



Magnetic Fields In Homes and School Source and Mitigation in Our Home



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Proposed Expansion by Nextel Creates Concern

Investigation of the possible effects of electrical signal radiation began when neighbors received notice from East Lansing city officials that Nextel Communications Inc., had applied for approval to expand the service cabinet and signal generator-transmitter at the city water tower in Patriarche Park. Voltage and current were measured from the Nextel ground wire in city park and homes of six neighbors and St. Thomas Aquinas School using an oscilloscope and a Gauss meter that measures electric and magnetic fields (EMF) emitted through the air. The ground wire is interconnected with the utility at user service panels, and is attached to the water pipes as part of the electrical grounding system.

Initial Discovery: Voltage of alternating current (V_{rms}), peak-to-peak (V_p), and direct current (DC) on Nextel's ground wire in Patriarche Park increased dramatically each time the signal generator under the water tank switched ON and was heard roaring from the recording position near the transformer and service box in the park (Figure 1).

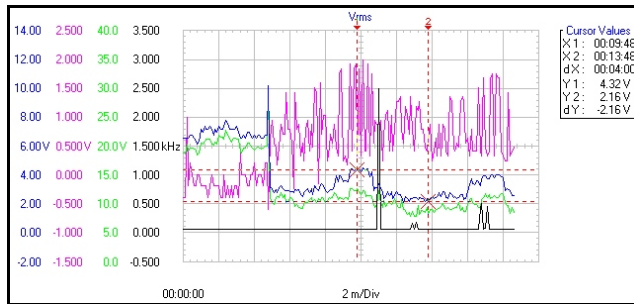


Figure 1. Ground-wire voltage and frequency from a cellular-telephone generator-transmitter in Patriarche Park, East Lansing, MI, 5/26/04, 11:25 a.m.

The waveform from the above recording shows big bites were taken out of the top and bottom peaks of the waveform (Figure 2). Signal generators take their electricity from the peak. This is a classical distorted waveform as described by Kennedy (14). The frequency spectrum revealed a rich source of 2nd, 3rd, 5th, and 7th harmonics; also described in references (14 and 15). Harmonics are integer multiples of the fundamental 60 Hertz (Hz) frequency, i.e., 2nd is 120 Hz, 3rd is 180 Hz, 4th is 240 Hz, 5th is 300 Hz, etc. [Hz are cycles per second voltage change of alternating current (AC)]. The distorted waveform, electrical signature, was also recorded at homes within 87 ft to 200 ft from the tower, and the neighborhood school with 655 students and staff across the street.

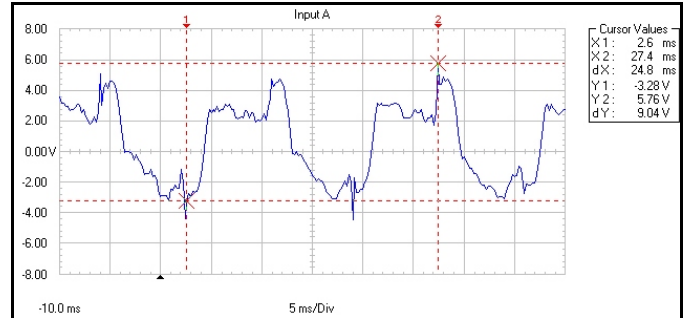


Figure 2. Distorted voltage waveform from a cellular-telephone generator-transmitter ground-wire readings in Figure 1. Signal generators took a little from the top and bottom peaks of the waveform.

The original report to East Lansing and Lansing Board of Water and Light (LBWL) officials advised them that the average current of 23 measurements was 1.67 amperes on the water lines. That was 1,670 times more than the 1 milliamper (mA) limit the Federal Environmental Protection Agency (EPA), Occupational Safety and Health Administration (OSHA) allows for human exposure in a public place, and 344 times more than the 5 mA considered the safe “let go current for women.” We advised officials of the potential risks to human health that had been reported in credible scientific journals since 1996, when the FCC had made their fateful decision to prohibit municipalities from rejecting cell towers on public property.

LBWL were involved later because the dirty electricity and EMF were on their circuits. The City of East Lansing contracts with LBWL for electrical service, controls the East Lansing-Okemos Water Authority, and participated in a financial contract with Nextel to install the cell phone station on the water tower. If city water pipes were contaminated with dirty electricity, it was being delivered to all community homes, schools, and workplaces.

LBWL Engineers came to our house October 28, 2004. After confirming that my measurements and procedures were correct the engineers measured magnetic fields surrounding the ground wire connected to the water pipe. They found 280 to 300 milli-Gauss. Gauss is a numerical measure of the flux density (magnetic induction or electron emission power) of a magnetic field. A milliGauss, (mG) is 1/1000 G. November 23 LBWL installed a Rustrak Ranger power quality recorder at the service panel on the two phase (hot) lines and the ground wire. A recording Gauss meter was also placed next to the ground wire to water pipe junction and recorded for 24 hours and again on January 19-20, 2005, for 24 hours. The Rustrak current results are in Figure 3.

¹Shocking News (dba) is a registered publisher of science-based information dedicated to public awareness of electric and magnetic fields (EMF) in the living environment and their effects on the health and welfare of humans and animals. Editor is Don Hillman, Ph.D., Professor Emeritus, Department of Animal Science, with help from wife Mary, MS, Michigan State University, East Lansing, MI. Don is a member of the American Society of Agricultural Engineers and The American Dairy Science Association. Telephone: (517) 351-9561.

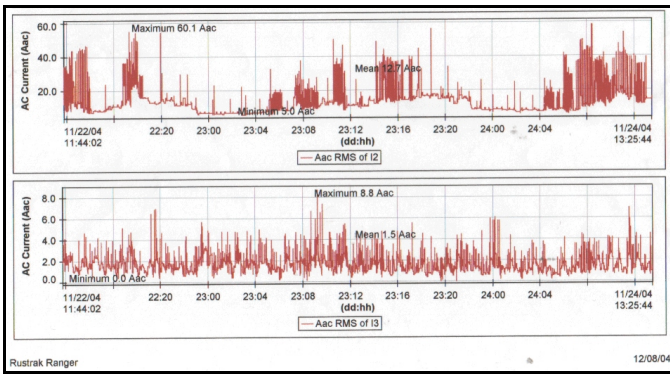


Figure 3. Amperage recorded by LBWL on the phase lead reflects current usage and is not remarkable. Current on the ground wire averaged 1.5 A (Ampere) and maximum 8.8 A and is too high.

Voltage on the two utility phase (hot) leads was 120 to 123 volts with no apparent sags or surges and was within the nominal $120\text{ V} \pm 5\%$ limits. Amperage (Aac) on the phase leads simply reflected the flow of electricity used throughout the 24 hours and was not remarkable.

Amperage on the ground wire (Figure 3, I3) ranged from 0 to 8.8 Aac and averaged 1.5 A for the 24-hour period. Ground wire current was similar to the average of 23 spot checks, $1.67 \pm 1\text{ A}$, that I had recorded at various times and locations in homes and school, and far in excess of OSHA safety standards.

Total Harmonic Distortion (Figure 4) (% THD) of current on Phase leads (I1 and I2) indicates considerable distortion of current ranging to 40% and 80% during certain periods of the day.

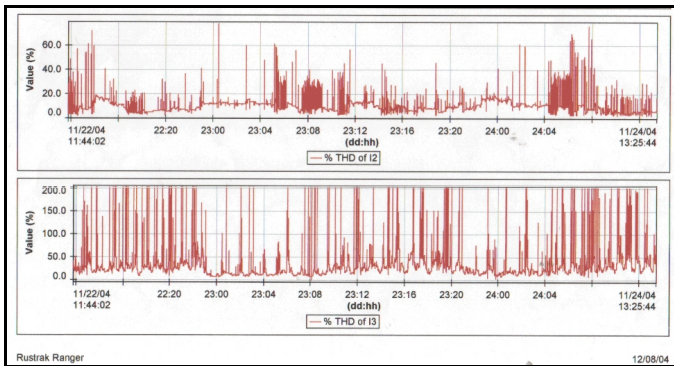


Figure 4. Total Harmonic Distortion (THD) was present on the phase wire and exceeded 200% on the ground wire as recorded by LBWL.

THD of current on the bond connection between service panel ground and water service (I3) was commonly 200% and failed to comply with the Institute of Electrical and Electronic Engineers (IEEE) standards – 5% on the utility side of the meter at the point of common coupling, with no one harmonic more than 3%. THD% represents non-sinusoidal transient-harmonic current as a percent of the 60 Hz (fundamental) transient current or voltage. Because the number and voltage of fundamental 60 Hz transients may also be very high, THD% is only a relative measure of what is known in the industry as “dirty electricity.”

Magnetic fields (MF) recorded by the utility averaged about 60 mG, maximum about 160 mG and a dozen or more values above 100 mG during the first 24-h test. MFs were measured by the utility again (Figure 5). The 24-h

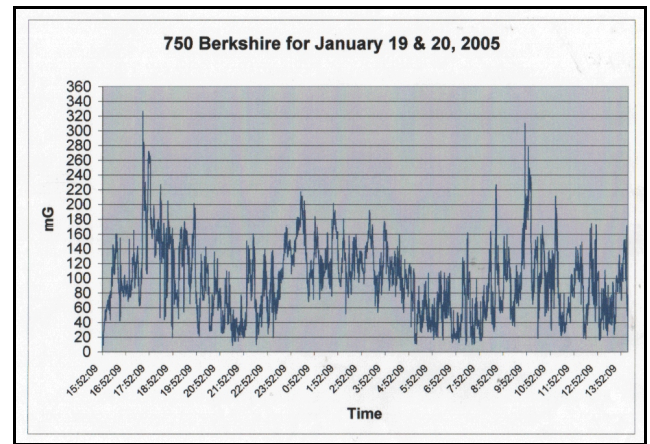


Figure 5. Magnetic field averaged 97.5 ± 39.5 milliGauss (mG) for 24 hours as recorded by LBWL on the ground wire-water pipe.

average magnetic field was 97.5 ± 39.5 mG (standard deviation) with maximum peak 330 mG and many peaks between 160 and 300 mG. Oscilloscope readings from the ground-wire attached to the water pipe averaged 0.049 ± 0.0038 Vpk-pk, and 532 ± 30.75 MHz (Mega = million Hz) frequency recorded simultaneously. The ground wire (¼ inch 6-wire copper cable) runs the full length of the house (70 feet) through two bedrooms and the living room on the main floor, and along the ceiling in two bedrooms and an office-study in the grade-level basement apartment of our home.

Oscilloscope readings at six homes on Berkshire Lane, King Court, Dunbar Court, and the school on Alton Road revealed similar voltage, amperage, and frequency spectrums, and ten houses had 40 to 100 mG magnetic fields next to the ground wire-water pipe junction.

EMF Living Room Floor – Gauss meter readings in the corona, on the living room floor directly above the ground wire were consistently 20 to 50 mG reflecting the flux density average 97.5 ± 39.5 mG next to the ground wire “ground zero” and various distances from the ground wire as in Table 1.

Table 1 – Ground Wire Corona Magnetic Fields (24-Hr. Ave), 750 Berkshire Lane, E. L.

milliGauss (mG)	Equivalent microTesla (µT)
0 Ground 0 = 97.5 ± 39.5 mG	9.75 µT
1 Ft (30 cm) = 15.9 mG*	1.59 µT
2 Ft (60 cm) = 7.8 mG	0.78 µT
3 Ft (90 cm) = 5.4 mG	0.54 µT
4 Ft (120 cm) = 3.6 mG	0.36 µT
Living Rm Floor, 20-50 mG	2.0 to 5.0 µT
Don’s Electric Chair, 4-8 mG	0.4 - 0.80 µT
Mary’s Bed Springs & Rail, 4-7 mG	0.4 - 0.70 µT
Iron Bed-rail, Air mattress (no springs) 4-7 mG	0.4 - 0.70 µT

* mG @ 1 foot distance was 16.3% of (Ⓛ) reading, recorded on ground wire by the utility 01/19-20/2005

A Steel I-beam floor-support, 12 ft. x 8 inch, that runs parallel within ½ inch of the ground wire was also energized and carried 100 to 700 mV of induced current equal to voltage on the utility ground wire. **Air ducts** constructed of galvanized steel sheeting, located within one inch of the ground wire and water pipes, were energized by induction and carried 98 to 550 mVAC above a desk in the basement, and 380 to 400 mVDC at other locations

throughout the house. A person wearing a modulator receiver attached to the arms with EKG patches would receive WKAR (Michigan State) and NPR 90.5 MHz radio programs from touching a light fixture over the dining table, the refrigerator, a desk, a computer, the kitchen sink, or the air ducts. The signals were strong enough to excite the modulator delivering voice and music through the body and the volume increased when another person was touched with the other hand. It was only meant to buzz, indicating that radio frequency (rf) signals were present.

Electron Eddys in Mary's Beddy – Electrical current on the box springs of Mary's bed was 1.6 A (Max 2.4 A(pk-pk). Fundamental signal frequency (1.029 kHz) ranged from 0.257 kHz (257 Hz) to 6.43 kHz, with Total Harmonic Distortion 1208.79% as recorded by oscilloscope 2/21/05. The current on the bedsprings was induced from rf waves.

Don's Electric Chair— A recliner-rocker chair in the living room located above the ground wire center line (Ⓡ) had 8 to 12 mG magnetic fields in the seat and back of the chair. Oscilloscope current clamp readings from the springs in the seat of the chair recorded 20-40 mVpk-pk, 1.04 A waveforms, and a multitude of microwave frequency impulses ranging from 0.167 to 1.2 GHz, typical of cell phone radio frequency signals, inducing current on chair springs and on bedsprings. The electric chair was considered important because Don had been sleeping nights in the recliner regularly for about 4 years.

Induced Body Current – Induced body current was measured for 35 minutes while Don was sitting on the sofa and had one foot on the Living Room floor above the ground wire. Oscilloscope readings (Figure 6) show signal frequencies ranging from about 0.06 to 1.25 GHz and numerous other signals in the 200 to 800 MHz range, similar to the cellular phone signal generation and antennae output located about 200 ft from the house

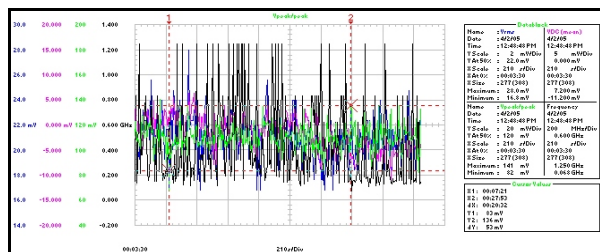


Figure 6. Reading of voltage and frequency of current induced through my body. The black spikes indicate 1.2 GHz signals typical of the cellular telephone transmitter on the water tower.

Don's Induced Body Voltage and Current are in Figure 7. Cursor values (between the vertical red --- lines) were 228 mV and - 2.4 amperes passing from the right leg (calf) through the torso and

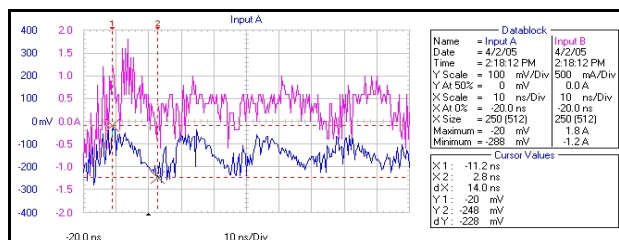


Figure 7. 2.4 Amperes of induced body current driven by 228 mV while sitting on the sofa with my feet in the magnetic field over the ground wire in our living room.

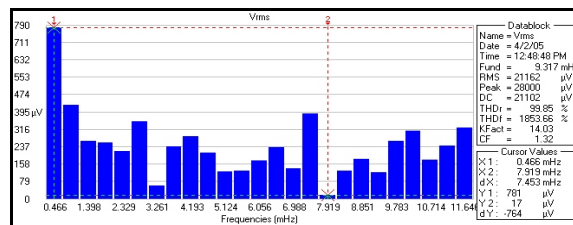


Figure 8. Frequency Spectrum of body current voltage showing that high frequency harmonics account for 228 milliVolts.

the left arm of the body. Voltage associated with various frequencies (Figure 8) indicate that these micro voltages from all frequencies accumulated into 228 mV driving 2.4 A current through the body. The cycle rate may have been reduced or other frequencies may have been eliminated while passing through the tissues.

Effect on Heart Rate and Blood Pressure – Don's systolic blood pressure (BP) increased from normal 127 to 140 (+10%). Diastolic BP increased from 70 to 104 (+48%), and heart rate increased from 62 to 80 beats per minute (+29% BPM) during exposure of a foot to induced current in the 20-35 mG, EMF corona while sitting on the sofa. BP and HR were measured by OMRON® Digital Blood Pressure Monitor HEM-712, used regularly in our home.

Mitigation of Magnetic Fields In Our Home – Driving two ground rods 8 ft into the earth, 6 ft apart and attaching a new ground wire to the rods, and reattaching to the water pipe failed to remove the EMF.

Installation of a dielectric union (rubber insulated coupling) in the water pipe inside the house where it enters from the City water main was successful in eliminating the magnetic fields from the ground wire and the water pipe. Comparison of Figure 9 "before" with Figure 10 "after" the dielectric coupling was

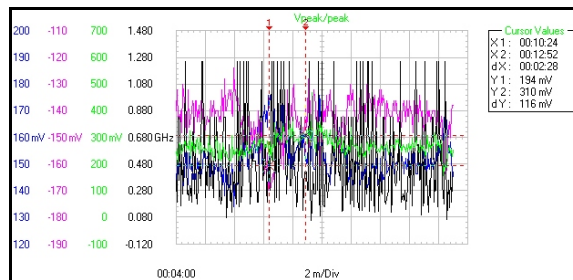


Figure 9. Ground-wire voltage and frequency readings 10/26/04 were heavily polluted with high-frequency signals (up to 1.2 GHz) before dielectric coupling was installed in waterline. Vrms (blue), Vdc (red), and 116 mVp-p (green).

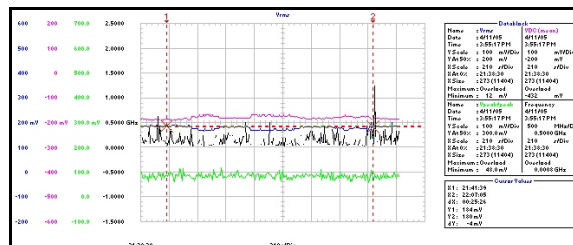


Figure 10. High frequency spikes and voltage on ground wires were dramatically reduced after installing dielectric coupling in water line 4/12/05.

installed reveals (1) the dielectric insulator prevented magnetic fields from flowing through the ground wire and water pipes to the city's main water pipe and using the earth or the water main line as a return circuit to the utility substation, (2) Magnetic fields on the living room floor decreased to less than 2 mGauss, (3) Most of the high frequency, i.e., MHz to 1.2 GHz (rf, microwave) signals disappeared from the oscilloscope reading, (4) Most of the peak-to-peak voltage also disappeared, and (5) Elimination of the rf, medium to high frequency signals from the ground wire, indicated that the cellular telephone installation was the source of the electromagnetic fields. However, power line frequency harmonic voltage 300-400 Vrms and DC current remained on the water line. The voltages and currents continued on the kitchen sink, water faucets, and bedsprings after the dielectric coupling was installed. A separate neutral to return the polluted neutral current to the substation may be required, instead of grounding it to plumbing and running it through houses and the earth.

Health Concerns of Local Citizens – Discovery of EMF at higher levels in our homes and school than have been positively associated with cancer raised serious concern about the possible relationship of EMF to the health of persons living in the local environment (1,3,7,15,17,18,19,21,22). The lady next door was currently in the local hospital under chemotherapy treatment for recurring lymphoma cancer. Sub-populations of lymphocytes of humans and cattle were affected by EMF exposure (6,7). The finding that induced current from the corona in the living room increased heart rate (HR) and blood pressure (BP) is a new environmental EMF discovery that has been demonstrated experimentally with humans (13). Exposure of cows to 4 and 8 mA contact current increased HR, BP, cortisol and oxytocin in blood (8). Milk decreased (5,11,12) and milk fat secretion of cows decreased, food intake increased (similar to diabetes), while melatonin decreased and Insulin-like growth factor in blood of cows increased when exposed to EMF experimentally (5). Melatonin excretion decreased from humans exposed to EMF (4), and sleep patterns were impaired by EMF exposure (2,13) as was mental health (10, 16).

Blood sugar of diabetics increased as microsurgers increased in the home and decreased when frequency filters were installed (9) Type II diabetes and allergies were higher and related to mG-hour exposure among persons living near electrical transmission lines in Australia (3). Pancreatic cells of laboratory animals exposed to EMF attenuated insulin secretion in 3 of 4 experiments (20). I developed diabetes while exposed to EMF as I slept (poorly) in my electric chair above the ground wire. Verschaeve (21) summarized odds ratio of cancer to EMF exposure based on human and animal studies as in Table 2:

Table 2
Comparison of Magnetic Field Exposure with Relative Risk

Group	Exposure μ T Average Daily Dose	Relative Risk (Cancer) Odds Ratio
Control	<0.15	1.0
1	0.16 - 0.19	1.2
2	0.20 - 0.28	2.5
3	>0.29	3.1
4	>0.41	4.2

We are grateful to LBWL for their cooperation and expect they will help correct the electrical pollution at neighbors as well. Reviews and summaries were published by the California Department of Health Services (17) and biophysicists (18,19,21).

For further EMF information: www.electricalpollution.com

References:

- Ahlbom, N. D., et al. 2000. A pooled analysis of magnetic fields and childhood cancer. *British Journal of Cancer* 83(5):692-698.
- Akerstedt, T., et al. 1999. A 50 Hz electromagnetic field impairs sleep. *J. Sleep Res* 8:77-81.
- Beale, Ivan L., et al. 2001. Association of health problems with 50 Hz magnetic fields in human adults living near power transmission lines. *J. Aust. Col. of Nutr. & Env. Med.* 20(2):9-30.
- Burch, James B., et al. 2000. Melatonin metabolite levels in workers exposed to 60 Hz magnetic fields: work in substations and with 3-phase conductors. *J Occup Envir Med* 42:136-142.
- Burchard, Javier, et al. 2003. Effect of 10 kV/m and 30 μ T, 60 Hz, electric and magnetic fields on milk production and feed intake in nonpregnant dairy cattle. *Bioelectromagnetics* 24:557-562.
- Calogero, S., et al. 2004. Effects of extremely low frequency electromagnetic fields exposition on circadian rhythms and distribution of some leucocyte differentiation antigens in cows. *Clinica di Oncoematologia Pediatrica*, University di Padova, Italy. International Conference of Veterinary Clinicians, Quebec City, Quebec, Canada, July 2004.
- Chen, G., et al. 2000. Effects of electromagnetic field exposure on chemically induced differentiation of Friend erythroleukemia cells. *Environmental Health Perspectives* 108:967-962. Contact: Trosko, Mich State University.
- Gorewit, et al. 1984. Physiological Effects of Electrical Current on Dairy Cows. Proceedings of the Nat. Stray Voltage Symposium. ASAE, St. Joseph, MI.
- Havas, Magda, and Dave Stetzer. 2004. G/S filters improve power quality in homes and schools, reduce blood sugar levels among diabetics. Int. Conf. Childhood Leukaemia, London, UK, September. dave@stetzerelectric.com
- Havas, Magda, and David Stetzer., 2004. Dirty electricity and electrical sensitivity: five case studies. WHO Workshop on Electrical Hypersensitivity. October, Czech Republic, Prague. mhavas@tremtu.ca
- Hillman, D., D. Stetzer, M. Graham, C. Goeke, K. Mathson, H. VanHorn, C. Wilcox. 2003. Relationship of electric power quality to milk production and behavior of dairy cattle. Paper No. 033116, Amer. Soc. Agr. Engineers, St. Joseph, MI (Video available).
- Hillman, D., Charles Goeke, and Richard Moser. 2004. Electric and magnetic fields (EMFs) affect on milk production and behavior of cows: results using shielded-neutral isolation transformer. 12th Int. Conf. On Production Diseases in Farm Animals, Mich. State Univ., Vet Col., July 2004 (Video available).
- Huber, Rito, et al. 2003. Radio frequency electromagnetic field exposure in humans: estimation of SAR distribution in the brain, effects on sleep, and heart rate. *Bioelectromagnetics* 24:262-276.
- Kennedy, Barry W. 2000. *Power Quality Primer*, McGraw-Hill, New York, NY.
- Kaune, W. T., et al. 2002. Study of high- and low-current-configuration homes from the 1988 Denver childhood cancer study. *Bioelectromagnetics* 23:177-188.
- Lyskov, E., et al. 1993. Effects of 45 Hz magnetic fields on functional state of the human brain. *Bioelectromagnetics* 14:87-95.
- Neutra, R., et al. 2001. An evaluation of the possible risks from electric and magnetic fields (EMFs) from power lines, internal wiring, electrical occupations and appliances, California Department of Health Services EMF Program, 1515 Clay Street, Oakland, CA 94612.
- Polk, Charles, and Elliot Postow. 1995. Handbook of biological effects of electromagnetic fields, 2nd ed. CRC Press.
- Reilly, J. Patrick. 1998. Applied Electricity from Electrical Stimulation to Electropathology. Springer-Verlog, NY, adapted from the same title, Cambridge University Press, 1992.
- Sakurai, T., et al. 2004. An extremely low frequency magnetic field attenuates insulin secretion from the insulinoma cell line, RIN-m. *Bioelectromagnetics* 25:160-166.
- Verschaeve, L. 1995. Can nonionizing radiation induce cancer? *The Cancer Journal* 8 (5):237-249.
- Villeneuve, Paul J., et al. 2000. Non-Hodgkin's lymphoma among utility workers in Ontario: the evaluation of alternative indices of exposure to 60 Hz electric and magnetic fields. *Occup Environ Med* 57:349-357.