Hans Karow
Coalition to Reduce Electropollution (CORE)
S 2 / C 49, RR # 1
3075 Hayman Road
Naramata, BC, V0H 1N0
E-mail: hkarow@shaw.ca

Mr. Robert J. Pellatt
Commission Secretary
B.C. Utilities Commission
900 Howe Street, Box 250
Vancouver, BC V6Z 2N3
Email: Commission.Secretary@bcuc.com

May 24, 2007

Dear Mr. Pellatt,

Re: FortisBC Inc. - Certificate of Public Convenience and Necessity (CPCN) for the Naramata Substation & Transmission Line Project No. 3698458

Project's website: http://www.bcuc.com/ApplicationView.aspx?ApplicationId=150

Please accept my Evidence # 1

"***C.U.R.E.'s Electrical Pollution Facts"***

(as per attached) into subject FortisBC project/CPCN oral hearing. Directly and indirectly affected persons have the right to be fully informed and refer to those facts in the hearing.

Sincerely,

Hans Karow, CORE

C.U.R.E.

ELECTRICAL POLLUTION FACTS

NOTE: This booklet is intended as an **introduction** to electro-magnetic fields, ("EMF's"; "electric fields"; "magnetic fields") and returning/neutral ground/earth currents ("stray voltage").

This is directed towards professionals and laymen who are unfamiliar with this subject.

This subject consists of highly technical and specialized fields. Often doctorates and professors of electrical engineering do not understand electricity's biological effects on people or animals, and vice versa: The biologists and physicians do not understand what the electric fields and magnetic fields do in the human body, or how to detect or measure it. This is probably one reason why it has taken so long for the countries of the world to begin to understand these problems and, more importantly, to act upon solving these problems.

On March 4th 2001, Great Britain's government officially acknowledged the connection between high volt transmission lines and childhood leukemia's.

In today's society the general public is physically interfacing with the potential health problems linked to this technology. The way we use electricity has changed. By changing AC electricity to DC electricity for our computers, CNC equipment and energy efficient lighting we have created harmonics. The amount of electricity consumed has geometrically grown. What once seemed to pose no problems now must be understood and dealt with by the general public and their governmental representatives, to insure public safety.

Technical terminology from the electrical engineering sciences and the biological sciences have usually been converted into laymen's terms for a cleaner basic understanding.

Very complex scientific concepts have also been generalized for easier understanding. It would take the years of learning invested into a doctorate degree to truly understand each scientific field discussed here – and yet these concepts must be understood by everyone today.

Information included is researched and referenced at the end of this booklet.

The subject of EMF's and electric currents' effects have been studied and researched for over 60 years, since the 1940's. If the amount of research and information were boxed and stacked, it would easily fill an entire fleet of semi-trailers.

Therefore, the information contained in this booklet and also the research references at the end represents only **a very minute amount** of the total information and research assembled on this subject.

C.U.R.E.
P.O. Box 43
Brantwood, WI 54513
Phone/Fax: 715 – 564 – 3362
darvr@newnorth.net
www.toxicelectricity.com
also view articles at:
www.strayvoltage.org

A. Where is Electrical Pollution?
B. History of Electrical Pollution
C. Types of Electrical Pollution
   1. Electromagnetic Fields (EMF's)
      (a) electric fields
      (b) magnetic fields
   2. Neutral/returning ground/earth currents ("stray-voltage")
   3. Harmonics, Transients
D. Measuring Electrical Pollution
   1. Electric Fields (Volts/meter – V/m)
      (a) allowable exposure levels
      (b) Arrowhead to Weston Transmission Line at edge of Right-of-Way
      (c) Arrowhead to Weston Transmission Line directly underneath
      (d) peak levels found
      (e) how electric fields go through the human body
      (f) body's own electric fields
      (g) effects of outside electric fields on human body
   2. Magnetic Fields (milli-Gauss – mG)
      (a) exposure levels – 2-4 mG linked to childhood Leukemias/cancers
      (b) 10 mG commonly found in barns, homes, schools, offices, factories
      (c) allowable exposure levels – 4 mG
      (d) electrical workers – ave. max. exposure – 60 mG
      (e) peak levels found
      (f) how magnetic fields go through the human body
      (g) What the United States, other countries and organizations say about EMF's
         (1) U.S. – Class 2-B Carcinogen
         (2) Great Britain officially recognizes link between EMF's and leukemia
         (3) U.S. Soc. Sec. Admin. – Granted disability for stray voltage
         (4) EPA – first draft – Class 1 Carcinogen
   3. Neutral/Returning Ground/Earth Currents – (volts (V); milliVolts (mV); milliAmps (mA)
      (a) allowable exposure levels
      OSHA – 1.0 mA (or) 0.5 Volts
      (b) peak levels found
      (c) induced currents on fences, pipelines, etc.
E. Effects of EMF's and Returning/Neutral Ground/Earth Currents on Living Cells
   1. Introduction – (60 Hertz field)
   2. Harmonics (defined)
   3. General Effects upon Cells
      (a) electric current induced in cells
      (b) induced currents cannot be felt
      (c) interactions at cell membrane affected
      (d) macromolecules, ions, hormones cannot function properly
      (e) EMF's affect cells
      (f) EMF's tested on cells in same strength found in environment
      (g) "Windows" of Exposure
         i) definition
         ii) for more information Dr. Polks' Book
   4. Electroporation – A Very Important Word
      (a) Definition
      (b) Reversible/Non-reversible Conditions
      (c) Hospitals and Medicines that treat Electroporation
         i) Research studies in this field
         ii) Univ. of Chicago – Electrical Trauma Center
         iii) Detection of Electroporation Tissue Damage
         iv) Medication to Seal Injured Cell Membranes
   5. Melatonin
      (a) What is Melatonin?
      (b) Melatonin's function in the body
      (c) Lack of Melatonin causes …
   6. Other diseases and health problems linked to EMF's and Neutral Returning Ground/Earth Currents.
      (a) General Public with Higher Exposure
      (b) Children with Higher Exposure
      (c) Electrical Workers
F. How to Limit Total Exposure
   1. Things that cannot be avoided
   2. Things to avoid while they are on
   3. Things to remove to remote area
   4. Things that can be mitigated
   5. Things to avoid
   6. Examples of Exposure Levels at specific distances

FACT SHEET – ELECTRICAL POLLUTION

A. WHERE IS ELECTRICAL POLLUTION?

Electrical Pollution occurs in cities, in suburbs, in the country and in small towns. The more electricity, the greater the chance for electrical pollution.

B. HISTORY of ELECTRICAL POLLUTION

Scientists and researchers have been aware of electrical pollution since the **1940's**. The solutions to fix these problems with electrical pollution have existed for many years. **The technology to fix electrical pollution already exists**.

The general population first became aware of electrical pollution in the **1970's**. Farmers first noticed that many cows in their herds got sick on the same days that they and their families got sick. The farmers checked their water, changed the cow's food according to nutritionists, and called their veterinarians. They finally found electrical pollution when they called out electricians. **The cows had been "the canary in the coal mine," warning mankind of this potential threat to their health**.

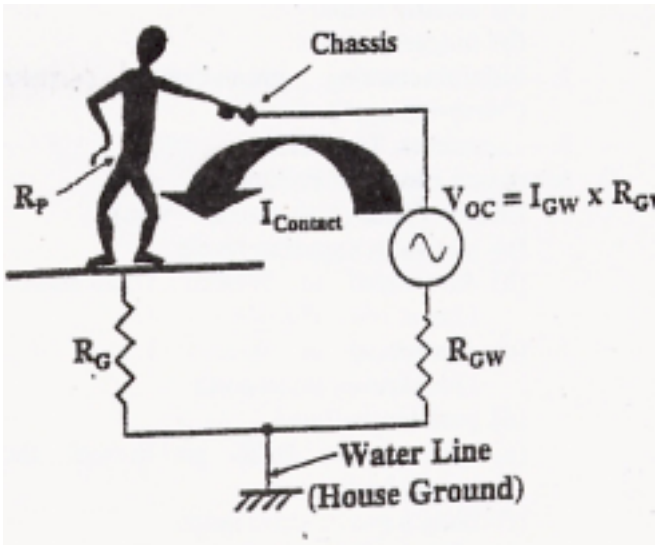
C. TYPES OF ELECTRICAL POLLUTION

1. Electromagnetic Fields (**EMF's**)
   (a) **electric <u>fields</u>;** "radiates" off from electricity
   (b) **magnetic <u>fields</u>;** "radiates" off from electricity
2. **neutral/returning ground/earth <u>currents</u>;** is electricity returning through and across the earth and through and across the floors, walls, etc. of homes, schools, offices, factories, etc. instead of returning on the electric wires.

The **National Electric Safety Code** (NESC) **Section 92.D**, states that objectionable currents are not allowed to remain on the ground wires or the earth. [1]

½ to ¾ of <u>all</u> electricity that is used – returns across the earth, across private property and through the people on it. [2, 3, 4]

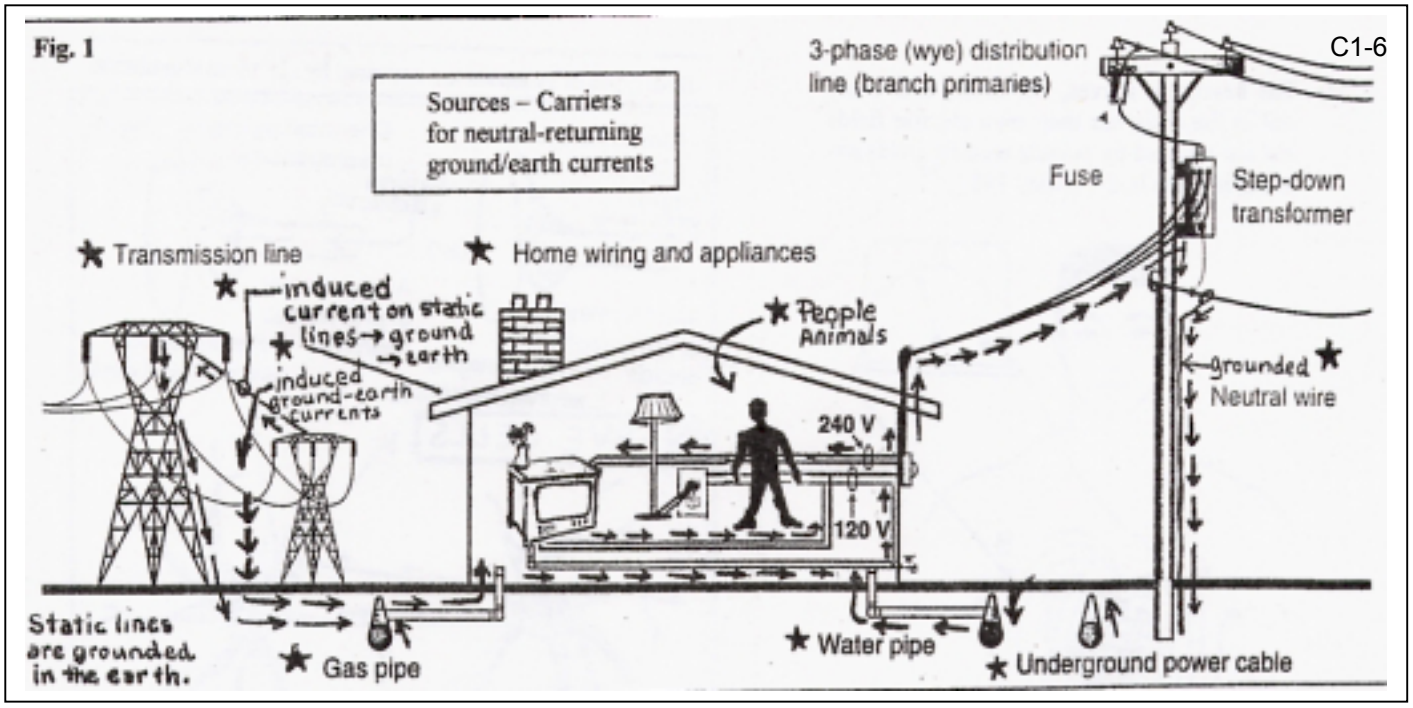
Our homes, our schools, our yards, our fields, our playgrounds, our offices, barns, and factories could all be a part of the return circuit for electricity – and – so could our bodies. (see fig. 1 on next page) Most of the time the current cannot be felt. [5]



Contact Current. A person contacting a chassis is exposed to V_{oc} which can drive current into that person, depending on the nature of his/her connection to the chassis and to the ground.
V_{oc} means – "open circuit voltage" or the current in an electric circuit. [4]

These neutral/returning ground/earth currents have also been called **"Stray Voltage."** "Stray voltage" is an unscientific term used by the Michigan, Minnesota and Wisconsin Public Service Commissions, the Agricultural Departments of the University of Wisconsin and Cornell University, Wisconsin Department of Agriculture (DATCP), their SVAT Team, their Rural Energy Management Council, the Wisconsin Federation of Electrical Co-ops, Governor Tommy Thompson and Governor McCallum, the electric companies and the electric companies' witnesses. The term "stray voltage" has not appeared in college or electrical engineering textbooks, nor in National Electrical Codes.

The Wisconsin Public Service Commission, in their definition of "stray voltage," states that it only applies to animals; and not to humans. [6] However, electric company witness, Dr. T. Dan Bracken,[7] the USDA Agriculture Handbook 696 [8], and the Minnesota Public Utilities Commission 1998 Study [9] all state that electric current will flow through a human or an animal contacting "stray voltage." Because of the confusion over this term, neutral/returning ground/earth currents is a better, more scientific term



3. The electric fields, magnetic fields, and neutral/ returning ground/earth currents occur at frequencies or "Hertz". These frequencies range from 50-60 Hertz (electricity) all the way up into the **radiofrequencies (RF)** called **harmonics** (multiples of the 60 Hertz) and **transients** (power surges).

D. MEASURING ELECTRICAL POLLUTION

The above types of electrical pollution comes in different strengths of exposure.

1. **ELECTRIC FIELDS**

   Electric fields are measured in **Volts per meter (V/m)**. This is the electric fields' intensity or strength.

   (a) **Allowable exposure levels** at the edge of the Right-of-Way (ROW) for transmission lines:

   (1) Montana Board of Natural Resources – 1000 V/meter [10]

   (2) New York Public Service Commission – 1600 V/meter [10]

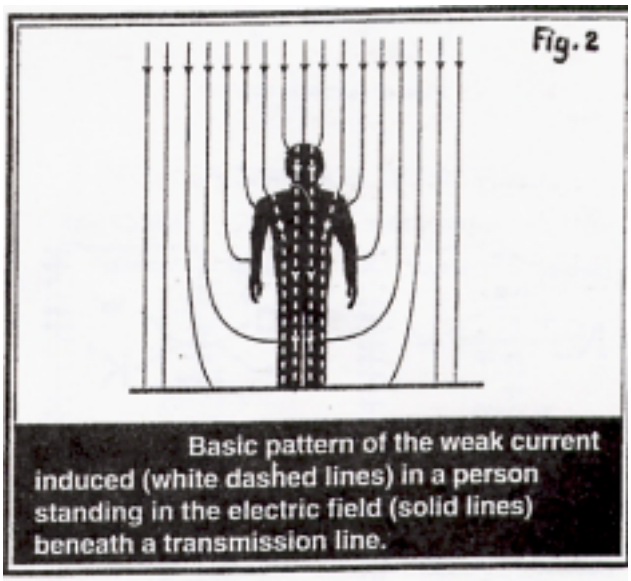
   (3) Wisconsin **?**

   (b) The Arrowhead to Weston 345,000 Volt Transmission Line at the edge of the Right-of-Way – 2400 V/meter [11]

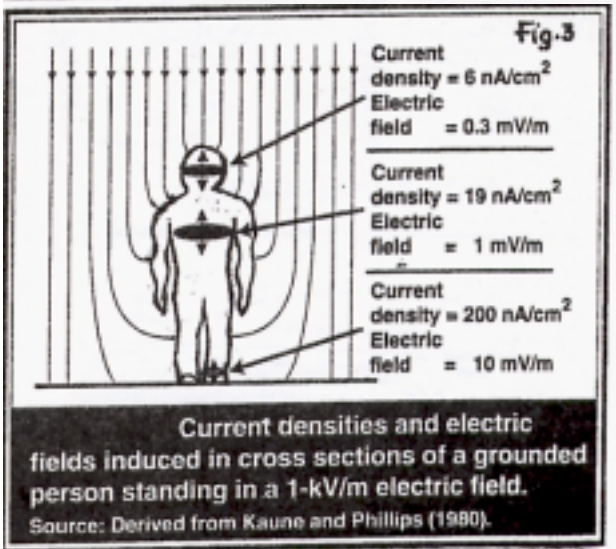
   (c) The Arrowhead to Weston 345,000 Volt Transmission Line directly under the line – 5800-8300 V/meter [12]

   (d) "Near high voltage transmission lines, the peak AC (electric) fields can reach 10,000 V/m or higher with typical levels near 2000-6000 Volts/meter." [13]

   (e) The following pictures show how electric fields go through people. The bottom picture is for a 1 kV/m electric field or 1000 V/m. The Arrowhead to Weston line is 2½ times stronger, at the edge of the ROW.



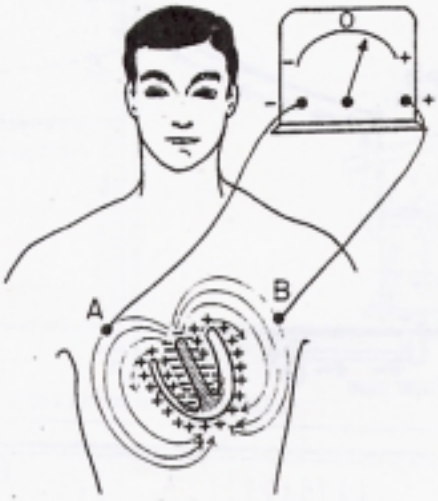
Basic pattern of the weak current induced (white dashed lines) in a person standing in the electric field (solid lines) beneath a transmission line.



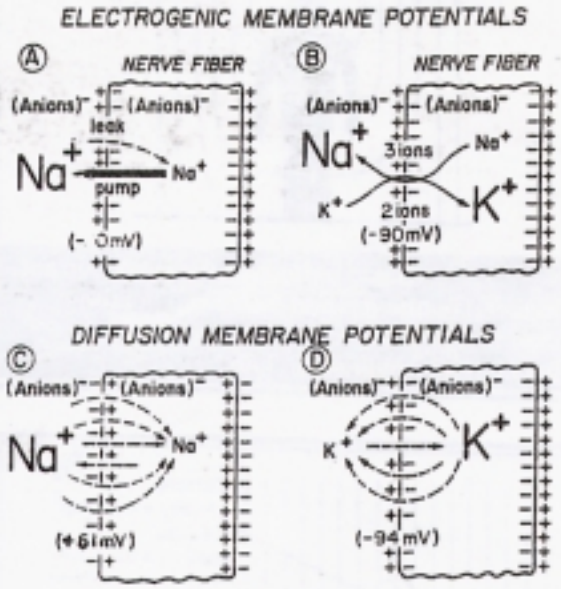
Current densities and electric fields induced in cross sections of a grounded person standing in a 1-kV/m electric field.
Source: Derived from Kaune and Phillips (1980).

Fig. 2; Fig. 3; adapted from p.1-9; 1-10; Electrical and Biological Effects of Transmission Lines: A Review; J.M. Lee, Ph.D.; Bonneville Power Administration: 1996.

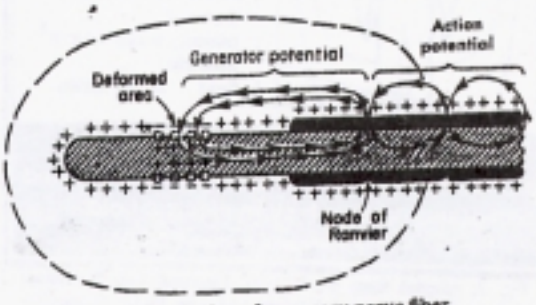
(f) The heart, the nerves, the brain, and every cell in the body has their own electric fields and are affected by outside electric fields entering into the body. (Adey 1981) [39]



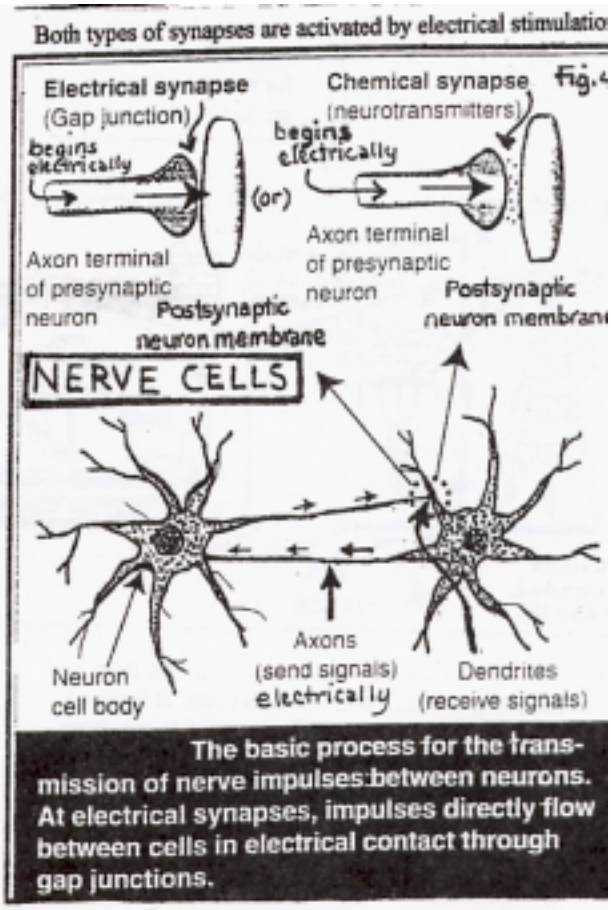
Flow of current in the chest



Cell Membranes



Excitation of a sensory nerve fiber



The basic process for the transmission of nerve impulses between neurons. At electrical synapses, impulses directly flow between cells in electrical contact through gap junctions.

(g) **Electric Field.** Most EMF research on the cardiovascular system has involved electric fields.

A wide variety of effects of electric fields on the cardiovascular system has been reported. Ragan et al. (1983) reviewed results of about a dozen of the early studies of electric fields on blood and serum. They found that the studies with electric fields of 10-100 kV/m showed indications of increases in neutrophils, eosinophils. SGOT, LDH, glucose, and urea nitrogen, and decreases in lymphocytes. [37]

Morris et al. (1989) used two formal methods, to combine results of 40 experiments on blood and serum chemistry by six research groups, including the studies by Ragen et al. (1983). [38]

In their analyses, Morris et al. (1989) considered 15 end-points that were addressed in the studies. The results of their combined analyses indicated possible decreases in total proteins, albumin, lymphocytes, and percent lymphocytes. Possible increases were seen in glucose, neutrophils, percent neutrophils, lymphocytes, and eosinophils. Morris et al. (1989) concluded that the combined results strongly suggests the presence of consistent effects on some end-points.

2. MAGNETIC FIELDS

Magnetic Fields are measured in **milli-Gauss (mG)** or microTeslas (μT). (10 mG = 1μT)

(a) Leading scientific researchers have linked **exposure levels of 2-4 mG to childhood leukemias and cancers**; (Schüz 2001 [14]; Ahlbom 2000 [15]; Wertheimer 1979 [16]; Tomenius 1986 [17]; Savitz 1990 [18]; Peters 1991 [19]; Bowman 1991 [20]; Lin 1991 [21]; Feychting and Ahlbom 1992 [22] and 1993 [23]).

(b) "Electrical transmission and distribution facilities (lines) that are close to a barn could contribute to AC magnetic fields at **10 mG levels** which are comparable to residential and occupational settings." [24]

… in other words:
10 mG levels are commonly found in barns, homes, offices and factories, when 2-4 mG levels are linked to leukemias and cancers.

(c) **Allowable exposure levels** at the edge of the Right-of-Way (ROW) for transmission lines:

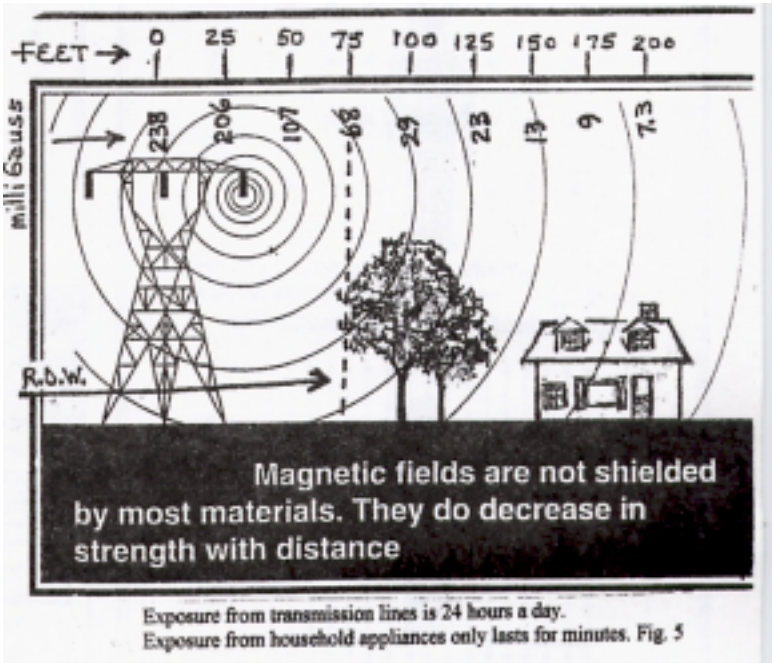
(1) Tennessee City Commission of Brentwood [25] – **4 mG** at edge of transmission ROW

(2) California – City of Irvine – exposure for general population [25] – **4 mG** per every 24 hours.

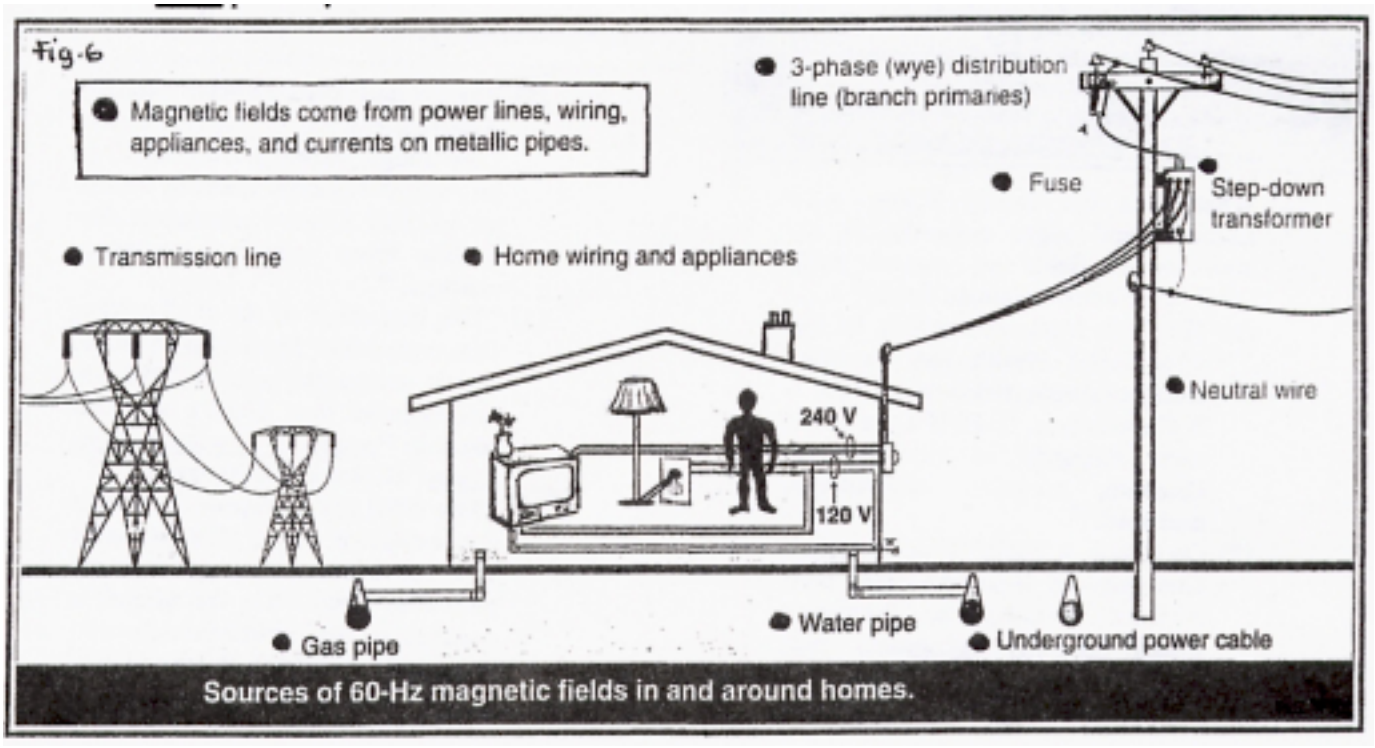
Note: (Picture below) Arrowhead to Weston 345,000 Volt transmission line at edge of ROW which is 75 feet from center = **68 mG** [26]

(d) **Electrical workers** average a maximum exposure of **60 mG.** [26]

(e) "Many studies show that the magnetic field intensity can be many hundreds or even **several thousand milligauss beneath transmission lines.**" [28]

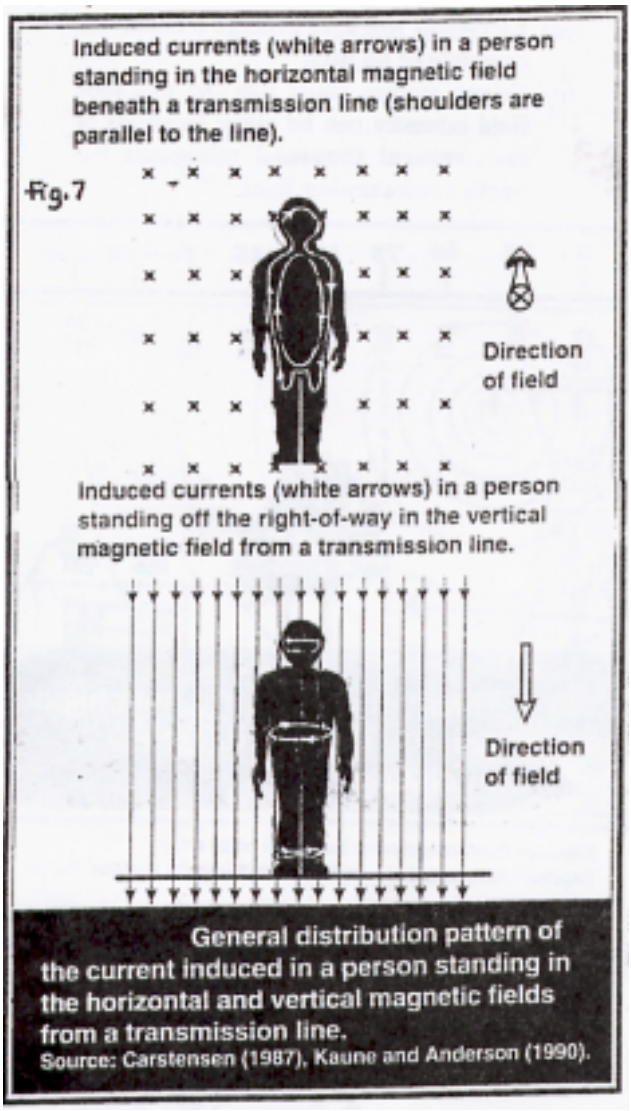


Exposure from transmission lines is 24 hours a day.
Exposure from household appliances only lasts for minutes. Fig. 5



(f) **Magnetic fields also induce or create electric currents inside the body.** (see picture below) [29, 30]

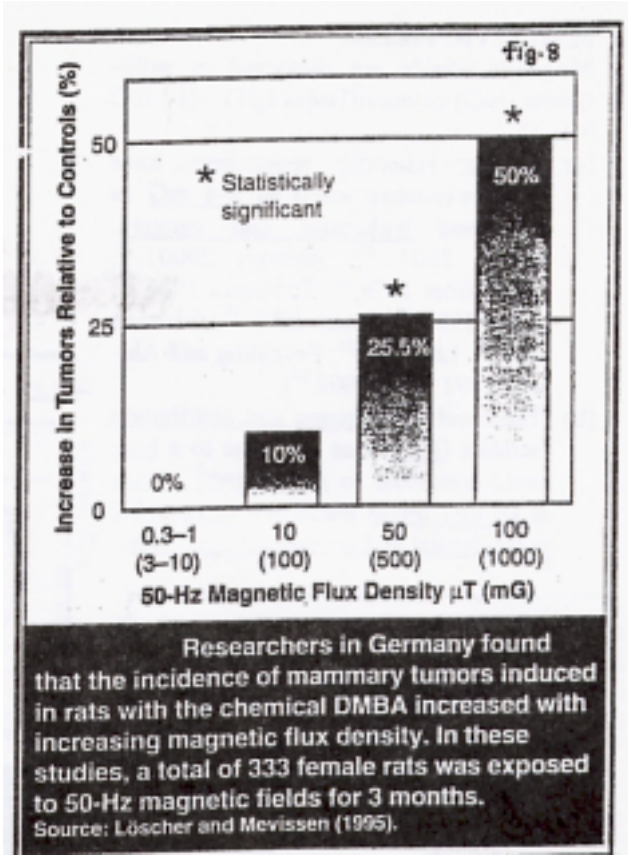
Fig. 7; Fig. 8; p.1-20; 4-43; Electrical and Biological Effects of Transmission Lines: A Review; J.M. Lee, Ph.D.; Bonneville Power Administration; 1996.



(g) What does the United States, other countries and major organizations say about electric fields and magnetic fields (EMF's – electromagnetic fields)?

(1) The U.S. National Institute of Environmental Health has classified electromagnetic fields as a **Class 2-B Carcinogen**. [31] EMF's are in the same category as **carbon-tetra-chloride, atrazine, chloroform, and lead**. [32]

(2) On March 4, 2001, **Great Britain's Government** announced that their National Radiological Protection Board **officially recognizes that high voltage power lines are linked to leukemias** and **cancers**. [33]



(see picture above) [35] Note: At **1000 mG 50%** of the rats had a statistically significant **increase in tumors:**

- Yet, the International Radiation Protection Association set allowable exposure levels for the general population at **1000 mG** [25]

Are our government agencies protecting us**?**

(3) The **United States Social Security Administration**, Administrative Law Judge, Edward Bergtholdt, in an August 17, 2000 decision awarded Michael Gunner permanent **disability from exposure to stray voltage**. [34]

(4) "The first draft of the (U.S.) **EPA** (Environmental Protection Agency) report, completed in early 1990, **recommended that EMF's be classified as "probably human carcinogens" (Class 1 Carcinogen)**.
"**The 1994** (EPA) **report** found that the **evidence of** an **EMF-Cancer link** had become **stronger** over the next four years. 'On the whole', it concluded, 'the epidemiologic evidence with respect to childhood cancer and EMF exposure more clearly

points to an **increased risk of cancer** especially **leukemia**, in relation to residence in homes, with exposures determined by high wire code configurations, close proximity or historically calculated fields."

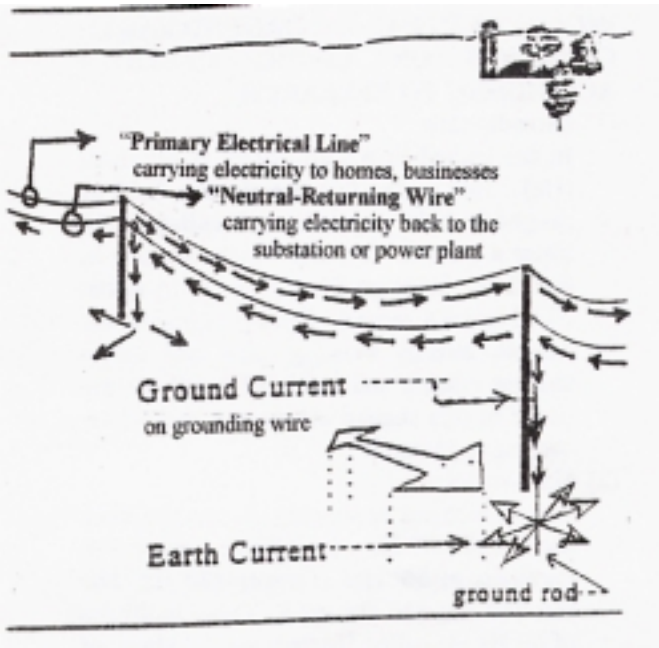
The 1990 EPA report caused an international sensation and prompted **strong criticism from the electric utility industry**. The following year, a review by EPA's Science Advisory Board down-played the cancer risk and asked that the report be revised.

In addition, industry pressured the agency not to release the cancer report. Leading this movement was **Douglas Bannerman** of the **National Electrical Manufacturers Association** in Washington. In 1995, Bannerman argued that, "**We should not have individual agencies (the EPA) popping up and giving their own risk assessments**." Later that same year, the **U.S. Senate** Committee on Appropriations **cut $350,000 out of** the **EPA budget** because '**the committee believes EPA should not engage in EMF activities**.' Soon afterwards, the EPA stopped all work on the cancer report." [36]
("Reprinted with permission, Microwave News, New York City")

2. **ELECTRIC CURRENTS** and **NEUTRAL/RETURNING GROUND/EARTH CURRENTS**
   Electric currents and **neutral/returning ground/earth currents** are measured in **volts (V), milliVolts (mV) or milli Amps (mA)**. (see Fig. 1 – page 2)
   (a) OSHA (Occupational Safety and Health Agency)

OSHA states "**a hazard exists at 1.0 mA or 0.5 Volts**" [40]

yet … **Wisconsin Public Service Commission** states their "**level of concern**" is **2.0 mA or 1.0 Volts** [41]
and … the **USDA Handbook 696** (the "Red Book") states their "**level of concern**' is **8.0 mA or 4.0 Volts** [42]
also note … according to **OSHA 6.0 mA** – has been established as the "**let go" threshold level** for humans in an electrocution situation. [40, 43]



(b) "AC currents introduced into the earth as **return currents** can vary widely from less than a milli ampere (mA) to more than **100 amperes** (**100,000 mA**). The result is that the AC voltage between two points on the earth could be **accessible by a person or animal** … when contact is made at two points then **current can flow through the body**." [44]

(c) "Magnetic fields from overhead transmission lines cause 60 Hz voltage gradients in the earth along the length of the line. These voltage gradients can lead to **current flow** on parallel pipelines, at least **tens of volts** (**20+ mA**) per kilometer, of consequences for long objects, fences, pipelines oriented parallel to a line." [45]

NOTE:
According to **OSHA** [40, 43]
15 mA – **respiratory tetanus**
breathing difficult
100 mA - **heart fibrillation**
in adults

E. THE EFFECTS OF ELECTRIC FIELDS (or) MAGNETIC FIELDS (or) RETURNING/ NEUTRAL GROUND/EARTH CURRENTS ON LIVING CELLS – ACCORDING TO RESEARCH

(1) **Introduction**

In the United States electricity is 60 Hertz (Hz). This means that **the electric field or magnetic field expands and collapses 60 times a second.** Another way to say this is, that these fields go from plus (+) to minus (-) 60 times a second. During exposure, the natural, already existing, plus and minus charges outside and inside of a cell are exposed to this change 60 times a second according to research.

(2) **Harmonics**

Many electrical appliances change the electricity from 60 Hz, or 60 times a second to multiples of 60; (for example 120 Hz; 180 Hz; 240 Hz; 360 Hz; etc.). These multiples of 60 Hz are called "harmonics." "**Many of the harmonic fields from appliances go all the way up into the Mega Hertz** (MHz) **frequency**." [46] The Mega Hertz frequency begins at 1,000,000 Hertz. A one Mega Hertz field goes from plus to minus one-million times a second.

(3) **Effects In General – At the Cell Level**

(a) When the electric field, or magnetic field or ground/earth currents are strong enough ***** (as discussed earlier) electrical currents are created (or induced) in the tissues/cells. [47]

(b) "EMF (electromagnetic fields) from transmission and distribution lines can induce currents in the body that are below perception." [48]

(c) "There is now a relatively strong body of evidence suggesting that induced electric signals influence cellular properties … involving interactions at the level of the cell membrane." [49, 50] (see picture of cells – next page)

(d) "A growing body of evidence indicates that induced ELF fields and currents circulating in the extracellular medium can alter ion binding to membrane macromolecules, influence ion transport across the membrane, and modify ligand-receptor interactions at the cell membrane surface (e.g. the binding of hormones, mitogens, etc.)" [47, 49, 50, 51] (see picture of cells – next page)

(e) During the past 25 years numerous studies have been published on biological effects of ELF (extremely low frequency – 50-60 Hz) fields at the tissue, cellular and subcellular levels. [52, 53, 54, 55]

Examples of such effects observed in eukaryotic cells – (most cells – cells with a nucleus) are alterations in the binding of Ca^{++} (calcium) to cell surfaces. [56, 57, 58]

(f) ***** Research studies and proposed mechanisms (listed here) have been done using the same strengths electric fields, and magnetic fields **as is found out in the world**, **and they have linked them to these types of changes.** [49, 52, 56, 57, 58, 59, 60, 61, 62, 63, 64, 65, 66, 67, 68, 69, 198, 199, 200]

(g) **"Windows" of Exposure**

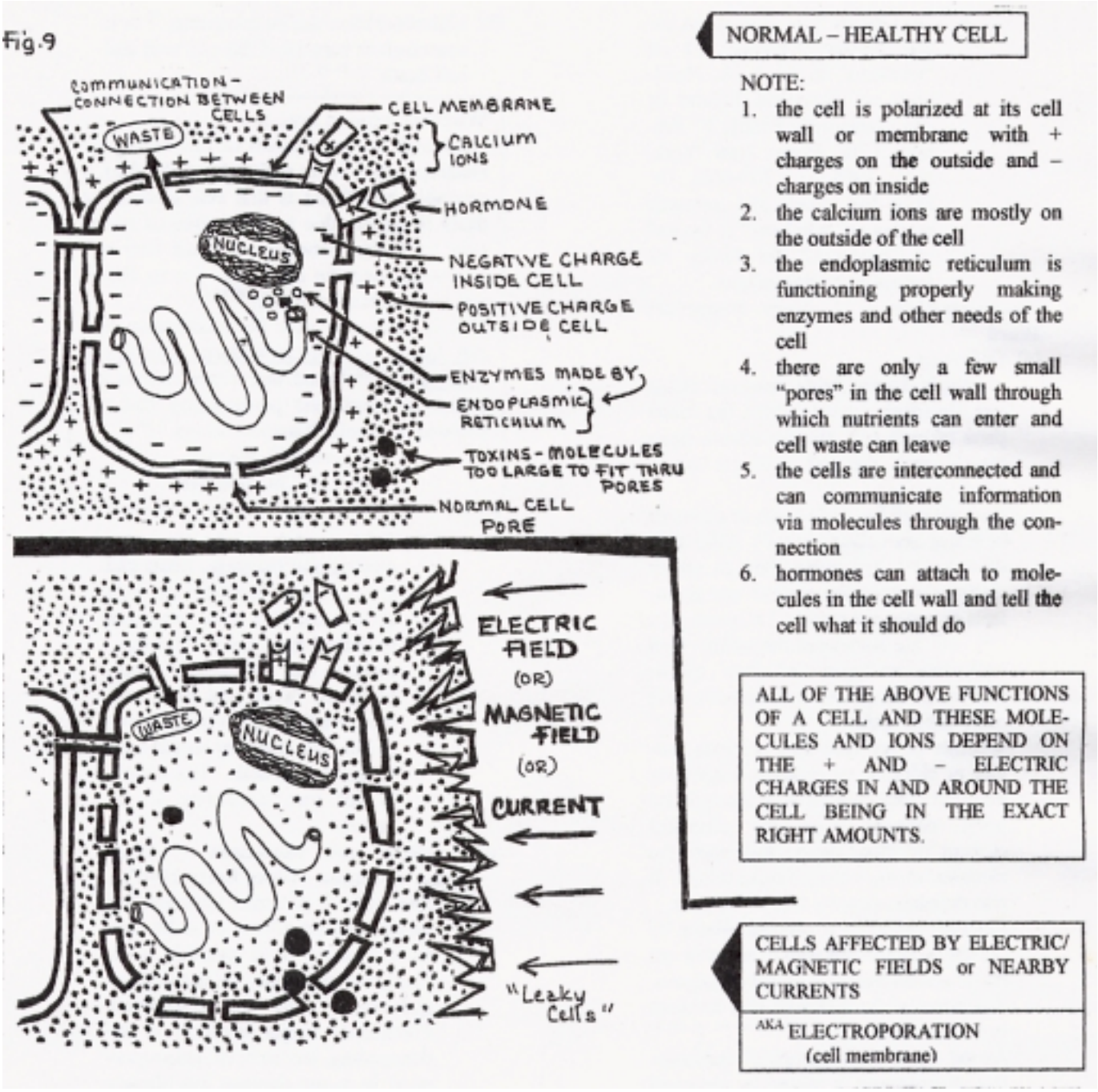
i) Researchers have exposed animals and humans to different frequencies (Hertz) at different strengths of electric and/or magnetic fields.

They have found out that effects are found at one frequency (Hertz) and not at another, with the same magnetic or electric field. Or they kept the frequency the same and changed the strength of the electric or magnetic field. At one strength something would happen to the human or animal and at another strength, it would not.

These are called "windows".

It is interesting that many positive "windows" are not always the highest frequency or, the strongest electric or magnetic field. Very small electric or magnetic fields have been linked to biological effects. Many researchers believe this is because those low levels are in a range that the body is very sensitive to.

It would be either foolish or criminal to only look at the negative "windows" of exposure and tell people they are safe because nothing bad happens at these frequencies or field strengths.



1. the cell wall/membrane is no longer polarized, neither can it depolarize correctly and repolarize, it has lost the "+" charged outside membrane and the "-" charged inside
2. the calcium ions are equally both inside and outside the cell – so the many cell functions so dependant on calcium ions being correctly balanced cannot take place.
3. The endoplasmic reticulum cannot manufacture enzymes and other products necessary for the cell to function.
4. The cell wall has opened up with many more pores, and larger pores, allowing waste back into the cell, allowing larger molecules of toxins, etc. into the cell.
5. The "+" and "-" charged hormones cannot act upon the cell and tell it what it should do.

If the electric/magnetic field or current only lasts for a short time the cell can recover. If it lasts too long the cell will die. Cells make up tissue, tissue makes up organs and organs make up the body.

ii) Dr. Charles Polk devoted an entire chapter (Chapter 12) on "windows" in his book, Handbook of Biological Effects of Electromagnetic Fields, 2nd Edition; CRC Press; New York, N.Y. 1996. (p. 353-568) Dr. Polk has cited 339 research studies on "windows" at the end of Chapter 12, for further information on this subject.

3. Electroporation – A Very Important Word

(a) Definition

Although electric fields, magnetic fields and electrical currents affect the many parts of each cell, electroporation deals mainly with the cell wall (or membrane).

The cell wall has little holes or channels in it that are called "pores". (The skin of a human has pores through which waste or perspiration can exit and chemicals or water can enter). The pores of a cell wall are somewhat the same. Cell wall pores can "open" or "close", allowing some things in, but not allowing other things inside.

Whether or not **ions like calcium** sodium or chloride, or proteins, sugars, or hormones, etc., are allowed through the pores depends upon the electrical charges on these things and upon the electrical charges around these things. It also depends upon the size of the pore.

Electroporation is a process where by the ability of the cell wall to allow or not allow certain things in or out is reduced. The pores of the cell wall also increase in number and in size. [81, 82, 83, 84, 85, 86, 87]

As the term "electroporation" indicates, this phenomenon is caused by electrical by-products such as electric fields, magnetic fields and nearby ground/earth currents, which all create induced electrical currents inside the body at the cell walls. (see pictures of cells, p. 8)

The **first experimental observation of electroporation** was seen in nerves breaking down and not being able to carry messages. This occurred in **1958.** [70] More research followed. [71, 72, 73, 74, 75, 76, 77, 78]

(b) Electroporation can be reversible, [78] or it can result in rupture of the cell wall and cell death. [79, 80, 81]

What the experts say …

"Although the mechanism of cell killing by electroporation is not definitely established, a plausible hypothesis is that cell survival or death is mainly due to the degree of molecular exchange between cells and their environment, and the cell stress due to chemical imbalances that result. [88, 89, 90]

This is consistent with the observation that **cell killing can occur without significant heating*,** [91, 92, 93] and that a tremendous increase in membrane permeability and associated molecular transport occurs." [94]

- Dr. James C. Weaver
- Dr. Yuri Chizmadzher

***** Many of those who claim that electric and magnetic fields and ground/earth currents are safe always use the same argument to defend their stand. The argument is that the electric fields, magnetic fields, and earth currents would have to be so strong to kill cells that they would have to heat up the cells. This simply is not true, according to research.

(c) **Hospitals and Medicines – Treat Electroporation – Since Early 1990's**

i) "As with all potential technologies, undesired side effects must be considered along with possible uses. Thus, the possibility of tissue damage must also be considered. Fortunately, major advances in understanding the role of electroporation in tissue damage has already begun, through a series of important studies motivated by electrical injury. [95, 96, 97, 98, 99, 100] Although electrical injury to tissue has in the past been interpreted as a thermal denaturation phenomenon, more recent studies make a convincing case that electroporation can be a significant factor, particularly for the larger cells such as skeletal muscle cells and nerve cells. [99, 100]

Tissue experiencing electroporation can be rapidly assessed electrically by impedance measurements." [101]

ii) An article in the IEEE (Institute of Electrical and Electronics Engineers) Power Engineering Review also discussed electroporation, in the context of "electrical burn" injuries among electrical workers.

Here also researchers discovered the mechansim underlying the tissue damage: that electric fields produced by the current as it traveled through the body caused hidden damage to cell membranes along the way.

Research by Dr. Raphael Lee and his colleagues at the University of Chicago led to the development of both new diagnostic techniques for determining the extent of the electrical injury and a drug therapy that is able to minimize post-electrical injury call cell degeneration, by fostering membrane repair.

The University of Chicago Hospitals established the Electrical Trauma Center, the United States first such center of its type in the early 1990's. Clinical trails of drug therapy began in 1993.

In 1987, Dr. Lee, a plastic surgeon who also held a doctorate in electrical engineering began publishing a series of papers that demonstrated the traumatic importance of electroporation.

iii) **Detection of Electroporation Tissue Damage**

A variety of imaging technologies are now available to detect such metabolic changes and thus locate tissue damaged by electroporation. **Magnetic resonance imaging** (MRI) shows up the dissociation of ATP during cell repair and shows the increase in concentration of various ions. MRI can also detect tissue edema and can monitor blood flow through an injured area.

Another technology is called **single photoelectron emission computerized tomography (SPECT).** Here a patient is injected with very small amounts of radioactive isotopes that tend to concentrate in areas of particular metabolic activity. A technitum compound called ^{99m}-Tc – pyrophosphate forms a complex with calcium ions and thus can serve as a SPECT indicator of increased local calcium concentration following cell membrane rupture. This compound can also indicate increased potassium ion concentrations – The rubidium isotope ^{86}Rb can be used to evaluate blood flow to electrically traumatized tissues.

iv) **Medicine to Seal Injured Cell Membranes (or Walls)**

Researchers at the University of Chicago developed Poloxamers (copolymers consisting of hydrophobic propylene segments and hydrophillic ethylene segments) that have proven to be safe and useful in medical applications. This is the first time that damage to cellular membranes has been repaired through therapeutic intervention.

This treatment has been used only on severe **electrical burns**, and is initiated within 6 hours of the injury. [102]

4. Melatonin –

An example of <u>only one</u> of the body's chemicals affected by electrical pollution, is melatonin.

(a) **What is Melatonin?**

Melatonin is a chemical produced in the brain in the pineal gland. It is only produced at night, during sleep when the eyes are not stimulated by light.

The pineal gland cells that make melatonin are an example of only <u>one</u> <u>type</u> of cell in the body shown to be adversely affected by EMF fields and electric currents. There are many others not discussed here because of limited space.

(b) Melatonin has many important functions in the body:

i) melatonin regulates the body's **internal clock** that controls when it performs certain functions (falling asleep – awaking; secretion of hormones, etc.) [103, 104, 105]

ii) Melatonin affects **gonadal** (reproductive) **hormones** [103, 104, 105]

iii) Melatonin levels affect peoples **moods and behavior** [103, 104, 105]

iv) Melatonin affects the body's **immune system** in making antibodies to attack foreign invaders. [103, 104, 105]

v) Melatonin exerts direct effects on the growth of **cancers in the breast, prostate and colon** [106, 107, 108, 109]

(c) Lack of melatonin causes:

i) **altered pituitary** timing signals [103, 104, 105]

ii) **decreased reproductive hormone production** [103, 104, 105]

iii) **depression and mood disorders** (and suicides) [103, 104, 105]

iv) **a weakened immune system** [103, 104, 105]

v) **faster growing breast, prostate and colon cancer** [106, 107, 108, 109]

Melatonin production is decreased by exposure to electric fields and magnetic fields in the low frequencies of 60 Hz electricity [110, 111, 112, 113, 114, 115, 116, 117, 118, 119, 120, 121, 122, 123, 124, 125, 126, 127, 128, 129, 130, 131]

6. **Other Diseases and Health Problems Research Links to EMF's, and Neutral/Returning Ground/Earth Currents**

(a) General Public With Higher Exposure
1. skin cancer [131]
2. breast cancer [132, 133, 134]
3. miscarriages [135, 136, 137, 138, 194, 195, 193, 196]
4. non-lymphocytic leukemia [139]
5. infertility [191]
6. congenital malformation [192, 193]
7. prolonged gestation (pregnancy) [194, 195, 196]

(b) Children with Higher Exposure
1. cancer [140, 141, 142, 143, 144]
2. leukemias [145, 146, 147, 148, 149, 150]
3. lymphomas [151]
4. brain tumors [151]

(c) Electrical Workers
1. leukemias [152, 154, 155, 156, 157, 158, 162, 163, 164, 165, 197, 173, 198, 171,.166, 167, 168, 169, 170]
2. brain tumors (gliomas, astrocytomas) [153, 152, 154, 159, 160, 161, 170, 178, 172, 173, 179, 197, 166, 174, 180, 181, 165, 175, 171, 198, 176, 177]
3. pharyngeal (throat) cancer [182]
4. respiratory cancer [182]
5. skin cancer, melanoma [183, 184, 185]
6. headache [189, 186, 187, 188]
7. irritability [186, 187, 188]
8. loss of memory [186, 187, 188]
9. insomnia [186, 187, 188]
10. sweating [186, 187, 188]
11. fatigue [186, 187, 188, 189]
12. general weakness [186, 187, 188, 189]
13. sexual impotence [186, 187, 188]
14. depression [186, 187, 188]
15. sleepiness [189]
16. breast cancer [190]

F. How to LIMIT TOTAL EXPOSURE

Everything carrying or using electricity emits electric and magnetic fields.

The 2-4 mG (milligauss) magnetic field exposure levels associated with childhood leukemia and brain cancers is the **TOTAL EXPOSURE LEVEL.** This means **all** of the sources of EMF's and earth currents **added together**.

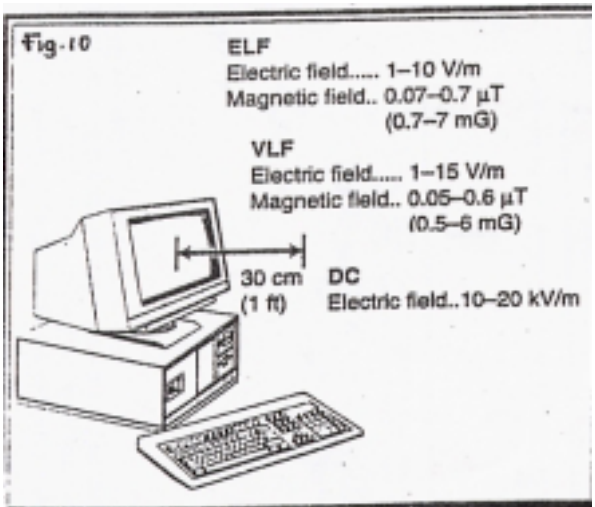
The way society uses electricity has changed. Converting AC electricity to DC electricity in computers, fluorescent lighting, CNC equipment, etc. has created **harmonics** (discussed earlier). The amounts of electricity being used has geometrically grown too. Electricity, which once seemingly posed no problems, now, must be understood and dealt with.

When estimating exposure **levels**, remember most appliances are **not** continuously running and emitting electric and magnetic fields. It is important to consider the **amount of exposure time** as a deciding factor in exposure.

1. **Some things can not be avoided.** These **must be included when adding up exposure levels**.
   (a) nearby transmission lines
   (b) nearby distribution lines
   (c) returning/neutral ground/earth currents
   (d) electrical wiring inside walls, ceilings of a house
   (e) water pipes inside of a house can carry returning electrical currents
2. **Some things can be avoided while they are turned on, staying at least 3-8 feet away, depending on the appliance**.
   (a) microwave ovens
   (b) televisions
   (c) electric ranges, ovens, stoves
3. **Some things can be moved to remote areas (6-8 feet away from immediate living space)**

(a) analog and digital clocks/alarm clocks (keep away from bed)
(b) ceiling fans
(c) air conditioners
(d) electric dryers
(e) electric space heaters
(f) base of cordless phone

4. **Some things can be mitigated with protective screening: found in office supply or electronics stores**.
   (a) computers (screen shield)
   (b) microwave ovens (shield the back and sides if they are not on an outside wall of the room)
5. **Some people have avoided, or substituted the following:**
   (a) fluorescent/energy saving lights have been substituted by old-fashioned incandescent light bulbs
   (b) heating pads, electric blankets (see research on pregnant women – for older models)
   (c) heated water beds
   (d) analogue and digital clocks/and alarm clocks have been substituted with older model electric clocks or wind-up alarm clocks
   (e) hair dryers
6. The following pictures are from public service informational brochures showing the electric fields and magnetic fields radiating from various appliances; transmission lines and distribution lines. Note the distances and the different field strengths.



Typical ranges of EMF at 30 cm (1 ft) from computer monitor screens. As used here; ELF = below 3 kHz, VLF = 15–100 kHz. Note that EMF may be stronger at sides and back of some monitors.
Sources: Advisory Group on Non-ionizing Radiation (1994), Tofani and D'Amore (1991).

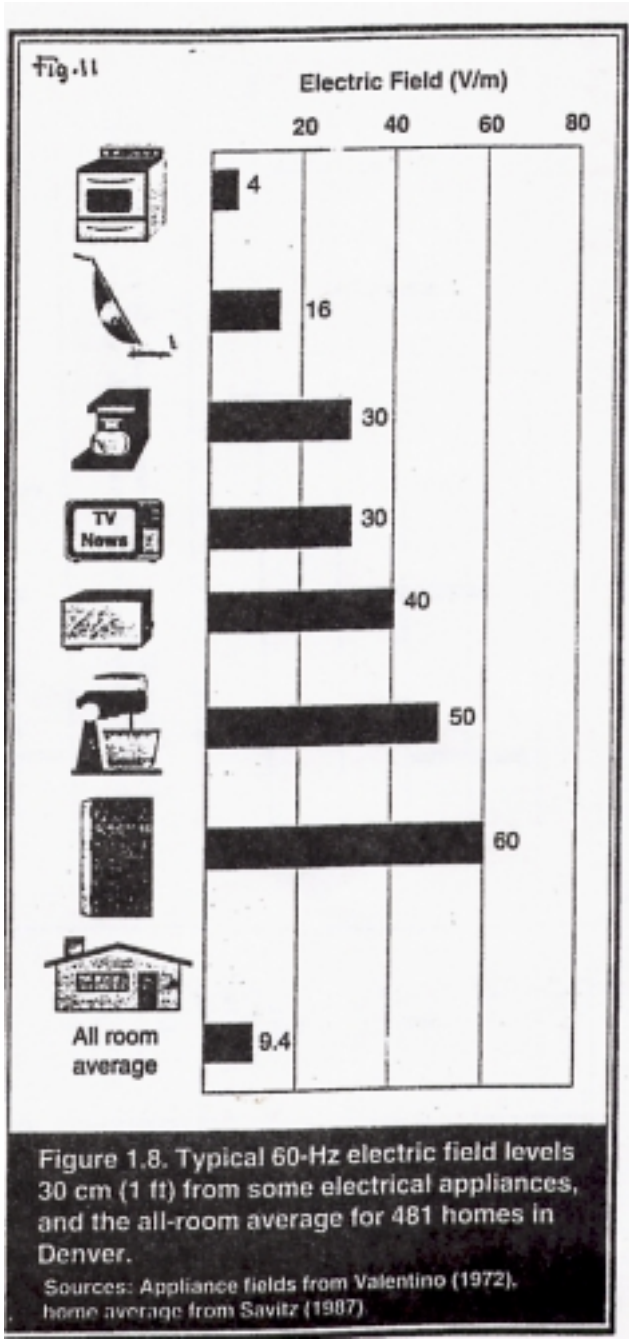


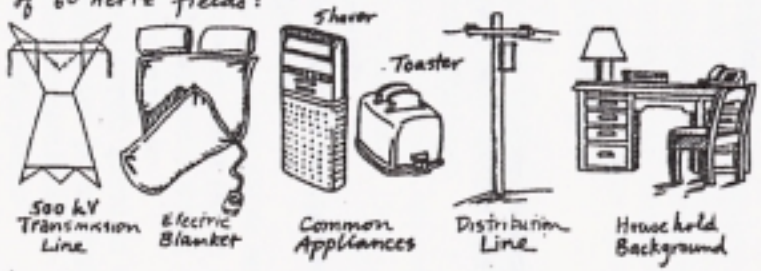
Figure 1.8. Typical 60-Hz electric field levels 30 cm (1 ft) from some electrical appliances, and the all-room average for 481 homes in Denver.
Sources: Appliance fields from Valentino (1972), home average from Savitz (1987).

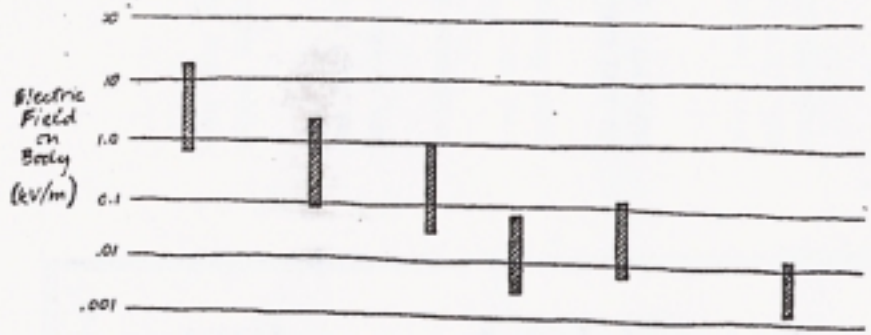
Fig. 10; Fig. 11; from p. 1-6; 2-21; Electrical and Biological Effects of Transmission Lines; A Review; J.M. Lee, Ph.D.; Bonneville Power Administration; 1996.

Fig. 12 and Fig. 13 from p.3 and p.22; Electric and Magnetic Fields from 60 Hertz Electric Power: What do we know about possible health risks?; Dept. Of Engineering and Public Policy: Carnegie Mellon University; Pittsburgh, PA; 1989.

Fig.12

Approximate strength of the average electric field at the surface of the body produced by several common sources of 60 herte fields:





Approximate strength of the average magnetic field produced within the body by several common sources of 60Herte fields:

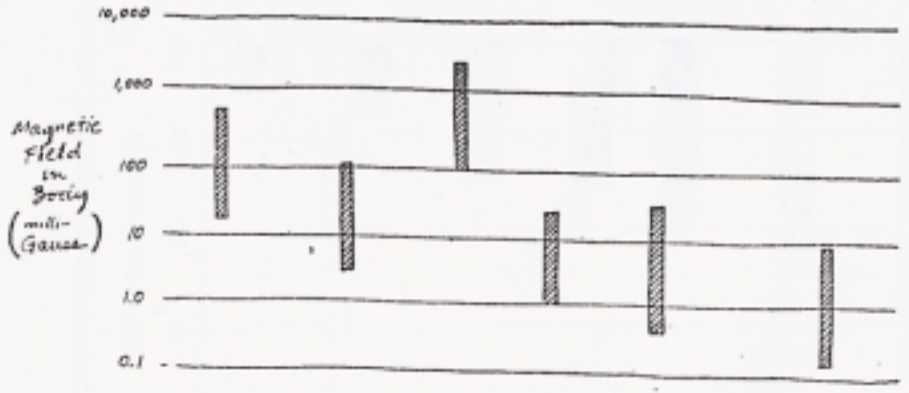


Fig.13

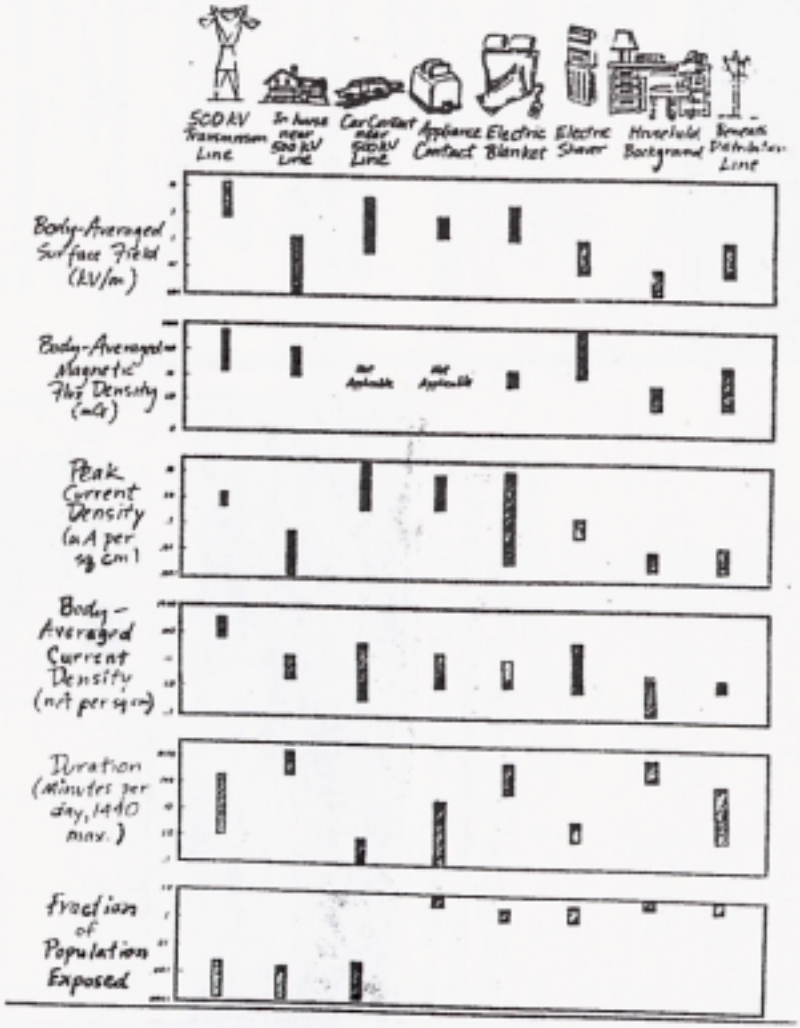


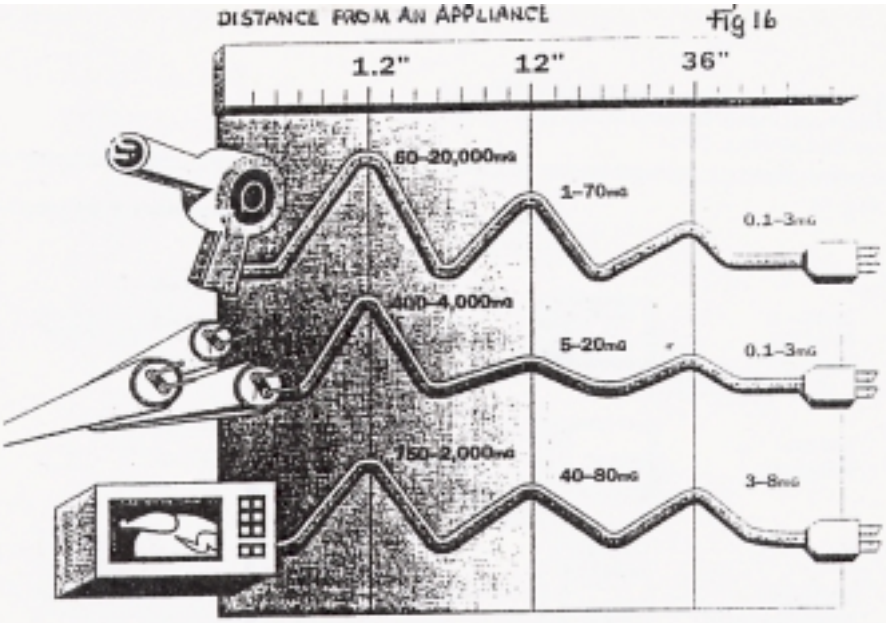
Fig. 14 from p.1-16; Electrical and Biological Effects of Transmission Lines: A Review; J.M. Lee, Ph.D.; Bonneville Power Administration, 1996.

Fig 14

Magnetic Flux Densities At Two Distances From Appliances on the Left

	27 cm (10.5 in)			1.17 m (46 in)		
95 Black & White TVs Measured	Maximum	Median	Minimum	Maximum	Median	Minimum
	12.1 mG	2.9 mG	0.7 mG	1.3 mG	0.1 mG	0.0 mG
343 Color TVs Measured	18.6 mG	7.0 mG	0.4 mG	1.4 mG	0.4 mG	0.02 mG
383 Electric Ranges Measured	28.6 mG	9.0 mG	0.5 mG	6.2 mG	0.3 mG	0.0 mG
485 Microwave Ovens Measured (outside 60-Hz field, not inside the oven)	263.9 mG	36.9 mG	0.9 mG	17.2 mG	2.1 mG	0.2 mG
118 Analog Clock/ Clock-Radios Measured	41.2 mG	14.8 mG	1.8 mG	3.2 mG	0.3 mG	0.0 mG
95 Digital Clock/ Clock-Radios Measured	5.7 mG	1.3 mG	0.3 mG	1.3 mG	0.2 mG	0.0 mG
117 Ceiling Fans Measured	49.5 mG	3.1 mG	0.2 mG	1.5 mG	0.3 mG	0.0 mG
86 Air Conditioners Measured (Window Units)	18.4 mG	3.0 mG	0.1 mG	3.8 mG	0.2 mG	0.0 mG
397 Fluorescent Lights Measured	56.7 mG	5.9 mG	0.2 mG	3.5mG	0.4 mG	0.0 mG
367 Refrigerators Measured	15.7 mG	2.6 mG	0.1 mG	10.4 mG	0.4 mG	0.1 mG

Measurements of 60-Hz magnetic flux density at two distances from various electric appliances. To convert from mG to μT, divide by 10 (10 mG= 1 μT).
Source: Zaffanella (1993).



The strength of the electric or magnetic field at different distances from power lines and appliances lies somewhere in these shaded regions.

mGmilligauss (a unit of measurement for magnetic fields)
Each appliance has a different field strength

Fig 15

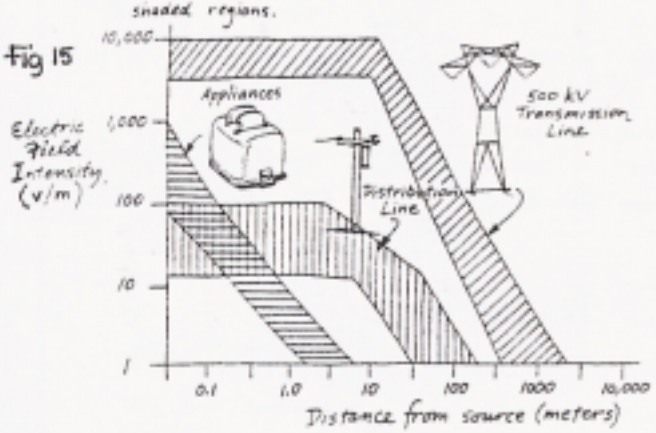
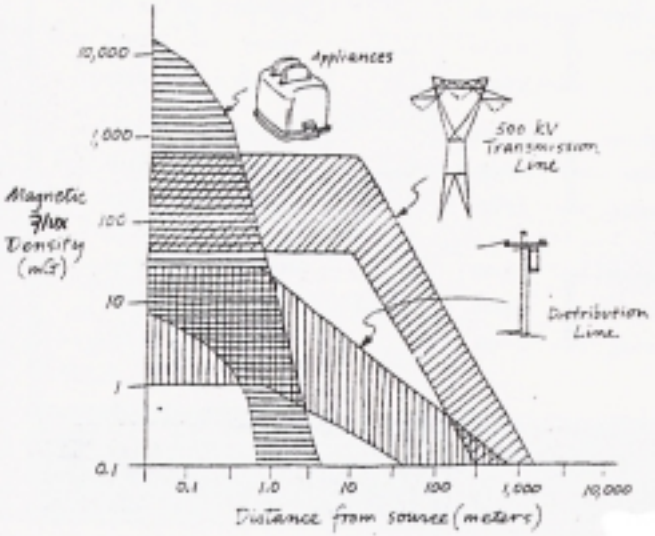


Fig. 15 from p.4; Electric and Magnetic Fields from 60 Hertz Electric Power: What do we know about possible health risks?; Dept. Of Engineering and Public Policy: Carnegie Mellon University; Pittsburgh, PA; 1989.

Fig. 16 from p.4; A Consumers Guide To Electric Magnetic Fields; Edison Electric Institute; 1991.



Wertheimer; Ahlbom; Wilson; and other scientists linked health risks at **4 mG**

Milli Gauss (mG)		**Gauss (G)**		**Tesla (T)**		**Micro Tesla (μT)**		
10 milli Gauss (mG)	=	1/100 Gauss (0.01G)	=	10^{-6} Tesla	=	1/1,000,000 T (or) 0.000001 T.	=	1 micro Tesla (μT) = 10 x 10 x 10 x 10 x 10 x 10 = 1/1,000,000
100 milli Gauss (mG)	=	1/10 Gauss (0.1 G)	=	10^{-5} Tesla	=	1/100,000 T (or) 0.00001 T.	=	10 micro Tesla (μT) = 10 x 10 x 10 x 10 x 10 = 1/100,000
1,000 milli Gauss (mG)	=	1 Gauss (G)	=	10^{-4} Tesla	=	1/10,000 T (or) 0.0001 T.	=	100 micro Tesla (μT) = 10 x 10 x 10 x 10 = 1/10,000
10,000 milli Gauss (mG)	=	10 Gauss (G)	=	10^{-3} Tesla	=	1/1,000 T (or) 0.001 T.	=	1 milli Tesla (mT) = 10 x 10 x 10 = 1/1,000
100,000 milli Gauss (mG)	=	100 Gauss (G)	=	10^{-2} Tesla	=	1/100 T (or) 0.01 T.	=	10 milli Tesla (mT) = 10 x 10 = 1/100
1,000,000 milli Gauss (mG)	=	1,000 Gauss (G)	=	10^{-1} Tesla	=	1/10 T (or) 0.1 T.	=	100 milli Tesla (mT) = 10 = 1/10
10,000,000 milli Gauss (mG)	=	10,000 Gauss (G)	=	1 Tesla	=	1 Tesla (T) or 1 T.	=	1 Tesla

STRENGTH OF RADIATION OF NON-IONIZING MAGNETIC FIELDS

FREQUENCY = MAGNETIC AND ELECTRIC FIELDS – HOW MANY TIMES PER SECOND THEY EXPAND & COLLAPSE
1 HERTZ = 1 TIME PER SECOND THE ELECTRIC FIELDS AND MAGNETIC FIELDS EXPAND & COLLAPSE
ELECTROMAGNETIC SPECTRUM

Total Exposure Government Safety Standards:
Australia, Austria: 0.001μW/cm²
Europe, Eastern Europe, Russia: 2-10μW/cm²
United States: 200 – 1000 μW/cm²
World Scientists – Salzburg Resolution
Total Max: 10 μW/cm²

NON IONIZING RADIATION

Extremely Low Frequency = (ELF) = 0 – 999 Hertz (Hz) = $0 – 10^2$ Hz = 10x10 = 100 Hertz (Hz)
(examples: Electricity, ELF Project, some Harmonics) 60 Hz = Electricity
(non-thermal) = 1,000 Hertz (Hz) = 10^3 Hz = 10x10x10 = 1,000 Hertz (Hz) = 1 kilo Hertz (1 kHz)

Radio Frequency = (RF)
(examples: AM, FM Radio Stations, = 100,000 Hertz (Hz) = 10^5 Hz = 10x10x10x10x10 = 100,000 Hz = 100 kilo Hertz (100 kHz)
Television, Cell Phone Towers, = 1,000,000 Hertz (Hz) = 10^6 Hz = 10x10x10x10x10x10 = 1,000,000 Hz = 1 Mega Hertz (1 MHz)
Cell Phones)
(thermal, heats what it strikes) = 10,000,000 Hertz (Hz) = 10^7 Hz = 10x10x10x10x10x10x10 = 10,000,000 Hz = 10 Mega Hertz (10 MHz)
= 100,000,000 Hertz (Hz) = 10^8 Hz = 10x10x10x10x10x10x10x10 = 100,000,000 Hz = 100 Mega Hertz (100 MHz)

800-900 MHz – analogue Cellular Phone
1850 – 2000 MHz – digital PCS Cellular Phone
2 GHz = 2000 MHz ↑
1 GHz = 1000 MHz ↓

Microwave (MW) (1 Billion) (1 Billion)
(examples: Cell Phones, = 1,000,000,000 Hertz (Hz) = 10^9 Hz = 10x10x10x10x10x10x10x10x10 = 1,000,000,000 Hz = 1 Giga Hertz (1 GHz)
Cell Phone Towers, Microwave = 10,000,000,000 Hertz (Hz) = 10^{10} Hz = 10x10x10x10x10x10x10x10x10x10 = 10,000,000,000 Hz = 10 Giga Hertz (10 GHz)
Ovens, Cordless Phones) = 100,000,000,000 Hertz (Hz) = 10^{11} Hz = 10x10x10x10x10x10x10x10x10x10x10 = 100,000,000,000 Hz = 100 Giga Hertz (100 GHz)

(1 Trillion)
Infrared (IR) = 1,000,000,000,000 Hertz (Hz) = 10^{12} Hz = 10x10x10x10x10x10x10x10x10x10x10x10 = 1,000,000,000,000 Hz = 1,000 Giga Hz (1000 GHz)
(examples: Heat Lamp)

IONIZING RADIATION

Ultra Violet (U.V.) $10^{15} – 10^{17}$ Hz
(examples: Sunlight, Tanning Booth)

X-Rays $10^{17} – 10^{20}$ Hz
(example: Medical X-Rays, Atomic Bomb, CT Scan, Sun Radiation, Nuclear Reactors)

C.U.R.E.
P.O. Box 43
Brantwood, WI 54513
Phone/Fax: 715 – 564 –3362
darvr@newnorth.net
www.strayvoltage.org

Chronological Order of Recent Events Concerning EMF's and Ground/Earth Currents.

1995 – UNITED STATES

NEW RESEARCH: Ground/Earth Currents in Cities

Wertheimer's earlier research (1970's) of magnetic field exposure being linked to childhood cancers was given **"significantly stronger associations"** when this research linked the magnetic fields and childhood cancers to electrical ground/earth current sources.

This was found to occur in **cities** because there the homes' water pipes are also connected to the electrical system.

> "An uninterrupted metallic path in the water pipes and water main connects the grounding systems of neighboring houses."
>
> "The associations of cancer with conductive plumbing ... suggest that cancer risk is increased among persons with elevated magnetic field exposure from residential ground currents."

Wertheimer, N.; Savitz, D.A.; Leeper, E.; Childhood Cancer in Relation to Indicators of Magnetic Fields from Ground Current Sources; Bioelectromagnetics; 16: 86-96 (1995)

1996 – UNITED KINGDOM

NEW RESEARCH: Electric Fields Linked To Childhood Leukemias

Coghill measured the electric fields of the "bedplace" of children with leukemia and found a significant dose-response relationship between electric field exposure and incidence of leukemia.

Coghill, R.W.; ELF Electric and Magnetic Fields In the Bedplace of Children Diagnosed With Leukemia: A Case-Control Study; Europ. J. Cancer Prev. 5: 3-10 (1996) and Biophysics 41: 806-816 (1996)

1999 – UNITED KINGDOM

Coghills Challenge

"My studies have shown that people sleeping in bedplaces where the ELF (extremely low frequency – ie: 60 Hz) electric field is elevated .. **above 20 Volts per meter** there is serious ill health from chronic exposure (asthenias and leukemias in adults and cot death in children.)."

The Coghill Challenge began on July 4, 1999 and initially was open for 1 year.

Coghill offered to pay $1500 to any power utility worker or any member of the (England's) National Radiological Protection Board (NRPB) (who sets Englands safety levels at **12,000 Volts per meter**) who would ...

"Place any human infant of less than 3 months of age to sleep each night for at least 8 hours in an ELF electric field of 100 Volts per meter for 30 days."

The NRPB and the power utilities investigation levels predict there will be no adverse effect.

2000 – CANADA

NEW RESEARCH: Electric Fields Linked to Adult Leukemia

Villeneuve's "results support the hypothesis that electric fields act as a promoting agent in the etiology of adult leukemia.

This was a nested case-control study of 31,453 Ontario electric utility workers: Those who had worked for at least 20 years working in electric fields above 10 and 20 Volts per meter had odds ratios (O.R.) of 10.17 of contracting leukemia.

Villeneuve, P.J.; Agnew, D.A.; Miller, A.B.; Corey, P.N.; Purdham, J.T.; Leukemia in Electric Utility Workers: The Evaluation of Alternative Indices of Exposure to 60 Hz Electric and Magnetic Fields; American Journal of Industrial Medicine 37: 607-617 (2000).

2000 – UNITED STATES

NEW RESEARCH: U.S. Electrical Grounding Practices cause "contact current" to flow in a person.

Kavet found that residential electrical wiring practices results in small voltages (few tenths of a volt) called "open circuit voltage", (V_{oc}).

Kavets analysis is based on a computer model of a 40 house neighborhood.

The highest magnetic field levels and V_{oc}'s were both associated with backyard electric lines and with long ground paths in the residence. He concluded that V_{oc} is a potentially important exposure with respect to childhood leukemia risks associated with residential magnetic fields.

Kavet, R.; Zaffanella, L.E.; Deigle, J.P.; Ebi, K.L.; The Possible Role of Contact Current in Cancer Risk Associated with Residential Magnetic Fields; Bioelectromagnetics 21: 538-553 (2000).

2000 – CANADA

NEW RESEARCH: Electric Fields May Play A Part In Promoting Non-Hodgkins Lymphoma (NHL)

Villeneuve studied male electric utility workers in Ontario. His data suggests that electric field exposure of 10 and 40 Volts/meter and above have an odds ratio of 3.05 predicting Non-Hodgkins Lymphoma in the electric workers.

Villeneuve, P.J.; Agnew, D.A.; Miller, A.B.; Corey, P.N.; Non-Hodgkins Lymphoma Among Electric Utility Workers in Ontario; the evaluation of alternate indices of exposure to 60 Hz electric and magnetic fields; Occup. Environ. Med. 57: 249-257 (2000).

2000 – UNITED STATES

NEW RESEARCH: Electric Utility Workers – Electromagnetic Fields and Suicide

Wijngaarden did a case-control study on electric utility workers. Suicide mortality was increased relative to work in exposed jobs and with indices of exposure to magnetic fields: odds ratios for an electrician 2.18; lineman 1.59.

Wijngaarden, E.; Savitz, D.A.; Kleckner, R.C.; Cai, J.; Loomis, D.; Exposure to electromagnetic fields and suicide among electric utility workers: a nested case-control study; Occup. Environ. Med. 57: 258-263 (2000).

2000 – SWEDEN – U.K. – U.S.A. – CANADA – GERMANY – DENMARK – NORWAY – FINLAND

NEW RESEARCH: Magnetic Fields and Childhood Leukemia

Ahlbom conducted a pooled analysis using the primary data from 9 studies on EMF and childhood leukemia.

They found a statistically significant relative risk of 2 fold increase for childhood leukemia in children with a residential EMF exposure of .4 μT (4 mG) or greater.

Ahlbom, A.; Day, N.; Feychting, M.; Roman, E.; Skinner, J.; Dockerty, J.; Linet, M.; McBride, M.; Michaelis, J.; Olsen, J.H.; Tynes, T.; Verkasalo, P.K.; A Pooled Analysis of Magnetic Fields and Childhood Leukemia; British Journal of Cancer; 83 (5), 692-698. (2000).

2000 – CANADA

Unbiased Review of the Reports by the U.S. National Research Council and the U.S. National Institute of Environmental Health Sciences (NIEHS)

These organizations collected research studies on the biological effects of non-ionizing electromagnetic fields.

Havas categorizes, charts, graphs these research studies and points out how these organizations have played down the findings of this research.

"Conclusions:

(1) low frequency electric and magnetic fields, separately and in combination, can affect living organisms.
(2) effects can be, neutral, harmful, beneficial.
(3) effects can occur at low intensities, commonly found in residential settings, and some effects are intensity specific (intensity windows).
(4) effects can occur at low frequencies, at, above and below the power distribution frequencies and some effects are frequency specific (frequency windows).
(5) we understand some of the mechanisms responsible and are at the threshold of understanding others that are involved."

Havas, Magda; Biological effects of non-ionizing electromagnetic energy: A critical review of the reports by the U.S. National Research Council and the U.S. National Institute of Environmental Health Sciences as they relate to the broad realm of EMF bioeffects; Environ-Rev. 8: 173-253 (2000). (Canada)

2000 – UNITED STATES

NEW RESEARCH: Neutral/Returning Ground Earth Currents and "Stray Voltage" Problems on Dairy Farms

Polk reviews the weaknesses of the Minnesota Public Utilities Commission Study; the effects of soil resistance, placement of ground rods, size of neutral return electric wires on the neutral/returning ground/earth currents, and their need to be investigated.

Polk, C.; Cows, Ground Surface Potentials and Earth Resistivity; Bioelectromagnetics 22: 7-18 (2001)

2000 – SWITZERLAND

Government Ruling: Swiss Government Adopts Strict EMF/EMR (electromagnetic fields/electro-magnetic radiation) **exposure limits for cell towers and power lines.**

The Swiss government adopted stringent new standards for public exposures from power lines and from cell towers used for cell phones, radio and T.V.

broadcasting. The new rules took effect on February 1, and are similar to those in Russia and China. New and existing cell phone towers are limited to 4.2 μW/cm² (the United States limits are 1000 μW/cm²). EMF's are limited to 10 mG.
Source: Microwave News, January/February 2000.

2001 – UNITED STATES – WISCONSIN

State Legislator, Barbara Gronemus sends letters to Wis. P.S.C. (Public Service Commission) and **State Health Dept.**

Representative Gronemus asked the Health Dept. and P.S.C. if they were responsible for dealing with electrical pollution problems.
What is the P.S.C. doing to enforce OSHA, IEEE, National Electric Safety Code (NESC) National Guidelines for safety on this subject?
Why isn't the State Health Dept. dealing with electrical pollution as an environmental health, and human health hazard issue?

Letters dated: February 22, 2001
From State Rep. Barbara Gronemus
91st Assembly District

2001 – UNITED KINGDOM

The British Sunday Times News stated:

"High voltage power cables have been officially linked to cancer for the first time. A study shows that children living near them run a small but significant increased risk of falling victim to the disease."
The Sunday Times News; March 4, 2001, Britain; "Top Scientists Establish Link – Pylons are cancer risk – Official"; by Jonathan Leake, Science Editor.

2001 – AUSTRALIA – NEW ZEALAND

NEW RESEARCH: Asthma, strongly associated with exposure to powerlines

Dr. **Ivan Beale** of New Zealand, has found that the immune related disease, asthma was strongly associated with exposure to high voltage power lines.
Beale, I.L.; Pearce, N.E.; Booth, R.J.; Association of Health Problems with 50-Hz Magnetic Fields in Human Adults Living Near Power Transmission Lines; (1997)

2001 – UNITED STATES

NEW RESEARCH: Historical Research "concludes the childhood leukemia peak of common acute lymphoblastic leukemia (ALL) **is attributable to residential electrification – 75% of childhood acute lymphoblastic leukemia and 60% of all childhood leukemia may be preventable.**

Milham, and Osslander obtained the records of the dates when the United States and Britain introduced electricity into their cities and rural areas, and compared this to the records of childhood deaths from leukemia, and found a parallel correlation.
Milham, S.; Osslander, E.M.; Historical evidence that residential electrification caused the emergence of the childhood leukemia peak; Medical Hypothesis, dai: 10.1054; 1138; Harcourt Publishers Ltd. (2001).

2001 – SPAIN

HIGH COURT DECISION: A Sentence Admits For The First Time, That Electromagnetic Waves Are A Health Hazard.

A Spanish electric company has been sentenced by the Provincial Court of Murcia, who found in favor of the inhabitants of a house affected by electromagnetic emissions originating from a transformer. This Court decision upheld a previous court decision that it is not the affected citizen who must demonstrate that electromagnetic emissions are hazardous, but that it is up to the energy supplying company to prove they are absolutely safe.
Newspaper: LaRazon; Monday March 5, 2001; Front Page: A Sentence Admits, for the First Time, That Electromagnetic Waves are A Health Hazard.

Facts provided in this book:

Therefore: neutral returning ground/earth currents have an RF component. Both 60 Hz current and RF current have been linked to health problems. RF having a quicker onset.

AC Power Interference Manual

New Insights into the Causes, Effects, Locating, And Correction of Power-Line and Other Electrical Interference.

By Marv Loftness

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Research References:

1. p. 29; 1997 National Electrical Safety Code Handbook; Section 92.D.
2. p. 18-25; Editors Fink, Donald; Beaty, Wayne; Standard Handbook for Electrical Engineers, 14th Edition; McGraw-Hill, New York, N.Y.; 2000
3. Hendrickson, Riley; Survey to Determine the Age and condition of Electric Distribution Facilities in Minnesota: Report 1: Analysis of Overhead Distribution Feeder Testing Data; Minnesota Public Utilities Commission: May 5, 1995.
4. Kavet, R; Zaffanella, L.E.; Daigle, J.P.; Ebi, K.L.; The Possible Role of Contact Current in Cancer Risk Associated With Residential Magnetic Fields; Bioelectromagnetics 21:538-553 (2000)
5. p.1-11; 1-12; 1-21; Lee, Jack M.; Electrical and Biological Effects of Transmission Lines; A Review; Bonneville Power Administration; Portland, Oregon; Dec. 1996.
6. Public Service Commission of Wisconsin; Docket 05-EI-106; 08-10-89
7. p.10; 4.1.1. – Stray Voltage: Bracken, T. Dan; An Assessment of Health Effects of the Electrical Environment on Dairy Farms; Prepared for Inter Utility Stray Voltage Task Force; Public Service Commission of Wisconsin; Docket 05-EI-108.
8. (p. 2-1) Lefcourt, A.M.; Effects of Electrical Voltage/Current on Farm Animals – How to Detect and Remedy Problems; United States Department of Agriculture Handbook Number 696 (The Red-Book) 1991.
9. (p.6 – Appendix A) State of Minnesota – Public Utilities Commission; Science Advisors; Research Findings and Recommendations Regarding Claims of Possible Effects of Currents in the Earth on Dairy Cow Health and Milk Production; July 31, 1998.
10. (p.587 – Table 3 – Electric Fields); Polk, Charles; Postow, Elliot; Editors: 2nd Edition; Handbook of Biological Effects of Electromagnetic Fields; 1996; CRC Press, New York, N.Y.: ISBN –0-8493-0641-8.
11. (graphed from data Fig. A-25-1; A-2503;) Arrowhead to Weston Transmission Line Application – Public Service Commission of Wisconsin – docket 05-CE-113, Vol. I.
12. (graphed from data Fig. A-251; A-2503;) Arrowhead to Weston Transmission Line Application – Public Service Commission of Wisconsin – Docket 05-CE-113, Vol. I.
13. (p.10) Public Service Commission of Wisconsin; Docket 05-EI-108; Testimony of T. Dan Bracken, Ph.D. (Electric Company Witness).
14. Schüz, Joachim; Grigat, Jan Peter; Brinkman, Karl; Michaelis, Jörg; Residential – Magnetic fields as a risk factor for childhood acute leukemia: Results from a German population – based case-control study; International Journal of Cancer; Sept. 29, 2000.
15. Ahlbom, A; Day, N.; Feychting, M.; Linet, J.; McBride, M.; Michaels, J.; Olsen, J.; Tynes, T.; Verkaszlo, P.; A pooled analysis of magnetic fields and childhood leukaemia; British Journal of Cancer, (2000): 83(5) 692-698.
16. Wertheimer, N.; Leeper, E.; Electrical Wiring Configurations and Childhood Cancer; American Journal of Epidemiology; 109 (1979): p. 273-284.
17. Tomenius, L.; 50 Hz Electromagnetic Environment and the Incidence of Childhood Cancers in Stockholm County; Bioelectromagnetics 7 (1986): p. 191-207.
18. Savitz, D.A.; et al.; Case-Control Study of Childhood Cancer and Exposure to 60 Hz Magnetic Fields; American Journal of Epidemiology 128, (1988) p. 10-20.
19. Peters, J.; Childhood Leukemia and Exposure to Electricity; American Journal of Epidemiology (Nov. 1991) p. 215-230.
20. Bowman, J.D.; The Risk of Childhood Leukemia from Home Exposure to Resonance from Static and Power Frequency Magnetic Fields; (1991); Presented at the U.S. Dept. of Energy Conference; Nov. 1991.
21. Lin, R.S.; Childhood Leukemia in Relation to Residential Magnetic Fields; (1991); Presented at U.S. Dept. of Energy Annual Review of Biological Effects of 50 and 60 Hertz Electromagnetic Fields; Nov. 3, 1991.
22. Feychting, M.; Ahlbom, A.; Magnetic fields and cancer in people residing near Swedish high voltage power lines; Institutet for Miljomedicin, Karolinska Institutet, 1992.
23. Feychting, M.; Ahlbom, A.; Magnetic Fields and cancer in children residing near Swedish high-voltage power lines, American Journal of Epidemiology; 138, 467, (1993).
24. (p. 13-14;) Testimony of T. Dan Bracken, Ph.D. (Electric Company witness) Public

Service Commission of Wisconsin, Docket 05-EI-108.

25. p. 588-589; Table 4 – Magnetic Fields; Polk, Charles; Postow, Elliot; Editors; 2nd Edition; Handbook of Biological Effects of Electromagnetic Fields; 1996; CRC Press, New York, N.Y.; ISBN-0-8493-0641-8.

26. (graphed from data, Fig. A-2607) Arrowhead to Weston Transmission Line Application -– Public Service Commission of Wisconsin – Docket 05-CE-113.

27. Bracken, T.D.; 1990; The EMDEX Project: Technology Transfer and Occupational Measurements (Three Volumes) EPRI EN-7048. Research Project 2966-1. Prepared by T. Dan Bracken, Inc. for Electric Power Research Institute, Palo Alto, CA. P. 2-6; figure 2-6 – Electric Utility Workers, Electrical and Biological Effects of Transmission Lines; A Review; Bonneville Power Administration, Portland, Oregon; Dec. 1996.

28. Dan Dasho P.E.; Mark Cook (electrician); Richard Reines (B.S. Engineering); Public Service Commission of Wisconsin, Stray Voltage Analysis Team; AND Douglas Reinemann, Ph.D. (Univ. – Wisconsin-Madison – Ag. Dept.) Magnetic Field Measurements on Wisconsin Dairy Farms; Paper No. 963071 – Presented to The American Society of Agricultural Engineers; July 15-20, 1996.

29. Carstensen, E.L.; 1987. Biological Effects of Transmission Line Fields. Elsevier. New York.

30. Kaune, W.T.; Anderson, L.E.; 1990. "Physical Aspects of ELF Electric and Magnetic Fields: Measurements and Dosimetry." Pages 17-45. In, Wilson B.W. et al. (editors) Extremely Low Frequency Electromagnetic Fields: The Question of Cancer. Battelle Press. Columbus, Ohio.

31. Conclusions and Recommendations from National Institute of Environmental Health Sciences (NIEHS) Report form EMF-RAPID Study/Program; Health Effects from Exposure to Power-Line Frequency Electric and Magnetic Fields – NIH Publication #99 – 4493; p. 35.

32. IARC (International Agency for Research on Cancer of the World Health Organization) and NTP (U.S. Gov't. National Toxicology Program) (website: http://users.westnet.gr/~aesclep/carcinog.htm)

33. The Sunday Times: News; Great Britain; March 4, 2001, Top Scientists Establish Link – "Pylons are cancer risk – Official" by Jonathan Leake, Science Editor.

34. United States Social Security Administration; Administrative Law Judge; Edward W. Bergtholdt – District for State of Washington and Idaho; Ruling; August 17, 2000, Awarded in favor of Michael Gunner.

35. Löscher, W.; Mevissèn, M.; 1995. Linear relationship between flux density and tumor co-promoting effect of prolonged magnetic field exposure in a breast cancer model. Cancer Letters 96: 175-180.

36. Long-Suppressed Draft EPA Report : EMF's Present a Cancer Risk ; Microwave News ; January/February 1998.

37. Ragan H.A. ; Buschbom R.L. ; Pipés, M. J.; Phillips R.D.; Kaune, W.T.; 1983. Hematologic and serum chemistry studies in rats exposed to 60 Hz electric fields. Bioelectromagnetics 4: 79-90.

38. Morris, J.D.; Kimbal, K.T.; Aldrich, T.E.; Easterly, C.E.; 1989. Statistical approach to combining the results of similar experiments with applications to the hematologic effects of extremely-low-frequency electric field exposures. Bioelectromagnetics 10: 23-34.

39. Adey, W.R.; Tissue Interactions With Nonionizing Electromagnetic Fields; Physiological Reviews; Vol. 61, No. 2; April 1981.

40. OSHA Directive – CPL 2-1.18A; Enforcement of the Electric Power Generation, Transmission and Distribution Standard, 10/20/1997.

41. p. F-84 – Application – Arrowhead – Weston Transmission Line Project – Vol. II. Appendix F; Public Service Commission of Wisconsin Docket 05-CE-113 and PSCW Docket 05-EI-115;

42. (p.7-18) Lefcourt, A.M.; Effects of Electrical Voltage/Current on Farm Animals – How To Detect and Remedy Problems; Agriculture Handbook Number 696 (The Red Book); Agriculture Research Service; United States Department of Agriculture; 1991.

43. (p.14-20) Fink, Donald; Beaty, H.W.; Standard Handbook for Electrical Engineers; 14th Edition; McGraw-Hill, New York, N.Y.; 2000. (Table 14-6)

44. (p.22-23) Testimony of T. Dan Bracken, Ph.D.; Public Service Commission of Wisconsin, Docket 05-EI-108.

45. (p.21) Bracken, T.D.; Erdreich, L.S.; An Assessment Of Health Effects Of The Electrical Environment On Dairy Farms; prepared for: Inter-Utility Stray Voltage Task Force – August 13, 1993 – Exhibit Public Service Commission of Wisconsin – Docket 05-EI-108.

46. (p.187) Polk, Charles; Postow, Elliot; Editors, 2nd Edition; Handbook of Biological Effects of Electromagnetic Fields; 1996; CRC Press; New York, N.Y.; ISBN-0-8493-0641-8.

47. (p.188, 189;) ibid.

48. (p.21) Bracken, T.Dan; An Assessment of Health Effects of the Electrical Environment on Dairy Farms; Prepared for Inter Utility Stray Voltage Task Force; Public Service Commission of Wisconsin; Docket 05-EI-108.

49. Adey, W.R.; Tissue interactions with nonionizing electromagnetic fields; Physiol. Rev. 61, 435, 1981.

50. Tenforde, T.S., Biological responses to static and time-varying magnetic fields in Extremely-Low-Frequency Electromagnetic Fields; The Question of Cancer, Wilson, B.W.; Stevens, R.G.; Anderson, L.E.; Eds. Battelle Press, Columbus, OH, 1990. 292.

51. Tenforde, T.S.; Cellular and Molecular pathways of extremely-low-frequency electromagnetic field interactions with living systems; Electricity and Magnetism in Biology and Medicine; Blank, M.; Ed.; San Francisco Press, San Francisco, CA. 1993.

52. Adey, W.R.; Nonlinear electrodynamics in cell membrane transductive coupling; Membrane Transport and Information Storage, Vol. 4. Aloia, R.C.; Curtain, C.C.; Gordon, L.M.; Eds.; Wiley-Liss; New York, 1990. 1

53. Tenforde, T.S.; Interactions of Elf Magnetic Fields with living matter; Handbook of Biological Effects of Electromagnetic Radiation; Polk, C.; Postow, E.; Eds. CRC Press, Boca Raton, FL: 1986, 197.

54. Sienkiewicz, Z.J.; Cridland, N.A.; Kowalczuk, C.L.; Saunders, R.D.; Biological effects of electromagnetic fields and radiation; The Review of Radio Science: 1990-1992; Stone, W.R.; Hyde, G.; Eds. Oxford Univ. Press; Oxford U.K.; 1993, 737.

55. Criland, N.A.: Electromagnetic Fields and Cancer: A Review of Relevant Cellular Studies, Rep. No. NRPB-R256. Nat'l Radiological Protection Board, Chilton, Didcot, Oxon, UK, 1993.

56. Wallaczek, J.; Liburdy, R.P.; Nonthermal 60 Hz sinusoidal magnetic field thymocytes: Dependence on mitogen activation, FEBS Lett. 271, 157, 1990.

57. Litovitz, R.; Krause, D.; Mullins, J.M.; Effect of coherence time of the applied magnetic field on ornithine decarboxylase activity, Biochem. Biophys. Res. Comm. 178, 862, 1991.

58. Kirschvink, J.L.; Kobayashi-Kirschvink, A.; Diaz-Ricci, J. and Kirschvink, S.J.; Magnetite in human tissues: A mechanism for the biological effects of weak ELF magnetic fields; Bioelectromagnetics, Suppl. 1, 101, 1992.

59. Polk, C.: Effects of extremely-low-frequency magnetic fields on biological magnetite, Bioelectromagnetics, 15, 261, 1994.

60. Kirschvink, J.L.; Kobayashi-Kirschvink, A.; Magnetite biomineralization in human tissues. Paper K 1-8, Abstracts of XXIVth General Assembly of the International Union of Radio Science, Kyoto, Japan: Aug. 25-Sept. 2, 1993, 512.

61. Liboff, A.R.; Rozek, R.J.; Sherman, M.L.; McLeod, B.R.; Smith, S.D.; Ca^{++} cyclotron resonance in human lymphocytes, J. Bioelectr. 6, 13, 1987.

62. Smith, S.D.; McLeod, B.R.; Liboff, A.R. and Cooksey, K; Calcium cyclotron resonance and diatom mobility, Bioelectromagnetics, 8, 215, 1987.

63. Lednev, V.V.; Possible mechanism for the influence of weak magnetic fields on biological systems. Bioelectromagnetics, 9, 381, 1988.

64. Bruckner-Lea, C.; Durney, C.H.; Janata, J.; Rappaport, C.; Kaminski, M.; Calcium binding to metallochromic dyes and calmodulin in the presence of combined AC-DC magnetic fields, Bioelectromagnetics, 13, 147, 1992.

65. Tenforde, T.S.; Kaune, W.T.; Interaction of extremely-low-frequency electric and magnetic fields with humans; Health Phy. 53, 585, 1987.

66. Tenforde, T.S.; Microscopic dosimetry of extremely-low-frequency electric and magnetic fields; Bioelectromagnetics, Suppl. 1, 61, 1992.

67. Liboff, A.R.; Williams, T. Jr.; Strong, D.M.; Wistar, R. Jr.; Time-varying magnetic fields: Effect on DNA synthesis, Science, 23, 818, 1984.

68. Lyle, D.B.; Wang, X.; Ayotte, R.D.; Shepard, A.R.; Adey, W.R.; Calcium uptake by leukemic and normal T-lymphocytes exposed to low frequency magnetic fields; Bioelectromagnetics, 12, 145, 1991.

69. Liburdy, R.P.: Calcium signaling in lymphocytes and ELF fields; FEBS Lett., 301, 53, 1992.

70. Stämpfli, R.; Reversible Electrical Breakdown of the Excitable Membrane of a Ranvier Node, An. Acad. Brasil. Ciens., Vol. 30. Pp.57-63.1958.

71. Neumann, E.; Rosenheck, K.; Permeability changes induced by electric impulses in vesicular membranes, J. Membrane Biol. Vol. 10. Pp. 279-290, 1972.

72. Abidor, I.G.; Arakelyn, V.B.; Chernomordik, L.V.; Chizmadzhev, Yu. A.; Pastushenko, V.F.; Tarasevich, M.R.; Electric breakdown of bilayer membranes: I. The main experimental facts and their qualitative discussion, Bioelectrochem. Bioenerget. Vol. 6, pp. 37-52, 1979.

73. Benz, R.; Beckers, F.; Zimmermann, U.; Reversible Electric Breakdown of Lipid Bilayer Membranes: A Charge-Pulse Relaxation Study, J. Membrane Bio., Vol. 48, pp. 181-204, 1979.

74. Benz, R.; Zimmermann, U.; Relaxation studies on cell membranes and lipid bilayers in the high electric field range, Bioelectrochem, and Bioenerg., Vol. 7, pp. 723-739, 1980.

75. Benz, R.; Zimmermann, U., Pulse-length dependence of the electrical breakdown in lipid bilayer membranes, Biochim., Biophys. Acta, Vol. 597, pp. 637-642, 1980.

76. Benz, R.; Zimmermann, U.: The resealing process of lipid bilayers after reversible electrical breakdown, Biochim. Biophys, Acta., Vol. 640, pp. 169-178, 1981.

77. Benz, R.; Conti, F.; Reversible electrical breakdown of squid giant axon membrane, Biochim. Biophys. Acta., Vol. 645, pp. 115-123, 1981.

78. Chernomordik, L.V.; Sukharev, S.I.; Abidor, M.G.; Chizmadzhev, Yu. A., The Study of the BLM Reversible Electrical Breakdown Mechanism in the Presence of UO $2/2^{+}$., Bioelectrochem. Bioenerget. Vol. 9, pp. 149-155, 1982.

79. Chernomordik, L.V. and Chizmadzhev, Y.A., Electrical breakdown of BLM: phenomenology and mechanism, in Electroporation and Electrofusion in Cell Biology, ed. E. Newmann, A. Sowers, C. Jordan (Eds.). pp. 83-96, Plenum, New York, 1989.

80. Benz, R.; Beckers, F.; Zimmermann, U.; Reversible Electrical Breakdown of Lipid Bilayer Membranes: A Charge-Pulse Relaxation Study, J. Membrane Bio., Vol. 48. Pp. 181-204, 1979.

81. Sugar, I.P.; Neumann, E., Stochastic model for electric field-induced membrane pores; electroporation, Biophys. Chemistry. Vol. 19, pp. 211-225, 1984.

82. Klenchin, V.A., Sukharev, S.L.; Serov, S.M.; Chermomordik, L.V. and Chizmadzhev, Yu. A.; Electrically Induced DNA Uptake by Cells is a Fast Process Involving DNA Electrophoresis, Biophysical J., Vol. 60, pp. 804-811, 1991.

83. Sukharev, S.L.; Klencin, V.A.; Serov, S.M.; Chernomordik, L.V.; Chizmadzhev, Y.A.; Electroporation and electrophoretic DNA transfer into cells, Biophysical J., Vol. 63, pp. 1320-1327, 1992.

84. Sowers, A.E.; Lieber, M.R.: Electropore diameters, lifetimes, numbers, and locations in individual erythrocyte ghosts, FEBS, Lett., Vol. 205, pp. 179-184. 1986.

85. Dimitrov, D.S.; Sowers, A.E.; Membrane electroporation – fast molecular exchange by electroosmosis, Biochim., Biophys. Acta. Vol. 1022, pp. 381-392, 1990.

86. Zimmermann, U.; Schnettler, R.; Klöck, G.; Watzka, H.; Mechanisms of electrostimulated uptake of macromolecules into living cells; Naturwissenschaft, Vol. 77, pp. 543-545, 1990.

87. Kim, D.; Lee, Y.J.; Rausch, C.M.; Borrelli, M.J.; Electroporation of extraneous proteins into CHO cells: increased efficiency by utilizing centrifugal force and micro-second electrical pulses, Esp. Cell. Res., Vol. 197, pp. 207-212, 1991.

88. Weaver, J.C.; Harrison, G.I.; Bliss, J.G.; Mourant, J.R.; Powell, K.T.; Electroporation; high frequency of occurrence of the transient high permeability state in red blood cells and intact yeast, FEBS. Lett., Vol. 229, pp. 30-34, 1988.

89. Michael, M.R.; Elgizoli, M.; Koblet, H.; Kempf, Ch.; Diffusion loading conditions determine recovery of protein synthesis in electroporated P3 x 63 Ag8 cells, Experientia, Vol. 44, pp. 199-203, 1988.

90. Weaver, J.C.; Molecular basis for cell membrane electroporation, Annals of the New

York Academy of Sciences, Vol. 720; pp. 141-152, 1994.

91. Sale, A.; Hamilton, J.H.; Effects of high electric fields on microorganisms: I. Killing of bacteria and yeasts, Biochim. Biophys., Acta, Vol. 148, pp. 781-788, 1967.

92. Hamilton,W.A.; Sale, A.J.H.; Effects of high electric fields on microorganisms: II. Killing of bacteria and yeasts, Biochim. Biophys. Acta. Vol. 148, pp. 789-800, 1967.

93. Sale, A.J.H.; Hamilton, W.A.; Effects of high electric fields on microorganisms: III. Lysis of erythrocytes and protoplasts, Biochem. Biophys. Acta. Vol. 163, pp. 37-43, 1968.

94. (p. 262) Polk, C.; Postow, E.: Editors. 2nd Edition; Handbook of Biological Effects of Electromagnetic Fields; 1996: CRC Press; New York, N.Y.: ISBN-0-8493-0641-8.

95. Lee, R.C.; Kolodney, M.S.; Electrical injury mechanisms; dynamics of the thermal response, Plast. Reconst. Surg., Vol. 80, pp. 663-671, 1987.

96. Lee, R.C.; Kolodney, M.S.; Electrical injury mechanisms; electrical breakdown of cell membranes, Plast. Reconst. Surg., Vol. 80, pp. 672-679. 1987.

97. Gaylor, D.C.; Prakah-Asante, K.; Lee, R.C.; Significance of cell size and tissue structure in electrical trauma, J. Theor. Biol., Vol. 133, pp. 223-237, 1988.

98. Lee, R.C.; Gaylor, D.C.; Bhatt, D.; Israel, D.A.: Role of cell membrane rupture in the pathogenesis of electrical trauma, J. Surg. Res., Vol. 47, pp. 709-719, 1988.

99. Bhatt, D.L.; Gaylor, D.C.; Lee, R.C.; Rhabdomyolysis due to pulsed electric fields, Plast. Reconstr. Surg., Vol. 86, pp. 1-11, 1990.

100. Gaylor, D.C.; Bhatt, D.L.; Lee, R.C.; Skeletal muscle cell membrane electrical breakdown in electrical trauma, in Electrical Trauma: Pathophysiology and Clinical Management. Ed. R.C. Lee, J.F. Burke; E.G. Cravalho (Eds.) pp. 327-360, Cambridge University Press, 1992.

101. p. 266: Polk, C.: Postow, E.: Editors: 2nd Edition: Handbook of Biological Effects of Electromagnetic Fields; 1996; CRC Press; New York, N.Y.

102. p. 20-22: Douglas, J.; Electrical Burn Treatment; New diagnostic techniques and promising drug therapy minimize post-electric shocks cell degeneration; IEEE Power Engineering Review; March 1993.

103. Wilson, B.W.; Stevens, R.G.; Anderson, L.E.; Neuroendocrine mediated effects of electromagnetic field exposure: Possible role of the pineal gland; Life Sci., 45, 1319; 1989.

104. Reiter, R.J.; Richardson, B.A.; Magnetic field effects on pineal indoleamine metabolism and possible biological consequences. FASEB. J.; 6: 2283, 1992.

105. Reiter, R.J.: A review of neuroendocrine and neurochemical changes associated with static and extremely low frequency electromagnetic field exposure: Integr. Physio. Behav. Sci., 28: 57; 1993.

106. Stevens, R.G.; Davis, S.; Thomas, D.B.; Anderson, L.E.; Wilson, B.W.; Electric power, pineal function, and the risk of breast cancer; FASEB., J., 6, 853, 1992.

107. Stevens, R.G.; Electric power use and breast cancer: A hypothesis. Am. J. Epidemiol., 125, 556, 1987.

108. Tamarkin, L.; Cohen, M.; Rosello, D.; Reichert, C.; Lippman, M.; Chahner, B.; Melatonin inhibition and pinealectomy enhancement of 7, 12-dimethylbenz (a) – anthracene-induced mammary tumors in the rat, Cancer Res., 41, 4432, 1981.

109. Librudy, R.P.; Sloma, T.R.; Sokolie, R.; Yaswen, P.; ELF magnetic fields, breast cancer, and melatonin: 60 Hz fields block melatonin's oncostatic action on ER + breast cancer cell proliferation; J. Pineal Res., 14, 89, 1993.

110. Udintsev, N.A.; Moroz, V.V.; Response of the pituatary-adrenal system to the action of a variable magnetic field, Byull. Eksp. Biol. Med.; 77, 51, 1974.

111. Sakarova, S.A.; Fyzhov, A.l.; Udintsev, N.A.; Mechanism of the sympathoadrenal systems response to the one time action of a variable magnetic field; Kosm, Biol. Aviakosmicheskaya Med., 15, 52, 1981.

112. Welker, H.A.; Semm, P.; Willig, R.P.; commentz, J.C.; Wiltschko, W.; Vollrath, L.: Effects of an artificial magnetic field on serotonin N-acetyl transferase activity and melatonin content of the rat pineal gland, Esp. Brain Res., 50, 426, 1983.

113. Cremer-Bartels, G.; Krause, K.; Kuchle, H.J.: Influence of low magnetic-field-strength variations on the retina and pineal of quail and humans; Graetes Arch. Clin. Exp. Opthalmol.; 220, 248: 1983.

114. Semm, P.; Schneider, T.; Vollrath, L.: Effects of an earth-strength magnetic field on

electrical activity of pineal cells, Nature, 288, 607, 1980.

115. Semm, P.; Neurological investigations on the magnetic sensitivity of the pineal gland in rodents and pigeons, Comp. Biochem. Physiol. 76A, 683, 1983.

116. Olcese, J.; Reuss, S.; Vollrath, L.; Evidence of the involvement of the visual system in mediating magnetic field effects on pineal melatonin synthesis in the rat, Brain Res., 333, 382, 1985.

117. Lerchl, A.; Nonaka, K.O.; Stokkan, K.A.; Reiter, R.J.; Marked rapid alterations in nocturnal pineal serotonin metabolism in mice and rats exposed to weak intermittent magnetic fields, Biochem. Biophys. Res. Comm., 169, 102, 1990.

118. Lerchl, A.; Honaka, K.O.; and Reiter, R.J.; Pineal gland "magnetosensitivity" to static magnetic fields is a consequence of induced electric currents (eddy currents): J. Pineal Res.: 10: 109, 1991.

119. Yellon, S.M.; An acute 60 Hz magnetic field exposure suppresses the nighttime melatonin rise in the pineal and circulation of the adult Djungarian hamster, Abstracts of the Annual Review of Research on Biological Effects of 50 and 60 Hz Electric and Magnetic Fields, Milwaukee, WI: Nov. 3-7, 1991, A-25.

120. Wilson, B.W.; Anderson, L.E.; Hilton, D.I.; Phillips, R.D.; Chronic exposure to 60 Hz electric fields: Effects on pineal function in the rat, Bioelectromagnetics, 2, 371, 1981, [erratum: 4, 293, 1983].

121. Reiter, R.J.; Anderson, L.E.; Buschbom, R.L.; Wilson, B.W.; Reduction of the nocturnal rise in pineal melatonin levels in rats exposed to 60-Hz electric fields in utero and for 23 days after birth; Life Sci.; 42, 2203, 1988.

122. Kato, M; Honma, K.I.; Shigemitsu, T.; Shiga, Y.: Effects of exposure to a •circularly polarized 50 Hz magnetic field on plasma and pineal melatonin levels in rats; Bioelectromagnetics, 14, 97, 1993.

123. Kato, M.; Honma, K.; Shigemitsu, T.; Shiga, Y.; •circularly polarized 50-Hz magnetic field exposure reduces pineal gland and blood melatonin concentrations of long-Evans rats: Neurosci. Lett.: 166, 59: 1994.

124, Kato, M.; Honma, K.; Shigemitsu, T.; Shiga, Y.; Recovery of nocturnal melatonin concentration takes place within one week following cessation of 50 Hz •circularly polarized magnetic field exposure for six weeks, Bioelectromagnetics, 15, 489, 1994.

125. Kato, M.; Honma, K.; Shigemitsu, T.; Shiga, Y.; •Horizontal or vertical 50 Hz, 1-μT magnetic fields have no effect on pineal gland or plasma melatonin concentration of albino rats, Neurosci. Lett.: 168, 205, 1994.

• Note #122, #123, #124, #125, #126
circularly polarized fields affected the melatonin levels – horizontal and vertical fields did not –
- important – it is the circularly polarized fields that come off from electric transmission and distribution lines.

126. Kato, M.; Honma, K.; Shigemitsu, T.; Shiga, Y.: •circularly polarized, sinusoidal, 50 Hz magnetic field exposure does not influence plasma testosterone levels of rats, Bioelectromagnetics, 15, 513, 1994.

127. Reuss, S.; Olcese, J.; Magnetic field effects on the rat pineal gland: Role of retinal activation by light, Neurosci. Lett. 64, 97, 1986.

128. Reiter, R.J.; Static and extremely low frequency electromagnetic field exposure: Reported effects on the circadian production of melatonin; J. Cell Biochem.; 51, 394, 1993.

129. Rudolph, K.; Wirz-Justice, A.; Krauchli, K.; Feere, H.: Static magnetic fields decreased nocturnal cAMP in the rat, Brain Res., 446, 159, 1988.

130. Wilson, B.W.; Wright, C.W.; Morris, J.E.; Buschbom, R.L.; Brown, D.P.; Miller, D.L.; Sommers-Flannigan, R.; Anderson, L.E.: Evidence for an effect of ELF electromagnetic fields on human pineal gland function; J. Pineal Res.: 9, 259, 1990.

131. Stuchly, M.A.; McLean, J.R.N.; Burnett, R.; Goddard, M.; Lecuyer, D.W.; Mitchel, R.E.J.; Modification of tumor promotion in the mouse skin by exposure to an alternating magnetic field: Cancer Lett., 65, 1, 1992.

132. Beniashvili, D. Sh.; Bilanishvili, V.G.; Menabde, M.Z.; Low-frequency electromagnetic radiation enhances the induction of rat mammary tumors by nitrosomethylurea: Cancer Lett. 61, 75, 1991.

133. Mevissen, M.; Stamm, A.; Buntenkotter, S.; Zwingelbert, R.; Wahnschaffe, U.; Löscher, W.; Mevissen, M.; Lemacher, W.; Stamm, A.; Effects of magnetic fields on mammary tumor development induced by 7, 12-dimethylbenz (a) anthracene in rats; Bioelectromagnetics: 14, 131, 1993.

134. Löscher, W.; Mevissen, M.; Lemacher, W.; Stamm, A.; Tumor promotion in a breast cancer model by exposure to a weak alternating magnetic field: Cancer Lett., 71, 75, 1993.

135. Wertheimer, N.; Leeper, E.: Possible effects of electric blankets and heated water beds on fetal development, Bioelectromagnetics, 7, 13, 1986.

136. Juulilainen, J.; Matilainen, P.; Saarikoski, S.; Läärä, E.; Suonio, S.: Early pregnancy loss and exposure to 50-Hz magnetic fields, Bioelectromagnetics, 14, 229, 1993.

137. Goldhaber, M.K.; Polen, M.R.; Hiatt, R.A.; Therisk of miscarriage and birth defects among women who use video display terminals during pregnancy; Am. J. Indust. Med., 13, 695, 1988.

138. Lindbohm, M.L.; Heitanen, M.; Kyyrönen, P.; Sallmen, M.; von Nandelstadh, P.; Ylikoski, M.; Hemminki, K.: Magnetic fields of video display terminals and spontaneous abortion, Am. J. Epidemiol, 136, 1041, 1992.

139. Lovely, R.H.; Buschbom, R.L.; Slarich, A.L.; Anderson, L.E.; Hansen, N.H.; Wilson, B.W.; Adult leukemia risk and personal appliance use: A preliminary study, Am. J. Epidemiol.; 140, 510, 1994.

140. Wertheimer, N.; Leeper, E.; Electrical wiring configurations and childhood cancer, Am. J. Edpidemiol., 109, 2743, 1979.

141. Tomenius, L.; 50-Hz electromagnetic environment and the incidence of childhood tumors in Stockholm County; Bioelectro-magnetics, 7, 191, 1986.

142. Savitz, D.A.; Wachtel, H.; Barnes, F.A.; John, E.M.; Tvrdik, J.G.; Case-control study of childhood cancer and exposure to 60-Hz magnetic fields; Am. J. Epidemiol.; 128, 21, 1988.

143. Feychting, M.; Ahlbom, A.; Magnetic Fields and Cancer in People Residing near Swedish High Voltage Power Lines, Rep. No. 6/92, Institutet for Miljomedicin, Karolinska Institutet, Skockholm, Sweden, 1992.

144. Feychting, M.; Ahlbom, A.; Magnetic fields and cancer in children residing near Swedish high-voltage power lines, Am. J. Epidemiol., 138, 467, 1993.

145. Wertheimer, N.; Leeper, E.; RE: Electrical wiring configurations and childhood leukemia in Rhode Island: Am. J. Epidemiol.; 111, 461, 1980.

146. London, S.J.; Thomas, D.C.; Bowman, J.D.; Sobel, E.; Cheng, T.-C.; Peters, J.M.; Exposure to residential electric and magnetic fields and risk of childhood leukemia; Am. J. Epidemiol.: 134, 923, 1991.

147. Myers, A.; Cartwright, R.A.; Bonnell, J.A.; Male, J.C.; Cartwright, S.C.; Overhead power lines and childhood cancer; IEEE Conf. Publ. No. 257, International Conference of Electric and Magnetic Fields in Medicine and Biology, London, England, December 4-5, 1985, 126.

148. (see #143)

149. (see #144)

150. Ahlbom, A.; Feychting, M.; Koskenvuo, M.; Olsen, J.H.; Pukkala, E.; Schulgen, G.; Verkasalo, P.; Electromagnetic fields and childhood cancer; Lancet, 342, 1296, 1993.

151. Lin, S.R.; Lu, P.Y.; An epidemiologic study of childhood cancer in relation to residential exposure to electromagnetic fields, presented at Annual DOE/EPRI Contractors Review on Biological Effects from Electric and Magnetic Fields, Portland, Oregon, Nov. 13-16, 1989.

152. Milham, S.Jr.; Mortality in workers exposed to electromagnetic fields, Environ. Health Perspect.: 62, 297, 1985.

153. McDowall, ME.: Mortality of persons resident in the vicinity of electricity transmission facilities.: Br. J. Cancer; 53, 271, 1986.

154. Savitz, D.A.; Calle, E.E.; Leukemia and occupational exposure to electromagnetic fields: Review of epidemiologic surveys; J. Occup. Med.: 29, 47, 1987.

155. Coleman, M.; Beral, V.: A review of epidemiological studies of the health effects of living near or working with electricity generation and transmission equipment; Int. J. Epidemiol.: 17, 1, 1998.

156. Motanoski, G.M.; Elliott, E.A.; Breysse, P.N.; Lynberg, M.C.: Leukemia in telephone line-men; Am. J. Edpidemiol. 137, 609, 1993.

157. Tynes, T.; Anderson, A.; Langmark, F.; Incidence of cancer in Norwegian workers potentially exposed to electromagnetic fields; Am. J. Epidemiol., 136, 81, 1992.

158. Floderus, B.; Persson, T.; Stenlund, C.; Linder, G.; Johansson, C.; Kiviranta, J.; Parsman, H.; Lindblom, M.; Wennberg, A.; Ost, A.; Knave, B.: Occupational exposure to electromagnetic fields in relation to leukemia and brain tumors: A case-control study; Cancer Causes and Cont., 4, 465, 1993.

159. Savitz, D.A.; Loomis, D.P.; Magnetic field exposure in relation to leukemia and brain

cancer mortality among electric utility workers: Am. J. Epidemiol.; 141, 123, 1995.

160. Loomis, D.P.; Savitz, D.A.; Mortality from brain cancer and leukemia among electrical workers: Br. J. Indust. Med.; 47, 633, 1990.

161. Mack, W.; Preston-Martin, S.; Peters, J.M.; Astrocytoma risk related to job exposure to electric and magnetic fields, Bioelectromagnetics, 12, 57, 1991.

162. (see #154)

163. Juutilainen, J.; Läärä, E.; Pukkala, E.; Incidence of Leukemia and brain tumors in Finnish workers exposed to ELF magnetic fields; Int. Arch. Occup. Environ. Health., 62, 284, 1990.

164. Preston-Martin, S.; Peters, J.M.; Prior employment as a welder associated with the development of chronic myeloid leukemia; Br. J. Cancer; 58, 105; 1988.

165. Tornqvist, S.; Knarc, B.; Ahlbom, A.; Persson, T.: Incidence of leukemia and brain tumours in some "electrical occupations"; Br. J. Indust. Med.; 48, 597, 1991.

166. Cammarano, G.; Crosignani, P.; Berrino, F.; Berra, G.; Cancer mortality among workers in a thermoelectric power plant; Scand. J. Work Environ. Health; 10, 259, 1984.

167. Pearce, N.; Reif, J.; and Fraser, J.; Case-control studies of cancer in New Zealand electrical workers; Int. J. Epidemiol; 18, 55, 1989.

168. Balli-Antunes, M.; Pfluger, D.H.; Minder, C.E.; The mortality from malignancies of haematopoietic and lymphatic systems (MHLS) among railway engine drivers; Environmetrics, 1, 121, 1990.

169. (see #156)

170. Floderus, B.; Persson, T.; Stenlund, C.; Linder, G.; Johansson, C.; Kiviranta, J.; Parsman, H.; Lindblom, M.; Wennberg, A.; Ost, A.; Knave, B.: Occupational exposure to electromagnetic fields in relation to leukemia and brain tumors. A case-control study: National Institute of Occupational Health, Solna, Sweden, 1992.

171. Törnqvist, S.; Norell, S.; Ahlbom, A.; Knave, B.; Cancer in the electric power industry: Br. J. Industr. Med.; 43, 212, 1986.

172. (see #163)

173. Lin, R.S.; Dischinger, P.C.; Conde, J.; Farrell, K.P.: Occupational exposure to electromagnetic fields and the occurrence of brain tumors. An analysis of possible associations; J. Occup. Med. 77, 413, 1985.

174. (see #152)

175. Coggon, D.; Pennett, B.; Osmond, C.; Acheson, E.D.: A survey of cancer and occupation in young and middle aged men. II Non-respiratory cancers, Br. J. Industr. Med., 43, 381, 1986.

176. (see #175)

177. Thomas, T.L.; Waxweiler R.J.: Brain tumors and occupational risk factors. A review.; Scand. J. Work Environ. Health; 12,1. 1986.

178. Thomas, T.L.; Stolley, P.D., Stemhagen, A.; Fontham, E.T.H.; Bleecker, M.L.; Stewart, P.A.; Hoover, R.N.; Brain tumor mortality risk among, men with electrical and electronic jobs: A case-control study: J. Nat'l, Cancer Inst.: 79, 233, 1987.

179. Speers, M.A.; Dobbins, J.G.; Miller, V.S.; Occupational exposure and brain cancer mortality: A preliminary study of East Texas residents: Am. J. Industr. Med.; 13, 629, 1988.

180. Modan, B.; Exposure to electromagnetic fields and brain malignancy: A newly discovered menace?: Am. J. Industr. Med.: 13, 625, 1988.

181. Loomis, D.P.; Savitz, D.A.; Mortality from brain cancer and leukemia among electrical workers: Br. J. Indust. Med.: 47, 633, 1990.

182. Vagero, D.; Olin, R.; Incidence of cancer in the electronics industry; Using the new Swedish Cancer Environment Registry as a screening instrument: Br. J. Industr. Med.; 40, 188, 1983.

183. Vagero, D.; Ahlbom, A.; Olin, R.; Sahlsten, S.: Cancer morbidity among workers in the telecommunications industry: Br. J. Industr. Med.; 42, 191, 1985.

184. DeGuire, L.; Theriault, G.; Iturra, H.; Provencher, S.; Cyr, O.; Case, B.W.; Increased incidence of malignant melanoma of the skin in workers in a telecommunications industry; Br. J. Indust. Med.; 45, 824, 1988.

185. Swerdlow, A.J.; Epidemiology of eye cancer in adults in England and Wales, 1962-1977; Am. J. Epidemiol.; 118, 294, 1983.

186. Bonnell, J.A.; Effects of electric fields near power-transmission plant.; Royal Soc. Med.; 75, 933, 1982.

187. Knave, B.; Gamerale, F.; Bergstrom, S.; Birke, E.; Iregren, A.; Kolmodin-Hedman, B.; Wennberg, A.; Long-term exposure to electric fields. A cross-sectional epidemiologic investigation of occupationally exposed workers in high-voltage substations; Scand. J. Work Environ. Health: 5, 115, 1974.

188. Danilin, V.A.; Voronin, A.K.; Madorskii, V.A.; The state of health of personnel working in high-voltage electric fields; Gig. Tr. Prof. Zabol; 13, 51, 1969.

189. Asonova, T.P.; Rakov, A.I.; The state of health of persons working in the electric field of ourdoor 400 kV and 500 kV switchyards; Piscataway, N.J.; Institute of Electrical and Electronic Engineers Power Engineering Society, (Special publ. No. 10), 1972.

190. Loomis, D.P.; Savitz, D.A.; Ananth, C.V.; Mortality from breast cancer among female electrical workers; J. Nat'l. Cancer Inst.; in press. 1994.

191. (see #187)

192. (see #135)

193. Goldhaber, M.K.; Polen, M.R.; Hiatt, R.A.; Therisk of miscarriage and birth defects among women who use visual display terminals during pregnancy: Am. J. Industr. Med. 13, 695, 1988.

194. (see #135)

195. (see #136)

196. (see #138)

197. Milham, S. Jr.; Increased mortality in amateur radio operators due to lymphatic and hemaopoitic malignancies: Am. J. Epidemiol.; 127, 50, 1988.

198. Blackman, C.F.; Benane, S.G.; Rabinowitz, J.R.; House, D.E.; Joines, W.T.; A role for the magnetic field in the radiation – induced efflux of calcium ions from brain tissue in vitro, Bioelectromagnetics; 6, 327, 1985.

199. Blackman, C.F.; Benane, S.G.; Elliot; D.J.; House, D.E. and Pollock, M.M.: Influence of electromagnetic fields on the efflux of calcium ions from brain tissue in vitro: A three-model analysis consistent with the frequency response up to 510 Hz: Bioelectromagnetics; 9, 215, 1988.

200. Blackman, C.F.; Benane, S.G.; House D.E.; Elliot, D.J.: Importance of alignment between local DC magnetic field and an oscillating field in responses of brain tissue in vitro and in vivo; Bioelectromagnetics, 11, 159, 1990.