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EXPOSURE LEVELS DUE TO RF RADIATION AT 900MHz AND 1800MHz BANDS IN HIGHLY POPULATED AREAS

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ABSTRACT

The use of radio-frequency measuring equipment is dramatically increasing, and one consequence is that the levels of radio-frequency radiation are increasing drastically.The most important use for RF energy is in providing telecommunications services. Biological effects that result from heating of tissue by RF energy are often referred to as "thermal" effects. It has been known for many years that exposure to very high levels of RF radiation can be harmful due to the ability of RF energy to rapidly heat biological tissue. Due to that, many research activities are carried out to find out whether there occur any hazards due to the radio frequency radiation. In this research the measurements were taken at the Kuliyapitiya premises of Wayamba University of Sri Lanka as a highly populated area. For this research project, to take the measurements a Handheld Spectrum Analyzer, Portable YAGI Antenna (885-975 MHz), N95 NOKIA cellular phone and NOKIA GPS were used. From the measurements the exposure quotient was calculated. Then the calculated exposure levels were compared with the FCC standards.

Keywords: *Radio Frequency Radiation, exposure quotient, Federal Communication Commission, Spectrum Analyzer*

1.0 INTRODUCTION

Most RF fields found in the environment are due to commercial radio and TV broadcasting, and from other telecommunications networks. RF exposure from radio or TV broadcasting is generally less than from telecommunications networks. RF sources in the home include microwave ovens, mobile telephones, cordless telephones, wireless computer networks, burglar alarms, and remote controls. The RF field background level from household appliances is low. Relatively high levels of exposure to RF fields can occur to workers in the broadcasting, transport and communications industries when they work in close proximity to RF transmitting antennas and radar systems. Some industrial processes

that use RF fields to heat materials can also produce high exposure to workers.Radiation sickness is damage to your body caused by a large dose of radiation often received over a short period of time. The amount of radiation absorbed by the body determines how sick you'll be. Radiation exposure can also increase the probability of developing some other diseases, mainly cancer, tumours, and genetic damage[1].

New cellular antennas and other RF emitting devices are being installed as quickly as possible. There are currently over 100,000 operating devices in the Sri Lanka alone. That number is expected to double in the very near future as the demand intensifies for more powerful wireless devices. Cell phones give off a form of energy known as radiofrequency (RF) waves, so some concerns have been raised about the safety of cell phone use. According to the increasing the number of cell phone users, inherently increase the number of cell phone towers. So inherently increase the amount of the radiations also. The main thing is we can't feel those changes. But it produces lot of issues. The main objective of this research project is aware the general public about the radio frequency radiation. Other than this, can find issues from the mobile phones radiations[2].

2.0 METHODOLOGY

Measurements were taken in Wayamba University of Sri Lanka Kuliyapitiya premises to determine the exposure levels due to EM fields radiated by Mobile cellular base stations. The measurements of field intensity were made at different locations in the university.

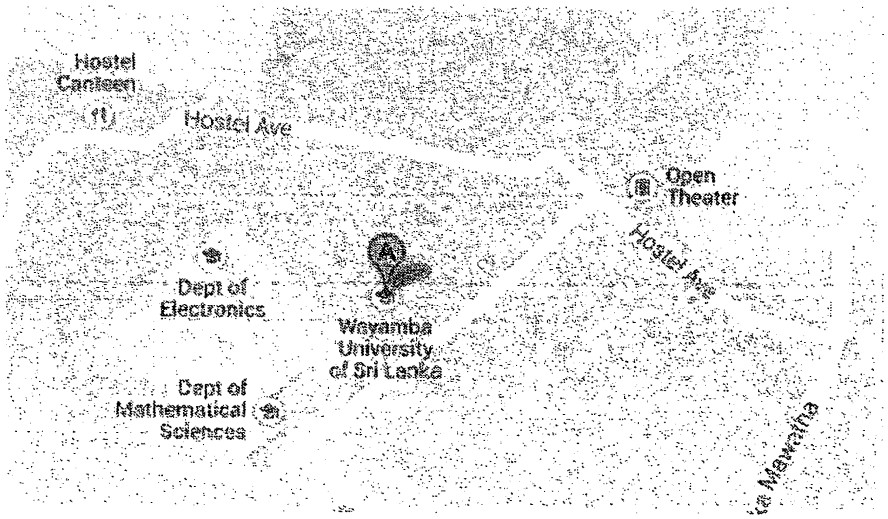

Figure 1: Wayamba University map with RF measured areas

These measurements are spot measurements and particular spot was selected from the most public access places such as canteen, open theatre and Applied Science Faculty building.

All measurements are taken during the daytime when most of the mobile phones are normally in use.

2.1 Used methods and materials

The spectrum analyzer was used to obtain the signal strength received from signals transmitted by mobile cellular base station antennas. The measurement equipments are shown in figure 2 and figure 3.

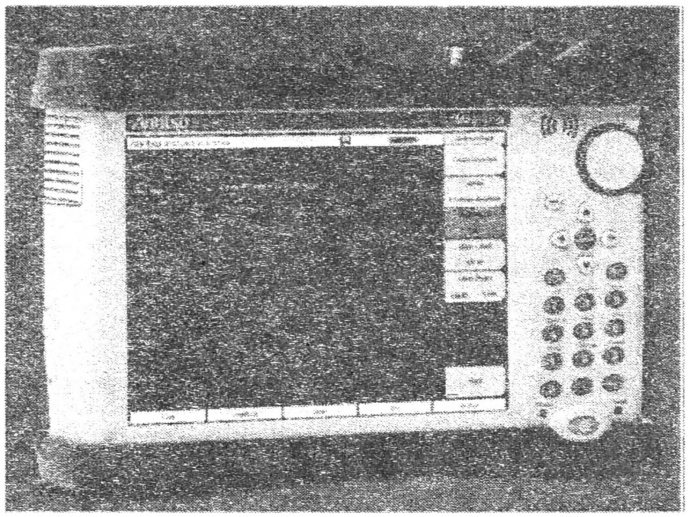

Figure 2: Spectrum Analyzer Spectrum Master E MS2711E

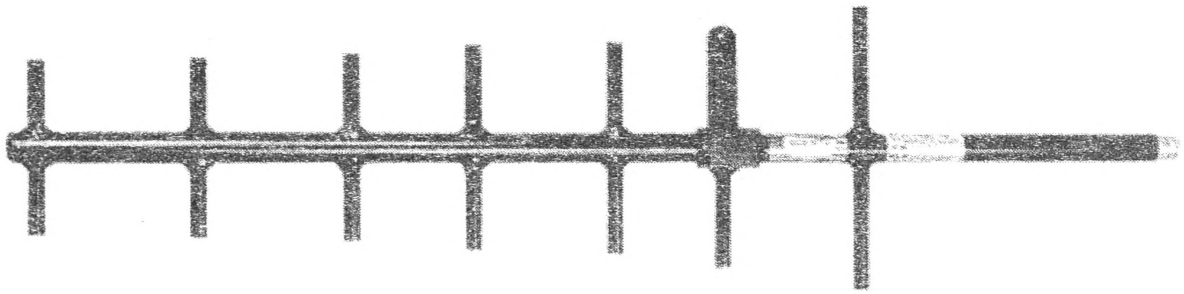

Figure 3: Adjustable dipole antenna: Portable YAGI Antenna, 885-975 MHz, N (f), and 10dBd

The antenna was mounted 1.4 m above the ground level as it in the average height of a man. For a particular signal, the maximum received voltage, Vm in dBμV, was obtained from the spectrum analyzer, rotating the antenna to the direction of maximum received field strength. This was repeated for five operators such as dialog, mobitel, etisalat, hutch and airtel.

QVoice software installed N95 NOKIA phone and GPS used to take measurements with the distance from base station. COL 200 base station situated at Mobitel (Pvt) Limited - Engineering Divisionwas selected for this purpose.

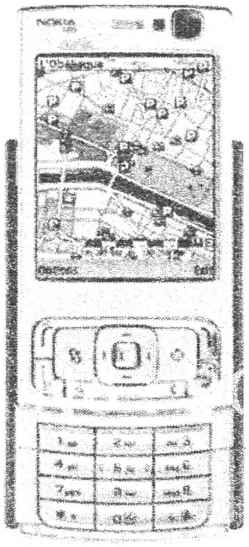

Figure4: NOKIA N95 Cellular phone

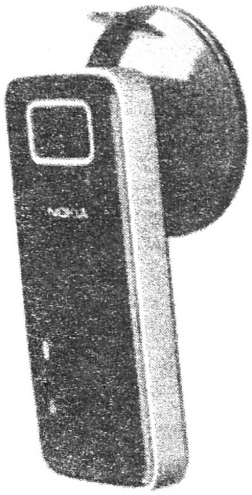

Figure5: NOKIA GPS

To comply with the MPE, the fraction of the MPE in terms of E^2, H^2 or S 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}, from measured results of the field strength and the maximum permissible power density, S^{ref}, for the same frequency. Thus,

$$\text{Exposure Quotient} = S^{meas}/S^{ref} \qquad [1]$$

$$TEQ = \sum_{n=1}^{N} \frac{S_n^{meas}}{S_n^{ref}} = \frac{S_1^{meas}}{S_1^{ref}} + \frac{S_2^{meas}}{S_2^{ref}} + \frac{S_3^{meas}}{S_3^{ref}} + \cdots + \frac{S_N^{meas}}{S_N^{ref}} \qquad [2]$$

Where TEQ is Total Exposure Quotient and N is the total number of signals[3].

3.0 RESULTS AND DISCUSSION

Table 1: Total Exposure Quotient of cellular mobile operators

Location	Cellular Mobile Operators				
	Dialog	Mobitel	Etisalat	Hutch	Airtel
Canteen	0.126826	0.109481	0.088722	0.107828	0.092795
Open Theater	0.105387	0.109984	0.110633	0.109184	0.141466
Faculty Building	0.129962	0.106999	0.114815	0.087039	0.099218

According to the table 3.1 total exposure quotients at canteen, open theatre and faculty building are below than unity. So the canteen, open theatre and faculty building are safe from RF exposure. Power density variation with the height is somehow complicated. So we cannot predict about the change of field strength with the height.

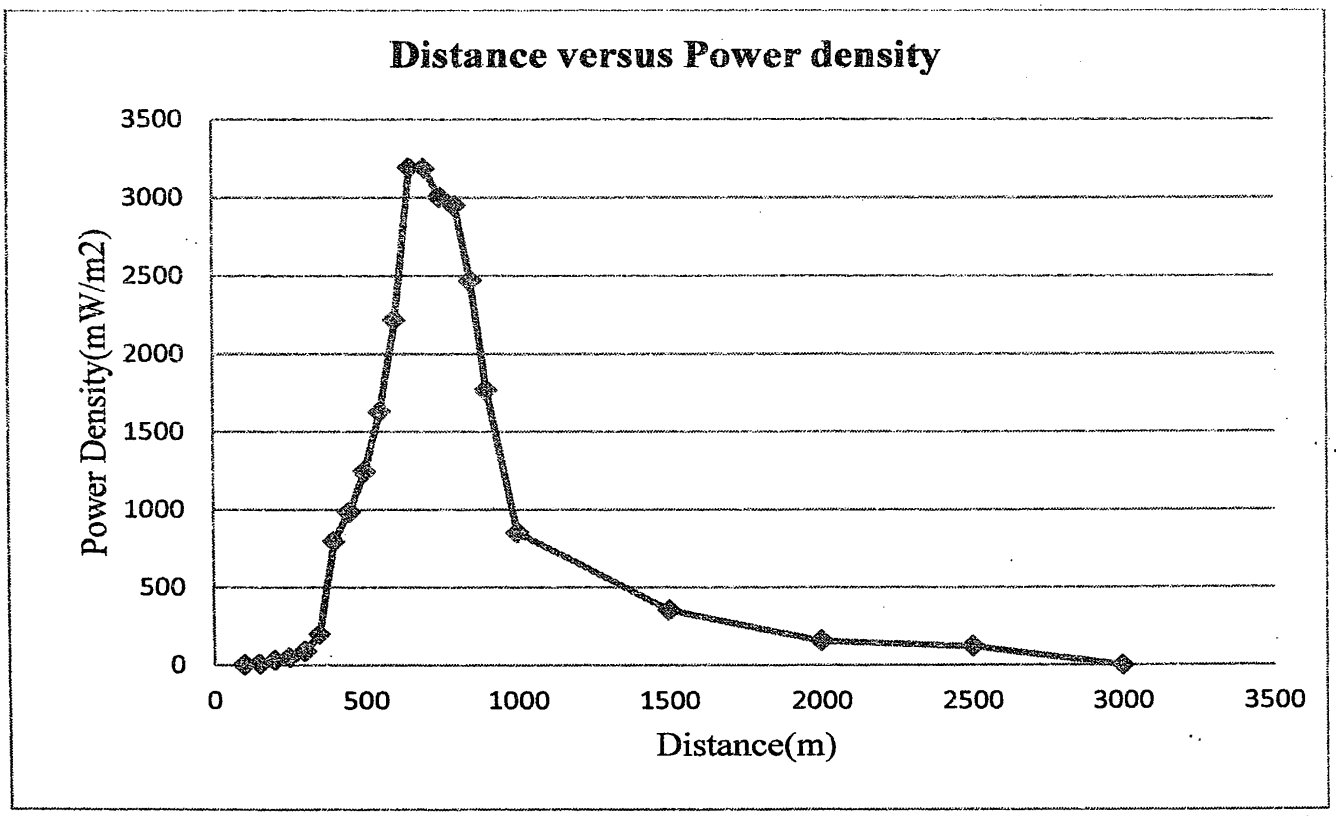

Figure 6: Distance versus Power density

According to figure 3.1, power density was increased up to certain distance and then begun to decreaseaway from base station.

4.0 CONCLUSION

Eventhough this is a preliminary study, the resultspredict the possibility of occurring hazards.There were factors responsible for these variations. Such factors include: Side lobe effects, attenuation and obstacles like buildings, trees, ground reflections etc.

Measurements have shown that ground-level power densities due to microwave directional antennas are normally a thousand times or more below recommended safety limits. Significant exposures from these antennas could only occur in the unlikely event that an individual was to stand directly in front of and very close to an antenna for a period of time[4].

ACKNOWLEDGEMENTS

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