EMF RESEARCH AT THE UNIVERSITY OF MALAYA

(*KAJIAN-KAJIAN SAINTIFIK BERKAITAN MEDAN ELEKTROMAGNET YANG TELAH DILAKUKAN)*

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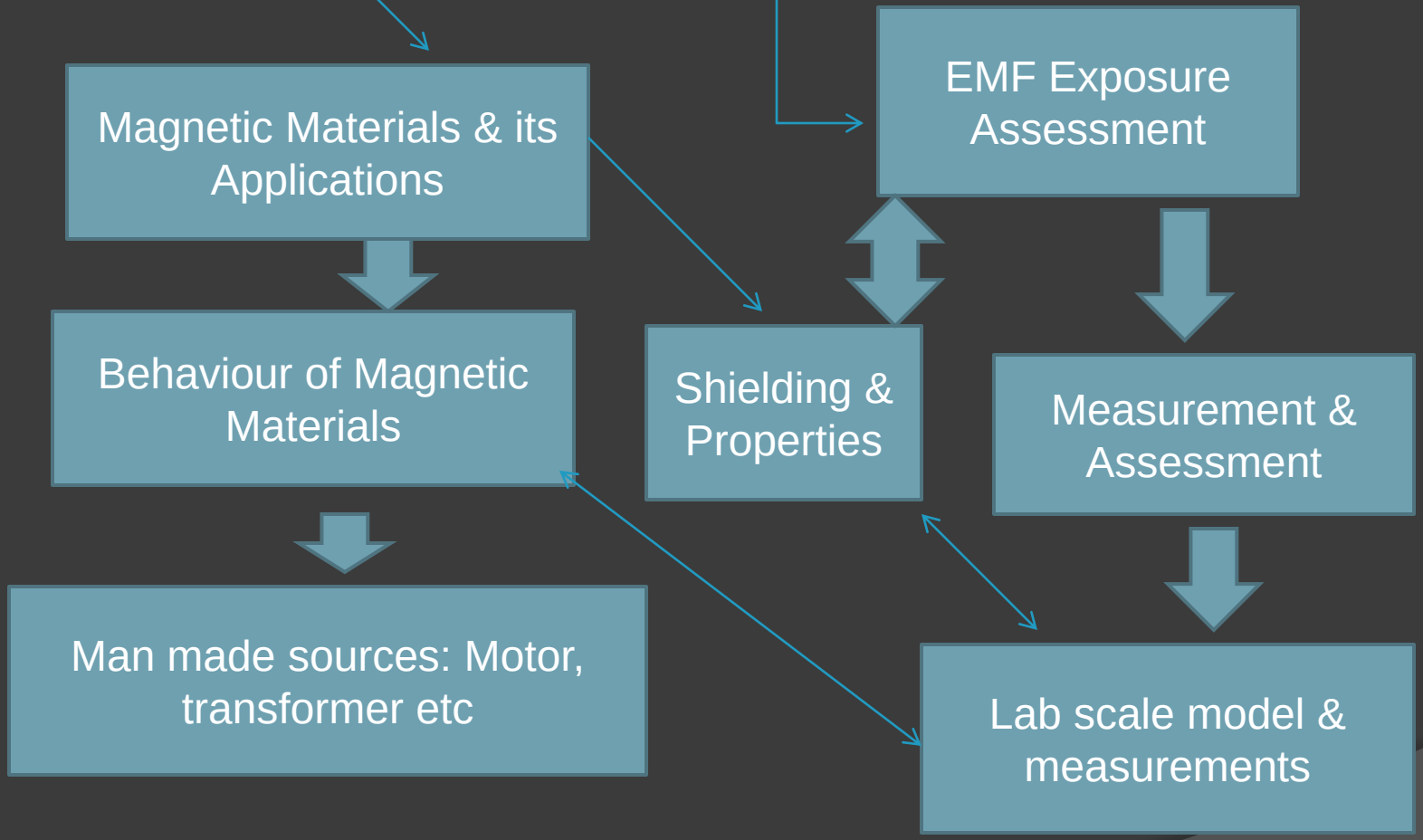
EMF Research



Exposure Assessment

Source Identification

Measurement Method

Assessment & Analysis

Validation between Simulated & Measured Values

Magnetic field exposure at U.M service substations UMRG Long Term Grants (2009-2010)

The objectives:

- To determine the safety levels of service substations which located at various faculties of UM.
- The criteria for the EMF measurements are:

  a.> stand alone substation

  b.> in-building substation

  c.> Transformer specifications

Sources of EMF in UM

a.) Stand Alone Distribution S/S

b.) In-building Distribution S/S

c.) Oil Insulation Type Transformer

ELF Exposure Measurements in UM

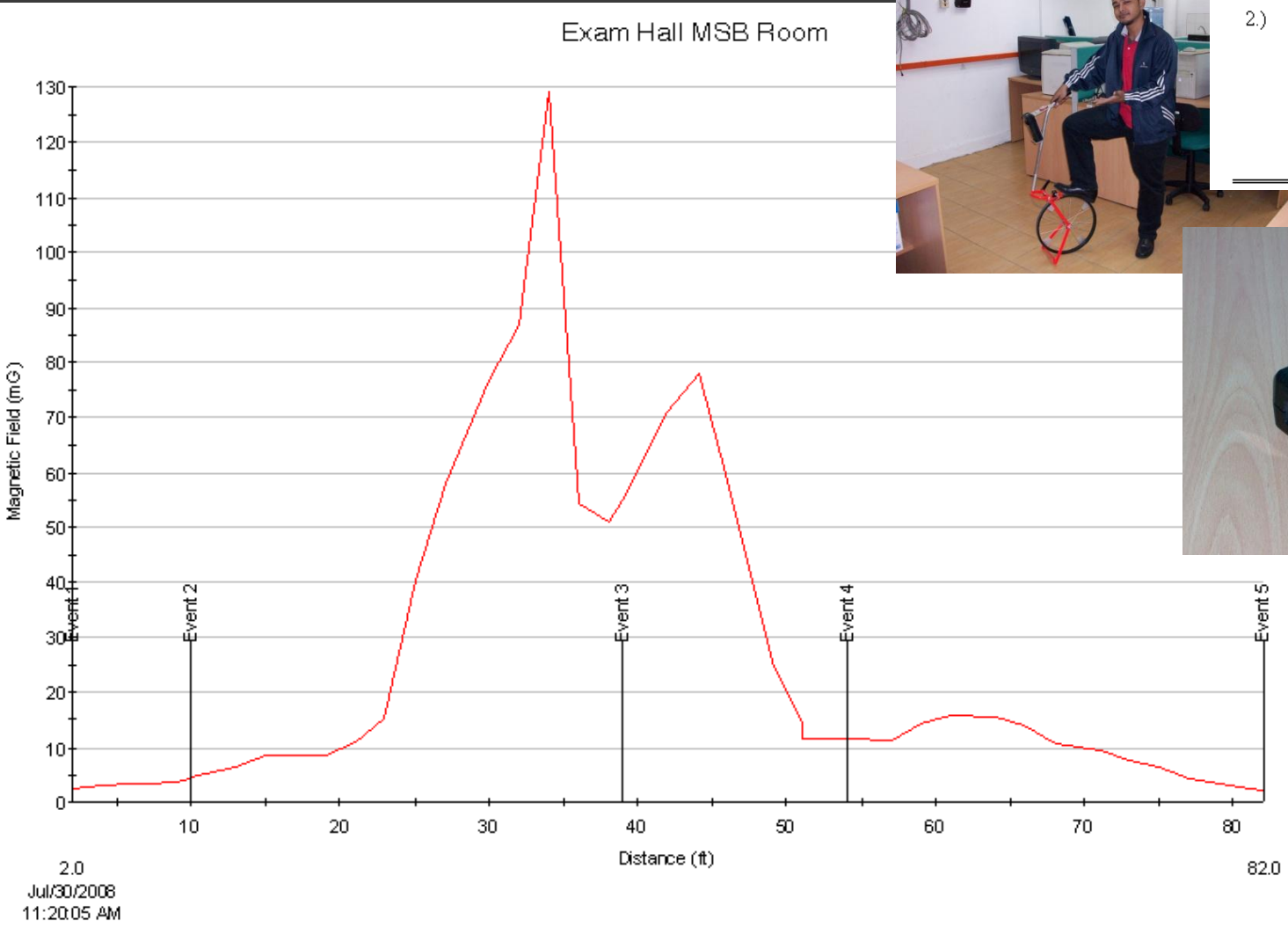
	Faculties and General Buildings	No. of Substations	Days/Hours	Remarks
a.	Faculty of Engineering	5	half day (3 to 4 hours)	Start at 11:00 a.m to 3:00 p.m
b.	Faculty of Built Environment	1	half day (3 to 4 hours)	Start at 11:00 a.m to 3:00 p.m
c.	Faculty of Medicine & Dentistry	5	half day (3 to 4 hours)	Start at 11:00 a.m to 3:00 p.m
d.	Faculty of Science	6	half day (3 to 4 hours)	Start at 11:00 a.m to 3:00 p.m
e.	Faculty of Economics	3	half day (3 to 4 hours)	Start at 11:00 a.m to 3:00 p.m
f.	Faculty of Languages & Linguistics	1	half day (3 to 4 hours)	Start at 11:00 a.m to 3:00 p.m
g.	Faculty of Art & Social Science	2	half day (3 to 4 hours)	Start at 11:00 a.m to 3:00 p.m
h.	Faculty of Education	1	half day (3 to 4 hours)	Start at 11:00 a.m to 3:00 p.m
i.	Faculty of Business & Accounting	1	half day (3 to 4 hours)	Start at 11:00 a.m to 3:00 p.m
j.	Faculty of Computer Science & Information Technology	2	half day (3 to 4 hours)	Start at 11:00 a.m to 3:00 p.m
k.	Faculty of Law	1	half day (3 to 4 hours)	Start at 11:00 a.m to 3:00 p.m
l.	Main Library	1	half day (3 to 4 hours)	Start at 11:00 a.m to 3:00 p.m
m.	Academy of Malay Studies (APM)	1	half day (3 to 4 hours)	Start at 11:00 a.m to 3:00 p.m
n.	Academy of Islamic Studies	1	half day (3 to 4 hours)	Start at 11:00 a.m to 3:00 p.m
o.	Institute of Postgraduate Studies (IGS)	1	half day (3 to 4 hours)	Start at 11:00 a.m to 3:00 p.m
p.	JPPHB	1	half day (3 to 4 hours)	Start at 11:00 a.m to 3:00 p.m
q.	Centre for Foundation Studies in Science	2	half day (3 to 4 hours)	Start at 11:00 a.m to 3:00 p.m
r.	Perdana Siswa Complex	1	half day (3 to 4 hours)	Start at 11:00 a.m to 3:00 p.m
s.	Great Hall of Chancellery	1	half day (3 to 4 hours)	Start at 11:00 a.m to 3:00 p.m
t.	Exam Hall	1	half day (3 to 4 hours)	Start at 11:00 a.m to 3:00 p.m
u.	Herbarium	1	half day (3 to 4 hours)	Start at 11:00 a.m to 3:00 p.m

Total = 39 s/s

ELF Measurement Tools

TABLE I
EQUIPMENT SPECIFICATIONS

No	Equipment	Details
1.)	Emdex Snap	3-Axis Magnetic Field Sensor Data Sampling Rate -1.5 sec. Field Range – 0.01 μT~100 μT
2.)	Emdex-II	3-Axis Magnetic Field Sensor Data Sampling Rate – 1.5 sec. Field Range – 0.01 μT~3 mT



UNIVERSITY OF MALAYA
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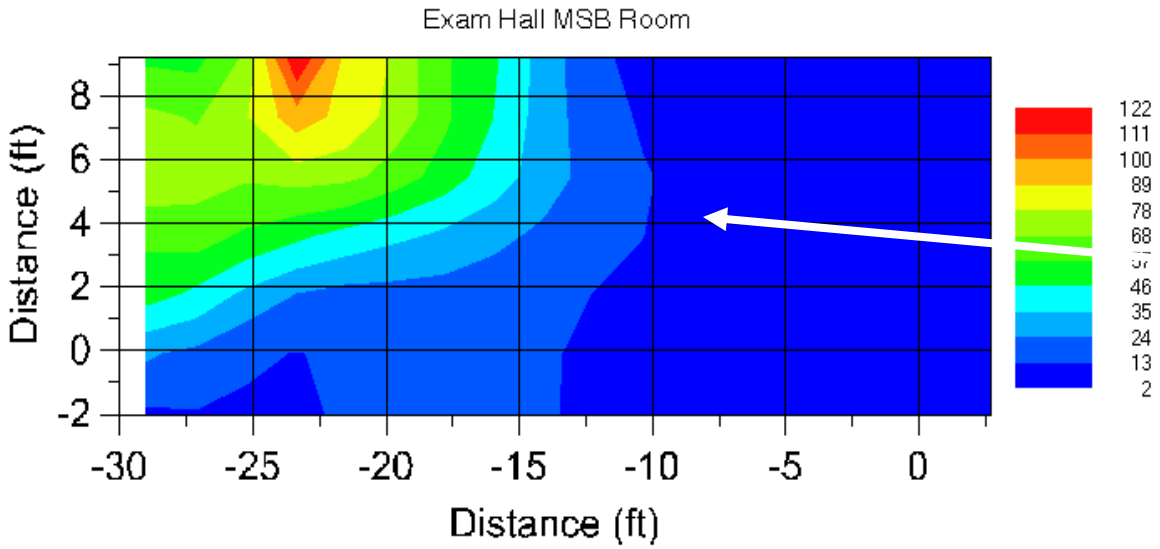
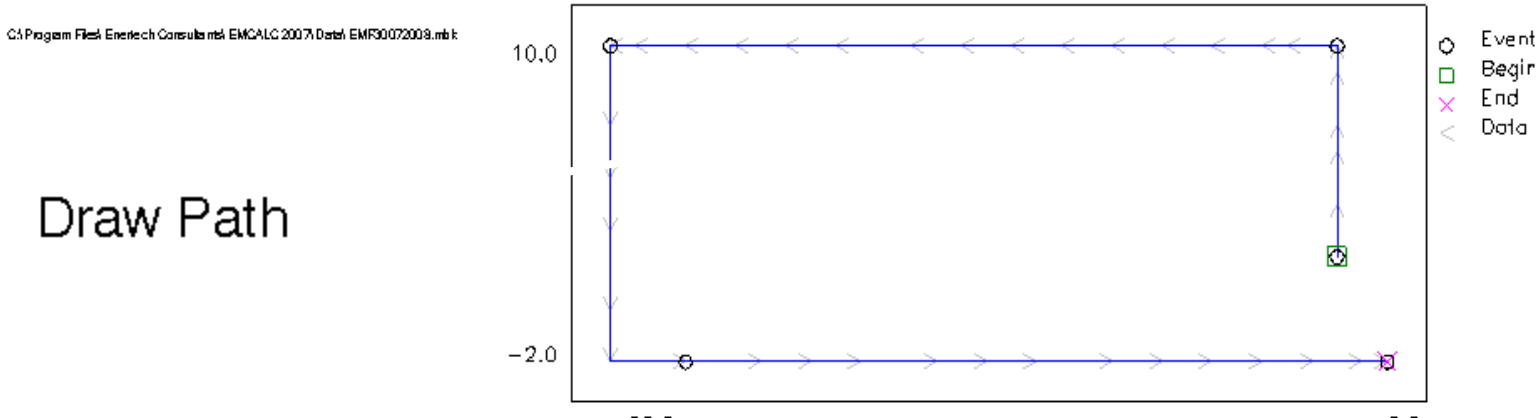
Results of magnetic exposure in high rise building



Contour Mapping



Draw Path

Measurement Results of S/s in UM Faculties

Faculty	Electrical room	Above 50 uT or 500mG
Faculty of Engineering & Built Environment	Tx and switchgear room: S/s Kej. Lama	115 uT or 1150 mG
	MSB room: S/s Kej Lama	80 uT or 800mG
	MSB room: S/s Fak.Kej.Kimia	65 uT or 650mG
Faculty of Medicine	Tx room A: S/s Medic 4	135 uT or 1350 mG
	Tx room B: S/s Medic 4	98 uT or 980 mG
	Tx room A: S/s Medic 5 (Pharmacy)	90 uT or 900 mG
	Switchgear room S/s Medic 4	80 uT or 800 mG
Faculty of Sciences	Switchgear room: S/s New Geology	73 uT or 730 mG
	MSB room: S/s Biochemistry	70 uT or 700 mG
	Tx A and Switchgear room: S/s Main Library	105 uT or 1050 mG
	Tx room: S/s Fac. Of Education	90 uT or 900 mG
	MSB room B: S/s Main Library	85 uT or 850 mG
	Tx room: S/s Fac. Of Art & Social Science	75 uT or 750 mG
	Tx room A: S/s Exam Hall	200 uT or 2000 mG
	Tx room B: S/s Exam Hall	140 uT or 1400 mG
	Tx room B: S/s KPS	130 uT or 1300 mG
	Switchgear room B: S/s P.Asasi Sains	110 uT or 1100 mG
	Switchgear room B: S/s Exam Hall	90 uT or 900 mG
	MSB room B: S/s KPS	80 uT or 800 mG
	Switchgear & Tx room B: S/s Canseleri	75 uT or 750 mG
	Tx room A: S/s API	145 uT or 1450 mG
	Switchgear room: S/s API	87 uT or 870 mG
	Tx room B: S/s API	85 uT or 850 mG
	Tx room:S/s Fsktm	68 uT or 680 mG
	Tx room: S/s Language & Linguistics	58 uT or 580 mG
	Switchgear room: Fsktm	55 uT or 550 mG

Significant s/s results will be undergone for 24hr measurements

Total of 16 S/s are above than 10uT or 100mG

(B.) Magnetic field exposure at high rise buildings

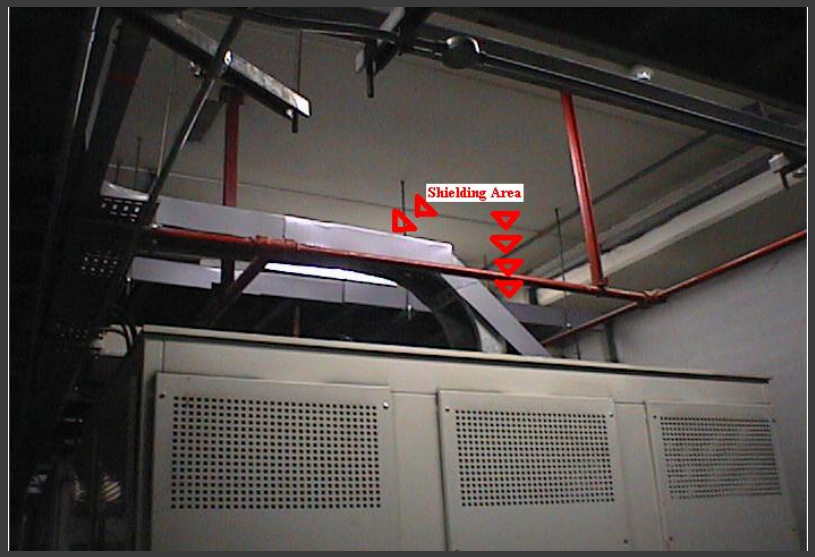
- To determine the levels of magnetic exposure from built-in substations at 15th floors of office building.
- The criteria for EMF investigations are:

  a.> Electromagnetic Interference

  b.> Built-In substation

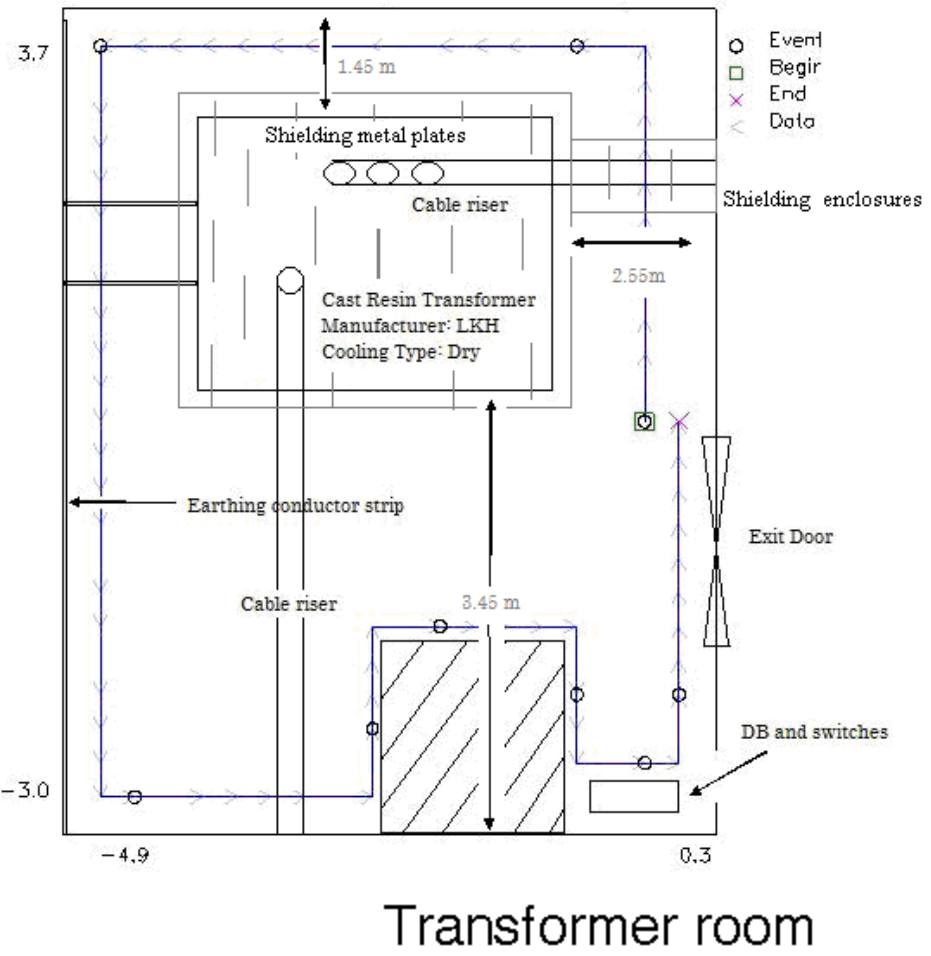
  c.> Transformer specifications

Cast Resin Transformer found in high rise building (Built-In substation)

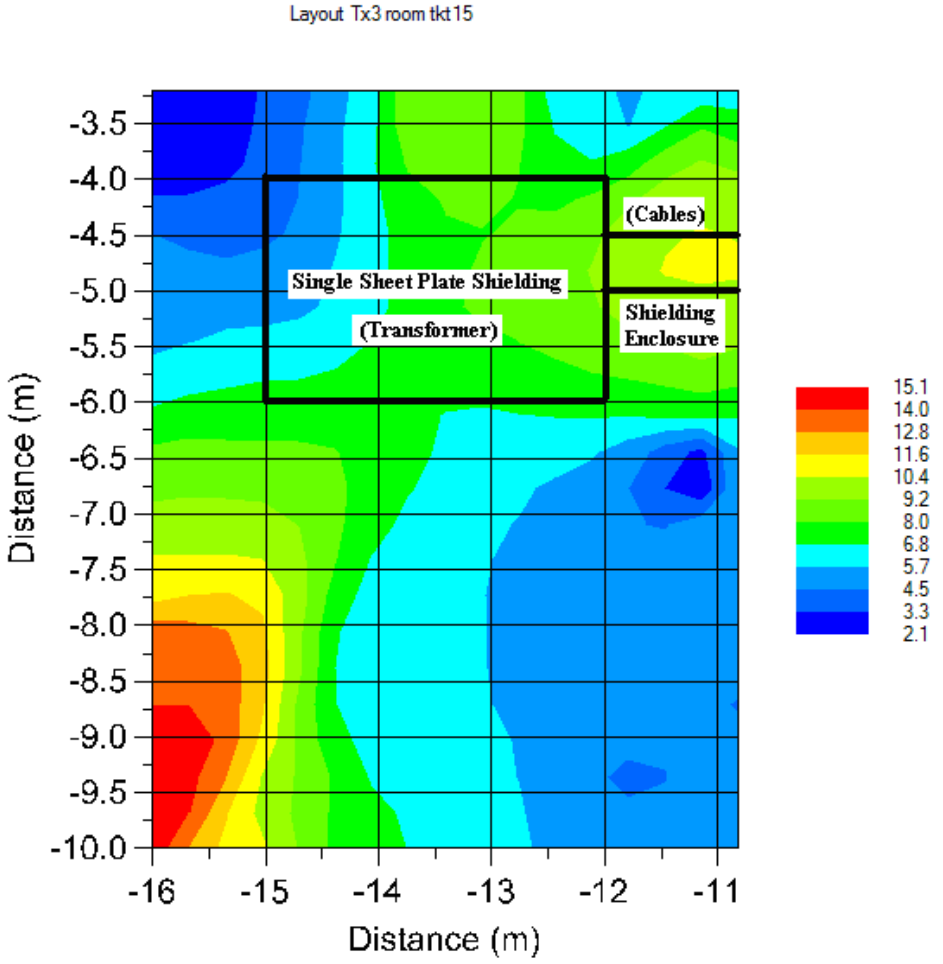


- **It is Dry Insulation Type Tx**
- **Used as indoor building substations in modern high rise buildings and commercial complexes**

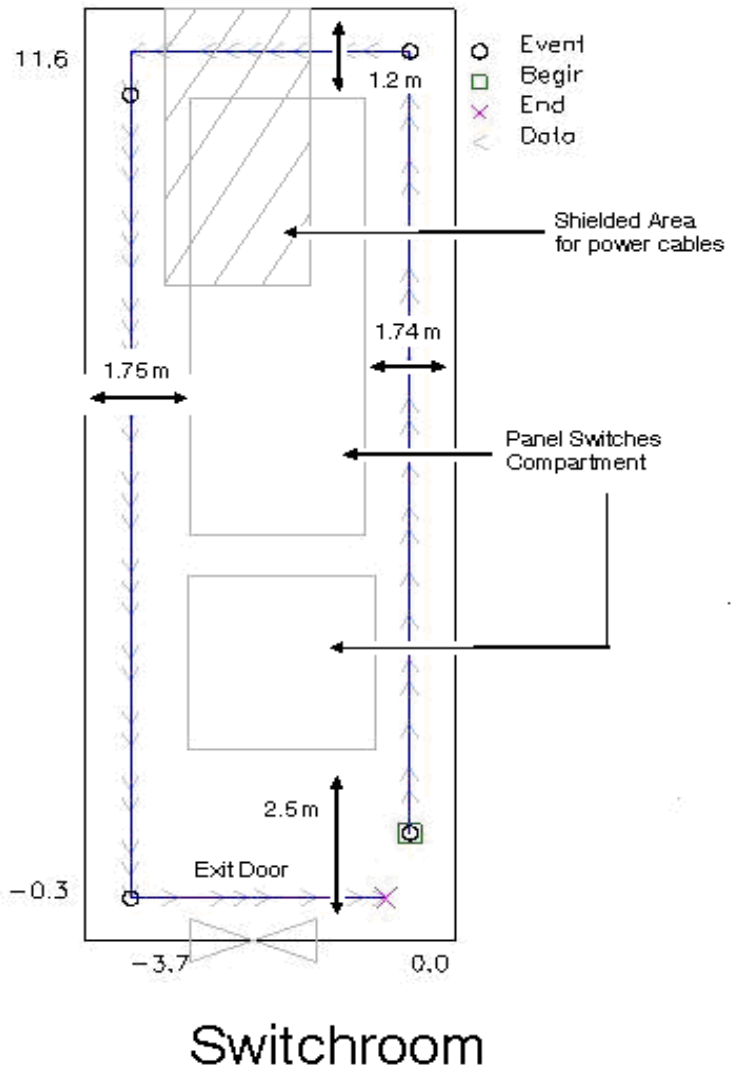
ELF Measurements in High Rise Buildings S/s (at 15th Floors)

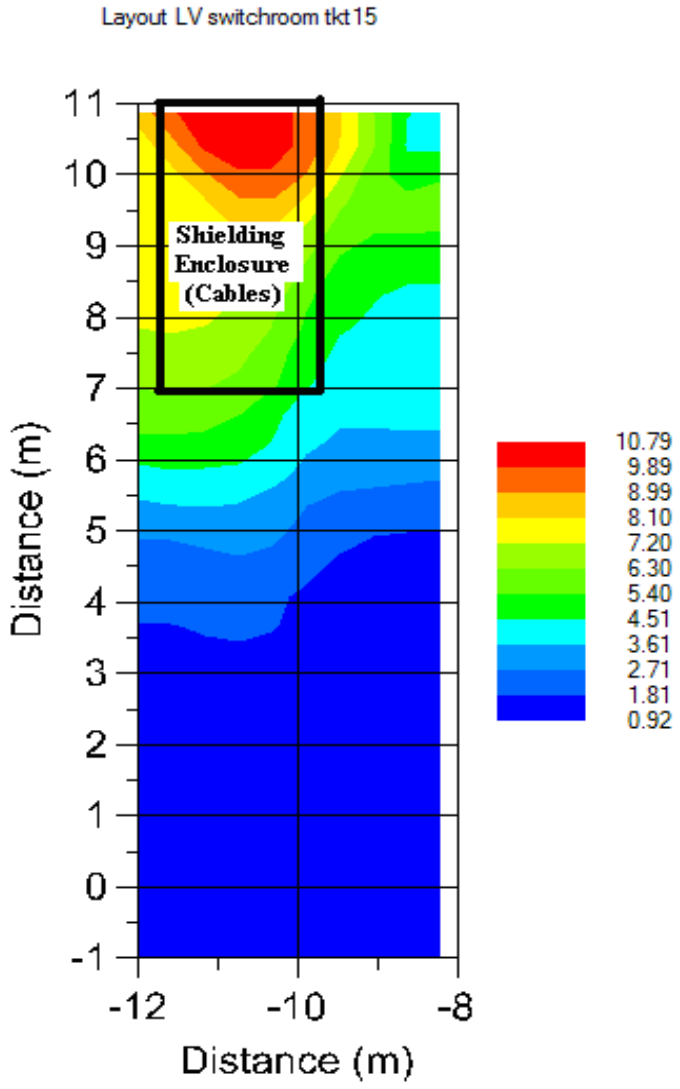


Transformer room



ELF Measurements in High Rise Building S/s (at 15th Floors)





C:\Program Files\Enertech Consultants\EMCALC 2007\Data\DBP 051208.mbk

(C.) Magnetic field exposure at Commercial Complex Buildings

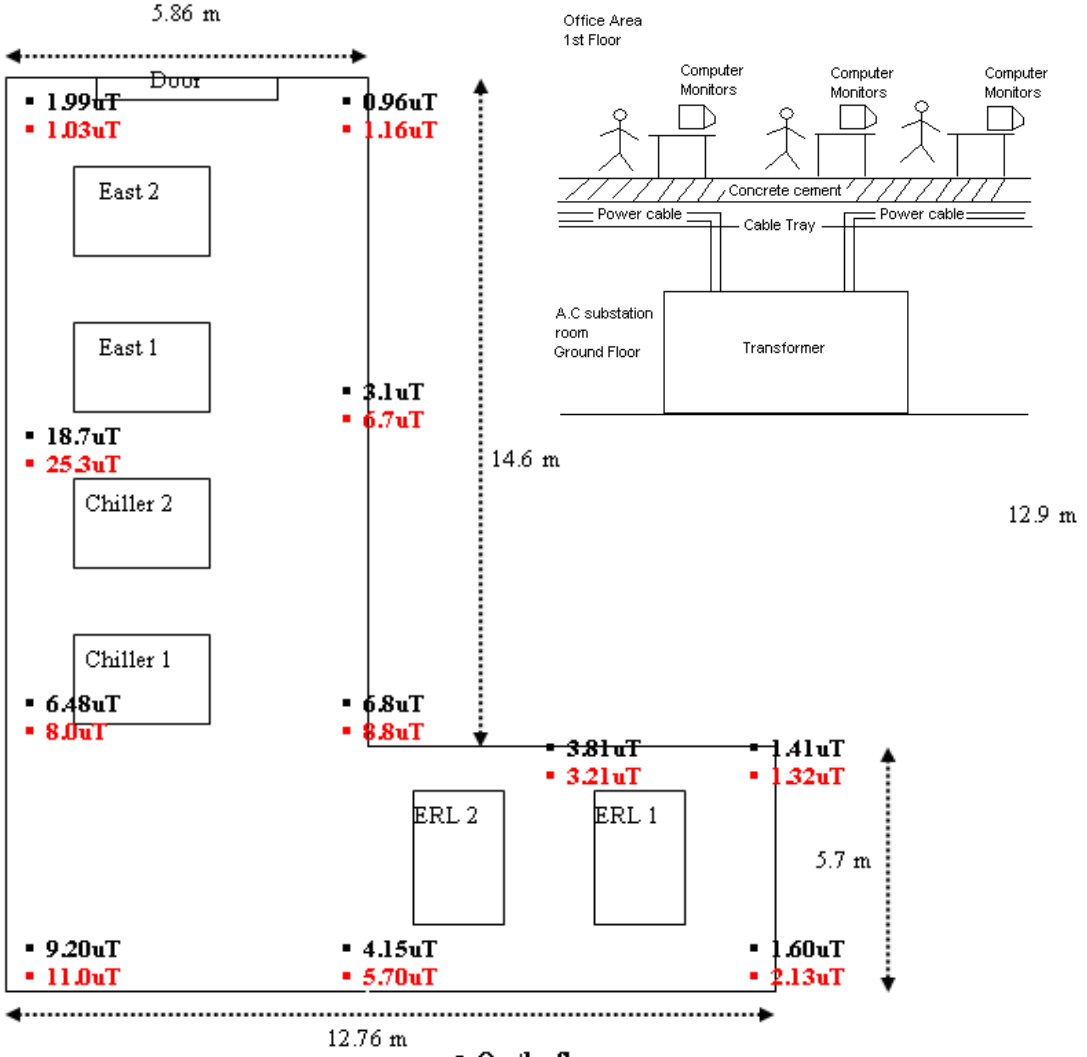
- To determine the levels of magnetic exposure from built-in substations at the operation counter of train office building.
- The criteria for EMF investigations are:

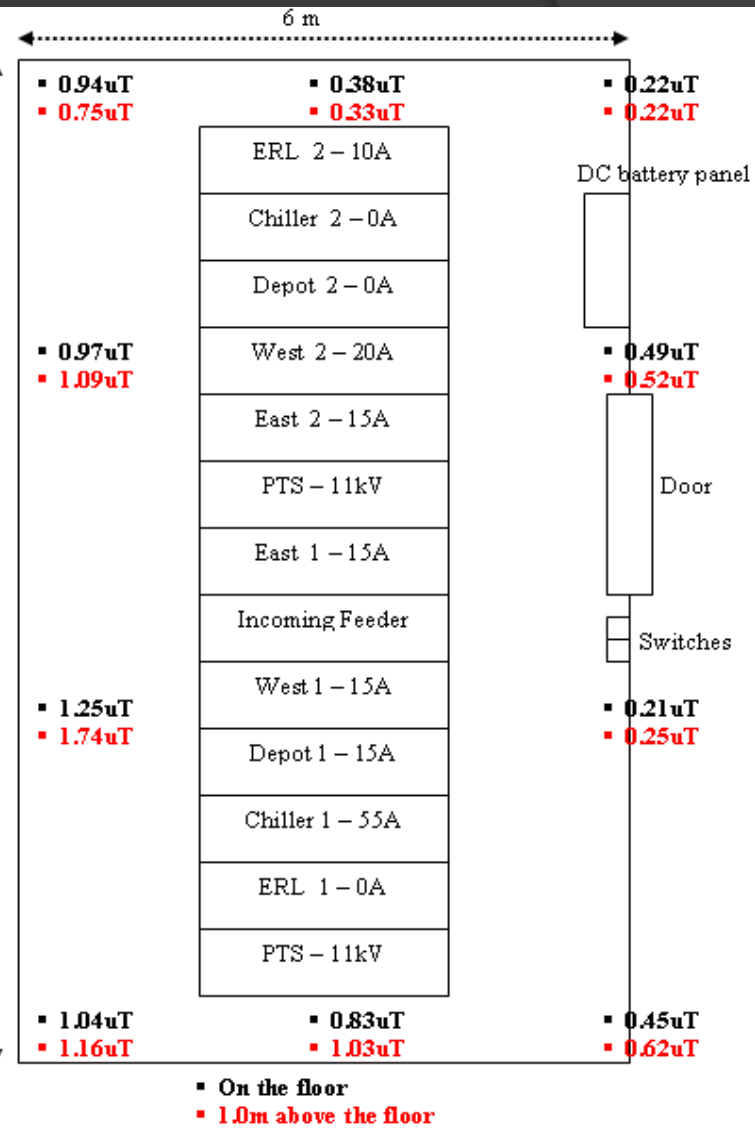
  a.> Electromagnetic Interference

  b.> Built-In substation

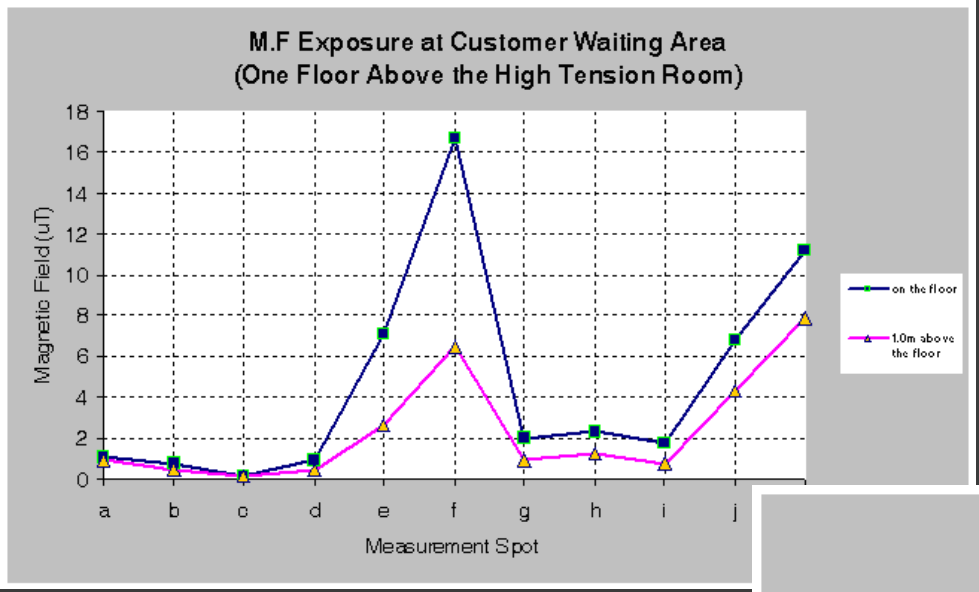
  c.> Transformer specifications

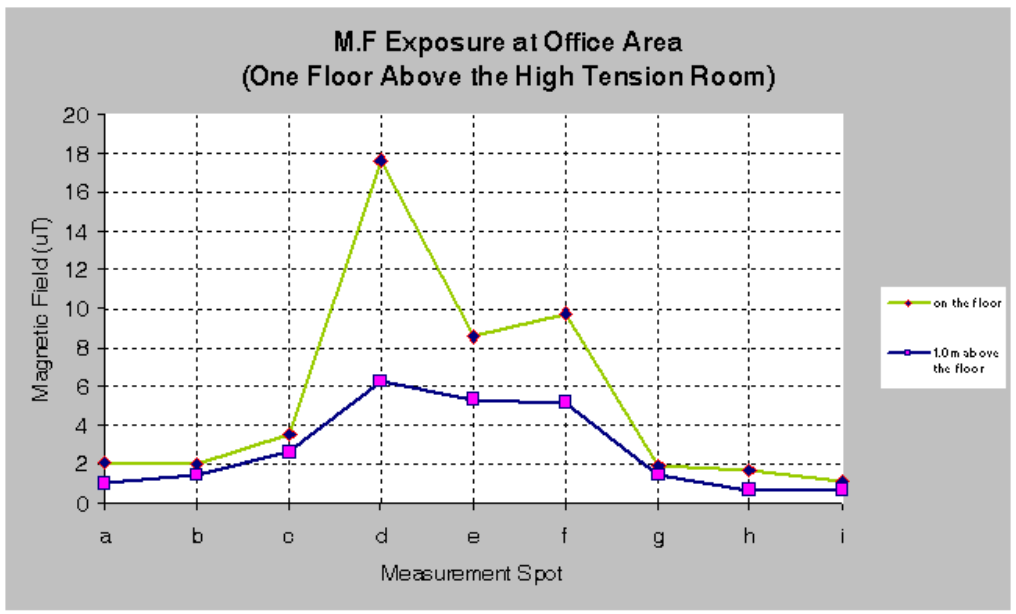
ELF Measurements in Commercial Complex Built-In Substn





ELF Results in Commercial Complex S/s





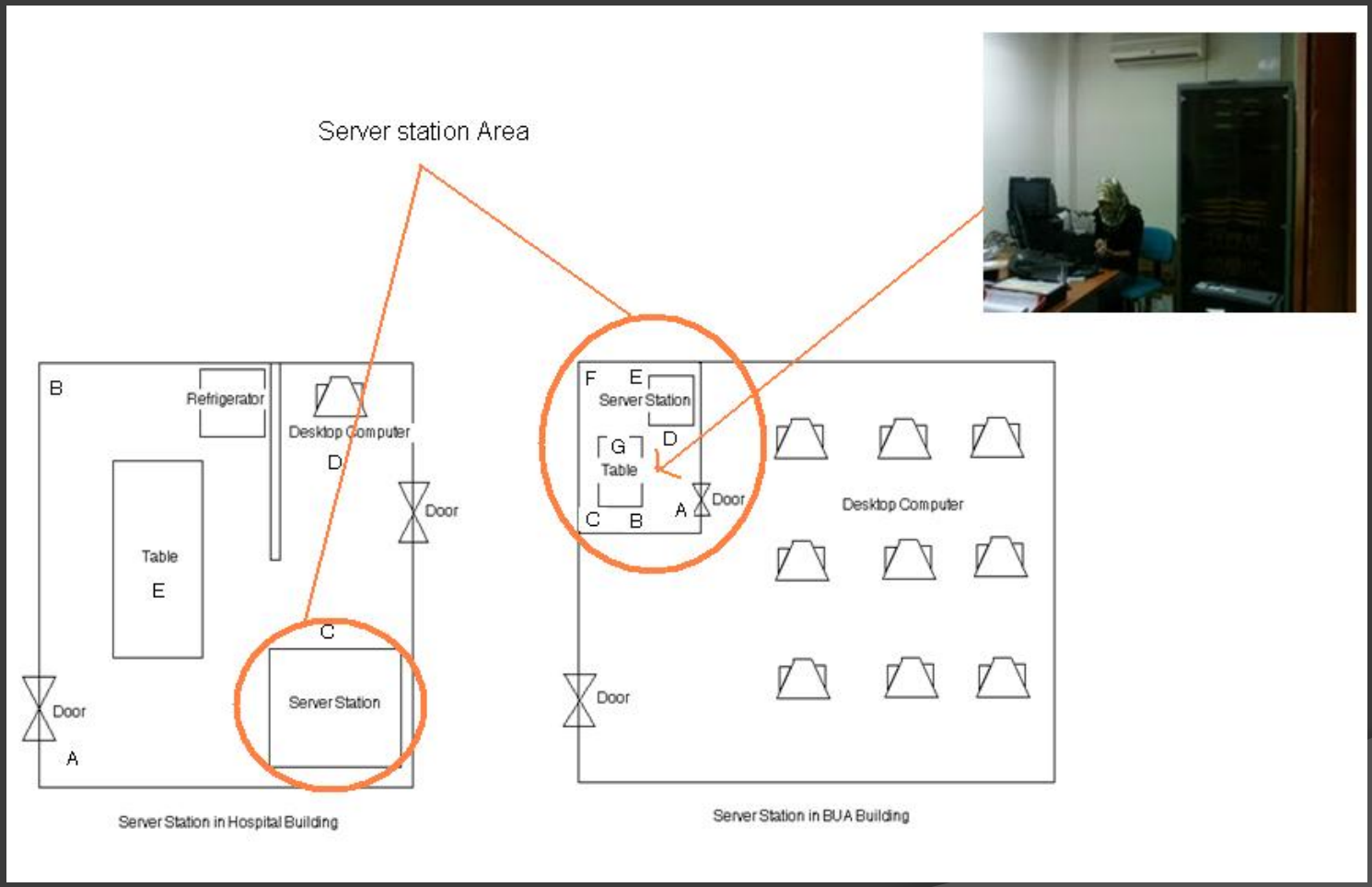
(D.) Magnetic Exposure from Computer Main-Server Station at Faculty of Dentistry, U.M

- To determine high emission EMF fields from the source of computer main server station which was allocated in the existing postgraduate study room level 2 of the Dental faculty Hospital Building and the computer laboratory at the Balai Ungku Aziz Building.
- The criteria of measurements are:

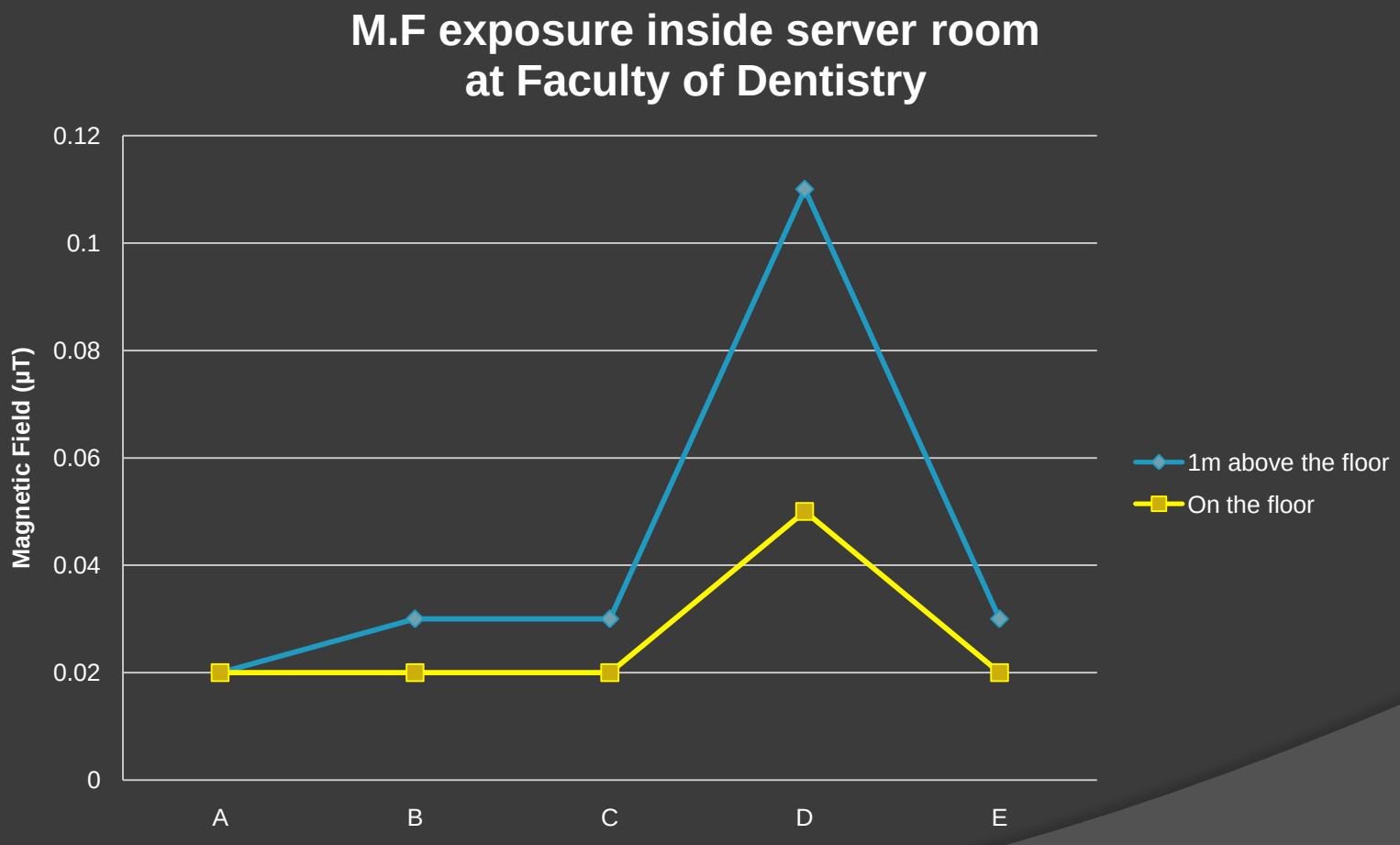
  a.> Safety level of magnetic field

  b.> Server devices specifications

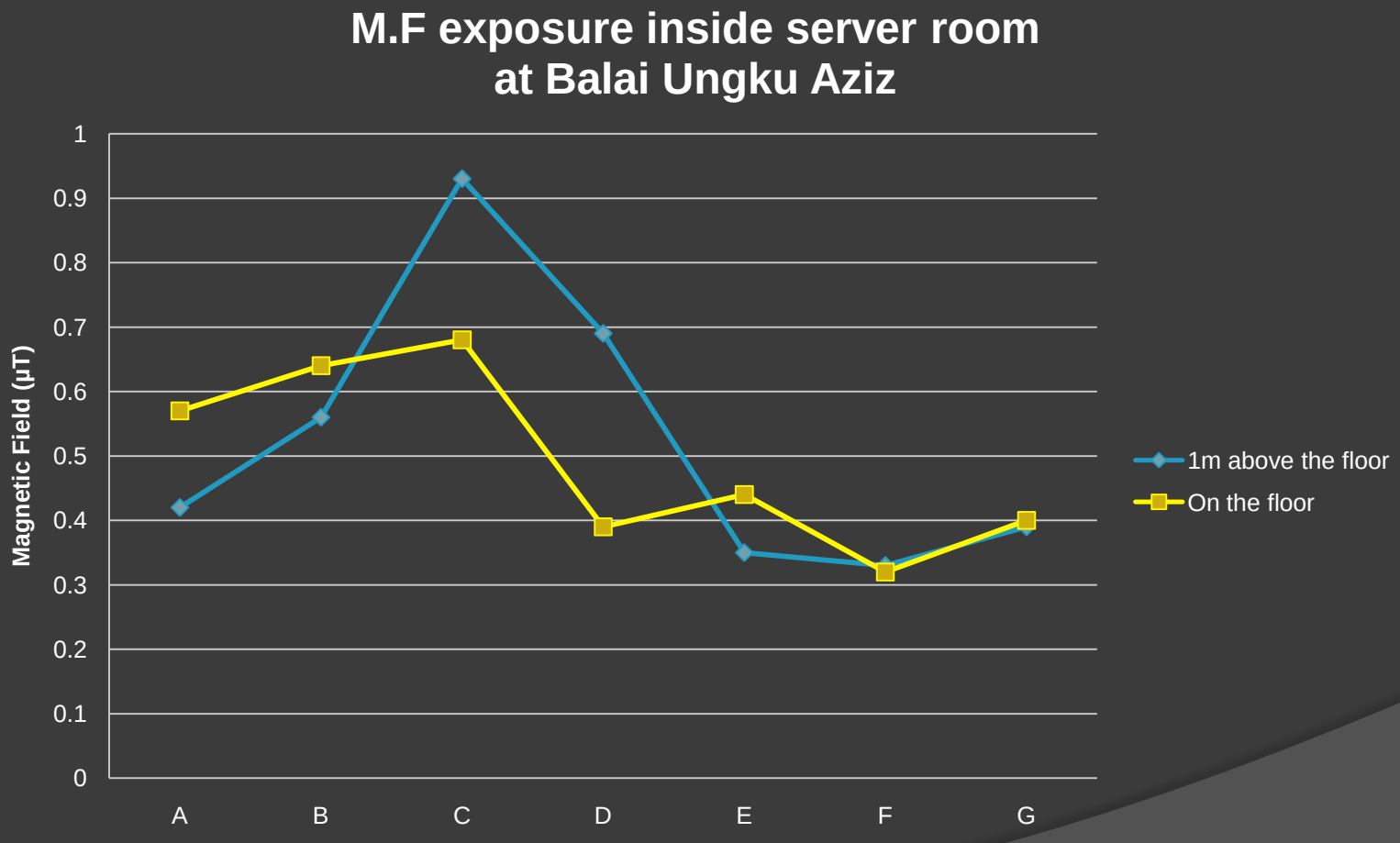
Measurement Layouts



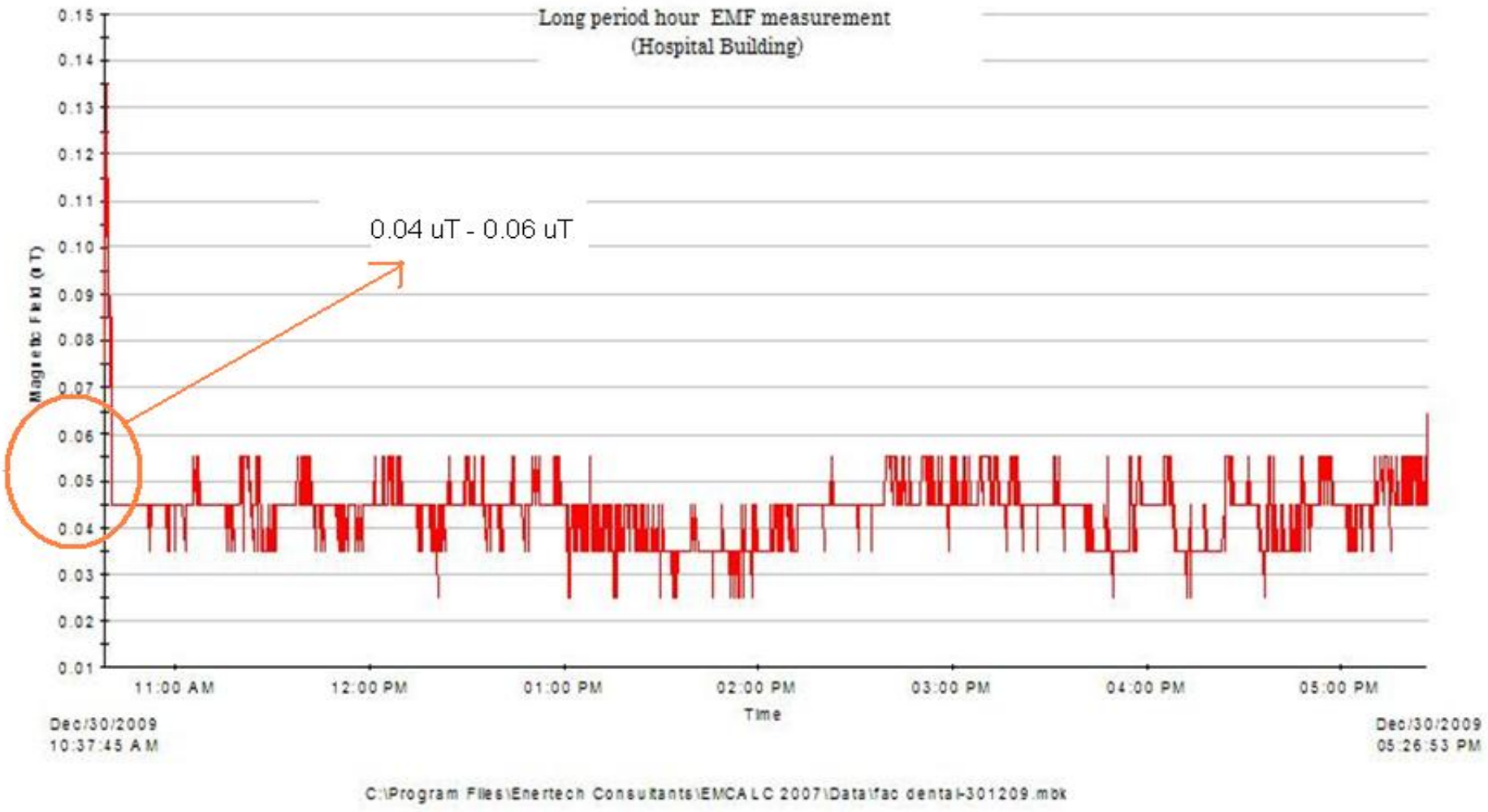
Magnetic Exposure Result Using Spot Measurements



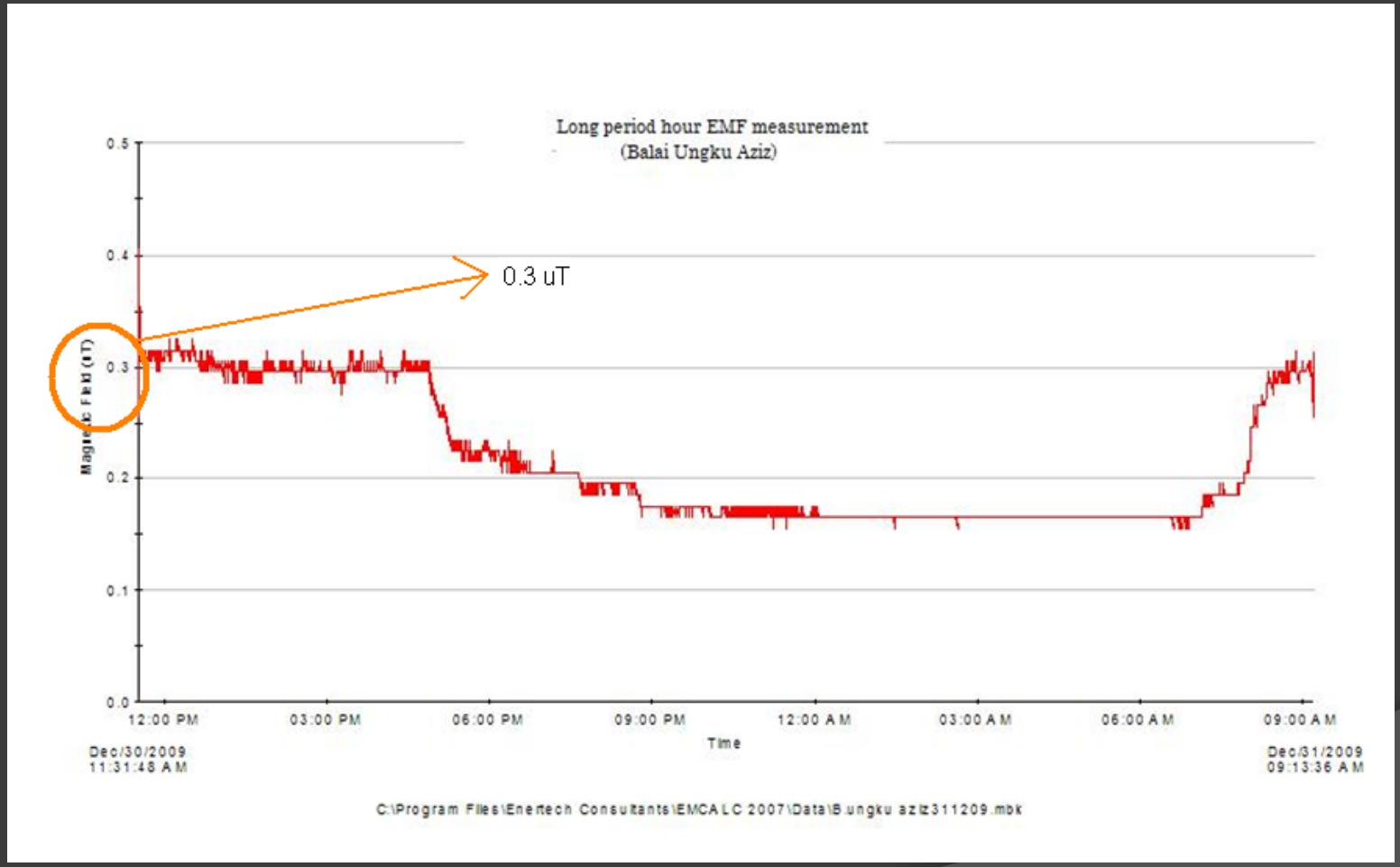
Magnetic Exposure Result Using Spot Measurements



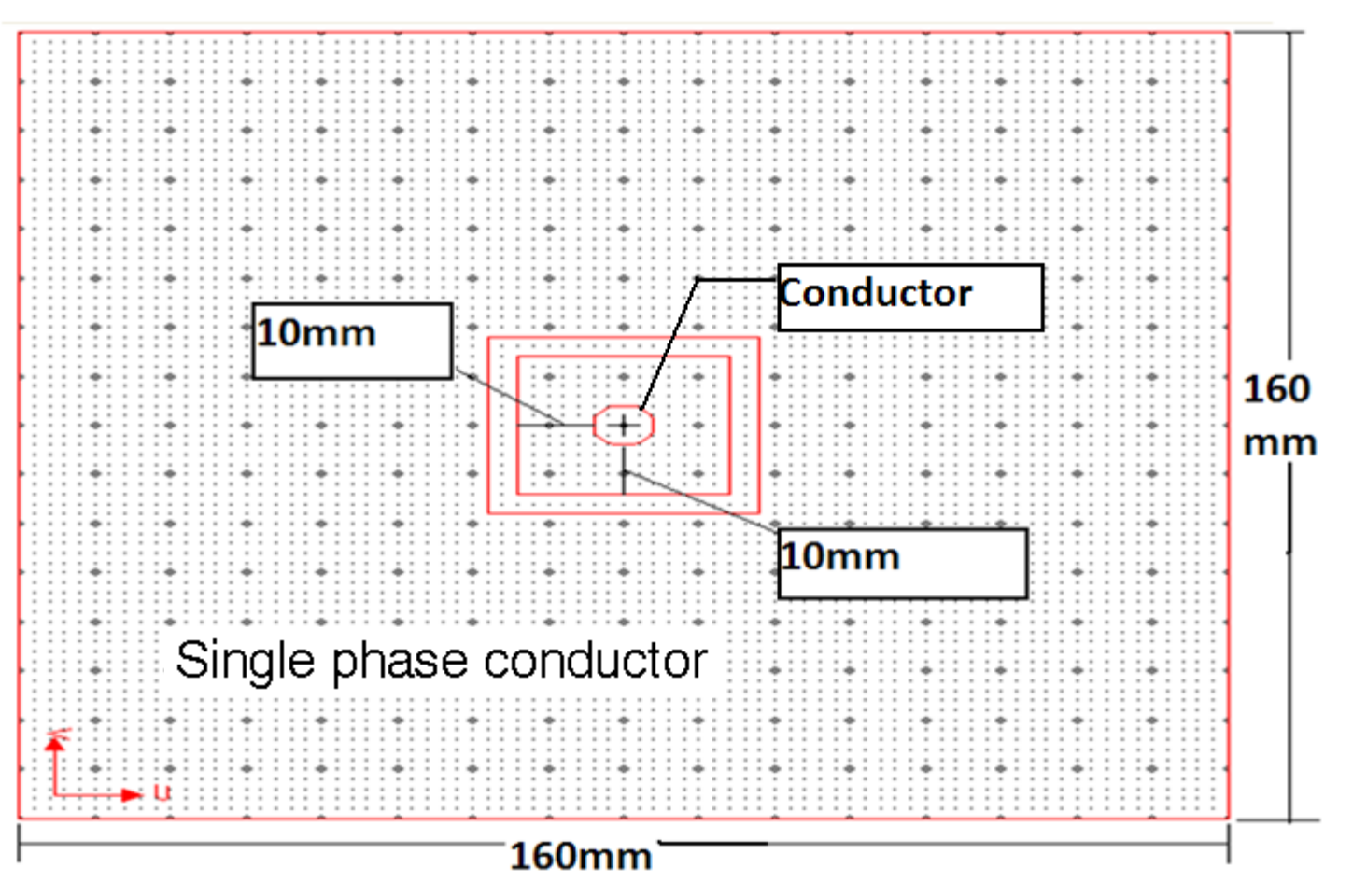
Magnetic Exposure With 24 hour Measurement



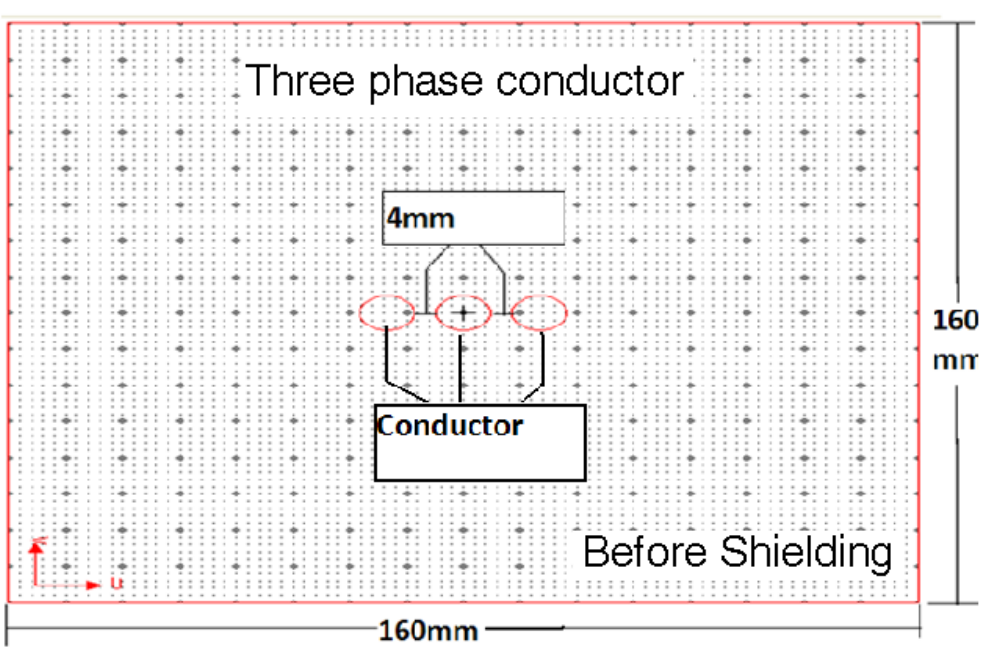
Magnetic Exposure With 24 hour Measurement

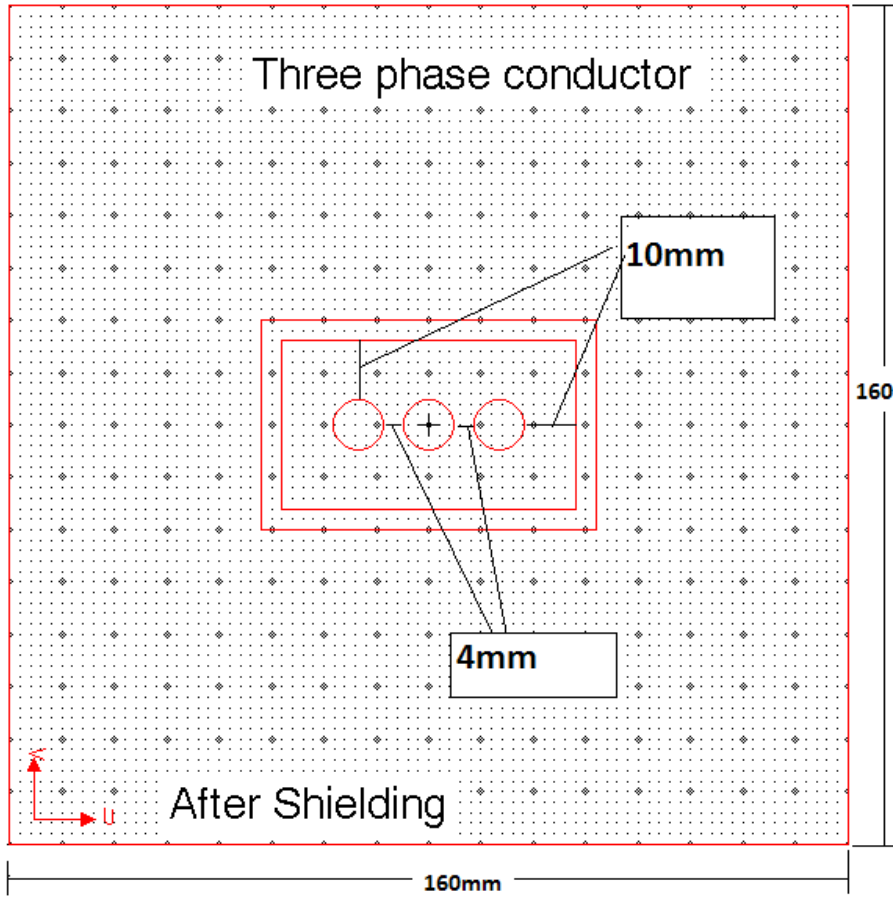


Modeling & Simulation using Finite Element Analysis Software



Modeling & Simulation using Finite Element Analysis Software





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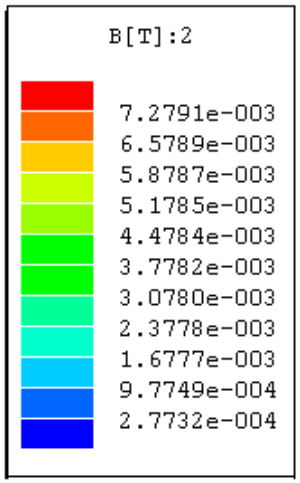
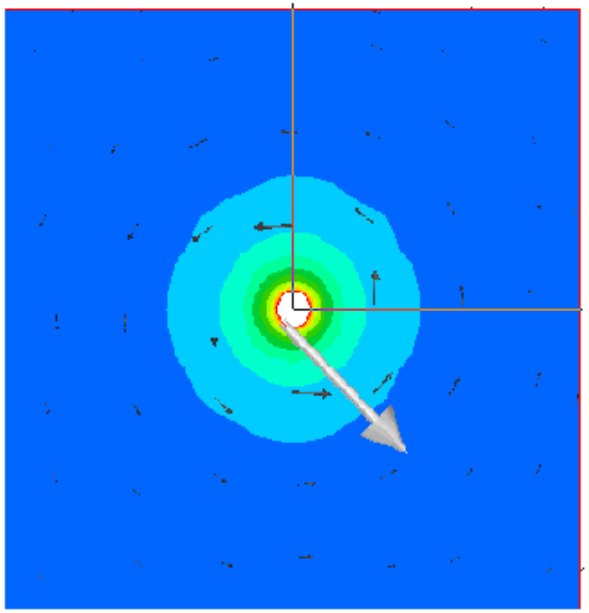
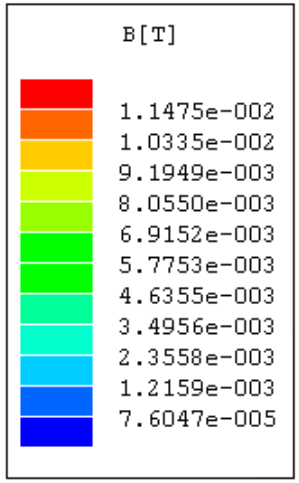
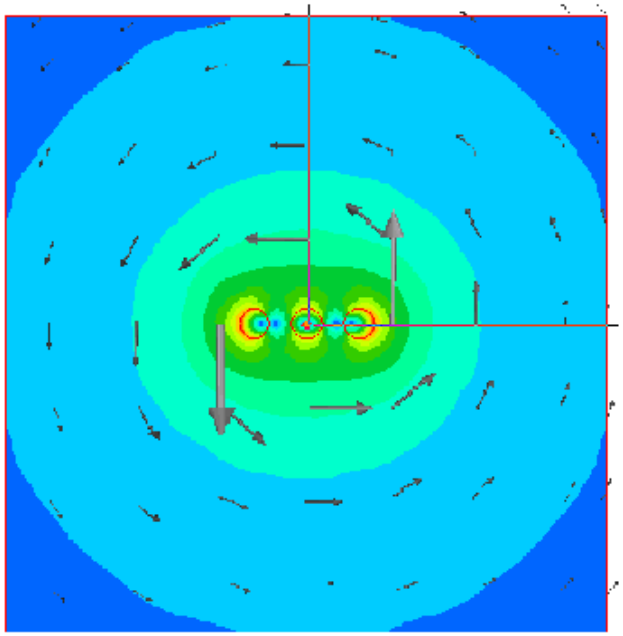




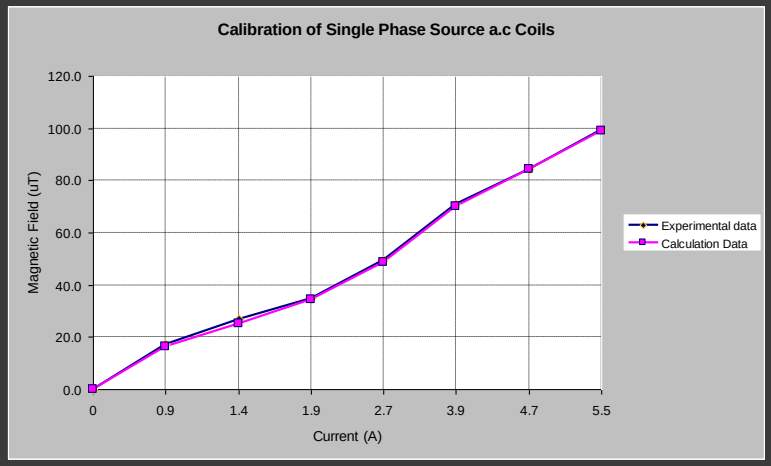
Single Phase Conductor
B Flux Direction



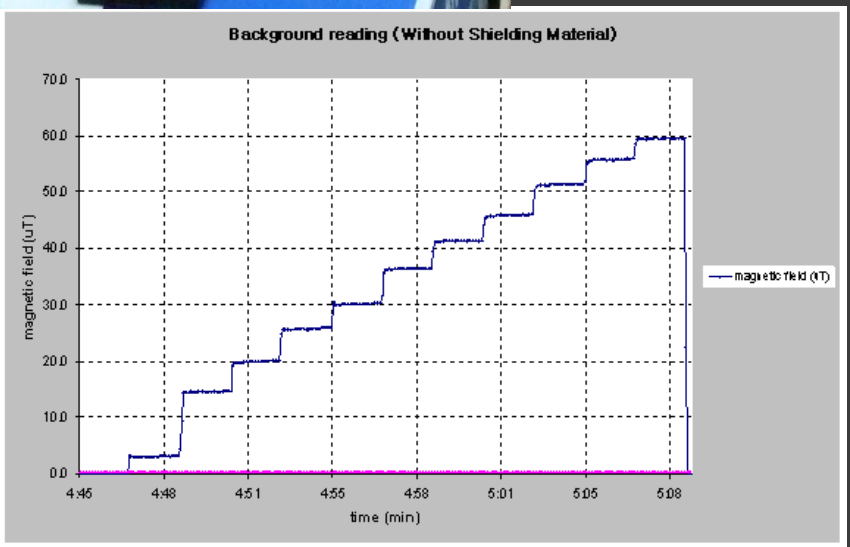


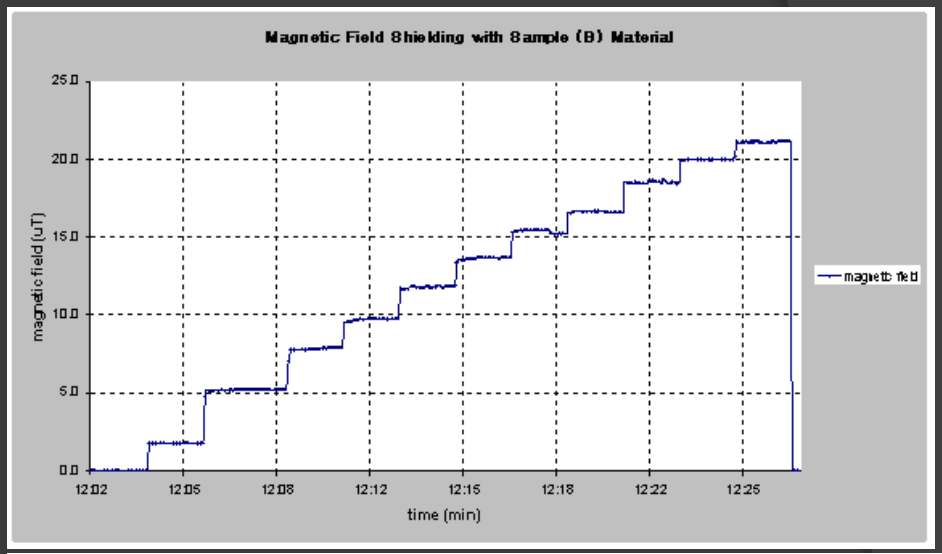
Three Phase Conductor
B Flux Direction

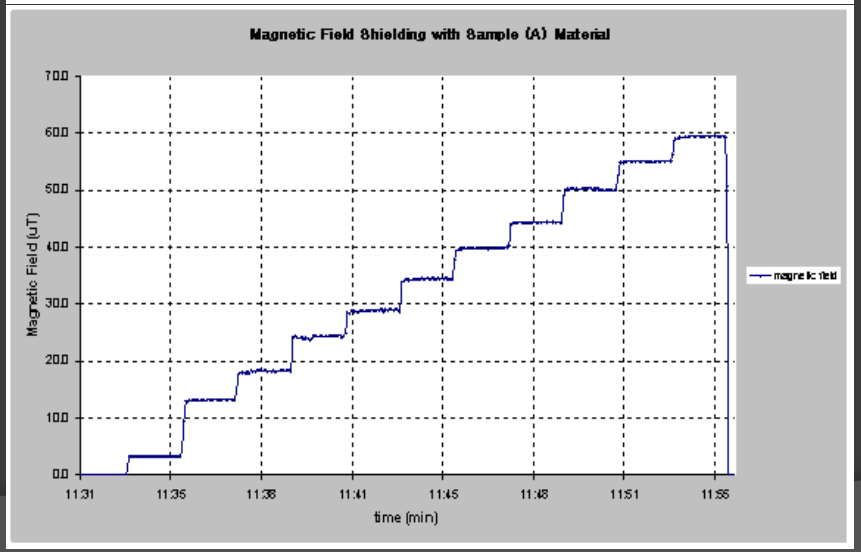
Design & development of lab. scale model

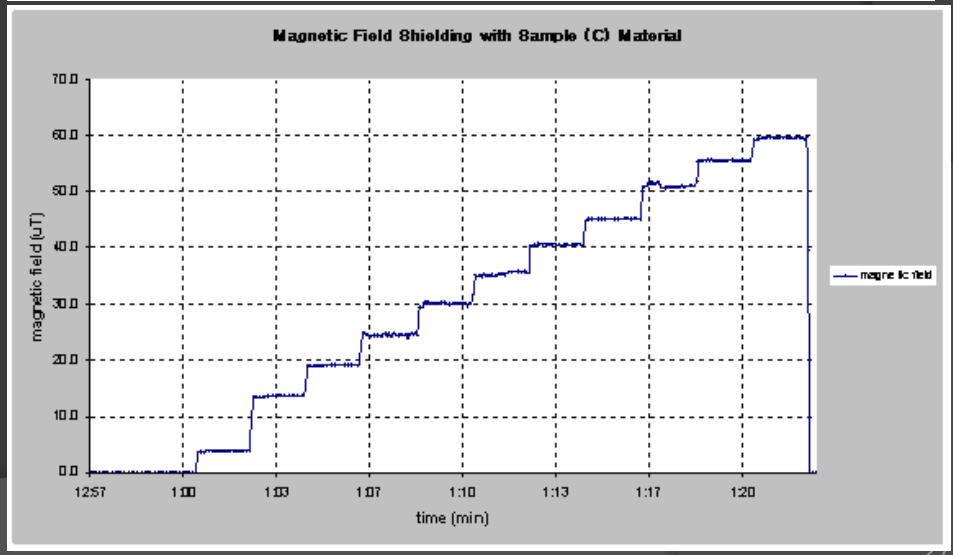


Preliminary of Shielding Experimental Results

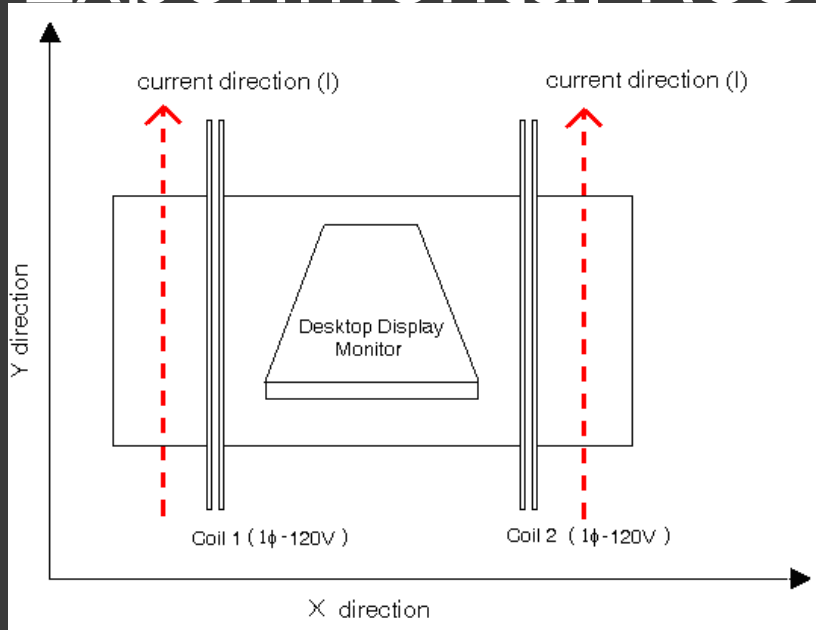


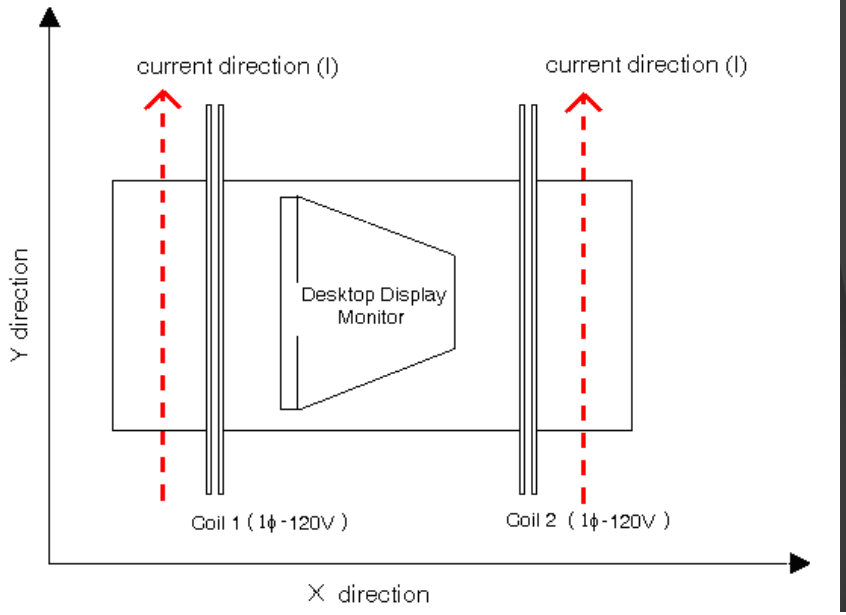


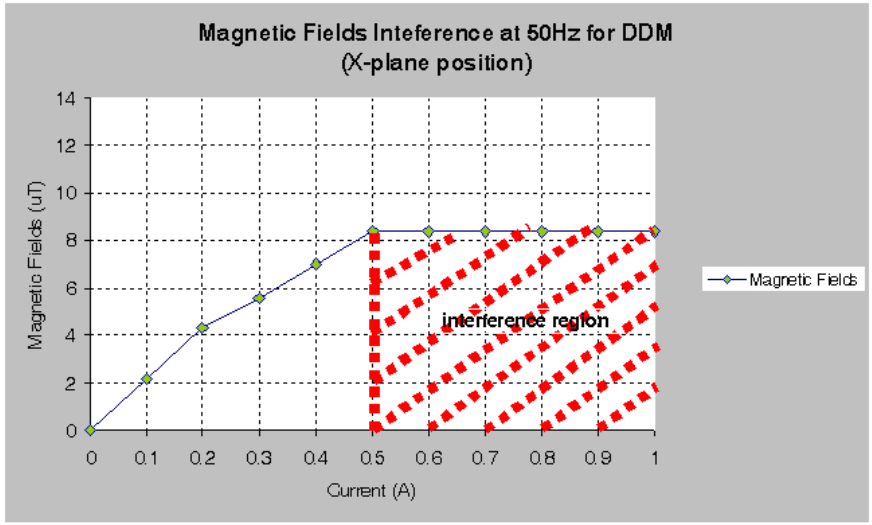


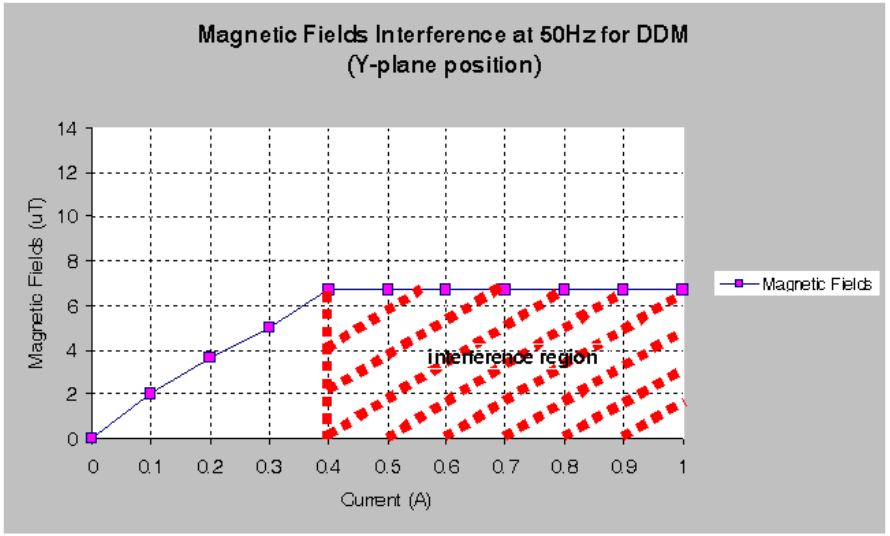


Preliminary of Interference Experimental Results









STUDY OF ELECTROMAGNETIC FIELD (EMF) ON THE HUMAN MUSCLE ACTIVITY: A PRELIMINARY STUDY

- During the 20th century, environmental exposure to man-made electromagnetic fields has been steadily increasing as growing electricity demand, ever-advancing technologies and changes in social behaviour have created more and more artificial sources. Everyone is exposed to a complex mix of weak electric and magnetic fields, both at home and at work, from the generation and transmission of electricity, domestic appliances and industrial equipment, to telecommunications and broadcasting. This study is focusing on computer simulation of electromagnetic fields in the human body. A new code was implemented allowing for the use of the HUGO model of the human body, a computer data set based on the Visible Human Data Set, produced by the National Library of Medicine, Maryland, in connection with the orientation data set for muscle fibers in the human body. Based on that simulation, the result obtained is compared to Electromyography (EMG) techniques.

Typical electric field strengths measured near household appliances (at a distance of 30 cm)

Electric appliance	Electric field strength (V/m)
Stereo receiver	180
Iron	120
Refrigerator	120
Mixer	100
Toaster	80
Hair dryer	80
Colour TV	60
Coffee machine	60
Vacuum cleaner	50
Electric oven	8
Light bulb	5
Guideline limit value	**5000**

Typical magnetic field strength of household appliances at various distances.

Electric appliance	3 cm distance (μT)	30 cm distance (μT)	1 m distance (μT)
Hair dryer	6 – 2000	0.01 – 7	0.01 – 0.03
Electric shaver	15 – 1500	0.08 – 9	0.01 – 0.03
Vacuum cleaner	200 – 800	2 – 20	0.13 – 2
Fluorescent light	40 – 400	0.5 – 2	0.02 – 0.25
Microwave oven	73 – 200	4 – 8	0.25 – 0.6
Portable radio	16 – 56	1	< 0.01
Electric oven	1 – 50	0.15 – 0.5	0.01 – 0.04
Washing machine	0.8 – 50	0.15 – 3	0.01 – 0.15
Iron	8 – 30	0.12 – 0.3	0.01 – 0.03
Dishwasher	3.5 – 20	0.6 – 3	0.07 – 0.3
Computer	0.5 – 30	< 0.01	
Refrigerator	0.5 – 1.7	0.01 – 0.25	<0.01
Colour TV	2.5 - 50	0.04 – 2	0.01 – 0.15

With most household appliances the magnetic field strength at a distance of 30 cm is well below the guideline limit for the general public of 100 μT.

Measurement of Electromagnetic (EMF) Exposure in Engineering Teaching Laboratories in the University of Malaya, Malaysia

- Concerns exist over the possibility that exposure to electric and magnetic fields (EMF) of extremely low frequency (ELF) of electrical appliances in laboratories may present a health hazard to researcher and student in the higher learning institution.

- This research aims at evaluating the EMF produced by the electrical appliances particularly used in higher education engineering laboratories.

EMF in Teaching Lab

- Measurements were carried out in three different laboratories. The spot measurement was chosen as it offers a standardized protocol for measuring magnetic fields in laboratory over a short time period because it involves the measurement of actual levels and has an ability to capture exposure from sources such as appliances and home wiring.

- The measurement was taken around the source identified and 0.6m away from the source in order to analyze the spatial distributions of magnetic fields for different distances from the source.

EMF in Teaching Lab

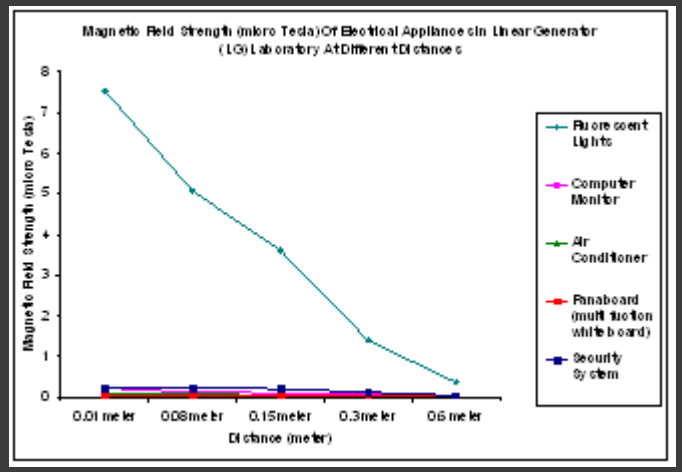
- Assessment was also conducted at different time during the day. The time chosen based on the normal working hour in Malaysia. Typical measurements on various sources and at varying distances indicate that the intensity of EMF exposure depends on the distance from the source and the time of the day.

- Types and the layout of various sources, as well as the laboratory dimensions are factors that need to be considered in evaluating, monitoring and minimizing EMF exposure in laboratories.

Typical field strength of laboratory equipments that available in EM laboratory.

Electrical Appliances	Spot Measurement (μT)		
	0.01m	**0.30m**	**0.60m**
Fluorescent lights	7.74	1.37	0.49
Computer Monitor	1.02	0.15	0.11
Air Conditioner	0.61	0.12	0.05
Function Generator	2.15	0.21	0.05
DC Power Supply	4.81	0.17	0.03
Teslameter	0.49	0.11	0.03
Gunn Power Supply	0.22	0.03	0.02
Digital Oscilloscope	5.13	0.22	0.06
Process Control System(PCR)	25.70	1.83	1.21
Digital Multimeter	14.90	8.00	3.75
Frequency Counter	2.72	0.26	0.08
Printer	0.15	0.02	0.01

Variation of magnetic field strength with time in Linear Generator Laboratory



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