time and does not heal.

5.11 Cell phone emission weaken bones

Researchers have measured bone density at the upper rims of the pelvis (iliac wings) in men who were mobile users and carried their phones on their belts. The iliac wings are widely used source of bone for bone grafting, so any reduction in bone density may be of special importance to reconstructive surgery. The results showed reduction in iliac wing bone density on the side where men carried their phones. In general, it is better to keep mobile phones as far as possible from our body during our daily lives.

5.12 Salivary gland tumor

Increased risk of salivary gland cancer among residents in Israel from 1970 to 2006 has been reported, which is believed to be linked to the use of mobile phones. Among salivary gland cancer cases, researchers found a worrying rise in the number of cases of malignant growth in parotid glands - the salivary gland located under the ear, near the location where cell phones are held during conversations. Users below the age of 20 were found to be more susceptible.

Another epidemiology study found that people who held a mobile handset against one side of their head for several hours a day have 50% more risk for tumor formation in the parotid gland - the largest salivary gland after 5-10 years.

5.13 Melatonin Reduction

Melatonin, a vital natural neuro-hormone is a powerful antioxidant, antidepressant and immune system enhancer that regulates our circadian rhythm. Every night as we go to sleep, our melatonin levels rise. Melatonin goes through our blood and clears our cells up, that is to say, scavenges free radicals in the cell to protect the DNA and reduce the possibility of cells becoming carcinogenic. The daily sleep/wake cycle, blood pressure and heart rate cycle, metabolic rate and thermal regulation, hormone production and immune system activity all have a daily cycle regulated by melatonin directly or indirectly through the autonomic system.

Various studies show that exposure to EMR reduce melatonin levels in animals and humans. Daily cellular telephone use of >25 minutes over years may lead to reduced melatonin production. Studies with animals show a reduction in melatonin levels following radiofrequency radiation exposure from cell phones and cell sites. Turning off the transmitters resulted in a significant increased melatonin levels within few days.

When availability of melatonin is impaired, a whole range of disorders including sleep disturbance, chronic fatigue, depression, cardiac, reproductive and neurological diseases and mortality can occur. Reduced melatonin is also associated with increased DNA damage and increased risk of cancer, arthritis, seasonally affective disorder (SAD), schizophrenia, increased eye stress, renal impairment, Alzheimer's and Parkinson's disease, miscarriage, sudden infant death syndrome (SIDS), and increased risk of childhood leukemia.

5.14 Sleep Disorders

Electromagnetic fields have been shown to affect the brain physiology. Use of mobile phones disturbs Stage 4 sleep, the stage important for full recuperation of brain and body. Use of the handsets before bed, delays and reduces sleep, and causes headaches, confusion and depression. The findings are especially alarming for children and teenagers as they use cell phones at night and also keep the phone next to their head; which may lead to mood and personality changes, depression, lack of concentration and poor academic performance.

The relationship of sleep disturbance with exposure to a cell phone/ tower radiation is shown in Fig. 8. It can be seen that percentage increase in sleep disturbance is proportional to the exposure dose. Even at $1\text{ nW/cm}^2 = 0.001\mu\text{W/cm}^2 = 10\ \mu\text{W/m}^2$, disturbance in the sleep is of the order of 35%. When the transmitter was turned off, the symptoms resumed gradually

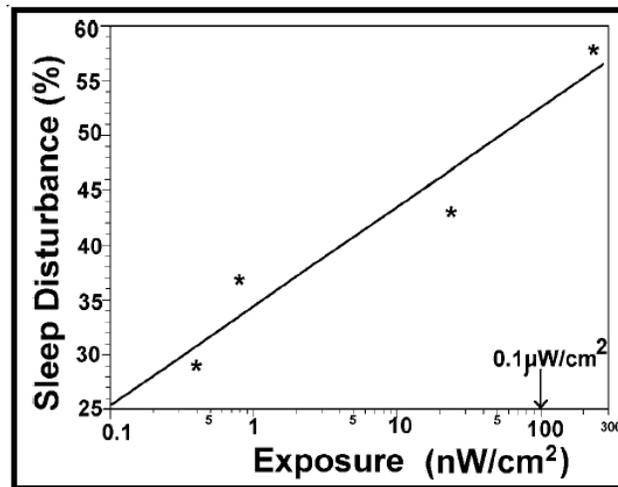


Figure 8 - Dose-response relationship for Sleep Disturbance with exposure in nW/cm²

5.15 Neurodegenerative Diseases

Exposure to electromagnetic fields has shown to be in connection with Alzheimer's disease, motor neuron disease and Parkinson's disease. All these diseases are involved with the death of specific neurons and are classified as neurodegenerative diseases.

People living near mobile phone base stations are also at risk for developing neuropsychiatric problems as headache, memory loss, nausea, dizziness, tremors, muscle spasms, numbness, tingling, altered reflexes, muscle and joint pain, leg/foot pain, depression, and sleep disturbance. More severe reactions include seizures, paralysis, psychosis and stroke.

5.16 Increase in Cancer risk

Heavy use of mobile phones can cause cancer. Use of mobile phones for >10 years give a consistent pattern of increased risk for brain cancer - glioma (cancer of the glial cells that support the central nervous system) and acoustic neuroma (a benign tumor in the brain on a nerve

related to hearing). The risk is highest for ipsilateral (on the same side of the head where the instrument is held) exposure. Children and teenagers, before the age of 20 are five times more likely to get brain cancer, as their brain is not fully developed and radiation penetration is much deeper. It is possible that today's young people may suffer an "epidemic" of the disease in later life.

Besides increase in brain tumour and acoustic neuroma, there is an increased risk of several other types of cancers following prolonged exposure to mobile phone/ tower radiation, such as, salivary gland tumors, uveal melanoma, lymphoma, facial nerve tumors, skin, blood, testicular and breast cancer. Interphone study has also found a 'significantly increased risk' of some brain tumors for heavy users of mobile phones (> 20 minutes per day) for a period of 10 years or more. It is suggested that children should be discouraged from using mobile phones and restrict use to emergency while adults should "keep calls short".

5.17 Epidemiological studies in various countries

There have been several epidemiological studies of people living near cell phone antennas in Spain, the Netherlands, Israel, Germany, Egypt, Austria, etc. All these studies documents adverse health effects and exposures are orders of magnitude below the FCC or ICNIRP guidelines. Some of these studies are summarized below:

Example 1: FRANCE (Santini, 2002)

In this study the people who lived closest to the cellular antennas had the highest incidences of the following disorders: fatigue, sleep disturbances, headaches, feeling of discomfort, difficulty in concentrating, depression, memory loss, visual disruptions, irritability, hearing disruptions, skin problems, cardiovascular disorders, and dizziness (See Figure 9).

Women were found to have more symptoms than men. This study, based on the symptoms experienced by people living in vicinity of base stations recommend that the cellular phone base stations should not be sited closer than 300 m to populations. This is probably not possible in Urban area, so the solution is to reduce the transmitted power level.

Example 2: GERMANY (Eger H, 2004)

The aim of this study was to examine whether people living close to cellular transmitter antennas were exposed to a greater risk of becoming ill with malignant tumors. The researchers found that the proportion of newly developing cancer cases was significantly higher among those patients who had lived within **400 meters** from the cellular transmitter site during the past 10 years, compared to those patients living further away. They also found that the patients fell ill on average 8 years earlier. After five years of operation of the transmitting installation, the relative risk of getting cancer had increased by 3-fold for the residents of the area near the installation, compared to the inhabitants outside the area. Breast cancer topped the list, and the average age of contracting this disease was considerably lower, 50.8 years compared to 69.9 years for the people living in the outer area. Cancers of the prostate, pancreas, bowel, skin melanoma, lung and blood cancer were all increased.

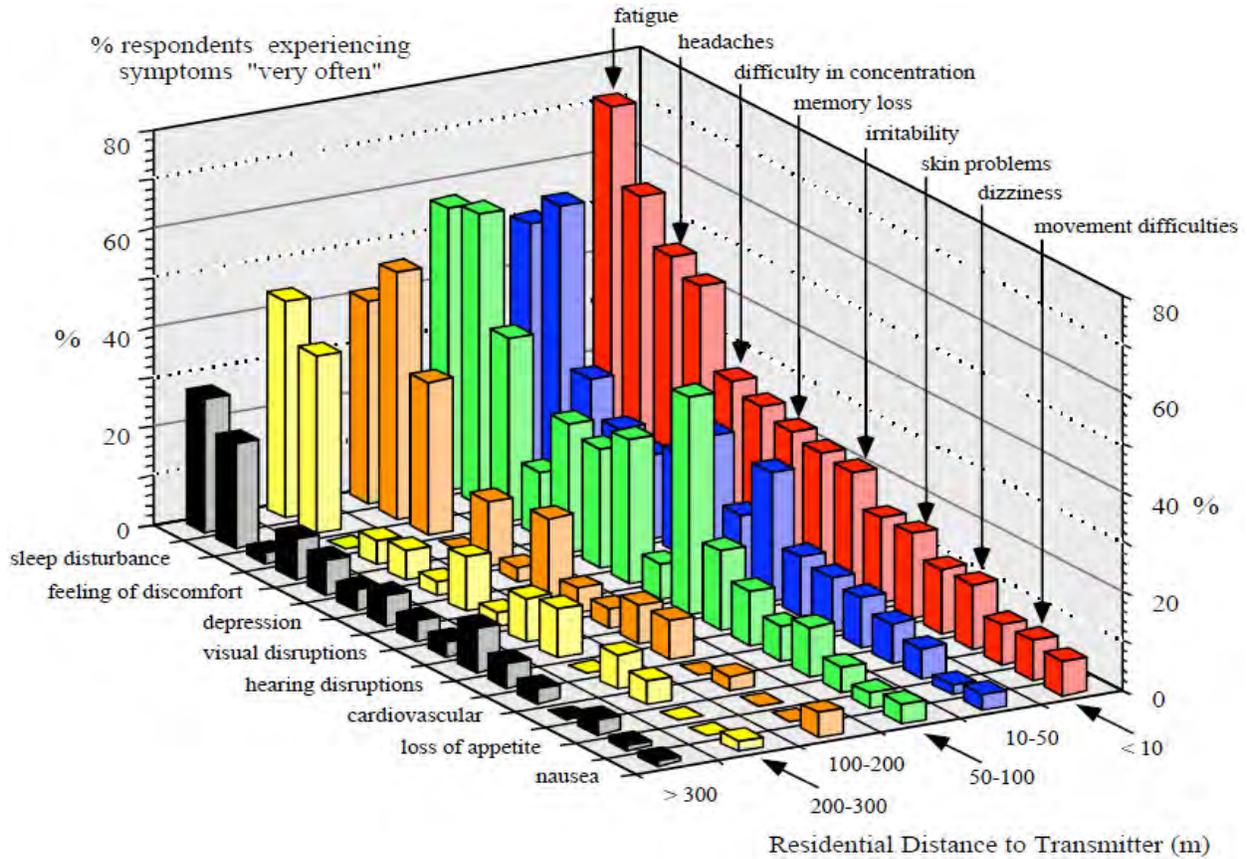


Figure 9. Response of residents living in the vicinity of a cellular phone base station in France.

Example 3: ISRAEL (Wolf R, Wolf D, 2004)

This study, based on medical records of people living within 350 meters of a long established phone mast, showed a fourfold increased incidence of cancer compared with the general population of Israel, and a tenfold increase specifically among women, compared with the surrounding locality further from the mast.

Example 4: SPAIN (Oberfeld 2004)

This study found significant ill-health effects among those living in the vicinity of two GSM mobile phone base stations. The strongest five associations found were depressive tendency, fatigue, sleeping disorder, difficulty in concentration and cardiovascular problems. The scientists reported the following symptoms within 50 to 150 m of the cell phone antenna at an average power density of $0.11 + 0.19 \mu\text{W}/\text{cm}^2$. Note that $0.11 \mu\text{W}/\text{cm}^2$ is considerably lower than $1000 \mu\text{W}/\text{cm}^2$ established by the FCC. This demonstrates that the FCC guideline does not protect the public from radio frequency radiation exposure.

Among the 350 inhabitants of Pérez, near the town of Velez-Malaga, there have been 43 cases of cancer, 35 of which have resulted in death.

Example 4: SWEDEN

Sweden was one of the first countries to claim 100% mobile connectivity. Survey studies show that somewhere between 230,000 - 290,000 Swedish men and women out of a population of 9,000,000 are now electrohypersensitive (EHS) and report a variety of symptoms when being in contact with electromagnetic field sources. Symptoms include - allergic reactions, redness of skin, memory loss, sleep disruption, headache, nausea, tingling, altered reflexes, buzzing in the head, palpitations of the heart, visual disorders, cardiovascular problems, respiratory problems etc. Severe symptoms like leukemia, brain cancer, and acoustic neuroma (tumor in the ear) have also been reported. Sweden is the only country in the world to recognize EHS as a functional impairment/ physical degradation and not a disease.

Example 5: UK

In Berkeley House, Staple Hill, Bristol, UK, where Orange mobile mast was erected on roof of a five story building; several people living on the top floor had cancer.

In Warwickshire, 31 cancer patients were detected on a single street and a quarter of 30 odd staff at a special school, within sight of 90 ft high mast, developed brain tumors since 2000. The masts are being pulled down under growing protests of thousands of people.

Example 5: Australia

The top floors of a Melbourne office building were closed down and 100 people were evacuated after a seventh worker in seven years was diagnosed with a brain tumour. The Australian Health Research Institute indicates that due to billions of times more in volume electromagnetic radiation emitted by billions of mobile phones, internet, intranet and wireless communication data transmission, almost one-third of world population (about 2 billion) may suffer from Cell Phone Cancer beside other major body disorders like heart ailments, impotency, migraine, epilepsy by 2020

Example 6: India:

Builder in Riddhi Park, Thakurlee (West) had installed mobile tower before the residents had occupied the building. Within 4 months of occupying the top floor flat, Mrs. Bhat was diagnosed with "brain tumor". She used to feel fatigued; and also suffered from white rashes on the body. Her neighbor delivered a baby with cancer of spinal cord. Another neighbor gave birth to a child having "Birth Defects"; and the child died immediately after birth. All the residents of the building are now demanding the demolition of the tower. In spite of these demands by residents, builder has installed another tower. Mrs. Bhat has left her flat now staying in Goregaon and spent around Rs. 10 lakhs for treatment on brain tumor. However her health is now improving.

Mr. Bhagwant Deshpande of Solapur has reported 9 deaths due to cancer living within 91m from the two towers. Details of the dead people are given below:

Name of deceased	Year of death	Cause of death	Age at time of death
Radhabai Sathe	2005	Breast cancer	66
Deshpande	2006	Oesophagus cancer	48
Shubhangee Deshpande	2007	Rectum cancer	66
Pujaree	2008	Cancer	46
Gawai	2008	Breast cancer	52
Shah	2009	Cancer	48
Vidyadhar Dev	2009	Liver cancer	52
Ransube	2009	Throat cancer	73
Archana Malvadkar	2009	Spinal cord cancer	17

Source: L B Deshpande, who studied the deaths in his Solapur locality since two towers were installed four years ago

6. Adverse effect on birds, animals and environment

Electromagnetic radiation from Cell phone and cell tower affects the birds, animals, plant and environment. One would never see a bee, sparrow, pigeon, or any bird flying and staying near the cell tower? The reason is that surface area of a bird is relatively larger than their weight in comparison to human body, so they absorb more radiation ($\text{power} = \text{power density} \times \text{area}$). Since fluid content is small due to less weight, it gets heated up very fast and also the magnetic field disturbs their navigational skills. These effects are given in the following sub-sections.

6.1 Effect on Honey Bees

It has been quoted that Albert Einstein had said, “If the bee disappears from the surface of the earth, man would have no more than four years to live.” In the US, an abrupt disappearance of bees was observed several years back and was associated with the rising electromagnetic pollution. This is known as Colony Collapse Disorder (CCD) where bees cannot find their way back to the hive as a result of consistent electromagnetic back ground noise that seems to disrupt intercellular communication within individual bees. CCD has since spread to Germany, Switzerland, Spain, Portugal, Italy, Greece, Scotland, Wales and north-west England. In England, the bee population fell by 54 percent between 1985 and 2005 compared to an average of 20 per cent across Europe.

Recently, a sharp decline has also been noticed in commercial bee population in Kerala posing a serious threat to honey bees, hitting apiculture (the cultivation of bees on a commercial scale for the production of honey). The State has the highest density of mobile towers. Similar cases have been observed in Bihar, Punjab, Nepal and other parts of India and have been attributed to increasing electro pollution in the environment.

When honey bee colonies were exposed with radiation, the honeycomb weight and area were reduced and returning time of honey bees increased compared to similar non-exposed colonies. Several other studies show that the high-frequency electromagnetic fields of mobile phones alter the resonant stimulus of living organisms and can cause modifications in certain areas of their brain. Changes in the brain structure of bees can be a cause of alterations of the returning capabilities of bees.

It's not just the honey that will be lost if populations plummet further. Bees are estimated to pollinate 90 commercial crops worldwide. The current dying/vanishing of honey bees can have serious consequences for human health. Scientists warn that the steady decline in bees and other pollinators could trigger crises bigger and more immediate than global warming.

Honey bees brain anatomy as well as the learning regions of the bee brain are well known and comparable to those of vertebrates and are well suited as a bio-indicator. We are fortunate that the warning bells have been sounded and it is for us to timely plan strategies to save not only the bees but human life and environment from the ill effects of such EMR.

6.2 Effect on Birds

When birds are exposed to weak electromagnetic fields, they disorient and begin to fly in all directions, which explain migratory birds undermining navigational abilities. A large number of birds like pigeons, sparrows, swans are getting lost due to interference from the new "unseen enemy", i.e. mobile phone masts. Several million birds of 230 species die each year from collisions with telecommunications masts in the United States during migration. Accidents happen mainly in the night, in fog, or bad weather, when birds might be using the earth's magnetic field for navigation, and could be seriously disoriented by the microwave radiation from telecommunication masts.

During recent decades there has been a marked decline of the house sparrow population. London has witnessed a steep fall in its sparrow population; a 75 per cent fall since 1994. There have been dramatic declines, almost to the point of extinction in Glasgow, Edinburgh, Hamburg, Ghent, Brussels, Dublin, Belgium, etc. Studies show that the disappearance of the sparrow and the introduction of phone mast GSM towers correlate closely in terms of time.

In Spain, to monitor the breeding success of the white stork population, 60 nests were selected and visited from May to June of 2003. Thirty nests were located within 200 m of mobile masts and other 30 were located at a distance of more than 300 m from any transmitter. 40% of the nests close to the antennae were without young, as opposed to 3.3% among those at a larger distance. Behavioural changes were also observed among birds close to the phone antennae. Young birds died from unknown causes and bird couples frequently fought while constructing their nests. Some nests were never completed and the storks remained passively in front of the antennae.

Microwaves from phone masts also interfere with reproductive success of birds. In an experiment, 75% of chicken embryos that were exposed to a GSM mobile phone during incubation died compared to 16%, who were not exposed to any radiation. Birds having nest near

towers were found to leave their nests within one week. The eggs laid in nests near towers failed to hatch.

A general disappearance of birds like Kestrel, White Stork, Rock Dove, pigeons, Magpie has been observed near base stations for mobile telecommunication. Locomotive problems, breeding problems, and tendency to stay long in lower parts of the trees and on the ground have been observed. In some tracked nests (blackbird), the eggs never hatched and also many dead specimens were found near phone masts areas.

A house sparrow is associated with human habitation. Being very sensitive to changes in the environment, it is one of the most preferred indicator species of urban ecosystems. A stable house sparrow population indicates a healthy ecosystem for human beings in terms of air and water quality, vegetation and other parameters of habitat quality. Whereas, a declining population of the bird provides a warning that the urban ecosystem is experiencing some environmental changes unsuitable for human health in the immediate future.

6.3 Effect on mammals and amphibians

The study in Germany showed that cows grazing near cell towers are more likely to experience still births, spontaneous abortions, birth deformities, behavioral problems and general declines in overall health. Moving cattle herds away from such towers has reportedly led to immediate health improvements. Exposing dairy cows to magnetic fields can also result in reduction in milk yield, changed milk composition and fertility problems. Recently, a significant increase of micronuclei in erythrocyte in the blood of cattle grazing on a farm near a transmitting facility was discovered. This is an indication of a genotoxic effect of the exposure, which means the change will pass on to their subsequent generations.

Similarly, impaired immune system in sheep, reproductive and developmental problems in dogs and cats, anxiety and alarm in rabbits, frequent death of domestic animals such as, hamsters, and guinea pigs living near base stations of mobile telecommunication towers has been observed.

Electromagnetic pollution is a possible cause for deformations and decline of some amphibian populations too. Morphological abnormalities, allergies, changes in blood counts, increase in the heart rate, arrhythmia and increased mortality has been found in amphibians like Newts and frog tadpoles. Bat activity is significantly reduced in habitats exposed to electromagnetic field. During a study, in a free-tailed bat colony, the number of bats decreased when several phone masts were placed 80m from the colony.

6.4 Effect on Plants

Apart from bees, birds and animals, electromagnetic radiation emanating from cell towers can also affect vegetables, crops and plants in its vicinity. Studies show definitive clues that cell phone EMF can choke seeds, inhibit germination and root growth, thereby affecting the overall growth of agricultural crops and plants. A reduction in wheat and corn yield in the fields near high EMF lines has also been reported.

Progressive deterioration of trees near phone masts has also been observed. Trees located inside the main lobe (beam), look sad and feeble, have dried tops, show slow growth and high susceptibility to illnesses and plagues. Also, electromagnetic radiations generate heat. Due to this, the microorganisms present in the soil near it would be killed. This in turn harms those organisms which feed on them and disturbs the ecological cycle.

7. Possible Solutions to reduce the ill effects of cell tower radiation

There are several health hazards due to radiation from the cell towers to the human, birds, animals and environment. In India, we have adopted very relaxed radiation norms of 4.7 W/m^2 for GSM900, whereas serious health effects have been noted at as low as $0.0001 \text{ W/m}^2 = 100 \mu\text{W/m}^2$. One of the first steps to be taken is to tighten the radiation norms and yet it should be practical enough to be cost effective without causing too much inconvenience to the users. It is recommended that maximum cumulative power density allowed should be reduced with immediate effect to 0.1 W/m^2 , which should then be subsequently reduced to 0.01 W/m^2 within a year, so that network planning can be carried out in a phased manner. It must be noted that a few countries have even adopted 0.001 W/m^2 or lower, so our proposed recommendation is higher than these countries to keep it cost effective. All the operators must be strictly instructed that power density inside residential or office buildings, schools, hospitals, and at common frequently visited places should be within these guidelines. People must be informed about the harmful radiation effects and corrective measures taken by Govt. of India. Also, people must be informed that for some time, they may have network problem (especially people living far away from the cell tower) due to reduction in the transmitted power but it is for their overall health benefit.

Solution is to have more numbers of cell towers with lesser transmitted power. When power transmitted is reduced, it will not require power hungry power amplifiers having lower efficiency. Heating effect will also be reduced, so lesser cooling or no cooling will be required; all of these will reduce the power requirement, which can also be met by solar panel. Thus, high power diesel generators will also be not required; it will reduce the carbon emission and we can earn from carbon credits.

In addition, repeaters or signal enhancers or boosters may have to be installed where signal is weak. Care must be taken that maximum power transmitted by these must not exceed 0.1W because of their close proximity to the users.

Self certification by the operators must be immediately abolished; measurements must be done by third party, which is independent and trustworthy. Also, radiation measurements must be monitored continuously, so that operators should not increase the transmitted power during the peak period. Very strict penalties must be imposed on those operators, who violate these norms as it causes serious health hazards to innocent people.

The reduction in the transmitted power for the above solutions will definitely increase the installation and maintenance cost, because of this reason, operators all over the world are claiming that there are no radiation health hazards. Increase in the cost of deployment of network can be met by increasing per minute charges from Rs. 0.30 to 0.35, extra carbon credits earned,

etc. Also, Govt. may consider reducing the tax or license fee in the overall interest of saving the lives of people, birds, animals, plants, and environment, thereby saving mother earth.

8. Conclusion

The seriousness of the health hazards due to radiation from the cell phones and cell towers has not been realized among the common man. Cell operators continue to claim that there are no health issues. Even organizations like WHO, ICNIRP, FCC, etc. have not recommended stricter safe radiation guidelines, whereas several countries have adopted radiation norms, which are $1/100^{\text{th}}$ to $1/1000^{\text{th}}$ of these values based on their studies. Cell phone industry is becoming another cigarette industry, which kept claiming that smoking is not harmful and now there are millions of people around the world who have suffered from smoking. In fact, cell phone/tower radiation is worse than smoking; as one cannot see it or smell it, and its effect on health is noted after a long period of exposure. Therefore, majority of people tend to have casualness towards personal protection. Unfortunately, ignorance and non-awareness adds to this misery and all of us are absorbing this slow poison unknowingly. Even if people are aware of the radiation hazard, they may not have the choice to move away from it if the tower is installed near their office or residential building.

In addition to the continuous radiation from cell towers, there is radiation from cell phones, wireless phones, computers, laptops, TV towers, FM towers, AM towers, microwave ovens, etc. We are exposed to all these radiations which are additive in nature. Hence, it is imperative that stricter radiation norms must be enforced by the policy makers.

This does not mean that we have to stop living near these towers. We all know that automobiles create air pollution – have we stopped using them? Instead, solutions were found such as unleaded petrol, catalytic converters to reduce emission, CNG driven vehicles, hybrid vehicles, etc. If people in the mobile companies think there is no health hazard, then let them stand in front of their own transmitting tower at 1m distance in the main beam for 6 hours – are they willing to take the risk? Similar effect will be there at 10m distance in about 600 hours (25 days). If mobile companies accept that radiation causes serious health problems, will people stop using cell phones? Not really, because the cell technology has its several advantages. However, then researchers/technocrats/entrepreneurs will come out with possible solutions, which may be expensive but that cannot be greater than the health risk faced by humans, birds, animals and environment.

Appendix A – Conversion from power received to electric field and power density

Power Density S can be calculated from the following equation in W/m²

$$S = \frac{P \cdot 4\pi \cdot f^2}{c_0^2 \cdot G_i}$$

where,

- P Measured Power in W (Example: P= -30dBm = 0.000001W)
- G_i Gain of receiving antenna
- f Frequency in Hz
- c₀ Velocity of light = 3 x 10⁸ m/s.

Following table gives values of electric field and power density for an isotropic antenna G_i = 1 for different values of power received.

Conversion table

Conversion between units: dBm to V/m, W/m			Conversion between units: dBm to V/m, W/m		
0 dBm	6,75V/m	0,121W/m ²	-36dBm	0,107V/m	0,000.030.4W/m ²
-1 dBm	6,02V/m	0,096.0W/m ²	-37dBm	0,095.4V/m	0,000.024.1W/m ²
-2 dBm	5,36V/m	0,076.3W/m ²	-38dBm	0,085.0V/m	0,000.019.2W/m ²
-3 dBm	4,78V/m	0,060.6W/m ²	-39dBm	0,075.8V/m	0,000.015.2W/m ²
-4 dBm	4,26V/m	0,048.1W/m ²	-40dBm	0,067.5V/m	0,000.012.1W/m ²
-5 dBm	3,80V/m	0,038.2W/m ²	-41dBm	0,060.2V/m	0,000.009.60W/m ²
-6 dBm	3,38V/m	0,030.4W/m ²	-42dBm	0,053.6V/m	0,000.007.63W/m ²
-7 dBm	3,02V/m	0,024.1W/m ²	-43dBm	0,047.8V/m	0,000.006.06W/m ²
-8 dBm	2,69V/m	0,019.2W/m ²	-44dBm	0,042.6V/m	0,000.004.81W/m ²
-9 dBm	2,40V/m	0,015.2W/m ²	-45dBm	0,038.0V/m	0,000.003.82W/m ²
-10dBm	2,13V/m	0,012.1W/m ²	-46dBm	0,033.8V/m	0,000.003.04W/m ²
-11dBm	1,90V/m	0,009.60W/m ²	-47dBm	0,030.2V/m	0,000.002.41W/m ²
-12dBm	1,70V/m	0,007.63W/m ²	-48dBm	0,026.9V/m	0,000.001.92W/m ²
-13dBm	1,51V/m	0,006.06W/m ²	-49dBm	0,024.0V/m	0,000.001.52W/m ²
-14dBm	1,35V/m	0,004.81W/m ²	-50dBm	0,021.3V/m	0,000.001.21W/m ²
-15dBm	1,20V/m	0,003.82W/m ²	-51dBm	0,019.0V/m	0,000.000.960W/m ²
-16dBm	1,07V/m	0,003.04W/m ²	-52dBm	0,017.0V/m	0,000.000.763W/m ²
-17dBm	0,954V/m	0,002.41W/m ²	-53dBm	0,015.1V/m	0,000.000.606W/m ²
-18dBm	0,850V/m	0,001.92W/m ²	-54dBm	0,013.5V/m	0,000.000.481W/m ²
-19dBm	0,758V/m	0,001.52W/m ²	-55dBm	0,012.0V/m	0,000.000.382W/m ²
-20dBm	0,675V/m	0,001.21W/m ²	-56dBm	0,010.7V/m	0,000.000.304W/m ²
-21dBm	0,602V/m	0,000.960W/m ²	-57dBm	0,009.54V/m	0,000.000.241W/m ²
-22dBm	0,536V/m	0,000.763W/m ²	-58dBm	0,008.50V/m	0,000.000.192W/m ²
-23dBm	0,478V/m	0,000.606W/m ²	-59dBm	0,007.58V/m	0,000.000.152W/m ²
-24dBm	0,426V/m	0,000.481W/m ²	-60dBm	0,006.75V/m	0,000.000.121W/m ²
-25dBm	0,380V/m	0,000.382W/m ²	-61dBm	0,006.02V/m	0,000.000.096.0W/m ²
-26dBm	0,338V/m	0,000.304W/m ²	-62dBm	0,005.36V/m	0,000.000.076.3W/m ²
-27dBm	0,302V/m	0,000.241W/m ²	-63dBm	0,004.78V/m	0,000.000.060.6W/m ²
-28dBm	0,269V/m	0,000.192W/m ²	-64dBm	0,004.26V/m	0,000.000.048.1W/m ²
-29dBm	0,240V/m	0,000.152W/m ²	-65dBm	0,003.80V/m	0,000.000.038.2W/m ²
-30dBm	0,213V/m	0,000.121W/m ²	-66dBm	0,003.38V/m	0,000.000.030.4W/m ²
-31dBm	0,190V/m	0,000.096.0W/m ²	-67dBm	0,003.02V/m	0,000.000.024.1W/m ²
-32dBm	0,170V/m	0,000.076.3W/m ²	-68dBm	0,002.69V/m	0,000.000.019.2W/m ²
-33dBm	0,151V/m	0,000.060.6W/m ²	-69dBm	0,002.40V/m	0,000.000.015.2W/m ²
-34dBm	0,135V/m	0,000.048.1W/m ²	-70dBm	0,002.13V/m	0,000.000.012.1W/m ²
-35dBm	0,120V/m	0,000.038.2W/m ²			

dBm = decibel milliwatts, W/m² = watts per square meter, V/m = volts per meter, A/m amperes per meter

dBm = decibel milliwatts, W/m² = watts per square meter, V/m = volts per meter, A/m amperes per meter

Appendix B - Videos on Radiation

- **Cell Phone Antennas on Apartment Rooftops and their Health Effects**
<http://www.youtube.com/watch?v=-G3CWrgDS5E>
Woman experiences illness after two months of cell phone antennas installed on roof top
- **Phone tumour**
<http://au.video.yahoo.com/watch/8546044/22969162>
Anna , 27, and her doctor convinced that her brain tumour is due to heavy mobile use.
- **New evidence in mobile phone tumour link**
http://www.youtube.com/watch?v=fMZhkDEsXU8&feature=player_embedded
David,30,developed tumour the size of gulf ball behind right ear where he held his phone.
- **Cell phone towers in cities health hazards?**
http://www.youtube.com/watch?v=IOc99xpiy2E&feature=player_embedded
Mrs. Bhatt, brain aneurysm patient, blames the cell phone tower for her problem.
- **Cell phone antennas blamed for kindergarten cancer cases, Chicago**
http://www.youtube.com/watch?v=BrQ9uXv57_s&feature=youtu.be
3 students died of leukemia and 30% of staff sick
- **EMF RF Exposure from cell phone radiation is potentially harmful**
<http://www.youtube.com/watch?v=BXn8c41ZVTQ>
Sarah Dacre, suffers from EHS and wears special shielded clothes to protect herself
- **Health danger - wifi radiation - 2 –**
<http://www.youtube.com/watch?v=EykTJJMvjCs>
Lady lives in a room with Silver foiling
- **Growing Evidence That Cell Phones Create Tumors**
http://www.youtube.com/watch?v=-9DuCzGLohc&feature=player_embedded
Alan,57, developed a gulf ball size tumour on right side of brain where he held his phone.
- **Dr. Charlie Teo - "explosion" in brain tumours and truth about the wireless society**
http://www.youtube.com/watch?v=Zq340oQPfK4&feature=player_embedded#!
John developed malignant tumour behind right ear; Dr. Teo's (neurosurgeon) testimony
- **Cell Phones & Cigarettes: What do they have in Common?**
<http://www.youtube.com/watch?v=K4uz2TUcwnI>
- **Live Blood & Electrosmog -** <http://www.youtube.com/watch?v=L7E36zGHxRw>
- **Street protests against Mobile masts in Taiwan –** <http://bit.ly/a2JNnZ>
- **Mumbai highly unsafe due to heavy mobile tower radiation but VVIPs house is safe**
<http://www.youtube.com/watch?v=JCN9FLSvwhQ&feature=youtu.be> - IN HINDI
- **The National Cell Phones and Disease Sept 26 2010**
http://www.youtube.com/watch?v=F4bp7Zi_8pk
Facts and fine prints about cell phone use
- **Invisible Dangers of Cell Phone Radiation**
<http://www.youtube.com/watch?v=eVo2maA7h1E>
- **Dr Magda Havas - On Cell /Transmission Towers and Your Health**
<http://video.google.ca/videoplay?docid=6284020723745580379#>
- **Cell Phones and Brain Cancer - The Interphone Study**
<http://www.youtube.com/watch?v=npK5HSxukyA>
Interphone witnesses testified about research into cell phone use and its impact on health

More reports and videos have been uploaded at Blog: <http://neha-wilcom.blogspot.com> and Twitter: https://twitter.com/wilcom_neha

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Dec 2012

CELL PHONE/TOWER RADIATION HAZARDS AND SOLUTIONS

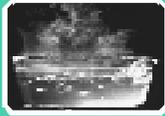
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OUTLINE OF PRESENTATION



Cell Tower Statistics



Microwave Heating Principle



Radiation Pattern of Cell tower Antenna



EMF exposure Safety norms



Radiation measurements near cell towers



Review Biological effects



Solutions

Cell Phone and Tower Statistics in India



India Population –
1.2 billion



Mobile Towers –
5 lakh



Mobile subscribers –
900+ Million

Microwave Radiation

Microwave radiation effects are classified as:

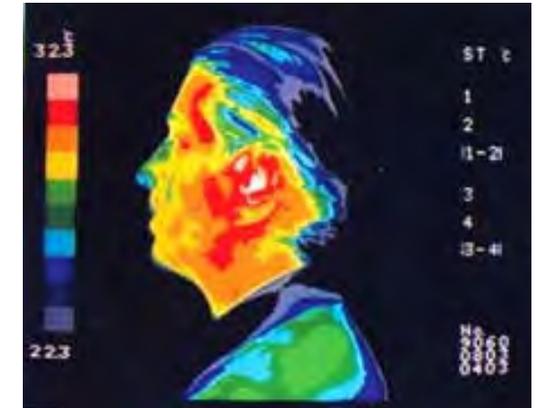
- Thermal
- **Non-thermal**

The current exposure safety standards are mainly based on the thermal effects, which are inadequate.

Non-thermal effects are several times more harmful than thermal effects.

Cell Phone - Ear Warming?

Have you ever noticed warm sensation in ear after using mobile phone for a long time?



Temp. of ear lobes increases by 1°C when cell phone is used for approx. 20 minutes.

Warm sensation/pain > tinnitus > irreversible hearing loss



All these effects lead to Ear Tumor

Tinnitus or "Ringxiety" - sensation of cell phone ring

SAR and Cell phone use time limit



6 minutes/day usage.

A Cell phone transmits
1 to 2 Watts of power

SAR (Specific absorption rate) - Rate at which radiation is absorbed by human body, measured in watts per kg (W/kg).

In USA, max. SAR limit for cell phones is **1.6W/Kg** which is for **6 minutes**. It has a safety margin of 3 to 4, so a person should not use cell phone for more than **18 to 24 minutes per day**.

This information is not given to people in India.

Warning from Blackberry

BlackBerry device keep the BlackBerry device at least 0.98 in. (25 mm) from your body when the BlackBerry device is transmitting. When using any data feature of the BlackBerry device, with or without a USB cable, hold the BlackBerry device at least 0.98 in. (25 mm) from your body. If you use a body-worn accessory not supplied by RIM when you carry the BlackBerry device, verify that the accessory does not contain metal and keep the BlackBerry device at least 0.98 in. (25 mm) from your body when the BlackBerry device is transmitting.

To reduce radio frequency (RF) exposure consider these safety guidelines:

- Use the BlackBerry device in areas where there is a strong wireless signal. The indicator that provides information about the strength of the wireless signal is located in the upper-right corner of the Home screen and displays five ascending bars. Three or more bars indicate a strong signal. A reduced signal display, which might occur in areas such as an underground parking structure or if you are traveling by train or car, might indicate increased power output from your BlackBerry device as it attempts to connect to a weak signal.
- Use hands-free operation if it is available and keep the BlackBerry device at least 0.98 in. (25 mm) from your body (including the abdomen of pregnant women and the lower abdomen of teenagers) when the BlackBerry device is turned on and connected to the wireless network. For more information about carrying your BlackBerry device, see the holster information in the "Additional safety guidelines" section of this document.
- Reduce the amount of time spent on calls.

Results of Re-evaluation of Interphone Study

INTERPHONE – WHO -10 years, 13 countries, largest (5,117 brain tumor cases), \$25 million dollars to evaluate risk on brain tumors.

Conclusion - no overall ↑ risk, but suggestions of ↑ glioma - heavy users & ipsilateral exposures

Re-evaluation - Risk underestimated by at least 25%

- For every 100 hours of use -26% ↑ risk of meningioma
- Initial 24% risk of glioma ↑ to 55% over 10 years- regular users are taken as people who use it for **2hrs/month**.
- **Doubled - quadrupled brain tumor risk for heavy users (1/2 hour/day) over 8 to 10 years.**
- Children, young adults– excluded. New study - Mobi-kids

WHO: Cell phone use can increase cancer risk

International Agency for Research on Cancer (IARC), a part of **WHO designates cell phones as "possible human carcinogen" [Class 2B]**



World Health Organization

Found evidence of increase in glioma and acoustic neuroma brain cancer for mobile phone

International Agency for Research on Cancer



World Health
Organization

PRESS RELEASE
N° 208

31 May 2011

IARC CLASSIFIES RADIOFREQUENCY ELECTROMAGNETIC FIELDS AS
POSSIBLY CARCINOGENIC TO HUMANS

Cell Tower Radiation

Antennas on Cell tower transmit in the frequency range of:

- 869 - 890 MHz (CDMA)
- 935 - 960 MHz (GSM900)
- 1805 – 1880 MHz (GSM1800)
- 2110 – 2170 MHz (3G)

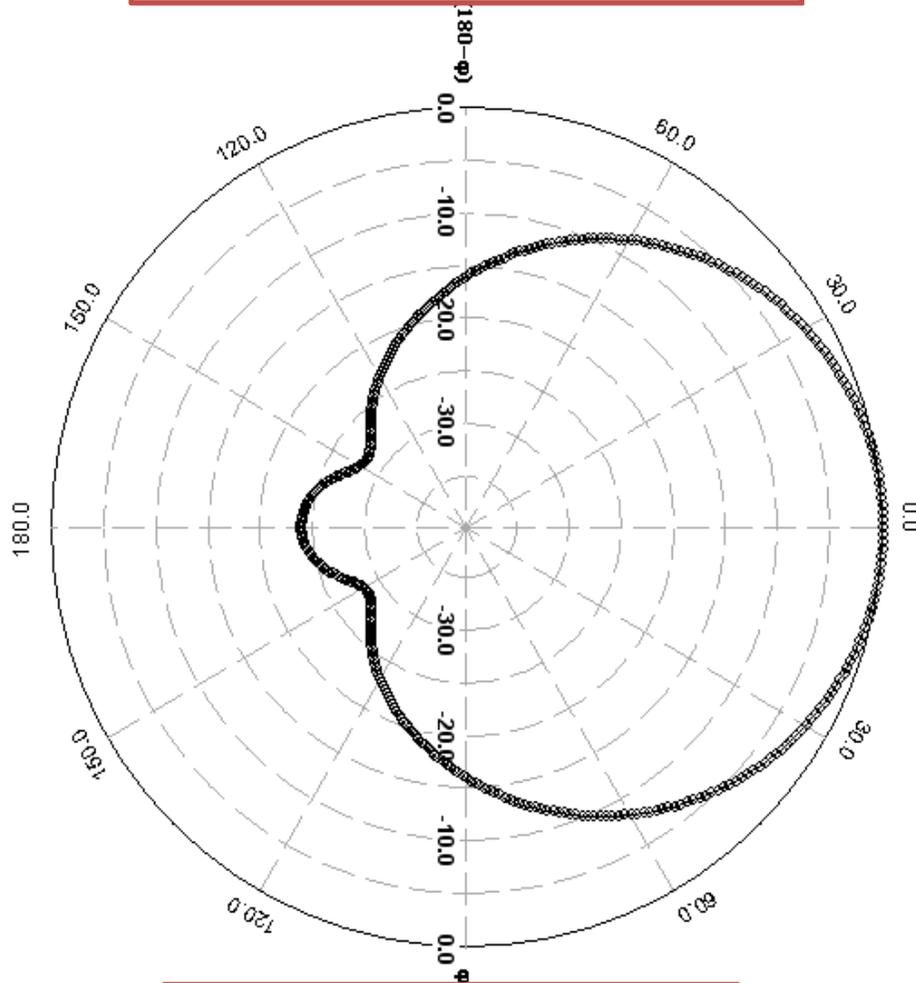


Cell Towers Installed in Mumbai



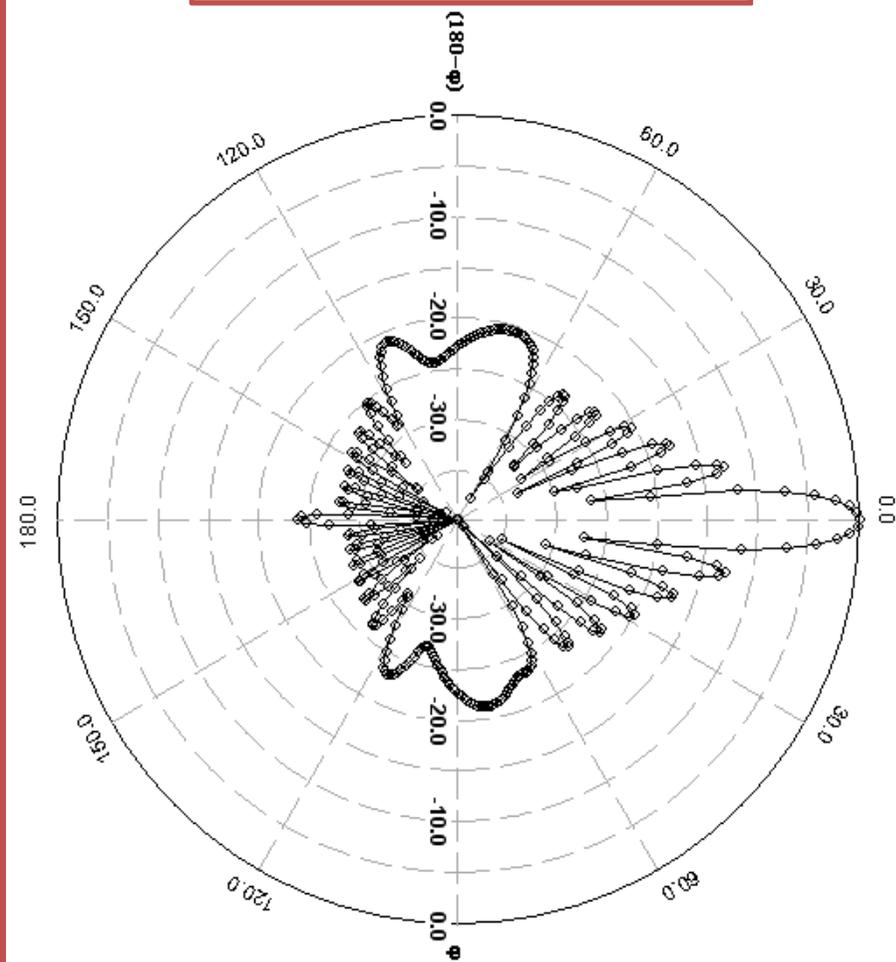
Radiation Pattern of Antenna

Horizontal plane



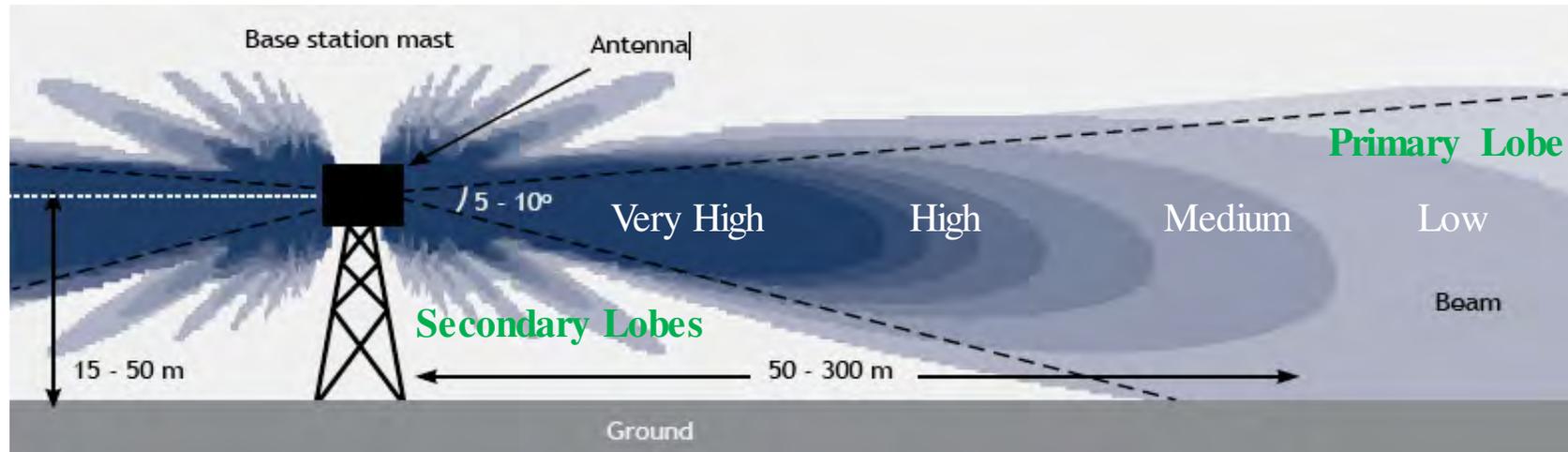
Beam is wide

Vertical plane



Main beam is narrow with secondary side lobes

Radiation Pattern of a Cell Tower Antenna



Propagation of "main beam" from antenna mounted on a tower or roof top

People living within 50 to 300 meter radius are in the high radiation zone (dark blue) and are more prone to ill-effects of electromagnetic radiation

Power varies by $1/R^2$, where R = Distance from tower

CASE STUDY

Usha Kiran Building, Worli, Mumbai



The cell phone towers installed on the Vijay Apartments terrace at Carmichael Road pic/Bipin Kokate



Usha Kiran Building

Six cancer cases in consecutive floors (5th, 6th, 7th, 8th and 10th) directly facing and at similar height as the mobile phone towers of four telecom companies placed on the roof of opposite building.

Power Density Calculations

Power density P_d at a distance R is given by

$$P_d = \left(\frac{P_t \times G_t}{4\pi R^2} \right) \text{ Watt/m}^2$$

P_t = Transmitter power in Watts

G_t = Gain of transmitting antenna

R = Distance from the antenna in meters

Power Density at distance from cell tower

For $P_t = 20 \text{ W}$, $G_t = 17 \text{ dB} = 50$

Distance R (m)	P_d (W/m ²)	P_d ($\mu\text{W}/\text{m}^2$)
1	79.6	79,600,000
3	8.84	8,840,000
5	3.18	3,180,000
10	0.796	796,000
50	0.0318	31,800
100	0.008	7,960
500	0.000318	318

Above values are for a **single carrier and a single operator.**

Power Density for multiple carriers and operators

For $P_t = 20 \text{ W}$, $G_t = 17 \text{ dB} = 50$

No. of carriers = 5, No. of operators = 3

Distance R (m)	P_d (W/m ²)	P_d ($\mu\text{W}/\text{m}^2$)
1	1194.0	1194,000,000
3	126.0	126,000,000
5	47.7	47,700,000
10	11.94	11,940,000
50	0.477	477,000
100	0.1194	119,400
500	0.00477	4,770

For **5 carriers** and **3 operators** on the same roof top or tower, radiation level is extremely high.

ICNIRP Guidelines

India adopts ICNIRP guideline for Power density (P_d)
= Frequency /200, frequency is in MHz
(averaged over **6 min** exposure)

For GSM900 (935-960 MHz), $P_d = 4.7\text{W/m}^2$ and
GSM1800 (1810-1880 MHz), $P_d = 9.2\text{W/m}^2$.

ICNIRP has given following disclosure:

ICNIRP is only intended to protect the public against short term gross heating effects and NOT against 'biological' effects such as cancer and genetic damage from long term low level microwave exposure from mobile phones, masts and many other wireless devices.

<http://ww.icnirp.de/documents/emfgdl.pdf>

ICNIRP Guideline – Adopted by India

According to ICNIRP, for frequency (400-2,000 MHz) safe power density = $f/200$
 So for GSM1840;
 Safe power density according to ICNIRP is $1840/200 = 9.2\text{W/m}^2$ which is for 6 min as mentioned in point no. 3

Table 7. Reference levels for general public exposure to time-varying electric and magnetic fields (unperturbed rms values).^a

Frequency range	E-field strength (V m^{-1})	H-field strength (A m^{-1})	B-field (μT)	Equivalent plane wave power density S_{eq} (W m^{-2})
up to 1 Hz	—	3.2×10^4	4×10^4	—
1–8 Hz	10,000	$3.2 \times 10^4/f^2$	$4 \times 10^4/f^2$	—
8–25 Hz	10,000	$4,000/f$	$5,000/f$	—
0.025–0.8 kHz	$250/f$	$4/f$	$5/f$	—
0.8–3 kHz	$250/f$	5	6.25	—
3–150 kHz	87	5	6.25	—
0.15–1 MHz	87	$0.73/f$	$0.92/f$	—
1–10 MHz	$87/f^{1/2}$	$0.73/f$	$0.92/f$	—
10–400 MHz	28	0.073	0.092	2
400–2,000 MHz	$1.375f^{1/2}$	$0.0037f^{1/2}$	$0.0046f^{1/2}$	$f/200$
2–300 GHz	61	0.16	0.20	10

^a Note:

1. f as indicated in the frequency range column.
2. Provided that basic restrictions are met and adverse indirect effects can be excluded, field strength values can be exceeded.
3. For frequencies between 100 kHz and 10 GHz, S_{eq} , E^2 , H^2 , and B^2 are to averaged over any 6-min period.

Figure 1 Reference (ICNIRP, Pg 18 Table 7)

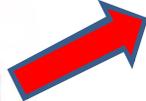
FCC limit for max. permissible exposure

Table 1. FCC Limits for Maximum Permissible Exposure (MPE)

(A) Limits for Occupational/Controlled Exposure

Frequency Range (MHz)	Electric Field Strength (E) (V/m)	Magnetic Field Strength (H) (A/m)	Power Density (S) (mW/cm ²)	Averaging Time (minutes)
0.3-3.0	614	1.63	(100)*	6
3.0-30	1842/f	4.89/f	(900/f ²)*	6
30-300	61.4	0.163	1.0	6
300-1500	--	--	f/300	6
1500-100,000	--	--	5	6

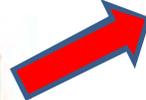
Table 1A – Safe Power density = f/300 averaged over 6 min exposure.



(B) Limits for General Population/Uncontrolled Exposure

Frequency Range (MHz)	Electric Field Strength (E) (V/m)	Magnetic Field Strength (H) (A/m)	Power Density (S) (mW/cm ²)	Averaging Time (minutes)
0.3-1.34	614	1.63	(100)*	30
1.34-30	824/f	2.19/f	(180/f ²)*	30
30-300	27.5	0.073	0.2	30
300-1500	--	--	f/1500	30
1500-100,000	--	--	1.0	30

Table 1B – Safe power density = f/1500 averaged over 30 min exposure.



f = frequency in MHz

*Plane-wave equivalent power density

(From FCC 1999 - Pg 17 - Table 1)

Tower Installation : USA (FCC Guidelines) vs India

In USA



❑ Cellular cell site towers are typically 50-200 feet high.

❑ In urban areas, cell sites commonly emit an ERP of 10 watts per channel or less. An ERP of 10 watts corresponds to an actual radiated power of around 1 watt depending on the type of antenna used.

<http://www.fcc.gov/guides/human-exposure-rf-fields-guidelines-cellular-and-pcs-sites>

In India

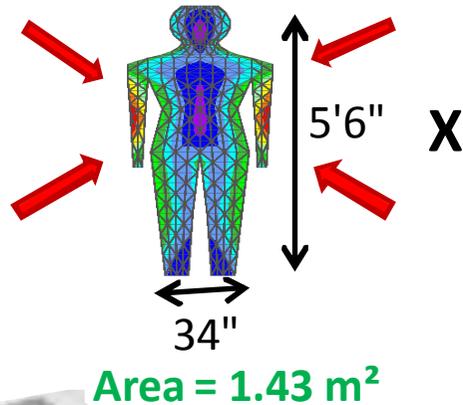


❑ Cellular cell site towers are even 5-10 feet high; on sides of building and outside window.

❑ In INDIA, cell sites transmit 100's of Watts of power with antenna gain of more than 10, so ERP > 1000 Watts

Power Absorbed by Human Body

Microwave power absorbed by human body if exposed to so called safe radiation level adopted in India, which is $f/200$, where f is in MHz?



ICNIRP Guideline –
At 940 MHz, Power density (P_d) is $4.7\text{W}/\text{m}^2$

Power received (P_r) by human body will be
 $[P_r = P_d \times \text{Area}] = 6.75$ Watts in one sec.



Microwave oven: 700 to 1000 W.
With say 60% efficiency, microwave power output is say 500 W.

In one day, microwave energy absorbed will be $[6.75 \text{ Watts} \times 60 \times 60 \times 24 \text{ sec}] = \underline{583.2 \text{ KW-sec}}$.

This implies that human body can be safely kept in a microwave oven for 1166 secs = **19 minutes per day**

EMF Radiation Standards (for GSM900)

Country	Milliwatt / m ²	Watts / m ²
INDIA (adopted ICNIRP)	4500	4.5 (f/200)
INDIA (Proposed 1/10th of ICNIRP)	450	0.45 (f/2000)
AUSTRALIA (New South Wales proposed)	0.01	0.00001
AUSTRIA (Salzburg city)	1	0.001
BELGIUM	45 to 1125	0.045 to 1.125
BELGIUM (Luxembourg)	24	0.024
BIO-INITIATIVE REPORT (Outdoor)	1	0.001
BIO-INITIATIVE REPORT (Indoor)	0.1	0.0001
CANADA (Toronto Board of Health - proposed)	100	0.1
CHINA	400	0.4
FRANCE (Paris)	100	0.1
GERMANY (ECOLOG 1998 - Precautionary Recommendation)	90	0.09
GERMANY (BUND 2007 - Precautionary Recommendation)	0.1	0.0001
ITALY	100	0.1
NEW ZELAND (Aukland)	500	0.5
POLAND	100	0.1
RUSSIA	100	0.1
SWITZERLAND (Apartments, Schools, Hospitals, Offices & Playgrounds)	42	0.042
USA (Implementation is strict)*	3000	3 (f/300)
Final Recommendations		
Indoor - include apartments, schools, hospitals, offices & playgrounds.	0.1	0.0001
Outdoor - where people spend few minutes a day.	10	0.01

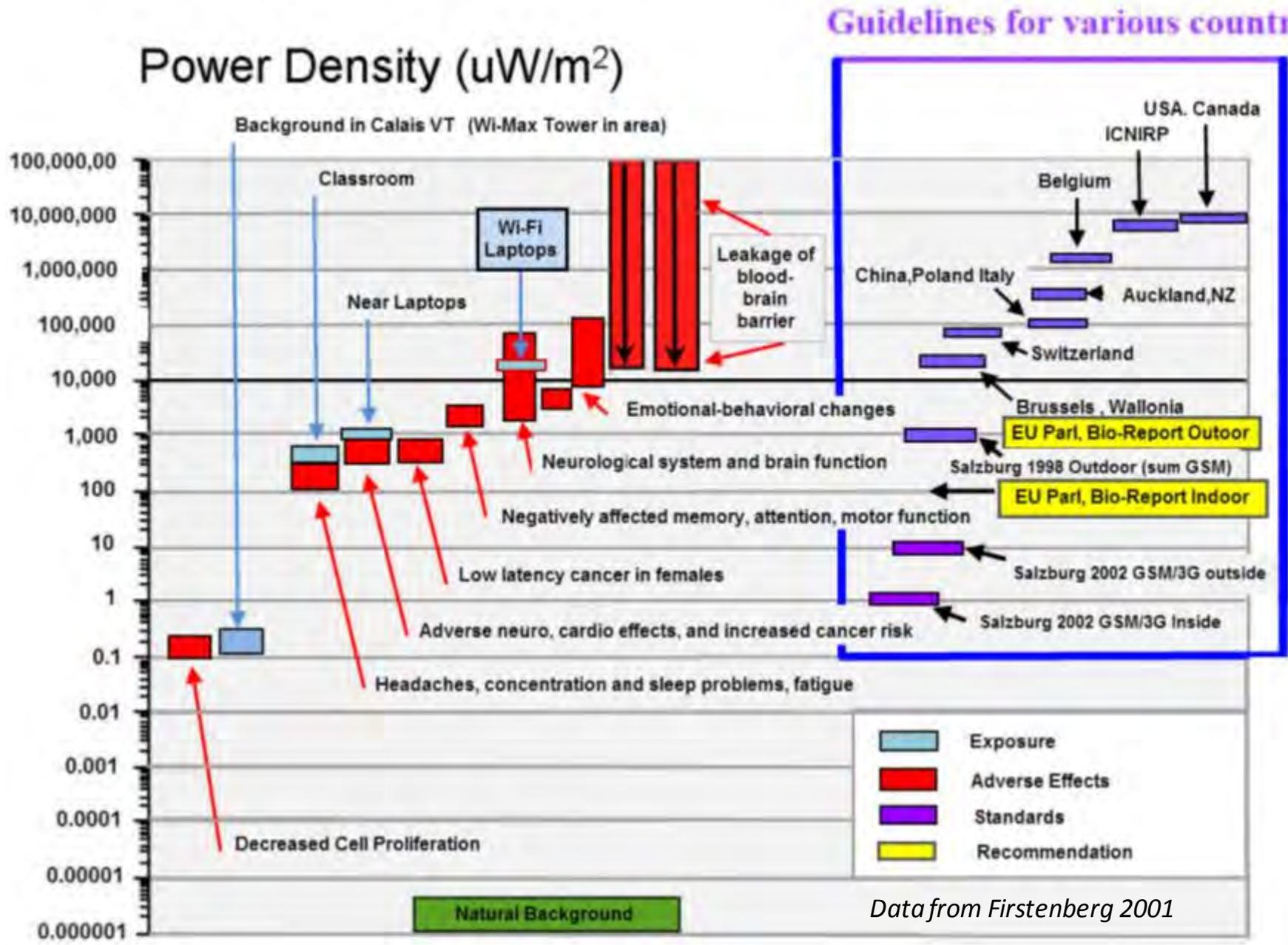
*USA - FCC Guidelines: f/300 if averaged over 6 minutes and f/1500 if averaged over 30 min

Radiation Measurement at various locations

Cumulative Readings including CDMA, GSM 900, and GSM 1800

Location	Reading in dBm	Readings in W/m ²	Readings in microW/m ²
Terrace, New Rajindra Nagar, Delhi	+09	0.561	5,61,479
Resident 1, Bedroom - Chowpatty	+06	0.281	2,81,406
Resident 2, Bedrooms - Opera House	+05	0.223	2,23,529
Resident 3, Bedroom – ML Dahanukar Marg	+05	0.223	2,23,529
Delhi-Gurgaon Highway - near Toll (3 towers)	0	0.0706	70,686
Vashi Bridge - after Railway Station	-4	0.0282	28,274
Resident 3, 4 th Fl: Sergean House Lady w/cancer	-6	0.0177	17,756
Resident 4, Dadar East, Lady w/cancer	-6	0.0177	17,756
Resident 5, Opposite roof, Rane Society, Powai	-10	0.00706	7,069
Ustav Chowk, Kharghar	-12	0.00446	4,460
Govandi- Residential towers - near Indian Oil	-14	0.002814	2,814
Lower Parel Employees-headaches, forgetfulness	-16	0.001776	1,776
Vashi Highway – near Turbhe	-18	0.001120	1,120
Nerul Bridge	-20	0.000707	707
Vivero pre School (opposite powai lake)	-22	0.000446	446
Rajeev Gandhi nagar	-26	0.000177	177
On road near Evita (Hiranandani Building)	-28	0.000112	112
D-Mart,Hiranandani, Powai	-34	0.0000280	28
IIT Bombay School of Management - Entrance	-46	0.00000178	1.78

Health concerns with current Safety Guidelines



BIOLOGICAL EFFECTS



Most common complaints:

- Sleep disruption
- Headache
- Concentration
- Forgetful memory
- Depression
- Fatigue
- Dizziness
- Palpitations of the heart
- Visual disorders
- Cardiovascular problems
- Buzzing in the head
- Altered reflexes



Many of these are related to changes in the electrical activity of the brain

BIOLOGICAL EFFECTS

Neurodegenerative Disorders –Alzheimer, Parkinson's

Immune System Degradation

Tinnitus and Ear Damage

Irreversible infertility

Effect on Skin

DNA Damage

Increase in Cancer risk



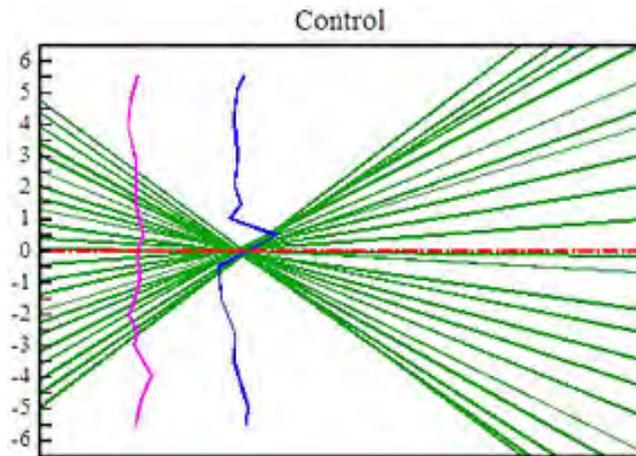
Breakdown of Blood Brain Barrier

Increased Risk of Eye Cancers

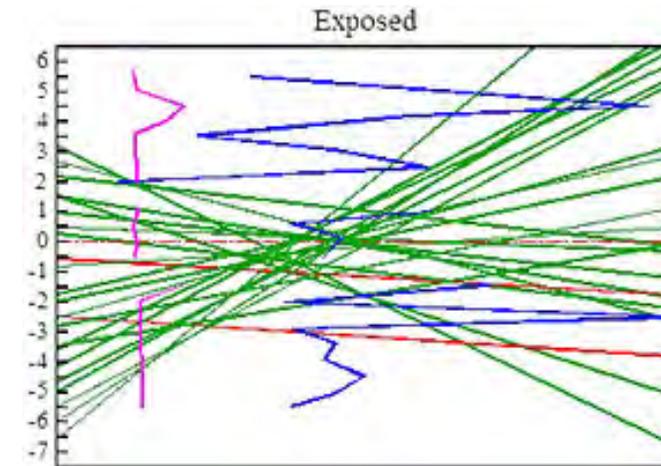
Increased Risk of Ear Tumors

Increased Risk of Other Cancers

Effect on Eye/ Uveal Melanoma



Good quality lens



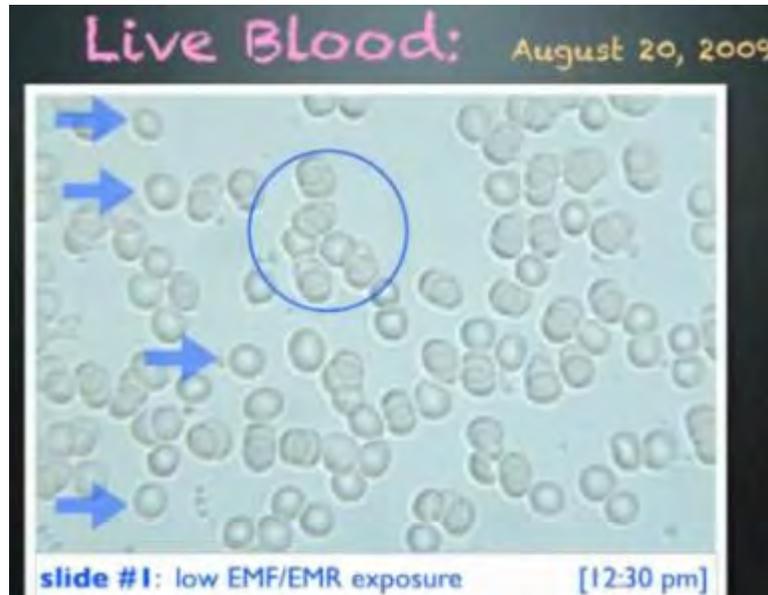
Ability to focus the laser beam at the various locations is altered.

Prolonged exposure to microwave radiation can lead to macroscopic and microscopic damage to the lens and part of this damage does not heal and accumulates with time.

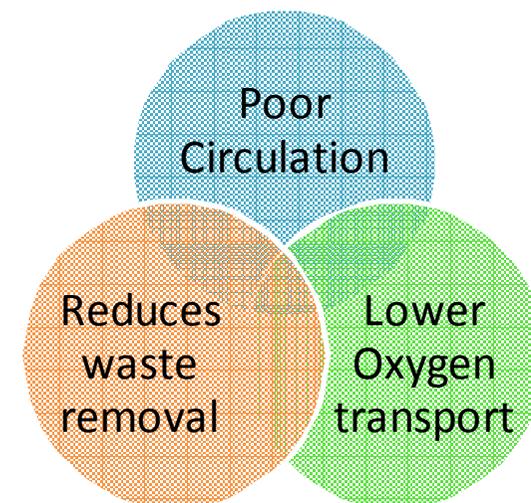
Live Blood Cells and Electromog



Dr. Magda Havas
Trent University, Canada



Consequences



DNA Damage



Prof. Henry Lai

University of Washington
1995, Diem *et al.* 2005

Single and double strand breaks observed in DNA from microwave exposure at levels below the current FCC exposure standard.

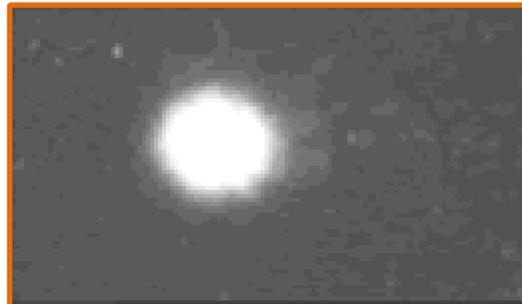


Fig.1 Unexposed control. Bundle of DNA (No-Tail)



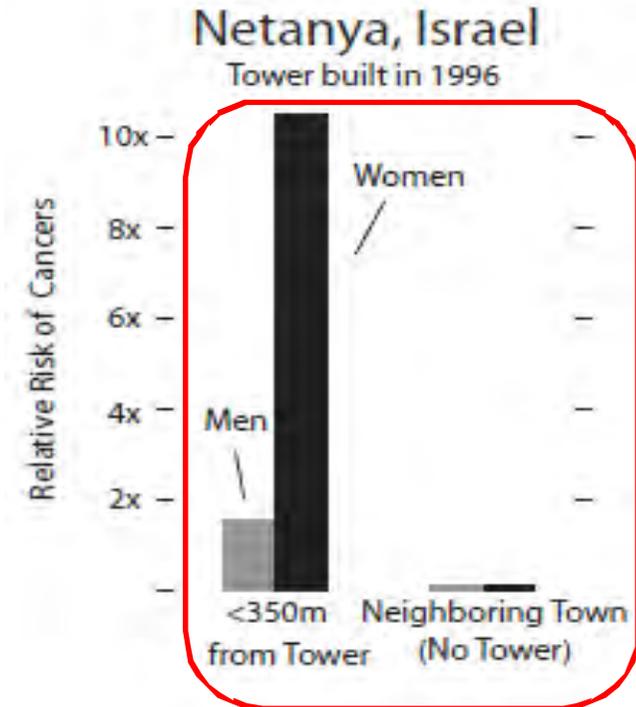
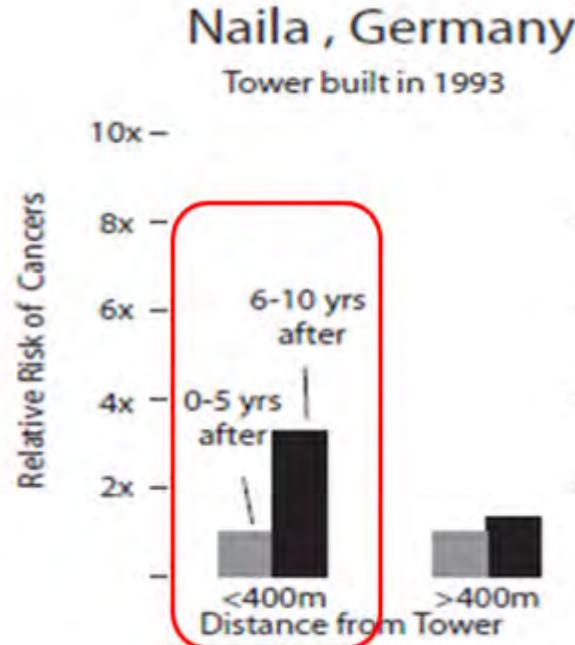
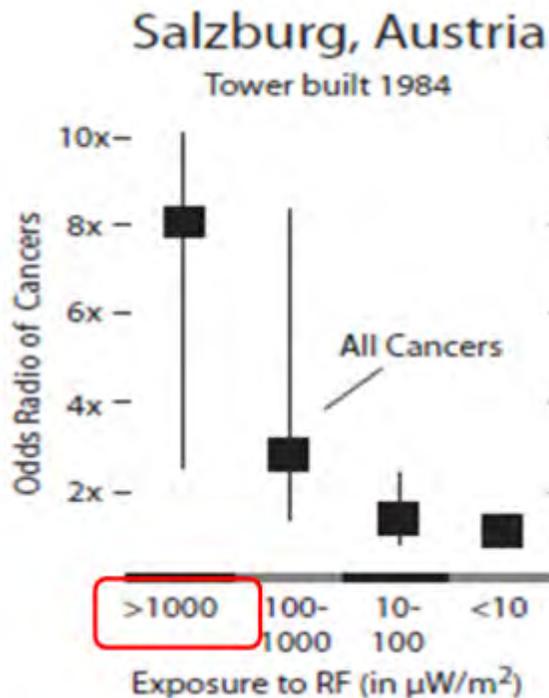
Fig.2 X-ray calibration 25.6 rads. DNA breaks are very obvious



Fig.3 Cell Phone level microwave exposure 2hrs 2.45GHz reaching so called safe SAR levels
Comet Tail = DNA Damage

When Damage to DNA $>$ Rate of DNA repaired, there is the possibility of retaining mutations and initiating cancer

Effect of Cell Towers (some references)



8 times increased cancer risk for exposure $> 1000\mu\text{W} / \text{m}^2 = 1 \text{mW} / \text{m}^2$

Risk is higher after 6-10 years of exposure

Women living near towers had 10 times increased cancer risk

Effect on Birds and Animals



Have you ever seen any bird near cell towers?

May be not, because birds have more volume and less weight, so heating effect is very fast.



Birds and Bees

- Interfere with navigation and reproduction



Animals

- Dairy cows – Decreased milk production, reproductive and developmental problems and decline in overall health.
- Sheep, dogs, cats, rabbits living near base stations affected.

Effect on Plants



4 cell towers near Gurgaon-Delhi Toll Naka

Output of most of fruit bearing trees drastically reduced from 100% to < 5% after 2.5 years of cell tower installation.

DOT Inter-Ministry Committee (IMC) accepts cell phone and tower radiation hazard

IMC Report ON EMF RADIATION was uploaded on DOT website in Jan. 2011.



Mentions several health hazards due to radiation on Human Health and Environment (pages 12-27).

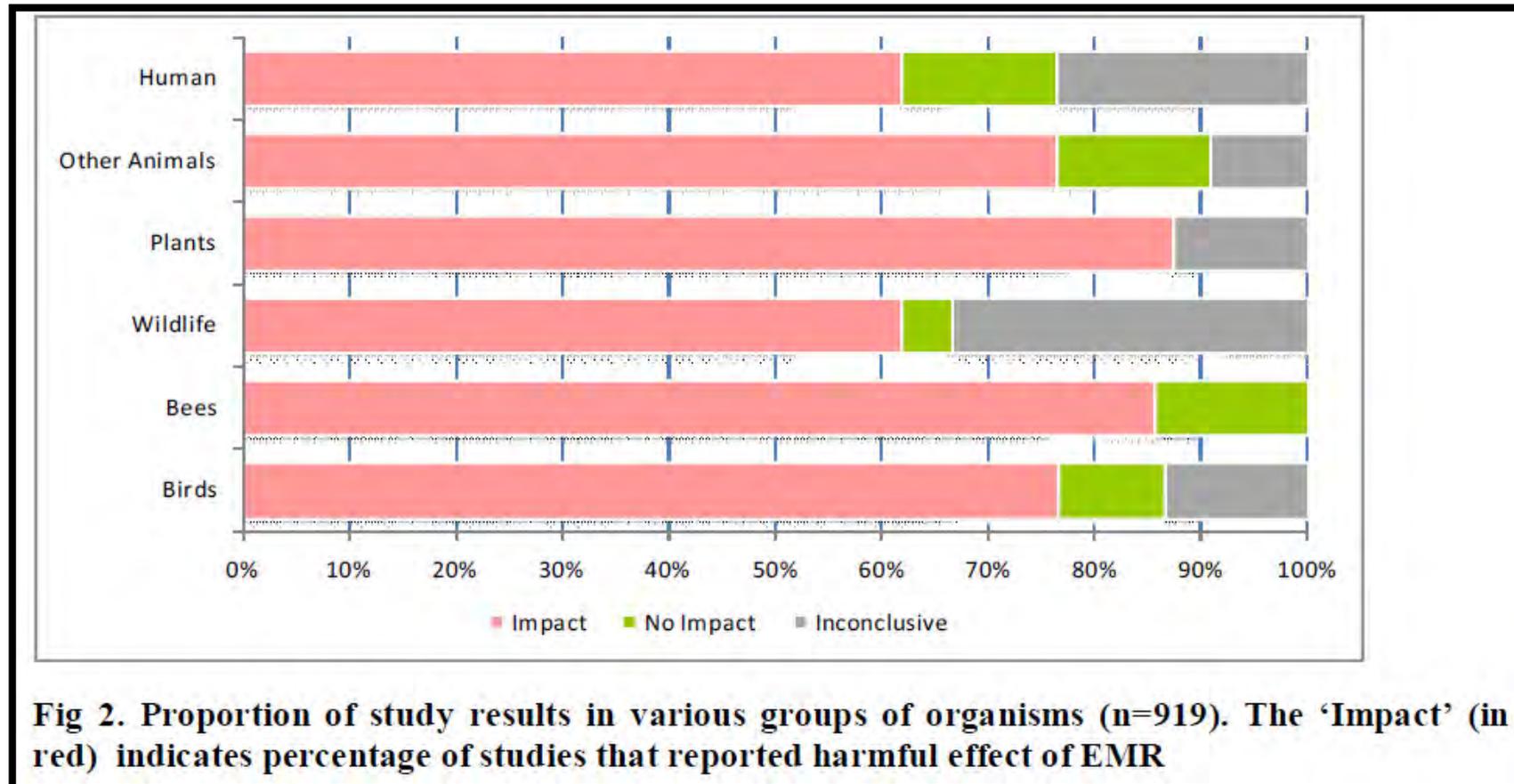


Mentioned Bio-initiative report 2007 recommendation 1000 microW/m² for outdoor cumulative RF exposure (Page 32).



Yet recommended RF exposure limits in India may be lowered to only 1/10th of the existing reference level, which will be 0.92W/m² for GSM1800 (Page 33)

Expert Group reported Impacts of Communication Towers on Wildlife including Birds and Bees (2011)



Out of 919 research studies collected:
593 - report Impact; 130 - No Impact; 196 - Inconclusive

Guideline of the Austrian Medical Association

Adopted on 3rd March 2012 in Vienna

Irrespective of the ICNIRP recommendations for acute effects, the following benchmarks apply to regular exposure of more than four hours per day.

High-frequency electromagnetic radiation (as power flow density)

- | | |
|--|-----------------------|
| ▫ $\geq 1000 \mu\text{W}/\text{m}^2$ ($\geq 1 \text{ mW}/\text{m}^2$) | very far above normal |
| ▫ $10\text{-}1000 \mu\text{W}/\text{m}^2$ ($0.01\text{-}1 \text{ mW}/\text{m}^2$) | far above normal |
| ▫ $1\text{-}10 \mu\text{W}/\text{m}^2$ ($0.001\text{-}0.01 \text{ mW}/\text{m}^2$) | slightly above normal |
| ▫ $\leq 1 \mu\text{W}/\text{m}^2$ ($\leq 0.001 \text{ mW}/\text{m}^2$) | within normal limits |

Ultimately, everything is related to Energy

$$\text{Energy} = (\text{Power} \times \text{Time})$$

If we want to be safe for:

- 100 years, power density must be $<100 \mu\text{W}/\text{m}^2$
- 10 years, power density must be $<1000 \mu\text{W}/\text{m}^2$
- 1 year, power density must be $<10,000 \mu\text{W}/\text{m}^2$

Above values are for continuous exposure. If we are exposed for only a few hours per day, then we can afford to be exposed to higher radiation density.

News Coverage in Jaipur, Rajasthan

Dec 2011

आदिनाथ मार्ग पर ज्यादा रेडिएशन सात लोगों को कैंसर, दो की मौत

रेडिएशन का स्तर खतरे से 1120 गुना अधिक, स्थिति खतरनाक

नगर संचालकालय, जापुर

सात लोग कैंसर और दो की मौत का कारण बनने के बाद आदिनाथ मार्ग पर रेडिएशन का स्तर खतरनाक स्तर पर बढ़ गया है। नगर संचालकालय के अनुसार, यहां रेडिएशन का स्तर खतरनाक स्तर पर बढ़ गया है। नगर संचालकालय के अनुसार, यहां रेडिएशन का स्तर खतरनाक स्तर पर बढ़ गया है।

बच्चों की उम्र में साधारण, सेंट्रल पार्क और नैतिकों के बंगले

ये बंगले के आदिनाथ मार्ग पर स्थित हैं। यहां रेडिएशन का स्तर खतरनाक स्तर पर बढ़ गया है। नगर संचालकालय के अनुसार, यहां रेडिएशन का स्तर खतरनाक स्तर पर बढ़ गया है।



SEVEN cancer cases in C-Scheme – Jaipur City

11 May 2012

शालीमार बाग समिति ने कहा- तीन की मौत

रेडिएशन से 6 को कैंसर का दावा

नगर संचालकालय, जापुर

शहर में मोबाइल के बढ़ते आउटमैर रोज़ रिकॉर्ड करीब 1000 बिलियन से अधिक हो गए हैं। नगर संचालकालय के अनुसार, यहां रेडिएशन का स्तर खतरनाक स्तर पर बढ़ गया है। नगर संचालकालय के अनुसार, यहां रेडिएशन का स्तर खतरनाक स्तर पर बढ़ गया है।



SIX cancer cases in Shalimar Bagh – Jaipur City

एक घर, दो को डेन कैंसर
आदिनाथ मार्ग पर स्थित एक घर के आदिनाथ मार्ग पर रेडिएशन का स्तर खतरनाक स्तर पर बढ़ गया है। नगर संचालकालय के अनुसार, यहां रेडिएशन का स्तर खतरनाक स्तर पर बढ़ गया है।

विज्ञान ज्ञान संस्थान के अनुसार, यहां रेडिएशन का स्तर खतरनाक स्तर पर बढ़ गया है। नगर संचालकालय के अनुसार, यहां रेडिएशन का स्तर खतरनाक स्तर पर बढ़ गया है।

अगर मोबाइल टावर सुरक्षित हैं ... तो इनकी बीमारी का राज क्या है?



मोबाइल टावरों में निरंतरता के कारण विकिरण स्तर का स्तर खतरनाक स्तर पर बढ़ गया है। नगर संचालकालय के अनुसार, यहां रेडिएशन का स्तर खतरनाक स्तर पर बढ़ गया है।

दो को कैंसर, एक को हृदय रोग, एक को लकड़ा
शहर में मोबाइल के बढ़ते आउटमैर रोज़ रिकॉर्ड करीब 1000 बिलियन से अधिक हो गए हैं। नगर संचालकालय के अनुसार, यहां रेडिएशन का स्तर खतरनाक स्तर पर बढ़ गया है।

If mobile towers were safe.. What is the mystery behind their illness?



डॉ. राजेश कुमार (MBBS) को यह सवाल पूछा कि रेडिएशन से कैंसर क्यों होता है? डॉ. कुमार ने कहा कि रेडिएशन का स्तर खतरनाक स्तर पर बढ़ गया है। नगर संचालकालय के अनुसार, यहां रेडिएशन का स्तर खतरनाक स्तर पर बढ़ गया है।

क्षेत्र में और भी पीड़ित
शहर में मोबाइल के बढ़ते आउटमैर रोज़ रिकॉर्ड करीब 1000 बिलियन से अधिक हो गए हैं। नगर संचालकालय के अनुसार, यहां रेडिएशन का स्तर खतरनाक स्तर पर बढ़ गया है।

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NEWS COVERAGE – FROM 1 SEP 2012

Hindustan Times-Mumbai 24 Nov 2012

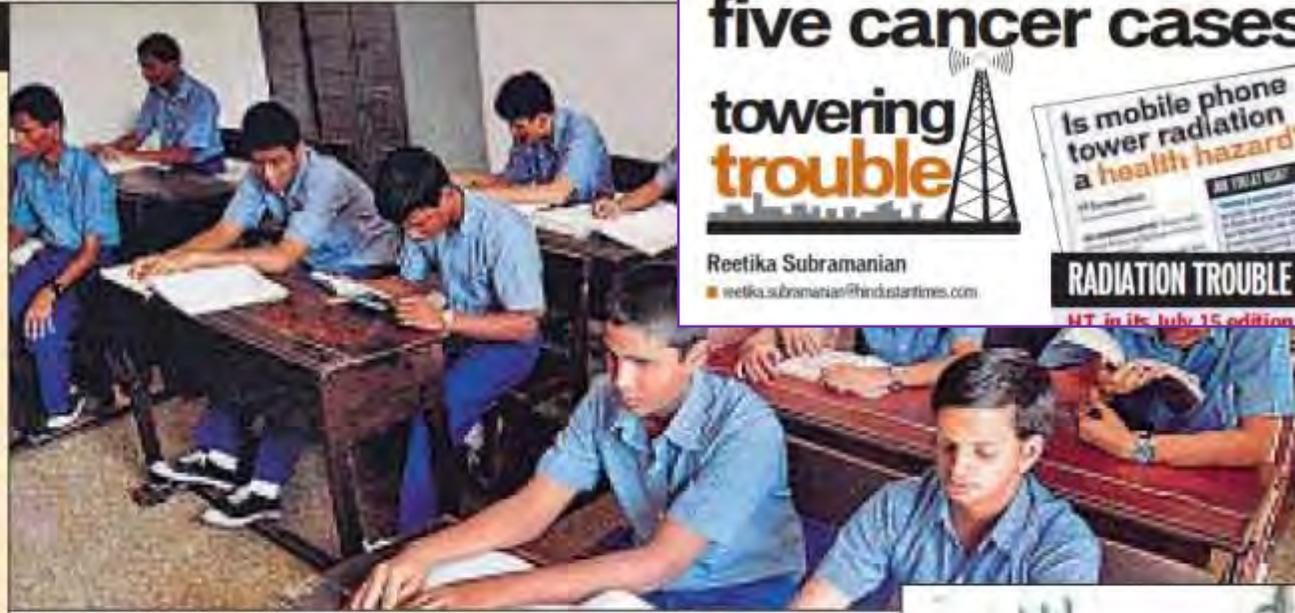
Experts say what is happening at the school shows the

[Click to decrease the magnification of the entire page](#)

THE STORY SO FAR

ON SEPTEMBER 1, the union department of telecommunication (DoT) revised the permissible limit for electromagnetic frequency radiation from mobile towers to 450 milliwatts/square metre from 4,500 milliwatts. However, anti-radiation campaigners claimed that the limit was too high.

ON OCTOBER 4, the DoT launched the complaint-handling system in the city on a pilot-basis. Citizens can register their complaints on the DoT helpline or website for a processing charge of Rs4,000. The money would be reimbursed if the reported tower violates the prescribed norm, and the tower operator would be charged Rs5 lakh fine. So far, no violation has been detected.



■ Student at the Happy Home and School for the Blind in Worli.

ON NOVEMBER 7, civic chief Sitaram Kunte conducted a review meeting to propose revised norms for the civic body's policy on mobile tower installations. The norms were revised on the basis of the guidelines proposed by the DoT.

ON NOVEMBER 9, the civic body in its general body meeting decided to appoint a special legal counsel to appeal to the high court to vacate the existing stay order, which prevented it from taking action on the 1,800 illegal mobile towers

City school blames mobile towers for five cancer cases

towering trouble



Reetika Subramanian

■ reetika.subramanian@hindustantimes.com

RADIATION TROUBLE

HT in its July 15 edition had



■ There are 10 mobile towers in school's vicinity. SHAKTI YADAV

NEWS COVERAGE – FROM 1 SEP 2012

Students take up fight against radiation

Reetika Subramanian

reetika.subramanian@hindustantimes.com

MUMBAI: Four final year information technology students of Xavier's Institute of Technology, Mahim, have taken up the task of creating awareness about the implications of mobile tower radiation emission among city's college students.

From forums on social networking sites and blogs, to college festivals and seminars, the students want to build pressure on the union government to take cognisance of the hazards of suspected high levels of radiation emitted by mobile towers.

Kanica Jain, 21, along with her classmates Sasha Sequeira, 21, Nileema Lobo, 21, and Jaysel Meledath, 21, began their research on mobile tower radiation six months ago. After receiving complaints from students and faculty members about headaches, dizziness and nausea, the students launched the campaign, 'The Radiation Zone — Red, Yellow n Green'.



WHY YOU SHOULD CARE

People living close to mobile phone towers are at the risk of health disorders such as sleep disturbances, headaches, fatigue, joint pains, memory loss etc. Prolonged exposure increases the risk of neurological disorders and cancer.

The city has 12 cellular operators and 18,000 cell towers. DoT officials say every operator needs at least 2,000 towers for sufficient network coverage in the city.

Civic data shows that of the 3,705 mobile towers in the city, 1,830 are illegal.

"Students working in the laboratory complained of uneasiness. After studying theory papers and discussing the topic with experts, we concluded that the health hazards were an effect of exposure to mobile tower radiation," said Lobo.

"What began as a college proj-



■ (From left) Jaysel Meledath, Fr John Rose, Sasha Sequeira, Nileema Lobo and Kanica Jain check the radiation at Mahim.

THE RADIATION ZONE - RED, YELLOW 'N GREEN

Suspect high radiation levels in your area? Act Now. Contact the public helpline (99695 55000) or log on to the

Department of Telecommunication (DoT) website www.dot.gov.in and click on the 'Public Grievance- EMF Radiation' link.

ect soon turned into a campaign, because everyone in the city is vulnerable to the hazards that could be posed by high radiation," said Meledath, a resident of Andheri. "In my locality, residents that have mobile towers fixed on their terrace continue to be apathetic because of the high month-

ly rents that the mobile operators pay," he added.

"We need to work out alternatives to deal with the problem. The first step has to be reduction in the permissible limit for mobile tower radiation emission, which is 450 milliwatts/square metre at present," said Sequeira.

ANSHUMAN POYREKAR/HT

NEWS COVERAGE – FROM 1 SEP 2012

TOI Mumbai_28 Nov 2012

Hindustan Times-29 Nov 2012
(MUMBAI)

Rajasthan HC bars mobile phone towers near schools & hosps

Abhinav Sharma | TIMES NEWS NETWORK

Jaipur: The Rajasthan high court on Tuesday ordered the relocation of mobile phone towers from educational institutions, hospitals and playgrounds in the state within two months.

It further ruled that they should be shifted at least 500 metres away from jails and 100 metres from monuments. A division bench comprising Chief Justice Arun Mishra and Justice NK Jain cited ob-

► Telecom bodies' plea rejected, P 23

servations of a inter-ministerial committee of the central government that radiation from mobile towers are hazardous to children and patients, while ordering the relocation.

The panel had in May emphasized that electromagnetic radiations from cell phones and towers have both thermal and non-thermal effect.

City demands mobile tower rules similar to Rajasthan's

NO RADIATION While BMC has rules in place for new towers, HC order stops it from taking action on old ones

Rethika Subramanian

rethika.subramanian@hindustantimes.com

MUMBAI A day after the Rajasthan high court ordered relocation of existing mobile towers from around educational institutions, hospitals and playgrounds within two months, anti-radiation campaigners in Mumbai are demanding similar action.

While the Brihanmumbai Municipal Corporation (BMC) - which is at present revising its policy on installation of mobile towers in the city - has banned installation of new towers near educational institutions and hospitals, it has not been able to take any action on existing ones on account of a Bombay high court stay order.

"It is essential to take immediate action even in Mumbai," said Preeti Baghi, principal, Activity High School located on Peddar Road, which recently launched a signature campaign to condemn the suspected health hazards posed by mobile towers located in its vicinity.

Even as there is no conclusive evidence on the direct correlation between electromagnetic field (EMF) radiations from mobile towers and health hazards, locals have complained about acidity, headaches, dizziness, and tumours in extreme cases because of direct exposure.

THE RAJASTHAN HIGH COURT ORDER

NOVEMBER 27, the Rajasthan high court directed telecom service providers operating in the state to remove mobile towers in the vicinity of schools, hospitals and playgrounds, within two months.

It also asked operators to relocate the towers from a periphery of 500 metres from prisons, and those falling in a 100-metre distance of ancient and archaeological heritage monuments.

The division bench of Chief Justice Arun Mishra and justice NK Jain Senior said radiation emitted from mobile phones and mobile base towers are "hazardous to children and patients", as accepted by the inter-ministerial committee of the Central govt.

SEPTEMBER 7,

the Supreme Court had refused to interfere with a Rajasthan high court's interim order to the state government to remove mobile phone towers from around the schools, hospitals and densely populated localities.

WHERE MUMBAI STANDS

In January 2012, the Bombay high court restrained the civic body from taking any concrete steps against the telecom companies that had moved the court challenging levying of a premium amount demanded by the BMC for regularising cell towers put up by them on roof tops of private buildings.

The premium was being levied as per the provisions of the BMC's new policy in August 2011.

The telecom operators - Wom Networks Ltd, Inks Towers Ltd, ATC Telecom Tower Corporation Pvt Ltd, Loop Mobile (India) Ltd, and GTL Infrastructure Ltd - contended that the policy was contrary to provisions of the Indian Telegraph Act, 1885, which prohibits levying any charge for construction of cell towers.

Earlier this month, the BMC decided to set up legal counsel to vacate this stay order.



"With more than 80% of the towers already operating in the city, what is the point in introducing norms for tower towers that are yet to be installed?" said activist Jitendra Gupta, who has launched a group on Facebook to discuss the implications of radiation exposure. "The proposed

norms should be applicable even to those seeking renewal." Others said the judgement was a sign of hope. "The Rajasthan high court judgment echoes our sentiments. There is need for concerned officials to look at this issue in a retrospective manner keeping in mind the overall health of

citizens," said Prakash Muralidharan, director general, Cellular Operators Association of India (COAI). "The industry has always complied with norms related to exposure. Mumbai will continue to work actively along with the government to ensure that compliance is maintained," he said.

However, telecom industry officials were disappointed. "We are disappointed with the order and will determine the industry's future course of action once we have the final order and have studied all details closely," said

NEWS COVERAGE - FROM 1 SEP 2012

3 Dec 2012

Mobile Cos to Seek Govt Intervention to Counter HC Verdict on Towers 3-12-12

KALYAN PARBAT
KOLKATA 172

Leading mobile phone companies will shortly seek the government's legal intervention to counter a recent Rajasthan High Court verdict calling for the removal of mobile towers in schools and hospitals by December 31, on fears that such a move could provoke similar action by courts across India, and, in turn, disrupt mobile coverage and force telcos to slip on network performance parameters benchmarked by sector regulator Trai.

The high court order, dated November 27, is confined to Rajasthan only, but telcos fear that if implemented, it could set the cat among the pigeons for other states to follow suit amid allegations that radiation from mobile towers is harmful.

Lobbies representing telcos offering services on the GSM and CDMA technology platforms will jointly approach the communication ministry since mobile towers have been installed in schools and hospitals in line with telecom department guidelines, top executives aware of the matter said. "We are writing to telecom minister Kapil Sibal, urging the government to challenge the Rajasthan HC order in Supreme Court as it threatens to throw mobile services off gear in places dealing with emergencies, hit customer service and even increase the chances of

telcos slipping on performance standards set by Trai," said Rajan Mathew, director general of Cellular Operators Association of India (COAI), the GSM lobby representing the likes of Bharti, Vodafone and Idea, among others.

A spokesman of the Association of Unified Telecom Service Providers (AUTSP) said the lobby representing CDMA operators like RCOM and Tata Teleservices "would work closely with COAI to tackle the serious ramifications of the Rajasthan HC order".

In a recent communique to Rajasthan chief minister Ashok Gehlot, Sibal has also claimed that compliance of the high court order would hit critical communication requirements in the state and impact law and order. "Doctors will be out of reach and they will also be unable to consult each other during any emergency," said Sibal in this note reviewed by ET, adding that there are no established studies that conclusively prove the effect of mobile tower radiation on the health of the human body", adding that mobile towers were radiating well within prescribed limits.



Rajasthan HC verdict calls for removal of mobile towers in schools and hospitals by Dec 31: co-ops fear such move could provoke similar action by courts across India

SUGGESTED SOLUTION TO REDUCE EMF HAZARD

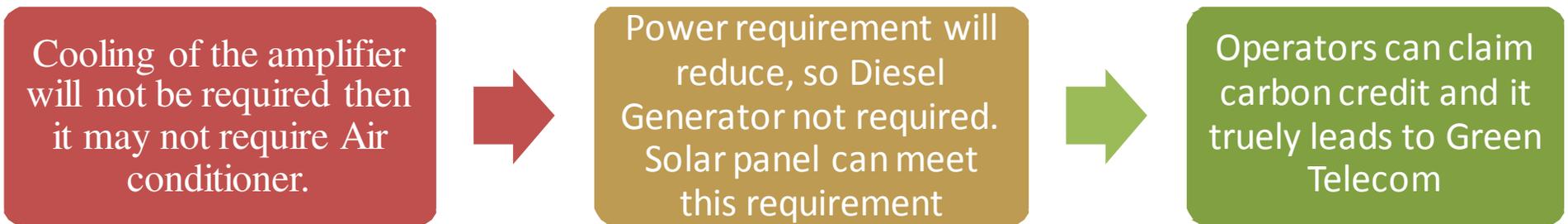
Step 1

- Convince operators to reduce transmitted power from 20W/carrier to max. 1 -2 W in dense urban area.

HOW TO IMPLEMENT ?

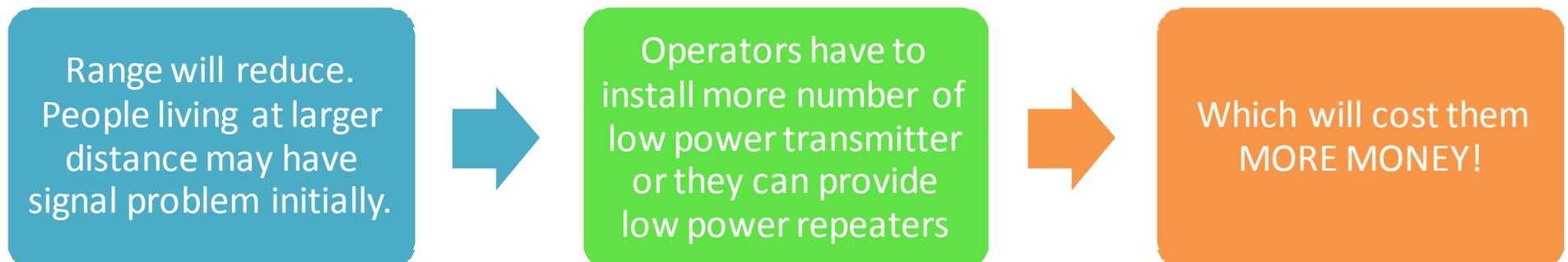
Remove the power amplifier or reduce gain of amplifier.

ADDITIONAL BENEFITS:



You can see [TRAI-Green-Telecom-Openhouse-GK Report](#)

DISADVANTAGES OF REDUCING POWER:



SUGGESTED SOLUTION TO REDUCE EMF HAZARD

Step 2

- Radiation measurements have to be done at residences, offices, schools, hospitals.

HOW TO IMPLEMENT ?

If power density level is still high (i.e, more than $100-1,000 \text{microW/m}^2$ after reduction of the transmitted power, then either:

Towers have to be relocated or

Height of the towers has to be increased or

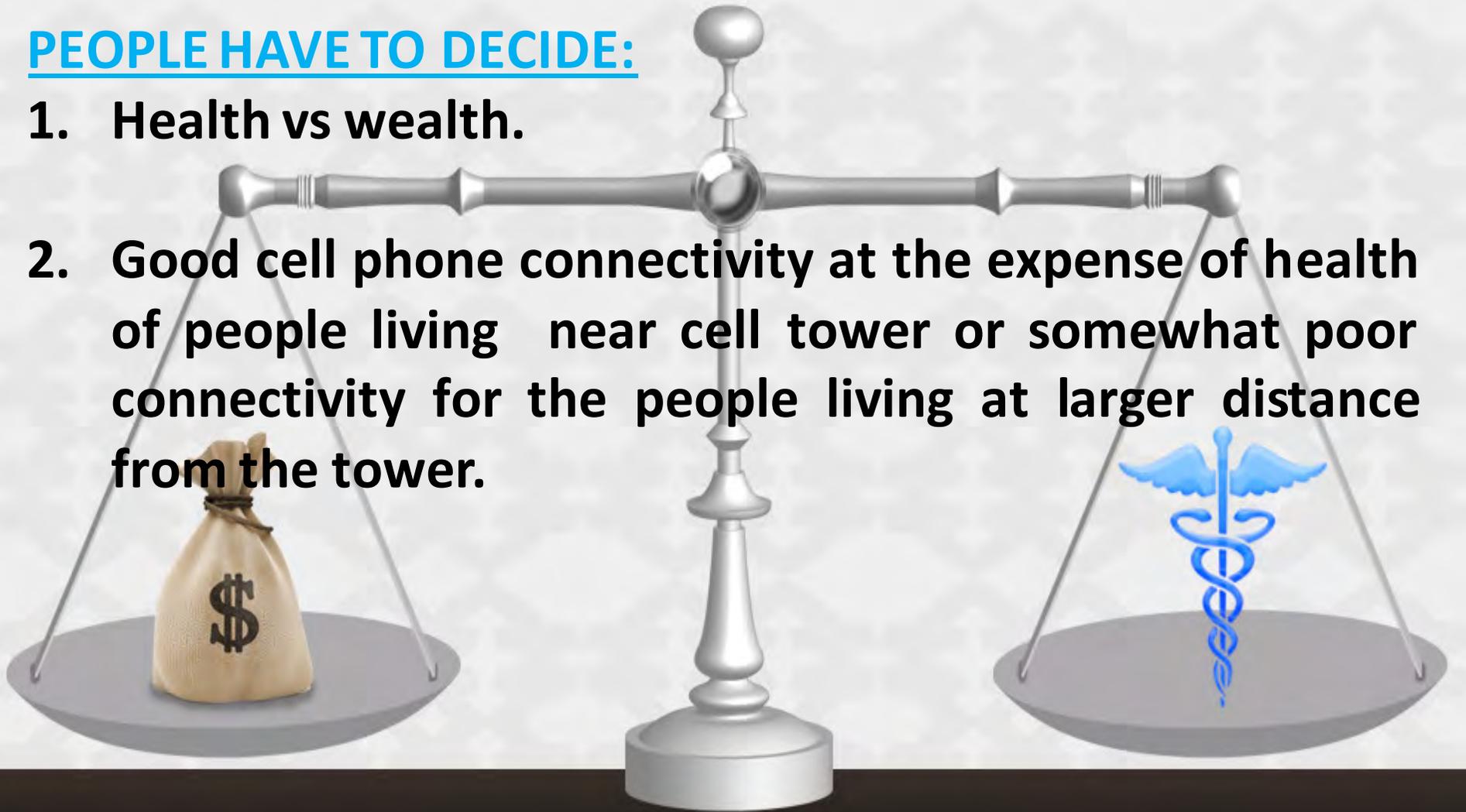
Direction of the antenna has to be changed. *

*Again, any of these steps will require additional investment.

PEOPLE HAVE TO DECIDE:

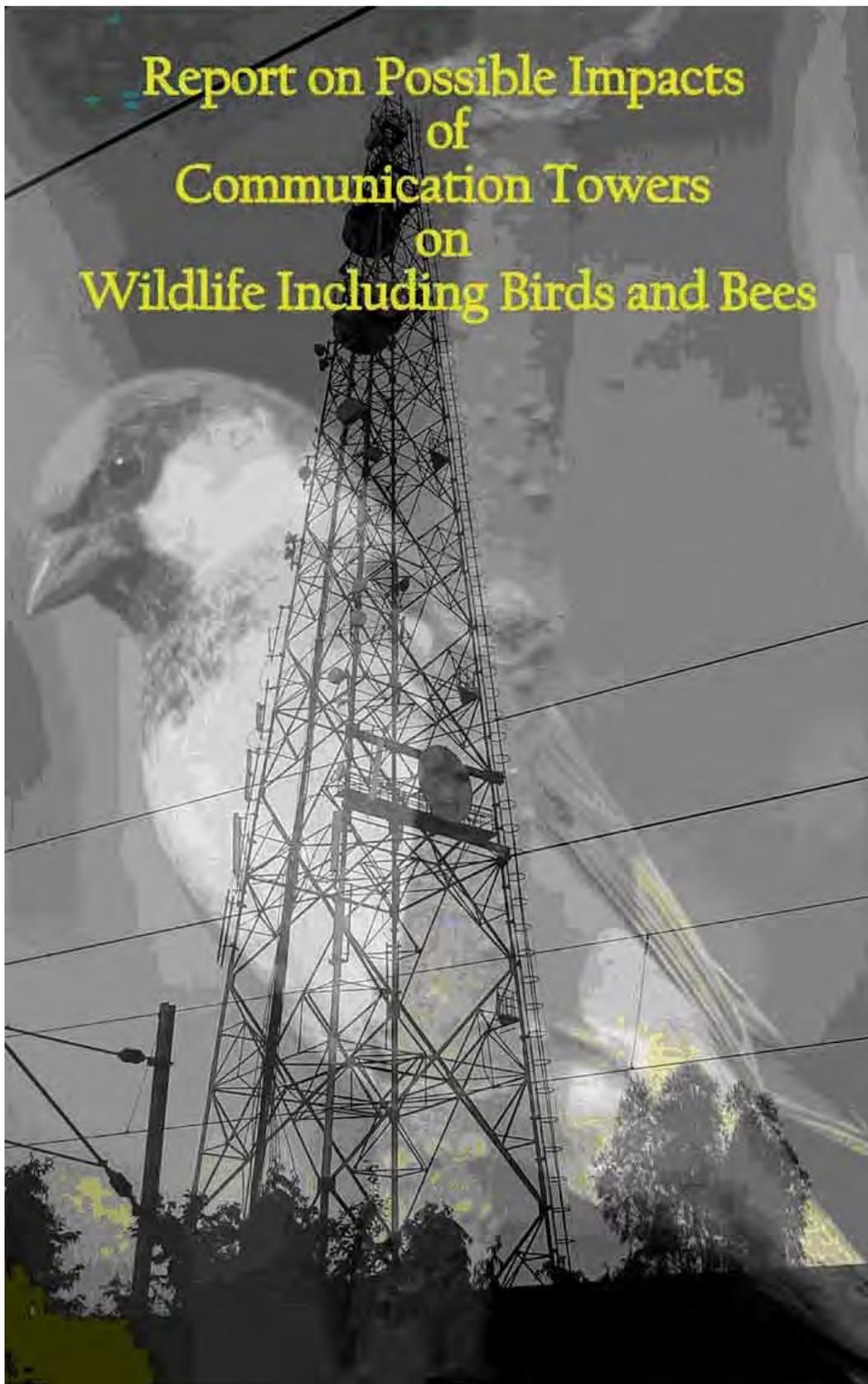
1. Health vs wealth.

2. Good cell phone connectivity at the expense of health of people living near cell tower or somewhat poor connectivity for the people living at larger distance from the tower.



Thank you

**Report on Possible Impacts
of
Communication Towers
on
Wildlife Including Birds and Bees**



Expert Group to study the possible impacts of communication towers on Wildlife including Birds and Bees

Executive summary

India is one of the fastest growing mobile telephony industries in the world. It is estimated that by 2013, 1 billion plus people will be having cell phone connection in India. To support this growth of cell phone subscriber in the country, there has also been a tremendous growth of infrastructure in the form of mobile phone towers. Today, in absence of any policy on infrastructure development and location of cell phone towers, large numbers of mobile phone towers are being installed in a haphazard manner across urban and rural areas including other sparsely populated areas in India.

The transmission towers are based on the electromagnetic waves, which over prolonged usage have adverse impacts on humans as well as on other fauna. The adverse effects of electromagnetic radiation from mobile phones and communication towers on health of human beings are well documented today. However, exact correlation between radiation of communication towers and wildlife, are not yet very well established.

The Ministry of Environment and Forests usually receives several questions regarding this issue. In view of one such Lok Sabha Starred question regarding 'Ill effects of Mobile Towers on Birds' received on 11th August, 2010, an 'Expert committee to Study the possible Impacts of Communication Towers on Wildlife including Birds and Bees' was constituted on 30th August, 2010 by Ministry of Environment and Forest, Government of India.

The Expert Committee had five important mandates which are as follows:

- I. To review all the studies done so far in India and abroad on aspects of ill effects of mobile towers on animals, birds and insects.
- II. To assess the likely impacts of the growth in the number of mobile towers in the country
- III. To suggest possible mitigatory measures.
- IV. To formulate guidelines for regulating the large-scale installation of mobile towers in the country
- V. To identify the gap areas for conducting further detailed research.

The Committee studied all the peer reviewed articles/ journals published on the impact of radiations on wildlife throughout the world and compiled them. Subsequently, detailed analysis of the papers was done to find out the impacts of electronic magnetic fields (**EMF**) on wildlife

including birds and bees and the gap areas for conducting further detailed research were identified.

The review of existing literature shows that the Electro Magnetic Radiations (EMRs) are interfering with the biological systems in more ways than one. There had already been some warning bells sounded in the case of bees and birds, which probably heralds the seriousness of this issue and indicates the vulnerability of other species as well. The electromagnetic radiations are being associated with the observed decline in the population of sparrow in London and several other European cities (Balmori, 2002, Balmori, 2009, Balmori & Hallberg, 2007). In case of bees, many recent studies have linked the electromagnetic radiations with an unusual phenomenon known as 'Colony Collapse Disorder'. A vast majority of scientific literature published across the world indicate deleterious effects of EMFs in various other species too.

In spite of the recent studies indicating possible harmful impact of EMF on several species, there are no long-term data available on the environmental impacts of EMRs as of now. Studies on impact of cell phone towers and EMR on birds and other wildlife are almost non-existent in India. Moreover, pollution from EMRs being a relatively new environmental issue, there is a lack of established standard procedures and protocols to study and monitor the EMF impacts especially among wildlife, which often make the comparative evaluations between studies difficult. In addition to the gap areas in research, the necessary regulatory policies and their implementation mechanism also have not kept pace with the growth of mobile telephoning. Our guidelines on exposure limits to EMF need to be refined since the ICNIRP Standard currently followed in India is coined based on only thermal impact of Radio Frequency and are dismissive of current epidemiological evidence on impacts of non-thermal nature on chronic exposure from multiple towers. Meanwhile, the precautionary principle should prevail and we need to better our standards on EMF to match the best in the world.

Along with the growth of phone towers and subscribers, India is also witnessing a rapid population growth. To feed and support this rapidly growing population the agricultural security and the factors influencing them should be of concern. However, the population of many species such as honey bees, which is one of the most important pollinator and important factor for agricultural productivity, has seen a drastic population drop. Unfortunately we do not have much data about the effects of EMR available for most of our free-living floral and faunal species in India. Therefore, there is an urgent need to do further research in this area before it would be too late.

Introduction

During recent years, there has been an increase in the usage of telecommunication devices, which has become an easy means for communication. The use of mobiles have become more conspicuous, during the last decade and this has led to construction of transmission towers in large numbers, both in the urban, as well as in rural areas including other sparsely populated areas. Transmission towers are based on the electromagnetic waves, which over prolonged usage have adverse impacts on humans as well as on other fauna. The adverse effects of electromagnetic radiation from mobile phones and communication towers on health of human beings are well documented today. Recently the electromagnetic fields from mobile phones and other sources have been classified as “possibly carcinogenic to human” by the WHO’s International Agency for Research on Cancer (IARC). However, exact correlation between radiation of communication towers and wildlife, are not yet very well established. Though, there have been growing concerns about the impacts of mobile towers on wildlife, and couple of studies conducted in India and worldwide indicates the possibility of negative effects of radiation.

The Ministry of Environment and Forests (MoEF) usually receives questions on such subject during the last couple of years. One such question, that the Ministry of Environment and Forests replied to on 11th August, 2010 was a Lok Sabha Starred question number 244 regarding ‘Ill effects of Mobile Towers on Birds’. In the above mentioned question, Hon’ble Member of Parliament (Lok Sabha), wanted to know, whether any studies have been conducted on the ill effects of mobile towers on birds and bees and also whether the Government has set up any committee to look into the issue.

In view of this, an urgent need was felt to constitute an Expert Group to assess the level of possible impacts of growth of mobile towers in urban, sub-urban and even rural/forest areas on the wildlife including birds and bees and to suggest appropriate mitigative measures for the problem. Hence, the ‘Expert committee to Study the possible impacts of communication towers on wildlife including Birds and Bees’ was constituted on 30th August, 2011 by Ministry of Environment and Forest, Government of India. The constitution and the terms of references of the committee are at **Annexure I**.

The committee had the following important five mandates to be completed:

- I. To review all the studies done so far in India and abroad on aspects of ill effects of mobile towers on animals, birds and insects.
- II. To assess the likely impacts of the growth in the number of mobile towers in the country
- III. To suggest possible mitigatory measures.

- IV. To formulate guidelines for regulating the large-scale installation of mobile towers in the country
- V. To identify the gap areas for conducting further detailed research.

In order to achieve its mandate, the committee had convened three meetings and discussed the issue thread bare. After the discussions, in third meeting, the committee had decided to finalise its report. Subsequently, hundreds of research papers were collated, analyzed and reviewed. Detailed descriptions were noted of important and relevant papers. Drafts were circulated within the Committee members for comments.

It should be noted that this is not a complete review of the impact of the electromagnetic radiation on all life forms as **the mandate of the Committee was limited to birds and bees**. However, for the context purpose the committee has referred to many papers concerning other taxa (See Literature Cited).

The findings of the committee based on the above mandates are provided in detail in the following paragraphs.

Scientific background on the issue

Rapid developments in various fields of science and technology in recent years have intensified the human interference into the natural environment and associated physical, biological and ecological systems resulting in various unintended and undesirable negative impacts on environment. With economic, social and scientific development, increasingly fresh avenues for environmental pollution are being thrown open in recent times. Pharmaceutical, genetic, nano-particulates and electro-magnetic pollutions are the prominent ones among them which were in the limelight in recent times for all the negative reasons.

The intensity of manmade electromagnetic radiation has become so ubiquitous and it is now increasingly being recognized as a form of unseen and insidious pollution that might perniciously be affecting life forms in multiple ways (Balmori 2006a; Balmori 2006b; Balmori 2009; Tanwar 2006). The **electro-magnetic fields (EMF)** as a pollution called 'electro-smog' is unique in many ways. Unlike most other known pollutants, the **electro-magnetic radiations (EMR)** are not readily perceivable to human sense organs and hence not easily detectable. However, their impacts are likely to be insidious and chronic in nature. However, it is possible that other living beings are likely to perceive these fields and get disturbed or sometimes fatally misguided. Because the EMR pollution being relatively recent in origin and lately being recognized as a pollutant coupled with its expected long-term impacts and lack of data on its effect on organisms, the real impacts of these pollutants are not yet fully documented in the scientific literature.

The electromagnetic radiations (EMR) are extensively used in modern communication and technology. Radio waves and microwaves are forms of electromagnetic energy that are collectively described by the term "**radiofrequency**" or "**RF**". RF emissions and associated phenomena can be discussed in terms of "energy", "power", "radiation" or "field". Electromagnetic "radiation" can best be described as waves of electric and magnetic energy moving together (i.e., radiating) through space (Cleveland, Fields, and Ulcek 1999).

The first mobile telephone service started on the non-commercial basis on 15 August 1995 in Delhi. During the last 16 years, India has seen exponential growth of mobile telephoning. With this growth, a number of private and government players are coming in to this lucrative and growing sector. At present nearly 800 million Indians have mobile phones, making it the second largest mobile subscribers in the world after China. At present, there are nearly 15 companies providing mobile telephoning. However, necessary regulatory policies and their implementation mechanism have not kept pace with the growth of mobile telephoning. Moreover, there have been not enough scientific studies on the impact of mobile phone towers on human health or its environmental impacts.

Most of the short-term studies primarily looking into the thermal impacts of EMR exposure on biological systems have neither succeeded to detect any statistically significant changes in the biological processes nor could prove any acute change in health conditions at the present background levels of exposures (Brent 1999; Hanowski Niemi and Blake 1996; Hoskote, Kapdi and Joshi 2008; Lönn *et al.* 2005; Mixson *et al.* 2009; Zach and Mayoh 1984; Zach and Mayoh 1986). On the other hand, long-term studies have reported alarming observations, detecting negative consequences on immunity, health, reproductive success, behaviour, communication, co-ordination, and niche breadth of species and communities (Preece *et al.* 2007; Levitt and Lai 2010; Hardell *et al.* 2008; Hardell *et al.* 2007; Fernie and Bird 2001).

- **Impact on birds and bees:** Of the non-human species, impacts on birds and bees appear to be relatively more evident. Exposure to EMR field is shown to evoke diverse responses varying from aversive behavioural responses to developmental anomalies and mortality in many of the studied groups of animals such as bees, amphibians, mammals and birds (Zach and Mayoh 1982; Zach and Mayoh 1982; Batellier *et al.* 2008; Nicholls and Racey 2007; Bergeron 2008; Coplestone *et al.* 2005; Sahib 2011). Honey bees appear to be very sensitive to EMF (Ho 2007; Sharma and Kumar 2010; Ho 2007) and their behavioural responses, if scientifically documented, could be used as an indicator of EMF pollution.
- **Impacts on other wildlife:** Other wildlife such as amphibians and reptiles also appear to be at high risk with possible interference of EMF with metamorphosis and sex ratios where temperature dependent sex determination is operational. Several investigations into

environmental effects of EM fields are covered in some of the unpublished / grey literature and impact assessments submitted to various regulatory government agencies (Bergeron 2008a; Bergeron 2008b; Cleveland, Fields, and Ulcek 1999; Copplesstone *et al.* 2005; G. Kumar 2010; Hutter *et al.* 2006). Such reports are either not in the public domain, or scattered and often difficult to access.

- **Impacts on Human:** Since its inception, there have been concerns about the ill-effect of the mobile towers and mobile phones. Despite being a relatively newly acknowledged form of pollution, EMRs and their negative impacts on biological systems and environment have already been reported by several studies. However most of the available scientific literature on the negative environmental effects of electromagnetic fields reports the results of experimental and epidemiological studies examining the impact on various aspects of human health (Tanwar 2006; Savitz 2003; Preece *et al.* 2007; Oberfeld *et al.* 2004; Navarro *et al.* 2003; Lönn *et al.* 2005; Kundi and Hutter 2009; Hardell *et al.* 2007; Kapdi, S. Hoskote and Joshi 2008; Hallberg and Johansson 2002).

Present scenario: At present, there could be more than 5 billion mobile phone subscribers globally (www.who.int/mediacentre/factsheets/fs193/en). Recently, in May 2011, the WHO's International Agency for Research on Cancer (IARC) has classified electromagnetic fields from mobile phones and other sources "possibly carcinogenic to human" and advised the public to adopt safety measures to reduce exposures, like use of hand-free devices or texting. For details please see Press Release No. 208, dated 31 May 2011 on IARC-WHO (http://www.iarc.fr/en/media-centre/pr/2011/pdfs/pr208_E.pdf). Their findings were published in the July 2011 issue of the medical journal *Lancet*. Later, WHO clarified that some of the findings published in *Lancet* were not reported properly in the media and the risk is not as great as made out in the media. Some of the cell phone manufactures have objected to these findings (For example see www.Physorg.com). Some earlier investigators also have contended that there is no measurable risk of reproductive failure and birth defects from EMF exposures in humans (Brent *et al.* 1993), while several others do not agree with that conclusion (Gandhi 2005; Kapdi, Hoskote and Joshi 2008; Pourlis 2009; G. Kumar 2010). Studies carried out on the RF levels in North India, particularly at the mobile tower sites at Delhi have shown that people in Indian cities are exposed to dangerously high levels of EMF pollution (Tanwar 2006).

Existing world-wide standard and permissible limits

Two major transmission protocols currently in use for mobile telephony are GSM (900 to 1800 MHz) and CDMA (824-844 MHz paired with 869-889 MHz). The Telecom Engineering Centre (TEC) of DoT had proposed display of Specific Absorption Rate (SAR) value in handsets. As indicated in the table below, current Indian standards on exposure are much higher than many other countries.

Power Density (W/m ²)	International Exposure limits adopted by various countries
10	FCC (USA) OET-65, Public Exposure Guidelines at 1800 MHz
9.2	ICNIRP and EU recommendation 1998 – Adopted in India
3	Canada (Safety Code 6, 1997)
2	Australia
1.2	Belgium (ex Wallonia)
0.5	New Zealand
0.24	Exposure limit in CSSR, Belgium, Luxembourg
0.1	Exposure limit in Poland, China, Italy, Paris
0.095	Exposure limit in Italy in areas with duration > 4hours
0.095	Exposure limit in Switzerland
0.09	ECOLOG 1998 (Germany) <i>Precaution recommendation only</i>
0.025	Exposure limit in Italy in sensitive areas
0.02	Exposure limit in Russia (since 1970), Bulgaria, Hungary
0.001	"Precautionary limit" in Austria, Salzburg City only
0.0009	<i>BUND 1997 (Germany) Precaution recommendation only</i>
0,00001	New South Wales, Australia

Table 1. Guidelines and Limits on Exposure Limits in Various Countries (Source: Girish Kumar 2010)

1. ICNIRP Guidelines (International Radiofrequency Guidelines):

In April 1998, the International Commission on Non-Ionizing Radiation Protection (ICNIRP) published, guidelines for limiting exposure to time-varying electric, magnetic and electromagnetic fields in the frequency range up to 300 GHz. These guidelines replaced previous advice issued in 1988 and 1990. The main objective of the ICNIRP Guidelines is to establish guidelines for limiting EMF exposure that will provide protection against known adverse health effects (ICNIRP, 1998). An adverse health effect is defined by ICNIRP as one which causes detectable impairment of the health of the exposed individual or of his or her offspring; a biological effect, on the other hand, may or may not result in an adverse health effect.

2. Guidelines and Limits followed by Other Countries:

Some countries have established new, low-intensity based exposure standards that respond to studies reporting effects that do not rely on heating. Consequently, new exposure guidelines are having hundreds or thousands times lower than those of Institution of Electronics and Electrical Engineers (IEEE) and ICNIRP. Table 2, shows some of the countries that have lowered their limits, for example, in the cell phone frequency range of 800 MHz to 900 MHz. The levels range from 10 microwatts per centimeter squared in Italy and Russia to 4.2 microwatts per centimeter squared in Switzerland. In comparison, the United States and Canada limit such exposures to only 580 microwatts per centimeter squared (at 870MHz) and then averaged over a time period (meaning that higher exposures are allowed for shorter times, but over a 30 minute period, the average must be 580 microwatts per centimeter squared or less at this frequency). The United Kingdom allows one hundred times of this level, or 580 x 100 microwatts per centimeter squared. Higher frequencies have higher safety limits, so that at 1000 MHz, for example, the limit is 1000 microwatts per centimeter squared (in the United States). The exposure standards for each individual frequency in the radiofrequency radiation range needs to be calculated. These are presented as reference points only. Emerging scientific evidence has encouraged some countries to respond by adopting planning targets, or interim action levels that are responsive to low-intensity or non-thermal radiofrequency radiation bio effects and health impacts.

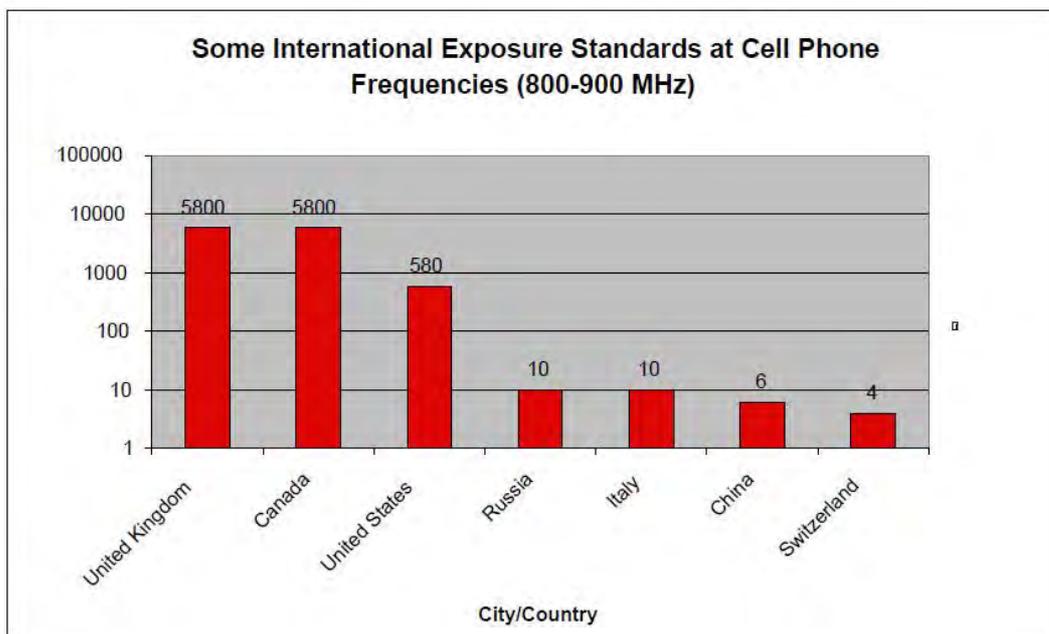


Table 2. Some International Exposure Standards at Cell Phone Frequencies (800-900 MHz) (Values of exposure in microwatts per centimeter squared)

Professional bodies such as IEEE and ICNIRP continue to support “thermal-only” guidelines:

- a) by omitting or ignoring study results reporting bio-effects and adverse impacts to health and wellbeing from a very large body of peer-reviewed, published science because it is not yet “proved” according to their definitions;
- b) by defining the proof of “adverse effects” at an impossibly high a bar (scientific proof or causal evidence) so as to freeze action;
- c) by requiring a conclusive demonstration of both “adverse effect” and risk before admitting low-intensity effects should be taken into account;
- d) by ignoring low-intensity studies that report bio-effects and health impacts due to modulation;
- e) by conducting scientific reviews with panels heavily burdened with industry experts and under-represented by public health experts and independent scientists with relevant low-intensity research experience;
- f) by limiting public participation in standard-setting deliberations; and other techniques that maintain the status quo.

(Source: “*Bio Initiative Report: A Rationale for a Biologically-based Public Exposure Standard for Electromagnetic Fields (ELF and RF)*” by 'Cindy Sage, and David Carpenter (2007))

Detailed analysis of the Issue vis-à-vis the TORs

- **TOR I: *To review all the studies done so far in India and abroad on aspects of ill effects of mobile towers on animals, birds and insects.***

Though EMR is a relatively newly recognised pollutant, many recent studies have pointed to their harmful long-term impacts on health and environment. Hence the most important mandate of the committee was to study all the peer reviewed articles/ journals published on the impact of radiations on wildlife throughout the world and to compile them. Subsequently, detailed analysis of the papers was done to find out the impacts of electronic magnetic fields (EMF). The research papers were then listed in to three categories: showing impact on organisms, no impact and neutral or inconclusive evidence (See Table No. 3).

Literature review:

A review during the international seminar entitled “Effects of electromagnetic fields on the living environment” held in Ismaning, Germany in 1999, organized under WHO’s International EMF Project, observed that the EMF impacts on environment are minimal and localized and has opined that the human EMF exposure limits recommended by the International Commission on Non-Ionizing Radiation (ICNIRP, 1998) would also be protective of the environment as well (Foster and Repacholi 1999). However, recent research reports are at odds with these propositions, including the latest report from WHO indicating a possible link with cell phone use and brain glioma (Baan *et al*, 2011).

Several species are known to have the capability to sense and respond to EM fields, especially the earth's magnetic field (Kirschvink 1982). However, little is known of the exact physiological mechanisms involved. Three major hypotheses of magnetic-field detection have been proposed (Lohmann and Johnsen 2000): a) *Electromagnetic induction* (as in Electro sensitive sharks and rays), b) *Biogenic magnetite* and c) *Chemical reactions modulated by magnetic fields*. Despite notable recent progress, primary magneto-receptors have not yet been identified unambiguously.

Most of the reported studies examined (n=919) deal with the EMF impacts on human subjects (81%), while only 3% of them reports impact on birds and just 2% on wildlife. The present report is based on relevant papers and documents obtained mainly from online archives of JSTOR (www.jstor.org) and Google scholar (<http://scholar.google.co.in/>). Salient features of the reported studies on the impact of EMF on different faunal groups are discussed below (can be included below).

An Analysis of Results of Literature Survey:

After careful screening that involved deletion of duplicate records and addition of new references, the 1080 references initially compiled for the analysis of literature (which formed the base for our overview) were reduced to 919 references. These final 919 study reports are used here for the present final analysis.

The studies were broadly classified based on the subject organisms into four categories- Birds, Bees, Other Animals (including wildlife) and humans. Based on the study's findings regarding the impact of EMFs on the subject, each category was further subdivided into three groups- Impact, No Impact or Neutral/ Inconclusive, as given in table 3 below. As noted below majority of the studies reported negative impacts by EMFs.

Table 3. Number of research studies (collected from Open access Bibliographic databases) collected and collated based on the study subjects and results

	Impact	No Impact	Neutral/ inconclusive	Total (n)
Birds	23	3	4	30
Bees	6	1	0	7
Human	459	109	174	742
Other Animals (+Wildlife)	85(+13)	16(+1)	10(+7)	111(+21)
Plants	7	0	1	8
Total	593	130	196	919

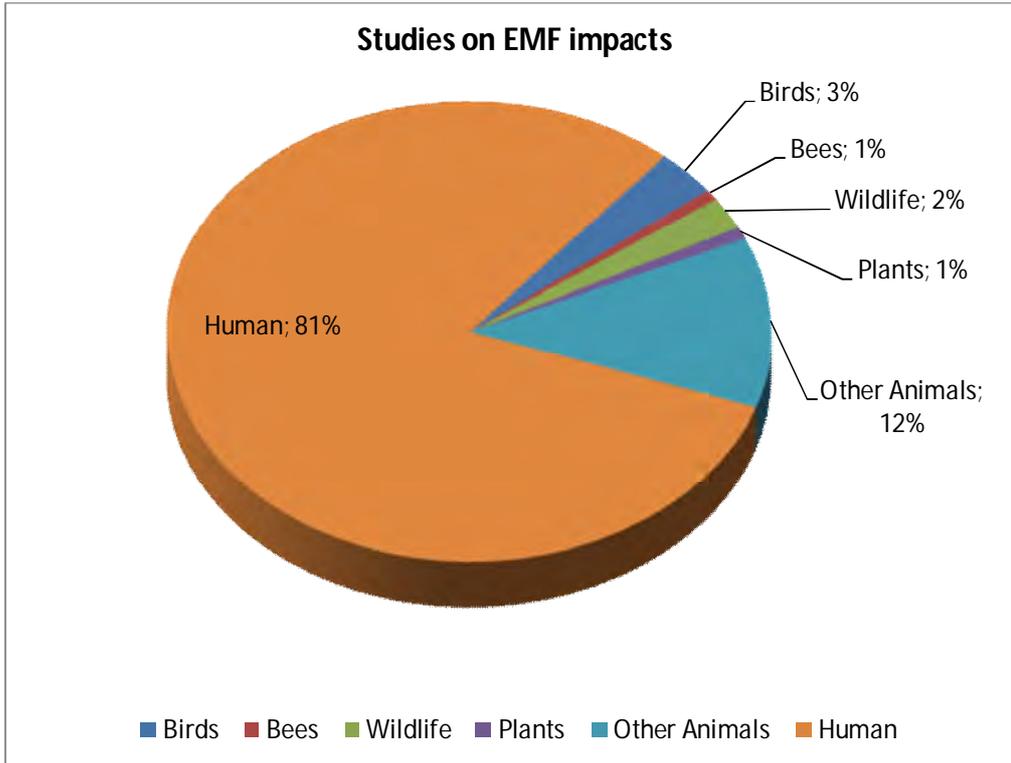


Fig 1. Proportion of studies on different groups of organisms

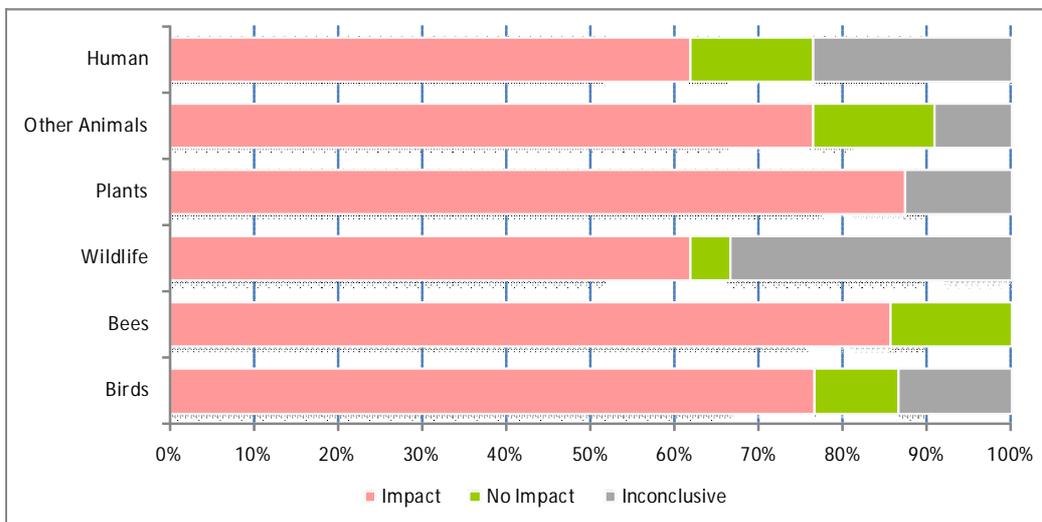


Fig 2. Proportion of study results in various groups of organisms (n=919). The ‘Impact’ (in red) indicates percentage of studies that reported harmful effect of EMR

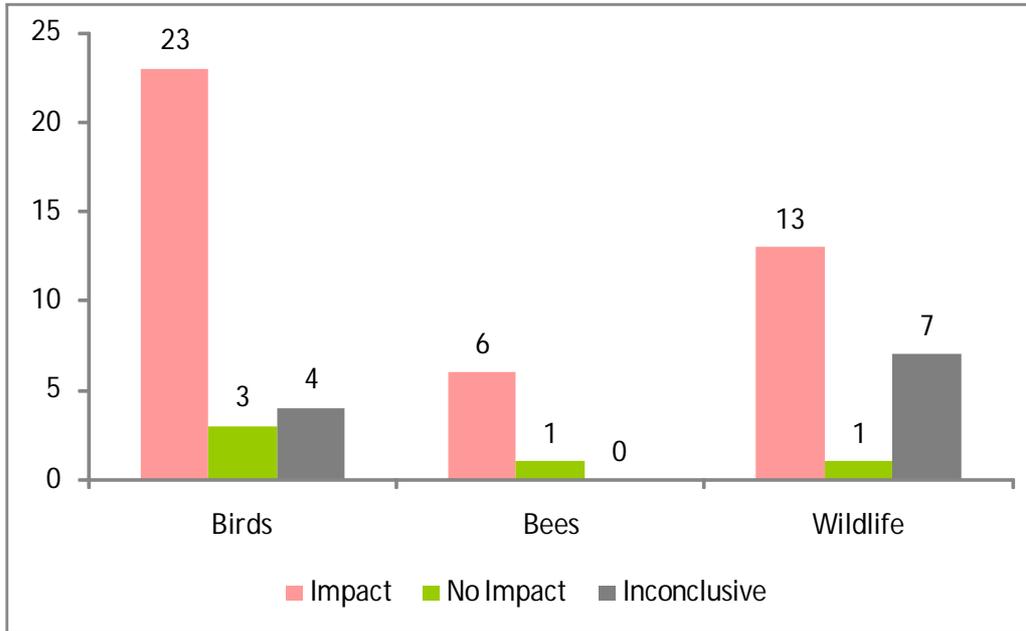


Fig 3. Proportion of study results in Birds, Bees and Wildlife (n=919).

- **TOR II: To assess the likely impacts of the growth in the number of mobile towers in the country.**

India has the second largest population of mobile subscribers in the world and in the absence of any proper policy regulating the construction of mobile towers, the risk of the likely negative impacts of EMF on the health of humans and wildlife is huge. Based on the analysis of the reported studies, the impacts of EMF on different faunal groups were identified, the salient features of which are as discussed below:

Effect on Birds: The earliest reported study on impacts of microwave radiation on birds dates back to 1960s (Tanner, Romero-Sierra, and Davie 1967). In birds, their ability to fly expose them to a greater risk of direct irradiation and hence they appear to be at greater risk as far as effects of EMRs are concerned (Balmori 2005; Balmori and Hallberg 2007; Summers-Smith 2003; Zach and Mayoh 1982; Zach and Mayoh 1984; Zach and Mayoh 1982; Joris and Dirk 2007). Observed effects of exposure to non-ionizing radiation in avian species are mostly from radiation-induced temperature increases (Batellier *et al.* 2008). The incubating avian egg provides a model to study non-thermal effects of microwave exposure since ambient incubation temperature can be adjusted to compensate for absorbed thermal energy. Non-thermal levels of non-ionizing radiation can affect a bird's ability to recover from acute physiological stressors, apart from other potential physiological and behavioural repercussions. Although earlier research indicated that modulated radiofrequency radiation increased calcium-ion efflux in chick forebrain tissue, disagreement on experimental techniques and incongruous results among related studies have

made final conclusions elusive. In another study, which was carried out by National Research Centre of Canada on interaction of electromagnetic fields and living systems with special reference to birds, it was observed that following the onset of radiation, stabilizing period of the egg production in birds was affected (Bigu, 1973).

Birds have been shown to be able to reliably detect magnetic fields in both the field and laboratory. The rapidly increasing number of cell-phone subscribers is resulting in higher concentration levels of electromagnetic waves in the air, which clashes with the earth's electromagnetic field (Hyland, 2000). Some researchers have reported malformations in chicken embryos exposed to a sinusoidal bipolar oscillating magnetic field (Balmori and Hallberg 2007).

According to a thermal modelling study of a bird subjected to continuous wave (CW) microwave radiation (2.45 GHz), the model predicted that tolerance to microwave radiation for a bird was positively correlated with its mass and that ambient temperature is the environmental variable that has most influence on the level of tolerance for microwave radiation (Byman *et al.* 1986).

Effect on House Sparrows: House Sparrow (*Passer domesticus*) is associated with human habitation and it is one of the indicator species of urban ecosystems. A declining population of the bird provides a warning that the urban ecosystem is experiencing some environmental changes unsuitable for living in the immediate future (Kumar, 2010). London has witnessed a 75 per cent fall in House Sparrow population since 1994, which coincides with the emergence of the cell-phone (Balmori, 2002). Electromagnetic radiation may be responsible, either by itself or in combination with other factors, for the observed decline of the sparrows in European cities (Balmori, 2009, Balmori & Hallberg, 2007). Research in Spain proved that the microwaves released from these towers are harmful to House Sparrows and the increase in the concentration of microwaves results into decrease in House Sparrow populations (Everaert & Bauwen, 2007). Reproductive and co-ordination problems and aggressive behavior has also been observed in birds such as sparrows (Balmori, 2005). General methodology used for such study was, from each area, all sparrows were counted in addition to the mean electric field strength (Everaert & Bauwens, 2007). In similar studies in India, population of *Passer domesticus* was found fast disappearing from areas contaminated with electromagnetic waves arising out of increased number of cell phones, in Bhopal, Nagpur, Jabalpur, Ujjain, Gwalior, Chhindwara, Indore & Betul (Dongre & Verma, 2009). It was also observed that when 50 eggs of House Sparrow, exposed to electromagnetic radiation (EMR) for durations of five minutes to 30 minutes, all the 50 embryos were found damaged in a study carried out by the Centre for Environment and Vocational Studies of Punjab University (Kumar 2010, Ram 2008).

Male sparrows were seen at locations with relatively high electric field strength values of GSM base stations, providing evidence of how long-term exposure to higher levels of radiation negatively affects the abundance or behavior of House Sparrows in the wild. Thus,

electromagnetic signals are associated with the observed decline in the sparrow population in urban areas.

Effect on White Storks: In monitoring a White Stork (*Ciconia ciconia*) population in Valladolid (Spain) in vicinity of Cellular Phone Base Stations, the results indicated the possibility that microwaves are interfering with the reproduction of White Stork (Balmori, 2010).

Effect of Mobile Radiation on Honey Bees: Many recent studies have linked the electromagnetic radiations with an unusual phenomenon in bees known as 'Colony Collapse Disorder'. Colony Collapse Disorder (CCD) occur when a hive's inhabitants suddenly disappear, leaving only queens, eggs and a few immature workers. The vanished bees are never found, but thought to die solitarily far from home. The theory is that radiation from mobile phones interferes with bees' navigation systems, preventing them from finding their way back to their hives. Even the other animals, parasites and other bees, that normally would raid the honey and pollen left behind when a colony dies, refuse to go anywhere near the abandoned hives. Some scientists believe that CCD is the result of high electromagnetic radiation. As long back as early 1970s, Wellenstein (1973) had reported that the navigational skills of the honey bees were being impacted by high tension lines. In a recent study (Stefan *et al.* 2010) significant differences have been detected in returning of honeybees to their hives: 40% of the non-irradiated bees came back compared to 7.3% of the irradiated ones.

The alarm was first sounded in last autumn, but has now hit half of all American states. The West Coast is thought to have lost 60 per cent of its commercial bee population, with 70 per cent missing on the East Coast. CCD has since spread to Germany, Switzerland, Spain, Portugal, Italy and Greece. John Chapple, one of London's biggest bee-keepers, announced that 23 of his 40 hives have been abruptly abandoned (<http://www.independent.co.uk/environment/nature/are-mobile-phones-wiping-out-our-bees-444768.html>).

In India, studies conducted by Sainudeen (2011) have proved experimentally that once mobile phones in working condition with frequency of 900 MHz for 10 minutes were kept in the beehives, the worker bees stopped coming to the hives after ten days. He also found drastic decrease in the egg production of queen bees (100 eggs/ day compared to 350 eggs/ day in the control colonies). Earlier studies have also shown (e.g. Greenberg *et al.* 1981) lower eggs being laid in beehives exposed to high voltage transmission lines. Another possible impact of EMR on the bees is the eggs that are exposed to cell phone radiation produce only drones (Brandes and Frish, 1986). Similar studies on a larger scale and better sample size are required in India.

Other wildlife: Phone masts located in the living areas of animals and birds are continuously irradiating some species that could suffer long-term effects, like reduction of their natural defences, deterioration of their health, problems in reproduction and reduction of their useful territory through habitat deterioration. Electromagnetic radiation can exert an aversive

behavioural response in rats, bats and birds such as sparrows. Therefore microwave and radiofrequency pollution constitutes a potential cause for the decline of animal populations and deterioration of health of plants living near phone masts (Balmori, 2005).

Arguably, the most serious concern about the impact of EMF on the living systems appears to be its long term effects on genes and reproductive fitness of species. Today, there is evidence that Electromagnetic Radiation is genotoxic (Blaasaas, Tynes, and Lie 2003; Joris and Dirk 2007; Pourlis 2009; Cherry 2000). An experiment on Common Frog (*Rana temporalis*, new name *Hylarana temporalis*) indicated that radiation emitted by phone masts in a real-time situation may affect the development and may cause rise in mortality of exposed tadpoles. This research may have huge implications for the natural world, which is now exposed to high microwave radiation levels from a multitude of phone masts (Balmori 2010). However, it requires long-term monitoring studies for establishing any causative link between reproductive fitness and EMFs and such data is presently lacking. Moreover, available short term studies are grossly inadequate. For instance a recent review that analysed the literature (till 2001) on the effects of EMF associated with mobile telephony on the prenatal and postnatal development of vertebrates reported that the majority of the studies examined indicated no strong impact on the animal reproduction and development (Pourlis 2009).

Effect on bats: Activity of bats seems to be much reduced in areas with Electro-magnetic fields with densities more than 2V/m (Balmori, 2009). Based on this fact it was recommended to use EMR to repel bats from wind farms (Nicholls and Racey, 2007). In another study in a Free-tailed bat colony (*Tadarida teniotis*) the number of bats decreased when several phone masts were placed 80m from the colony (Balmori *et al.*, 2007).

- **TOR III: To suggest possible mitigatory measures**

Decision was taken in the first and second meetings of the Expert Group to study all peer reviewed articles/ journals published on the impact of radiations on wildlife and to compile the list of the measures taken throughout the world to mitigate the effects of radiations on wildlife including birds and bees. Hence, the standards and exposure limits of radio frequency of different countries were studied in this regard.

Various organizations and countries have developed standards for exposure to radio frequency energy as discussed above. Some countries have established new, low-intensity based exposure standards that respond to studies reporting effects that do not rely only on heating. Currently, the World Health Organization is working to provide a framework for international harmonization of RF safety standards.

Emerging scientific evidence has encouraged some countries to respond by adopting planning targets, or interim action levels that are responsive to low-intensity or non-thermal radiofrequency radiation bio effects and health impacts. It is the WHO's view that scientific

assessments of risk and science-based exposure limits should not be undermined by the adoption of arbitrary cautionary approaches. Therefore, throughout the world there has been a growing movement to adopt a precautionary approach.

- **TOR IV: *To formulate guidelines for regulating the large-scale installation of mobile towers in the country***

With the rapid growth of the mobile industry in India, mobile towers are being built in a haphazard manner without any prior planning and regulation. Hence in view of this, along with lack of any policy controlling the construction of such mobile towers, one of the main tasks of the committee is to formulate guidelines to regulate their installation. At the first meeting of the Expert Committee held on 09.2010, it was decided that few members of the Expert Group will participate in the meeting of the Inter-Ministerial Committee on EMF Radiation held in Ministry of Telecommunications on 06.12.2010, to share the concerns on human as well as wildlife health and to devise a common set of guidelines for mobile towers in the country. The minutes of the meeting was submitted to the Ministry.

- **TOR V: *To identify the gap areas for conducting further detailed research***

At the first meeting of the committee, all the members had agreed that the research in India on this issue is very scanty and much research has to be done in this field especially on birds and bees, as well as to find solutions to this issue. Hence, in the second meeting of the Expert Group held on 14.02.2011, a decision was taken to identify the gap areas in research on the issue of impact of radiations on wildlife including birds and bees.

Gap areas for research: Ample information on the impact of EMF on human health is available. However these results cannot be extrapolated to reflect impacts on wildlife impacts since the impact highly varies even within same species depending on multiple factors such as body size, age, earthing, fat content in the body, objects in the immediate vicinity and so on.

Not much data is also available on biological impacts on wild species except for a few species like sparrows and bees. Even this little available information is not reflective of the impact of present background levels of radiation. Information on effects with regards to specific frequencies and species response is lacking. Data on navigation and seasonal migrations as indicated by studies on homing pigeons (Kirchwink 1982) are lacking from the Indian context.

The current ICNIRP guidelines on EMF are developed based especially on laboratory studies, epidemiological data on humans, occupational exposures, in-vitro investigations, observations on cellular changes under control conditions etc. Ecological issues appear to be hardly taken care of. One needs to acknowledge that laboratory observations need not necessarily reflect field effects. Therefore we have to re-visit the guidelines taking account low level electro-smog on wild species especially birds, bees, amphibians etc and modify them accordingly. Our guidelines need to be refined since the ICNIRP Standard currently followed in India is coined

based on only thermal impact of RF and is dismissive of current epidemiological evidence on impacts of non-thermal nature on chronic exposure from multiple towers. The limit on whole-body average SAR is 0.08 W/kg. It is a long way to go before we can have the required long-term 'Species specific data' to decide on the threshold exposure levels for various wildlife species. Till such time a **precautionary principle approach to be used to minimize the exposure levels and we may have to move ahead and adopt stricter norms followed in some other countries like Russia, China, New Zealand etc.**

Since EMF being an invisible form of pollution there needs to be an independent system for monitoring of EMF pollution across the country.

The EMF pollution has reportedly caused population declines on sparrows and bees (causing disorientation and Colony Collapse Disorder (CCD)). It has also resulted in aversive behaviour in bats and sparrows, abnormal behaviour in Tits, Kestrels, reproductive failure in White Storks and also fatal bird collisions with involving communication towers causing the death of several million birds of 230 species each year in the USA alone. However, sound scientific investigations in this regard are lacking in India and such studies needs to be undertaken on an urgent basis.

The following areas for specific studies are suggested to be taken up:

- Field studies on impact of cell towers on bee colonies and apiculture,
- Bird/bat/insect mortalities at mobile phone towers with special reference to towers along bird migratory paths,
- Studies on birds / bats / bees to find the effect of EMR on their communication, orientation and co-ordination
- Effect of EMF on amphibian metamorphosis and sex determination in reptiles
- Laboratory studies to develop an understanding on certain species, on their physiological and behavioural aspects, making use of the techniques of bioassay/bio-monitoring
- Measurement, monitoring and mapping of background EMF levels and power density across India involving independent research agencies.
- Regulations/standards to include the ecological characteristics of an area while determining the location of transmission towers, relay stations etc
- Regulations to control installation of transmission towers in human residences/hospitals/dense habitations
- Conduct ecological impact assessment of transmission towers and base stations, with standardised protocols/parameters

Future Scenario

India is one of the fastest growing mobile telephony industries in the world. It is estimated that by 2013, 1 billion plus people will be having cell phone connection in India. With the growth of cell phone subscriber, it has also lead to growth of infrastructure in the form of mobile phone towers. Today, in absence of any policy on infrastructure development and location of cell phone towers, large number of mobile phone towers are being installed in a haphazard manner across urban and sub urban habitats in India.

Along with the growth of phone towers and subscribers, India is also witnessing a rapid population growth. To feed and support this rapidly growing population the agricultural security and the factors influencing them should be of concern. However, the population of many species such as honey bees, which is one of the most important pollinator and important factor for agricultural productivity, has seen a drastic population drop.

Precautionary approach

Throughout the world there has been a growing movement to adopt a precautionary approach. The WHO defines the Precautionary Principle as a risk management concept that provides a flexible approach to identify and manage possible adverse consequences to human health even when it has not been established that the activity or exposure constitutes harm to health.

It is the WHO's view that scientific assessments of risk and science-based exposure limits should not be undermined by the adoption of arbitrary cautionary approaches. The compliance of mobile phone networks and handsets with the ACMA regulations is regarded as a prudent and cautious approach to ensure that the community is not adversely affected by, but benefits from developments in communications.

The Department Of Telecom has constituted an Inter-Ministerial Committee to examine the effect of EMF Radiation on health. The report of the committee is placed in DOT website. The IMC report is under examination of DOT at present.

Recommendations

Following recommendations have been put forward by few members of the Committee:

- 1) EMF should be recognised as a pollutants/ regular auditing of EMF should be conducted in urban localities/educational/hospital/industrial/residential/recreational premises and around the protected areas and ecologically sensitive areas.
- 2) Introduce a law for protection of urban flora and fauna from emerging threats like ERM/EMF as conservation issues in urban areas are different from forested or wildlife habitats.
- 3) Bold signs and messages on the dangers of Cell phone tower and radiation which is emitted from it are displayed in and around the structures where the towers are erected. Use visual daytime markers in areas of high diurnal raptor or waterfowl movements.
- 4) To avoid bird hits, security lighting for on-ground facilities should be minimized and point downwards or be down-shielded.
- 5) Independent monitoring of radiation levels and overall health of the community and nature surrounding towers is necessary to identify hazards early. Access to tower sites should be allowed for monitoring radiation levels and animal mortality, if any.
- 6) Procedure for removal of existing problematic mobile towers should be made easy, particularly in and around protected area or urban parks and centres having wildlife .
- 7) Strictly control installation of mobile towers near wildlife protected areas, Important Bird Areas, Ramsar Sites, turtle breeding areas, bee colonies, zoos, etc up to a certain distance that should be studied before deciding and should also be practical. Ecological assessment / review of sites identified for installing towers before their installation also may be considered in wildlife / ecologically / conservational important areas.
- 8) The locations of Cell phone towers and other EMF radiating towers along with their frequencies should be made available on public domain. This can be at city/ district/ village level. Location wise GIS mapping of all cell phone towers be done by DoT. This information will help in monitoring the population of birds and bees in and around the mobile towers and also in and/or around wildlife protected areas.
- 9) Public consultation to be made mandatory before installation of cell phones towers in any area. The Forest Department should be consulted before installation of cell phone towers in and around PAs and zoos. The distance at which these towers should be installed should be studied case by case basis.
- 10) Awareness drive with high level of visibility in all forms of media and regional languages should be undertaken by the Government to make people aware about various norms in regard to cell phone towers and dangers from EMR. Such notices should be placed in all wildlife protected areas and in zoos.
- 11) To prevent overlapping high radiations fields, new towers should not be permitted within a radius of one kilometer of existing towers.

- 12) If new towers must be built, construct them to be above 80 ft and below 199 ft. tall to avoid the requirement for aviation safety lighting. Construct ungued towers with platforms that will accommodate possible future co-locations and build them at existing 'antenna farms', away from areas of high migratory bird traffic, wetlands and other known bird areas.

Note: Many of the above recommendations have already been given by Government of Delhi and West Bengal (appendix III). The Supreme Court of India has sought explanation from all mobile phone operators and various government and semi-government agencies over the issue of alleged "illegal" and unregulated constructions of mobile phone towers on top of buildings across the country (see www.thehindubusinessline.in/2005/09/27/stories/2005092703950900.htm). Similarly, recent rulings in June 2011 by Punjab and Haryana High Courts also direct the government to inform public about the health hazards (www.indianexpress.com/news/Inform/public/about/health/hazards/of/mobile/tower//HC-to-Govt/800786/).

Conclusion

The review of existing literature shows that the EMRs are interfering with the biological systems in more ways than one and there had already been some warning bells sounded in the case on bees (Warnke 2007; vanEngelsdorp *et al.* 2010; Gould 1980; Sharma and Neelima R Kumar 2010) and birds, which probably heralds the seriousness of this issue and indicates the vulnerability of other species as well. Despite a few reassuring reports (Galloni *et al.* 2005), a vast majority of published literature indicate deleterious effects of EMFs in various species. The window of frequency range and exposure time required to make measurable impacts would vary widely among species and unfortunately we do not have any such data available for most of our free-living floral and faunal species in India. There is an urgent need to focus more scientific attention to this area before it would be too late.

Microwave and radiofrequency pollution appears to constitute a potential cause for the decline of animal populations (Balmori 2006; Balmori and Hallberg 2007; Balmori Martínez 2003; Joris and Dirk 2007; Summers-Smith 2003) and deterioration of health of plants and humans living near radiation sources such as phone masts. Studies have indicated the significant non-thermal long-term impacts of EMFs on species, especially at genetic level which can lead to various health complications including brain tumours (glioma), reduction in sperm counts and sperm mobility, congenital deformities, Psychiatric problems (stress, 'ringxiety', sleep disorders, memory loss etc.) and endocrine disruptions. However similar aspects are yet to be studied among animal populations.

Pollution from EMRs being a relatively new environmental issue, there is a lack of established standard procedures and protocols to study and monitor the EMF impacts especially

among wildlife, which often make the comparative evaluations between studies difficult. Moreover, there are no long-term data available on the environmental impacts of EMRs as of now. Well-designed long-term impact assessment studies would be required to monitor the impact of ever-increasing intensities of EMRs on our biological environment. Meanwhile the precautionary principle should prevail and we need to better our standards on EMF to match the best in the world.

Studies on impact of Cell phone tower radiation on Birds and wildlife are almost non-existent from India. There is an urgent need for taking up well designed studies to look into this aspect. Available information from the country on the subject of EMF impacts is restricted to few reports from honey-bees. However, these studies are not representative of the real life situations or natural levels of EMF exposure. More studies need to be taken up to scientifically establish if any, the link between the observed abnormalities and disorders in bee hives such as Colony Collapse Disorder (CCD).

Appendices

Appendix I: Photographs showing mobile towers

Appendix II: Precautionary boards about mobile towers

Appendix III: GRs of Delhi and West Bengal Governments

Appendix IV: Bibliography

Members of the Expert Committee

1. Dr. Asad Rahmani, Director, BNHS (Chairman)
2. Representative of Wildlife Institute of India (Dr. Dhananjai Mohan, Dr. B.C. Choudhary)
3. Representative of Deptt. of Telecommunications, New Delhi [Shri. P. K. Panigrahi, Sr. DDG (BW)]
4. Representative of the Centre for Environment & Vocational Studies, Punjab University
5. Representatives of WWF India (Gp Captain Naresh Kapalia, Dr. Parikshit Gautam)
6. Representative of Indian Institute of Science, Bangalore (Prof. H.S. Jamadagni)
7. Representative of Indian Institute of Technology, New Delhi (Prof. R.K. Patney, Deptt. of Electrical Engineering)
8. Representative of SACON (Dr. P.A. Azeez, Director, Dr. Arun Kumar)
9. Dr. Sainuddin Pattazhy, Associate Professor, Deptt. of Zoology, University of Kerala
10. Ms. Prakriti Srivastava, DIG(WL), MoEF (Member Secretary)

Appendix I



Cell phone Towers on commercial and residential Structures



Cell Phone Tower



Cell Phone towers near Keoladeo National Park, Bharatpur, Rajasthan

Appendix II

Precautionary Boards (Some samples)

AREA DEMARCATATION



CAUTION

RADIOFREQUENCY RADIATION

- Area of Unrestricted Occupancy
- Minor Injury Possible from Misuse



WARNING

RADIOFREQUENCY RADIATION

- Area of Restricted Occupancy
(RF Workers Only)
- Serious Injury Possible from Misuse



DANGER

RADIOFREQUENCY RADIATION

- Area of Denied Occupancy
- Critical Injury or Death Possible

Appendix III

Delhi
Government

Vivek Rao
Principal Secretary (Health & FW)

D.O.No.
Dated

141 / Exposure at Electro magnetic /
Pg secy hb w / 133-14 /
10/01/2008

Dear

The existing guidelines for granting permission for installation of towers on ground/roof tops for Cellular Mobile Phone Services finalized pursuant to a meeting held at Raj Niwas on 26.7.2002 have been reviewed on the basis of certain representations from the public and it has been decided that henceforth such towers in residential areas should be permitted only in consultation with the concerned Resident Welfare Associations and not left to bilateral negotiations between Telecom companies and individual residents/house owners. In this regard the following additional precautionary measures are also recommended for adoption by the local authorities:

- * Installation of Base Station Antennas within the premises of schools and hospitals may be avoided because children and patients are more susceptible to Electro Magnetic Field.
- * Installation of Base Station Antennas in narrow lanes should be avoided in order to reduce the risks caused by any earth quake or wind related disaster.
- * The Base Station Antennas should be at least 3 m away from the nearby building and antennas should not directly face the building. Further, the lower end of the antenna should be at least 3 meter above the ground or roof.
- * In case of multiple transmitter sites at a specific locality sharing of a common tower infrastructure, should be explored, as far as possible, which can be coordinated through a nodal agency.
- * Access to Base Station Antenna sites should be prohibited for general public by suitable means such as wire fencing, locking of the door to the roof etc. Access to tower site, even for the maintenance personnel, should be for a minimum period as far as possible.
- * Sign boards/Warning Signs are to be provided at Base Station Antenna sites which should be clearly visible and identifiable. A warning sign should be placed at the entrance of such zone.

Contd....2/-

41708181

: 2 :

* The "Warning Sign" should discourage longer stay in the zone, even for the maintenance personnel. The sign board may contain the following text:

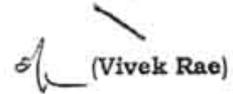
- j. Danger! RF radiations, Do not enter!
- ii. Restricted Area

* The operators and maintenance personnel, who are dealing with radio frequency devices, specially with Base Station Antennas installed on towers and at any other outdoor sites, should be protected from electromagnetic radiations. It is required that operators and maintenance personnel should be educated for possible hazards from these devices.

This issues with the approval of LG.

With regards,

Yours sincerely,

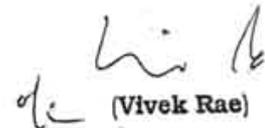

(Vivek Rae)

To

1. Shri Ashok Nigam, Commissioner, MCD, Delhi
2. Shri Dinesh Rai, VC, DDA, Delhi
3. Shri Parimal Rai, Chairperson, NDMC, New Delhi

Copy to the following:

1. Principal Secretary to LG, Raj Niwas, Delhi.
2. Principal Secretary to CM, Delhi
3. Pr.Secretary(Urban Development), GNCT of Delhi
4. Secretary (Environment), Govt. of NCT of Delhi, Delhi.
5. Shri T.V.Ramachandran, Director General, Cellular Operators Association of India, 14, Bhai Veer Singh Marg, New Delhi-01.
6. Shri S.C.Khanna, Secretary General, Association of Unified Telecom Service Providers of India, B-601, Gauri Sadan, 5, Hailey Road, New Delhi-01.


(Vivek Rae)

West Bengal Government

In case of non-compliance of the aforementioned directions, regulatory order will be issued in accordance with law.

By Order,
Sd/-
(M. L. Meena)
Principal Secretary,
Department of Environment

No. EN/ 939 /11-V-1/001/2006

Dated: April 24th, 2008

Copy forwarded to :-

1. The Incharge, M/s. Bharti Mobitel Limited (Airtel), Infinity Building, 5th Floor, Salt Lake Electronics Complex, Bidhannagar, Block G.P. Sector-V, Kolkata-700091.
 2. The Incharge, Vodafone Essar East Limited (Vodafone), Constantia Office Complex, 4th Floor, 11, Dr. U.N. Brahmachari Road, Kolkata-700017.
 3. The Incharge, Aircel Business Solutions (Aircel), Benfish Bhawan, No. 31, GN Block, 5th Floor, Sector-V, Salt Lake, Kolkata-700 091.
 4. The Incharge, Tata Teleservices Limited (Tata Indicom), C/o, Videsh Sanchar Bhawan, Camp Office- 1/18, C.I.T. Scheme, VII M, Ultandaga, Kolkata-700054.
 5. The Incharge, Bharat Sanchar Nigam Limited (BSNL Mobile), Telephone Kendra, P-10, New CIT Road, Kolkata-700073.
 6. The Chairman, West Bengal Pollution Control Board.
 7. The Member-Secretary, Central Pollution Control Board, Paribesh Bhawan, CBD-cum-Office Complex, East Arjun Nagar, Delhi-110032.
 8. The Chief Environment Officer, Department of Environment, Govt. of West Bengal.
 9. The Member-Secretary, West Bengal Pollution Control Board, 'Paribesh Bhawan', Salt Lake City, Kolkata-700098.
 10. The Commissioner, Kolkata Municipal Corporation, 5, S.N. Banerjee Road, Kolkata-700013.
 11. The Commissioner, Howrah Municipal Corporation, Howrah.
 12. The Chief Executive Officer, _____
 13. The Executive Officer, _____
 14. The Secretary,Zilla Parishad.
- with a request to circulate this memo. to the Panchayats for information and necessary action.
15. The District Magistrate _____

Sd/-

HENCE, in exercise of the powers conferred under Environment (Protection) Act, 1986 and rules made thereunder, all mobile phone service providers are hereby directed to follow the following guidelines strictly at the time of installation of the mobile towers.

- Installation of Base Station Antennas within the premises of schools and hospitals may be avoided because children and patients are more susceptible to Electro Magnetic Field.
- Installation of Base Station Antennas in narrow lanes should be avoided in order to reduce the risks caused by any earth quake or wind related disaster.
- The Base Station Antennas should be at least 3 m away from the nearby building and antennas should not directly face the building. Further, the lower end of the antenna should be at least 3 metre above the ground or roof.
- In case of multiple transmitter sites at a specific locality sharing of a common tower infrastructure, should be explored, as far as possible, which can be coordinated through a nodal agency.
- Access to Base Station Antenna sites should be prohibited for general public by suitable means such as wire fencing, locking of the door to the roof etc. Access to tower site, even for the maintenance personnel, should be for a minimum period as far as possible.
- Sign boards/Warning Signs are to be provided at Base Station Antenna sites which should be clearly visible and identifiable. A warning sign should be placed at the entrance of such zone.
- The "Warning Sign" should discourage longer stay in the zone, even for the maintenance personnel. The sign board may contain the following text :
 - i. Danger ! RF radiations, Do not enter !
 - ii. Restricted Area.

The operators and maintenance personnel, who are dealing with radio frequency devices, specially with Base Station Antennas installed on towers and at any other outdoor sites, should be protected from electromagnetic radiations. It is required that operators and maintenance personnel should be educated for possible hazards from these devices.

All local authorities are also requested that before giving any permission for installation of the mobile towers aforementioned guidelines should be

Appendix IV

Bibliography

List of Scientific Papers (n=919) on Impact of EMFs classified Subject-wise

Each bibliographic entry is marked with category codes in square brackets []

**B= Birds; E= Bees; H = Humans; W= Animals/Wildlife; P= Plants
+ = Impact reported; - = No Impact; * = Inconclusive/ Impact not evaluated**

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- Al-Khlaiwi T, Meo SA, (June 2004) Association of mobile phone radiation with fatigue, headache, dizziness, tension and sleep disturbance in Saudi population, *Saudi Med J*. 2004 Jun;25(6):732-6. [H+]
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RADIOFREQUENCY / MICROWAVE EXPOSURE GUIDELINES

(High Frequency Electromagnetic Waves)

1> BUILDING BIOLOGY PRECAUTIONARY GUIDELINES (SBM-2008) For Sleeping Areas

Power density in microwatt	No Concern	Slight Concern	Severe Concern	Extreme Concern
per square meter $\mu\text{W}/\text{m}^2$	< 0.1	0.1-10	10 - 1000	> 1000
per square cm $\mu\text{W}/\text{cm}^2$	< 0.000,01	0.000,01 - 0.001	0.001 - 0.1	> 0.1

2> BIOINITIATIVE REPORT PERCAUTIONARY GUIDELINES (2007) www.bioinitiative.org/

Dr. Martin Blank - Columbia University

Biologically Based Precautionary Levels 1,000 $\mu\text{W}/\text{m}^2$ or 0.1 $\mu\text{W}/\text{cm}^2$

3> CANADA AND USA GOVERNMENT GUIDELINES (1999)

In Canada, guidelines for Radio Frequency Wave exposure lay under the jurisdiction of Health Canada. Safety code 6 was developed in 1999 and offers federal guidelines for safe RF exposure levels. These limits are in the range of **2,000,000 to 10,000,000 $\mu\text{W}/\text{m}^2$ or 200 to 1000 $\mu\text{W}/\text{cm}^2$** and are based solely on the short term thermal effects or the heating of body tissue. Adverse biological effects have been documented at levels far below Safety Code 6 guidelines. No Canadian biological exposure guidelines exist for long term exposure to low level Radio Frequency Radiation. This also holds true for the USA.

AC MAGNETIC & AC ELECTRIC FIELD EXPOSURE GUIDELINES

(Low Frequency Electromagnetic Fields ELF, VLF)

1> BUILDING BIOLOGY EVALUATION GUIDELINES (SBM-2008) For Sleeping Areas

AC Magnetic - Flux Density	No Concern	Slight Concern	Severe Concern	Extreme Concern
in nanotesla nT	< 20	20-100	100 - 500	> 500
in milligauss mG	< 0.2	0.2-1	1-5	> 5

AC Electric Field strength with ground potential in volt per meterV/m	< 1	1-5	5 - 50	> 50
Body voltage with ground potential in millivolt mV	< 10	10-100	100 - 1000	> 1000
Field strength potential-free in volt per meterV/m	< 0.3	0.3-1.5	1.5 - 10	> 10

2> BIOINITIATIVE REPORT PERCAUTIONARY GUIDELINES (2007) www.bioinitiative.org/

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AC Magnetic Field Levels 1-2 mG / 100-200 nT

AC Electric Field Levels – Not Addressed in Report

3> CANADA AND USA GOVERNMENT GUIDELINES (1999)

In Canada, guidelines for EMF exposure lay under the jurisdiction of Health Canada. Health Canada has not independently established guidelines for magnetic field or electric field exposure. When pressed, they will state that Canada follows the International Commission on Non-Ionizing Radiation Protection "ICNIRP" guidelines of 830 mG or 83,000 nT (Magnetic Field) or 5000 V/m (Electric Field) for a 24-hr period. Since these guidelines are based on short-term acute exposure we still do not have guidelines that protect the public from long-term low level exposure, which is the case with the distribution of electricity. Associations based on epidemiological studies and cause-effect relationships based on laboratory experiments suggests that exposure to magnetic and electric fields should be thousands of times lower.



Creating Healthy Living Spaces

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International Radio Frequency "RF" Exposure Limits for 1800 MHz Range

(Cell Phone, WiFi, Smart Meters, etc)

Location	Reference	Exposure time	Limit Based On	Lower by	$\mu\text{W}/\text{m}^2$	V/m
Canada	Safety Code 6, Table 5	6 minutes	Thermal / Heating	-	10,000,000	61.4
USA	(FCC) IEEE C95.1-1999 and ICNIRP	30 minutes	Thermal / Heating	-	10,000,000	61.4
Most of Western Europe	IEEE C95.1-1999 and ICNIRP	30 minutes	Thermal / Heating	-	10,000,000	61.4
Russia	Sanitary Norms and Regulations 2.2.4/2.1.8.055-96	3 hours +	Biological Effects	100 x	100,000	6.14
China	UDC 614.898.5 GB 9175 -88	3 hours +	Biological Effects	100 x	100,000	6.14
Italy	Sanitary Norms and Regulations 2.2.4/2.1.8.055-96	3 hours +	Biological Effects	100 x	100,000	6.14
Most of Eastern Europe	Sanitary Norms and Regulations 2.2.4/2.1.8.055-96	3 hours +	Biological Effects	100 x	100,000	6.14
Switzerland	Ordinance on Protection from Non-ionising Radiation (NISV)	Long Term	Precautionary	100 x	100,000	6.14
Toronto Board of Health, Canada	Proposed 1999	Long Term	Precautionary	100 x	100,000	6.14
Bio-Initiative Report recommendation	Bio-Initiative Report 2007	Long Term	Biological / Precautionary	10,000 x	1,000	0.614
Salzburg Resolution on Mobile Telecommunication	Preventive public health protection, Salzburg, June 7-8, 2000	Long Term	Precautionary	10,000 x	1,000	0.614
European Parliament	Resolution 1815, Strasburg, May 27, 2011	Long Term	Precautionary	10,000 x	106	0.2
Building Biology Guidelines Germany (Sleeping Areas)	SBM2008 - Level of No Biological Concern	Long Term	Precautionary	100,000,000 x	0.1	0.006,14
Cell Phone Operational Requirements				10,000,000,000 x	0.001	0.000,061.4
Natural Cosmic Radiation	MAES 2000	Long Term	Natural Exposure	10,000,000,000,000 x	0.000,001	0.000,000,061.4
Average Indoor Urban Exposure Toronto, Canada	Safe Living Technologies Inc. 2011	Long Term			200 - 5000	0.3 - 1.4