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Electromagnetic Fields Factsheet

What is EMF?

Electricity and magnetism are two closely related fundamental forces of the universe which have existed since the beginning of time. Early civilizations were aware of their existence and used the earth's natural magnetic field for navigational purposes. The use of compasses made with naturally occurring magnetic ores is older than written historical records. Until about 100 years ago, human exposure to electric and magnetic fields was limited to naturally occurring fields. With the introduction of electricity into homes and businesses, the potential for Electromagnetic Field (EMF) exposure has significantly increased. EMFs are created anywhere electricity is generated, transmitted or used.

Characteristics of Electromagnetic Fields

EMF is a combination of electrical and magnetic fields. The strength of an EMF is directly related to the amount of electricity in use (the current) and to the electrical potential (the voltage) in the electric circuit. That means the more current or the higher the voltage, the greater the EMF which could be generated.

Electric fields are measured in volts per meter (V/m). A one volt electrical potential one meter away will have an electric field of 1 V/m. This is a very small field, so it is common to see measurements which are thousands of volts per meter (kV/m).

The standard unit of magnetic field strength is called the tesla (T). The tesla is a very large unit, so measured magnetic fields are often only a few millionths of a tesla, called a microtesla (μT). An older, nonstandard unit of magnetic field is the gauss (G). 10,000 gauss = 1 tesla.

An important characteristic of an EMF is the frequency of the electrical source. Frequency is the change in the flow of electric current over time. It can range from zero for a direct current (DC) to several millions of cycles per second. The unit of frequency is the hertz (Hz), which is equal to one electrical cycle per second. In North America, the frequency of the electrical power system is 60 Hz. Europe and other parts of the world use 50 Hz electricity. Three phase electrical devices may have EMFs with a frequency of 180 Hz. Fields at other frequencies arise when devices modify the electricity, such as computer video screens.

Why are some people worried about EMF?

Within all organisms are internally generated electrical currents which play a role in complex physiological mechanisms such as neuromuscular activity, glandular secretion, cell membrane function and the growth, development and repair of tissue. Because of the role of these internal electric fields and currents in so many basic physiological processes, concern has been raised about the possible biological effects of exposure to external, artificially produced EMFs.

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Public concern regarding these effects has grown, and many countries have requested regulatory and scientific advisory groups to investigate these possible effects. In many places, there is a controversy between the proponents of restrictive regulations versus advocates of technological growth which will increase the EMF exposure of the population. There are gaps in the scientific understanding of the effects of EMFs, and many research projects are currently underway to increase that knowledge. Studies have been, and are being, conducted by the Institute of Electrical and Electronics Engineers (IEEE), United Nations World Health Organization (WHO), United States Environmental Protection Agency (EPA), United States Department of Energy (DOE) and many other organizations. The International Radiation Protection Association (IRPA) has chartered a committee called the International Non-Ionizing Radiation Committee (INIRC) to study the issue of EMFs. This committee is a scientific advisory group whose members have extensive expertise with non-ionizing radiations like microwaves and EMFs. They have published guidelines on limits of exposure to 50/60 Hz electric and magnetic fields. These recommendations considered all the available scientific information. The recommendations state that "members of the general public should not be exposed on a continuous basis to . . . electric field strengths exceeding 5 kV/m," or to magnetic fields exceeding 0.1 mT (1 gauss or 1,000 mG). Electrical workers, such as utility linemen or electrical service personnel, should not be exposed to electric fields greater than 10 kV/m except for short periods of time. Magnetic fields for occupational exposures should be limited to less than 0.5 mT (5 gauss or 5,000 mG).

Should I be worried about my exposure to EMF?

The scientific information which exists doesn't indicate that exposure levels which are commonly encountered have any health effect which requires corrective action. In 1989, the U.S. Department of Labor asked the Committee on Interagency Radiation Research and Policy Coordination (CIRRPC) to help in evaluating the articles in the popular press which reported cancer being caused by EMFs from electric power transmission lines and household appliances. CIRRPC was an executive-branch federal agency which coordinated radiation related issues between various federal agencies, such as the Nuclear Regulatory Commission, Food and Drug Administration, and EPA. A panel was formed to conduct an independent scientific review of exposure data and reported biological and health effects. The panel reviewed about 1,000 scientific articles. They concluded that there was "No convincing evidence . . . that exposures to extremely low-frequency electric and magnetic fields (ELF-EMF) generated by sources such as household appliances, video display terminals, and local power lines are demonstrable health hazards."

The Electric Power Research Institute (EPRI) is a non-profit research institute funded by a group of electrical equipment manufacturers. EPRI conducted a large study called the Electric and Magnetic Field Measurement Project for Utilities. Measurements were collected in eight work and three non work environments. The measurements were intended to be representative of the type and magnitude of EMF exposure which would be encountered in these environments. These measurements indicate that the EMFs encountered in all the non work environments, and the work environments not considered to be "electrical work" were well below the levels which the IRPA INIRC have set as guidelines for the limits of exposure to 50/60 Hz electric and magnetic fields. Even some of the work environments which would be clearly considered to be "electrical work," such as electrical utility lineman, were below these guidelines. The average electrical field measured in a typical office environment was below 0.01 kV/m and the magnetic field was only about 0.1 μT (1 mG).

What about the "Swedish Standard?"

There is a government regulation in Sweden which requires that all video display terminals (VDTs) and Cathode Ray Tube (CRT) video monitors have magnetic fields less than 2 mG at the operator's position, which is assumed to be 1 meter in front of the screen. This Swedish standard was the first law anywhere in the world which put limits on EMF. This standard only applies to video display units, but has been widely misunderstood and applied to circumstances for which it is not appropriate. It was never intended to be a limit on general EMF exposures.

Some vendors of dubious EMF measuring devices have sales literature with out-of-context references to the Swedish standard, and imply that any EMF above 2 mG is hazardous and needs to be fixed. Often these same vendors also sell something like a "Low EMF" video display to help you fix it.

Summary

Electricity and magnetism are fundamental forces of nature. Electric and magnetic fields exist wherever electricity is made or used. Some measurable biological effects from exposure to very high levels of EMF can be detected. There is no scientific evidence that exposure to normal levels of EMFs has any health effect.