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Measurement of extremely low frequency electric and magnetic fields beneath 66 kV power lines at Burnside Park, Christchurch

09/05

MINISTRY OF HEALTH
MANATŪ HAUORA

Technical Report

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This test report has been produced under the controls established by a quality management system that meets the requirements of AS/NZS ISO 9001:2000 which has been independently certified by BVQI under certificate number: 149269.

This is an electronic copy of an original report signed by Martin Gledhill on 24 May 2005.

Measurement of extremely low frequency electric and magnetic fields beneath 66 kV power lines at Burnside park, Christchurch

Introduction and Summary

This report describes the measurement of extremely low frequency electric and magnetic fields beneath 66 kV overhead power lines at Burnside Park in Christchurch. The measurements were recorded on 30 May 2003 at 9 am. Measurements were made as a response to public interest.

The maximum electric field strength measured was 0.55 kilovolts per metre and the maximum magnetic field 0.89 microtesla.

All readings were well below the public reference levels of 5 kilovolts per metre and 100 microtesla recommended for the public by the International Commission on Non-Ionising Radiation Protection (ICNIRP). The ICNIRP recommendations were published in 1998, and are based on a review of the health effects research and include a safety factor.

1 Measuring equipment and procedures

The instrument used to measure the ELF magnetic fields was a Wandel and Goltermann EFA-3 magnetic field monitor (serial no. D-0037), with a 100 cm^2 isotropic measurement probe (serial no. B-1052). Electric fields were measured using the same Wandel and Goltermann EFA-3 with external electric field probe (serial no. A-0087). Full specifications are given in an Appendix.

Measurement results are reported in units of kilovolts per metre (kV/m) for electric fields and microtesla (μT), for magnetic flux density in the SI (International System) of units. In some literature on the subject, an older unit, the milligauss, is sometimes used. There is a factor of ten difference between these two units: 1 microtesla = 10 milligauss, 0.1 microtesla = 1 milligauss, etc. All readings are true RMS (root-mean-square) values.

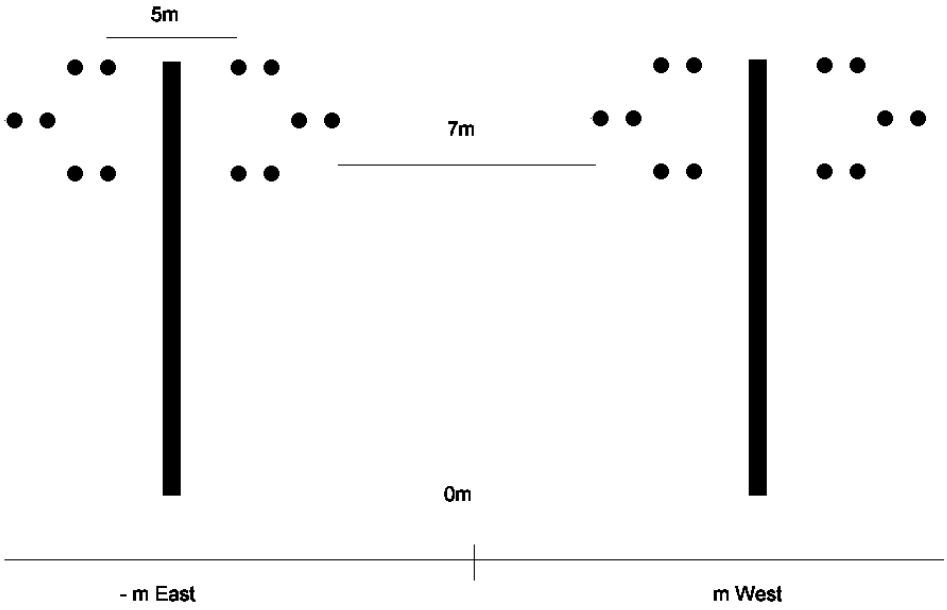
Magnetic field measurements were made with the probe hand-held at a height of one metre. Electric fields were measured with the probe mounted on a one-metre-high non-conducting tripod.

It should be noted that the results reflect the line loadings at the time of measurement. Magnetic field strengths vary according to the amount of current flowing through the lines. The electric field strength fluctuates only a few percent, whatever the loading of the line.

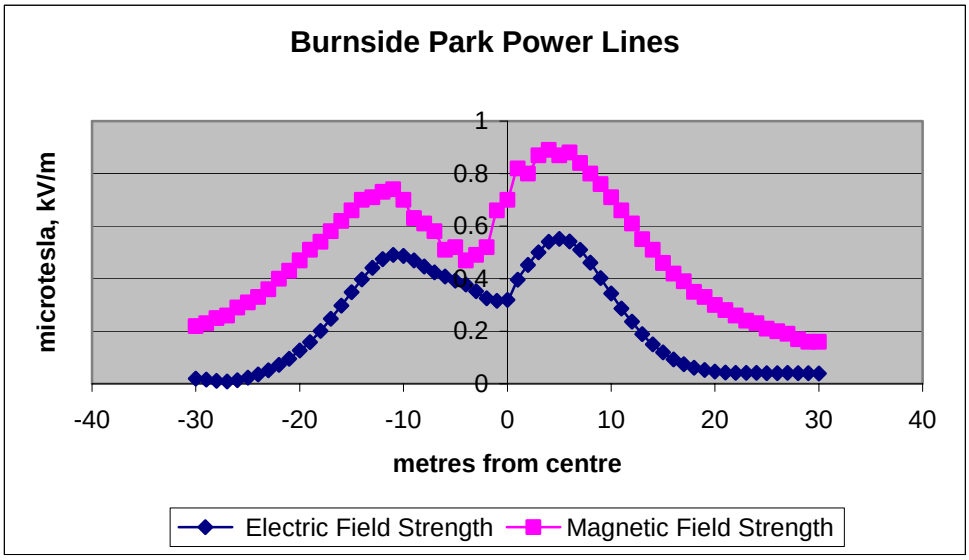
2 Measurement results

Measurements were made at one metre intervals along a line perpendicular to the power lines in an East-West direction beneath the lowest point of the lines.

The drawing below details the configuration of the power lines and the location of the measurement line.



Measurement results are presented on the graph below.



3 Recommended exposure limits

In common with nearly all countries, there are no Regulations or Standards in New Zealand setting out exposure limits for low frequency magnetic fields. The National Radiation Laboratory recommends the use of proposals put forward by the International Commission on Non-Ionizing Radiation Protection. These proposals are based on a careful examination of the research data on the health effects of exposure to low frequency magnetic fields, and include margins for safety. They were first proposed in 1990, and reconfirmed in 1993 and 1998[1] after consideration of more recent research results.

The ICNIRP guidelines set *basic restrictions* on the density of electric currents induced in the body by low frequency magnetic fields. As induced current density is difficult to measure, the guidelines also prescribe *reference levels* in terms of the more easily measured magnetic flux density. Compliance with the reference levels ensures compliance with the basic restrictions, and in most applications the reference levels can effectively be regarded as "exposure limits" (although this term is not used as such). If exposures exceed the reference levels, this does not necessarily mean that the basic restriction is also exceeded. However, a more comprehensive analysis is required in order to verify compliance with the basic restrictions.

The recommended limit varies with the frequency of the magnetic field, and at a frequency of 50 Hz the reference level for continuous exposures of the public

1 International Commission on Non-Ionizing Radiation Protection. Guidelines for limiting exposure to time-varying electric, magnetic, and electromagnetic fields (up to 300 GHz). Health Physics, 74 (4), 494 – 522.

is 100 μT. For occupational exposures, the reference level is 500 μT. The reasons for adopting different limits for occupational and public exposures are:

- Occupational exposures are normally restricted to a limited period of the day
- People exposed occupationally should normally be aware of the exposure and any precautions that may need to be taken
- People exposed occupationally would normally be in good health, whereas the public may be of any age and in any state of health.

The National Radiation Laboratory recommends that the occupational limits should only be applied to people like electricians or others who are aware of their exposures and trained in any precautions that might be necessary. In offices and most other work sites, the public limits should apply.

Since publication of the ICNIRP guidelines, the research data (including new studies published since 1998) has been reviewed several times by (amongst others) the US National Institute of Environmental Health Sciences[2], the British National Radiological Protection Board[3,4,5], the Health Council of the Netherlands[6,7,8], the International Agency for Research on Cancer[9], and ICNIRP[10]. Although the major focus of the research and reviews has been possible effects of exposure to ELF magnetic fields on cancer, other outcomes such as effects on pregnancy, neurodegenerative diseases (Alzheimer's disease, amyotrophic lateral sclerosis (ALS) etc) and cardiovascular disease have also been investigated.

Overall, there is a wide consensus that there is a weak but relatively consistent association between prolonged exposure to relatively strong magnetic fields and childhood leukaemia. There is no known mechanism which could explain this association, and hence there is considerable doubt over whether it is indicative of a cause and effect relationship. Evidence of links between exposures and adult cancers

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2 NIEHS. Assessment of health effects from exposure to power-line frequency electric and magnetic fields. NIEHS working group report. NIEHS, Research Triangle Park, North Carolina, USA, 1998.

3 NRPB. ELF electromagnetic fields and the risk of cancer. Report of an advisory group on non-ionising radiation. Documents of the NRPB 12 (1), 1-179, 2001.

4 NRPB. ELF electromagnetic fields and neurodegenerative disease. Report of an advisory group on non-ionising radiation. Documents of the NRPB 12 (4), 1-24, 2001.

5 NRPB. Review of the scientific evidence for limiting exposure to electromagnetic fields (0 - 300 GHz). Documents of the NRPB 15 (3), 1-215, 2004.

6 Health Council of the Netherlands: ELF electromagnetic fields committee. Exposure to electromagnetic fields (0 Hz – 10 MHz). Health Council of the Netherlands, The Hague, 2000.

7 Health Council of the Netherlands: Electromagnetic fields committee. Electromagnetic fields: annual update 2001. Health Council of the Netherlands, The Hague, 2001.

8 Health Council of the Netherlands: Electromagnetic fields committee. Electromagnetic fields: annual update 2003. Health Council of the Netherlands, The Hague, 2004.

9 IARC. Static and extremely low frequency electric and magnetic fields. IARC monographs on the evaluation of carcinogenic risks to humans, volume 80. Lyon, IARC, 2002.

10 ICNIRP standing committee on epidemiology. Review of the epidemiologic literature on EMF and health. Environmental Health Perspectives (109, Supplement 6), 911 – 933, 2001.

are, at most, very weak, and generally inconsistent. There is no good laboratory evidence suggesting an effect of ELF fields on the development of cancer. The review groups have not felt that the evidence on cancer is sufficient to provide a basis for exposure guidelines. While there is some evidence of an association between employment in electrical occupation and ALS, it is felt that this is more likely to be due to risk of electric shocks, rather than ELF fields, and there is no persuasive evidence of other health effects being caused by ELF fields.

4 Comparison with recommended exposure guidelines

The maximum electric and magnetic fields at the location of the measurements are 11% and 0.89% respectively of the public exposure limits recommended by ICNIRP.

Appendix A Technical Summary of Monitor

Manufacturer:	Wandel and Goltermann
Model:	EFA-3 magnetic field monitor, serial number D-0037
Probe:	100 cm^2 isotropic, serial number B-1052
Ranges:	0.01 microtesla – 10,000 microtesla
Spectrum:	30 Hz to 20 kHz (other sub-ranges selectable)
Calibration:	by ARPANSA, April 2002 Uncertainty 3% Recommended interval: 2 years

Manufacturer:	Wandel and Goltermann
Probe:	EFA-3 electric field sensor serial no. A-0087
Range:	0.5 V/m – 100 kV/m
Spectrum:	30 Hz to 20 kHz (other sub-ranges selectable)
Calibration:	by ARPANSA, April 2002 Uncertainty 5% Recommended interval: 2 years
Date of last response check:	May 2005