

EMF



WHAT ARE ELECTRIC AND MAGNETIC FIELDS?

All of us depend on electricity on a daily basis. We rely on electricity to meet basic needs such as heating, cooling and lighting our homes. And we depend on electricity to meet the transportation, communication and industrial requirements of a modern society.



Electric and magnetic fields, often collectively referred to as EMF, are natural occurrences as a result of our use of

electricity. Wherever an electric current is present, fields of magnetic force occur.

For example, the earth has a large magnetic field which makes compass needles point north, and the human body generates its own electric current which is necessary for life.

Because electricity is so common in daily life today, most of us are in contact with electric and magnetic fields virtually all of the time. Examples include home wiring, cars, water pipes, kitchen appliances, televisions, computers, hair dryers, electric clocks and utility power lines.

HOW DO THESE FIELDS BEHAVE?

Electric Fields

Electric fields are created by voltage. The higher the voltage, the stronger the electric fields. You will find an electric field near any electrical appliance that is plugged in, even if it is not operating. Electric fields are strongest closest to their source.

Magnetic Fields

Magnetic fields are created by current or electricity flowing through a wire. Magnetic field strength increases with

current, so you will find a stronger magnetic field near an appliance when it runs on “high” than when it runs on “low.” An appliance must be plugged in and operating to create a magnetic field. Magnetic fields are also strongest close to their source.

WHERE MIGHT I FIND ELECTRIC AND MAGNETIC FIELDS?

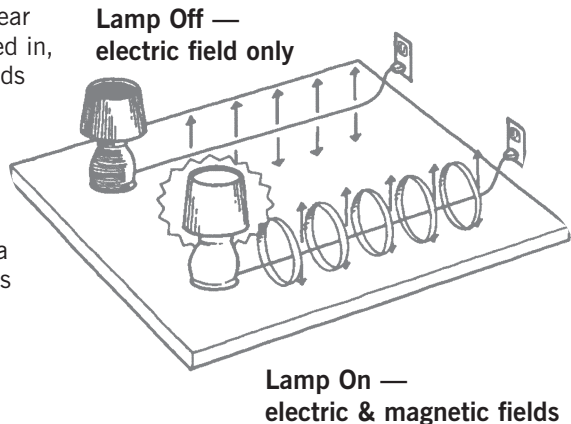
Electric and magnetic fields are found everywhere electricity is used, such as personal computer terminals, televisions and other household appliances. The magnetic fields are measured in milligauss. Magnetic fields associated with appliances are typically stronger than those fields found near power lines.

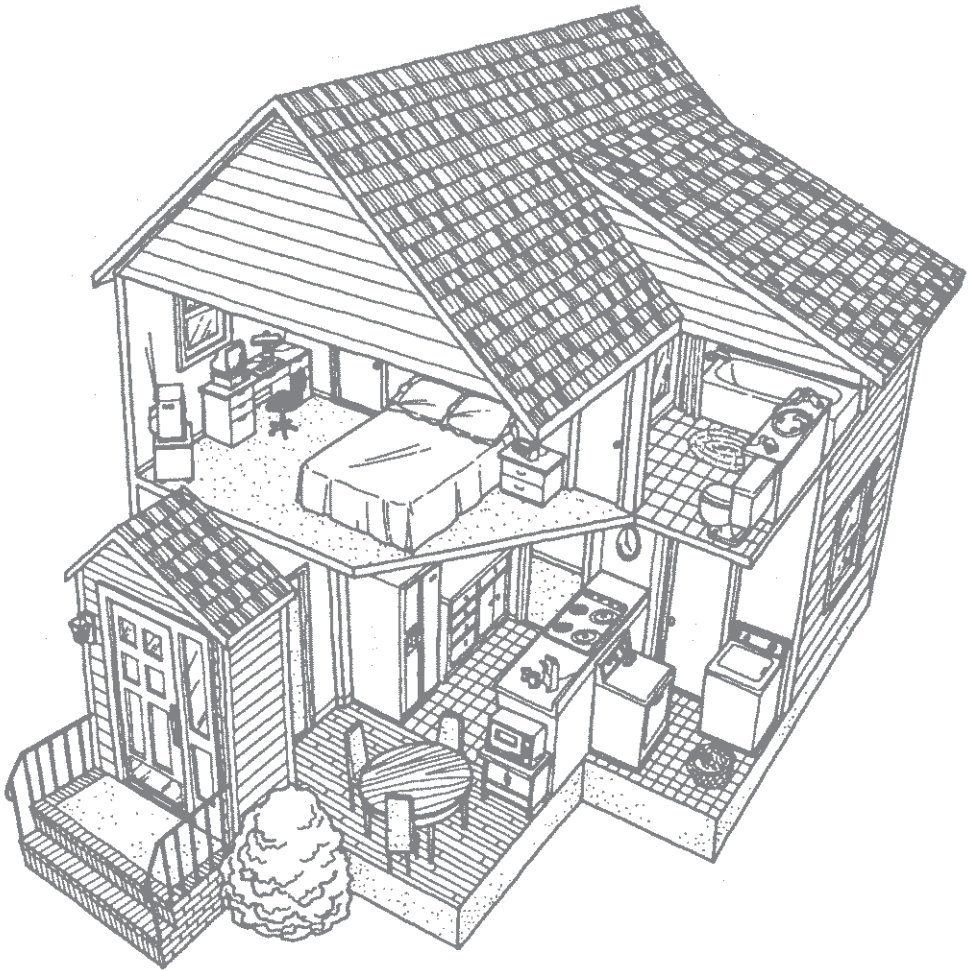
CAN THESE FIELDS BE BLOCKED?

Electric fields can be blocked by most objects such as trees, the ground, buildings and other objects. However, magnetic fields pass through most objects. This is one reason why burying power lines will not necessarily eliminate magnetic fields.

HOW DO YOU MEASURE THESE FIELDS?

The strength of electric and magnetic fields can be measured with special instruments. Electric fields are measured in units of volts per meter (abbreviated V/m) with an electric field strength





TYPICAL MAGNETIC FIELD READINGS

Typical 60 hertz magnetic fields measured at various distances.
Magnetic fields are measured in milligauss (mG).

Typical items in the home	1 inch	1 foot	3 feet	Maximum
Microwave oven	140.0	65.0	10.0	2,000
Refrigerator	6.0	4.0	1.2	15
Electric range	250.0	25.0	2.0	2,000
Electric razor	500.0	-	-	15,000
Hair dryer	100.0	30.0	-	20,000
Electric can opener	5000.0	470.0	24.0	30,000
Computer terminal/TV	26.0	3.4	1.2	500
Electric clock	130.0	15.5	2.5	900

meter. Magnetic fields are measured in units of milligauss, (abbreviated mG) with a gaussmeter. Most scientific research and public issues have focused on measuring magnetic fields. Therefore, we will be referring more frequently to magnetic fields.

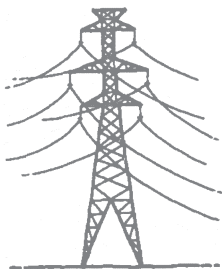
The electric field's strength is determined by the "push" – or voltage – necessary to make the electricity move. The higher the voltage, the greater the field produced. Current does not have to be flowing in an object for an electric field to exist. Thus, a stereo or toaster that is plugged in, but not operating, may still produce an electric field.

The amount of electric current flowing through a wire determines the strength of the magnetic field. Just as a magnet loses the ability to attract as it is moved away from an object, the magnetic field decreases as you move away from the source. Anything that has electricity flowing through it produces a magnetic field.

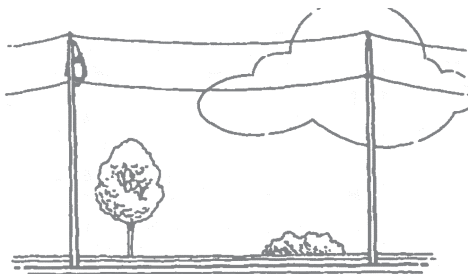
Fields Decrease with Distance

EMF levels are higher close to their source and drop off rapidly with distance. This is one reason why you may measure stronger levels of EMFs from certain home appliances than from nearby power lines.

Typical Transmission Line



Typical Distribution Line



TYPICAL MAGNETIC FIELD READINGS

Typical 60 hertz magnetic fields measured at various distances. Magnetic fields are measured in milligauss (mG).

Transmission lines*	Under line	Edge of right of way	50 ft. from edge
44kV	1.0 - 25.0	0.2 - 2.5	0.1 - 1.0
100kV	2.1 - 19.3	0.6 - 3.4	0.3 - 1.9
230kV	4.5 - 29	1.9 - 6.4	1.0 - 3.5
525kV	17 - 40	6 - 15	2.4 - 4.0
Distribution lines*	0.1 - 35		

Substation – Magnetic fields from the equipment in a substation, measured at the fence, are generally negligible. However, readings at the fence can reflect the magnetic fields from the power lines entering and exiting the substation and generally do not exceed readings in this table for distribution lines.

*These are typical readings under normal operating conditions at moderate load.

WHAT DO THESE MEASUREMENTS REALLY MEAN?

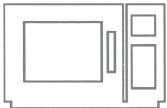
Although new technology has made it easier to measure EMFs, it is still very difficult to relate these measurements to human exposure. Measurements vary from moment to moment, depending on the current flow, the type of appliance and a person's position in relation to the source of the fields.

Interpreting measurements and setting guidelines for exposure levels are difficult, and there is still no consensus as to any health effects resulting from EMFs, let alone whether such effects are related to stronger or weaker fields. It's also not clear whether brief, high level fields from appliances such as hair dryers have more impact than continuous low-level fields from power lines, wiring or other sources.

ARE EMFs LIKE MICROWAVES AND X-RAYS?

No, they are not the same although they are all forms of electromagnetic energy.

EMFs from 60 Hertz electric utility power do not have the energy of higher frequency



EMFs such as microwaves that can heat substances or x-rays that can break apart molecules.

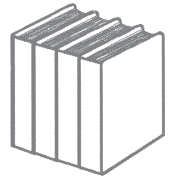
When you use a microwave oven, the energy passes through materials containing water, converting the energy to heat energy. This heat is absorbed by the materials making your food or liquid hot.

X-rays are much stronger. The energy in X-rays is strong enough to break apart the molecules that contain genes. Excessive X-ray exposure can lead to mutations and cancer. While X-ray exposure has its risks,

so do the conditions that X-rays are meant to diagnose. This is why you and your doctor should make careful judgments about when you have X-rays taken. EMFs do not have enough energy to break apart molecules like X-rays do. And although EMFs can cause heating in substances, this heat is barely detectable. Normally occurring temperature changes in human cells are greater than the temperature changes EMFs can produce. Some laboratory studies have suggested EMFs may produce small changes in human cells. These changes are yet to be understood.

WHAT KIND OF RESEARCH HAS BEEN DONE?

Two types of studies are being done: laboratory studies and epidemiology studies. Millions of dollars are being spent worldwide on EMF research and more conclusive information is expected in the next few years. To be able to put research results in perspective, it is helpful to understand the strengths and weaknesses of each type of study.



Laboratory studies primarily involve exposing cells, tissues and animals to either electric or magnetic fields under a variety of controlled conditions. These studies allow research to closely control exposure to EMF and provide information about the small-scale changes EMFs may cause. Most emphasis to date focuses on the changes caused by magnetic fields. However, laboratory studies have not shown how or if these changes affect human health. Nor have they been able to precisely duplicate the types of EMF exposures that people experience throughout the day.

In EMF epidemiological studies, researchers try to establish whether there is a statistical association between selected groups of people with certain types of EMF exposure and certain kinds

of disease. However, these types of studies cannot establish a clear cause-and-effect relationship between EMFs and disease. This is because real-life studies cannot rule out other possible explanations for health effects – such as diet and lifestyle – and because it is difficult to discover what past exposures to EMFs and other factors have been.

WHAT DO YOU MEAN BY “ASSOCIATION?”

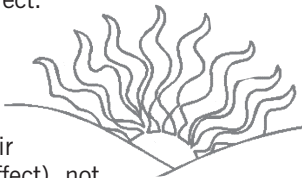
Some studies have suggested an “association” between EMF and some types of cancer. An association is different from a “cause and effect.” Association means that two or more events can be joined or linked together. This linking of events does not necessarily mean that the association is valid. Cause and effect means that if one event occurs (cause) another event (effect) will occur a percentage of the time.

The most common analogy of an association is this:

ASSOCIATION: A rooster crowing in the morning will cause the air temperature to rise several hours later.

There is strong statistical association between a rooster crowing and the air temperature rising. We know that this occurs a very high percentage of the time. However, the association, while statistically linked, is incorrect. Therefore, there is NOT a cause and effect.

The sun rising (cause) is the common event that results in the air temperature (effect), not the rooster crowing.



Some studies thus far have tied a slight association to EMF and cancer. No common cause has been directly related to the effect.

Scientists are trained to sort out true causes from observed associations such as

that above. This is especially important in the EMF research now under way.

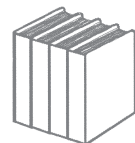
HAVE THERE BEEN RECENT STUDIES ON EMF?

Some laboratory studies have suggested that EMFs may cause small, sometimes reversible changes in cell reproductions, rhythms, communication and growth. Research is being done to confirm these results and to determine how these changes occur and whether they have implications for human health.



WHAT ABOUT STUDIES OF PEOPLE, PARTICULARLY STUDIES INVOLVING CANCER?

Much attention has focused on the incidence of cancer among people living or working near electric and magnetic fields. Researchers in Colorado, Washington, Rhode Island, England, Canada, Denmark and Sweden have completed studies on the statistical incidence of cancer. Some suggest a possible relationship between cancer and the proximity of outdoor power lines; the others found no such relationship. However, none of the researchers found a direct link between actual EMF exposure and cancer incidence. Studies of people who work around electric equipment also have been inconclusive. Some studies suggest that electric and telephone lineworkers, electricians and aluminum workers have a slightly higher risk of cancer while other studies find no evidence of increased risk.



HAVE ANY OF THE LABORATORY, CHILDHOOD OR OCCUPATIONAL STUDIES ESTABLISHED A CAUSE AND EFFECT RELATIONSHIP BETWEEN EMF AND CANCER?

No.

The researchers would like to find a way to separate other factors such as exposure to heavy traffic, air pollution or chemicals that might play a role in increased cancer rates reported in EMF epidemiological studies. For instance, workers exposed to EMFs may also be exposed on the job to chemicals that could cause cancer. Study findings may also be due to the small sizes of the groups studied.

ARE THERE HARMFUL HEALTH EFFECTS?

The use of electricity has increased greatly in the last 40 years, but there has been no corresponding significant increase in childhood leukemia or any of the other cancers suggested by epidemiological studies. The consensus among health professionals and scientists studying the issue is that no firm conclusions can be drawn. Based on this fact, and on the research to date, some researchers believe that if EMFs are shown to cause health effects, the risk of these effects will probably be comparatively small.

Voluntary risks are more accepted.

Individuals will typically accept great risks that they choose for themselves if they think that related benefits are worth it, but still reject even the slightest risks they feel are imposed on them. For example, more than 3 million people are killed or injured in motor vehicle accidents each year – but people continue to drive. Although the risks related to EMFs remain unproven, people may be unwilling to accept those risks because they believe that their exposure is not a matter of choice.

Deciding what is right for you.

We all face risks in life all the time and probably have our own ways of determining what actions are sensible. Do you always spend the extra time it takes to buckle your seatbelt? How much time and money do you invest in fire safety around your home? Like these decisions, the EMF issue requires that we gather information, weigh the risks and do what makes the most sense to us. The aim of Duke Energy is to provide you with the information you need to make that informed decision.

Several states have set guidelines for power line design and location. But because there is no consensus on the issue, most states and regulatory agencies recommend that further study occur before health-based standards are set – or high expenditures are made – to limit EMF levels from power lines and electrical equipment. In the absence of widespread government standards, it becomes a matter of personal responsibility to weigh the potential risks associated with EMFs and to determine your response.

PUBLIC CONCERN

In the early 1970s, public concern began to surface over possible health effects associated with electric and magnetic fields. Since then, hundreds of studies have been completed or are under way. Many of the studies have dealt specifically with magnetic fields that exist around appliances or power lines.

To date, none of these studies have shown a cause and effect relationship between EMF and human health.

The weight of reliable evidence suggests that long-term risk to public health – if it exists at all – appears to be very small. According to a number of science and health experts researching the issue,

including panels convened by the World Health Organization, the National Academy of Sciences and the American Institute of Biological Sciences, there exists no persuasive scientific evidence that electric and magnetic fields can lead to public health problems.

Duke Energy's Commitment to Health and Safety

Our mission is to provide our customers with safe, reliable, cost-effective electric service.

At Duke Energy, one of our top priorities is the health and safety of our customers and employees. We continue to follow ongoing research surrounding electric and magnetic fields (EMFs) and are strongly committed to understanding the scientific facts about EMF and human health.

Hundreds of studies have been generated since the early 1970s. These studies show some inconsistencies in their findings. Scientists continue working diligently and openly to understand the effects of these fields. Our hope is that these studies will resolve the inconsistencies and provide a basis for informed decisions.

Additional research on this complex subject is needed. We also recognize the need to continue developing reliable information on the subject so that responsible, informed decisions can be made. Duke Energy will continue to fund and support a vigorous research effort in conjunction with other electric utilities and research institutions. By participating in and monitoring the results of future studies, Duke Energy will keep abreast of developments and be in a position to provide objective, timely information to you. If this research shows a need to alter our procedures, we will take the steps necessary to continue safe delivery of electricity.

Duke Energy also makes a yearly financial contribution to the Electric Power Research Institute (EPRI), which funds about 40 percent of the world's EMF research. We have joined with other leading energy companies in supporting federal funding with the expectation that those dollars will help speed up the research process.

If you have questions about EMF, call your local Duke Energy office and someone will put you in touch with the EMF contact.

