

## ***Measurement of Magnetic Field from Lab Equipment in Computer Science and Engineering Labs of Southeast University Bangladesh***

***Munima Haque\**, *Md. Quamruzzaman\*\****

*Assistant Professor \**, *Associate Professor\*\**

*Department of Electrical and Electronic Engineering,*

*Southeast University, Dhaka, Bangladesh*

***Corresponding Author's E-mail: munima.haque@gmail.com \****

### ***Abstract***

*The aim of this survey is to investigate the impact of Electromagnetic Fields (EMF) emitted from various lab equipment on the students and employees. There is a standard threshold value recommended by WHO for both electric and magnetic fields. Electromagnetic fields are emitted from high power transmission lines, computer monitor/video display unit, radio waves of different frequencies (extremely low frequency to microwaves), telecommunication, satellite, radar etc. which cause health hazards to living systems and environment. There hasn't been many studies in Bangladesh on this aspect of electromagnetic fields. For this paper, the data were collected from various lab equipment of different computer science and engineering labs at Southeast University in Dhaka, Bangladesh. Both threshold values of electric and magnetic fields were measured for various electronic equipment. Also, the maximum value of the magnetic field results showed that in many cases, the magnetic field radiated from different sources are greater than the threshold limit.*

***Keywords: EMF, NIR, WHO, ELF, EF, MF***

### **INTRODUCTION**

Ionizing radiation is the radiation of sufficiently high energy to cause ionization in the medium through which it passes. It may consist of a stream of high-energy

particle (e.g. electron, protons, alpha particles) or short wavelength electromagnetic radiation (ultraviolet, X-rays, gamma-rays). Radiation, which does not cause any ionization of the media

while passing through it, is known as non-ionizing radiation (NIR). Examples of non-ionizing radiation are ultraviolet, visible light, infrared, microwave and radiowave. Their energy is relatively low; it only manages to cause molecules to vibrate and induces heating effects.

Exposure to Extremely Low Frequency (ELF) electric and magnetic fields does produce biological effects. However, except for fields strong enough to induce current densities above the threshold for the stimulation of nerve tissue, there is no consensus as to whether these effects constitute a hazard to human health. Human data from epidemiological studies, including reported effects on cancer promotion, congenital malformations, reproductive performance and general health, though somewhat suggestive to adverse health effects, are not conclusive.

Magnetic fields associated with appliances are typically stronger than those fields found near power lines [1]. There must be a limit, both in the residential and occupational levels between 0.2 to 0.3  $\mu\text{T}$  or 2.5 mG, which are internationally recognized as the standard limit in many countries. For an electric field, this value is 25V/m. It must be ensured that intensity of radiation in the body does not exceed the

recommended maximum level (10 mW/cm<sup>2</sup>, 195V/m in U.S.A. and 0.1 mW/cm<sup>2</sup>, 20 V/m in CIS). [2-3]. Electric fields can be blocked by most objects (e.g. trees, the ground, buildings etc.). However, magnetic fields pass through most objects. This is one reason why burying power lines will not necessarily eliminate magnetic fields. As most scientific research and public issues have focused on measuring magnetic fields [1], in this study different magnetic fields have been measured. Lower animals are reported to be very sensitive to electromagnetic fields. It is seen that animals like rats make their living holes away from the high electric field lines and bees block-up their hives in the chronic presence of NIR. As a result, scientists and health physicians in developed countries have become aware of the effects of NIR [4]. Their research and observations have brought out some remarkable results linking low level alternating electromagnetic fields with serious health hazards. There is also evidence that biological effect like immune deficiency, sensitive lymphocytes, disrupting DNA, cellular breakdown is being affected by NIR [5].

Leukaemia and exposure to EMF are discussed in Savitz works [6]. Also, there

have been studies of childhood cancer due to EMF exposure. [7]. Exposure of Magnetic Fields Alternating at Extremely Low Frequency is also discussed [8]. There have been studies on Environmental power-frequency magnetic fields and suicide. [9]. Stray voltage and developmental, reproductive and other toxicology problems in dogs, cats and cows have also been investigated in various studies [10]. RF-field interactions with biological systems have also been investigated [11]. Many research studies have been carried out in these fields. Most recently, Epidemiological survey of people working in EMF field exposed to high frequency was investigated [12]. Also, research was conducted for epidemiological survey on effect of EMF emitted by photocopy machines generally used in Dhaka City, Bangladesh [13]. Survey was done on EMF emitted by Lab equipment in various labs of Southeast University in Bangladesh for possible health hazards [14]. A case study was done on EMF near high voltage transmission line [15]. Also, a review was done on Non Ionizing Radiation (NIR), its harmful effects especially from Mobile/Cell Phone and Towers [16]. An epidemiological survey was performed on CRT monitors used in Dhaka city [17]. Measurement of

EMF was also done on Pharmacy Lab equipment in Southeast University [18].

There have been various papers published on EMF of radio, TV etc. but not much on lab equipment. At Southeast University, all the labs have equipment for experimentation. The students, as well as faculties and other employees, spend around 7-8 hours each day in these classrooms and labs. The aim of this research is to investigate whether the EMF emitted from these lab equipment are within threshold values and also whether the students and employees are safe from these equipment.

## **METHODS**

A Cornet ED78S EMF RF Meter Electromagnetic Detector [19] was used for measuring the magnetic field values for various air conditioners and switch board equipment. A Coghill Field Mouse for Biohazard Awareness was used for measuring the threshold values for both electric field (EF) and magnetic field (MF) around the instrument. The threshold voltage setup inside the Coghill Field Mouse is according to ICNIRP. The readings were taken all around the equipment. The readings were taken at the centre of the equipment (front side), upper backside, at 45O both front side and back.



**Figure 1: Electromog RF/LF Field Strength power meter Dual mode RF power meter & LF gauss meter ED-78S measuring magnetic field in front of Lab equipment (top image) and the COGHILL FIELD MOUSE measuring the EF and MF threshold values (see the red and green lights). Green light indicates that the EF threshold has reached while the MF threshold reading still showing red i.e. threshold not reached yet (bottom image).**

## RESULTS

All the readings were taken from different labs of Textile Engineering department, Southeast University Tejgaon Permanent

campus. Readings were taken from lab equipment of each lab.

**Table 1: EMF values measured for lab equipment in Computer Lab-3 in Computer Science and Engineering department in Southeast University (SEU), March 2016.**

Serial No.	Equipment info. (Machine #, Machine Model, made country, year made, Date of installation)	Threshold dis. in front of the equipment measured from the centre of the equipment (cm)		Magnetic Field (mG) in front of the eqpt.	Threshold dis. at right side of the equipment (cm)		Magnetic Field (mG) at right side of the equipment	Threshold distance at the left side of the equipment (cm)		Magnetic Field (mG) at left side of the equipment	Magnetic Field maximum (mG)
		EF	MF		EF	MF		EF	MF		
1a	SAMSUNG-LCD monitor Model: Sync master – B1930	37.5 cm	*	1.5 $\mu$ T	0 cm	18 cm	0.2 $\mu$ T	0 cm	20 cm	0.3 $\mu$ T	1.5 $\mu$ T
1b	SAMSUNG-LCD monitor Model: Sync master – B1930	9 cm	*	1.5 $\mu$ T	0 cm	5 cm	0.2 $\mu$ T	0 cm	2 cm	0.3 $\mu$ T	1.5 $\mu$ T
1c	SAMSUNG-LCD monitor Model: Sync master – B1930	*	0 cm	0.7 $\mu$ T	*	0 cm	1.3 $\mu$ T	*	0 cm	1.3 $\mu$ T	1.3 $\mu$ T
1d	SAMSUNG-LCD monitor Model: Sync master – B1930	60 cm	*	0.L red	2 cm	68.8 cm	4.4 $\mu$ T	7.7 cm	28 cm	18.5 $\mu$ T	O.L.
1e	SAMSUNG-LCD monitor Model: Sync master – B1930	0 cm	*	1.6 $\mu$ T	*	0 cm	1.1 $\mu$ T	*	0 cm	1.3 $\mu$ T	1.6 $\mu$ T

1f	SAMSUN G-LCD monitor Model: Sync master – B1930	*	0 cm	0.8 $\mu$ T	*	0 cm	0.5 $\mu$ T	*	0 cm	0.3 $\mu$ T	0.8 $\mu$ T
1g	SAMSUN G-LCD monitor Model: Sync master – B1930	31 cm	*	1.4 $\mu$ T	0 cm	18 cm	0.4 $\mu$ T	0	22 cm	0.3 $\mu$ T	1.4 $\mu$ T
1h	SAMSUN G-LCD monitor Model: Sync master – B1930	0 cm	59 cm	1.1 $\mu$ T	*	0 cm	0.5 $\mu$ T	*	0 cm	0.2 $\mu$ T	1.1 $\mu$ T
1i	SAMSUN G-LCD monitor Model: Sync master – B1930	*	0 cm	0.9 $\mu$ T	55 cm	0 cm	0.5 $\mu$ T	60 cm	0 cm	0.3 $\mu$ T	0.9 $\mu$ T

**Table 2: EMF values measured for lab equipment in Physics Lab in Computer Science and Engineering department in Southeast University (SEU), March 2016.**

Serial No.	Equipment info. (Machine #, Machine Model, made country, year made, Date of installation)	Threshold dis. in front of the equipment measured from the centre of the equipment (cm)		Magnetic Field (mG) in front of the eqpt.	Threshold dis. at right side of the equipment (cm)		Magnetic Field (mG) at right side of the equipment	Threshold distance at the left side of the equipment (cm)		Magnetic Field (mG) at left side of the equipment	Magnetic Field maximum (mG)
		EF	MF		EF	MF		EF	MF		
2a	DC power supply Model: SAKO SK1730SL 2A Made:	11.7	57.4	4.0 $\mu$ T	18.1 cn	84.8 cm	22.6 $\mu$ T	16 cm	30.7 cm	16.1 $\mu$ T	22.6 $\mu$ T

	China										
2b	DC power supply Model: SAKO SK1730SL 2A Made: China	12.8	66.8	4.9 $\mu$ T	17.3 cm	93.7 cm	25.0 $\mu$ T	14.1 cm	44.2 cm	21.5 $\mu$ T	25.0 $\mu$ T
2c	DC power supply Model: SAKO SK1730SL 2A Made: China	10.2	31.9	4.4 $\mu$ T	14.0 cm	57.9 cm	15.7 $\mu$ T	13.5 cm	32.3 cm	16.8 $\mu$ T	16.8 $\mu$ T

**Table 3: EMF values measured for lab equipment in Digital Logic Design (DLD) Lab in Computer Science and Engineering department in Southeast University (SEU), March 2016.**

Serial No.	Equipment info. (Machine #, Machine Model, made country, year made, Date of installation)	Threshold dis. in front of the equipment measured from the centre of the equipment (cm)		Magnetic Field (mG) in front of the eqpt.	Threshold dis. at right side of the equipment (cm)		Magnetic Field (mG) at right side of the equipment	Threshold distance at the left side of the equipment (cm)		Magnetic Field (mG) at left side of the equipment	Magnetic Field maximum (mG)
		EF	MF		EF	MF		EF	MF		
3a	Oscilloscope Model: GWINSTEK GOS-620 Made: China	0	47.3	0.2 $\mu$ T	6.3	13.4	6.1 $\mu$ T	1.5	0	1.4 $\mu$ T	6.1 $\mu$ T
3b	Oscilloscope Model: GWINSTEK GOS-620, 20 MHz Made: China	0	24	0.2 $\mu$ T	9.5	31.6	4.4 $\mu$ T	6	24.5	1.3 $\mu$ T	4.4 $\mu$ T
3c	Function Generator Model: GWINSTEK GFG-8215A	10.7	20.1	2.9 $\mu$ T	7.5	10.5	2.6 $\mu$ T	24.1	39.2	6.7 $\mu$ T	6.7 $\mu$ T

3d	Function Generator Model: GWINSTEK GFG-8215A	10.6	14.5	2.6 $\mu\text{T}$	4.5	6.6	2.1 $\mu\text{T}$	11.5	15.6	3.0 $\mu\text{T}$	3.0 $\mu\text{T}$
3e	Function Generator Model: GWINSTEK GFG-8215A	10	27	1.8 $\mu\text{T}$	6.5	*	2.2 $\mu\text{T}$	12.7	*	2.6 $\mu\text{T}$	2.6 $\mu\text{T}$
3f	Function Generator Model: GWINSTEK GFG-8215A	5	34.3	2.0 $\mu\text{T}$	4.5	*	2.2 $\mu\text{T}$	12.9	*	3.0 $\mu\text{T}$	3.0 $\mu\text{T}$
3g	Photocopy Machine Gente MP1900	0	32.3	0.2 $\mu\text{T}$	11.2	*	0.7 $\mu\text{T}$	34.2	*	0.9 $\mu\text{T}$	0.9 $\mu\text{T}$
3h	DC power supply Model: KOOUCU-1502DD	8	47.7	6.7 $\mu\text{T}$	8.7	*	35.4 $\mu\text{T}$	10.6		9 $\mu\text{T}$	35.4 $\mu\text{T}$
3i	DC power supply Model: KOOUCU-1502DD	5.7	8.0	9.9 $\mu\text{T}$	5.2	7.7	O.L.a bove 600 mG	7.2	12.8	14.2 $\mu\text{T}$	O.L.
3j	DC power supply Model: KOOUCU-1502DD	6.5	9	9.6 $\mu\text{T}$	6	8.5	O.L.a bove 600 mG	7	14	15.6 $\mu\text{T}$	O.L.
3k	DC power supply Model: DAZHENG PS-305D Made: China	14.2	23.2	33.4 $\mu\text{T}$	12.1	77.5	57.4 $\mu\text{T}$	24	*	34.6 $\mu\text{T}$	57.4 $\mu\text{T}$
3l	DC power supply Model: DAZHENG PS-305D Made: China	12.5	16.2	35.5 $\mu\text{T}$	11.7	41.1	20 $\mu\text{T}$	19	*	29 $\mu\text{T}$	35.5 $\mu\text{T}$
3m	DC power supply Model: DAZHENG PS-305D Made: China	15.1	32.0	48.2 $\mu\text{T}$	16.2	51.5	100 $\mu\text{T}$	17.3	29.4	100 $\mu\text{T}$	100 $\mu\text{T}$
3n	DC power supply	11.7	14.0	7.6 $\mu\text{T}$	17.0	30.0	100 $\mu\text{T}$	14.6	21.7	100 $\mu\text{T}$	100 $\mu\text{T}$

	Model: DAZHENG PS-305D Made: China										
3o	DC power supply Model: DAZHENG PS-305.D Made: China	13.7	34.1	26.6 μT	14.1	22.0	100 μT	11.9	16.0	100 μT	100 μT

**ANALYSIS**

In Table 1, 2 and 3, experimental data were collected from the following labs: serial nos. 1a-1i from Computer Lab-3, serial nos. 2a-2c from Physics lab, and serial nos.3a-3o from Digital Logic Design (DLD) Lab respectively. Lab equipment of various labs were measured for their Electric field and Magnetic field threshold distances as well as the magnetic field values (i) in front of the equipment measured from the centre of the equipment (ii) at right side of the equipment and (iii) at left side of the equipment. Also, the maximum magnetic fields were measured for the equipment of these labs. The “\*” sign indicates that the threshold distance was above recommended level and out of range. O.L. means overload.

In Physics lab, there was enough space for taking the EF and MF readings without any problem. In DLD lab, all the lab equipment were close to each other. For this reason, it was difficult to get the required values of EF and MF of each

equipment. Also, in DLD lab, it was difficult to measure the right/left side of the instruments because they were situated beside the switch board that can disrupt taking the reading. In computer lab, (i) as two LCD PCs were close to each other, it was difficult to get the required value of EF and MF of each PC (ii) as some PCs were situated beside the pillar, there were some problems to measure EF reading.

**DISCUSSION**

It was found from the results that the magnetic field values are much higher than the threshold level. Reading from equipment showed the maximum magnetic field to be 600 mG and from air conditioners, the maximum magnetic field value was 25 mG. Air compressors had the maximum magnetic fields (600 mG) and electric balance had the lowest (9 mG). Because of the nature of the wiring, both in the ceiling and floor, all the rooms had higher magnetic field than threshold value. Students work on an average of 3-6 hours a day in those labs. We have decided to

include labs from other departments of Southeast University for further study along the same lines.

There has been an increase in use of air conditioners in Bangladesh during the last few years in various offices and organizations to increase the work efficiency of the employees. Load shedding has increased tremendously in the last few years as air conditioners are used increasingly more in offices, organizations and private homes.

## CONCLUSION

From the above lab results, it has been found that in most cases, the magnetic field has crossed threshold value. The electric field also has a higher threshold value in some of the equipment. The magnetic field exposure was as high as 600 mG in some cases. To reduce this, wiring must be done according to the building code 2012. If the air conditioners are installed on the wall close to the roof, the resultant distance from the students eliminates the electromagnetic hazards. It is hoped that this paper will be helpful as a corrective and preventive measure for students and employees of Southeast University.

## REFERENCES

- I. Electric and Magnetic Fields (EMF) Duke Energy. [https://www.duke-energy.com/pdfs/emf\\_brochure.pdf](https://www.duke-energy.com/pdfs/emf_brochure.pdf) (accessed on 21.3.2016)
- II. N. Wertheimer and E. Leeper. Electrical wiring configurations and childhood cancer. *American journal of Epidemiology*. 1979, vol. 109, no. 3, pp. 273-284.
- III. S. Milham. Mortality from leukaemia in workers exposed to electrical and magnetic fields. *New English J Med*. 1982, vol. 307, pp.249.
- IV. H. Repacholi. An Overview of WHO's EMF Project and the Health Effects of EMF Exposure. *Proceedings of the International Conference on Non-Ionizing Radiation at UNITEN (ICNIR 2003), Electromagnetic Fields and Our Health*.2003;1-13.
- V. Nordenson, K.H. Mild, G. Andersson, M. Sandström. Chromosomal aberrations in human amniotic cells after intermittent exposure to fifty hertz

- magnetic fields. Bioelectromagnetics. 1994; 15, 293-301, 1994.
- VI. D.A. Savitz, & Calle. Leukemia and occupational exposure to electromagnetic fields. Journal of Occupational Medicine. 1987; Vol 29, pp. 47-51.
- VII. Savitz. Childhood cancer and electromagnetic field exposure. Journal of Epidemiology. 1988; Vol. 128, pp. 21-38.
- VIII. D.E. Beischer and R.E. Mitchell. Exposure of man to Magnetic Fields Alternating at Extremely Low Frequency. Aerospace Medical Research Laboratory. Pensacola, Florida, USA.
- IX. F.S. Perry. Environmental power-frequency magnetic fields and suicide. Health Physics. 1981; 41, pp. 267-277.
- X. T.A. Marks, C.C. Ratke, WO. English. Stray voltage and developmental, reproductive and other toxicology problems in dogs, cats and cows: a discussion. Vet Hum Toxicol. 1995 Apr; 37 (2):163-72.
- XI. H.P. Schwan, and K.R. Foster. RF-field interactions with biological systems. Proceedings of the Institute of Electrical & Electronics Engineering. 1980; 68, 104-113.
- XII. M. Quamruzzaman, M. Haque. Epidemiological Survey of People Working in EMF Field Exposed to High Frequency. Proceedings of the Global Engineering, Science and Technology Conference 2012, 28-29 December, Dhaka, Bangladesh.
- XIII. M. Haque, M. Quamruzzaman. Epidemiological survey on effect of EMF emitted by photocopy machines generally used in Dhaka city Bangladesh. IJRET: International Journal of Research in Engineering and Technology. 2015; 4(4): 92-100.
- XIV. M. Haque, M. Quamruzzaman. Survey of EMF emitted by Lab equipment in various labs of Southeast University in Bangladesh for possible preventive health hazards. IFRSA International

- Journal Of Electronics Circuits And Systems. 2015; 4(1): 26-32.
- XV. M. Quamruzzaman, M. Haque, F. Ahmed, M.S.Zaman. Effects of electromagnetic fields (EMF) near high voltage transmission line: a case study. Bangladesh Journal of Medical Physics. 2014; 7(1): 66-68.
- XVI. M. Haque, M. Quamruzzaman. Non Ionizing Radiation (NIR), its harmful effects especially from Mobile/Cell Phone and Towers. Southeast University Journal of Science and Engineering.2014; 8(1).
- XVII. M. Haque, M. Quamruzzaman. Survey on Effect of EMF Emitted by CRT Computer Monitors in Bangladesh. Universal Journal of Electrical and Electronic Engineering 2015; 3(5): 149-158.
- XVIII. M. Haque, M. Quamruzzaman. Survey of EMF emitted by Lab equipment in Pharmacy labs of Southeast University in Bangladesh. International Journal of Research in Engineering and Technology (IJRET), 2015; 4(9): 13-17.
- XIX. Cornet ED78S EMF RF Meter ElectroMagnetic Detector (2015) <http://www.radmeters.com/Cornet-ED78S-ep.html> and [http://www.amazon.com/Cornet-ED78S-Meter-ElectroMagnetic-Detector/dp/B00P67QLA0/ref=sr\\_1\\_1?s=industrial&ie=UTF8&qid=1458266517&sr=1-1&keywords=Cornet](http://www.amazon.com/Cornet-ED78S-Meter-ElectroMagnetic-Detector/dp/B00P67QLA0/ref=sr_1_1?s=industrial&ie=UTF8&qid=1458266517&sr=1-1&keywords=Cornet) (accessed on 21.3.2016)