

June 1994

ELECTROMAGNETIC FIELDS

Federal Efforts to Determine Health Effects Are Behind Schedule



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United States
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**Resources, Community, and
Economic Development Division**

B-256305

June 21, 1994

The Honorable George Miller
Chairman, Committee on
Natural Resources
House of Representatives

Dear Mr. Chairman:

This report responds to your March 2, 1993, request that we examine the public's exposure to the electromagnetic fields that are emitted from federally owned power lines. You also asked us to review the responses of states and utilities to the public's concerns about these fields and the efforts of the Department of Energy and other agencies to implement a federal electromagnetic field research and communication program, as mandated in the Energy Policy Act of 1992.

As arranged with your office, unless you publicly announce its contents earlier, we plan no further distribution of this report until 30 days after the date of this letter. At that time, we will send copies of the report to the appropriate congressional committees; the Secretary of Energy; the Secretary of Health and Human Services; the Director, National Institute of Environmental Health Sciences; and the Director, Office of Management and Budget. We will also make copies available to others upon request.

This work was performed under the direction of Victor S. Rezendes, Director, Energy and Science Issues, who can be reached at (202) 512-3841 if you or your staff have any questions. Other major contributors to this report are listed in appendix V.

Sincerely yours,

Keith O. Fultz
Assistant Comptroller General

Executive Summary

Purpose

The public is widely exposed to electromagnetic fields from many sources, including federally owned power lines located close to where people live and work. The public's concerns about these fields have grown as various studies have indicated an association between the fields and cancer—particularly childhood leukemia. However, the scientific community has not reached consensus that exposure to the fields harms human health.

Concerned about the health risks that the federal power line network may pose, the Chairman, House Committee on Natural Resources, asked GAO to determine (1) the extent to which federal power lines may expose people to electromagnetic fields, (2) the actions that state regulators and commercial and federal utilities have taken to mitigate exposure to electromagnetic fields from power lines and the costs of these actions, and (3) the status of the federal role under the Energy Policy Act of 1992 for determining the health effects of exposure to the fields.

Background

Electromagnetic fields are generated when electricity flows through the power lines of federal and commercial utilities. The fields are also generated by household appliances, office equipment, and wiring in buildings—sources that almost everyone is exposed to daily. The strength of the exposure to electromagnetic fields varies with the source and the distance from the source.¹ Generally, the closer the source, the stronger the field. For example, at 20 feet, a 230-kilo-Volt power line generates about 120 milligauss; at 300 feet, it generates under 2 milligauss. In contrast, at a distance of 1 inch, the exposure from a hair dryer ranges from 60 to 20,000 milligauss.

Federal and nonfederal organizations have been researching the potential health effects of electromagnetic fields since the 1970s. To focus increased resources on the issue, the Energy Policy Act of 1992 directed the President, the Department of Energy (DOE), and the Department of Health and Human Services' National Institute of Environmental Health Sciences to establish a coordinated, 38-month federal research program to determine whether exposure to the electromagnetic fields produced by generating, transmitting, and using electricity affects human health.² The

¹Units called "milligauss" express the strength of the magnetic field component of electromagnetic fields, while "kilo-Volts" express the strength of the electric field. Because potential human health problems have been associated primarily with magnetic fields, this report expresses the strength of electromagnetic fields in milligauss.

²The 38-month period is the interval between the statutory deadlines for selecting research projects and reporting the research findings to the Congress.

act specifies tasks that must be completed and associated milestones that must be satisfied to establish the research program. For example, by January 24, 1994, the National Institute of Environmental Health Sciences was to solicit and select research projects. The act requires the Institute to report its findings to the Congress by March 31, 1997. The act authorized DOE appropriations of up to \$65 million for the program. Federal funds may not be obligated unless they are matched by nonfederal funds.

Results in Brief

We estimate that less than 1 percent of the U.S. population lives near enough to federally owned power lines to be exposed to electromagnetic fields from those lines. The 50,000-mile federal power line network accounts for only about 2 percent of all U.S. power lines. Furthermore, according to data provided by federal utilities, about 85 percent of the federal power lines are located in nonmetropolitan areas where the public is unlikely to be exposed to electromagnetic fields. Sources other than federal power lines, such as home appliances and office equipment, are more common sources of exposure to electromagnetic fields.

Lacking conclusive scientific evidence on the health effects of exposure to electromagnetic fields, states and utilities have responded cautiously to the public's concerns and have taken relatively inexpensive and convenient measures to reduce the public's exposure. These measures, called "prudent avoidance," include restricting public uses of power line rights-of-way and limiting the strength of magnetic fields at the edges of the rights-of-way for new power lines to the levels emitted from existing lines. Future actions will be driven largely by the results of scientific research.

DOE and other agencies have missed milestones specified by the Energy Policy Act of 1992 for implementing a national research program on electromagnetic fields, thereby delaying much needed research on the health effects of the fields. According to DOE officials, the delays took place, in part, because of other competing priorities during the transition from one presidential administration to another in late 1992 and early 1993. Because of the delays, many research projects that are to be implemented under the act will not begin until fiscal year 1995, thus reducing the amount of information that can be obtained and reported to the Congress by March 31, 1997.

Principal Findings

Exposure to Electromagnetic Fields From Federal Power Lines Is Minimal

The U.S. public is less likely to be exposed to electromagnetic fields from federal power lines than from other sources. For instance, the Bonneville and Western Area Power administrations and the Tennessee Valley Authority (federal electric utilities) operate about 50,000 miles of the approximately 2.3 million miles of power lines nationwide. Of these 50,000 miles, approximately 7,500 miles are estimated by federal officials to be located in or near metropolitan areas, where higher population densities increase the number of people who may be exposed to electromagnetic fields. The remainder of the miles are located in sparsely populated areas, where opportunities for exposure are minimal.

More common sources of exposure to electromagnetic fields include electrical wiring in buildings, office and household appliances and equipment, and electric commuter rail trains and subways. Nationwide, exposure to electromagnetic fields from these other sources is significantly more common than exposure from federal power lines.

States and Utilities Have Taken Limited, Inexpensive Actions to Minimize the Public's Exposure

The public's concerns about the health effects of electromagnetic fields can delay or thwart planned power line projects. For example, in Pennsylvania, public pressure stemming from these concerns contributed to the cancellation of a planned 500-kilo-Volt, 268-mile power line project. According to a utility official, the delay and ultimate cancellation of the project cost the affected utilities \$23 million in legal and planning fees.

Facing public pressure without scientific consensus, states and utilities are responding in convenient ways that primarily affect planned, not existing, power line projects. In at least 11 states, state regulators have adopted prudent avoidance practices when utilities build or modify power lines. In New York, for example, magnetic fields at the edges of rights-of-way for high-voltage power lines cannot exceed 200 milligauss—the calculated median strength of fields from existing lines in the state. Similarly, federal electric utilities practice prudent avoidance. For example, the Bonneville Power Administration has decided not to erect power lines in populated areas if practical alternatives can be found. According to an analyst employed by Resources for the Future,³ about \$1 billion per year is spent in the nation to mitigate exposure from electromagnetic fields.

³A nonprofit natural resource and environmental policy research institution located in Washington, D.C.

If researchers develop a consensus that the fields pose a health threat, then states and utilities may need to implement more comprehensive and expensive measures to mitigate the fields' effects at existing as well as planned power lines. Such measures include reconfiguring power lines or burying them in fluid-filled steel pipes, purchasing wider rights-of-way, or buying homes near power lines and relocating the residents. Studies funded by states, utilities, and DOE's Energy Information Administration have found that implementing these measures could increase the costs of building and maintaining the lines by billions of dollars if the measures were applied across the United States. For example, according to preliminary estimates by the analyst at Resources for the Future, burying power lines near homes could cost \$200 billion nationwide.⁴

Electromagnetic Fields Research Program Is Delayed

Delays in implementing the federal electromagnetic fields research program have decreased the time available to perform the research directed by the Energy Policy Act of 1992. For example, the Office of Science and Technology Policy in the Executive Office of the President fell almost 11 months behind a statutory deadline in establishing an Interagency Committee to develop (1) a research agenda, (2) guidelines for coordinating the electromagnetic fields research activities of various federal agencies, and (3) recommendations for communicating the results of the research to the public. According to an Office of Science and Technology Policy official, despite the act's deadline of December 24, 1992, the Committee was not established until November 15, 1993, when it held its first meeting. Similarly, although the Secretary of Energy has signed a required agreement with the Department of Health and Human Services to delineate the agencies' roles in implementing the research program, the Secretary of Health and Human Services had not signed the agreement as of April 1994.

These delays, together with the 8 months required by the Institute to solicit, evaluate, and select research proposals, will affect the time available to complete many federal research efforts directed by the act. Projects will not begin until fiscal year 1995—leaving at most 30 months for research before the statutory reporting date. Thus, the final report to be delivered to the Congress by March 31, 1997, will be based on a reduced level of research.

⁴Present value discounted at 7 percent.

Recommendations

This report contains no recommendations.

Agency Comments

GAO obtained written comments on a draft of this report from DOE and the Institute. In its comments, DOE agreed that human exposure to electromagnetic fields from federal power lines is minimal. DOE and the Institute also agreed that some delays occurred in satisfying statutory deadlines for organizing the research program. However, neither DOE nor the Institute concurred with the report's conclusion that these delays will decrease the amount of research that can be completed by March 31, 1997. GAO believes that this view is inconsistent with the statements made by DOE's program staff and management during GAO's review. A program official explained that a 9-month reduction in research time would be difficult to offset by compressing research or by performing it concurrently because science frequently utilizes a "building block approach" through which later research builds on the results of earlier research. Furthermore, although research may still begin in calendar year 1994, because of the delays, it is now scheduled to begin around October 1994 instead of January 1994. DOE and the Institute did not provide information to show how they plan to overcome the 9-month delay in soliciting and selecting research projects. Therefore, GAO still concludes that the final report to the Congress will be based on a reduced level of research. The agencies also provided detailed editorial revisions and information about federal activities pertaining to electromagnetic fields that GAO incorporated in the report where appropriate. The agencies' comments and GAO's responses are discussed at the end of chapter 4 and in appendixes III and IV.

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Abbreviations

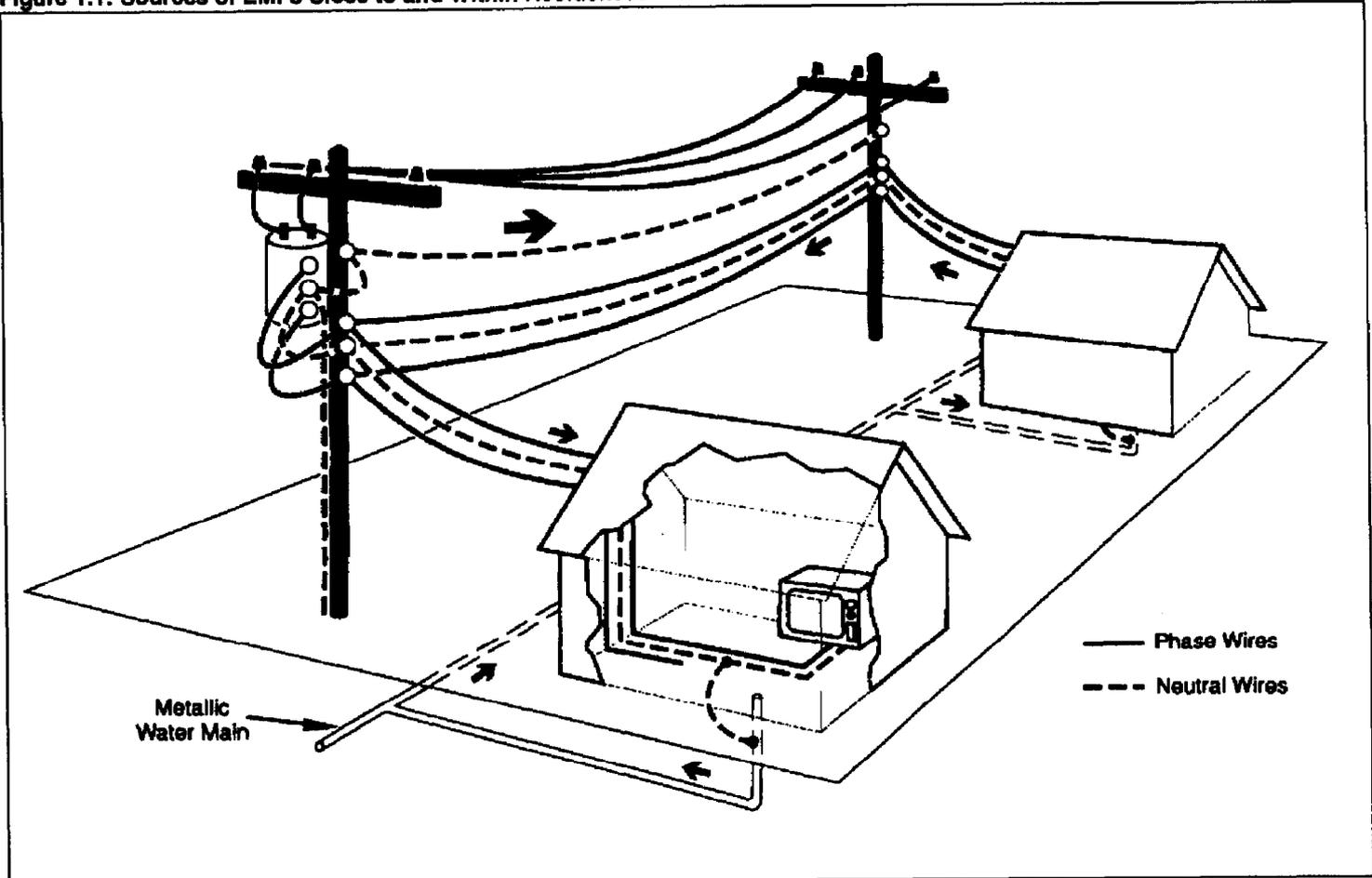
DOE	Department of Energy
DOT	Department of Transportation
EMF	electromagnetic field
EPA	Environmental Protection Agency
EPRI	Electric Power Research Institute
FDA	Food and Drug Administration
kV	kilo-Volt
mG	milligauss
NEMA	National Electric Manufacturers Association
NIEHS	National Institute of Environmental Health Sciences
NIOSH	National Institute of Occupational Safety and Health
OSTP	Office of Science and Technology Policy
PUC	Public Utility Commission
PG&E	Pacific Gas and Electric Company
TVA	Tennessee Valley Authority

Background

Electric and magnetic fields, more commonly called electromagnetic fields (EMF), are invisible lines of force that exist in any area near electric wires or devices. EMFs are commonplace in industrialized societies and occur whenever and wherever electric currents flow. EMFs are generated by transmission lines owned by commercial utilities as well as by those owned by federal utilities, such as the Tennessee Valley Authority and DOE's Bonneville, Western Area, and Southwestern Power administrations.¹ Distribution electric lines, wiring in buildings, and common appliances and office equipment—such as hair dryers, dishwashers, refrigerators, clothes dryers and washers, electric stoves and ranges, computers, video display terminals, and office copiers—are also sources of EMFs. Commuters who use electric commuter rail or subways are also exposed to EMFs from these modes of transportation. Figure 1.1 depicts some common sources of EMFs.

¹Transmission lines are power lines that can carry large amounts of power (in most cases, at least 69 kilo-Volts) to transformers. Lower-voltage distribution lines then deliver the power to homes and businesses. Except for a few miles of distribution lines, federal agencies operate only transmission power lines.

Figure 1.1: Sources of EMFs Close to and Within Residences



Note: Some sources of EMFs include appliances (a television set in this figure), grounding systems, and overhead distribution lines. The arrows indicate the direction of the current's flow. The current's flow may change when the load changes, as it does when appliances are used. Phase wires carry electricity to the point of end-use. Neutral wires complete the electrical circuit, returning the electricity to the transformer.

Source: Electric Power Research Institute.

The strength of EMFS is often expressed in terms of milligauss (mG).² EMFS rapidly weaken as the distance from the source of the field increases; for example, at 20 feet from a 230-kilo-Volt (kV) power transmission line, the average magnetic field is about 120 mG, while at 300 feet, it is under 2 mG. In contrast, at a distance of about 1 inch, an electric hair dryer emits from 60 to 20,000 mG and an electric shaver emits from 150 to 15,000 mG. Table 1.1 shows EMF strengths from various sources.

Table 1.1: Comparison of EMFs From Different Sources

Source	Distance from source	Field strength measured (mG)
230-kV overhead power line	300 feet	Less than 2
230-kV overhead power line	20 feet	Less than 120
Color television set	2 feet	2
Electric range	2 feet	2
Vacuum cleaner	1 foot	60
Electric blanket	2 inches	40
Microwave oven	1 foot	40 to 80
Electric shaver	1 inch	150 to 15,000
Hair dryer	1 inch	60 to 20,000

Note: Except for microwave ovens, electric shavers, and hair dryers, the field measurements are the median measurements taken. Actual EMF levels for an appliance depend on the model being used.

Source: Environmental Protection Agency and Bonneville Power Administration.

Scientific Research on Health Effects of EMFs Is Inconclusive

Numerous laboratory and epidemiological³ studies conducted over the years have tested whether exposure to EMFS is a cause of human illness. While some laboratory studies have shown that EMFS can induce biological changes, there is no consensus within the scientific community that exposure to EMFS causes serious health effects, including cancer. Although some epidemiological studies have positively associated exposure to EMFS

²Milligauss (mG) are the units used to express the strength of the magnetic field component of EMFs. Kilo-Volts (kV) are the units used to express the strength of the electric field component. Because potential human health problems have been most commonly associated with magnetic fields, this report expresses the strength of EMFs in mG.

³Epidemiological studies address the patterns of a human illness, such as cancer, within society. The studies use statistical methods to determine whether agents, such as EMFs, are associated with an increased risk of an illness.

and the risk of cancer, other studies have not demonstrated the same results.

Laboratory Studies Show Some Biological Effects

Laboratory studies involving the exposure of animals or cells to EMFs show that magnetic fields can cause biological changes. However, science has not linked biological responses to EMFs with cancer. Consequently, the human health implications of exposure to EMFs remain unclear.

For example, some research has shown that EMFs suppress the production of melatonin in rats. Melatonin, which is secreted by the pineal gland in the brain, guides biorhythms and may also have an effect on immune system activities. Some scientists believe that by suppressing the production of melatonin, EMFs may suppress the body's ability to fight tumors and may thus promote, but not initiate, cancer. Laboratory studies also show that magnetic fields affect the flux of calcium ions, which regulate cellular activities. These responses, some scientists theorize, may also promote biological changes that increase the risk of cancer without necessarily initiating new cancers.

Some Epidemiological Studies Suggest EMFs May Increase Risk of Cancer; Others Do Not

Since 1979, several epidemiological studies have suggested that for people—especially children—who live near electric transmission or distribution lines, the risk of cancers, such as leukemia, lymphoma, or cancers of the central nervous system, may be greater than for the general population. Other studies, however, have found no statistically significant correlation between exposure to EMFs and cancer.

The debate about whether EMFs cause cancer began in earnest in 1979 when two researchers, N.W. Wertheimer and E. Leeper, found a positive statistical association between exposure to magnetic fields and leukemia in children who lived near power lines in the Denver, Colorado, area.⁴ Because historic levels of EMFs cannot be measured directly, researchers frequently rely on substitute measures to estimate the levels of EMFs to which people were exposed over an extended period of time. For example, Wertheimer and Leeper's study relied on "wire codes" to estimate the levels of magnetic fields to which children were exposed over time. Wire codes are based on wiring configurations, the proximity of a house to power lines, and the estimated electric loads carried by the power lines. Some wire codes are presumed to represent higher, while others are

⁴"Electrical Wiring Configurations and Childhood Cancer," *American Journal of Epidemiology*, Vol. 109 (1979), pp. 273-284.

presumed to represent lower, historic EMF levels. The study found that children who lived in homes whose wire codes were associated with higher historic EMF levels were roughly twice as likely to develop leukemia as were children who lived in homes whose wire codes were associated with lower EMF levels.

Other studies replicated the association between exposure to EMFs and childhood leukemia. For example, the Savitz study, commissioned by the state of New York and also performed in the Denver area, found a statistically significant risk factor of 1.5 for childhood leukemia; these results were derived by comparing the incidence of leukemia for wire codes presumed to represent relatively high magnetic fields with the incidence of leukemia for wire codes presumed to represent relatively low magnetic fields.⁵ Furthermore, a study conducted in Los Angeles by London, Peters, and others⁶ found a statistically significant risk factor of 2.15, also for childhood leukemia.⁷ A Swedish study published in 1992 found a risk factor for childhood leukemia of 2.7 among children who lived near power lines and who were believed to have been exposed, over time, to magnetic fields that exceeded 2 mG.⁸

Other studies did not find a link between exposure to EMFs and leukemia but did find associations with other cancers. For example, a 1992 study of the association between exposure to EMFs and childhood cancers in Denmark found a statistically significant association between exposure to EMFs and childhood lymphoma.⁹ A 1986 study of cancer among people who lived near power lines found an increased risk for cancers of the brain and central nervous system but a decreased risk for leukemia.¹⁰

⁵David A. Savitz, et al., "Case-Control Study of Childhood Cancer and Exposure to 60-Hz Magnetic Fields," American Journal of Epidemiology, Vol. 128, No. 1 (1988), pp. 21-38.

⁶S.J. London, J.M. Peters, et al., "Exposure to Residential Electric and Magnetic Fields and Risk of Childhood Leukemia," American Journal of Epidemiology, Vol. 134, No. 1 (1991), pp. 923-937.

⁷Epidemiological studies express risks for a disease on a scale of zero to infinity. A risk factor of less than one indicates that a certain population is less likely than the general population to contract an illness. A risk factor of more than one indicates that a certain population is more likely than the general population to contract an illness. However, if the lower boundary of the confidence interval is less than one, then a risk factor is not statistically significant.

⁸M. Feychting and A. Ahlbom, Magnetic Fields and Cancer in People Residing Near Swedish High Voltage Power Lines (Stockholm, Sweden: Institutet for Miljomedicin, June 1992).

⁹J.H. Olden, et al., Residences Near High-Voltage Plants and the Risk of Cancer in Children (Copenhagen, Denmark: Cancer Registry of the Fight Against Cancer, Oct. 1992).

¹⁰L. Tomenius, "Fifty Hertz Electromagnetic Environment and the Incidence of Childhood Tumours in Stockholm County," Bioelectromagnetics, Vol. 7 (1986), pp. 191-207.

During the 1980s and 1990s, however, other studies found no association between exposure to EMFs and any type of cancer. A 1980 study conducted in Rhode Island found no association between exposure to EMFs and childhood leukemia.¹¹ Similarly, a 1990 study conducted in England¹² and a 1993 study of cancers in U.S. electric utility workers found no association between exposure to EMFs and cancer.¹³ A Finnish study did find elevated risks for childhood leukemia and cancers of the central nervous system; however, these findings were not statistically significant.¹⁴

It is important to note that even when findings are statistically significant, epidemiological studies do not prove causality between two factors; they merely show that two factors, such as EMFs and some types of cancers, coexist. Moreover, according to some researchers, studies may yield inconsistent results when the studies attempt to measure the incidence of relatively rare cancers with small samples.

The Public's Concerns About EMFs Affect Transmission and Distribution Projects

In the last decade, the public's concerns about the health effects of EMFs from power lines have affected the completion of transmission and distribution projects. State regulators as well as commercial and federal utilities have addressed these concerns without the benefit of scientific consensus about the human health effects of EMFs. According to DOE, over 100 challenges to the construction of new transmission lines have been filed in the past 10 years because people have expressed concerns about EMFs. Consequently, the public's concerns can force government officials and utilities to take actions, some of which may be costly and may delay the building of new power lines.

In Pennsylvania, for example, concerns about the health effects of EMFs led the public to oppose two planned transmission projects. In one case, an electric utility's attempt to energize and upgrade an existing but dormant power line in the Philadelphia area was delayed by EMF and other concerns. Although the Pennsylvania Public Utility Commission (PUC) approved the project on February 1, 1990, citizens intervened, complaining

¹¹J.P. Fulton, et al., "Electrical Wiring Configurations and Childhood Leukaemia in Rhode Island," *American Journal of Epidemiology*, Vol. 111 (1980), pp. 292-296.

¹²Myers, et al., "Overhead Power Lines and Childhood Cancer: A Case Control Study," *British Journal of Cancer*, Vol. 62 (1990), pp. 1008-1104.

¹³J.D. Sahl, et al., "Cohort and Nested Case-Control Studies of Hematopoietic Cancer and Brain Cancer Among Electric Utility Workers," *Epidemiology*, Vol. 4 (Mar. 1993), pp. 104-114.

¹⁴P.K. Verkasalo, et al., "Risk of Cancer in Finnish Children Living Close to Power Lines," *British Medical Journal*, Vol. 307 (1993), pp. 895-899.

that they had not been duly notified about the line's being energized. They stated they were concerned about the health effects of exposure to EMFs as well as about decreased property values, reduced aesthetics, and interference with television and radio reception. After many days of hearings and testimony, an administrative law judge decided in July 1993 that because evidence did not support a finding of a conclusive causal connection between exposure to EMFs and adverse human health effects, the utility should be allowed to energize the power line. A PUC staff member estimated that concerns about the effects of EMFs had delayed the energizing of the line by over a year.

In another case, a holding company and a Pennsylvania utility attempted to build a 500-kv, 268-mile transmission line from western to central Pennsylvania. At first, the project was delayed in order to resolve citizens' and regulators' concerns. PUC staff said that these concerns may have persuaded the holding company to cancel the project. These staff members added that, although concerns about EMFs were clearly the most important and most frequently cited, others were also voiced—including concerns about the project's high costs, impacts on electric rates, alleged variances with land-use plans, diminution of property values, and degradation of wildlife habitat and the environment. On December 8, 1993, the holding company announced its withdrawal from the project. A PUC staff person said that the project had not been resurrected; she believed that it had been terminated. The holding company's subsidiaries will write off \$23 million in legal and planning costs.

In Virginia, the public's concerns about EMFs affected the location of power lines. In the late 1980s, citizens of Alexandria, Virginia, expressed concerns about EMFs from the 4- and 34.5-kv distribution lines in the city's historic Old Town district. Despite the local utility's assurances that the power lines were safe, public pressures led the city and the local utility to initiate a project to bury the power lines in a 30-block area of Old Town. The local utility agreed to remove the overhead power lines, and the city agreed to acquire easements, install conduits, and restore the surface area. To complete the project, the city has budgeted about \$3 million over 6 years and expects its total costs to be about \$15 million over 30 years. Work in the 7-block area targeted in the first phase of the project took 36 months to complete from design through removal of the lines and cost the city \$1 million.

DOE Has Been Assigned the Lead Role in the Federal Research Effort

Research on the health effects of exposure to EMFs is widespread and has been going on since the late 1970s. As the primary federal sponsor of EMF research, DOE has spent about \$50 million through fiscal year 1992. According to DOE records, in fiscal year 1993 total funding for federal EMF research exceeded \$12 million, of which DOE contributed \$6 million. Other federal agencies that have sponsored or conducted EMF research include the Environmental Protection Agency, the Food and Drug Administration, the National Cancer Institute, the National Institute of Environmental Health Sciences, the National Institute for Occupational Safety and Health, the National Institute of Standards and Technology, the Department of Transportation, and the Department of Defense. (See app. I for a partial description of federal EMF research.)

Much research on the health effects of EMFs will be carried out through a program required by the Energy Policy Act of 1992. Under this act, DOE and the Department of Health and Human Services' National Institute of Environmental Health Sciences (NIEHS) are jointly responsible for directing a national EMF research and communication program. NIEHS is responsible for research on the possible effects of EMFs on human health. According to DOE officials, DOE will perform or sponsor research on, and the development and demonstration of, technologies for improving the measurement and characterization of EMFs and for assessing and managing exposure to EMFs. Moreover, DOE is responsible for negotiating an agreement with the Department of Health and Human Services for conducting EMF research and disseminating information about the results of its research projects. DOE will also transfer funds to NIEHS to pay for research activities. DOE and NIEHS will communicate information to the public about the results of the EMF research. Under the act, by March 31, 1997, NIEHS is to report its findings and conclusions to the Congress on the extent to which exposure to the EMFs produced by generating, transmitting, and using electric energy affects human health. Authority for the EMF research program ends on December 31, 1997.

The act authorizes up to \$65 million to be appropriated to DOE over 5 years for the program. Before federal funds can be expended, however, they must be matched by nonfederal contributions. Although the EMF research and communication program mandated by the act was authorized to begin in fiscal year 1993, funds were not appropriated for that year, nor did DOE request any funding from the Congress. DOE explained that the 1993 Energy and Water Development Appropriation Bill, which predated the Energy Policy Act of 1992, did not appropriate funds for the EMF research and communication program for fiscal year 1993.

However, through the 1994 Energy and Water Development Appropriation Bill, the Congress appropriated \$4 million for EMF research to be implemented under the act in fiscal year 1994. The federal funds are to be matched by nonfederal contributions of \$4 million. The Manager of DOE's EMF research and communication program expects that in fiscal year 1995 and beyond, federal and nonfederal funding for EMF research performed under the act will range from \$12 million to \$15 million per year. The Manager envisions that each year approximately \$2 million to \$3 million will be used for DOE's research on exposure to EMFs and on technologies to mitigate this exposure, about \$8 million to \$11 million will be used for NIEHS' research on the health effects of EMFs, and about \$500,000 to \$1 million will be used to compile and disseminate the research results. According to the Manager, at the same time that research is performed as authorized by the act, preexisting DOE research projects will continue to be funded at about \$6 million per year.

According to DOE's May 1993 draft strategic plan, the EMF research program's activities will be closely coordinated with the activities of other federal and nonfederal parties involved in EMF research. The largest private sponsor of EMF research has been the Electric Power Research Institute (EPRI), a nonprofit research organization for the electric utility industry. EPRI spent \$15 million in 1993 to study the health effects and exposure parameters of EMFs. Cumulative funding for EPRI's EMF research totaled about \$60 million through 1993. Other nonfederal research has been funded by state agencies and utilities in states such as California, Florida, New York, and Rhode Island.

Objectives, Scope, and Methodology

Concerned about the potential health risk that federal transmission lines may pose to people who live and work near them, the Chairman, House Committee on Natural Resources, asked GAO to determine (1) the extent to which federal power lines may expose people to EMFs, (2) the actions that state regulators and utilities have taken to mitigate exposure to EMFs from power lines and the costs of these actions, and (3) the status of the federal role under the Energy Policy Act of 1992 for determining the health effects of exposure to EMFs.

To determine the extent to which federal power lines contribute to EMF exposure, we initially contacted the Bonneville Power Administration, Western Area Power Administration, Southwestern Power Administration,

and Tennessee Valley Authority for available data.¹⁵ After finding that these agencies do not maintain precise, accurate data on the number of people that are exposed to EMFs from their transmission lines, we tried to match electronically digitized maps of federal power lines with population data from the Census tracts in which the power lines are located. However, we could not accurately determine by this method how many people live near federal power lines because the digitized maps did not contain the locations of all federal power lines and because Census tracts do not show precisely where persons reside. Ultimately, to illustrate the miles of federal lines that may expose people to EMFs, we obtained estimates from the Tennessee Valley Authority, the Bonneville Power Administration, the Southwestern Power Administration, and the Western Area Power Administration of the miles of federal power lines that are located in relatively populous metropolitan statistical areas. We also obtained data to show the relationship of federal power lines to nonfederal power lines. Moreover, from the Environmental Protection Agency and the Bonneville Power Administration, we obtained other data that compared EMFs from federal power lines with EMFs from common household appliances and office equipment.

To determine how state regulators, commercial utilities, and federal utilities mitigate the public's exposure to EMFs, we contacted regulatory and utility officials and reviewed documents on electric regulations from 11 states¹⁶ that had adopted formal or informal policies to address the public's concerns about the health effects of EMFs. We also contacted regulatory officials in Pennsylvania because the public's concerns about EMF health effects had contributed to a delay and a cancellation of planned transmission line projects in the state. We contacted the Director, Transportation and Environmental Services, for the city of Alexandria, Virginia, because citizens' concerns about the health effects of EMFs had caused the city and the local electric utility to bury power lines in the historic district of the city. To determine how much it may cost to reduce the public's exposure to EMFs, we reviewed cost estimates from the state regulatory agencies in Florida, New York, and Rhode Island; the Missouri Public Service (a utility); and an analyst at Resources for the Future—a nonprofit institution in Washington, D.C., that studies public policy issues.

¹⁵The Southeastern and Alaska Power administrations were not contacted because they do not have many miles of power lines.

¹⁶California, Colorado, Connecticut, Florida, Illinois, New Jersey, New York, Ohio, Rhode Island, Texas, and Wisconsin.

To examine efforts to implement a research program on the health effects of EMFS, as required by the Energy Policy Act of 1992, we conducted a legislative review of the act to identify the mandated tasks and deadlines for the President, DOE, and NIEHS. In addition, we interviewed officials from DOE, NIEHS, the Environmental Protection Agency, the National Cancer Institute, the National Institute of Standards and Technology, and the President's Office of Science and Technology Policy, and we reviewed budget and program documents.

We obtained comments on a draft of this report from DOE and NIEHS. Their comments and our responses appear in appendixes III and IV. We performed our work between May 1993 and April 1994 in accordance with generally accepted government auditing standards.

Exposure to EMFs From Federal Power Lines Is Relatively Low

Complete data are not available to quantify the public's exposure to EMFs from federal power lines. However, exposure to EMFs from these lines is low when compared with exposure from other sources. Specifically, (1) the miles of federally operated power lines account for only 2 percent of the total miles of transmission and distribution lines operated in the United States, (2) 85 percent of the federal power lines are located in nonmetropolitan areas where exposure to the EMFs emitted from those lines is relatively scarce, and (3) other sources of EMFs, such as home appliances and office equipment, are more common sources of EMFs for many people.

Federal Utilities Lack Data on Proximity of Population to Power Lines

The federal utilities—the Bonneville, Western Area, Southwestern, Southeastern, and Alaska Power administrations and the Tennessee Valley Authority—have not determined how many people are exposed to EMFs because they live or work near federal power lines. However, to address the public's concerns more proactively, the Bonneville, Western Area, and Southwestern Power administrations recently identified some schools and common civic areas close to their power lines.

For example, in 1991 Bonneville identified 14 schools, 9 parks and playground areas, and at least 8 other public areas, such as campgrounds and parking areas, in the geographic area near Puget Sound that were located near transmission lines. Bonneville's definition of "near" was nonspecific and was based on the judgment of the agency's personnel who surveyed the facilities in question. In early 1993, Western surveyed the location of "publicly sensitive" facilities that were located within 1,000 feet of transmission lines and substations—the distance considered in a Swedish study of childhood leukemia among residents who live close to power lines.¹ Western found that there were 67 schools, 11 churches, and 46 other common facilities located within 1,000 feet of its transmission lines. Ten of the schools were located 100 feet or closer to the lines. The Southwestern Power Administration also surveyed the location of public facilities near its power lines. Southwestern identified one school within 150 feet of a power line. The other federal utilities have not collected data on the locations of schools or other structures and have no plans to do so.

¹M. Feychting and A. Ahlbom, Magnetic Fields and Cancer in People Residing Near Swedish High Voltage Power Lines (Stockholm, Sweden: Institutet for Miljomedicin, June 1992).

Federal Power Lines Are a Relatively Small Source of EMFs Nationwide

Although the extent of the population's exposure to EMFs from federal power lines is unknown, it is small compared with the exposure from other transmission and distribution lines and from such sources as appliances and home wiring. Relative to other sources, federal power lines account for a small fraction of the population's exposure to EMFs nationwide.

Federal Lines Represent Small Portion of Total Miles

The miles of federal power lines account for only 2 percent of all the miles of power lines in the United States. Nationwide, there are over 2.3 million miles of power lines²; however, federal power lines account for only about 50,000 miles.³ According to a statement made by a researcher employed by Resources for the Future before the Subcommittee on Energy and Power, House Committee on Energy and Commerce, transmission lines contribute only a small fraction of the population's total exposure to magnetic fields. Specifically, this researcher estimated that only 1 or 2 percent of the nation's population live close to any of the transmission lines. His statement is consistent with information provided by officials of the Bonneville and the Western Area Power administrations, which shows that many miles of federally owned power lines are located in sparsely populated areas of the West, where few people are likely to be exposed to EMFs. Federal utility officials estimated that about 7,500 miles, or 15 percent of the total miles of federal power lines, are located in metropolitan areas. Therefore, it is likely that less than 1 percent of the U.S. population is exposed to EMFs from federal power lines.

Other Sources of Exposure to EMFs Are Also Common

High-voltage transmission lines are by no means the sole source of exposure to EMFs. As discussed in chapter 1, other significant sources of EMFs also exist. According to an EPRI report about exposure to EMFs in residences,⁴ the most common sources of EMFs in homes include not only the distribution lines from the utility but also the electrical appliances and the grounding system of the residences.⁵ The study concluded that average

²These miles of power lines include about 350,000 miles of transmission lines and over 2 million miles of distribution lines.

³The 50,000 miles of federal power lines are operated by the Tennessee Valley Authority, and the Bonneville, Western Area, and Southwestern Power administrations.

⁴L.E. Zaffanella, *Survey of Residential Magnetic Field Sources—Interim Report* (Palo Alto, Cal.: EPRI, Sept. 1992).

⁵The grounding system of a residence consists of the neutral wire of the service drop, the ground connection at the service entrance, and the conductive path, such as that provided by a metallic water distribution system.

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EMFs from distribution lines generally exceed the EMFs from other sources; however, at peak times, EMFs from electrical appliances exceed EMFs from distribution lines.

According to this study, accurately quantifying human exposure to EMFs would require a research program that would follow all of the activities of selected people over a specified period of time to account not only for the intensity but also for the duration of this exposure. Since people are exposed to EMFs throughout the day, it is not enough to quantify their exposure at home; a complete assessment also has to measure their exposure in nonresidential settings, such as offices, where significant exposure to EMFs may occur.

Efforts to Reduce Exposure to EMFs Have Been Limited But, If Increased, Could Be Costly

To address the public's concerns about EMFs from power lines and to reduce the public's exposure to them, state regulators as well as commercial and federal utilities have taken various actions. Thus far, such actions have been directed primarily at new or planned power lines and have generally been low-cost, easily implemented measures intended to reduce exposure to EMFs. These measures have not been based on scientific consensus about the health effects of exposure to EMFs.

If clearer scientific evidence of adverse health effects emerges, instituting comprehensive measures that would affect existing power lines could be exceedingly expensive. Although the costs of mitigating measures would depend on such factors as the design and geographic location of the power line structures, efforts such as burying and redesigning these structures could cost billions of dollars.

States and Utilities Have Adopted Practices to Mitigate Exposure to EMFs

State regulators and utilities (both federal and nonfederal) are responding cautiously to the public's concerns about power lines. Measures have generally not been taken in response to scientific findings but in response to the public's concerns. States and utilities have adopted "prudent avoidance" policies or practices calling for low-cost, easily implemented solutions that are intended to minimize the public's exposure to EMFs.

Some States Limit Magnetic Fields, Endorse Prudent Avoidance

Regulators in at least 11 states that we contacted have adopted practices for mitigating exposure to EMFs. For example, Florida and New York have limited the EMF levels of new transmission lines. In Florida, EMF limits at the edges of rights-of-way are 150 mG for transmission lines of 230 or fewer kV and 200 mG for larger transmission lines. New York has adopted an interim standard of 200 mG at the edges of rights-of-way, measured 1 meter above the ground. Officials from Florida and New York said that their magnetic field limits were based solely on the EMFs of existing lines and are applicable to new, not existing, transmission lines. They stated that these standards were not based on scientific evidence about exposure thresholds above which human health might be impaired.

The state of New York also directed utilities in the state to measure and model EMF levels along the distribution network for the entire state. Moreover, the New York Attorney General requested the state's electric utilities to perform comprehensive surveys of EMFs emanating from transmission lines near schools. The utilities then identified schools located near existing power lines and estimated the magnetic field levels

at the edge of the school property and in the school building nearest to the power line.¹ According to the results of the survey released in July 1993, 115 of the 6,129 schools in New York State are located near high-voltage overhead power lines, and magnetic fields at 24 of these schools exceeded 2 mG at some time during the year. Magnetic field levels, however, varied widely. For example, at one school, which was located near 69-, 115-, and 230-kV power lines, the peak magnetic fields in the building nearest to the power line were 33.5 mG, and the average magnetic fields were 28.3 mG. In contrast, at another school located close to 115-kV power lines, peak fields in the building nearest the power lines were only 0.2 mG.

Ten other states that we contacted have endorsed policies requiring utilities to apply prudent avoidance or related concepts when seeking approval to site new transmission lines or modify the location of existing ones. For example, Rhode Island law endorses the concept of prudent avoidance. The state also requires that electricity be produced not only at the lowest possible cost but also in the most environmentally friendly manner feasible. The state requires utilities that plan to construct new transmission projects to provide information to state utility regulators about the potential impact on public health of a planned project, including any increased risk due to an increased exposure to EMFs. (See app. II for a more detailed description of states' efforts to address EMFs.)

Commercial Utilities Have Responded to the Public's Concerns

Some commercial utilities have also adopted prudent avoidance or other "low-cost/no-cost" policies to address the public's concerns about EMFs. Such policies are not based on scientific knowledge about the health effects of exposure to EMFs. According to an official from the Edison Electric Institute, the national trade association for commercial ("investor-owned") utilities, "many" of these utilities have informally adopted such policies, although some utilities prefer to use the term "field management practices" rather than "prudent avoidance."

Certain utilities have taken proactive measures to reduce the public's exposure to EMFs. For example, Delmarva Power of Delaware limits magnetic field levels for new power line projects to 200 mG at the edges of its rights-of-way. According to a Delmarva official, the EMF standards, adopted in the late 1980s, were modeled on the standards of New York and Florida. The standards were established to allay customers' concerns

¹The Attorney General has defined the schools located "near" power lines as schools with property lines that are located within 100 feet of transmission lines.

about EMFs and are not intended to require "major mitigations," such as moving or burying existing power lines.

The Pacific Gas and Electric Company (PG&E), which serves San Francisco and northern California, has adopted a policy for addressing EMFs that includes (1) implementing low- and no-cost mitigation measures, (2) providing the public with information and education about EMFs, and (3) funding and sponsoring EMF research and development. In implementing low- and no-cost mitigations, PG&E funds measures that cost no more than 4 percent of a transmission project's total costs if these measures reduce EMF levels by at least 15 percent. PG&E's low- and no-cost policy was adopted as a guideline for state utilities by the California Energy Commission.

To educate the public about EMFs, PG&E inserted literature into customers' electric bills in the early 1990s. In addition, the utility offered to measure EMFs without charge at customers' homes, commercial and industrial facilities, and schools. PG&E is presently surveying some 6,000 schools in its service area to determine how many are close to transmission lines of 50 kv or more. Moreover, the utility supports and funds studies on EMFs that are conducted by the Electric Power Research Institute (EPRI), state agencies, and the federal government. The utility is studying the effects of EMFs on its own employees.

Federal Utilities Have Adopted Conservative Practices for New Lines

Federal agencies that generate and sell power have adopted prudent avoidance practices to mitigate the public's exposure to EMFs. The Tennessee Valley Authority (TVA), the Bonneville Power Administration, and the Western Area Power Administration are evaluating planned projects case by case in order to reduce the exposure to EMFs of nearby residences, businesses, and schools. In addition, in order to comply with the National Environmental Policy Act of 1969, as amended, Bonneville and Western solicit public participation and consider public comments when they evaluate the impacts of EMFs that would be generated by planned projects.

According to TVA officials, the agency's interim guidelines provide for locating lines no nearer than 1,200 feet from schools and hospitals and 300 feet from other buildings. In designing new transmission lines and upgrading existing ones, TVA reduces EMFs through such techniques as arranging lines in a triangular configuration, using taller structures to suspend transmission lines, reversing the phasing of adjacent lines, and

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using multiple circuits on the same transmission structures. For example, according to TVA officials, in the past 3 years TVA has increased the width of rights-of-way for 161-kV lines from 75 to 100 feet. Moreover, TVA informs customers of ongoing EMF activities and participates with distributors of TVA power in joint training sessions on how to measure EMF levels.

In deciding on the design and location of transmission lines, the Bonneville Power Administration exercises the prudent avoidance approach used by other utilities. Specifically, Bonneville considers potential exposure to EMFs as a major factor in its decision-making. Bonneville further maintains that it will not increase the public's exposure to EMFs if practical alternatives exist. For instance, when planning new power lines, Bonneville considers such options as increasing the width of rights-of-way and altering the geometry of the lines or towers. Bonneville has also imposed a moratorium on new development and on the use of the rights-of-way that it owns under transmission lines. Finally, Bonneville has issued guidelines that call for communicating proactively with the public about EMFs and for continuing to support research and development on EMFs.

The Western Area Power Administration has decided that it will take prudent avoidance actions in response to concerns about EMFs. Although Western has not adopted criteria for maintaining specific distances between transmission lines and particular structures, such as schools or residences, it has taken the position that, on a case-by-case basis, it will investigate alternative design and siting approaches for new and upgraded transmission facilities in order to reduce the public's exposure to EMFs. Unlike Bonneville, Western does not restrict the use of its rights-of-way because most of Western's rights-of-way are easements that are owned and controlled by private landowners. Also, in 1990, Western established an EMF Committee to study EMF issues and make policy recommendations to the agency's Administrator. The Committee addressed such matters as how the agency should respond to the public's inquiries about EMFs and how it should measure EMF levels for consumers.

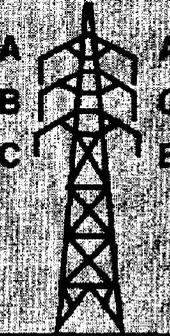
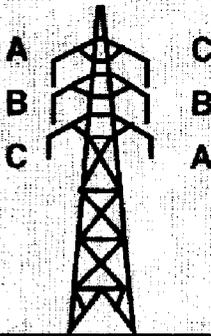
The Southwestern Power Administration, although relatively small, has also begun to address the public's concerns about EMFs. It has drafted a formal policy for investigating these concerns and has decided not to build or relocate lines within a nonspecific "reasonable distance" of homes.

Future Steps to Mitigate Exposure to EMFs Could Be Very Costly

If consensus is reached in the scientific community that EMF emissions from power lines pose a health hazard, overhead power lines can be designed and built to reduce EMF emissions by 75 percent or more.² Exposure to magnetic fields from new or existing overhead lines can be mitigated through such means as (1) increasing the widths of the rights-of-way, (2) heightening power line structures, (3) using double or multiple circuits, and (4) reconfiguring overhead power lines. Figure 3.1 shows how overhead transmission lines can be reconfigured to reduce EMF levels.

²The way in which EMFs may cause human illness is not understood. For example, the intensity of magnetic fields may or may not be the key parameter that determines whether the fields harm human health. Other factors that may be responsible include the frequency of the electric current (the number of oscillations of a current in 1 second, as measured in hertz) and biological effects that occur only in certain "windows" of intensity or frequency.

Figure 3.1: Ways of Reconfiguring Power Lines to Reduce Exposure to EMFs

METHOD	BASE DESIGN	REDUCED EMF DESIGN
MOVE CONDUCTORS CLOSER TOGETHER		
ARRANGE CIRCUITS TO OBTAIN SOME FIELD CANCELLATION	<p>CIRCUIT 1 CIRCUIT 2</p> <p>1 2</p> <p>A A</p> <p>B C</p> <p>C B</p> 	<p>CIRCUIT 1 CIRCUIT 2</p> <p>1 2</p> <p>A C</p> <p>B B</p> <p>C A</p> 
USE "DELTA" INSTEAD OF "FLAT" DESIGN	<p>"FLAT"</p> 	<p>"DELTA"</p> 

Source: Bonneville Power Administration.

Reducing EMF levels by reconfiguring overhead power lines can be more expensive than using the configurations that have been used in the past, usually because the new designs entail higher construction and maintenance costs. For example, according to a study sponsored by the state of Rhode Island, implementing the new designs can increase construction costs by up to 41 percent over conventional designs and life-cycle maintenance costs by up to 27 percent over the life of a transmission line.

Burying power lines can, under certain conditions, greatly reduce magnetic fields. For example, according to an engineering study prepared for the state of Florida, if buried 230-kV power lines are encased in fluid-filled steel pipe, then the EMF levels may decrease to about 3 percent of the EMF levels near overhead lines.³

Buried power lines, however, can be more expensive to build, maintain, and repair than overhead lines. Although overhead lines can be damaged by natural forces, such as wind and lightning, the damaged lines are easy to find. In contrast, underground lines are protected from most of these hazards, but locating and correcting damaged lines that are buried is difficult, time consuming, and expensive. A 1990 DOE report indicated that the average lifetime operating and maintenance cost per mile for an underground line was \$5,714, as compared with \$885 for an overhead line.⁴

A study of the options and associated costs for reducing magnetic fields from existing Missouri Public Service power lines also showed that the highest costs per mile were for burying the power lines.⁵ For example, in this study, the costs to reduce EMFs from a 161-kV line would range from \$90,000 per mile for using a delta design above-ground wiring configuration (see fig. 3.1) to \$2 million per mile for burying the line in a fluid-filled steel pipe. These two options would reduce magnetic fields by approximately 45 percent and 99 percent, respectively. While these cost estimates were made specifically for the Missouri Public Service power lines and the associated local conditions, they provide some indication of

³At voltages below 230 kV, utilities install solid dielectric direct buried cables more frequently than they install buried power lines encased in fluid-filled steel pipe. The dielectric buried cables are more economical to install and maintain and have less potential for causing environmental damage by leaking fluid. Although dielectric buried cables have reduced magnetic fields at short distances, the magnetic fields very close to the cables may be higher than magnetic fields from aerial lines.

⁴Financial Statistics of Selected Investor-Owned Electric Utilities, 1990, Energy Information Administration, Department of Energy (Washington, D.C.: Jan. 1990).

⁵Missouri Public Service is an electric utility.

the range of costs and results that could be associated with different designs.

The need to accommodate local environmental conditions when designing power lines complicates the selection of line designs and may ultimately increase the costs of building, operating, and maintaining power lines. For instance, a recent study performed in Florida identified factors such as high winds, lightning, and contamination from salt that could require utilities in the state to adopt different and perhaps more expensive line designs than utilities in other states.

An analyst for Resources for the Future estimated the costs of implementing certain regulatory and technical options nationwide. According to his estimates, about \$1 billion per year is spent in the United States to address the public's concerns about the health effects of EMFs. He also developed the following estimates:

- Limiting magnetic field levels to 10 mG at the edges of the rights-of-way for planned new transmission lines could cost \$1 billion.
- Reducing magnetic fields at homes where grounding systems are the dominant sources of magnetic fields could cost from \$3 billion to \$9 billion.
- Burying transmission lines nationwide near homes with magnetic fields greater than 1 mG could cost \$200 billion.
- Buying approximately 1 million homes that are estimated to be near power lines and exposed to magnetic fields exceeding 1 mG and then moving the residents could cost \$90 billion.
- Reducing the average exposure to fewer than 2 mG from all existing transmission and distribution lines could cost \$250 billion.⁶

These estimates are preliminary because, according to the analyst, they were based on initial data from a national study by EPRI of about 400 homes from a planned sample of 1,000 homes. Moreover, these estimates did not distinguish between federal or nonfederal lines and were based on projections that only 1 to 2 percent of the U.S. population lives close enough to transmission lines to be affected by them.

Conclusions

To date, states and utilities have taken actions to mitigate exposure to EMFs, such as prudent avoidance, mainly in connection with new power

⁶These estimates are expressed as the present value cost of new transmission lines discounted at 7 percent.

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line projects. These actions have not been taken in response to scientific knowledge about the health effects of EMFs; rather, they have been designed to respond to the public's concerns at minimal cost to utilities and ratepayers.

Future actions will be driven largely by the results of scientific research. If scientists widely conclude that EMFs pose adverse health effects, then the required actions could be very expensive. The costs of mitigating EMF emissions from existing and new lines will vary with various geographic, engineering, and environmental factors. Nevertheless, the estimates presented in this report, amounting in some cases to hundreds of billions of dollars nationwide, indicate the magnitude of the costs that could be incurred to reduce the public's exposure to EMFs from all transmission and distribution lines.

Efforts to Implement EMF Research and Communication Program Are Behind Schedule

The Energy Policy Act of 1992 mandated the establishment of a comprehensive federal research program to determine whether exposure to EMFs affects human health, to explore and develop technologies that can mitigate any adverse health effects, and to communicate the research results to the public. The act contains specific tasks that DOE and other agencies are to accomplish to implement the national EMF research and communication program. However, the agencies have not completed some of these tasks within the milestones established by the act. It is likely that the delays will reduce the amount of research that the agencies will complete before reporting the research results to the Congress by March 31, 1997—the statutory reporting deadline.

Agencies Have Missed Deadlines in the Energy Policy Act

The Energy Policy Act of 1992, which was signed into law on October 24, 1992, sets forth specific tasks and deadlines that DOE, the Department of Health and Human Services, and the President were supposed to complete in order to manage and organize a national EMF research and communication program. The act requires that the President name an Interagency Committee to (1) develop a comprehensive agenda for conducting research, development, and demonstration under the EMF research program, with particular emphasis on EMFs under 60-hertz frequency; (2) develop recommendations for guidelines for the coordination of the activities of federal agencies that research the human health effects of EMFs; (3) develop recommendations for communicating the research results to the public, including recommendations on the scope and nature of the information to be disseminated; and (4) monitor, review, and periodically evaluate the program. Moreover, the Secretary of Energy and the Secretary of Health and Human Services were to enter into an agreement to carry out research on the biological effects of EMFs and to compile and disseminate the results of this research. Also, the Secretary of Energy and the Director of the National Institute of Environmental Health Sciences (NIEHS) were to solicit and select proposals for EMF research to be performed. As table 4.1 shows, these tasks were not completed within the deadlines prescribed in the act—some were missed by nearly 11 months, and others have not yet been accomplished.

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Table 4.1: Status of Efforts to Implement the EMF Research and Communication Program

Task	Deadline in Energy Policy Act	Status as of Feb. 14, 1994
Office of Science and Technology Policy (OSTP), acting for the President, establishes EMF Interagency Committee.	Dec. 24, 1992	Committee held its first meeting on Nov. 15, 1993. Although the Committee has not been formally chartered, an OSTP official stated that the date of the first meeting is considered the date the Committee was established.
Interagency Committee publishes research agenda and related guidelines.	June 24, 1993	Committee received draft documents to review on Dec. 28, 1993. Final guidelines had not been released as of Feb. 14, 1994.
DOE and Department of Health and Human Services enter into an agreement on the scope of research to be performed.	Apr. 24, 1993	The Secretary of Energy signed a memorandum of understanding on Jan. 13, 1994; the Secretary of Health and Human Services has not signed the agreement.
DOE and NIEHS solicit and select research proposals.	Jan. 24, 1994	NIEHS released requests for applications on Oct. 30, 1993. Grant selection process is expected to be completed by Sept. 30, 1994. Fiscal year 1994 is the first year for which the Congress appropriated funding for the program.

Appointment of Interagency Committee Was Delayed

The Office of Science and Technology Policy (OSTP) in the Executive Office of the President, after being delegated responsibility by the President, was to establish an Electric and Magnetic Fields Interagency Committee by December 24, 1992.¹ An OSTP official explained that although the Interagency Committee has not been formally chartered, the date of the Committee's first meeting can be considered the date that the Committee was established. The Interagency Committee held its first meeting on November 15, 1993. OSTP and DOE officials said that the establishment of the Committee was delayed by the transition from one presidential administration to another during late 1992 and early 1993. During the high level of activity that accompanied the presidential

¹The Interagency Committee consists of representatives of DOE and NIEHS as well as the Department of Defense, the Department of the Interior, the Department of Labor, the Department of Transportation, the Environmental Protection Agency, the Federal Energy Regulatory Commission, the National Institute for Standards and Technology, the Occupational Safety and Health Administration, and the Rural Electrification Administration.

transition, the outgoing administration did not nominate members for the Interagency Committee. The new administration had to address competing priorities during the transition period and did not nominate members to the Committee expeditiously. According to DOE, before the members of the Interagency Committee were appointed, the Department organized an interagency working group that met regularly to coordinate and plan federal EMF research.

The Interagency Committee is responsible for developing planning documents to focus federal and nonfederal resources for researching the health effects of EMFS. The planning documents, which should have been developed by June 24, 1993, include (1) a comprehensive agenda for conducting research, development, and demonstration under the EMF research program; (2) recommendations for guidelines for the coordination of the activities of federal agencies that research the human health effects of EMFS; and (3) recommendations for communicating the research results to the public, including recommendations on the scope and nature of the information to be disseminated.

The Manager of DOE's EMF research and communication program said that DOE had conveyed a draft implementation plan containing the comprehensive research agenda, interagency coordinating guidelines, and communication recommendations to the Interagency Committee on December 28, 1993. On January 31, 1994, at its second meeting, the Interagency Committee suggested revisions to the planning documents. According to the Manager, DOE must analyze and incorporate the comments into the planning documents before the planning documents can be completed.

Other Deadlines Were Also
Not Satisfied

DOE and the Department of Health and Human Services had not entered into an agreement to implement the EMF research and communication program by April 1994. This agreement was to have been concluded by April 24, 1993. Specifically, DOE and NIEHS officials have drafted a memorandum of understanding, which states that DOE and NIEHS will cooperate in implementing their responsibilities under the act. The Manager of DOE's program said the memorandum of understanding identifies DOE's and NIEHS' roles only in principle and is not intended to facilitate the transfer of funds from DOE to NIEHS. Under the memorandum of understanding, NIEHS has sole responsibility for biomedical research on the health effects of exposure to EMFS, and, in consultation with the Interagency and Advisory committees, will solicit and support grants and

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contracts to conduct activities under the program. DOE has responsibility for the research, development, and demonstration of technologies to improve the measurement and characterization of EMFs. The Secretary of Energy signed the memorandum on January 13, 1994; however, the document still awaits the signature of the Secretary of Health and Human Services.

According to the Manager of DOE's program, DOE and NIEHS will also sign a procurement agreement that will designate specific areas for research and will also contain funding requests. This agreement, said the Manager, will enable DOE to transfer funds to NIEHS to fund research on the health effects of EMFs. The Manager does not expect this agreement to be completed until May 1994.

DOE also did not establish the Electric and Magnetic Fields Advisory Committee by December 24, 1992, as mandated by the act. The Advisory Committee—which consists of EMF experts; officials from state regulatory agencies; and representatives of electric utilities, electrical equipment manufacturers, labor unions, and the public—is to recommend to the Interagency Committee activities for the EMF research and communication program. The Advisory Committee, which was chartered on January 14, 1993, did not hold its first meeting until August 5, 1993.²

DOE Needs to Solicit
Additional Nonfederal
Funds

The Energy Policy Act of 1992 authorizes DOE to spend up to \$65 million in federal funds for EMF research. However, according to the Manager, DOE currently plans to spend \$32.5 million in federal funds through fiscal year 1997, to be matched by an equal amount of nonfederal funds. Under the act, DOE is not authorized to spend appropriated funds unless the amount of federal funding is matched by an equal amount of funding from nonfederal sources.

Although the act authorized the program to begin in fiscal year 1993, funds were not appropriated for that year, and DOE did not request funding for the program for that year. DOE officials explained that the 1993 Energy and Water Appropriation Bill was enacted before the Energy Policy Act of 1992; therefore, no funds were appropriated for the EMF research program for fiscal year 1993. For fiscal year 1994, the federal appropriation for EMF research under the act is \$4 million. According to DOE, as of March 1994, the Department had secured matching funds from private, public, and

²According to DOE officials, the Secretary of Energy sent letters of appointment to members of the Advisory Committee on March 31, 1993.

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cooperative electric utilities and from the National Electric Manufacturers Association (NEMA) for fiscal year 1994. Officials representing the electric utility industry said the delays in the program's implementation will have no effect on their intentions to contribute to the research program in the future.

According to officials from utility associations, DOE will have to solicit approximately \$9 million in additional nonfederal funds through fiscal year 1997, when the research program is to be terminated. Utility association and NEMA officials have pledged a total of about \$23.5 million of the \$32.5 million in nonfederal funds that DOE estimates is needed for the program. Officials from utility trade associations believe that the electric utility industry has pledged its fair share and that additional nonfederal funding should come from other industries, such as the railroad and electric appliance industries, that may be affected by the public's concerns about EMFs. Agreeing with this assessment, DOE published a solicitation for nonfederal funding in the Federal Register on December 7, 1993. In February 1994, the Manager of DOE's EMF research and communication program informed us that, except for NEMA, nonutility parties had not yet pledged funding to support the research program. He said that nonutility parties were not faced with the same public pressures as electric utilities to address the health effects of EMFs.

Because of Delays,
Amount of EMF
Research to Be
Performed May Be
Reduced

The Energy Policy Act of 1992 requires the Secretary of Energy to establish a comprehensive program to determine whether exposure to EMFs affects human health. The Director, NIEHS, is to report the research findings to the Congress by March 31, 1997. The act envisioned that DOE and NIEHS would implement an intensive and coordinated interagency research program over a period of about 38 months.³ However, because of the delays in establishing the Interagency Committee (discussed earlier in this chapter) and the lengthy process for soliciting and evaluating research proposals, DOE and NIEHS will be able to sponsor EMF research under grants for only about 30 months before the congressionally mandated reporting date.

The process of soliciting and evaluating research proposals began on October 30, 1993, when NIEHS published two requests for applications for research project grants—one for research on the effects of EMFs on cells

³If DOE and other agencies had met deadlines in the act, grant recipients would have had about 38 months to perform EMF research—from January 24, 1994 (the act's deadline for soliciting and selecting EMF research projects) until March 31, 1997 (the act's deadline for reporting the EMF research results to the Congress).

and another for research on the effects of EMFs on live animals. Grant applications were due to NIEHS by February 16, 1994. NIEHS officials explained that the research proposals will be evaluated and ranked by panels of scientists within the National Institutes of Health and then forwarded to NIEHS officials for the final selection. Grants will not be awarded before September 30, 1994, after the completion of the application and review process that is expected to last up to 8 months.

The delays in implementing the EMF research and communication program cast doubt on the completeness of the report that NIEHS is to release to the Congress by March 1997. The Manager of DOE's program explained that because of the delay in beginning EMF research, the final report to the Congress will be based on a reduced level of research. He said that research is not expected to begin until after research projects are selected (on September 30, 1994) and probably will not be completed until October 1997—well after the March 31, 1997, deadline for reporting to the Congress. Because research by grantees is not expected to begin until after September 30, 1994, DOE and NIEHS will conduct or sponsor research for only 30 months before the research findings must be reported to the Congress. The Manager explained that because scientific research programs generally build on the results of earlier research projects, the research presently being planned cannot be accelerated or performed concurrently in order to be completed by March 31, 1997. The Manager further stated that although a major breakthrough cannot be expected, the research to be accomplished should substantially contribute to resolving questions about the effects of EMFs on human health.

Conclusions

Delays in DOE's establishment of the EMF research and communication program mandated by the Energy Policy Act of 1992 have decreased the amount of research that can be completed by the act's statutory reporting date of March 31, 1997. While the act envisioned a 38-month federal research program, research grants will not be awarded until September 1994, limiting the research time under these grants to not more than 30 months before the statutory reporting date. Consequently, NIEHS' final report on the human health effects of exposure to EMFs, to be delivered to the Congress by March 31, 1997, will be based on a reduced level of research.

Agency Comments and Our Evaluation

GAO obtained written comments on a draft of this report from DOE and NIEHS. In its comments, DOE agreed that human exposure to EMFs from

Chapter 4
Efforts to Implement EMF Research and
Communication Program Are Behind
Schedule

federal power lines is minimal. DOE and NIEHS also agreed that some delays occurred in satisfying statutory deadlines for organizing the research program. However, neither DOE nor NIEHS concurred with the report's conclusion that these delays will decrease the amount of research that can be completed by March 31, 1997. We believe this view is inconsistent with the statements of DOE's program staff and management, as expressed during our review. As previously noted, the Manager of DOE's EMF research and communication program explained that a 9-month reduction in research time would be difficult to offset by compressing research or by performing it concurrently because science frequently utilizes a "building block approach" through which later research builds on the results of earlier research. Furthermore, although research may still begin in calendar year 1994, because of the delays, it is now scheduled to begin around October 1994 instead of January 1994. DOE and NIEHS did not provide information to show how they plan to overcome the 9-month delay in soliciting and selecting research projects. Therefore, GAO still concludes that the final report to the Congress will be based on a reduced level of research.

The agencies also provided detailed editorial revisions and information about federal activities pertaining to EMFs that we incorporated in the report where appropriate. The agencies' comments, together with our detailed responses, appear in appendixes III and IV.

Federal EMF Research Not Directed by the Energy Policy Act of 1992, as of April 30, 1994

Federal sponsor	General description of research activities
Department of Energy (DOE)	<p><u>Cellular studies</u>—DOE is researching (1) effects of melatonin on breast cancer cells after EMFs have suppressed the body's production of melatonin, (2) effects of EMFs on basic cellular processes (such as gene expression, neurite outgrowth, and gap functions), and (3) effects of EMFs on immune functions.</p> <p><u>Animal studies</u>—DOE is researching (1) EMFs and their effects on neuroendocrine functions, baboon behavior, and human physiological responses; (2) effects of EMFs on circadian activities in rodents; and (3) suppression of nocturnal melatonin rhythm by 60-hertz magnetic fields in hamsters.</p> <p><u>Engineering research</u>—DOE is (1) measuring internal electric fields in rats and (2) characterizing EMFs for motor-driven appliances and small electric appliances. Moreover, for DOE and the Electric Power Research Institute (EPRI), the National Institute of Standards and Technology conducts quality assurance site visits for assessments of EMF exposure and assists in developing apparatus and standards for measuring EMFs.</p> <p><u>Field management studies</u>—As part of an operational test of a 6-phase transmission line, DOE, in conjunction with EPRI and the Empire State Electric Energy Research Corporation, is constructing and testing a demonstration project for exploring reductions of EMFs. According to DOE, the primary purpose of the operational test project will be a higher flow of electric power; EMF reduction is a secondary benefit.</p> <p><u>Policy support</u>—DOE is summarizing federal and nonfederal EMF policy activities and identifying various public responses to specific EMF situations.</p>

(continued)

**Appendix I
Federal EMF Research Not Directed by the
Energy Policy Act of 1992, as of April 30,
1994**

Federal sponsor	General description of research activities
National Institute of Environmental Health Sciences (NIEHS)	<p>Cellular studies—NIEHS is researching (1) EMFs and cancer in cells that have been exposed to EMFs, (2) the promotion of cancer in cells exposed to magnetic fields, (3) the effects of EMFs on gene expression in yeast, and (4) human cell biology in an EMF environment.</p> <p>Animal studies—Studies conducted under NIEHS' National Toxicology Program characterize the toxicity and carcinogenicity of 60-hertz magnetic fields in rats and mice in order to determine whether the magnetic fields alter pineal functions and whether the fields cause developmental or reproductive toxicity. Specifically, according to NIEHS, a study of the effects of EMFs on reproductive development has been completed and a report has been drafted. Moreover, a report on the toxicity of EMFs is due to be published in April 1994. A 2-year carcinogenicity study in rats and mice will begin in August 1994.</p> <p>NIEHS has also initiated efforts to establish EMF exposure facilities at a Food and Drug Administration facility in Rockville, Maryland, and at a National Institute of Occupational Safety and Health facility in Cincinnati, Ohio. These facilities will be used to replicate studies and to explore the potential biological effects of EMFs that may explain the increased cancer rates found in some epidemiological studies.</p>
Food and Drug Administration (FDA)	<p>Cellular studies—FDA is researching (1) the effects of EMFs on oncogene expression and (2) neoplastic transformation induced by 60-hertz magnetic fields.</p> <p>Animal studies—FDA is researching the effects of EMFs on the development of embryos, including chick embryos.</p> <p>Engineering research—FDA's efforts include evaluating whole-body and local internal exposure to EMFs from power lines and appliances.</p>
National Cancer Institute	<p>Epidemiology—The National Cancer Institute is implementing research projects, including (1) a case control study in 11 states examining a broad range of environmental factors, including EMFs and their influence on childhood leukemia, and (2) a case control study of women in Seattle to examine the potential link between EMFs and breast cancer. Moreover, with NIEHS, the National Cancer Institute cosponsors a case-control study of malignant glioma (brain cancer) in adults in San Francisco.</p>
National Institute of Occupational Safety and Health (NIOSH)	<p>Epidemiology—NIOSH is studying members of the International Brotherhood of Electrical Workers to assess the mortality of 27,000 building and construction workers.</p> <p>Engineering research—NIOSH is investigating different methodologies for assessing occupational EMF exposure.</p>

(continued)

**Appendix I
Federal EMF Research Not Directed by the
Energy Policy Act of 1992, as of April 30,
1994**

Federal sponsor	General description of research activities
Environmental Protection Agency (EPA)	<p>Engineering research—EPA is developing portable instrumentation to measure and analyze magnetic fields in a nonlaboratory environment.</p> <p>Communicating about EMFs—EPA has written (1) a source book containing bibliographies, contact lists, research reviews, news clippings, and information on regulations and legislation; and (2) a brochure to answer commonly asked questions about EMFs. EPA also administers a hot line to answer questions about EMFs.</p> <p>EPA is also updating its summary and assessment of scientific EMF literature.</p>
Tennessee Valley Authority (TVA)	<p>Engineering research—Along with EPRI and Empire State Electric Energy Research Corporation, TVA is determining whether transient fields vary across different types of wiring systems.</p> <p>Field management studies—TVA is (1) analyzing and demonstrating various line configurations and conductor arrangements and (2) developing workstations to provide remote data collection and interactive analysis of EMFs.</p>
Bonneville Power Administration	<p>Animal studies—Bonneville is researching the effects of EMFs from power lines on melatonin levels in sheep.</p> <p>Engineering research—Bonneville is calculating fields from power lines and developing a new statistical approach for estimating exposure to EMFs.</p> <p>Field management studies—Bonneville is experimenting with field reduction by reducing the phase spacing of a transmission line near a school and correlating actual, measured reductions with theoretical, projected reductions.</p>
Department of Transportation (DOT)	<p>Engineering research—DOT has finished efforts to characterize EMFs from different rail systems and to measure magnetic fields around vehicles at a test facility for magnetic levitation trains.</p> <p>Field management studies—DOT is investigating passive and active high-temperature superconducting shielding.</p>

States' Efforts to Mitigate the Public's Exposure to EMFs, as of April 30, 1994

State	Actions taken
California	California adopted no-cost/low-cost (prudent avoidance) guidelines for new and upgraded transmission facilities.
Colorado	On November 30, 1992, the Colorado Public Utilities Commission ruled that prudent avoidance would be the standard procedure when utilities plan, site, construct, and operate transmission lines.
Connecticut	According to a state official, the state is studying how to address EMFs. Currently, the state's "best management practices" policies require utilities to implement nonspecified methods to reduce EMFs. Moreover, Connecticut also implements a "voluntary exposure control" policy that encourages concerned individuals to educate themselves about the EMF issue in order to make informed choices about reducing or avoiding exposure to EMFs.
Florida	According to state officials, the state has (1) limited magnetic fields at the edges of rights-of-way to 150 mG for new lines equal to less than 230 kV and 200 mG for 500-kV lines and (2) required utilities to submit EMF information to the Public Service Commission when proposing to build transmission lines.
Illinois	In March 1992, the Illinois Department of Public Health and Illinois Environmental Protection Agency, in a report to the state legislature, recommended that utilities reduce EMF levels by implementing "prudent" measures, such as buying wider rights-of-way for transmission lines, avoiding schools and population centers when erecting transmission lines, and using low-EMF configurations for transmission lines.
New Jersey	According to state officials, New Jersey has (1) reached informal agreement for utilities to identify schools and school facilities within 100 feet of transmission lines and to measure EMFs at these locations and (2) adopted an informal prudent avoidance policy that it implements case by case, as utilities file applications to build or remodel transmission lines.
New York	New York has (1) adopted an interim standard limiting magnetic field levels to 200 mG at edges of rights-of-way for new power lines, (2) directed utilities to model EMF levels throughout the state, and (3) requested utilities to identify schools near transmission lines of 69 kV or more. EMF research is funded through state agencies and private organizations.
Ohio	The state generally practices its prudent avoidance policy when utilities apply to site new power lines and requires utilities to minimize the exposure of schools, hospitals, nursing homes, community centers, and churches to EMFs. The Ohio Power Siting Board approves applications for power lines and rights-of-way after utilities (1) examine the nature and impact of EMFs on residences, farms, highways, recreation areas, and other places of assembly near the planned facility and determine how to mitigate these impacts; (2) estimate EMFs at the edges of the planned rights-of-way under various load scenarios; and (3) detail the utility's consideration of EMFs, both generally and specifically for the proposed project.

(continued)

Appendix II
States' Efforts to Mitigate the Public's
Exposure to EMFs, as of April 30, 1994

State	Actions taken
Rhode Island	Rhode Island formally endorses prudent avoidance. In addition, it requires utilities to (1) produce electricity at the lowest cost and in an environmentally friendly manner and (2) provide data on potential public health impacts, including increased EMF exposure, for planned transmission projects.
Texas	According to a state official, Texas has no formal EMF policies but implements a de facto prudent avoidance policy for new transmission projects. In March 1992, the state's Electro-Magnetic Health Effects Committee endorsed the state's informal prudent avoidance policy but recommended that the Public Utility Commission not expand existing transmission line routing criteria to include concerns about EMF health effects. The Committee also recommended that the state not set EMF standards through guidelines, regulations, or legislation.
Wisconsin	The state requires utilities to favor resource options that decrease EMFs, such as demand-side management programs, when planning future electric resources. When applying for new transmission lines or upgrading existing ones, utilities must (1) use new designs that will reduce EMF levels in a cost-effective manner (referred to as the "best available control technology"); (2) identify schools, hospitals, day care centers, and homes within 300 feet of the planned project and estimate EMF levels along the power line corridor; and (3) file plans detailing how they will reduce EMFs. Utilities also fund EMF research, including research on the uniform measurement of EMF levels.

Comments From the Department of Energy

Note: GAO comments supplementing those in the report text appear at the end of this appendix.



Department of Energy
Washington, DC 20585

May 4, 1994

Mr. Victor S. Rezendes
Director, Energy and Science Issues
Resources, Community, and
Economic Development Division
U.S. General Accounting Office
Washington, D.C. 20548

Dear Mr. Rezendes:

The Department of Energy appreciates the opportunity to review and comment on the General Accounting Office draft report GAO/RCED-94-115 titled "Electromagnetic Fields: Federal Efforts to Determine Health Effects Are Behind Schedule." While the Department agrees with the report's conclusion that exposure to electric and magnetic fields from Federal power lines is minimal, we do not concur with the conclusion that delays in implementation of the Electric Magnetic Fields Research and Public Information Dissemination Program will result in a decrease in the amount of research that can be completed by March 31, 1997.

The report states that the Department has missed key milestones associated with the organization and management of a national electromagnetic field research program specified in the Energy Policy Act of 1992. These milestones include the establishment of the Advisory Committee and the Interagency Committee, entering into an agreement between the Secretary of Energy and the Secretary of Health and Human Services on program implementation, and the timely solicitation and selection of research proposals. Please be aware that the Advisory Committee was chartered on January 14, 1993. With the required input from the Secretary of Health and Human Services, the Secretary of Energy sent letters of appointment to the Advisory Committee members on March 31, 1993. In addition, the Energy Policy Act required the President to establish the Interagency Committee. While the Interagency Committee did not have its first meeting until November 15, 1993, the Department worked in the interim through an interagency working group to facilitate the development of a research agenda and to enhance the interagency coordination of efforts.

In early 1993, the Department drafted a Memorandum of Understanding between the Secretary of Energy and the Secretary of Health and Human Services concerning program implementation. The Department has worked diligently with the National Institute of Environmental Health Sciences on the finalization of this document. The resultant Memorandum of Understanding was signed by the Secretary of Energy on January 13, 1994, and is awaiting signature by the Secretary of Health and Human Services. The interagency agreement mentioned in the report will be a procurement document that will transfer funds from the Department to the National Institute of Environmental Health Sciences to implement the program.

See comment 1.

See comment 2.

See comment 3.

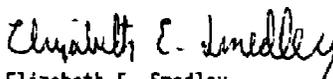
Appendix III
Comments From the Department of Energy

See comment 4.

The 1993 Energy and Water Development Appropriation Bill, which was enacted on October 2, 1992, predates the Energy Policy Act of 1992, which was enacted on October 24, 1992. The first fiscal year in which the Department could and did request an appropriation for the program authorized by the Energy Policy Act was 1994. For the fiscal year 1994 appropriation, the Department has, in a timely manner, solicited and is receiving non-Federal contributions to implement the program. The Energy Policy Act states that the Secretary of Energy may not obligate funds for this program in any fiscal year unless funds received from non-Federal sources are available to offset at least 50 percent of the appropriations for that fiscal year. The minimal level of non-Federal contributions to initiate implementation of the program was met in March 1994. Concurrent to the collection of required non-Federal contributions, both the Department and the National Institute of Environmental Health Sciences have initiated efforts on procurements for this program to minimize any slippage in the implementation of the program. For example, in October 1993 the National Institute of Environmental Health Sciences issued application requests for health effects research grants. Therefore, the report's conclusion that significant delays on the part of the Department have decreased the amount of research that can be completed for the mandated March 31, 1997, report is inaccurate.

In addition, minor editorial changes have been provided to the General Accounting Office in a letter forwarded under separate cover. The Department hopes that the comments in both letters will be helpful in the preparation of a more accurate final report.

Sincerely,


Elizabeth E. Smedley
Acting Chief Financial Officer

The following are GAO's comments on DOE's letter dated May 4, 1994.

1. DOE did not provide any new information in its response letter to support its disagreement with our report. Furthermore, this disagreement appears to be inconsistent with the views and explanations of DOE staff whom we contacted during our review. For example, DOE staff acknowledged that the program was hampered by repeated delays and stated that the Congress would benefit from a full EMF research effort. The staff therefore expressed the wish that the Congress would extend the reporting deadline in the act so that more research could be implemented. In response to our questions, the Manager of DOE's EMF research and communication program explained that it would be difficult to make up the lost time by simultaneously performing or compressing the research. As indicated in our report, he explained that the research would utilize a "building block approach" through which later research would build on the results of earlier research.
2. DOE did not furnish significant new information in response to our finding that DOE, NIEHS, and the President's Office of Science and Technology Policy missed deadlines in organizing the national EMF research and communication program. Our draft report stated that the Advisory Committee was chartered on January 14, 1994, and our final report notes that letters of appointment were sent to committee members on March 31, 1993. However, the Advisory Committee was established after the December 24, 1992, deadline specified in the act. Our draft report also stated that the Interagency Committee held its first meeting on November 15, 1993—the date that both DOE and the Office of Science and Technology Policy hold as that Committee's formal founding date. It should be noted that the statutory date for establishing the Interagency Committee was December 24, 1992. We agree that DOE worked through a staff-level interagency working group to facilitate the development of the research agenda, and our final report reflects the work of that group.
3. Although the act called for DOE to enter into an agreement with the Department of Health and Human Services by April 24, 1993, this agreement has not yet been completed. The final report indicates that the Secretary of Energy signed the memorandum of understanding on January 13, 1994. It also contains information conveyed by DOE about the interagency agreement.
4. We still conclude that delays in establishing the organizational and management framework for the program will decrease the amount of

research that will be accomplished. As stated in chapter 4, DOE, NIEHS, and the Office of Science and Technology Policy missed key deadlines for accomplishing such tasks as establishing the Interagency Committee and concluding the memorandum of understanding between DOE and the Department of Health and Human Services. Most significantly, under provisions of the act, research proposals were to have been solicited and selected by January 24, 1994. Although the research solicitations were issued on October 30, 1993, the researchers for the health effects research will not be selected until September 30, 1994—over 9 months late. Had NIEHS met the deadline in the act for soliciting and selecting researchers, the March 31, 1997, report to the Congress could have been based on research performed over about 38 months—from February or March of 1993 through early 1997. Instead, because of the delays described in the report, the report to the Congress will be based, to a large extent, on grant-funded research that will be performed over only about 30 months—from about October or November 1994 through early 1997.

Comments From the National Institute of Environmental Health Sciences

Note: GAO comments supplementing those in the report text appear at the end of this appendix.



DEPARTMENT OF HEALTH & HUMAN SERVICES

Public Health Service

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National Institute of
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P.O. Box 12233
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April 22, 1994

Mr. Victor S. Rezendes
Director for Energy Issues
Resources, Community, and Economic
Development Division
U.S. General Accounting Office
Washington, DC 20548

Dear Mr. Rezendes:

Thank you for the opportunity to review and comment on the draft of your proposed report: **Electromagnetic Fields-Federal Efforts to Determine Health Effects are Behind Schedule (GAO/RCED-94115, Code 307322).**

In this letter, I will provide you with general comments with respect to the draft report. I am also including comments contained in a memorandum (dated April 1, 1994) to me from Dr. Gary Boorman and Ms. Naomi J. Bernheim of the National Institute of Environmental Health Sciences (NIEHS) and a draft of comments from the Department of Energy (DOE). I concur with the content of these two documents and urge that you incorporate them in the final version of your report.

My comments follow:

1. The title you selected for your report skillfully deflects attention from the original intent of Congress in requesting the General Accounting Office (GAO) to examine the extent of human exposure to electric and magnetic fields from Federally owned power lines. The difficulty encountered by the GAO in carrying out the request to evaluate human exposure from these lines is symptomatic of the enormous complexity of designing a research and public communications program to address the public policy questions and the scientific uncertainty involved in determining whether the electric and magnetic fields generated by the transmission and use of electric power pose any risk to human health.

In selecting the title you focus attention on a failure of the Executive Branch to formally establish committees authorized in the National Energy Policy Act and obtain the signatures of two Cabinet Secretaries on certain internal documents. The title and the content of the report ignores the substantial efforts made by DOE and NIEHS to design and

See comment 1.

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begin the implementation of a national program to resolve a critically important public policy matter with the vast potential to affect human health and the economic health of the electric power industry in the United States.

See comment 2.

2. The draft report suggests that much valuable time has been lost in implementing the program. It is an unavoidable fact that funds to support the new authorities set forth in Section 2118 of the National Energy Act of 1992 could not be appropriated until fiscal year 1994. Still, substantial progress has been made to prepare for the efficient distribution of the funds appropriated. These include:
 - A. Development of a draft health effects research plan for the national program. The plan was presented to the National Advisory Committee at each of their three meetings and was adopted in principle at the meeting in November 1993. The draft plan was also presented to the Federal Interagency Committee.
 - B. In November 1993, two Requests for Applications (RFA's) to study the biological mechanisms that might explain how electric or magnetic fields could be involved in carcinogenesis or other health effects were published by NIEHS and distributed throughout the academic and private research communities. NIEHS received just over 100 applications for grants to support such studies. These applications will be peer reviewed in May 1994 and supported by funds appropriated by Congress for this purpose in fiscal year 1994.
 - C. NIEHS and DOE have jointly developed the first comprehensive plan to collect, evaluate, interpret, and communicate the findings of the worldwide scientific and engineering research efforts to measure human exposure to and possible biological and health effect resulting from exposure to electric and magnetic fields. This proposed public communications plan has also been presented to the National Advisory Committee and to the Federal Interagency Committee. This ambitious and unique plan will assure that the findings and recommendations contained in the required reports to Congress are based on both the research supported by the expanded and accelerated program and other relevant research supported through other public and private funding sources.

In summary, we do not share the somewhat pessimistic view expressed in the draft Report about the potential contribution to be gained from the expanded and accelerated programs of scientific and engineering research into the possible health

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effects from electric and magnetic fields. We have assumed our new responsibilities contained in Section 2118 with enthusiasm. We believe that our proposal for an intense and aggressive research effort, carried out in full partnership with DOE and with the careful oversight of Congress and the National Advisory and Federal Interagency Committees, will produce data that will reduce the current uncertainties about effects and management options regarding these fields.

Sincerely yours,



Daniel C. VanderMear, Director
Office of Program Planning and Evaluation

Enclosures

The following are GAO's comments on NIEHS' letter dated April 22, 1994.

1. We disagree with NIEHS' statement that the title of our report "skillfully deflects attention from the original intent of Congress in requesting the General Accounting Office (GAO) to examine the extent of human exposure to electric and magnetic fields from Federally owned power lines." Rather, we believe that the title of our report accurately conveys our primary message. We agree with NIEHS that the health implications of EMFs are a critical issue with significant policy and economic ramifications for the entire nation, and, like NIEHS, we believe that researching the health effects of EMFs will be time consuming and complex. We also agree that the EMF research and communication program, required under section 2118 of the Energy Policy Act, is an important effort to address many of these issues. Therefore, as requested by Chairman Miller's office, we focused much of our time and many of our resources on the progress being made by DOE and NIEHS in implementing the EMF research program rather than restricting our efforts to the relatively limited issue of EMFs from federal power lines.

We disagree with NIEHS' apparent belief that the delays in establishing the EMF research program are merely procedural matters and that these delays will have little or no impact on the amount of research that the government can perform before reporting to the Congress in March 1997. NIEHS states that the committees and agreements specified in the law are only "authorized." In fact, however, the Energy Policy Act required the establishment of the committees and the conclusion of certain agreements, and it specified dates for completing these tasks. The key delay specified in the report is the failure of the government to elicit and select research proposals by the January 24, 1994, deadline contained in the statute. Because of the delays in program implementation, NIEHS released the requests for applications in October 1993, and research grantees and projects will not be selected until September 30, 1994—9 months after the statutory deadline. In our view, the 9-month, or approximately 25-percent, reduction in the 38-month period allotted for research is significant.

During our fieldwork, the Manager of DOE's research and communication program explained that it would be difficult to offset the reductions in research time by compressing research or by performing it concurrently; he explained that science frequently utilizes a "building block approach" through which later research builds on the results of earlier research. In fact, during the course of our review, the Manager expressed his wish that

the program's March 31, 1997, reporting deadline could be extended so that the report to the Congress could be based on a full complement of research.

2. Although the Congress did not appropriate funding for the EMF research and communication program for fiscal year 1993, we believe that DOE, NIEHS, and the President's Office of Science and Technology Policy could have accomplished more during fiscal years 1993 and 1994 to organize the Interagency and Advisory committees, to conclude the agreement between DOE and NIEHS, and to solicit and select research proposals within the times required by law. As NIEHS remarked in its comments on the draft report, these tasks were primarily administrative; hence, in our view, they could have been accomplished without a separate appropriation. Moreover, if these tasks had been accomplished in a timely fashion, then DOE and NIEHS could have begun to implement key EMF research 9 months earlier than they are now able to do. Ultimately, for the reasons we stated in responding to NIEHS' first comment, we continue to disagree that the delays in program implementation will have little or no impact on the amount of EMF research that can be accomplished before the March 31, 1997, reporting deadline.

In addition, NIEHS' points A, B, and C serve to illustrate the delays in program implementation.

- Under the act, the draft health effects research plan for the national program (see NIEHS' points A and C) and its components (the comprehensive research agenda and the recommendations for interagency coordination and communication of research results) were to have been published by June 24, 1993. As stated in our report, when we completed our fieldwork, the research plan had not yet been approved by the Interagency Committee.
- According to NIEHS, two requests for applications (see NIEHS' point B) were issued in November 1993, will be peer reviewed in May 1994, and will be supported by funds appropriated by the Congress in fiscal year 1994. GAO reiterates that the act required the government to solicit and select research proposals by January 24, 1994—not by September 1994, as currently projected.

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