



To the Minister of Housing, Spatial Planning and the Environment

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Subject : Advisory letter *High-voltage power lines and health*  
Your reference : -  
Our reference : U 1458/EvR/iv/673-E1      Publication no. 2007/25E  
Enclosure(s) : -  
Date : November 9, 2007

Dear Minister,

In the meeting on 27 September with the management of the Health Council of the Netherlands, you raised the subject of “high-voltage power lines and health”. You asked for details on what is known about the possible effects of exposure to electric and magnetic fields produced by underground high-voltage power lines. I have submitted your question to the Health Council's Electromagnetic Fields Committee. The Committee informed me as follows, after incorporating the comments of the Health Council of the Netherlands' Standing Committee on Radiation and Health:

Laying high-voltage power lines underground changes the field strength produced at ground level. This almost entirely shields the electric fields but not the magnetic fields. Whether and to what extent the magnetic field strength is reduced by laying the lines underground depends on the depth at which they are laid and the distance between the conductors of the three phases which make up the high-voltage circuit.<sup>1</sup> If the cables are laid at a fairly shallow depth, the magnetic field strength at ground level may even increase along a narrow strip immediately above the cables, relative to the field strength below overhead cables. The magnetic field strength at a horizontal distance of more than around 10 metres from this strip will actually be lower. It should be pointed out here that high-voltage power lines are not the only source of such fields, as they are also produced by electrical equipment and electrical conductors in homes. Consequently, these fields also exist in homes that are not close to a high-voltage power line.

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<sup>1</sup> Closing the distance between the phase conductors reduces the strength of the fields. However, more cooling is required if cables are close together, and this increases the costs.



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The question therefore arises as to whether laying cables underground would reduce the possible health effects of exposure to the electric and magnetic fields produced by high-voltage power lines. To answer this question it is necessary to make a distinction between three types of supposed health effects: indirect effects of electric fields, direct, acutely occurring effects of electric and magnetic fields, and the long-term effects of magnetic fields.

Indirect effects are the result of a discharge current upon touching large metal objects that may become charged by the electric field. The likelihood of any such effects occurring is reduced to zero when high-voltage power lines are laid underground. Hardly any electric field is present at ground level, as the electric field is shielded by the earth above the cables. There is very little likelihood of effects occurring anyway at the field strengths present below high-voltage power lines in the Netherlands. Such effects can only occur at the field strengths which occur below 380 kV power lines.

Acute effects are the result of small electric currents induced in the body. The exposure limits proposed by various organisations, including the Health Council, are based on these effects. They do not occur near high-voltage power lines, as the magnetic field strengths occurring at the level at which people live is much too low. Therefore, laying cables underground will not change anything in this respect.

This leaves the possible long-term effects, especially the possibility of an increased risk of childhood leukaemia. It is uncertain whether this is affected by a reduction in the magnetic field strength at the level at which people live, when high-voltage power lines are laid underground. This is because there is a lack of clarity about whether the association observed in epidemiological studies between magnetic field strength and childhood leukaemia is causal. If it is causal, laying cables underground would have a very minor, positive effect on the incidence of childhood leukaemia.



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## Explanation

These conclusions are further explained below in a brief account of current scientific knowledge on the health effects of exposure to the extremely low frequency (ELF) electric and magnetic fields produced by high-voltage power lines.

In June 2007, the World Health Organisation (WHO) published Environmental Health Criteria Monograph No.238, "Extremely Low Frequency Fields", which is currently only available in electronic form (see [http://www.who.int/peh-emf/publications/elf\\_ehc/en/index.html](http://www.who.int/peh-emf/publications/elf_ehc/en/index.html)). The printed version is expected to be published in a few months.<sup>2</sup> In addition to a summary of technical aspects, such as the strength of ELF electric and magnetic fields in various situations, the document provides an overview of current scientific knowledge of the effects of exposure to these fields. The Health Council concurs with the conclusions on the latter subject, which are summarised below.

- Negative health effects have only been scientifically confirmed for exposure to ELF electric or magnetic fields with high field strengths. Such effects are the result of induced electric currents in the body and may lead to unwanted stimulation of the nerves and muscles. The exposure limits proposed by the International Commission on Non-Ionising Radiation Protection (ICNIRP) in 1998, and the Health Council of the Netherlands in 2000<sup>3</sup> are intended to prevent effects of this kind. The exposure limits include safety margins, so that limits for the general population's exposure and for the occupational exposure of professionals are respectively a factor of 50 and a factor of 10 below the levels at which health effects could occur. Therefore, exceeding the limits does not immediately indicate the

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<sup>2</sup> The Health Council has made a considerable substantive and logistical contribution to this publication's production with financial support from your ministry.

<sup>3</sup> ICNIRP - International Commission on Non-Ionising Radiation Protection. Guidelines for limiting exposure to time-varying electric, magnetic, and electromagnetic fields (up to 300 GHz). Health Phys, 1998; 74(4): 494-522. Health Council: Electromagnetic Fields Committee. Exposure to electromagnetic fields (0 Hz - 10 MHz). The Hague: Health Council of the Netherlands, 2000; publication no. 2000/06E.



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likelihood of effects on health occurring. Exposure limits are not statutorily determined in the Netherlands but in practice the ICNIRP's recommendations are adopted. At the frequency of the power grid in the Netherlands, 50 Hz, the limit for the magnetic field to which the general population is exposed is 100 microtesla ( $\mu\text{T}$ ) and the figure for the occupational exposure of professionals is 500  $\mu\text{T}$ ; the figures for the electric field are 5 and 10 kilovolts per metre respectively. Field strengths in excess of these values, at which adverse health effects could occur, do not occur at the level at which people live in the vicinity of high-voltage power lines.

- Furthermore, the WHO concluded that there are few indications that acute lymphatic leukaemia in children is possibly related to long-term exposure to relatively low magnetic field strengths. Depending on the situation, the levels concerned are those that can be detected within a strip of around 100-200 metres on each side of aboveground high-voltage power lines. This conclusion is based on a weak but reasonably consistent statistical link found in epidemiological research to a doubling of the incidence of acute lymphatic leukaemia among children who live in the vicinity where the calculated magnetic field strength exceeds approximately 0.4  $\mu\text{T}$ . However, none of the many laboratory studies conducted has found indications of a biological mechanism that can explain the detected association. Therefore, no causal link has been demonstrated between the incidence of childhood leukaemia and exposure to ELF magnetic fields, and it is therefore conceivable that other factors play a role in this.

According to calculations of the Health Council and the National Institute for Public Health and the Environment (RIVM), the detected association would account for approximately one case of childhood leukaemia every two years in the Netherlands, out of a total of around 110 new cases annually. However, it should be pointed out that the group of children exposed is relatively small; approximately 15,000 children in the Netherlands live in zones surrounding high-voltage power lines where the strength of the magnetic field exceeds around 0.4  $\mu\text{T}$ . If there is a risk, it is approximately twice as great for these children as that for children living outside those zones.

- There are no indications that exposure to ELF electric fields can lead to diseases such as childhood leukaemia.

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## Gezondheidsraad

Health Council of the Netherlands



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- Indirect effects may also occur. This applies when large metal objects, such as a fence or lorry is in the vicinity of a high-voltage power line. When objects of this kind are not earthed, they can become charged by the electric field produced by the high-voltage power line. A discharge current flows when the object is touched and a perceptible electric shock may be felt if the current is too strong. The recommended exposure limits for ELF electric fields drawn up by the ICNIRP and the Health Council are intended to prevent effects of this kind.

Yours sincerely,

(signed)

Professor M. de Visser  
Vice President