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MEASUREMENT OF MAGNETIC FIELD EMITTED FROM LAB EQUIPMENT AND ELECTRICAL APPLIANCES IN ETE LABS OF DAFFODIL INTERNATIONAL UNIVERSITY, BANGLADESH

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ABSTRACT

The aim of this survey is to investigate whether the Electromagnetic Fields (EMF) emitted from various lab equipment and air conditioners and switch boards affect the students, faculties and employees. There is a standard threshold value recommended by WHO for both electric and magnetic fields. Electro-Magnetic Field also named Non Ionizing Radiation is emitted from high power transmission lines, computer monitor/video display unit, radio waves of different frequencies, telecommunication, satellite, radar etc. which causes health hazards to living system and environment. There has not been much study performed in Bangladesh. The data were collected from various Electronics and Telecommunication Engineering (ETE) department labs at Daffodil International University in Dhaka, Bangladesh. Threshold values of Magnetic fields are measured for various lab equipment, air conditioners and switchboards. The maximum value of the magnetic field results showed that in many cases the magnetic field radiated from the different sources are greater than the threshold limit, which are the main point of our findings.

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

1.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 a 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. Since magnetic field is more harmful than electric field, there must be a limit both in the residential and occupational levels between 0.2 to 0.3 µT or 2.5 mG. (This value is internationally recognized as standard limit in many countries). Also, for 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/cm2, 195V/m in U.S.A. and 0.1 mW/cm2, 20 V/m in CIS). These human made electric and

magnetic fields (typically 25 V/m and 2.5 mG or 0.25 μT) are substantially above the naturally occurring ambient electric and magnetic fields of 10-4 V/m and 10-13 T respectively[1-2].

Lower animals are reported to be very much sensitive to electromagnetic fields. It is observed that animals like rats make their living brooding holes away from the high electric field and bees block-up their hives in the chronic presence of NIR/EMF. As a consequence, scientists and health physicians in developed countries have become aware of the effects of NIR [3]. 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 [4].

Much research has been performed in this regard. Most recently, Epidemiological survey of people working in EMF field exposed to high frequency have been investigated [5]. Also, research was performed for epidemiological survey on effect of EMF emitted by photocopy machines generally used in Dhaka city Bangladesh [6]. Survey was done on EMF emitted by Lab equipment in various labs of Southeast University in Bangladesh for possible health hazards [7]. A case study was done on EMF near high voltage transmission line [8]. Also, a review was done on Non Ionizing Radiation (NIR), its harmful effects especially from Mobile/Cell Phone and Towers [9]. An epidemiological survey was performed on CRT monitors used in Dhaka city [10]. An investigation was performed in finding the magnetic field emitted from various Lab equipment in Textile Labs in Southeast University [11]. Also, magnetic fields and threshold values of EF and MF were measured for CSE lab equipment in Dhaka Bangladesh [12]. Magnetic Field and threshold values of electric and magnetic fields were tested for various air conditioners and switchboards of EEE classrooms of a University in Bangladesh [13]. Health Effects of EMF Emitted from cell phones has been investigated [14].

There have been various papers published on EMF of radio, TV etc. but not much on Air Conditioners (AC). Since the invention of modern electrical air conditioning unit in 1902 by Willis Carrier, Buffalo, New York [15] there has been tremendous increase in use of air conditioning in the world. In some cases it has been used in cooling the building, theatres, and for commercial purposes. Since air conditioner has been used for comfort, its demand has increased. After the invention of portable air conditioners, it has been easier to purchase one. Especially in tropical countries like Bangladesh, it is in high demand not only at offices, but at homes also. With the increase in the efficiency of the modern air conditioners as well as the attractive decrease in its price, offices and private homes have their own air conditioner systems. At Daffodil International University, all the offices, labs and classrooms have air conditioners due to very hot and humid weather during the summer. Each office, labs and classrooms have one or multiple switchboards. The students spend around 7-8 hours each day in these classrooms and labs while the faculties and employees also do the same. The aim of this research is to investigate whether the EMF emitted from these air conditioners and switchboards are within threshold values and also if the students and employees are safe from these equipment.

2. MATERIALS AND METHODS

A Cornet ED78S EMF RF Meter Electro Magnetic Detector [16] was used for measuring the magnetic field values for the 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 to cover all around the equipment. The method followed was: at the centre of the equipment (front side), right side, at left side of the equipment.

Figure 1: Electrosmog RF/LF Field Strength power meter Dual mode RF power meter & LF gauss meter ED-78S measuring magnetic field in front of air conditioner (left image) and the COGHILL FIELD MOUSE measuring the EF and MF threshold values (see green lights). Green lights indicate the EF and MF both threshold have reached. (Right image).

3. RESULTS

Findings at different EMF sources: All the readings were taken from different labs of Electrical and Telecommunication Engineering (ETE) department, Daffodil International University Dhaka. Readings were taken from lab equipment and air conditioning units and the switchboards of each lab. Electric Field (EF) and Magnetic Field (MF) threshold values and magnetic field values of each lab equipment and electrical appliances were taken.

Table 1: EMF values measured for lab equipment, air conditioners and switchboards in ETE lab in Daffodil International University (DIU), August2016. Lab location address: Main building Analog Electronics Lab, Room no: 504.Analog Electronics Lab

SRNO.	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)
		Electric field (EF)	Magnetic field (MF)		EF	MF		EF	MF		
1	Daffodil pc, LCD monitor	45	*	20	15	*	25 mG	blocked	*	20 mG	25
2	Ami90, CRT monitor	33	*	100	Althrough red	*	62 mG	blocked	*	10 mG	100
3	Switch board	150	*	60	9	*	150 mG	blocked	*	blocked	150
4	AC, Diu/M/4th/R-504/w-01	6	*	6	30	*	25 mG	blocked	*	26 mG	26
5	AC,Diu/M/4th /R-504/w-02	14	*	41	27	*	blocked	blocked	*	15 mG	41
6	Ac power supply	60	*	10	16	*	3.5 mG	blocked	*	1.6 mG	10

Table 2: EMF values measured for lab equipment, air conditioners and switchboards in ETE lab in Daffodil International University (DIU), August 2016. Main building, Room no: 505: Digital Electronics Lab

SR 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)
		Electric field (EF)	Magnetic field(MF)		EF	MF		EF	MF		
1	AC, Diu/M/4th/R-505/w-01	30	*	5	blocked	*	blocked		*	7 mG	8.5
2	Switch board	15	*	14	blocked	*	30		*	5 mG	13
3	AC, Diu/M/4th/R-505/w-02	25	*	10	blocked	*	blocked		*	5 mG	9.5
4	Ami90, CRT monitor	75	*	12	blocked	*	20 mG		*	5 mG	8.7
5	Daffodil pc, LCD	70	*	4	blocked	*	blocked		*	blocked	6.1
6	Signal generator	Right indicator always red, left is green at 70 cm	*	10 mG	blocked	*	30 mG	blocked	*	blocked	35
7	Oscilloscope, AL210, YOKOGAWA	Left indicator is green at 50 cm, right indicator althrough green.	*	180 mG	blocked	*	4 mG	blocked	*	10 mG	190
8	DC power supply	Both indicator are green at 60 cm	*	80 mG	blocked		100 mG	blocked		30 mG	87

Table 3: EMF values measured for lab equipment, air conditioners and switchboards in ETE lab in Daffodil International University (DIU), August 2016. Lab location address: Main building, room no: 506. Electrical Circuit Lab

Sr 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		
1	Trainer Board AT-700 portable analog/digital laboratory	0.4mG 6 cm	*	0.5 mG	4.5mG 18 cm	*	4.5 mG	1 mG 15 cm	*	5 mG	4.5
2	Oscilloscope AL210 20 MHZ	168cm	*	8.5 mG	5 cm	*	13.1 mG	12 cm	*	16.5mG	16.5
3	Function generator 5 MHZ MFG-8205A	224cm	*	5.1	closed	*	6.3 mG	56 cm	*	30.4mG	30.4
4	CRTpc monitor Daffodil	79 cm	*	49.5 mG	closed	*	16.9 mG	closed	*	8.5mG	49.5
5	Switch Board	54 cm	*	25.5 mG	closed	*	22.5 mG	closed	*	11.5mG	25.5

Table 4: EMF values measured for lab equipment, air conditioners and switchboards in ETE lab in Daffodil International University (DIU), August 2016. Lab location address: Main building, room no: 507. Communication Engineering Lab

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		
1.	EMONA Telecoms Trainer 101	0 cm (Green signal)	*	3 mG	Closed	*	3.6 mG	33 cm	*	17.9 mG	17.9 mG
2.	CRT pc monitor Daffodil	0 cm (Green signal)	*	15.7 mG	closed	*	3.9 mG	7 cm	*	12.5 mG	15.7 mG
3.	Microwave Communication Base	0 cm (Green signal)	*	6.6 mG	closed	*	4.1 mG	closed	*	6.3 mG	6.6 mG
4.	AC, DIU/M/4th /R-507/w-01	30 cm	*	10 mG	closed	*	10	closed	*	12	20
5.	Switch board	75 cm	*	60 mG	closed	*	30 mG	closed	*	25	70

Table 5: EMF values measured for lab equipment, air conditioners and switchboards in ETE lab in Daffodil International University (DIU), August 2016. Lab location address: Main building, room no: 508.DSP and Microprocessor Lab

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		
1	AC DIU/M/4th/R-508/W-01 LG Gold	45 cm	*	12 mG	closed	*	2.5 mG	closed	*	5.5 mG	12
2	CRT pc monitor Daffodil 7002FD	33 cm	*	15.5mG	64 cm	*	5 mG	0.7mG 39 cm	*	6.5 mG	15.5
3	Daffodil pc Model-W901OSI Widescreen LCD monitor	0 cm (Green signal)	*	30 mG	closed	*	2.4 mG	closed	*	15 mG	30
4	Microprocessor Kit Model: 8086	8 cm	*	7.5 mG	closed	*	7.1 mG	closed	*	7.2 mG	7.5

3.1 EMF Measurements from lab room 504

In Table 1, experimental data of EMF values measured for lab equipment, air Conditioner and switch board were collected from the Analog Electronics Lab room 504.The "*" sign indicates that the threshold distance was above recommended level and out of range. In all case, the threshold values of the magnetic fields showed red all through, indicating it was above recommended value and out of range. For the switchboard, the EF threshold values also were above recommended value and out of range. AC, switchboard, PC-HD and CRT monitor were tested for their Electric field and Magnetic field threshold distances as well as the magnetic field values for (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 each equipment and electrical appliances of this lab.

3.2 EMF Measurements from lab room 505

In Table 2, experimental data of EMF values measured for lab equipment, air Conditioner and switchboard were collected from the Lab room 505. The "*" sign indicates that the threshold distance was above recommended level and out of range. In all case, the threshold values of the magnetic fields showed red all through, indicating it was above recommended value and out of range. Except for in front of equipment in all cases, the EF threshold values on right and left sides also were above recommended value and out of range. Air conditioner (AC), switchboard, AC Function generator, Oscilloscope, Ami90 and trainer boardwere tested for their Electric field and Magnetic field threshold distances as well as the magnetic field values for (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 each equipment and electrical appliances of this lab.

3.3 EMF Measurements from equipment of room 506

In Table 3, experimental data of EMF values measured for lab equipmentand switchboard were collected from the Lab room 506. This is a newly developed lab and so the air conditioner has not yet been setup/installed in this lab. The "*" sign indicates that the threshold distance was above recommended level and out of range. In all cases, the threshold values of the magnetic fields showed red all through, indicating it was above recommended value and out of range. Switchboard, Function generator, Oscilloscope, personal computer (PC) and trainer board were tested for their Electric field and Magnetic field threshold distances as well as the magnetic field values for (i) in front of the equipment measured from the center 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 each equipment and electrical appliances of this lab. For some equipment, the EF threshold values for right side and some for left side were not obtained (closed) as there were an obstacle (wall, pillar or other equipment).

3.4 EMF Measurements from equipment of room 507

In Table 3, experimental data of EMF values measured for lab equipment and switchboard were collected from the Lab room 507. This is a newly developed lab and so the air conditioner has not yet been setup/installed in this lab. The "*" sign indicates that the threshold distance was above recommended level and out of range. In all cases, the threshold values of the magnetic fields showed red all through, indicating it was above recommended value and out of range. In all cases, the EF threshold values were green all through meaning zero distance, which was good indication. EMONA Telecoms trainer, microwave communication base and CRT PC monitor were tested for their Electric field and Magnetic field threshold distances as well as the magnetic field values for (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 each equipment and electrical appliances of this lab. For all equipment, the EF threshold values for right side was not obtained (closed) as there were an obstacle (wall).

3.5 EMF Measurements from equipment of room 508

In Table 3, experimental data of EMF values measured for lab equipment and switchboard were collected from the Lab room 507. The "*" sign indicates that the threshold distance was above recommended level and out of range. In all cases, the threshold values of the magnetic fields showed red all through, indicating it was above recommended value and out of range. In all cases, the EF threshold values were green all through meaning zero distance, which was good indication. Air conditioner, microprocessor kit, CRT PC monitor, LCD monitor were tested for their Electric field and Magnetic field threshold distances as well as the magnetic field values for (i) in front of the equipment measured from the center 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 each equipment and electrical appliances of this lab. For LCD pc monitor and microprocessor

kitequipment, the EF threshold values for right and left side were not obtained (closed) as there was an obstacles (wall and equipment).

4. DISCUSSIONS

It was found from the results that the magnetic field values are much higher than the threshold level. 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 3-4 hours a day in those labs. We have in mind to include labs and classrooms from other departments of Daffodil International University for the study to continue.

There has been an increase of use of the air conditioners in Bangladesh for the last few years in various offices and organizations to increase the working efficiency of the employees. For this reason, the load shedding of electricity has increased tremendously for the last few years due to excessive air conditioner used in offices, organizations and private homes for comfort living.

5. CONCLUSION

From the above classroom and substation, generator 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. Also, the magnetic field maximum exposure was nearly 50 mG in one case. Wiring must be done according to the building code 2012. As the locations of air conditioners were on the wall near to the roof, therefore because of this height (distance) students they do not possess that much hazards as it should be. It is hoped that this survey will be helpful as a preventive health measure for students and employees of Daffodil International University.

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