

# Frequently Asked Questions About Electric and Magnetic Fields (EMF)

## Environmental Issues

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### **What are electric and magnetic fields?**

The use of electricity produces electric and magnetic fields (EMF). Magnetic fields are produced by the flow of electric current in a wire or cable; electric fields are produced by voltage, the electrical "pressure" that drives the current. Currents traveling on transmission lines (which are mounted on tall towers) or distribution lines (which carry electricity directly to homes and businesses) or in ground pathways all generate magnetic fields; electrical appliances and devices are other sources. Electric fields are found in rights-of-way under high-voltage transmission lines and, at lesser strengths, under distribution lines and in homes. EMF can be imagined as invisible, weightless lines of force that occupy the space around a source. Both magnetic fields and electric fields decrease with increasing distance from a source.

### **What is known about health effects from EMF?**

Research investigating electric fields at levels encountered in homes has found no evidence of any health effects. In 1979, the focus of EMF science started shifting to magnetic fields. After nearly 30 years of research addressing health outcomes among both the general population and workers, there is no conclusive evidence that magnetic fields adversely affect

health. Epidemiologic studies, which examine patterns and causes of disease among human populations in residential and occupational environments, form a significant segment of the research. Many epidemiologic studies have investigated the possible relationship between magnetic fields and childhood leukemia. Although a cause-and-effect relationship has not been established, several expert panels have concluded that higher rates of childhood leukemia are statistically associated with higher levels of magnetic fields in homes.

### **What expert panels have evaluated EMF health effects?**

During the past several years, organizations concerned with public health have convened expert panels to conduct in-depth evaluations of the scientific literature on EMF and health effects. Among these organizations are the National Institute of Environmental Health Sciences (NIEHS) in the United States, the National Radiological Protection Board (NRPB; now the Radiation Protection Division of the Health Protection Agency) in the UK, the International Agency for Research on Cancer (IARC), and the World Health Organization (WHO). The panels convened by these organizations consisted of scientists who are specialists in a number of fields, including epidemiology, exposure assessment, laboratory sciences, physics, and engineering.

### **Is childhood leukemia the only health effect of concern?**

No. Other health effects have also been studied, including cancers of different types, such as adult leukemia, childhood and adult brain cancer, and male and female breast cancer. Health effects other than cancer have also been investigated. For example, two studies published in 2002 have renewed interest in the possible relationship between magnetic field exposure and miscarriage. Some studies have suggested that occupational magnetic field exposure might be linked to amyotrophic lateral sclerosis (ALS, or Lou Gehrig's disease). At present, however, the evidence for this outcome remains inadequate for drawing conclusions.

### **On the basis of the association between magnetic fields and childhood leukemia in epidemiologic studies, can we conclude that magnetic fields cause cancer?**

Evaluations of potential risk from any environmental exposure rely on a broad base of scientific evidence. The evidence consists of (1) data from epidemiologic studies; (2) results from laboratory studies using rodents or cell cultures; and (3) information on the possible mechanism by which an exposure could produce a biological effect. Although a number of epidemiologic studies show an association between magnetic field exposure and childhood leukemia, experts agree that the data do not justify a conclusion that a cause-and-effect relationship exists. The vast majority of lifetime experiments in rodents have not supported a link between residential levels of magnetic fields and cancer. Moreover, biophysicists have not identified a mechanism by which low-level magnetic fields could interact with living tissue to produce biological effects. Therefore, while epidemiologic associations cannot be dismissed, magnetic fields cannot be implicated as a cancer-causing agent.

### **What was concluded in the California Department of Health Services Report?**

This health risk evaluation, mandated by the California Public Utilities Commission (CPUC), was led by three scientists from the California Department of Health Services (CDHS). With input from two external advisory groups—one consisting of stakeholders, the other of scientists—they reviewed the scientific literature on potential biological and health effects from exposure to EMF and also supported new research on EMF and miscarriage. The results were formally released to the CPUC in October 2002 in a 385-page report. The report states that, to varying degrees, the authors believe that EMF exposure can increase the risk of childhood leukemia, adult brain cancer, ALS, and miscarriage.

### **What is EPRI's view of this report?**

Before the report was finalized, it was circulated as a draft for public comment. The authors received hundreds of pages of comments, including 35 pages from the Electric Power Research Institute (EPRI). Many of the comments expressed by EPRI were echoed in comments CDHS received from the broader scientific community. EPRI noted that the strengths of the CDHS work are that it was conducted in a transparent manner, with public participation, and that its evaluation of the literature on possible EMF health effects was extensive. EPRI's main comments were:

- The health risk assessment team consisted of only three scientists, two of whom are epidemiologists. Typically, such assessments involve many more participants from a wide range of disciplines.
- The CDHS reviewers did not fully weigh the wealth of data from laboratory studies in animals; the results of these studies did not indicate a link between magnetic fields and adverse health effects. Also, the reviewers placed little weight on the lack of evidence for a mechanism to explain how exposure to EMF in homes and workplaces could cause biological effects.

As already mentioned, several expert scientific groups have assessed the EMF health literature. All, including CDHS, have pointed to a possible association between magnetic fields and childhood leukemia; the NIEHS also suggested that magnetic fields in the workplace might be associated with adult leukemia. However, only CDHS indicated that the evidence was adequate to implicate magnetic fields as a contributor to adult brain cancer, miscarriage, or ALS.

## Where do we go from here?

The evaluation of potential health risks from environmental factors is an ongoing process. As new data become available, government and scientific organizations often reevaluate information to determine whether previous positions on possible health effects remain valid. In 2007, the World Health Organization released a new health risk assessment that did not change the conclusion of previous evaluations that there is an epidemiologic association between magnetic fields and childhood leukemia. WHO found inadequate evidence for an association with other cancers, ALS, or miscarriage and recommended further research in these areas. However, WHO concluded that the evidence does not support a link with cardiovascular disease, breast cancer, or electromagnetic hypersensitivity.

Research on health effects potentially associated with electrical environments continues in the United States, Europe, and Asia. EPRI has a very active EMF research program that is investigating a variety of residential and occupational health issues. The program includes in-progress studies to address many of WHO's highest priority research recommendations.

## What is EPRI's role in all this?

EPRI's EMF Health Assessment program participated in both the IARC and NIEHS evaluations and contributed to the WHO evaluation. In addition, the program was represented on the CDHS Stakeholders Advisory Committee. EPRI is the only organization in the United States funding a multidisciplinary research program to investigate uncertainties concerning the association of magnetic fields with childhood leukemia and address other EMF health and safety issues. Since its founding in 1973, EPRI has invested approximately \$150 million in EMF research. Regular consultation with an independent scientific advisory committee composed of eminent scientists adds assurance that the EMF program is conducted in a manner consistent with the highest scientific principles.

## Contact Information

For more information, contact the EPRI Customer Assistance Center at 800.313.3774 ([askepri@epri.com](mailto:askepri@epri.com)).

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### Electric Power Research Institute

3420 Hillview Avenue, Palo Alto, California 94304-1338 • PO Box 10412, Palo Alto, California 94303-0813 USA  
800.313.3774 • 650.855.2121 • [askepri@epri.com](mailto:askepri@epri.com) • [www.epri.com](http://www.epri.com)