

Additionally, as per the data collected from DoT, as on 31.12.2015, a total of 2,57,457 BTSs have been tested by various TERM Cells to cross-check whether they fulfil the EMF radiation norms or not and 192 have been found non-compliant. A total penalty of Rs.10,80,00,000/- has been imposed and 1 BTS in Haryana has been removed due to violation of norms.

4.2.3 Advisory for local governments

Although fixation of standards for exposure limits of radio frequency field emissions from mobile base stations, monitoring their compliance, all radiation related technical issues, issues related to Access Service Licence/ Infrastructure Provider registration and SACFA clearance for frequency allocation at any place are dealt with by DoT but the NOC/ approval for installation of mobile towers is given by local bodies which come under state governments. Accordingly, DoT has given advisory in the form of broad guidelines related to clearances for installation of Mobile Towers, to all the State Governments on 23.08.2012 which were later revised from 01.08.2013³⁸ and some of its salient points are as follows,

4.2.3.1 Documents to be submitted by Telecom Service Providers/ Infrastructure Providers for obtaining clearance from local bodies/ state governments for installation of mobile towers:

- Copy of relevant license/ Infrastructure Provider Registration Certificate from Department of Telecommunications.
- Data Sheet
 - Name of Service/Infrastructure Provider

³⁸ <http://www.dot.gov.in/sites/default/files/Annexures/01-08-2013.pdf> (accessed 5 March 2016)

- Location
- Tower Reference: i) Height, ii) Weight, iii) Ground/Roof Top, iv) Pole/wall mounted, v) Number of antennae
- Copy of SACFA clearance/ copy of SACFA application for the said location submitted to WPC wing of DoT with registration number as WPC acknowledgement along with undertaking that in case of any objection/ rejection, TSPs/ Infra Providers will take corrective actions/ remove the tower.
- Copy of structural stability certificate for ground based tower. In case of roof top BTS towers, structural stability certificate for the building and tower based on written approvals of any authorized Structural Engineer of state/ local bodies/ Central Building Research Institute (CBRI), Roorkee/ IIT/ NIT or any other agency authorized by local body.
- Copy of type test certificate issued by Automotive Research Association of India (ARAI) to the manufacturers of the Diesel Generator (DG) Sets.
- Copy of clearance from Fire Safety Department only in case for high rise buildings where Fire Clearance is mandatory.
- For forest protected areas, the copy of clearance from State Environment & Forest Department, if applicable.
- Local bodies may also seek submission of copy of No Objection Certificate (NOC) from Building Owner/ entities having roof top rights or roof top tenants in case of roof based tower/ land owner in case of ground based tower, as the case may be. As per their rules in force, State Governments, may seek fresh NOC at the time of renewal of site (tenancy) contract for mobile tower.

- Acknowledgement receipt issued by TERM Cells (DoT) of the self-certificate submitted by Telecom Service Provider/ Infrastructure Provider in respect of BTS/ mobile tower (ground based/ roof top/ Pole/ wall mounted) in the format as prescribed by TEC, DoT, establishing/ certifying that all General Public areas around the tower will be within safe EMR exposure limit as per peak traffic measurement after the antennae starts radiating.

4.2.3.2 Action by State government/ Local body

- Nominal one time Administrative Fee as decided by the State Government to recover its costs on issue of permission for installation of tower.
- Single Window Clearance may be provided in a time bound manner to telecom service provider/ infrastructure provider by the local body/ State Government. This will ensure issuance of faster clearances.
- Telecom towers have been given infrastructure status by Government of India vide gazette notification no 81 dated 28.03.2012. All benefits, as applicable to infrastructure industry, should be extended. Electricity connection may be provided to BTS site on priority.
- Telecom installations are lifeline installations and a critical infrastructure in mobile communication. In order to avoid disruption in mobile communication, an essential service, sealing of BTS towers/ disconnection of electricity may not be resorted to without the consent of the respective TERM Cell of DoT in respect of the EMF related issues.
- State Governments along with DoT may organise public awareness programmes involving civil society members.

- In order to effectively address Public Grievances relating to installation of towers & issues related to telecom infrastructure, State Govts. may setup:
 - State Level Telecom Committee (STC) consisting of officers from TERM Cells, State Administration, representative(s) of concerned Telecom Service Provider(s) and eminent public persons etc.
 - District Level Telecom Committee (DTC) consisting of officers from District Administration, representative(s) of concerned Telecom Service Provider(s) and eminent public persons etc.

4.2.3.3 Action by DoT/ TERM Cells

- Public awareness programme (Through DoT web portal / Govt. Publication).
- a) Ensuring periodic self-certificates for all the existing as well as new BTSs/ Towers from Telecom Service Providers in format prescribed by TEC, DoT, in order to ensure that all general public areas around the site are within safe EMR exposure limits. Any violation noticed attracts heavy penalties on Service Provider(s) leading to shut down of BTS in case violation persists.
- b) The TERM Cells have been given clear instructions with regard to the technical audit of BTS, including for radiation from towers within safe limits. These include roof top/ ground based/ pole mounted/ wall mounted towers. They will also verify antenna orientation, safe distance from the tower (exclusion zone) etc. Installation and augmentation of BTS and antenna is a continuous process. DoT is organizing frequent workshops for these officers to ensure observance of the latest guidelines issued by DoT on the subject of EMF radiation and public safety.

4.2.3.4 Additional Guidelines to TERM Cells for auditing BTS for EMF radiation

- In case of both ground based towers/ roof top towers/ wall mounted/ pole mounted antenna, there shall be no building right in front of the antenna(e), of equivalent height taking into account tilt of lowest antenna as per details in table below. Further, antennae at same height only are to be counted, as the beam width of the mobile antennae, in the vertical direction, is very narrow.

Table 4.5: Guidelines for safe distance from towers

Number of antenna(e) pointed in the same direction	Building/Structure safe distance from the antenna(e) at the same height (in meters)
1	20
2	35
4	45
6	55

(Source: DoT website)

Distance figures above are based considering that all antennae are emitting at maximum RF power of 20 W & exactly in same direction with same height (worst case scenario). In practice, values of safe distance will depend upon actual deployment scenarios & mostly, may be far less than depicted above.

- Wall/ Pole mounted Antenna: Wherever antennae are mounted on wall of building or pole, their height should be at least 5m above ground level/ road level. However, such installations will have to comply with the radiation limits.

4.2.4 Additional actions

DoT has issued an informative guide³⁹ on 'Mobile Communications – Radio Waves and Safety' which covers a basic introduction to radio waves, various

³⁹ Government of India, Ministry of Communications & IT, Department of Telecommunications, *Mobile Communication – Radio Waves & Safety*

terminologies, Do's & Don'ts related to mobile phone usage, clarification of various myths regarding deployment, use of Radio waves/ Safety Standards and frequently asked questions relating to Mobile phones & Human health, in common language.

In the FAQ in last question related to difference between EMF Radiation from mobile phone towers and mobile phones, it says, "Radiation emitted from cell phone is of a short-term, repeated nature (coherent) at a relatively high intensity, whereas Radiation emitted from BTS (mobile towers) is of long duration but is of a very low intensity. Also in the starting section of Radio Waves and Human Body, it says, "A strong EMF may be due to a weak radiation source nearby or a powerful source far away. A human body is exposed to more EMF radiation in case of a call from mobile phone in comparison to the one from a mobile tower. The mobile phone is a weak source of RF signal, but it is very close to human body, whereas the more powerful mobile tower is at far end."

Advertisement for ensuring safety from radiations of Mobile Towers & handsets has also been issued by DoT which has been published in National and Regional Newspapers. Also to provide a public interface for viewing the EMF compliance status of mobile towers, anywhere in India, so as to generate confidence among the public about effectiveness of the EMF compliance process in India, TEC is carrying out a pilot project on EMF web portal for implementation of online database for EMR of BTS towers in three circles – Mumbai, Haryana, Karnataka and city of Hyderabad. This is to be replicated all over India after trial.

Science and Engineering Research Board (SERB)⁴⁰, Department of Science & Technology (DST), Government of India, had invited R&D proposals from eligible Scientist/ Organizations-public or private, individually or in collaboration, for conducting India specific research on possible impact of EMF Radiation exposure from mobile tower and handset on life (humans, living organism, flora & fauna and environment). 19 projects, as shown below, have been approved around April 2015⁴¹ for a period extending from 18 months to 36 months and the work has been initiated.

Table 4.6: List of Projects Approved under Cell Tower Radiation Programme

S. No.	Project Title	Address of Institute
1.	Cell tower radiation: Psychosocial implications.	National Institute of Mental Health Neurosciences, Hosur Road, Bangalore, Karnataka.
2.	Molecular genetic correlates of DNA damage and repair and of circadian rhythm dysfunction in humans from non-ionizing radiation exposure.	Guru Nanak Dev University Amritsar, Punjab.
3.	Morphological, functional, biochemical and behavioural evaluation post - emf radiation.	All India Institute of Medical Sciences, New Delhi, Delhi.
4.	Effects of EMF exposure on the blood and semen parameters including sperm morphological changes by scanning and transmission electron microscopy in rabbits.	
5.	To study the effect of mobile phones on well-being, sleep and cognitive function.	
6.	Effect of EMF radiation due to mobile phone use on sleep and neurocognitive functions: A molecular approach.	

⁴⁰ <http://www.serb.gov.in/pdfs/linkages/Cell%20Tower%20Radiation.pdf> (accessed 5 March 2016)

⁴¹ Somit Sen (3 April 2015) 'Centre nod to mega research on mobile radiation', *The Times of India* (Online) <http://timesofindia.indiatimes.com/home/science/Centre-nod-to-mega-research-on-mobile-radiation/articleshow/46790047.cms>

7.	Effect of microwave radiation (Mobile Telephony) on the reproductive system of the human male and modulation of the effect by environmental variables.	Indian Institute of Technology Kharagpur, West Bengal.
8.	Development of nano composite absorbers for suppression of excess EMF radiation.	Thiagarajar College of Engineering, Madurai, Tamil Nadu
9.	Impact of EMF radiation on animal development at cellular and molecular levels.	Agharkar Research Institute, Pune, Maharashtra.
10.	Effect of electromagnetic frequency radiation (EMF) on auditory system of mobile users.	All India Institute of Medical Science, Rishikesh, Uttarakhand.
11.	Investigations on the prenatal and postnatal EMF radiation exposure in a mouse model.	Manipal University, Manipal, Karnataka.
12.	Mobile phone and tower exposure measurements and biological correlations.	Amity University, Noida, Uttar Pradesh.
13.	To study the effect of electromagnetic radiations on biological cell/ tissues/ blood cell using non-invasive imaging techniques.	Indian Institute of Information Technology and Management Gwalior, Madhya Pradesh
14.	Exploration of biological impacts of electromagnetic frequency radiation of cell-phone range and understanding mechanism of its action in plant system.	Punjab University Chandigarh, Chandigarh.
15.	To study the effect of mobile phones on well-being, sleep and cognitive function.	Sri Venkateswara Institute of Medical Sciences, Tirupathi, Andhra Pradesh.
16.	To study the effect of mobile phones on well-being, sleep and cognitive function.	Post Graduate Institute of Medical Education and Research Chandigarh, Chandigarh.
17.	Mobile-based diagnosis of sleep apnea.	Indraprastha Institute of Information Technology New Delhi, Delhi.
18.	Brain hemodynamics, cognition and subtle energy levels in teenagers: Investigation of potential acute effects of mobile phone induced EMF and the protective value of yoga intervention.	Swami Vivekananda Yoga Anusandhana Samsthana University, Bangalore, Karnataka.
19.	Statistical estimation of electromagnetic radiation using large data analysis of cell phone signal levels.	Indian Institute of Technology Madras, Chennai, Tamil Nadu

(Source: SERB website)

4.3 Summary

While reviewing the work done by WHO and Indian government bodies, to address the large concerns of society, it is seen that work related to planning, research and establishing of standards is substantial. Although in case of India it appears to be a bit late. Further, to reach some conclusive evidence of health effects, more quality researches are still required at national as well as international level. In India, the major area of concern is the implementation of guidelines and accepted norms. All the telecom functionaries, such as private operators, government agencies, etc. have to realize, that their crucial role is to ensure proper following/ implementation of the prescribed norms in the field of Electromagnetic Radiations.

Second thing which has come into light, as the new researches are coming up gradually, is the increased effect of mobile phones over mobile towers. It is becoming more and more evident that people have to be aware of not only the effects of EMR from mobile towers but also those from the gadget in their hand.

CHAPTER – 4

ACTIONS BY W.H.O. AND GOVERNMENT OF INDIA

4.1 What does WHO say?

As part of its charter to protect public health and in response to public concern over health effects of EMF exposure, the World Health Organization (WHO) established the International EMF Project in 1996 to assess the scientific evidence of possible health effects of EMF in the frequency range from 0 to 300 GHz. The International EMF Project, one out of around 200 programmes/projects being run by WHO, encourages focused research to fill important gaps in knowledge and to facilitate the development of internationally acceptable standards limiting EMF exposure.

As per the International EMF project progress report, June 2013-2014²³, oversight of the Project is provided by the International Advisory Committee (IAC), composed of members of international organizations, WHO collaborating centres, and national authorities from all regions of the world. The Project has formal collaboration with different entities, i.e. non-governmental organizations (NGOs), international organizations and WHO collaborating centres. It also cooperates in an ad-hoc manner with other institutions (e.g. co-sponsoring of meetings) and with individual experts.

The International Agency for Research on Cancer (IARC), a specialized agency of WHO, based in Lyon, France, has strong links with the International EMF Project. Its mission is to coordinate and conduct research on causes of

²³ World Health Organization, The International EMF Project, *Progress Report: June 2013-14*

human cancer, mechanism of carcinogenesis and to develop scientific strategies for cancer control. It is involved in both epidemiological and laboratory research.

The International Telecommunications Union (ITU) is the leading United Nations agency for information & communication technology issues and global focal point for governments & private sector in developing networks & services. All three of its sectors – the Telecommunication Standardization Sector (ITU-T), the Radio communication sector (ITU-R) and the Telecommunication Development Sector (ITU-D) have been involved with the WHO EMF Project through Study Group 5 - Protection from Electromagnetic Environment Effects.

EMF Project is also having active collaboration with the International Commission on Non-Ionizing Radiation Protection (ICNIRP) - an NGO in official relations with WHO. ICNIRP and WHO have been in discussions regarding aligning timelines on the development of the Environmental Health Criteria (EHC) RF monograph and the ICNIRP RF guidelines.

Further as per the report referred above, WHO receives its funding principally through assessed contributions from Member States and voluntary contributions but with the economic crisis over the past few years, assessed contributions have become a smaller proportion of the total resources received, and reliance is increasing significantly on specified voluntary contributions provided by partners and donors. Over the years, several governments have given direct contributions to the WHO EMF Project, either on a periodic or ad-hoc basis.

Some of important publications of WHO, related to topic are discussed ahead.

4.1.1 Electromagnetic fields and public health – Base stations and wireless technologies²⁴ (Backgrounder, May 2006)

WHO (International EMF project) has been issuing various fact sheets and over the past year, several fact sheets have been renamed as backgrounders. This fact sheet no. 304 of May 2006, although has become a backgrounder now, but is very much relevant to be discussed here because it reviews the scientific evidence on the health effects from continuous low-level human exposure to base stations and other local wireless networks.

Regarding the health concerns, it says, “A common concern about base station and local wireless network antennas relates to the possible long-term health effects that whole-body exposure to the RF signals may have. To date, the only health effect from RF fields identified in scientific reviews has been related to an increase in body temperature ($> 1\text{ }^{\circ}\text{C}$) from exposure at very high field intensity found only in certain industrial facilities, such as RF heaters. The levels of RF exposure from base stations and wireless networks are so low that the temperature increases are insignificant and do not affect human health. Recent surveys have indicated that RF exposures from base stations and wireless technologies in publicly accessible areas (including schools and hospitals) are normally thousands of times below international standards.”

It also says that in fact, due to their lower frequency, at similar RF exposure levels, body absorbs up to five times more signal from FM radio and TV than

²⁴ World Health Organization, The International EMF Project (May, 2006) *Backgrounder: Electromagnetic fields and public health – Base stations and wireless technologies*. (Online) <http://www.who.int/peh-emf/publications/facts/fs304/en/>

from mobile base stations. This is because the frequencies used in FM radio (around 100 MHz) and in TV broadcasting (around 300 to 400 MHz) are lower than those employed in mobile telephony (900 MHz and 1800 MHz) and because a person's height makes the body an efficient receiving antenna. Further, radio and television broadcast stations have been in operation for the past 50 or more years without any adverse health consequence being established. While most radio technologies have used analog signals, modern wireless telecommunications are using digital transmissions. Detailed reviews conducted so far have not revealed any hazard specific to different RF modulations.

While discussing specifically about Cancer, it says, "Media reports of cancer clusters around mobile phone base stations have heightened public concern. It should be noted that geographically, cancers are unevenly distributed among any population. Given the widespread presence of base stations in the environment, it is expected that possible cancer clusters will occur near base stations merely by chance. Moreover, the reported cancers in these clusters are often a collection of different types of cancer with no common characteristics and hence unlikely to have a common cause. Scientific evidence on the distribution of cancer in the population can be obtained through carefully planned and executed epidemiological studies. Over the past 15 years, studies examining a potential relationship between RF transmitters and cancer have been published. These studies have not provided evidence that RF exposure from the transmitters increases the risk of cancer. Likewise, long-term animal studies have not

established an increased risk of cancer from exposure to RF fields, even at levels that are much higher than produced by base stations and wireless networks.”

Similarly regarding other effects, it says that there have been few studies which have investigated general health effects in individuals exposed to RF fields from base stations. This is because of difficulty in distinguishing possible health effects from very low signals emitted by base stations from other higher strength RF signals in environment. Thus most studies have focused on RF exposures of mobile phone users. Human and animal studies examining brain wave patterns, cognition and behaviour after exposure to RF fields, such as those generated by mobile phones, have not identified adverse effects. RF exposures used in these studies were about 1000 times higher than those associated with public exposure from base stations. No consistent evidence of altered sleep or cardiovascular function has been reported. Some individuals have reported experiencing non-specific symptoms upon exposure to RF fields emitted from base stations and other EMF devices. As recognized in other WHO fact sheet ‘Electromagnetic Hypersensitivity’, EMF has not been shown to cause such symptoms.

Regarding protection standards, it says that international exposure guidelines have been developed to provide protection against established effects from RF fields by the International Commission on Non-Ionizing Radiation Protection (ICNIRP, 1998) and the Institute of Electrical and Electronic Engineers (IEEE, 2005). National authorities should adopt international standards to protect their citizens against adverse levels of RF fields. They should restrict access to areas where exposure limits may be exceeded.

Regarding public perception of risk, it says, "Some people perceive risks from RF exposure as likely and even possibly severe. Several reasons for public fear include media announcements of new and unconfirmed scientific studies, leading to a feeling of uncertainty and a perception that there may be unknown or undiscovered hazards. Other factors are aesthetic concerns and a feeling of a lack of control or input to the process of determining the location of new base stations. Experience shows that education programmes as well as effective communications and involvement of the public and other stakeholders at appropriate stages of the decision process before installing RF sources can enhance public confidence and acceptability."

The fact sheet, now a background, concludes by saying, "Considering the very low exposure levels and research results collected to date, there is no convincing scientific evidence that the weak RF signals from base stations and wireless networks cause adverse health effects". Regarding the WHO Initiatives, it intimates that while no health effects are expected from exposure to RF fields from base stations and wireless networks, research is still being promoted by WHO to determine whether there are any health consequences from the higher RF exposures from mobile phones.

4.1.2 IARC classifies radiofrequency Electromagnetic fields as possibly carcinogenic to humans²⁵

Most of the literature reviewed during this study had been saying at some point or the other that WHO has declared EMR from mobile towers as causing

²⁵ International Agency for Research on Cancer (31 May 2011) *Press Release No. 208: IARC classifies radiofrequency electromagnetic fields as possibly carcinogenic to humans*

cancer, hence this issue was specifically studied. On 31st May 2011, the WHO/ International Agency for Research on Cancer (IARC) issued a press release. Its opening line says, "IARC has classified radiofrequency electromagnetic fields as possibly carcinogenic to humans (Group 2B), based on an increased risk for glioma, a malignant type of brain cancer, associated with wireless phone use." The point seen here and ahead in the press release is that it mostly discusses about the increased risk of cancer due to phone use and not towers.

As per the press release, "From May 24–31 2011, a Working Group of 31 scientists from 14 countries met at IARC in Lyon, France, to assess the potential carcinogenic hazards from exposure to radiofrequency electromagnetic fields. These assessments have been published as Volume 102 of the IARC Monographs, which is the fifth volume in this series to focus on physical agents, after Volume 55 (Solar Radiation), Volume 75 and Volume 78 on ionizing radiation (X-rays, gamma-rays, neutrons, radio-nuclides), and Volume 80 on non-ionizing radiation (extremely low-frequency electromagnetic fields). The IARC Monograph Working Group discussed the possibility that these exposures might induce long-term health effects, in particular an increased risk for cancer and evaluated the literature available at that time on the following exposure categories involving radiofrequency electromagnetic fields:

- occupational exposures to radar and to microwaves;
- environmental exposures associated with transmission of signals for radio, television and wireless telecommunication; and
- personal exposures associated with the use of wireless telephones."

The Working Group reviewed the evidence critically and overall evaluated as being limited among users of wireless telephones for glioma and acoustic neuroma, and inadequate to draw conclusions for other types of cancers. The evidence from the occupational and environmental exposures mentioned above was similarly judged inadequate. The Working Group did not quantitate the risk; however, as per the press release, "one study of past cell phone use (up to the year 2004), showed a 40% increased risk for gliomas in the highest category of heavy users (reported average: 30 minutes per day over a 10-year period)."

As a result, Dr Jonathan Samet (University of Southern California, USA), overall Chairman of the Working Group, indicated, "the evidence, while still accumulating, is strong enough to support a conclusion and the 2B classification. The conclusion means that there could be some risk, and therefore we need to keep a close watch for a link between cell phones and cancer risk."

IARC Director, Christopher Wild said, "Given the potential consequences for public health of this classification and findings, it is important that additional research be conducted into the long-term, heavy use of mobile phones. Pending the availability of such information, it is important to take pragmatic measures to reduce exposure such as hands-free devices or texting."

4.1.3 IARC Monographs²⁶

As the IARC Monographs appear to be related, hence the same are detailed here. They identify environmental factors that can increase the risk of human cancer. These include chemicals, complex mixtures, occupational exposures,

²⁶ International Agency for Research on Cancer, *Agents Classified by the IARC Monographs, Volumes 1–112*. (Online) <https://monographs.iarc.fr/ENG/Classification/ClassificationsGroupOrder.pdf>

physical and biological agents and lifestyle factors. Since 1971, more than 900 agents have been evaluated by IARC, of which approximately 400 have been identified as carcinogenic or potentially carcinogenic to humans and grouped as, Group 1: The agent is carcinogenic to humans. This category is used when there is sufficient evidence of carcinogenicity in humans. E.g. Ultra Violet Radiation, X & gamma radiation, solar radiation, tobacco, etc.

Group 2: This category includes agents for which, at one extreme, the degree of evidence of carcinogenicity in humans is almost sufficient, as well as those for which, at the other extreme, there are no human data but for which there is evidence of carcinogenicity in experimental animals. They are further grouped as, Group 2A: The agent is probably carcinogenic to humans. This category is used when there is limited evidence of carcinogenicity in humans and sufficient evidence of carcinogenicity in experimental animals. E.g. DDT, benzene, red meat (consumption), petroleum refining (occupational exposure), etc.

Group 2B: The agent is possibly carcinogenic to humans. This category is used for agents for which there is limited evidence of carcinogenicity in humans and less than sufficient evidence of carcinogenicity in experimental animals. E.g. chloroform, surgical implants – polymeric prepared as thin smooth film, pickled vegetables (traditional Asian), magnetic fields, etc.

Group 3: The agent is not classifiable as to its carcinogenicity to humans. This category is used most commonly for agents for which the evidence of carcinogenicity is inadequate in humans and inadequate or limited in experimental animals. E.g. cholesterol, caffeine, ampicillin, tea, etc.

Group 4: The agent is probably not carcinogenic to humans. This category is used for agents for which there is evidence suggesting lack of carcinogenicity in humans and in experimental animals.

The definition of evidence relevant to carcinogenicity is as follows:

Sufficient evidence of carcinogenicity: Working Group considers that a causal relationship has been established between exposure to agent & human cancer.

Limited evidence of carcinogenicity: A positive association has been observed between exposure to the agent and cancer for which a causal interpretation is considered by the Working Group to be credible, but chance, bias or confounding could not be ruled out with reasonable confidence.

Inadequate evidence of carcinogenicity: The available studies are of insufficient quality, consistency or statistical power to permit a conclusion regarding the presence or absence of a causal association between exposure and cancer, or no data on cancer in humans are available.

Evidence suggesting lack of carcinogenicity: There are several adequate studies covering full range of levels of exposure that humans are known to encounter, which are mutually consistent in not showing a positive association between exposure to the agent and any studied cancer at any observed level of exposure.

4.1.4 Health risks associated with mobile phones and their base stations²⁷

This appeared in the online question & answer dated 20 September 2013, wherein WHO says, "Because exposure to the radiofrequency (RF) fields emitted

²⁷ World Health Organization, The International EMF Project (20 September 2013) *Online Questions & Answers: What are the health risks associated with mobile phones and their base stations?* (Online) <http://www.who.int/features/qa/30/en/>

by mobile phones is generally more than a 1000 times higher than from base stations, and the greater likelihood of any adverse effect being due to handsets, research has almost exclusively been conducted on possible effects of mobile phone exposure.” After summarizing the researches in four areas, cancer, other health effects, electromagnetic interference and traffic accidents, it concludes, “While an increased risk of brain tumours from the use of mobile phones is not established, the increasing use of mobile phones and the lack of data for mobile phone use over time periods longer than 15 years warrant further research of mobile phone use and brain cancer risk. In particular, with the recent popularity of mobile phone use among younger people, and therefore a potentially longer lifetime of exposure, WHO has promoted further research on this group and is currently assessing the health impact of RF fields on all studied endpoints.”

4.1.5 Electromagnetic fields and public health: mobile phones²⁸

This fact sheet no.193 was last reviewed in Oct.'14 and is the latest fact sheet which could be located on WHO website on subject matter. Being mainly related to mobile phones, only a summarized part is explained here. The fact sheet says that electromagnetic fields produced by mobile phones are classified by IARC as possibly carcinogenic to humans. Studies are ongoing to fully assess potential long-term effects of mobile phone use. While an increased risk of brain tumors is not established, increasing use of mobile phones and the lack of data for mobile phone use over time periods longer than 15 years warrant further research of

²⁸ World Health Organization, The International EMF Project (Reviewed October 2014) *Factsheet: Electromagnetic Fields and public health – mobile phones*. (Online)
<http://www.who.int/mediacentre/factsheets/fs193/en/>

mobile phone use and brain cancer risk. In particular, with the recent popularity of mobile phone use among younger people and therefore a potentially longer lifetime of exposure, WHO has promoted further research on this. Several studies investigating potential health effects in children and adolescents are underway. WHO will conduct a formal risk assessment of all studied health outcomes from radiofrequency fields exposure by 2016. The use of commercial devices for reducing radiofrequency field exposure has not been shown to be effective.

4.1.6 ICNIRP workshops

Annual workshop²⁹ "A closer look at the thresholds of thermal damage" jointly organized by WHO and hosted by Ministry of Health of Republic of Turkey took place from 26-28 May 2015 in Istanbul, Turkey. ICNIRP reviewed the current scientific knowledge on the thresholds of thermal damage, in view of updating the guidance on limiting exposure to high frequency (HF) fields. They revisited the ICNIRP 1998 concept, that the health relevant increase of body core temperature is approximately 1°C and a whole-body exposure with an average SAR of 4 W/kg results in a core temperature increase of less than 1°C within 30 min. Details of this concept as well as thresholds for partial/ local body exposures are being reviewed. Amongst others, the following topics and questions were addressed:

- a) Definition/ Specification of the threshold for thermal damage:
- with respect to the whole body, parts of the body (limbs, trunk, head), different organs (i.e. brain, eye, testis, skin etc.), different tissues (muscle, fat, nerve, connective tissue)

²⁹ International Commission on Non-Ionizing Radiation Protection, *Workshops: Thresholds of thermal damage*. (Online) <http://www.icnirp.org/en/workshops/article/workshop-thermal-damage.html>

- regarding frequency dependence
 - with respect to external conditions (cold/ hot environment, humidity, clothing)
 - with respect to internal/ individual conditions (interindividual variations, age-dependence, health status, metabolic status, medication, compromised thermoregulation, pregnancy, etc.)
- b) Definition/ Specification of the health relevant quantity like SAR, power flux density, temperature, thermal dose, etc.
- c) Is our thermoregulation (evolved to respond to physical work and hot environments) effective in responding to local (internal) HF-induced heating?
- d) Is averaging time of 6 min and mass of 10g of contiguous tissue appropriate?
- e) Has exposure duration to be taken into account (even at low)?

Next i.e. the 8th International NIR (Non Ionizing Radiations) Workshop³⁰ is to be held at the Cape Town International Convention Centre, Cape Town, South Africa, 9-11 May 2016. As per its website, "The update of the ICNIRP High Frequency Guidelines that are currently under revision and the related development of the WHO Environmental Health Criteria on Radiofrequency Fields will be a high-point of the workshop."

4.1.7 EHC monograph on Radiofrequency fields

WHO has addressed possible health effects from exposure to EMF through 3 Environmental Health Criteria (EHC) monographs on extremely low frequency (ELF - up to 100 kHz) fields (1984), static (0Hz) and ELF magnetic fields (1987) and radiofrequency (RF - 100 kHz to 300 GHz) fields (1993). WHO revises them

³⁰ International Commission on Non-Ionizing Radiation Protection, *Workshops: 8th International NIR workshop*. (Online) <http://www.icnirp.org/en/workshops/article/workshop-nir2016.html>

if new data are available that would substantially change the evaluation, if there is public concern for health or environmental effects of the agent because of greater exposure or if appreciable time period has elapsed since last evaluation. So 3 monographs spanning 0- 300 GHz EMF frequency range had been planned by WHO: static fields (0Hz), ELF fields (up to 100 kHz) and RF fields (100 kHz – 300 GHz). So far, they have developed first two volumes on Static Fields (2006) and ELF fields (2007). WHO is undertaking a health risk assessment of RF fields, to be published as a monograph in the EHC Series, which will complement other two monographs and will update the monograph on radiofrequency fields (1993).

4.2 Indian Government Actions

In year 2008 when mobile connections in India had crossed the mark of 300 Million, mobile tele-density was reaching 30% mark and annual mobile growth rate had stabilized to around 150%, Government of India, based on global developments and growing public concerns in India, focussed its attention towards EMR from mobile. In India, this monitoring work is done by Department of Telecommunications (DoT), who issues instructions regarding setting up of acceptable EMF radiation limits and the testing procedure to be followed.

Since the mobile services in India are operated by various telecom service providers (TSPs) based on the licences issued to them, as a first step, DOT issued orders to amend the conditions of Licence agreement of various Cellular Mobile Telecom Services (CMTS) and Unified Access Service (UAS) providers

on 4th November 2008³¹. As recommended by WHO, DoT adopted the ICNIRP (1998) Guidelines and prescribed limits/ levels for antennas (Base Station Emissions) for general public exposure, as an immediate measure. In the licence agreement, a clause 43.6A was inserted after clause 43.6, which reads as under, "43.6 A. Licensee shall conduct audit and provide self-certificates annually as per procedure prescribed by Telecommunication Engineering Centre (TEC)/ or any other agency authorized by licensor from time to time conforming to limits/ levels for antennae (Base station Emissions) for general public exposure as prescribed by International Commission on Non-Ionizing Radiation Protection (ICNIRP) from time to time. The present limits/levels are reproduced as detailed below:

Frequency Range	E-Field Strength (Volt/Meter (V/m))	H-Field Strength (Amp/Meter (A/m))	Power Density (watt/Sq. Meter (W/Sq. m))
400MHz to 2000MHz	$1.375f^{1/2}$	$0.0037f^{1/2}$	$f/200$
2GHz to 300GHz	61	0.15	10

(f=frequency in MHz)

Note: The compliance in the form of Self Certificate shall commence six months after the date of issue of prescribed test procedure by TEC or any other agency authorized by licensor."

As per above letter, operators are required to conduct audit and submit self-certificates on annual basis. For this, based on, ITU-T Recommendation K.52 (2004) (Guidance on complying with limits for human exposure to EMF) & ITU-T

³¹ <http://www.dot.gov.in/sites/default/files/Annexures/04-11-2008.pdf> (accessed 5 March 2016)

Recommendation K.61 (2003) (Guidance to measurement & numerical prediction of EMFs for compliance with human exposure limits for telecom installations), TEC, the technical wing under DoT, issued an elaborate test procedure for measurement of EMFs from base station antenna for telecommunication sector during the last quarter of 2009, which was then circulated to all operators.

Based on the above test procedures, DoT asked all the operators to submit self-certificates of all their sites by 15.05.2010 (date later extended to 15.05.2010 and then to 31.03.2011) to DoT's field unit in each state i.e. the Telecom Enforcement Resource & Monitoring (TERM) cell. Additionally, it was ordered that

- any new BTS site will start radiating only after self-certification,
- TERM cell was also entrusted with the job of 10% random sample check and to test the sites against which there are public complaints,
- The cost of this testing, @ Rs.10,000 per site and the testing tools & equipments are to be provided by the concerned operator,
- In case of any site failing in tests, penalty of Rs.5 lakh was imposed per BTS per operator, with a time limit of 1 month to comply else site to be shut down.
- Additionally DoT also gave 10 best practices to be followed by the operators like financial support to government's independent research on mobile communications health issues, participate in pre-rollout consultation with local planning authorities, local communities & other stakeholders, etc.

4.2.1 Revision of norms

On 24.08.2010, due to continuing public concern about adverse effect of EMF radiation on health, DoT set up an Inter-ministerial Committee consisting of

officers from DoT, Indian Council of Medical Research (Ministry of Health), Department of Biotechnology and Ministry of Environment and Forest to examine the effects of Electromagnetic Field radiation from base stations and mobile phones on human health at levels below the existing standards. The committee³² took into consideration the presentations/ view points of Prof. J. Behari from JNU, Telecom Equipment Manufacturers Association (TEMA), Cellular Operators Association of India (COAI)/ Association of Unified Service Providers in India (AUSPI), Telecom Users Group of India (TUGI), Consumer Care Society (CCS), Bangalore and Prof. Girish Kumar, IIT, Bombay. As per the report, *“The hot tropical climate of the country, low body mass index (BMI), low fat content of an average Indian as compared to European countries and high environmental concentration of radio frequency radiation may place Indians under high risk of radio frequency radiation adverse effect and the level of susceptibility of an average Indian may be different. Hence revision of radiation norms may be considered for adoption in India keeping in view the possible health concern.”*

Recommendation of committee, related to mobile base stations stated, *“The RF exposure limits in India may be lowered to 1/10th of the existing level keeping in view the data submitted by COAI/ AUSPI during presentation made to the committee and trend adopted by other developed countries.”* Similarly that related to handsets stated, *“Adoption of SAR level for mobile handsets limited to 1.6 Watt/Kg, averaged over a 6 minutes period and taken over a volume containing a mass of 1 gram of human tissue as per the FCC norms of U.S.”*

³² http://www.dot.gov.in/sites/default/files/1.IMC%20Report_0.pdf (accessed 5 March 2016)

Based on above recommendations, DoT issued orders to all the operators asking for the self-certificates for all BTSs, as per the lowered norms, with effect from 01.04.2012 (later shifted to 01.09.2012),

Table 4.1: Revised limits for EMRs from mobile towers

Frequency Range	E-Field Strength (Volt/Meter (V/m))	H-Field Strength (Amp/Meter (A/m))	Power Density (W/Sq. m)
400MHz to 2000MHz	$0.434f^{1/2}$	$0.0011f^{1/2}$	f/2000
2GHz to 300GHz	19.29	0.05	1

(f=frequency in MHz)

(Source: DoT website)

Accordingly the revised test procedure as per the new norms was issued by TEC on 02.SEP.2012³³ and the revised norms were incorporated by DoT in the Licence agreements on 10.01.2013³⁴ wherein the period of self-certification was also changed from 1 year to 2 years with the running cycle ending on 31.03.2013. As per the TRAI information paper³⁵, consequent to this revision by DoT, Indian standards are now 10 times more stringent than many countries (like USA, Canada, Japan and Australia) in the world which follow ICNIRP guidelines.

On 20.11.2013³⁶, through an elaborate letter, DoT revised the penalties in case of violation on the matter of Electromagnetic Radiations as

- penalty for delay/ non-submission of self-certificate for new/ up-gradation of BTS as

³³<http://www.dot.gov.in/sites/default/files/Annexures/TEC%20Test%20Procedure%20EMFields%20From%20BTS%20Antennae.pdf> (accessed 5 March 2016)

³⁴<http://www.dot.gov.in/sites/default/files/Annexures/8.%2010.01.2013.pdf> (accessed 5 March 2016)

³⁵ Telecom Regulatory Authority of India (30th July, 2014) *Information paper No. 01/2014-QoS on Effects of Electromagnetic Field Radiation from Mobile Towers and Handsets*

³⁶<http://www.dot.gov.in/sites/default/files/Annexures/15.%20Scheme%20of%20penalty%20in%20case%20of%20violation%20of%20terms%20and%20conditions%20of%20License%20and%20related%20instructions%20on%20the%20matter%20of%20EMF%20Radiation.pdf> (accessed 5 March 2016)

Table 4.2: Revised penalties for new/ upgraded BTS

Delay from due date	Total penalty per BTS per incidence
Up to 15 days	Rs.5,000/-
Beyond 15 days to 30 days	Rs.20,000/-
Beyond 30 days to 60 days	Rs.50,000/-
Beyond 60 days	BTS to be shut down

(Source: DoT website)

- penalty for delay/ non-submission of biennial self-certificate for existing BTSs

Table 4.3: Revised penalties for delay/ non-submission of self-certificate

Delay from due date	Total penalty per BTS per incidence
Up to 30 days	Rs.5,000/-
Beyond 30 days to 60 days	Rs.20,000/-
Beyond 60 days to 90 days	Rs.50,000/-
Beyond 90 days	BTS to be shut down

(Source: DoT website)

- in case of non-compliance of norms being found by TERM cell, the penalty was increased to Rs.10 lakh per BTS.

4.2.2 Implementation of norms

As mentioned above DoT gets the above norms implemented through 34 TERM cells located all over India. Various operators submit the self-certificate of all their existing and new/ upgraded/ modified BTSs to the respective TERM cells. These TERM cells also undertake the work of 10% sample checks and testing of the BTS sites on the basis of public complaints. The information related to number of BTSs (for 2G/ 3G/ 4G Services) installed as on 30.11.2015 was collected from DoT and the same was appended to the number of BTSs Tested by TERM Cells to check EMF radiation exposure norms prescribed by DoT as on 28.02.2015 as available on DoT website. The appended table is as given ahead.

Table 4.4: Number of installed and tested BTSs

S. No.	Term Cell	Number of BTSs installed as on 30.11.2015	Total number of BTS tested as on 28.02.2015
1	Andhra Pradesh	75,903	14,364
2	Hyderabad		6,621
3	Assam	18,737	3,818
4	Bihar	52,234	5,907
5	Jharkhand		3,563
6	Delhi	53,823	6,616
7	Gujarat	67,753	9,722
8	Ahmedabad		2,887
9	Haryana	26,467	5,867
10	Himachal Pradesh	9,980	2,599
11	Jammu & Kashmir	14,428	1,568
12	Karnataka	75,388	12,692
13	Bangalore		9,905
14	Kerala	41,119	10,140
15	Kolkata	23,917	3,926
16	Madhya Pradesh	64,372	9,434
17	Chhattisgarh		2,891
18	Maharashtra	89,648	9,813
19	Pune		3,772
20	Mumbai	35,762	5,125
21	North East – I	12,096	1,521
22	North East – II		1,276
23	Odisha	26,681	8,172
24	Punjab	38,174	6,058
25	Rajasthan	45,844	6,146
26	Jaipur		2,299
27	Tamilnadu	84,372	11,513
28	Chennai		8,371
29	UP (East)	63,492	7,572
30	Lucknow		1,897
31	UP (West)	50,327	6,094
32	Uttarakhand		2,797
33	West Bengal	39,958	5,052
34	Andaman & Nicobar Islands		105
	Grand Total	10,10,475	2,00,076

(Source: DoT and its website³⁷)

³⁷<http://www.dot.gov.in/sites/default/files/u10/details%20of%20BTSs%20tested%20by%20TERM%20cell%20as%20on%2028.02.2015%20%281%29.pdf> (accessed 5 March 2016)