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Questions And Answers About Electric And Magnetic Fields (EMFs)

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QUESTIONS AND ANSWERS ABOUT
ELECTRIC and MAGNETIC FIELDS (EMFs)

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I. INTRODUCTION

The purpose of this document is to help EPA staff better understand and respond to questions from the public about electric and magnetic fields, also known as EMFs. Scientific understanding of the potential health risks from EMF exposure is in an early stage. Because the science is complicated and the health issue unresolved, it is critical that we carefully explain what we know and don't know and not give contradictory messages. We want to provide information that is consistent and scientifically correct.

This document lists commonly asked questions and suggested answers by topical area. The questions and answers are given in a somewhat casual style to simulate a telephone conversation. Some of the questions anticipate issues that will arise in the course of a conversation. The questions and answers were derived from the experience of EPA staff, both at Headquarters and in the Regions, who routinely field inquiries from the public on EMFs. We do not expect that the answers will be given verbatim. Answers must be tailored to respond to the specific questions and needs of the caller. The reader may find that some of the answers seem repetitious. Repetition and reinforcement are here by design. The document is designed so that the user can start at any topic of interest to callers without always having to refer to background or related information in other sections. For example, some callers are only interested in video display terminals (VDTs) at work. Some are interested in schools, including VDTs at schools. To meet both needs, some questions and answers on VDTs are repeated. Most questions about EMFs concern sources and uses of electricity, namely 60 Hz power. The questions and answers in this booklet focus on 60 Hz exposures rather than exposures from sources transmitting higher frequencies.

Certain basic ideas should be understood and transmitted when responding to the public. The first item on this list is a quote from the EPA Science Advisory Board review of the EPA document "Evaluation of the Potential Carcinogenicity of Electromagnetic Fields"

1) "Some epidemiological evidence is suggestive of an association between surrogate measurements of magnetic field exposure and certain cancer outcomes. In such studies, the existence of confounders is always a possibility, but since no common confounder has yet been identified, the existing evidence can not be dismissed. In the absence of much better exposure information and an understanding of which exposures are significant, no precise exposure-response relationship has yet been adduced. This lack, together with limited understanding of possible biological mechanisms, prevents the inference of cancer causality from these associations at this time." In other words, there is some evidence that points to a relationship between EMFs and some types of cancer. Though the body of evidence can not be dismissed, it is not complete enough to draw meaningful conclusions.

2) Other health effects have not been studied as extensively as cancer so any possible relationship with EMF exposure is even more uncertain than the cancer issue.

3) Although the public tends to focus on exposure from transmission lines, for most people exposure to magnetic fields comes more from sources such as appliances and household wiring.

4) Research is being sponsored and conducted by both government organizations and the electrical power and products industry. A combined government and industry research effort is planned for 1993.

I. BACKGROUND

I.1. What are EMFs?

"EMFs" is a shorthand term for "electric and magnetic fields" or "electromagnetic fields." Electric and magnetic fields may occur alone or in combination and are a form of non-ionizing radiation. Examples of non-ionizing radiation include microwaves, visible light, and some ultraviolet radiation. The American electric power system operates at 60 hertz (Hz). This means that the electric charges (current) flowing in the system changes direction 60 times a second. Although electric and magnetic fields from 60 Hz exposures are not considered "radiation" for various technical reasons, they are still called "non-ionizing radiation".

I.2. What are the sources of EMFs?

Electric fields are produced by the presence of electrical charges, and magnetic fields are produced by the movement of those charges. Electricity flowing in a wire or being used in an appliance creates electric and magnetic fields. All power lines and electrical appliances that draw current have electric and magnetic fields around them.

I.3. Are EMFs like X-rays?

No. X-rays, microwaves and other radio waves, and the electric and magnetic fields from power lines and and electrically powered appliances are all part of the electromagnetic spectrum. But X-rays are a form of electromagnetic radiation with high levels of energy. This energy is sufficient to dislodge electrons from atoms that the x-ray strikes; a process called ionization which can result in cancer. EMFs, microwaves and other similar types of electric and magnetic fields do not ionize atoms because of their lower energy levels.

I.4. What can EMFs do to me?

There are many unanswered questions raised by the research done so far. There have been both positive and negative studies. We are not sure if EMF exposure adversely affects human health. More careful and extensive study of EMFs is needed.

Since 1979, some studies of human populations, called epidemiology studies, suggest a potential relationship between exposure to EMFs and certain cancers. Unfortunately, there are many uncertainties surrounding this information. For example, most of the epidemiological studies have very limited information on what types of exposure were experienced by the people in the studies. The observed increase in cancer was more pronounced for what are called "surrogates" or "indirect" estimates of EMF exposure than for electric and magnetic fields measured using meters. You may have heard about "wiring codes." Coding or characterizing houses according to the types of nearby power lines has been one method to estimate EMF exposure in these studies. This is a "surrogate" of exposure.

The fact that disease incidence is correlated with surrogate indexes for magnetic field exposure but not with direct measurements, could be explained in each of three ways or combination of these ways: a) the fields were different in the past, during the onset of disease; than those measured later during the study; b) the wrong component or attribute of the fields was measured; and/or c) some other crucial factor may be present which is unknowingly part of what is being defined by the surrogate measure of exposure. That factor could be some feature of the EMF exposure or something else altogether, such as a chemical exposure or differences in lifestyle.

Some laboratory studies have shown that extremely low frequency (ELF) electric and magnetic fields can affect various activities of cells. The laboratory studies on biological effects also are uncertain. For example, many of the positive results have only been found in one laboratory. Usually, before a

result is accepted as proof by scientists, it has been seen by several different investigators.

Additionally, it is not clear whether some of the biological effects seen in laboratory studies of cells would be harmful effects if they also occurred in people or whether they are minor changes that our bodies could adjust to.

The bottom line is that there is no established cause and effect relationship between EMF exposure and cancer or other disease. For this reason, we can't define a hazardous level of EMF exposure.

It is known that one type of magnetic field can have beneficial health effects. One treatment used by doctors to help heal broken bones that are not healing normally, is to expose the area for a few minutes a day to a specific type of magnetic field. This apparently affects the body's capability for healing bone.

I.5. How do I reduce my exposure?

While electric fields can be easily shielded, magnetic fields are much more difficult to shield. Electric fields are shielded to some degree by almost everything such as trees, bushes, walls, and so forth. Magnetic fields can be reduced by enclosing the source in certain types of metal such as something called Mu metal which is a special alloy. The fields are still present, but the metal has the capability to contain them. This approach to reducing field levels is not practical for many sources, including power lines. (Some gadgets have recently appeared on the market, such as buttons, pens, etc., claiming to shield one from fields; it is almost certain that these do not work.) Magnetic field intensity can also be reduced by placing wires close together so that the field from one wire cancels the field from the other. This is now being done in new designs for electric blankets. To some degree the same thing can be done for power lines, but for safety and reliability reasons power lines have minimum required spacing.

Because of the way appliances are made, they have the potential to have very high localized fields, but then the fields decrease rapidly with distance. For example, typical magnetic field strengths not near an appliance are 0.1 to 4 milligauss (mG), but the field from an electric can opener can be 20,000 mG at 3 centimeters (approximately 1 inch) from the appliance. At 30 centimeters (approximately 1 foot), appliance fields are usually around 1000 times lower. For the can opener mentioned above, the level would probably be around 20 milligauss.

When you stand under a power line, you are already at least 20 feet or more away from the line, depending on its height above ground. Under a typical 230 kilovolt transmission line the magnetic field is probably less than 120 milligauss. In contrast, if you move about 100 feet away from the line, the magnetic field is probably about 15 milligauss, and if you are 300 feet away from the line, the magnetic field is probably less than 2 milligauss.

From these examples, we can see that distance from the source of the magnetic or electric field can substantially reduce exposure.

I.6. What is a gauss?

The gauss is a unit for the strength of a magnetic field, also known as magnetic flux density. A related unit used internationally for magnetic flux density is the tesla. One tesla is equal to 10,000 gauss. Magnetic flux density is measured in terms of lines of force per unit area. Remember the patterns that were generated by iron filings on a piece of paper which was placed over a magnet? These patterns are field lines. We normally speak of magnetic fields in terms of thousandths of a gauss or milligauss, abbreviated "mG."

I.7. What is a safe level?

We don't know if EMF exposure is harmful (aside from the concern for electric shocks and burns for extreme exposure). We don't know if certain levels of EMFs are safer or less safe than other levels.

With most chemicals, we assume exposure at higher levels is worse than less exposure at lower levels. This may or may not be true for EMFs also. More research is required to identify dose-response relationships. There is some evidence from laboratory studies that suggests that there may be "windows" for effects. That means that biological effects are observed at some frequencies and intensities but not at others. Also, we do not know if continuous exposure to a given field intensity causes a biological effect, or if repeatedly entering and exiting of the field causes effects. There is no number to which we can point and say "That is a safe or hazardous level of EMF exposure."

I.8. Is it true that levels below 2 milligauss (mG) are safe? Is there a standard?

We do not yet know what if any magnetic field levels are safe or unsafe. The level of 2 mG is an arbitrary value used in some epidemiological studies to place people in broad exposure categories. Some other level could have been used. But, because no dose/response relationship has yet been determined for EMFs, we cannot establish a level which would be considered safe or unsafe.

As a result, neither the EPA nor any other federal regulatory agency has established a standard for EMFs.

I.9. What is a safe distance from a magnetic field source?

Since we do not know if EMF exposure is harmful, we don't know what intensity of field is safe or unsafe. In turn, we cannot say what is a safe distance. A related question is, "At what distance is the strength of the field indiscernible from the background field levels?" It depends on the source of the magnetic field and the what the background field level is. Background magnetic fields usually range from 0.1 to 4.0 illigauss (mG). In the case of most high voltage power lines, at 300 feet from the center span, the magnetic field has usually dropped below 2 mG. In the case of an electric can opener, the magnetic field is probably below 2 mG approximately 3 feet away.

I.10. Why isn't the federal government setting a standard for EMF levels? Why have some states set standards?

Several states have established standards for electric and/or magnetic fields at the edge of the right of way for power lines, usually transmission lines. These standards either have been on the books for a while, and are based on older scientific information, or were set more recently to establish levels of exposure that should not be exceeded. The standards were intended to keep field levels from going any higher, because of the existing uncertainty about health risks.

I.11. Are there natural sources of EMFs? Are they like the fields created by power lines? Can these cause health effects?

Yes, there are natural sources. The earth has a magnetic field that is approximately 500 milligauss. The earth's magnetic field is relatively constant, meaning that it does not change very much with time, unlike power lines. There are electromagnetic fields associated with thunderstorms. Lightning is a source of EMFs. Some animals like sense natural electric and magnetic fields. Our bodies also produce electrical fields that make our nervous systems and hearts work. These internal electric fields are fairly high.

Batteries and some electrical systems also have fields that do not change with time; these are called static or DC fields. DC stands for direct current. In contrasts, fields from most electrical power systems and appliances vary in time and so are called time-varying fields or AC fields. AC stands for alternating current. Electric power systems in the United States operate at 60 Hz which cycles 60 times per second.

II. MEASUREMENTS

II.1. Do I need to get EMF measurements?

That's up to you. EPA neither recommends nor discourages people from obtaining field measurements. You may decide to have EMF measurements made if you want to satisfy personal questions, concerns, or curiosity about EMF exposures.

II.2. What will EMF measurements tell me?

Magnetic and electric field measurements will not tell you whether or not your exposure is harmful or puts you at an increased risk, but they may allow you to tell how your home compares to the "average" home. You should be aware that the meters typically used for home measurements can only tell you "average field strength" in milligauss units, at the time the measurements are performed. Even these measurements will vary over time based on many factors, such as which appliances are being used. EMF laboratory studies show that biological effects may depend on one or more of many aspects of exposure like frequency, intensity, orientation of the field, duration, transient or intermittent current, and voltage spikes. Scientists still do not know what aspects of exposure, if any, are important. We therefore have no way of establishing either a safe or unsafe level. On the basis of available scientific data, there is no way of interpreting the health significance of EMF measurements.

II.3. How do I get my house or school measured?

Depending on where you live, your local power company may offer to conduct field measurements around your home. Additionally, your state Health Department or State Department of Environmental Protection may also be able to provide you with field measurements or refer you to consulting firms that conduct electric and magnetic field measurements. Consulting firms may also be found through advertisements in environmental and computer magazines. These firms will perform EMF measurements usually for $200 - $300. Alternatively, you can buy your own meter for $75 and up. These meters usually come with instructions.

II.4. Does EPA recommend measurement contractors?

No. EPA does not recommend or endorse private companies and contractors. EPA does not have a proficiency program - like the one for radon testing firms - to measure the qualifications of contractors who conduct electric and magnetic field measurements. Therefore, we cannot endorse or comment on the qualifications of any contractor. The state of California is developing a list of firms making EMF measurements. But the state is not recommending or certifying these firms. To obtain the list when it is completed, call (415) 540-2669 or write to the Special Epidemiology Studies Program, California Department of Health Services, 2151 Berkeley Way, Room 704, Berkeley, CA 94704.

II.5. Can I trust the measurements made by the utility?

Yes. Utilities should have the expertise and proper equipment to make accurate measurements. There is no reason to believe that the utility is trying to mislead you by providing you with false readings. Since we do not understand very much about the possible health effects of EMFs or what levels, if any, might be hazardous, there is no reason for the utility to give you false results. It is important to remember that readings will vary depending on factors such as the time of day the measurements were taken. The differences in readings usually reflect how much electricity is being used by the power system and other things, like what appliances are being used.

II.6. My neighbors had EMFs around their house measured. Is my house the same?

Probably not. Measurements in the house are often affected by many sources of magnetic fields

including electrical appliances or power system components (transmission or distribution lines, transformers, or house wiring). Fields are even produced by "ground currents" flowing in water pipes. EMFs decreases quickly with distance from the source. A power line or other source close to your neighbor's house may generate a measurable field there but levels at your house may be very different.

EMFs can also be generated by many sources in addition to power lines such as small appliances, hot water heaters, auxiliary power generators, and household wiring. Since the presence of various kinds of appliances varies from house to house, so do EMF levels. Therefore, EMF levels in your neighbor's house may be very different from those in your own house.

II.7. Can I make my own EMF measurements?

Yes, but be sure to learn how to make measurements properly. Before using any instruments, you should educate yourself on the use and degree of sensitivity, accuracy, and proper operation of the meter. This information can be provided by the manufacturer. You could also follow recommendations from trade associations on how to measure fields. Table 1 includes some sources of measurement protocols.

Most simple magnetic field meters only read average field intensity, given in milligauss (mG). Measurements can vary with time, space, and power load on the electrical system. Some meters only measure magnetic fields. Some meters measure both electric and magnetic fields. Remember, even if you or someone else makes the measurements properly, there is no basis for judging the meaning of the data, relative to possible health effects.

II.8. Where can I buy or rent a meter?

Advertisements for companies that sell or rent meters can be found in environmental or computer magazines. Similar advertisements can also be found in scientific equipment journals, as well as newsletters such as Microwave News, EMF Health and Safety Digest and journals such as IEEE Spectrum.

Microwave News also maintains a directory of companies which sell or rent magnetic field meters. We can send you a copy of that list, or you may obtain a copy of this directory by sending a letter requesting the "Gaussmeter Table" and a self-addressed stamped envelope and $1.00 for shipping and handling to:

Microwave News
P.O. Box 1799
Grand Central Station
New York, NY 10163

II.9. Does EPA recommend meters?

EPA does not recommend any specific supplier, manufacturer, or type of measurement equipment.

II.10. How much do meters cost? Which one is the simplest or best?

Prices for meters range between $75 and $650. Companies may rent meters for between $60 and $100 per week. Electric and magnetic fields are three dimensional. Each dimension is called an "axis" (the plural is "axes"). To properly measure a magnetic field all three axes of the field should be measured-- horizontal (front), horizontal (side) and vertical. "Single-axis" meters measure only one axis at a time and must be rotated until it is aligned with the field. A three-axis meter can get an accurate measurement no matter how it is oriented in the field, and they measure all three axes at the same time. Single-axis meters are generally the cheapest; while three-axis meters which display an integrated measurement (all three axes) are more expensive.

The less interpretation needed, the simpler an instrument is to use, and readings are less subject to error. Therefore, meters displaying an integrated measurement of all three axes together are the

simplest to use. However, these meters tend to be more expensive, and also have some additional capabilities that may be hard to learn and require a computer. The single-axis meters are generally the cheapest, but must be properly oriented.

II.11. How can I get instructions on how to make these measurements?

There are protocols (intructions for standardized measurement procedures) that can tell you how to perform the measurements. Table 1 is a list of these protocols, and where they may be obtained. Additional assistance may be available at universities with engineering or physics departments. You may also wish to contact the manufacturer of the instrument for specific operating guidance.

II.12. How do I know how my readings compare to others?

Table 2 shows some typical magnetic field measurements near transmission lines. Your utility company can tell you whether the line you are measuring is a transmission or distribution line. It is important to remember that measurements may vary for a variety of reasons like weather and operating conditions. Typical residential exposures, away from any appliances, rage from 0.1 mG to 4 mG.

This sort of information on typical values and comparative exposures is also given in several publications such as those available from the Bonneville Power Administration or in the brochure prepared by Carnegie Mellon University entitled, Electric and Magnetic Fields from 60 Hertz Electric Power: What do we know about possible health risks.

TABLE 1
SOURCES OF PROTOCOLS AND METHODS TO MEASURE ELECTRIC AND MAGNETIC FIELDS

Electric and Magnetic Fields: Measurements and Possible Effects on Human Health from Appliances, Power Lines, and Other Common Sources. May be obtained from:

Special Epidemiology Studies Program
California Department of Health Services
2151 Berkeley Way, Room 704
Berkeley, CA 94704
(415) 540-2669

IEEE Standard Procedures for Measurement of Power Frequency Electric and Magnetic Fields from AC Power Lines. Standard 644-1987.

IEEE Measurements of Power Frequency Magnetic Fields Away from Power Lines. 90 SM 423-4 PWRD.

IEEE Guide for Measurement of DC Electric Field Strength and Ion Related Quantities. Report I.D.: SH13805. 1990.

All IEEE protocols may be obtained from:

The Engineering Societies Library
345 E. 47th Street
New York, NY 10017
(212) 705-7611

IEC Measurement of Power Frequency Electric Fields. International Electrotechnical Commission (IEC), Document 833. 1987. May be obtained from:

American National Standards Institute
1430 Broadway
New York, NY 10018
(212) 354-3300

TABLE 2

MAGNETIC FIELDS NEAR ELECTRIC POWER TRANSMISSION LINES

Types of Transmission Line	Maximum on Right-of-way	Distance from lines 50'	100'	200'	300'
115 Kilovolts (kV)	**Magnetic Fields in milligauss (mG)**				
Average usage	30	7	2	0.4	0.2
Peak usage	63	14	4	0.9	0.4
230 Kilovolts (kV)					
Average usage	58	20	7	1.8	0.8
Peak usage	118	40	15	3.6	1.6
500 Kilovolts (kV)					
Average usage	87	29	13	3.2	1.4
Peak usage	183	62	27	6.7	3.0

Information courtesy of Bonneville Power Administration.

III.HEALTH

III.1. What can EMFs do to me?

There are many unanswered questions raised by the research done so far. There have been both positive and negative studies. We are not sure if EMF exposure adversely affects human health. More extensive study of EMFs is needed.

Since 1979, some studies of human populations, called epidemiology studies, suggest a potential relationship between surrogates for exposure to EMFs and certain cancers. Unfortunately, there are many uncertainties surrounding this information. For example, most of the epidemiological studies have very limited information on what types of exposure were experienced by the people in the studies. The observed increase in cancer was more strongly associated with what are called "surrogates" or "indirect" estimates of EMF exposure than for electric and magnetic fields measured using meters. You may have heard about "wiring codes." Coding or characterizing houses according to the types of nearby power lines has been one method to estimate EMF exposure in these studies. This is a "surrogate" of exposure.

The fact that disease incidence is correlated with surrogate indexes for magnetic field exposure but not with direct measurements, could be explained in each of three ways or combination of these ways: a) the fields in the past, during the onset of disease, were different than those measured later during the study; b) the wrong component or attribute of the fields was measured; and/or c) some other crucial factor may be present which is unknowingly part of what is being defined by the surrogate measure of exposure. That factor could be some feature of the EMF exposure or something else altogether, such as a chemical exposure or differences in lifestyle.

Also, some laboratory studies have shown that extremely low frequency (ELF) electric and magnetic fields can affect various activities of cells. The laboratory studies on biological effects also are uncertain. For example, many of the positive results have only been found in one laboratory. Usually, before a result is accepted by scientists as proof, it has been seen by several different investigators. Additionally, it is not clear whether some of the biological effects seen in laboratory cellular studies would be harmful effects if they also occurred in people or whether they are minor changes that our bodies could adjust to.

The bottom line is that there is no established cause and effect relationship between EMF exposure and cancer or other disease. For this reason, we can't define a hazardous level of EMF exposure.

On the other hand, it is known that one type of magnetic field can have beneficial health effects. One treatment used by doctors to help heal broken bones that are not healing normally, is to expose the area for a few minutes a day to a specific type of magnetic field. This apparently affects the body's capability for healing bone.

III.2. What are cancer clusters?

The amount of disease (measured by either rates or number of cases) in any population or community naturally fluctuates somewhat over time. If you look at enough populations or if you look at one population for a long period of time, you would expect to see an unusually large (or small) amount of disease once in a while. If the makeup of the community changes, the amount and type of disease also changes. For example, a community with mostly older people will have more cases of chronic diseases such as cancer or heart disease. Yet sometimes the amount of disease, usually a specific disease, varies more than might be expected for a given community. This unusual variation is called a "cluster."

It is often difficult to evaluate clusters. First, it must be determined with statistical methods whether a truly unusual change has occurred or whether this is only normal fluctuation. Second, the cause of the change or cluster must be determined. This is the hard part, especially for chronic diseases. Cancer, like most diseases, has multiple causes; that is, no single reason can explain why one person gets cancer and another does not. It may be relatively simple to determine the cause of food poisoning hepatitis, or influenza clusters. But usually impossible to clearly determine the cause of a cancer cluster. Suspected EMF cancer clusters are even more problematic because of the uncertainty of EMF and cancer connections.

III.3. There are a lot of sick people in my neighborhood. There is *[some source]* here. Could that be the reason?

The following additional questions will often come up in this sort of a health discussion:

Can we get it measured?
Can you do a study here?
Why hasn't somebody done something?
What are the standards?
What effects are associated with EMFs?
Do EMFs cause this disease or symptoms?

It is important to realize that what seems to be an unusual excess may not necessarily be a greater than normal variation in the expected incidence of health problems. Especially in small communities where people are familiar with many of the other people in the area, one becomes aware of the many problems that do occur normally. If one particular kind of disease or health effect occurs many times in a community, the odds that some agent is a cause of the disease increases. However, when the kinds of problems or diseases vary it becomes less likely that one particular agent is at work. Trying to weed out the health cases that are not common to a particular agent, in order to actually "see" the cluster, is an important part of the epidemiologist's job. This becomes very important and at the same time very difficult for an agent whose health effects are not well known and whose effects might vary from person to person.

EMFs are particularly difficult for epidemiologists. The problems that have been attributed by some people to EMFs include several different kinds of cancer, birth defects, behavioral changes, slowed reflexes, and spontaneous abortions. Therefore, the process of deciding which health problems in a community belong to the "cluster" becomes exceedingly difficult. So...the answer to the question, "Can that source be the cause of my problems?", is "maybe-maybe not". The source might be the problem but trying to show that it is can be very difficult if not just impossible. The health officials have to be good detectives as well as competent health professionals. Because of the difficulties, expense and uncertain results, unless the conditions are right, there is usually not much value in conducting an epidemiological study.

One way to get measurements taken is to request that the utilities (in the case of power lines), or the owner of whatever source is of concern, perform the measurements. So far most health agencies do not have the staff, expertise or equipment to provide that service. Private measuring businesses are being established to fill this demand but at this time there is no licensing or quality assurance available to indicate the qualifications of these people.

Another problem associated with getting measurements is that there really is little advice that can be given when the results are in. The standards in effect are associated with very high field levels, so you can be reasonably certain that you won't be measuring anything near this range.

III.4. Who should we contact when we suspect a cluster?

The first responder to calls of suspected clusters is the local health department and then state health agencies. When the state lacks a specific capability, the state may request assistance from EPA or from the Centers for Disease Control (CDC). EPA has provided EMF measurement assistance several times over the past few years. CDC investigates health problems and disease outbreaks.

If you suspect that there are too many cases of a particular disease in your community or if you suspect that the health of people within your community is simply not what it should be, contact your county health agency. They should have statistics for the local areas and would be able to discuss local issues. If they determine that a problem exists and do not have the capability to respond properly, they will in turn request assistance from the state authorities. While investigations of clusters and determinations of clusters are very difficult, the suspected cluster should always be reported. Often, a closely knit community will be aware of health concerns before an agency will. At other times, the agencies that maintain health registries will note statistical increases and initiate an investigation.

It is difficult to determine the possible causes of clusters. People are exposed to many things in their environment. And people have differing lifestyles. Any one agents might be responsible or many agents might all be working together to produce some combined effect which is more significant than simply the sum of their individual effects.

III.5. I can percieve electric and magnetic fields, what can I do?

The following questions will often come up in this sort of a discussion.

> Why is this?
> Where is it coming from?
> Are there other people like me?
> What can I do?
> My doctor can't help. Where else do I go?
> Where do I find information?
> Can you do something? ...make it stop?
> I know its from _____ (source). Can you make them stop?

Generally, humans appear unable to sense or detect low levels of EMFs. Some animals have developed this capability and use it for detecting and capturing prey and possibly for navigating. Yet, since these abilities evolved in some animals, it is possible that biological systems have at least a very rudimentary ability to respond to such fields and some people may be more sensitive than others. Additionally, there are "large" effects that can be detected, such as static charges making the fine hairs on the body stand up, dental work acting as radio receivers, induced body currents which might be felt (if large enough) and possibly effects which we have not yet documented. Some people report that they can "sense" low-level EMFs, however, this subject has not been studied very much.

We don't have much advice for people who say they are sensitive to electric or magnetic fields. While grounding of sources might alleviate large static charges and dental work might reduce the radio effects, too little is known about the actual field-body interaction to suggest anything further in terms of mitigation.

III.6. I'm pregnant. Will EMFs (or specific source) hurt me or my baby?

This following additional questions will often come up in this sort of health discussion.

> I work at a VDT all day long. Is that safe?
> We just moved into a home near power lines. Will that hurt my unborn child?
> I just lost a baby. Could it be because of my electric blanket (power lines, etc.)?

There are several issues to consider with respect to concerns about pregnancy and EMF exposure:

1. Are EMFs harmful? There is insufficient scientific evidence to establish whether EMFs are harmful. The EPA recently reviewed the scientific literature with respect to any potential cancer effect and concluded that although some epidemiological studies have shown an association between cancer and surrogates of EMF exposure, cause and effect relationships have not been established. Laboratory studies have demonstrated that biological changes within cell and tissue cultures can be induced by EMFs, but these changes have not been linked to human health effects. EPA has not formally assessed potential reproductive and developmental effects. These effects have not been studied as extensively as cancer. The few epidemiological studies concerning reproductive effects have been inconclusive.

2. I have heard children are more sensitive? We have no evidence that children are especially sensitive. Some of the first studies concerned cancer and children, and received a great deal of attention. But there have also been some occupational studies dealing with adults that also found some correlations with potential exposure to EMFs.

3. Are pregnant women and unborn children more sensitive? We do not have enough evidence to answer that question. There have been reports about clusters of miscarriage and birth defects among VDT users or from electric blanket exposures. Some studies have been negative, and some have been positive. This question has not be

studied as extensively as cancer, and so may be viewed as even more uncertain.

4. How can exposures from VDTs and other devices be reduced?

a) By sitting at arms length from a terminal or pulling the keyboard back still further; magnetic fields fall off rapidly with distance.

b) By switching VDTs off (not the computer necessarily) when not in use.

c) By spacing and locating terminals in the workplace, so that work stations are isolated from the fields from neighboring VDTs. Fields will penetrate partition walls, but do fall quickly with distance.

d) By using electric blankets (or water bed heaters) to warm beds but unplugging them before sleeping. Magnetic fields disappear when the electric current is switched off. However, electric fields may exist as long as a blanket is plugged in.

e) By not standing close to sources of EMFs such as microwave ovens while in use. Standards are in place to limit microwave emissions, however, the electric power consumption by a microwave oven results in magnetic fields that are high close to the unit. The same is true of other appliances as well.

III.7. The EPA report is just about cancer, but I've heard there are other effects. What are they? Why hasn't EPA looked into those effects?

Various bioeffects have been attributed to EMFs. These include behavioral changes in lab animals, altered circadian rhythms (daily metabolic and behavioral cycles), altered levels of melatonin production (a hormone thought to play a role in cancer inhibition), altered movement of certain ions across cell membranes and other "biological" responses.

Also, birth defects, miscarriages, low birth weight, loss of memory, and slowed reflex responses are health effects sometimes attributed to EMFs, but there is not broad scientific support for such assertions. Cancer is the most extensively studied health effect, yet no cause and effect relationship has been established between EMF exposure and cancer, and no hazardous effect level can be defined. The potential for other health effect should be viewed as even more uncertain. EPA has prepared a report describing the research needed to reduce the uncertainties in a health risk assessment of EMF. These research needs address cancer, reproduction, development, the central nervous system, and the immune system as well as biophysical mechanisms, exposure assessment, and control technology.

IV. SCHOOLS

IV.1. They've taken measurements in my child's school. I know what the measurements are, but what do they mean?

The measurements were probably made with a Gaussmeter which is used to measure magnetic fields. If so, the measurements represent the intensity of the magnetic fields in that location. Magnetic fields are produced by any source that uses electricity, including components of the electric power system (power transmission or distribution lines, transformers, or building wiring) and electrical and electronic devices. Magnetic fields are even produced by "ground currents" flowing in water pipes. The intensity of the magnetic field depends on the amount of electric current flowing through the electrical system or device.

While the possibility of a public health concern has been raised in some epidemiological studies, we do not yet have enough information to say whether EMFs pose a health risk or not. These same studies helped us to understand that we need to learn more about what aspect of EMF exposure may be most

relevant. For example, scientists do not know whether we should be concerned with the strength of the field, the rate of change in the field strength, the electric current induced in the body, or other variables or exposures completely unrelated to electric and magnetic fields. This makes interpretation of field measurements very difficult. Although not completely satisfactory, your measurement results can, however, be compared to others to see if yours are typical or not. It must be remembered that no safe or unsafe levels have been determined.

IV.2. The measurements were higher in some areas (playgrounds, classrooms, etc.). Shouldn't the kids be prevented from entering those areas?

We cannot provide such advice, because we do not yet fully understand the risks, if any, of exposure to electric and magnetic fields. We have very little information on what scientists call "dose-response," that is, how much of a given exposure is how harmful, if at all.

IV.3. How do we get our school measured?

Your school officials may call your local electric utility or health department. Many power companies offer free electric and magnetic field testing. They may even have an office or individual who will assist the public with EMF questions. If not, your utility may know of private firms in your area who make such measurements or the phone directory may list environmental consultants who make EMF measurements. You may also be able to find someone who advertises in EMF trade publications such as Microwave News, EMF Health and Safety Digest, or in computer magazines. Magnetic field meters can be leased or purchased; many of the meters aren't too expensive or hard to use. Most of the manufacturers provide instructions that should be carefully followed in order to assure accurate results. EPA does not keep a list nor recommend or certify private contractors who make measurements.

IV.4. I heard that a nearby school had its schoolyard measured. I know the values. Is my schoolyard the same?

No, each schoolyard's magnetic field levels must be measured or calculated separately. An EMF measurement represents the intensity of electric or magnetic fields. The intensity of the fields decreases with distance from a source. Depending on where your schoolyard is located with respect to the power system, the field levels can vary. In addition, EMF levels are dependent upon the amount of current flowing through the electric power system. Field levels can also vary with time and weather conditions as a result of differences in electricity use for things such as air conditioners.

IV.5. Our children use VDTs at school. Is that safe?

VDTs, like other electrical appliances, generate electric and magnetic fields. VDTs have been a source of great concern not so much because the fields around them are greater than other sources, but because many of us spend so much of our time so close to them. VDTs also represent a relatively new and growing technology. Some epidemiological studies suggest no health risks from EMF exposures from VDTs, while some studies suggest a potential risk. Thus the health risks associated with VDTs are inconclusive.

IV.6. Can't the computer be set up to minimize exposure?

Yes, fields from VDTs can be reduced by reorganizing the workplace or changing how VDTs are used:

Work stations can be arranged so that an operator sits at least an arm's length from the monitor. Most people sit that far away anyway. At that distance, the fields produced by the monitor are usually less than background levels of EMFs from lights and building wiring.

The same practice could be applied to how close you are to machines operated by other people. Field levels are sometimes highest at the sides and back of a VDT. The field strength decreases rapidly with distance from the terminal. Levels at, say, two feet have dropped substantially. Therefore, it is possible to organize VDT equipment to reduce exposure from a neighboring VDT.

IV.7. Can you tell me about low emission VDTs and screens that are supposed to block EMFs? We were thinking about buying that sort of equipment for our school if it works.

Computer manufacturers are beginning to design and produce computers that emit lower electric and magnetic fields. Several computer magazines have recently reported measured fields around various models of VDTs (for example, MacWorld December 1990 and Info World November 1990). But it would be wise to verify any "low emission" claims by a manufacturer with measurements made by such independent sources.

There might be some tradeoffs between low emission VDTs and other VDTs for cost, availability, and machine capabilities. It is best to contact manufacturers for details on their products.

One way manufacturers reduce magnetic fields in computers is to place a metal called "mu metal" around the coils that produce the fields. The fields are still present, but the metal has the capability to contain them.

Laptop computers are different. The display screens on laptop computers do not use the cathode ray tube technology that emits EMFs from VDTs. However, the battery packs and chargers that laptops use sometimes produce fields around them like any electrical device.

Screens that are placed on the front of the monitor help block glare and may reduce electric fields, but they do not shield against magnetic fields.

IV.8. Besides power lines, substations, and VDTs, what are other common sources of EMFs in schools?

All electrical and electronic products are to varying degrees sources of electric and magnetic fields. These products are found at home, at work, and at school. Copy machines, cordless telephones, fluorescent lights, electric typewriters, word processors, printers, fax machines, coffee makers, vending machines, microwave ovens, and building wiring are some of the typical sources of electric and magnetic fields. Schools may have some additional devices or tools in laboratories or industrial arts workshops. In general, all electrical appliances and wiring can be considered to be sources of EMFs.

V. TRANSFORMERS

V.1. What are transformers?

Transformers are electrical devices used to adjust the voltage-current relationship of an electrical power circuit for best efficiency during transmission, distribution, and use. Utility companies use a variety of transformers throughout their systems. Step-up transformers are used at the power generating station to raise the voltage so the power can be economically delivered over transmission lines. Step-down transformers are used to reduce the transmission line voltage for distribution of electrical power to our homes.

Transmission and distribution substations, located where a main line has to feed a number of lower-voltage lines, are fenced yards containing transformers and other electrical equipment. Overhead (pole-mounted) transformers are used where distribution lines are overhead, and surface (pad-mounted) transformers are used where distribution lines are underground. Frequently in urban situations the substations (or equivalent) are located within buildings.

V.2. What is that metal electrical box on the corner of my lot.

If the electric distribution lines in your neighborhood are underground, the boxes you see in your neighborhood are probably surface (pad-mounted) transformers. Each transformer provides electrical service to several different residences (typically four to eight) in your neighborhood.

V.3. Do EMFs come from transformers?

There are electric and magnetic fields near the transformer and the lines that connect to them. This is because there is electricity running through the boxes. But, the fields tend to drop off very quickly as you move away from the transformers. Pad-mounted transformers can produce elevated magnetic fields close to their surface which are generally comparable to levels from other devices that use electric motors such as air conditioner compressor units.

V.4. Aren't there chemicals in the transformers?

Some older transformers contain an insulating fluid called polychlorinated biphenyls (PCBs) that are harmful to humans and the environment. But, PCBs have not been used in new transformers since the 1970's, and their use is being phased out in accordance with EPA regulations. You could consult your local electric company about transformers and PCBs.

V.5. Are transformers safe?

Transformers produce electric and magnetic fields. The fields from transformers are localized and decrease rapidly with distance. These fields are no different than fields from other sources. We do not know whether various levels of exposure to EMFs are harmful or not.

The high voltage equipment inside the box covering a pad-mounted or surface transformer can cause electrical shocks or burns, if touched. But pad-mounted transformers are required to meet local ordinance requirements for safety and so are insulated to protect against electrical shock hazards. Nevertheless, transformers should not be treated as toys or playground equipment. Children should be discouraged from playing on or near pad-mounted transformers or climbing trees near pole-mounted transformers. Your power company can provide you with further information on safety practices they follow for transformers.

VI. REAL ESTATE

VI.1. What are the regulations about EMFs that pertain to houses and real estate transactions?

At the present time there are no federal regulations or guidelines about power frequency EMFs. There are presently no state or federal regulations about EMFs and real estate transactions.

VI.2. What do I tell people about the power lines behind my house?

There are no federal requirements that obligate you to inform buyers about power lines or EMF levels in your house. In spite of the uncertainty about whether EMFs are hazardous, some state and local governments may set limits on EMF levels or may set some requirements, such as notification about EMF levels, for real estate transactions. Check with your state or municipality about local rules and regulations on EMFs.

VI.3. Should I buy/rent a house near a power line or substation?

The evidence on EMF effects is not clear enough to determine whether or not locating near a power line or a substation presents any health problem. But we do know that field levels decrease as distance from a source increases. With high voltage transmission lines, the field intensity drops off after a few hundred feet to "background" levels. There are charts in many brochures that show field levels at

various distances for several kinds of power lines. Occupants of the average household are probably exposed to higher fields from their house wiring and appliances than from the outside wiring.

Being close to power lines or substations could affect a property's value simply for aesthetic reasons; some people might find that situation to be a nuisance or unattractive. This issue may be only one of many factors to weigh and judge when making real estate decisions.

VI.4. If I am buying a house, can I get the seller to test for EMFs?

If you are considering buying a house and would like EMF measurements made, any agreement about who pays for them would be between the buyer and the seller. In many areas, the utility company will make tests upon request at no charge.

VII. MITIGATION

VII.1. How can I stop the fields from coming into my house? Can't I shield them?

There is no simple way to block EMFs since the fields are generated by the electrical system and devices in the home including the wiring and appliances. Electric fields from outside the home (power lines, etc.) are shielded to some extent by natural and building materials, but magnetic fields are not. The further a building is from an EMF source, the weaker the fields at the building would be. Keeping fields out of the home would mean keeping any electricity from coming into or being used in the home. Often the fields from sources inside the home (e.g., appliances, wiring, etc.) will result in higher fields than from sources outside the home.

VII.2. I commute on the subway/train - are there fields there? Is it safe?

Electrically-powered trains do produce electric and magnetic fields, especially when accelerating and decelerating. Studies are underway to try to define exposures, and to determine whether or not exposure to electric and magnetic fields from transportation systems, results in health effects.

VII.3. I've heard about "Prudent Avoidance." What is that? How can I apply it to my life?

Prudent avoidance is an approach to making decisions about risks. This decision-making process is based on judgment and values, can be applied by groups and individuals, and can be considered for all aspects of our lives, not just EMFs. Prudent avoidance applied to EMFs suggests adopting measures to avoid EMF exposures when it is reasonable, practical, relatively inexpensive and simple to do. This position or course of action can be taken even if the risks are uncertain and even if safety issues are unresolved. Prudent avoidance decisions about all sorts of risks are made by people every day. For example, we decide whether it is within our ability and desire to avoid possible hazards from activities such as driving automobiles, sun tanning, and participation in sports. Individuals make their own decisions based on their lifestyle, their concerns about risks, and their willingness to assume some cost or burden for a given action. U.S. EPA has no official policy on prudent avoidance of EMF exposure. Until the health issues are clearer, it is entirely up to individuals to decide if they wish to take actions which may or may not reduce any potential health risks.

The idea of applying the concept of prudent avoidance to EMF exposures was developed in a report written by Carnegie Mellon University, for the Office of Technology Assessment, titled "Biological effects of Power Frequency Electric and Magnetic Fields: Background Paper". Some examples of prudent avoidance from that report are: (1) "... put away their electric blanket (or electrically heated water bed) and go back to using regular blankets.;" (2) "... a motor driven electric clock ... may produce a fairly strong magnetic field by your head ... you could move it ... or replace it with one of the newer digital clocks ..."

VII.4. How can I avoid EMFs?

EMFs are produced by all electrical devices and electronic devices - power lines, microwave ovens, home wiring, appliances, light fixtures, VDTs, etc. It would be impossible to avoid EMFs completely, but field levels get lower the farther you are away from sources.

VII.5. What can be done to assure that new transmission/distribution lines have low fields? Can fields be completely eliminated?

You should direct questions of concern to the utility in question and to your state commissions that regulate placement (siting) of the lines. They should be able to provide information as to the calculated field strength of the proposed lines. State officials can provide you with information on any EMF regulations that might be in effect for your state.

All electrical devices produce EMF. There are designs that can reduce electric and magnetic field levels. However, the effectiveness and cost of these measures varies with the type of application (e.g., appliances, transmission lines, etc.). Fields cannot be eliminated, but rapidly decrease with distance. Research is underway on additional designs to reduce electric and magnetic field levels. Research on the configuration of transmission lines may allow reduction in field strength when transmission capacity is increased.

VII.6. What can be done to reduce fields from existing transmission/distribution lines? Can fields be completely eliminated?

Questions should be addressed to the utility which operates the line and appropriate state agencies to see if the line in question meets state EMF regulations, if any exist. All electrical devices as well as power lines emit electric and magnetic fields. EMFs cannot be completely eliminated as long as electricity is used. Research on ways to reduce fields from power lines and appliances is being studied, especially by the utility industry. Controlling exposures and field levels is termed mitigation, field management, or control technology engineering.

VII.7. What can be done to reduce or eliminate exposure in homes?

Electric and magnetic fields cannot be completely eliminated, if we want to have electricity and electrical appliances and other devices. As long as electrical devices are used, EMFs will be produced. Consultation with builders, architects or engineers might help identify some building practices that should reduce EMF exposure.

VII.8. What are utilities/manufacturers doing about reducing EMF exposure?

Questions concerning reduction of electromagnetic fields can be addressed directly by the utility or appliance manufacturers. The industry, primarily through the Electric Power Research Institute (EPRI), is conducting research and development on field management techniques. Government agencies and other countries are also working on field management techniques.

VIII. VDTs PLUS THE OFFICE ENVIRONMENT

VIII.1. I am concerned about EMFs and my VDT. What is the bottom line?

VDTs have been a source of concern not so much because the fields around them are greater than other sources, but because many of us spend so much of our time so close to them. There are several different kinds of health effects that have been suggested but not proven to be associated with EMFs. Currently available information is insufficient to conclude that electric or magnetic fields are carcinogenic. Studies of other health effects possibly associated with exposures from VDTs have been inconclusive. In the meantime, if you are concerned, you may want to arrange your work stations so that you sit at least an arms length

from your monitor. Most people sit that far away anyway. At that distance, the fields produced by your monitor are usually less than background levels of EMFs from lights and building wiring.

VIII.2. What can you tell me about low emission VDTs and screens that are supposed to block EMFs?

Computer manufacturers are beginning to design and produce computers that emit lower electric and magnetic fields. Several computer magazines have recently reported measured fields around various models of VDTs (for example, MacWorld December 1990 and Info World November 1990). But it would be wise to verify any "low emission" claims by a manufacturer with measurements made by such independent sources.

There might be some tradeoffs between low emission VDTs and other VDTs for cost, availability, and machine capabilities. It is best to contact manufacturers for details on their products.

One way manufacturers reduce magnetic fields in computers is to place a metal called "mu metal" around the coils that produce the fields. The fields are still present, but the metal has the capability to contain them.

Laptop computers are different. The display screens on laptop computers do not use the cathode ray tube technology that emits EMFs from VDTs. However, the battery packs and chargers that laptops use sometimes produce fields around them like any electrical device.

VIII.3. I read an ad that said this company's VDTs were safe and certified by EPA to have little/no EMFs. Is that true?

No, it is not. The EPA does not have any certification program, guideline, or standards for VDTs. Nor has EPA tested VDT emissions. The VDT may have low field emissions, or it may not. Several computer magazines have recently reported measured fields around various models of VDTs (for example, MacWorld December 1990 and Info World November 1990). If you choose to buy a "low emission" VDT, you might verify any "low emission" claims by a manufacturer with measurements made by such independent sources.

VIII.4. Who else can I talk to about different VDTs and claims about low fields and "safe" monitors?

The Center for Devices and Radiological Health (CDRH) in the Food and Drug Administration (FDA) is the federal agency with primary responsibility for controlling emissions from specific electrical and electronic consumer products such as VDTs. If you have some specific scientific or technical questions, the FDA would be your best source of information.

The National Institute for Occupational Safety and Health (NIOSH) has also conducted research on VDTs and office workers, and may be able to provide you with information.

The Occupational Safety and Health Administration (OSHA) has a brochure on VDT use. In addition to EMFs, the brochure has some helpful information on the use of VDTs to avoid problems such as eyestrain.

VIII.5. How do I contact the FDA, NIOSH, or OSHA?

The phone number for the Director of FDA's Center for Devices and Radiological Health is (301) 443-4690. If you call, ask to be directed to someone who can help answer questions about VDTs. Or, if you wish to write, the address for FDA is:

Center for Devices and Radiological Health
U.S. Food and Drug Administration
5600 Fishers Lane
Rockville, Maryland 20857

The FDA also has district offices throughout the country.

The group in the National Institute of Occupational Safety and Health (NIOSH) that deals with EMFs is based in Cincinnati, Ohio. You can call (513) 533-8482, or write to:

Physical Agents Effects Branch
NIOSH
4676 Columbia Parkway
Cincinnati, OH 45226

You can write to the Occupational Safety and Health Administration (OSHA) at:

OSHA
U.S. Department of Labor
Technical Data Center, N2439
200 Constitution Avenue, NW
Washington, D.C. 20210

VIII.6. Are VDTs different than my television?

VDTs and TVs are similar in design and operation. Both produce fields that can be similar in magnitude depending on the particular model or size of the unit. Some very large televisions might have higher fields than are emitted by your PC's VDT. Fields tend to be highest at the back, sides, and top of both devices rather than the front where you usually are. Color screens generally have higher fields than black and white or monochrome screens. The reason that people were advised to sit about 6 feet or more from a television is that some very early televisions produced a very small amount of weak X-rays (ionizing radiation). The solid state electronic circuitry of modern TVs in combination with thick picture tubes with lead have eliminated the problem of X-ray exposure.

VIII.7. How far should I sit from my VDT? What about from other people's VDTs?

There is not sufficient scientific information to say whether VDT emissions cause any health problems or not. However, sitting an arms length from your VDT greatly reduces your exposure to the field produced by it. (This is about where you sit anyway.) The same common sense rule could be applied to how close you are to machines operated by other people. When placing computers and VDTs, remember that fields tend to be highest at the back, sides, and top of VDTs rather than in front where the operator sits.

VIII.8. Why doesn't the U.S. have VDT standards like Sweden?

Actually the Swedish standard has not yet been ratified. Some of the standards are based on what is practical and easy for manufacturers to design and engineer in their products rather than on safety and health considerations. In general, we do not believe there is sufficient information about the health effects of EMFs to write responsible health-based guidelines for VDTs or other sources. We aren't even sure that the field strength is the most important thing to limit or reduce. For example, many scientists believe that changes in field levels may be more important biologically than the average value or magnitude of the fields.

You might want to discuss VDT standards in Europe with the Food and Drug Administration (FDA). The Center for Devices and Radiological Health (CDRH) in the Food and Drug Administration (FDA) is the federal agency with primary responsibility for controlling emissions from specific electrical and electronic consumer products such as VDTs. If you have some specific scientific or technical questions, the FDA would be your best source of information.

VIII.9. I've heard that laptops are safe. Is this true?

The display screens on laptop computers do not use the cathode ray tube technology that emits EMFs from VDTs. The battery packs and chargers that laptops use sometimes produce fields around them.

VIII.10. Is there someone who can come to our office to measure EMFs?

EPA does not keep such a list nor recommend or certify private contractors who make measurements.

You may be able to find someone who advertises in EMF trade publications or in computer magazines or listed in your telephone directory. Your local utility may be able to measure fields outside of your building free of charge, but they may not be willing (some are) to measure VDTs or other sources in your office or home. But, the utility may know of private firms in your area who could make such indoor measurements. Field meters can be purchased. Many of the meters aren't expensive or hard to use, but be sure to learn how to use them properly. Manufacturers usually provide instructions. (Also consult Chapter 2 when responding to questions on measurement.)

VIII.11. What are other common sources of EMFs in the office?

Copy machines, cordless telephones, fluorescent lights, electric typewriters, word processors, printers, fax machines, coffee makers, vending machines, microwave ovens, transformer rooms, and building wiring are some of the typical sources of electric and magnetic fields that are found in modern offices. In general, all electrical appliances and wiring can be considered to be sources of EMFs. But it is important to remember that field strength decreases rapidly with distance.

IX. RESEARCH

IX.1. Isn't all research being done by the utilities?

Much of the research in the past and at present has been funded by utilities largely through their research organization, the Electric Power Research Institute (EPRI). Federal agencies such as the Department of Energy, including its Bonneville Power Administration, have conducted and continue to support research. Research is also being sponsored by many foreign countries. The States of New York and California have supported research.

IX.2. Isn't that (utility) work biased?

The utilities are interested in determining whether or not exposure to EMF causes health effects. The research sponsored by the utility industry (typically performed by independent researchers) has been of high quality. This research has identified bioeffects and has suggested potential relationships between certain exposures and specific health effects and has contributed to our understanding of EMF effects.

IX.3. What research is underway now?

World-wide, there are more than 230 research projects underway, including epidemiological studies, laboratory studies on biological effects, and exposure and measurement studies.

IX.4. Why isn't the federal government doing more research?

The federal government has expended over $60 million in the past on EMF research. The rate of expenditure decreased in the early and mid-eighties, but increased to over $10 million in FY 92. There is currently a process underway to coordinate research among the federal, state, and private efforts.

IX.5. Why is the federal government so slow in responding?

This is largely due to the need to develop consensus between the executive and legislative branches of the government on what areas, out of the many high priorities faced by the government, are most clearly in need of support. It is only fairly recently that some consensus has grown to resolve that EMFs are an issue deserving more careful and extensive study.

X. STANDARDS AND REGULATIONS

X.1. Can the federal government make the power company move/change the transmission/distribution lines?

No, we cannot make the power company move or change power lines. Utility power line siting and operations are regulated by states and local governments.

X.2. Can the federal government stop the power company from putting in that new line or increasing the voltage?

No, we cannot stop the power company from making changes in their system. These sorts of actions are regulated by local or state governments.

X.3. What is a right-of-way (ROW)?

A right-of-way (ROW) is the area of land around a power line, usually most visible around a transmission line, that the utility uses. They typically extend 50-65 feet from the center of the line(s).

X.4. Measurements at the edge of the ROW are higher than state rules. What should I do to make the power company fix this?

Call the power company and talk it over. They may be willing to check it out for you. Or, they may be able to make additional measurement to compare to yours. Lots of factors can affect measurements and different instruments or meters may produce variable results. If you are still unsatisfied after talking to the utility, contact your local or state regulatory authority.

X.5. Why have some states written or proposed standards for EMFs?

Several states have standards of limits for electric or magnetic fields at the edge of ROWs. These states are Montana, Minnesota, New Jersey, New York, North Dakota, Oregon, and Florida. Electric field limits are most common. Some of these limits are old; some are new. Generally, since the potential health risks of EMF exposure is not known, several states took action to limit EMF exposure to present levels along existing ROWs. That is, exposures are not permitted to go any higher.

X.6. Why hasn't the federal government regulated EMFs?

Utilities are usually regulated by state and local authorities. In any event, the data on health effects from exposure to EMF is insufficient to establish responsible health-based standards.

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