

An Overview on Governments' Positions  
and Policies Regarding Electromagnetic Fields

Research and Library Services Division  
Legislative Council Secretariat  
October 1995

# An Overview on Governments' Positions and Policies Regarding Electromagnetic Fields

## Background

At the end of the last legislative year, the Research and Library Services Division was asked to perform the following to facilitate discussions on issues related to the Black Point Power Transmission System by concerned LegCo Panels:

- (i) Survey the government policies of other countries in regard to electromagnetic fields;
- (ii) Survey the application of International Radiation Protection Association guidelines in other countries; and
- (iii) Study the urgency of providing electricity supply to Tseung Kwan O and East Kowloon districts.

This paper covers findings of (i) and (ii) above and another research paper entitled "Commissioning Schedule of the Tseung Kwan O Substation and the Tsz Wan Shan to Tseung Kwan O Transmission Link" (RP02/95-96) covers those of (iii).

2. A vast amount of reference materials kindly provided by various international and national authorities for these studies are now deposited in the Legislative Council Library for the reference of those interested.

## Basics of Electromagnetic Fields

3. Electricity is such a basic element of modern life that everybody is exposed to a certain degree of electromagnetic fields. Two fields are associated with the use of electricity - electric fields which are produced by the voltage, and magnetic fields which are produced by the current. The two fields taken together are the electromagnetic fields (EMF).

4. All electrical devices, including power lines and home electrical appliances such as microwave ovens and washing machines emit EMF. Electric field strength are measured in volt per metre or kilovolts per metre (kV/m); while magnetic flux density in units of Tesla (T) or microtesla ( $\mu\text{T}$ )<sup>1</sup>. The strongest electric fields are associated with high voltage transmission lines. Strong magnetic fields are found in the vicinity of high voltage transmission lines, but the

---

<sup>1</sup> Units of electric field strength: 1000 volts per metre = 1 kilovolt per metre  
Units of magnetic field strength: 1 tesla(T) = 1,000 millitesla(mT) 1 millitesla = 1000 microtesla( $\mu\text{T}$ )

strongest magnetic field occur in occupational situations that involve strong current. EMF cannot be eliminated but they decrease rapidly with distance from their sources, as illustrated by Appendix I and the table below.

	Electric fields (in volts per metre)	Magnetic fields (in microteslas)
Under 400 kV power lines	10,000	40
25 metres from centre line of overhead 400 kV power lines	1,000	8

The above refers to UK situation.

Source: Electric and Magnetic Fields, UK National Radiological Protection Board At-A-Glance Leaflet

### **Studies on Health Effects of Exposure to EMF**

5. In 1979, a study in Denver, Colorado suggested that children living near to distribution power lines had a slightly higher risk of leukaemia. A large number of research studies have been conducted since then, in response to increased concern worldwide regarding the health effects of EMF. These studies fall into two main categories: experimental and epidemiological studies. Epidemiological studies conducted prior to 1992 are of varying quality. But the childhood cancer studies in Denmark, Finland and Sweden published in 1992 are regarded as well-controlled and substantially better than those conducted previously.

6. These research data have been reviewed by various national and international organisations and advisory groups, including the World Health Organisation, Congress of United States Office of Technology Assessment, the International Non-ionizing Radiation Committee of the International Radiation Protection Association, the Advisory Group on Non-ionizing Radiation appointed by the National Radiation Protection Board in UK, Advisory Group appointed by the New South Wales Government, Expert Group in Non-ionizing Radiation appointed by the Danish Ministry of Health. Hitherto, there is a lack of consistent and conclusive evidence of health risks associated with exposure to EMF. However, all of them consider that the research studies cannot be dismissed and recommend more intensified research studies be undertaken to answer unresolved questions regarding the correlation of health risks and exposure to EMF.

7. Numerous research projects are being carried out in various countries, notably the large-scale epidemiological study of childhood cancer in England, Scotland and Wales, which is examining the possible influence of a number of agents, including magnetic fields, on the incidence of childhood cancer. The World Health Organisation is also seeking collaboration with government agencies and research institutions to conduct a major project on the health and environmental effects of exposure to static and time varying electric and magnetic fields over a 5-year period.

## International Radiation Protection Association Guidelines

8. It could be some time before results of extensive studies become available to throw light on the health effects of exposure to power frequency EMF. Because of the uncertainties and the complication that the level of exposure in question as revealed by epidemiological studies is very low, governments find it difficult to introduce regulations at this stage. However, in recognition of the need for guidelines on exposure limits based on objective analysis of currently available knowledge, the International Non-Ionizing Radiation Committee (INIRC) of the International Radiation Protection Association (IRPA) published interim guidelines on limits to exposure to 50/60Hz EMF in 1990. The limits are given in the table below:

Limits of exposure to 50/60 Hz electric and magnetic fields		
Exposure Characteristics	Electric field strength (kV/m)	Magnetic flux density (mT)
Occupational		
Whole working day	10	0.5
Short term <sup>a</sup>	30	5
For limbs	-	25
General public		
Up to 24 hours per day <sup>b</sup>	5	0.1
Few hours per day <sup>c</sup>	10	1

- a) For electric fields of 10-30 kV/m, field strength (kV/m) x hours of exposure should not exceed 80 for the whole working day. Whole-body exposure to magnetic fields up to 2 hours per day should not exceed 5 mT.
- b) 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, meeting grounds and the like.
- c) These values can be exceeded for a few minutes per day provided precautions are taken to prevent indirect coupling effects.

It must be noted that these limits are drawn up based on established or predicted effects of exposure to EMF, and there are still areas of research where questions have been raised that need to be addressed.

9. These guidelines remained interim until 1993. At its first annual meeting held in May 1993, the International Commission on Non-ionizing Radiation Protection (ICNIRP), formerly the INIRC, reviewed all scientific data released since the interim guidelines were published in 1990. The Commission concluded that the data related to cancer did not provide a basis for health risk assessment of human exposure to power frequency fields and it confirmed the interim guidelines. The ICNIRP is currently reviewing these guidelines and the results are expected to be available in 1996.

## Standards and Guidelines Used by Countries

10. The IRPA guidelines are adopted by a number of countries, including Austria, Australia, Germany, Italy and Taiwan. Countries including the former Czechoslovakia, Japan, UK and the former USSR have their own guidelines, some being less stringent and some more conservative than the IRPA limits, as illustrated in the table below:

Standards and Guidelines on  
Public Exposure to Transmission Line EMF

<u>Country</u>	<u>Electric Field</u>	<u>Magnetic Field</u>
Former Czechoslovakia	15 kV/m	-
Japan	3 kV/m	-
UK	12 kV/m	1.6 mT
Former USSR	20 kV/m*	-
IRPA	5 kV/m	0.1 mT

\* 1 kV/M applies where there are homes, hospitals, schools and the like.

Source: Positions and Developments on EMF of Different Countries/International Organisations, HK Working Group on Electric and Magnetic Fields.

11. Many countries, on the other hand, do not issue standards or guidelines at all. Canada, France, Finland and Sweden are of the view that current knowledge is not sufficient to tell whether EMFs are harmful to health and hence standards could not be set. Norway is of the view that the IRPA guidelines are too high above likely public exposure to be of any practical value. In New Zealand, the IRPA guidelines are recommended by its National Radiation Laboratory and observed by the utility companies. However, the Standing Committee which provides advice to concerned Ministries has considered the guidelines but does not recommend them to be adopted into any legislative proposals. In the US, there are no federal health standards for power frequency EMF. Some States however have set standards for EMF emitted from transmission lines, to ensure that future power lines do not exceed existing EMF levels. Their standards are set out below:

State Transmission Line EMF Standards and Guidelines				
State	Electric Field		Magnetic Field	
	On R.O.W.	Edge R.O.W.	On R.O.W.	Edge R.O.W.
Florida	8 kV/m <sup>a</sup> 10 kV/m <sup>b</sup>	2 kV/m	---	0.015 mT <sup>a</sup> (max. load) 0.02 mT <sup>b</sup> (max. load) 0.025 mT <sup>c</sup> (max. load)
Minnesota	8 kV/m	---	---	---
Montana	7 kV/m <sup>d</sup>	1 kV/m	---	---
New Jersey	---	3 kV/m	---	---
New York	11.8 kV/m 11 kV/m <sup>e</sup> 7 kV/m <sup>d</sup>	1.6 kV/m	---	0.02 mT (max. load)
Oregon	9 kV/m	---	---	---
<sup>a</sup> For lines of 69-230 kV. <sup>b</sup> For 500-kV lines. <sup>c</sup> For 500-kV lines on certain existing R.O.W.			<sup>d</sup> Maximum for highway crossings. <sup>e</sup> Maximum for private road crossings. R.O.W. = right-of-way.	

Source: Questions and Answers about EMF National Institute of Environmental Health Services and US Department of Energy

In Singapore, there are no guidelines on EMF exposure because all high voltage transmission and distribution of electricity are carried out through underground cables.

### Other Restrictions Related to Overhead Power Lines

12. It must be noted that even without the limits, exposure to EMF is restricted in some countries because of distance clearance from the high voltage power lines, which are often not related to EMF or health concerns. In countries like Canada and the former Czechoslovakia, siting of dwellings is prohibited within the right-of-way, the corridor through which a power line runs. In Sweden, living quarters, schools, day nurseries and other buildings, with minor exceptions, are not allowed in the right-of-way. High voltage power lines are not allowed to run over existing dwellings. There are also strict distance limits between the outer power line and the buildings. The local authorities, the municipalities, are also in the position to have their own restrictions in their detailed development planning. In Italy, in addition to the IRPA guidelines, minimum distance limits ranging from 10 metres for 132 kV lines or substations to 28 metres for 380 kV lines or substations are imposed. Information on the US situation is not complete. However, as far as the Department of Housing and Urban Developments' (HUD) policy is concerned, no housing receiving HUD assistance or mortgage assistance is allowed to be located within ten feet from the edge of the right-of-way.

## Policy Choices

13. The present scientific knowledge is inadequate to support a safety-based standard for power frequency fields and it could be a number of years before scientific consensus is reached. Three major policy choices are identified by Morgan<sup>2</sup>:

- (i) Minimal responses - these range from denial, supplying information on request; to supplying information on a proactive basis;
- (ii) Prudent avoidance - to avoid exposing people to EMF environments at modest costs and with little inconvenience; and
- (iii) Major response, including major response for new facilities and major/limited retrofit of old facilities.

14. In recent years, many countries and utilities provide various forms of information on EMF to the public. Some utilities provide on a regular basis updated information in their monthly mailings to their customers. Many offer measurement services to customers on request. A number of utility companies even provide large-scale and proactive educational programmes, including constructing of museum, public demonstration rooms and mobile exhibits.

15. The prudent avoidance policy is favoured by the Nordic countries. In Norway, the Radiation Protection Authority recommends prudent avoidance for future power line building projects in residential areas and vice versa. The Danish Ministry of Environment and Energy recommends the avoidance of installing high-voltage lines transmitting alternating current close to residential areas. Also, it is one of their principles for choosing between overhead lines and underground cables that construction of new 400 kV lines should be aimed for a reduction of the total network of overhead lines. The Finnish Centre for Radiation and Nuclear Safety also recommends that exposure should be limited when this can be done at reasonable cost. In Sweden, when towns and villages are being planned, EMFs are to be avoided at reasonable costs. Furthermore, the National Electrical Safety Board recommended in 1991 to avoid building new schools and day-care centres so close to power lines that the magnetic field exceeds 0.2  $\mu\text{T}$ .

16. In the US, although the words "prudent avoidance" are rarely mentioned in public, some utilities have in fact adopted the policy for siting new transmission lines. By having representatives on their planning committees, the public has greater involvement in the selection of routes and prudent avoidance is naturally one of the goals put forward by them.

---

<sup>2</sup> Morgan, M. Granger, Power-Frequency Electric and Magnetic Fields: Issues of Risk Management and Risk Communication, Biological Effects of Electric and Magnetic Fields, Volume 2

## **Situation in Hong Kong**

17. The IRPA guidelines are adopted in Hong Kong. In 1990, the Electrical and Mechanical Services Department (EMSD), in consultation with the Department of Health, issued these guidelines to the power companies on limits of exposure to the EMF. It is recommended that when the erection of permanent overhead power lines is planned, the following considerations, which apply to open spaces in which the general public is expected to spend a substantial part of the day, should be made.

- (a) the electric field strength should not exceed 5 kilovolts per metre, and
- (b) the magnetic flux density should not exceed 0.1 millitesla.

18. A working group comprising representatives of the two power companies, tertiary education institutions and relevant government departments, under the chairmanship of a Directorate staff of EMSD was formed in March 1993 to monitor the EMF issue, to ensure that the guidelines are reviewed and updated in line with the latest international standards and research findings. The Working Group completed a progress report in August 1995 after reviewing the vast amount of research studies and reports as well as considering the latest positions and developments in different countries. The salient points of the Working Group's conclusion and recommendations are as follows:-

- (i) The Working Group maintains its position that there is no convincing scientific evidence to support the possible connection between power frequency EMF exposure and adverse human health effects.
- (ii) The Working Group considers that the adoption of IRPA guidelines is appropriate.
- (iii) The Working Group would like to bring up for the attention of the Advisory Council on the Environment and the Administration about the adoption of prudent avoidance in the planning of new developments.
- (iv) The Working Group recommends a proper public education programme and participation in the World Health Organisation 5-year research project.

19. The Hong Kong Planning Standards and Guidelines of the Administration also recommend the following clearance for 400 kV overhead lines to ensure safety:

#### Minimum vertical ground clearance

- With no house development underneath power lines 7.6 metres
- With house development underneath power lines 15.6 metres

Safety clearance to account for swing of conductors due to wind deflection 5.5 metres

In addition, a corridor of 50 metres is required for 400 kV overhead power lines. This requirement is not based on EMF consideration but is for route protection and to provide sufficient space for pylon erection, operation, inspection, maintenance, repair etc. Siting of dwellings and other structures are not prohibited within the corridor as long as the vertical ground and safety clearance requirements are satisfied. According to estimates by the Administration, the number of living quarters and persons that fall within the corridor of the Black Point 400 kV power transmission system are 283 and 849 respectively.

### **Concluding Remarks**

20. In recent years, there have been increased concerns worldwide on the health effects of exposure to electromagnetic fields emitted from power lines. Despite the fact that numerous research studies have been conducted, there are no conclusive scientific evidence to establish a link between the two. More intensified research are being undertaken or planned but it will be many years before results of such activities be available.

21. The International Radiation Protection Association has issued guidelines on limits of exposure to 50/60 Hz EMF. While these are followed by some, there are also many countries which do not adopt any guidelines because they believe the present scientific data are not sufficient to support the determination of EMF safety limits. Some countries also hold the view that the IRPA guidelines are too high to be of practical value.

22. Even without any limits, there is a certain degree of restriction on exposure to EMF around power lines in countries that prohibit siting of dwellings and other structures in the right-of-way.

23. In view of the uncertainties and the fact that it may be many more years before solid information on the health effects of EMF is available and a scientific consensus can be reached, the Nordic countries favour the "prudent avoidance" policy.

24. In Hong Kong, the Working Group on Electric and Magnetic Fields, comprising representatives of government departments, universities and power companies, advises the Administration on issues relating to EMF. The Working Group endorses the application of IRPA guidelines in Hong Kong. In its recent progress report, it also draws the attention of the Administration to the "prudent avoidance" policy adopted in some countries.

RP01/95-96  
Research and Library Services Division  
Legislative Council Secretariat  
October 1995

## References:

Biological Effects of Electric and Magnetic Fields, Edited by David O. Carpenter, Sinerik Ayrapetyan: Volumes I & II

English Summary of the Report of the Working Group on Principles for Choosing Between Overhead Lines and Underground Cables of High Voltage Systems, Spatial Planning Department, The Ministry of Environment and Energy, Denmark

Report on the Risk of Cancer in Children Living in Homes Exposed to 50Hz Magnetic Fields from High-voltage Lines, Expert Group on Non-ionising Radiation, Danish Ministry of Health

The Possibly Adverse Health Effects of Magnetic Fields, Finnish Centre for Radiation and Nuclear Safety

Second Progress Report of the Working Group on Electric & Magnetic Fields, Hong Kong

Electric and Magnetic Fields and Your Health, National Radiation Laboratory, Ministry of Health, New Zealand

Health Effects of Power-line Electromagnetic Fields: A Review Paper, The National Radiation Laboratory, Department of Health, New Zealand

Magnetic Fields, Sweden

Health and Environmental Effects of Static and Time Varying Electric and Magnetic Fields, World Health Organization, UN

Electromagnetic Fields and the Risk of Cancer, Report of an Advisory Group on Non-ionising Radiation, National Radiation Protection Board, UK

Overhead Power Lines and Health, Research Paper of the UK House of Commons Library

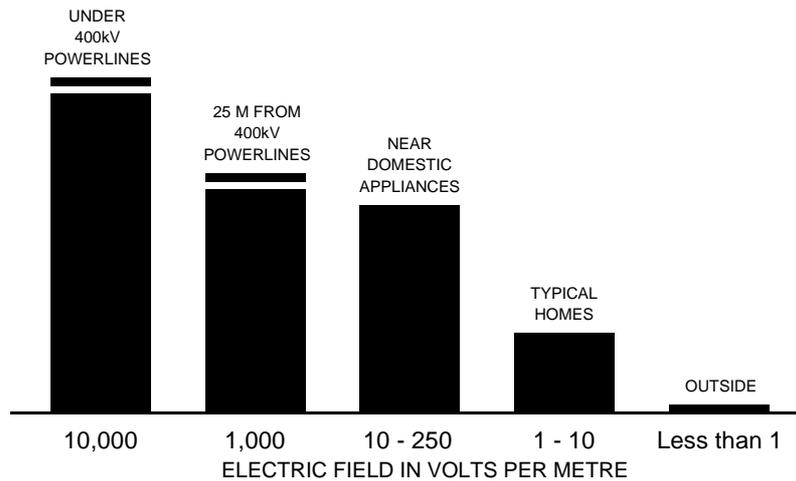
Electric and Magnetic Fields Associated with the Use of Electric Power, National Institute of Environmental Health Sciences and U.S. Department of Energy

FAQs on Power-Frequency Fields and Cancer, John Moulder, Internet Web Site: <http://www.cis.ohio-state.edu/hypertext/faq/usenet/powerlines-cancer-FAQ>

## Relationship of Field of Strength and Distance from Source

### Electric Fields

The electric field decreases rapidly with distance from the centre line of overhead power lines.



### Magnetic Fields

The magnetic field decreases rapidly with distance from the centre line of overhead power lines.

