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Assessment of Public Exposure to Electromagnetic Fields by Overhead Power Transmission Lines: A Case Study

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ABSTRAK

Pengumpulan data bagi medan elektromagnetik (EMF, Electromagnetic Fields) yang dihasilkan oleh transmisi kuasa 33KV telah dijalankan pada Ogos 2002 di 3 lokasi berlainan dalam rangkuman Bahagian Kuching, Sarawak. Semua bacaan diambil pada jarak cerunan 3.5m, 7m, 10m, 15m, 20m, 30m dan 40m dari kabel kuasa. Data EMF dari 3 lokasi tersebut bagi kabel 33KV dan 132 KV telah dipuratakan bagi mendapatkan purata hasil bagi setiap jarak daripada kabel kuasa. Untuk kabel kuasa 33KV, jumlah purata EMF ialah 8608 milliGauss (mG) pada jarak 3.5m, 4,972mG (7m), 785.5mG (10m), 114.3mG (15m), 41.6mG (20m), 6.1mG (30m) and 0.2mG (40m). Bagi kabel 132KV, jumlah purata EMF adalah lebih besar daripada 20,000 milliGauss (mG) pada jarak 3.5m, 10,1612mG (7m), 4,164mG (10m), 1,720mG (15m), 802mG (20m), 139mG(25m), 9mG (30m), and 0.9mG (40m). Tahap standard normal ketinggian bagi kabel kuasa 33KV dan 132 KV ialah 12m dari paras bumi dengan jarak perantaraan 20m pada kedua-dua belah kabel, dan aktiviti manusia kebiasaannya berlaku pada jarak lebih daripada 50m (jarak cerunan) dari kabel kuasa. Kuasa EMF yang dihasilkan oleh kabel kuasa 33KV dan 132 KV tidak mendatangkan sebarang kesan buruk terhadap kesihatan orang ramai yang pada kebiasaannya terdedah pada tahap kuasa EMF di bawah 4.0 mG.

ABSTRACT

Data collection of the electromagnetic fields (EMF) produced by 33KV and 132KV power transmission lines were carried out in August 2003 at 3 different locations in Kuching Division, Sarawak, Malaysia. All readings were taken at a slope distance of 3.5m, 7m, 10m, 15m, 20m, 30m, and 40m, respectively from the power lines. The EMF values measured from the three locations of 33KV and 132KV lines were averaged to obtain the mean values of each distance from the power lines. For the 33KV power lines, it was found that the mean EMF values were 8,608 milliGauss (mG) at 3.5m away, 4,972mG (7m), 785.5mG (10m), 114.3mG (15m), 41.6mG (20m), 6.1mG (30m) and 0.2mG (40m). For the 132KV power lines, the mean EMF values were greater than 20,000 milliGauss (mG) at 3.5m, 10,1612mG (7m), 4,164mG (10m), 1,720mG (15m), 802mG (20m), 139mG(25m), 9mG (30m), and 0.9mG (40m). The normal standard height of both 33KV and 132 KV power lines are 12 m above ground level and an easement width of 20 m on both sides of the power lines, and human activities generally occur at a distance greater than 50m (slope distance) from the power lines. It was found that the EMF produced by both 33KV and 132KV power transmission lines do not pose adverse health effects on the public who are generally exposed to EMF levels below 4.0 mG.

Keywords: Kilovolts, electromagnetic fields, milliGaus

INTRODUCTION

In Malaysia, the electric and magnetic field (EMF) issue has become an area of increasing public concern (Wertheimer and Leeper, 1979). Epidemiological and laboratory studies suggested that EMF may act as promoters of carcinogenesis, especially brain tumours and

leukaemia, while the epidemiological results remain inconsistent (Tomenius, 1986; Savitz *et al.*, 1989). There are a number of researches conducted on the effects of EMF on human population, animals and isolated cells (London *et al.*, 1991; Feychting and Ahlbom, 1992), and some of the scientific evidences have suggested that the EMF exposures pose any health risk is rather weak (Morgan, 1989; Portier and Wolfe, 1997). The strongest evidences for health effects in association with EMF exposures observed in human populations in the forms of cancer are childhood leukaemia and chronic lymphocytic leukaemia among occupationally exposed adults (Hatch *et al.*, 1998).

In some researches, they claimed that a long-term exposure to 16mG or greater EMF may cause miscarriage in humans (Belanger *et al.*, 1998). There is also an association found between the long-term EMF exposure to 4mG or above and the children leukaemia (Washburn *et al.*, 1994). For animals, when they are directly below the conductors, where the clearance is about 9 meters and the EMF level is more than 1.0 Gauss, it may promote increased growth and size of tumour. However, it is also claimed that EMF alone does not cause any tumours in animals (Tsurita *et al.*, 2000). A study claimed that a 500mG magnetic field exposure of rats treated with carcinogens may increase their incidence of breast cancer, but did not affect tumour growth in individual animals. Another study found that there was an increase in the DNA strand breaks in brain cells of rats when exposed to more than 1 Gauss of EMF (Lai and Singh, 1997).

METHODOLOGY

A total of three 33KV transmission lines at 3 different locations, Jalan Stampin (near SRJK Stampin), Jalan Tun Jugah (near Petronas Petrol Station) and at the junction of Jalan Tun Razak and Jalan Foochow Road No.1 (*Fig. 1*) were identified for this study. All the power transmission lines are located along the main roads and all the EMF readings were taken based on the slope distance of 3.5, 7, 10, 15, 20, 30, and 40 m from the 33KV power lines. The EMF readings were taken on 22 and 23 August 2002 during peak demand hours between 11:00 A.M and 1:00 P.M.

Similarly, three 132KV power transmission lines at 3 different locations within Kuching Division, namely Muara Tebas, Muara Tabuan and Mambong (*Fig. 2*). All the power transmission lines are located along the main roads and all the EMF readings were taken based on the slope distance of 3.5, 7, 10, 15, 20, 25, 30, and 40 m from the 132KV power lines. The EMF readings were taken on 26, 27 and 30 August 2002 during peak demand hours between 11:00 A.M. and 1:00 P.M.

The instrument used to collect the data is called Lutron EMF-827 Detector. Lutron EMF-827 Detector has wide measuring range with 3 ranges; 200 mG, equivalent to 20 microTesla (μT), 2,000mG (200μT), 20,000mG (2,000μT). This EMF tester is a handheld instrument designed and calibrated to measure EMF radiation at different bandwidths down to 50Hz/60Hz. It has a separate probe serving as receiver to the main meter. The probe will detect the amplitude and frequency of EMF. Hence, depending on the amplitude of the electromagnetic field frequency within the range, the display unit on the main meter will then display the level of EMF detected by the probe.

Precautions were taken during the data collection to make sure that the readings from the display unit of the EMF tester were stable before recording. Even though the manufacturer of the instrument claims that the sampling time takes about 0.4 second, it is always wise to stay long on the sampling point to let the reading stabilize. In this study, only highest readings were recorded. It is worth noting that the EMF is not necessary



Fig. 1: Sampling locations for 33KV power transmission lines in Kuching City



Fig. 2: Sampling locations for 132KV power transmission lines

stable at all times, generally due to fluctuations of the current levels in the conductors (related to power demand) at different times of the day. Sometimes, the EMF might drop significantly for a short while before rising back again to its normal level. Thus, about 5 to 10 minutes are needed at each sampling point.

RESULTS AND DISCUSSIONS

The EMF readings for all the 33KV transmission lines were taken at 3 different locations, namely Jalan Stampin, Jalan Tun Jugah, and Jalan Tun Razak. All the power transmission lines are located along the main roads and all the EMF readings were taken based on the slope distances of 3.5, 7, 10, 15, 20, 30, and 40 m from the power lines. The EMF

readings for the 33KV for individual transmission lines taken on 22 and 23 August 2002 are shown in Table 1, whereas the plots of mean EMF levels versus slope distances are illustrated in *Fig. 3.*

The EMF Readings for all the 132KV transmission lines were taken at 3 different locations, namely Muara Tebas, Muara Tabuan, and Mambong. All the power transmission lines are located along the main roads and all the EMF readings were taken based on the slope distance of 3.5, 7, 10, 15, 20, 30, and 40 meters from the power lines. The EMF readings for the individual 132KV transmission lines taken on 26, 27 and 30 August 2002 are shown in Table 2, and plots of mean EMF levels versus slope distances are illustrated in *Fig. 4.*

The mean EMF readings obtained from the 33KV transmission lines along Jalan Stampin, Jalan Tun Jugah and Jalan Tun Razak were 8,608.6mG for a slope distance of 3.5m away from the power line, 4,972.7mG for the 7m, 783.5mG for the 10m, 114.2mG for the 15m, 41.6mG for the 20m, 6.1mG for 30m, and 0.2mG for the 40m. For the 33KV transmission lines investigated, it was noticed that all the power lines are located higher

TABLE 1
EMF data for 33KV power transmission lines (22 & 23 Aug 2005)

Slope Distance (m)	3.5m	7m	10m	15m	20m	30m	40m
Jalan Stampin (mG)	8,812.6	5,113.4	816.6	108.3	42.9	6.9	0.3
Jalan Tun Jugah (mG)	8,526.4	4,894.1	772.4	128.4	41.6	6.2	0.2
Jalan Tun Razak (mG)	8,486.6	4,910.6	761.9	105.6	40.3	5.3	0.2
Mean (mG)	8,608.6	4,972.7	783.5	114.2	41.6	6.1	0.2

TABLE 2
EMF data for 132KV power transmission lines (26, 27 & 30 Aug 2005)

Slope Distance (m)	3.5m	7m	10m	15m	20m	30m	40m
Muara Tebas, Kuching	19,961.8	10,287.6	4,140.9	1,708.2	801.4	8.9	1.5
Muara Tabuan, Kuching	>20,000	10,094.5	4,206.1	1,734.0	829.1	9.2	0.5
Mambong, Kuching	>20,000	10,101.6	4,144.4	1,718.9	776.0	8.7	0.7
Mean (mG)	>20,000	10,161.2	4,163.8	1,720.4	802.2	8.9	0.9

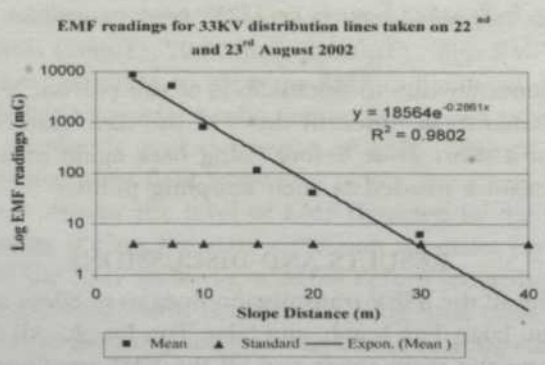


Fig. 3: Mean EMF vs. slope distance (33KV)

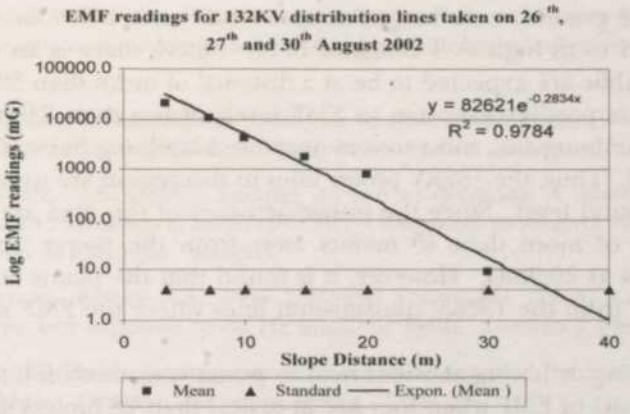


Fig. 4: Mean EMF vs slope distance (132 KV)

than the standard height of 8m above ground level. However, one of the towers is located inside the compound of SRJK© Stampin at Jalan Stampin, a primary school which has more than 1,000 students aged between 7 to 12 years old. Even though the tower is properly fenced and the lowest conductor from the ground level is more than 10 meters, the school children are likely to be exposed to 6 to 40mG of EMF. At the same location, the 33KV power lines are as far as 5m away from the overhead pedestrian road-crossing bridge. The public or school children using the bridge may be exposed to as high as 5,000mG of EMF.

Along Jalan Tun Jugah and Jalan Tun Razak, some stretches of the road levels is 1.5 to 2m higher than the ground levels on the roadside. Thus, the towers built alongside the roads are approximately 1.5 to 2m lower. At some spots, the power lines are actually less than 7m above road level. If a person with a height of 1.70m standing below the lines at those spots, the lines are approximately 5.3m above his head. This means that the individual may be exposed to as high as 6,000 mG of EMF.

The mean EMF readings obtained from the 132KV transmission lines along Muara Tebas, Muara Tabuan, and Mambong were >20,000mG for a slope distance of 3.5m away from the power line, 10,161.2mG for the 7m, 4,163.8mG for the 10m, 1,720.4mG for the 15m, 802.2mG for the 20m, 138.5mG for 25m, 8.9mG for the 30m, and 0.9mG for the 40m. For all the 132KV transmission lines investigated, it was noticed that the power lines are located well above the normal recommended height of 9m, i.e., the distance between the lowest conductor and the ground level. The minimum requirement of clearance for power lines that are not exceeding 132KV is 6.7 meters above the ground level. In Muara Tebas area, some of the towers located near to the commercial centres, schools and housing areas are found to have approximately 6.0 meters clearance distance from ground, and the nearest row of shops of 10.0 meters high are located approximately 9.0 meters from the power lines. As such, the 132KV power lines are approximately 4m to 5m above the head of a pedestrian crossing the power line zone. Generally, human activities occur at distances greater than 30m (slope distance) from the power lines, taking into consideration the easement width of 20 m on both sides of the power lines, the public staying outside the easement zone may be exposed to less than 8.9 mG EMF.

In Muara Tabuan area, it was found that the 132KV power transmission lines running near Sekolah Menengah Kerajaan Tabuan Laru could pose a potential adverse health impact to the public. At this zone, even though the power lines are generally more than

10.0 meters above ground, a student or anyone who stands below or nearby to the lines could be exposed to as high as 4 Gauss of EMF. Again, there is an easement width of 20 meters, the public are expected to be at a distance of more than 30 meters away from 132KV power lines possibly exposing to EMF levels of less than 8.9mG.

As for the Mambong site, most towers near the Mambong Substation are located on top of a small hill. Thus, the 132KV power lines in this region are usually more than 15.0 meters above ground level. Since the public activities of this area are found to occur at a slope distance of more than 40 meters away from the power lines, they could be exposed to as low as <0.9mG. However, it is found that the plants are usually less than 19.0 meters away from the 132KV transmission lines where the EMF could be as high as 1.0 Gauss.

The public living or having activities near to power transmission lines may be exposed to 16 mG and 4 mG of EMF when they are at or less than 28 meters and 35 meters away from the 132KV transmission lines, respectively. As the normal standard height of 132 KV transmission lines are usually 10 to 12 meters above ground levels, where the ground level EMF is about 4 Gauss or 4,000 mG, it is advised to avoid prolonged exposure underneath or near to those power lines especially the conceived women and children. A study found that there is a correlationship between increased incidences of leukaemia among adults living within 50 meters of a high voltage power line [3]. Therefore, the public should minimize their outdoor activities near the 132KV power lines or to keep a slope distance of more than 50 meters.

CONCLUSIONS

From the data gathered, it is found that one could be exposed to about 16mG of EMF at about 26 meters away from the 33KV transmission line; and 4mG of EMF at about 32 meters away. It is also concluded that an individual standing below 33KV transmission power lines at a slope distance of less than 7 meters could exposed to the EMF higher than the permissible level of 4 mG.

From this study, it is demonstrated that one could be exposed to about 16mG at about 28 meters away from the 132KV power transmission lines; and exposed to 4mG of EMF at about 35 meters away. Since the safety clearance slope distance of 132KV and 33KV transmission lines are about 50 meters or more, it is concluded that the EMF of power transmission lines are unlikely to pose any adverse health effects to the public.

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