Radio Frequency (RF) Exposure Levels at Different Parts of Sri Lanka Due to Mobile Base Station Antennas

Karunarathna M.A.A.[a*], Fernando C.A.N.[a] and Samarasekara P.[b]

[a] Department of Electronics, Faculty of Applied Sciences, Wayamba University of Sri Lanka, Sri Lanka;
[b]Department of Physics, Faculty of Science, University of Peradeniya, Sri Lanka
*Corresponding author (email:asanka55@yahoo.com)

Abstract

The remarkable growth of telecommunication industry resulted in boost in the number of cell-phone user everyday. It has been known for some time that high intensities of RF radiation can be harmful since RF energy can heat biological tissues rapidly. Body tissue damages can be caused due to its inability to cope with or dissipate the excessive heat. Under certain conditions, exposure to RF radiation with power densities of approximately 10 mW/cm^2 or more could result in measurable heating of biological tissues.

Body absorption of RF radiation is due to resonance phenomenon. RF safety standards consider this frequency dependence into account. Safety guidelines for exposure of the public to the RF radiation from transmitting antennas are set by different organizations. In Sri Lanka, Telecom Regulatory Commission (TRCSL) uses Federal Communication Commission (FCC) standards for RF safety issues.

In Sri Lanka, people are exposed to RF radiation transmitted by antennas of base stations of Cellular Mobile systems operating in the 900 MHz, 1.8 GHz and 2 GHz bands. Up to now, approximately over 6000 mobile base station antennas are established within the country. Therefore, public much concern about the levels of exposure to RF fields and whether these levels are comply with the standards or not. As such, a study on the exposure levels of RF radiation in different parts of our country has turned out to be a very timely requirement.

In this study, the worst-case RF exposure levels in different parts of Sri Lanka due to a variety of RF & microwave transmitters of mobile base station antennas were investigated. The resultant exposure levels are to be compared with the international standards for compliance testing. The measurements of field intensity were made at different locations, which represent highly populated flat urban environment, the coastal belt from northwest to south of the country and hilly areas at high elevation.

Spectrum analyzer and the standard measuring antenna set were used to do the measurements. For a particular location, a large number of received signals exist which were emitted from different sources. When number of sources at different frequencies; contribute to the total exposure, it becomes necessary to weigh each contribution relative to the Maximum Permissible Exposure (MPE) in accordance with the standards. To comply with the MPE, the fraction of the MPE in terms of E^2(E-Electric field), H^2 (H-Magnetic field), or S(Power density) incurred within each frequency interval should be determined and the sum of all such fractions should not exceed unity. This dimensionless quantity is known as the *exposure quotient*. In this investigation, the exposure quotient is expressed in terms of the calculated power density, S^{meas} ,measured results of the field strength and the maximum permissible power density, S^{ref} , for the same frequency. Thus,

$\text{Exposure quotient} = \frac{S^{meas}}{S^{ref}}$ The present work is concerned with simultaneous exposure to many different signals, each with a different frequency. All of the individual signals will contribute to a person's exposure level and the total exposure quotient will be equal to the sum of the quotients for each signal, as expressed by; $Total\ \exp osure\ quotient = \sum_{i=1}^{N} \frac{S_i^{meas}}{S_i^{ref}} = \frac{S_1^{meas}}{S_1^{ref}} + \frac{S_2^{meas}}{S_2^{ref}} + \ldots\ldots + \frac{S_N^{meas}}{S_N^{ref}}$

where N is the total number of signals. This total exposure quotient should not exceed unity to ensure safety. i.e., Total exposure quotient = $\sum_{i=1}^{N} \frac{S_i^{meas}}{S_i^{ref}} \leq 1$. If this condition is met, then the environment is safe from RF exposure. Twenty different sites with different topologies were selected for measurements. In each measured location, all available signals were measured with respect to all frequency ranges by repeated scanning. Results showed that for most of the cites, the total exposure quotient is below unity. But for the places such as Badulla, Kandy and Gampaha showed a significant increment. Colombo fort recorded comparatively lower values possibly due to the microcellular base stations put up for the high population density in the area. Measurements indicated that the exposure levels due to all mobile communication services as at December 2016 at the locations considered in this work are below FCC specified safety standards. Since the calculated exposure levels are not very much below the standards, there may be a health risk in future due to the rapid rate of installation of mobile base station antennas.

Keywords: Maximum Permissible Exposure (MPE); Radio Frequency (RF); Exposure Quotient; Spectrum Analyzer; Base Station Antennas.