MEASUREMENTS OF MAGNETIC FIELDS IN THE INDOOR POWER DISTRIBUTION TRANSFORMERS AND IN THE VICINITY OF THE HV OVERHEAD POWER LINES IN EGYPT

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ABSTRACT

This paper presents the results obtained from the magnetic field measurements to both indoor power distribution transformers and near (220 KV) transmission lines.
For the indoor power distribution transformers, the measurements had been taken to transformers having different ratings and different loads.
The measurements were carried out for two hundred transformers with capacity of 500 KVA, 1000 KVA and 1500 KVA in different areas in south Cairo electricity distribution network.
The measurements were carried out at three positions two of them lie at one and two meters distance from the transformer core while the third position lies at three meters from the low tension board.
A school located near (220 KV) transmission line in South Cairo area complained from the effect of the magnetic field resulting from the transmission line on pupils health.
Measurements were carried out in different positions inside the school and beside the transmission line.
Results of the measurements illustrated that the value of the magnetic field range from 0.1 to 0.2 micro-tesla and this is less than the standard limits.
Also this paper presents a comparison between measurements for the magnetic field at the transformers and that near to the transmission line. These results showed a good indication about magnetic field value for the indoor power distribution transformers and near to extra high voltage transmission lines.

INTRODUCTION

Exposure to electromagnetic fields (EMFs) is not a new phenomenon. However, during the 20th century environmental exposure to manmade EMFs has been steadily increasing because of the growing demand for electricity, ever-advancing technologies and changes in social behaviour which created more and more artificial sources. In spite of the enormous benefits from using electricity in everyday life and health care are unquestionable , during the past 20 years , the public concern about potential health hazards of exposure to electric and magnetic fields at low frequencies has been significantly increased [1].

Since about 1980 , the 50/60-Hz magnetic fields (and their frequency harmonics) have suspected to cause various types of negative health effects [1] . For instance, many people have concern about the assumed relationship between EMFs at low frequencies and the increased risk of cancer [1]. Internationally accepted scientific groups in [2]-[7] believe that the data are not sufficient to support the conclusion that power-frequency electric or magnetic fields in the workplace or at home cause cancer or lead to reproductive and developmental abnormalities or to learning and behavior problems .
The most accurate answer to the question "do ELF EMFs present a human health hazard?" is that the numerous studies around the world have failed to produce technically convincing evidence of such a hazard. Although some health effects have been statistically related to ELF EMFs exposure, these effects are poorly understood and may exist only as statistical or scientific errors. The expert working groups prepared a report [8] that evaluates possible health effects from exposure to static and ELF EMFs. The authors of [2], [9] and [10] identify gaps in knowledge that require more research to improve health risk assessments , including statistical , epidemiological , experimental , laboratory , and other studies .

1-STANDARD OF MAGNETIC FIELDS

The maximum exposure values for the power frequency electric and magnetic field which is adapted in this paper are as follows:
- Values was issued by world health organization (w h o).
- IEEE 644 : IEEE standard procedure for measurement of power frequency electric fields from AC power lines.
- IEEE 519 : IEEE standard definition of terms relating to corona and field effects of over head power lines.

2-POWER DISTRIBUTION TRANSFORMERS

In cities where many buildings are in close proximity to each other, the load density is high. Therefore indoor power distribution transformers, which usually have high nominal power are located in the basement or the ground floor of buildings .The standardized indoor power distribution of the public power corporation (PPC) in Egypt have nominal power of 500,1000, 1500 KVA. The dimensions of transformers rooms are 3.5*4.5 m.

3-MAGNETIC FIELD MEASUREMENTS

One of the instruments that can be used for the measurement of low frequency magnetic and electric fields in the frequency range 5 Hz to 100 kHz is PPM – 8053 analyzer with the following characteristics:
1- Measurements ranges from 1 nT (nano-Tesla) to 10 mT (mille-Tesla) and 0.1 V/m to 100 KV/m
2- True root-mean –square (rms).
The measurements are carried out at three positions :
1- 1 m distance from transformer.
2- 2 m distance from transformer.
3- 1 m distance from low voltage board.
The measurements were taken at a distance of one meter from the ground.

4 – MEASUREMENTS RESULTS

The measurements are carried out for two hundred transformer have nominal power of 500,1000,and 1500 KVA in different areas of south Cairo electricity distribution network , samples of these measurements are shown in table (1).
The conclusions of measurements are:
1- Magnetic field increases with increasing of transformer loading.
2- Magnetic field increases at a distance of 1 m from low voltage distribution board.
3- Magnetic field ranges between 1.9 µT(micro-Tesla) to 98 µT at a distance of 1 m from transformer.
4- Magnetic field ranges between 1.01 µT to 75.37 µT at a distance of 2 m from transformer.
5- Magnetic field ranges between 1.37 µT to 98.19 µT at a distance of 1m from low voltage board.

5- MAGNETIC FIELD NEAR TRANSMISSION LINES

A school is located near transmission lines (220 KV) in south Cairo area.
Magnetic field measurements are carried out in different positions inside the school and beside the transmission lines. The value of magnetic field ranges from 0.1 µT to 0.2 µT and this is less than the standard limits.

6- CONCLUSION

Magnetic field in indoor distribution transformers is higher than near transmission lines. The value of magnetic field near transmission lines is lower than the standard limits. The value of magnetic field in indoor distribution transformer is lower than 100 µT.

TABLE (1) **: RESULTS OF MAGNETIC FIELD MEASUREMENT**

No	1 m distance From Transformer (µT)	2 m distance From Transformer (µT)	1 m distance From distribution board (µT)
1	37.71	33.74	31.02
2	22.58	18.86	15.16
3	12.21	7.68	8.47
4	18.63	13.55	11.93
5	12.56	6.66	11.06
6	29.45	18.58	30.2
7	17.67	9.69	15.4
8	12.82	7.61	12.99
9	18.79	12.82	11.48
10	42.59	30.50	42.03
11	42.31	25.35	28.25
12	42.74	23.91	36.53
13	42.30	33.08	29.70
14	43.4	21.08	57.19
15	48.71	27.77	43.82
16	30.55	21.42	23.48
17	16.50	10.68	11.82
18	12.26	6.96	11.28
19	21.56	16.06	13.31
20	15.86	9.57	18.33
21	24.78	20.3	17.01
22	22.39	13.56	25.59
23	45.87	31.41	47.01
24	37.71	33.74	31.02
25	21.01	14.62	15.71
26	31.66	18.32	32.01
27	21.34	12.56	16.21
28	74.18	37.16	75.41
29	36.63	24.76	30.65
30	45.59	27.39	39.39
31	45.96	31.58	49.56
32	35.71	24.27	37.88
33	50.90	29.10	45.01
34	11.02	11.24	10.23
35	22.97	11.75	17.82
36	4.73	4.21	4.82
37	26.98	17.92	34.94
38	17.67	9.69	15.4
39	74.18	48.17	75.41
40	21.7	15.65	9.35

41	42.74	23.91	36.53
42	11.02	11.24	10.23
43	74.18	37.16	75.41
44	21.7	15.65	9.35
45	23.23	17.35	25.04
46	20.2	16.25	18.1
47	30.3	26.0	28.20
48	19.6	13.2	10.3
49	15.76	11.21	16.31
50	7.39	3.84	5.21
51	10.99	7.99	12.29
52	18.83	6.95	16.3
53	8.34	5.55	5.23
54	11.85	9.55	30.24
55	21.1	20.13	13.49
56	7.59	5.42	7.68
57	20.86	12.13	19.9
58	20.55	6.28	9.85
59	5.12	4.78	3.9
60	3.17	2.09	2.42
61	22.74	15.84	22.4
62	12.07	11.76	14.51
63	9.98	6.45	7.36
64	11.26	5.58	9.28
65	13.88	8.02	11.53
66	12.26	6.77	21.84
67	10.94	4.68	21.23
68	13.4	9.25	15.73
69	28.01	14.82	35.18
70	26.98	17.92	34.94
71	10.52	5.62	9.05
72	6.33	4.95	3.9
73	1.9	1.31	1.37
74	2.82	2.14	3.71
75	1.41	1.28	2.01
76	9.36	6.03	9.06
77	10.06	4.27	7.76
78	17.62	11.72	13.73
79	28.49	13.25	25.85
80	9.8	7.78	6.2
81	6.17	4.38	5.75
82	20.4	8.51	14.63
83	4.16	3.06	2.94
84	17.09	7.11	28.19
85	3.16	1.01	11.35
86	8.01	6.7	8.95
87	5.48	3.87	5.67
88	5.65	4.46	8.98
89	34.18	23.27	38.2
90	27.07	21.3	27.08
91	32.02	12.37	27.73
92	27.38	8.73	29.18
93	22.74	15.84	22.4
94	12.07	11.76	14.51
95	9.98	6.48	10.63
96	3.8	2.75	3.41
97	13.6	8.52	22.3
98	6.75	4.17	9.93
99	11.82	7.61	12.99
100	20.19	15.30	19.11

MAXIMUM EXPOSURE VALUES FOR THE POWER FREQUENCY (50 / 60 HZ) ELECTRIC AND MAGNETIC FIELD BY (WHO)

	Occupational	Public	Status	Basis
Electric field limits (kV/m) (rms)				
Former Czechoslovaki **a**	15		S	P,H
West Germany	20.7	20.7	S	J
Poland	20 [a] , 15	10, 1 [e]	S	P,H
UK	12 , 3 [b]	12 ,3 [b]	G	I
Former USSR	25 to 5 [c]		S	J
IRPA	30 to 10 [d]	10 [t] ,5 [g]	G	P,H
Magnetic – field limits (mT) (rms)				
West Gennany	5	5	S	J
UK	2 [h]	2 [h]	G	I
Former USSR	7.5 to 1.8 [i]		G	W
IRPA	25 [i] , 5 [k] , 0.5 [I]	1 [f] ,0.1 [g]	G	J

Notes: IRPA: International Radiation Protection Association

G	Guideline
H	Health-concern for possible effects
I	Basic restriction of induced current
J	Basic restriction of induced current density
P	Perception of spark discharges or tingling sensations
S	Standard , order or rule , usually with legal force
W	These values seem to have been developed primarily for electric-are welding
A	2 Hours maximum
b	reference levels may be exceeded if the basic restriction is observed (a limit on the continuous induced current of 1.03 mA at 50 Hz in any arm , hand , leg ,ankle or foot)

c	depends on duration (t, hours per workday) of exposure, t =50/ E-2 for E between 5 and 20 KV/m ; between 20 and 25 KV/m , only 10 minutes exposure is permitted .
d	depends on duration (t , hours per workday) of exposure t = (3/4)* 80/E for E between 10 and 30 kV/m
e	1kV/m applies where there are homes, hospitals and schools .
f	for up to a few hours per day and can be exceeded for a few minutes per day provided precautions are taken to prevent indirect coupling effects.
g	for up to 24 hours per day this restriction applies to open spaces in which members of the general public might reasonably be expected to spend a substantial part of the day , such as recreational areas and meeting grounds .
h	reference levels may be exceeded if the basic restriction is observed (see note b).
i	varies with duration of exposure from 1 to 8 hours per workday .
k	maximum exposure duration is 2hours per workday
I	for whole working day .

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