



Mark Twain Transmission Project

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Know the Facts about the Mark Twain Transmission Project

Ameren Transmission Company of Illinois (ATXI) is planning to build a 345,000-volt transmission line in northeast Missouri along with a new substation near Kirksville. Known as the **Mark Twain Transmission Project**, it consists of two line segments, from Palmyra to Kirksville, and Kirksville to the Iowa border. The total length of these segments is approximately 100 miles. The Mark Twain Transmission Project also includes construction of a 161,000-volt connector transmission line from the existing Adair Substation to the Zachary Substation. This connection will be approximately 2.2 miles in length.



- A need for delivering renewable energy** – Missouri law requires utilities to provide greater amounts of renewable energy. To help meet this need for renewable energy, the Midwest region's transmission system operator developed an electricity grid improvement plan, including the Mark Twain Transmission Project, to provide the transmission capacity needed to promote the development and delivery of renewable energy.
- Greater reliability** – From communications and transportation to manufacturing, virtually every aspect of our society depends not just on electricity, but a reliable supply of electricity. The Mark Twain Transmission Project will improve reliability by strengthening the Midwestern transmission grid.
- Job creation and economic benefits** – It is anticipated that construction of the Mark Twain Transmission Project will create 200 good, well-paying jobs. A study released on Sept. 30, 2014, by the Mid-Continent Independent System Operator (MISO) also found the economic benefit of the regional transmission plan to Missouri will be 2.3 to 3.3 times the transmission investment. Missouri electric customers all along the route will benefit from the availability of electricity transported on the Mark Twain Transmission Project line.
- A source of tax revenue** – The Mark Twain Transmission Project will lead to additional local tax revenue to support schools, roads, police and fire protection districts.
- No one source of power** – The power carried by the Mark Twain Transmission Project line will not come from any one source, but from any and all electric generation sources connected to the Midwest grid.
- A cleaner environment** – In its Sept. 30, 2014 study, the regional transmission operator finds its plan will reduce carbon emissions from electric generating units by 9 to 15 million tons annually.
- Compatible with farming** – The Mark Twain Transmission Project will utilize single-shaft, steel poles that do not require guy wires. Farmers can continue to use land under the transmission line for crops and pasture. Large equipment can be used around and under the transmission lines, with some restrictions and recommendations regarding proximity to the pole structures and clearances under the line. The line will be designed to meet or exceed minimum NESC code design clearances (25 feet for 345,000 volts). Our goal is to minimize the impact on agriculture.
- Acquiring easements** – The Mark Twain Transmission Line Project will primarily be built on permanent easements ranging in width from 100 feet to 150 feet depending on the voltage of the line. ATXI will need to acquire these easements, and additional land rights, from landowners. Project representatives will be contacting landowners for the purpose of conducting good-faith negotiations with a goal of reaching agreements with each landowner. Fair market value paid for the easements is discussed in more detail below. ATXI cannot rule out the possibility that eminent domain authority would be exercised if our good-faith efforts to negotiate the required easements prove unsuccessful.



- **Fair compensation for transmission line impact** – Landowners are fully compensated for the impact of the transmission line. ATXI's offer of compensation for easements is intended to "make the landowners whole" by fully compensating them for any effect on the market value of their property caused by the imposition of the easement. Upon completion of construction, ATXI's representatives assess, and, if necessary, repair or compensate landowners for damages that may result from construction of the transmission line. This includes damages to crops, soil, fences and other property or improvements.
- **No tax money** – No federal, state or local tax monies will be used to build, operate or maintain this transmission line. This transmission line will be built, operated and maintained by ATXI, a wholly-owned subsidiary of St. Louis-based Ameren Corporation.
- **Explaining electromagnetic fields** – Electromagnetic fields (EMFs) are generated by anything that uses or conducts electricity. Some typical in-home sources of EMFs include refrigerators, microwave ovens, vacuum cleaners, hair dryers, video display monitors and fluorescent lamps to name just a few. Distribution and transmission lines also can contribute to magnetic fields in homes, but the electric field from these outside sources contributes little to indoor levels because it is effectively shielded by building materials.

Based on a recent in-depth review of the scientific literature, the World Health Organization (WHO) concluded that current evidence does not confirm the existence of any health consequences from exposure to low level EMFs. Furthermore, it is clear that the exposure to EMFs of people living in the vicinity of high voltage power lines differs very little from the typical range of exposure of the entire population. Studies have also found no adverse effect of EMFs from power lines on crops or farm animals, including cattle that graze below power lines.
- **Compatible with hunting** – The Mark Twain Transmission Project will not interfere with hunting. According to the University of Michigan, "White-tailed deer prefer forest edges that are close to farmlands, old fields, and brushland." Thus, deer populations tend to do well where transmission lines border wooded areas. Ameren has also fostered a relationship with the National Wild Turkey Federation to improve turkey habitats in the right of way.

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FOR THREE DECADES, RESEARCHERS HAVE STUDIED ELECTRIC AND MAGNETIC FIELDS (ELECTROMAGNETIC FIELDS - EMF) — THOSE FIELDS GENERATED BY EVERYTHING ELECTRICAL FROM POWER LINES AND HOUSE WIRING TO PERSONAL COMPUTERS AND HOUSEHOLD APPLIANCES.



Ameren appreciates your interest in this scientific topic and hopes you find this brochure useful. We have included information from respected scientific sources to many of the questions previously asked by Ameren customers regarding EMF concerns. These sources include The National Institute of Environmental Health Sciences (NIEHS), The World Health Organization (WHO), United States Environmental Protection Agency (EPA), The International Commission on Non-Ionizing Radiation Protection (ICNIRP) and the American Conference of Governmental Industrial Hygienists (ACGIH).

If you need additional information on EMF, please visit the information sources websites, addresses provided, or call our EMF information line at 314.554.2402.

WHAT IS EMF?

Electromagnetic fields are generated by anything that uses or conducts electricity — not just power lines.

EMF consists of two components:

- Electric fields are created by the voltage of electricity in a wire (similar to water "pressure" in a hose) — the higher that voltage, the stronger the electric field. Electric fields are produced on any energized conductor regardless of whether current is flowing.
- Magnetic fields exist only when current is flowing (similar to water moving through a hose) — the greater the current, the stronger the magnetic field.

HOW ARE MAGNETIC FIELDS MEASURED?

The intensity of magnetic fields is measured with an instrument called a gauss meter. Field intensity is typically recorded in milligauss (one-thousandth of a gauss). Electromagnetic fields

decline substantially with distance from the source. Lines that are many feet away from a person offer less exposure than appliances that are much closer. Measurements are merely a snapshot of values at a given time and are valid only for that moment. Values can change dramatically depending upon the amount of electricity flowing through power lines or appliances at any given time.

Magnetic fields close to electrical appliances are often much stronger than those from other sources, including magnetic fields directly under power lines. Appliance fields decrease in strength with distance more quickly than do power line fields.¹ See table in this publication of typical field levels compiled by the National Institute of Environmental Health Sciences.

EMF EXPOSURE STANDARDS

Are there exposure standards for 60-Hz EMF? In the United States, there are no federal standards limiting occupational or residential exposure to power line EMF.² Two states have set standards for magnetic fields — Florida and New York.³

STATE TRANSMISSION LINE STANDARDS AND GUIDELINES

State	Magnetic Field	
	On R.O.W.	Edge R.O.W.
Florida	—	150 mG* (max. load)
	—	200 mG* (max. load)
	—	250 mG* (max. load)
New York	—	200 mG (max. load)

* R.O.W. = right-of-way (or in the Florida standard, certain additional areas adjoining the right-of-way). For lines of 69-230 kV. For 500 kV lines on certain existing R.O.W.

Ameren levels at the edge of Right-Of-Way for 345 kV transmission lines (75 ft) are typically at or below 90 mG.

TYPICAL MAGNETIC FIELD LEVELS FROM HOUSEHOLD SOURCES* (in milligauss, mG)

Distance from Source	6 in.	1 ft.	2 ft.	4 ft.	Distance from Source	6 in.	1 ft.	2 ft.	4 ft.
Blenders					Hair Dryers				
**Lowest	50	9	1	—	**Lowest	1	—	—	—
Median	200	40	5	—	Median	300	1	—	—
Highest	1,000	300	40	4	Highest	700	70	10	1
Power Saws					Video Display Terminals (PCs with color monitors)				
Lowest	500	40	3	—	Lowest	7	2	1	—
Median	600	150	20	2	Median	14	5	2	—
Highest	1,500	300	30	4	Highest	20	6	3	—
Vacuum Cleaners					Refrigerators				
Lowest	100	20	4	—	Lowest	—	—	—	—
Median	300	60	10	1	Median	2	2	1	—
Highest	700	200	50	10	Highest	40	20	10	10
Microwave Ovens					Fluorescent Lights				
Lowest	100	1	1	—	Lowest	20	—	—	—
Median	200	40	10	2	Median	40	6	2	—
Highest	300	200	30	20	Highest	100	30	8	4

The dash (—) in the above table means that the magnetic field measurement at this distance from the operating appliance could not be distinguished from the background measurements taken before the appliance had been turned on.

* From EMF in Electric and Magnetic Fields Associated with the Use of Electric Power, National Institute of Environmental Health Sciences (June 2002).

** Refers to the lowest, median and highest readings of all appliances measured in each category.

TYPICAL MAGNETIC FIELDS PRODUCED BY AMEREN TRANSMISSION LINES¹ (in milligauss, mG)

Type of Transmission Line	Maximum on Right-of-Way	Distance from the Center of the Right-of-Way					
		50 ft	75 ft	100 ft	200 ft	300 ft	400 ft
138/161 Kilovolts (kV)							
Single power line ² on two wooden poles	45-160	15-55	5-30	5-15	1-5	0-2	0-1
Single power line ² on one steel pole	25-105	10-35	5-20	3-11	1-3	0-2	0-1
Two power lines ² on steel towers or steel poles	10-85	5-55	3-35	2-23	0-7	0-3	0-2
345 Kilovolts (kV)							
Single power line ³ on two wooden poles	72-240	40-130	25-75	15-50	4-13	2-6	1-4
Single power line ³ on one steel pole	60-160	30-90	20-55	12-35	3-10	2-5	1-3
Two power lines ³ on steel towers or steel poles	55-155	45-120	30-80	20-55	5-16	2-7	1-4
Combination 345kV and 138kV⁴							
	35-180	10-145	10-90	8-55	3-13	1-6	1-3

¹ The values shown in this table are typical for normal system peak operating conditions and do not reflect abnormal circumstances that rarely occur for a short period of time.

² A single 138/161 kV transmission line consists of three large wires and one or two small wires to protect the line from lightning damage.

³ A single 345 kV transmission line consists of three sets of two large wires and one or two small wires to protect the line from lightning damage.

⁴ Values in this table should not be added or subtracted to calculate different combinations of line configurations because the field from each wire affects the fields from other wires and are not necessarily cumulative.



Two organizations have developed voluntary occupational exposure guidelines for EMF exposure — ICNIRP and ACGIH.¹

ICNIRP GUIDELINES FOR EMF EXPOSURE

Exposure (60 Hz)	Magnetic field
Occupational	4.2 G (4,200 mG)
General Public	0.833 G (833 mG)

International Commission on Non-Ionizing Radiation Protection (ICNIRP) is an organization of 15,000 scientists from 40 nations who specialize in radiation protection. Source: ICNIRP, 1998.

ACGIH OCCUPATIONAL THRESHOLD LIMIT VALUES FOR 60-HZ EMF

	Magnetic field
Occupational exposure should not exceed	10 G (10,000 mG)
Exposure of workers with cardiac pacemakers should not exceed	1 G (1,000 mG)

American Conference of Governmental Industrial Hygienists (ACGIH) is a professional organization that facilitates the exchange of technical information about worker health protection. It is not a government regulatory agency. Source: ACGIH, 2001.

The above levels are not exceeded near Ameren transmission lines.

An important point to make is that a guideline limit is not a precise delineation between safety and hazard.²



WHY DOESN'T THE UTILITY COMPANY BURY LINES IF FIELDS DROP OFF RAPIDLY?

Burying lines does not eliminate exposure. While electric fields are easily shielded, magnetic fields are not. At street level, magnetic field strength from underground power lines depends on the number of cables, the spacing of the cables, the amount of current flowing through the lines and the distance you are from them.

Peak magnetic field levels as high as 70 mG have been measured directly below overhead distribution lines and as high as 40 mG above underground lines.¹

HEALTH EFFECTS

Are people living near high voltage power at greater risk?

Even the exposure of people living in the vicinity of high voltage power lines differs very little from the average exposure in the population.²

Have clusters of cancer or other adverse health effects been linked to EMF exposure?

There have been no proven instances of cancer clusters linked with EMF exposure.¹

What are the health effects on general health?

Based on a recent in-depth review of the scientific literature, the WHO concluded that current evidence does not confirm the existence of any health consequences from exposure to low level electromagnetic fields.²

Is there an increase risk of cancer?

It is clear that if electromagnetic fields do have an effect on cancer, then any increase in risk will be extremely small. The results to date may contain inconsistencies, but no large increases in risk have been found for any cancer in children or adults.¹

How do you interpret epidemiological studies?

Epidemiological studies alone typically cannot establish a clear cause and effect relationship, mainly because they detect only statistical associations between exposure and disease, which may or may not be caused by the exposure. The case for a cause-and-effect link is strengthened if there is a consistent and strong association between exposure and effect, a clear dose-response relationship, a credible biological explanation, support provided by relevant animal studies, and above all consistency between studies. These factors have generally been absent in studies involving electromagnetic fields and cancer. This is one of the strongest reasons why scientists have generally been reluctant to conclude that weak electromagnetic fields have health effects.²

Is there a link between EMF exposure and childhood leukemia?

Despite more than two decades of research to determine whether elevated EMF exposure, principally to magnetic fields, is related to an increase risk of childhood leukemia, there is still no definitive answer.¹

Extremely low frequency (ELF) magnetic fields were classified as possibly carcinogenic to humans based on epidemiological studies of childhood leukemia. An example of a well-known agent classified in the same category is coffee, which may increase risk of kidney cancer, while at the same time be protective against bowel cancer. "Possibly carcinogenic to humans" is a classification used to denote an agent for which there is limited evidence of carcinogenicity in humans and less than sufficient evidence for carcinogenicity in experimental animals. . . . While the classification of ELF magnetic fields as possibly carcinogenic to humans has been made by the International Agency for Research on Cancer, it remains possible that there are other explanations for the observed association between exposure to ELF magnetic fields and childhood leukemia.³

Does EMF affect people with pacemakers or other medical devices?

The occupational exposure guidelines developed by ACGIH state that workers with cardiac pacemakers should not be exposed to a 60-Hz magnetic field greater than 1,000 mG. If you are concerned about EMF exposure effects on pacemakers, implantable defibrillators or other implanted electronic medical devices you should consult your doctor.¹

OTHER POSSIBLE EFFECTS

What are the effects of EMF on farm animals?

Studies performed to date have found little evidence of EMF effects on fauna at levels below ICNIRP's guideline levels. In particular, there were no adverse effects found on cattle grazing below power lines.⁴

What are the effects on crops and other plants?

Field studies of 50-60 Hz exposure to plants and crops have shown no effects at the levels normally found in the environment, nor even at field levels directly under power lines up to 765 kV.⁴

How does EMF affect GPS for farm equipment?

Right up close to a pylon, there might be some degradation in GPS performance, just as there can be some degradation close to buildings and trees. Other than that, there is no evidence of power lines interfering with GPS.

USEFUL ADDRESSES AND PHONE NUMBERS

Ameren's EMF Information Line
314.554.2402

U.S. Environmental Protection Agency Office of Radiation and Indoor Air Radiation Protection Division (MC 6608J)
1200 Pennsylvania Avenue, NW
Washington, D.C. 20460-0001
202.343.9677

National Institute of Environmental Health Sciences Office of Communications & Public Liaison
P.O. Box 12233, MD N1-10
Research Triangle Park, NC 27709-2233
919.541.3345

Regional Office for the Americas of the World Health Organization
525 Twenty-third Street, N.W.
Washington, D.C. 20037
202.974.3000

REFERENCES

¹ The National Institute of Environmental Health Sciences (NIEHS) — EMF Electric and Magnetic Fields Associated with the Use of Electric Power June 2002.
niehs.nih.gov/health/topics/agents/emf/.

^{2,3,4} The World Health Organization (WHO) - What is EMF: Establishing a Dialogue on Risks from Electromagnetic Fields — 2002; Electromagnetic Fields and Public Health Effects of EMF on the Environment — February 2005.
who.int/peh-omf/about/WhatIsEMF/en.

⁵ U.S. Environmental Protection Agency — Electric and Magnetic Field (EMF) Radiation from Power Lines — April 2006
epa.gov/radtown/power-lines.html#resources

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ANSWERING YOUR QUESTIONS ABOUT

Electromagnetic Fields