

# Electric and Magnetic Fields (EMF)

There are **many types of electric and magnetic fields** in nature, including the large magnetic fields that are generated by the Earth that comprise magnetic north and south. The electromagnetic (EM) spectrum is a term scientists use to describe a variety of types of radiation when they want to talk about them as a group. This spectrum includes electric and magnetic fields, infrared radiation, visible light, and x-rays. The “electromagnetic spectrum” is the frequency range of electromagnetic radiation with wavelengths that range from thousands of kilometers down to fractions of the size of an atom.

## How are electric and magnetic fields related to transmission lines?

**Electricity** is a natural phenomenon which can occur as lightning and even within the human body as electric fields and currents that allow information to flow within cells and tissues. In addition to these natural occurrences, electric and magnetic fields are present wherever electricity flows, which includes power lines, residential wiring, and electrical appliances.

**Electric fields** are produced by voltage. Voltage is like the *pressure* in a pipe. The higher the voltage, the stronger the electric field. Electric fields are measured in volts per meter (V/m). Electric fields can be shielded by objects such as walls and trees.

**Magnetic fields** are produced by the flow of current. Current is the *movement* of electric charge. The strength of a magnetic field is determined by the level of current flowing in the conductor (wire) as well as the distance from it. Magnetic fields are measured in units of tesla (T) or gauss (G); 1T = 10,000G. Magnetic fields are not easily shielded by most materials.

Both types of fields decrease rapidly with increasing distance from the source. In transmission lines, both electric and magnetic fields are considered strongest at the point where the conductors are nearest to the ground, usually in the middle area between two transmission towers. Power line EMF is typically in the range of 50-60 Hertz (Hz) and is considered Extremely Low Frequency Electric and Magnetic Fields (ELF-EMF) relative to other types of electromagnetic radiation.



## Is exposure to electric and magnetic fields a health risk?

There is no definitive answer to this question. Concerns regarding the impacts of EMF and the possible effects on human and animal health have been expressed since the 1970s. Since then thousands of studies have been completed worldwide in an effort to determine if harmful effects are caused by electrical equipment such as transmission lines and household appliances that utilize electricity. To date, no conclusive evidence exists that proves electric and magnetic fields are harmful.

In 1999, the US National Institute of Environmental Health Sciences (NIEHS) published a review of all EMF research that had been conducted to date. This study represented the culmination of \$60 million and six years of research and communication that was requested by the United States Congress. The main conclusion of

the report was that “The scientific evidence suggesting that ELF-EMF exposures pose any health risk is weak.”

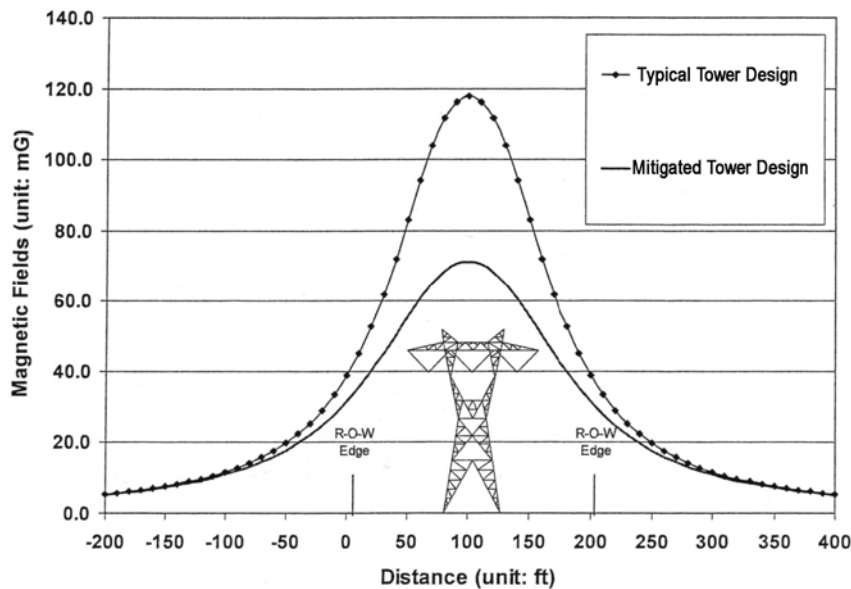
Essentially, no consistent link between ELF-EMF exposure and health risks (including cancer) have been found. Some studies have found negative effects while others have found no evidence of any effects.

Coordinated international research has resolved many questions about specific diseases. While some health authorities have identified magnetic field exposure as a possible human carcinogen, they acknowledge that additional research will be necessary before a more definitive conclusion can be made.

Questions remain about whether EMF exposure at home or work is linked to some diseases such as childhood leukemia, adult cancers, and miscarriages. While scientific research is continuing, a quick resolution of the remaining scientific uncertainties is not expected.

**While questions remain, is the potential for public exposure to EMF being addressed?**

- The California Department of Energy (CDE) has established “setback” limits for schools, which are minimum distances that must be maintained between school property lines and the edge of easements containing overhead power lines rated 50 kV and above.
- The California Public Utilities Commission (CPUC) directed their Energy Division to monitor and report on new EMF-related scientific data as it becomes available.
- The CPUC requires utilities to employ “no cost” and “low cost” measures to reduce public exposure to EMF from transmission lines.
- The following EMF reduction methods may be considered for new and up-graded electrical facilities:
  - ◆ Increasing the distance from electrical facilities by:
    - \* Increasing structure height or trench depth
    - \* Locating power lines closer to the centerline of the corridor.
  - ◆ Reducing conductor (phase) spacing.
  - ◆ Phasing circuits to reduce magnetic fields.



Magnetic field surrounding a typical single-circuit 500-kV tower compared to a tower with EMF mitigation included in the design. Note the decrease in the magnetic field with increasing distance from the right-of-way (ROW).

Appliance	Magnetic field (mG) 12" from appliance
Electric oven	2-25
Garbage disposal	10-20
Iron	1-3
Can opener	35-250
Vacuum cleaner	20-200
Hair dryer	1-70
Color TV	9-20

Magnetic field from household appliances. Units are in milligauss (mG). Source: Gauger, 1985