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### A Review of the Exposure Level Guidelines for Electromagnetic Fields...

By MICHAEL R. NEUERT © 2012 Michael R Neuert

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There are three main types of electromagnetic fields (EMFs) to be considered. All three have been linked to important biological effects in the scientific studies, and each type of EMF is measured with a different kind of test instrument...

• **ELF Magnetic Fields**

ELF Magnetic Fields are the EMF component most often linked to serious health effects – such as childhood leukemia and other cancers – in the research studies. Common sources include power lines, electrical wiring, light fixtures, appliances and most other electrical devices. Wiring errors and stray electricity in pipes can sometimes create surprisingly high levels. Magnetic fields are measured with an ELF\* gaussmeter, in units called "milligauss" (mG).

(\*Note: "ELF" or "extremely-low-frequency" is the scientific name for the EMF frequency range that includes the 60 cycles-per-second – or 60 Hertz – electricity used in the US and Canada.)

• **ELF Electric Fields**

ELF Electric Fields have also been linked to important biological effects, but have been studied less in the research. Anecdotally, they are often involved when people feel "sensitive" to electromagnetic sources. Electric fields are usually caused by hidden electrical wiring within walls, by nearby power cords for lamps and devices, and sometimes from overhead power lines. Electric fields induce measurable voltages onto the skin, which are easily detected with a Body Voltage Meter, in units of "AC Volts" (VAC).

• **Radio Frequency (RF) Fields (including microwaves)**

Radio Frequency (RF) Fields (including microwaves) have been linked to several kinds of tumors and health problems. RF fields are emitted from many wireless and electronic devices – cell towers, cell phones, cordless phones, TV/radio broadcast towers, Smart Meters, Wi-Fi, wireless computers and components, baby monitors, microwave ovens, radar, etc. In the US, they are usually measured in units of "microwatts per centimeter squared" ( $\mu\text{W}/\text{cm}^2$ ).

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(In many cases, the ELF electric and magnetic fields will also carry some added RF frequencies due to the use of dimmers, fluorescent lights, computers, Wi-Fi, Smart Meters, etc. This is called "Dirty Electricity".)

**What Are the Health Concerns?**

Published studies from around the world have linked electromagnetic fields (EMFs) to increased risks for several types of cancer, as well as increased stress, suppression of the immune system, important cellular and hormone changes, and even depression and suicide. Well over a thousand scientific studies have reported biological effects related to EMFs.

Some specific illnesses that have been linked to EMFs include leukemia, lymphoma, brain tumors, melanoma, breast cancer, asthma, Alzheimer's disease, Lou Gehrig's disease, miscarriage and birth defects. Anecdotally, EMFs have also been associated with sleep problems, headache, fatigue, anxiety, mental confusion, irritability, memory loss, dizziness, itchy or burning skin sensations, and tinnitus (ringing in the ears).

There is still great controversy about these potential health effects. To offer some assistance, I have provided several EMF safety guidelines to consider on the following page. Some of the information presented is anecdotal – based on my professional testing work over the last 20 years. So please refer to the proper medical authorities and scientific research literature to make your own decisions regarding EMF health effects and safety levels.<sup>9</sup>

**Possible EMF Safety Levels to Consider... See Note 9**

<b>"Possible EMF Safety Levels To Consider" for the 3 Types of EMF →</b>	<b>ELF Magnetic Fields</b>	<b>ELF Electric Fields</b>	<b>Radio Frequency (RF) &amp; Microwaves</b>
<b>Unit of Measurement in USA (Abbreviation)</b>	<b>Milligauss (mG)</b>	<b>AC Volts on skin (VAC)</b>	<b>Microwatts/cm<sup>2</sup> (μW/cm<sup>2</sup>)</b>
<b>Lowest Level Linked to Cancer</b> <i>See Note 1</i>	<b>1.0 (2.0)</b>	<b>Unknown</b>	<b>Unknown</b>
<b>Average Level in Homes</b> <i>See Note 2</i>	<b>0.5 to 1.0</b>	<b>0.5 to 2.0</b>	<b>0.0001 to 0.5</b>
<b>BioInitiative Report</b> <i>See Note 3</i>	<b>1.0</b>	<b>N/A</b>	<b>0.1</b>
<b>General Public Precautionary Level</b> <i>See Note 4</i>	<b>0.5</b>	<b>1.0 (sleep 0.5)</b>	<b>0.01</b>
<b>EMF Hypersensitivity Advice</b> <i>See Note 5</i>	<b>0.1</b>	<b>0.1</b>	<b>0.001 or less</b>
<b>FCC Guidelines for General Public</b> <i>See Note 6</i>	<b>N/A</b>	<b>N/A</b>	<b>1000</b> <i>Note 8</i>
<b>ICNIRP Guidelines for General Public</b> <i>See Note 7</i>	<b>833</b>	<b>N/A</b>	<b>1000</b> <i>Note 8</i>

## Special Notes about the EMF Safety Levels above...

**Note 1 The Lowest Level Linked to Cancer:** For magnetic fields, the strongest evidence comes from the Swedish epidemiological study which reported increased leukemia for children at levels of 2.0 mG or more (Feychting & Ahlbom, 1993). Also, a Canadian study has reported increased leukemia starting at 1.5 mG for children under age six (Green, Miller Villeneuve, Agnew, Greenberg, Li & Donnelly, 1999). And a German study has linked exposures as low as 1.0 mG to reduced survival rates for children recovering from leukemia (Svendson, Weikopf, Kaatsch & Schuz, 2007).

**Note 2 The Average Level in US Homes** for magnetic fields is derived from nationwide research studies and confirmed by my own testing experience. The average levels for electric fields and RF fields are estimates based on my 20 years of professional testing in the San Francisco Bay area.

**Note 3 The BioInitiative Report Recommendations** are from the 2007 "BioInitiative Report: A Rationale for a Biologically-based Public Exposure Standard for Electromagnetic Fields" (go to [www.bioinitiative.org](http://www.bioinitiative.org)).

**Note 4 The General Public Precautionary Level** is my own offering to concerned clients based on my own understanding of the EMF research, and leaning towards caution. For example for magnetic fields, to offer some margin of safety below the 1.0 mG linked to cancer, I might suggest a safety level of 0.5 mG.

**Note 5 The EMF Hypersensitivity Advisory** is based on anecdotal experience by EMF professionals like myself who often find it necessary to reduce EMF exposures below these levels for sensitive individuals to report relief of their symptoms. However, there is no guarantee that these levels will be low enough for any particular person – especially with RF exposure, as some people report symptoms at surprisingly low levels.

**Note 6 The FCC Guidelines for General Public** show the current US standards for Radio Frequency exposure from FCC/OET Bulletin 56, based on the ICNIRP guidelines (go to [http://www.fcc.gov/Bureaus/Engineering\\_Technology/Documents/bulletins/oet56/oet56e4.pdf](http://www.fcc.gov/Bureaus/Engineering_Technology/Documents/bulletins/oet56/oet56e4.pdf)).

**Note 7 The ICNIRP Guidelines for General Public** are taken from the commonly cited 1998 publication by the International Commission on Non-Ionizing Radiation Protection (go to [www.icnirp.de/documents/emfgdl.pdf](http://www.icnirp.de/documents/emfgdl.pdf)).

**Note 8** The official safety level depends on frequency. Value shown is for frequencies of 2.0 GHz and higher.

**Note 9** I am engineer, not a medical doctor, and I cannot diagnose or treat any EMF-related health problems. Please consult with your own doctor or other health professional regarding proper exposure guidelines.

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## EMF Health & Safety Guide

A Review of the Exposure Level Guidelines for  
Electromagnetic Fields...

The 2014 Updated PDF Version,  
with Revised Exposure Standards

# **Information about EMFs & Safety Levels** <sup>1</sup>

By MICHAEL R. NEUERT, MA, BSME

## **What Are the Health Concerns?**

Published studies from around the world have linked electromagnetic fields (EMFs) to increased risks for several types of cancer, as well as increased stress, suppression of the immune system, cellular and hormone changes, and even depression and suicide. In fact, several thousand studies have reported biological effects related to EMFs.

Some of the specific illnesses include leukemia, lymphoma, brain tumors, melanoma, breast cancer, asthma, Alzheimer's disease, Lou Gehrig's disease, miscarriage and birth defects. Anecdotally, EMFs are often associated with sleep problems, headache, fatigue, anxiety, mental confusion, irritability, memory loss, dizziness, itchy or burning skin, tinnitus, and other symptoms.

There are three main kinds of EMFs. All three types have been linked to important biological effects. And each type of EMF is measured with a different kind of test instrument...

- A. **ELF Magnetic Fields** <sup>Note 2</sup> are the particular EMF component most often linked to serious health effects – such as childhood leukemia and other cancers – in the research studies. Common sources include electric power lines, electrical wiring, lighting fixtures, electric appliances and most electrical devices. Wiring problems and stray electrical current in metal pipes can also create surprisingly high levels. Magnetic fields are measured with an ELF gaussmeter, in units of “milligauss” (mG).
- B. **ELF Electric Fields** <sup>Note 2</sup> are also linked to important biological effects, but have been studied less. Anecdotally, they are often involved when people feel “sensitive” to electromagnetic fields. Common sources include hidden electrical wiring, power cords for lamps and devices, and power lines. Electric fields create unnatural electric voltages on the skin, which can be measured with a Body Voltage Meter, in units of “Volts AC” (V).
- C. **RF Fields** (*radio frequency fields, includes microwaves*) have been linked to various types of cancer, tumors and health effects similar to the ELF fields. RF fields are commonly emitted from modern wireless and electronic equipment – cell towers, cell phones, cordless telephones, wireless computers, Wi-Fi routers, baby monitors, Smart Meters, TV and radio broadcast towers, microwave ovens, radar, etc. They are measured with an RF meter, usually in units of “microwatts per centimeter squared” ( $\mu\text{W}/\text{cm}^2$ ). <sup>Note 3</sup>

*Special Note:* There is still great controversy about the potential health effects from EMFs. Please refer to the proper medical authorities and scientific research literature to make your own decisions regarding health effects and safety levels.<sup>1</sup> The attached “*What EMF Level Is Safe?*” page shows some of the more common EMF exposure guidelines that you may wish to consider.<sup>4</sup>

Note 1 I am engineer and not a medical doctor. I cannot diagnose or treat any EMF-related health concerns. Please consult with your own doctor or other health professional regarding EMF exposure guidelines.

Note 2 Extremely-Low-Frequency or “ELF” is the EMF frequency range which includes the common 60 hertz (60 cycles-per-second) electric utility power used in the US/Canada and the 50 Hz power in Europe.

Note 3 When RF frequencies are also added to the ELF magnetic and electric fields due to the use of electronic dimmers, fluorescent lights, computers, Smart Meters, etc., this is called “Dirty Electricity”.

Note 4 Some of this information is anecdotal, based on my 22 years of professional experience with clients.

# What EMF Level is Safe? <sup>9</sup>

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<b>“Possible Safety Levels To Consider”</b> 3 Types of EMF → (See attached page for more information)	<i>ELF</i> <b>Magnetic Fields</b>	<i>ELF</i> <b>Electric Fields</b>	<b>Radio Frequency (RF) &amp; Microwaves</b>
Unit of Measurement in USA (Abbreviation)	Milligauss (mG)	AC Volts on skin (VAC)	Microwatts/cm <sup>2</sup> ( $\mu$ W/cm <sup>2</sup> )
<b>Lowest Level Linked to Cancer</b> <small>See Notes 5 &amp; 6</small>	<b>1.0 (2.0)</b> <sup>5</sup>	<b>unknown</b>	<b>0.2</b> <sup>6</sup>
<b>Average Level in Homes</b> <small>See Note 7</small>	<b>0.5 to 1.0</b>	<b>0.5 to 2.0</b>	<b>0.0001 to 0.5</b>
<b>Building Biology Severe Concern</b> <small>See Note 8</small>	<b>1.0</b>	<b>0.1 (sleep)</b>	<b>0.001</b>
<b>BiolInitiative 2012 Report</b> <small>See Note 9</small>	<b>1.0</b>	<b>n/a</b>	<b>0.0003</b>
<b>General Public Precautionary Level</b> <small>See Note 10</small>	<b>0.5</b>	<b>1.0 (sleep 0.5)</b>	<b>0.01</b>
<b>EMF Hypersensitivity Advice</b> <small>See Note 11</small>	<b>0.1</b>	<b>0.1</b>	<b>0.0001 or less</b>
<b>Official FCC Safety Limit</b> <small>See Note 12</small>	<b>n/a</b>	<b>n/a</b>	<b>1000</b> <small>Note 13</small>
<b>ICNIRP Guidelines for General Public</b> <small>See Note 12</small>	<b>833</b>	<b>n/a</b>	<b>1000</b> <small>Note 13</small>

<sup>5</sup> The Lowest Level Linked to Cancer for Magnetic Fields: The strongest evidence comes from the Swedish epidemiological study which reported increased leukemia for children at levels of 2.0 mG or more (Feychting & Ahlbom, 1993). And a German study has linked exposures as low as 1.0 mG to reduced survival rates for children trying to recover from leukemia (Svendsen, Weikopf, Kaatsch & Schuz, 2007).

<sup>6</sup> The Lowest Level Linked to Cancer for RF is from two Australian studies of radio/TV broadcast towers that found increased childhood leukemia at levels as low as 0.2 microwatts/cm<sup>2</sup>. The first (Hocking, 1996) found that leukemia death rates were more than double for the exposed children. The second (Hocking, 2000) found that children trying to recover from leukemia were twice as likely to survive in a lower exposure home.

<sup>7</sup> The Average Level in Homes for *magnetic fields* is derived from nationwide research studies and confirmed in my own testing experience. The average levels for *electric fields* and *RF fields* are estimates from my own 22 years of professional testing in the San Francisco Bay area.

<sup>8</sup> The Building Biology Severe Concern level is from the "Standard of Building Biology Testing Methods" published by the Institute for Baubiology. (Go to [www.hbelc.org/pdf/standards/sbm2008.pdf](http://www.hbelc.org/pdf/standards/sbm2008.pdf).)

<sup>9</sup> The BiolInitiative Report Recommendations are from the 2012 "BiolInitiative Report: A Rationale for a Biologically-Based Public Exposure Standard for Electromagnetic Fields". (Go to [www.bioinitiative.org](http://www.bioinitiative.org). For a detailed list of the RF studies reporting adverse health effects and the related RF exposure levels, go to [www.bioinitiative.org/report/wp-content/uploads/pdfs/BiolInitiativeReport-RF-Color-Charts.pdf](http://www.bioinitiative.org/report/wp-content/uploads/pdfs/BiolInitiativeReport-RF-Color-Charts.pdf).)

<sup>10</sup> The General Public Precautionary Level is my own offering to healthy concerned clients based on my own understanding of the EMF research, and leaning towards caution. For example for *magnetic fields*, to offer some margin of safety below the 1.0 mG linked to cancer, I might suggest a safety level of 0.5 mG.

<sup>11</sup> The EMF Hypersensitivity Advisory is based upon anecdotal experience by EMF professionals like myself who often find it necessary to reduce exposures to these levels for sensitive individuals to report relief of symptoms. However, there is no guarantee that these levels will be low enough for any particular person.

<sup>12</sup> The FCC Safety Limit is the US "Maximum Permissible Exposure for the General Public" in FCC/OET Bulletin #56 ([www.fcc.gov/Bureaus/Engineering\\_Technology/Documents/bulletins/oet56/oet56e4.pdf](http://www.fcc.gov/Bureaus/Engineering_Technology/Documents/bulletins/oet56/oet56e4.pdf)). The ICNIRP Guidelines are from the commonly cited 1998 publication by the International Commission on Non-Ionizing Radiation Protection ([www.icnirp.de/documents/emfgdl.pdf](http://www.icnirp.de/documents/emfgdl.pdf)).

<sup>13</sup> The official safety level depends on frequency. Value shown is for frequencies of 1500 MHz and higher.



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## What EMF Level is Considered Safe? — Exposure Level Guidelines...

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"Possible EMF Safety Levels To Consider" for the 3 Types of EMF →	ELF Magnetic Fields	ELF Electric Fields	Radio Frequency (RF) & Microwaves
Unit of Measurement in USA (Abbreviation)	Milligauss (mG)	AC Volts on skin (VAC)	Microwatts/cm <sup>2</sup> (μW/cm <sup>2</sup> )
<b>Lowest Level Linked to Cancer</b> <i>See Note 1</i>	1.0 (2.0)	Unknown	Unknown
<b>Average Level in Homes</b> <i>See Note 2</i>	0.5 to 1.0	0.5 to 2.0	0.0001 to 0.5
<b>BioInitiative Report</b> <i>See Note 3</i>	1.0	N/A	0.1
<b>General Public Precautionary Level</b> <i>See Note 4</i>	0.5	1.0 (sleep 0.5)	0.01
<b>EMF Hypersensitivity Advice</b> <i>See Note 5</i>	0.1	0.1	0.001 or less
<b>FCC Guidelines for General Public</b> <i>See Note 6</i>	N/A	N/A	1000 <i>Note 8</i>
<b>ICNIRP Guidelines for General Public</b> <i>See Note 7</i>	833	N/A	1000 <i>Note 8</i>

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**Special Notes about the EMF Safety Levels above...**

**Note 1 The Lowest Level Linked to Cancer:** For magnetic fields, the strongest evidence comes from the Swedish epidemiological study which reported increased leukemia for children at levels of 2.0 mG or more (Feychting & Ahlbom, 1993). Also, a Canadian study has reported increased leukemia starting at 1.5 mG for children under age six (Green, Miller Villeneuve, Agnew, Greenberg, Li & Donnelly, 1999). And a German study has linked exposures as low as 1.0 mG to reduced survival rates for children recovering from leukemia (Svendsen, Weikopf, Kaatsch & Schuz, 2007).

**Note 2 The Average Level in US Homes** for magnetic fields is derived from nationwide research studies and confirmed by my own testing experience. The average levels for electric fields and RF fields are estimates based on my 20 years of professional testing in the San Francisco Bay area.

**Note 3 The BioInitiative Report Recommendations** are from the 2007 “BioInitiative Report: A Rationale for a Biologically-based Public Exposure Standard for Electromagnetic Fields” (go to [www.bioinitiative.org](http://www.bioinitiative.org)).

**Note 4 The General Public Precautionary Level** is my own offering to concerned clients based on my own understanding of the EMF research, and leaning towards caution. For example for magnetic fields, to offer some margin of safety below the 1.0 mG linked to cancer, I might suggest a safety level of 0.5 mG.

**Note 5 The EMF Hypersensitivity Advisory** is based on anecdotal experience by EMF professionals like myself who often find it necessary to reduce EMF exposures below these levels for sensitive individuals to report relief of their symptoms. However, there is no guarantee that these levels will be low enough for any particular person – especially with RF exposure, as some people report symptoms at surprisingly low levels.

**Note 6 The FCC Guidelines for General Public** show the current US standards for Radio Frequency exposure from FCC/OET Bulletin 56, based on the ICNIRP guidelines (go to [http://www.fcc.gov/Bureaus/Engineering\\_Technology/Documents/bulletins/oet56/oet56e4.pdf](http://www.fcc.gov/Bureaus/Engineering_Technology/Documents/bulletins/oet56/oet56e4.pdf)).

**Note 7 The ICNIRP Guidelines for General Public** are taken from the commonly cited 1998 publication by the International Commission on Non-Ionizing Radiation Protection (go to [www.icnirp.de/documents/emfgdl.pdf](http://www.icnirp.de/documents/emfgdl.pdf)).

**Note 8** The official safety level depends on frequency. Value shown is for frequencies of 2.0 GHz and higher.

**Note 9** I am engineer, not a medical doctor, and I cannot diagnose or treat any EMF-related health problems. Please consult with your own doctor or other health professional regarding proper exposure guidelines.

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## Possible Safety Distances to Consider for EMF Sources

The following table of [Safe Distances from EMF Sources](#) is offered below to help reduce your exposure to electromagnetic fields (EMFs). But the actual EMFs emitted from different sources can vary greatly, and the distances needed to reach a desired "safety level" are difficult to predict. For more accurate safety distances, on-site measurements with appropriate test meters are strongly advised.

The guidelines below are the minimum distances usually needed to reduce the EMFs down to the [General Public Precautionary Levels](#). In many cases the distances needed will be less than is shown here — but in a few cases, a greater distance will be required. Therefore, it is always best to measure with the proper EMF test equipment to verify distances for your situation.

Individuals with a heightened sensitivity to electromagnetic fields — or other serious health issues such as chronic fatigue, cancer or Lyme Disease — may want to reduce their exposures even further, perhaps down to the much stricter [EMF Hypersensitivity Advisory](#) levels. For these concerns, consider doubling many of the distances shown in the table below. And perhaps most important, please listen to your own body, intuition and experience as your final guide.

### Safe Distance from Power Lines...

It is difficult to predict a safe distance from power lines, because the EMFs can vary greatly depending upon the situation. The best advice is to measure with a gaussmeter to determine the actual levels of magnetic fields and the distance required in your particular case. (Special note: magnetic fields are particular EMF component most often linked to health effects in the studies. They are measured with special instruments called [gaussmeters](#).)

The strongest magnetic fields are usually emitted from high voltage transmission lines — the power lines on the big, tall metal towers. To be sure that you are reducing the exposure levels to 0.5 milligauss (mG) or less, a safety distance of 700 feet may be needed. It could be much less, but sometimes more. You must test with a gaussmeter to be sure.

It's even more difficult to predict a safe distance from neighborhood power distribution lines — the type typically found on wooden poles. For example, homes with a nearby transformer will sometimes have higher EMFs because the transformer is a hub and the power lines carry more electricity for a group of homes. The issue is complicated by the fact that there can be stray electricity flowing in the metal water service pipes of the neighborhood, increasing the magnetic fields from both the power lines and from the buried pipes!

Thus, there is no reliable safety distance for neighborhood power lines. In general, a magnetic field level of 0.5 mG will be reached somewhere between 10 and 200 feet from the wires. But you cannot tell by simply looking up at the power lines. You have to test on-site with a gaussmeter to be sure.

If the electrical power lines are installed underground, the magnetic fields may be just as strong, or even stronger. This is because the power lines could actually be closer to you when only buried a few feet down, rather than up 20 or 30 feet overhead. For neighborhoods with buried power lines, you must always test with a gaussmeter.

Power lines also emit electric fields. The electric fields from high voltage transmission lines (metal towers) can be very strong outside near the wires, and extend for over a thousand

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feet. However once inside the home, the building structure usually provides some shielding, and the electric fields from electrical wiring and cords will usually be much stronger than that from the power lines.

**Safe Distance from Cell Towers...**

It is also difficult to predict a safe distance from cell towers. For example, cell towers are designed to transmit most of their radio frequency (RF) energy horizontally. Some areas below the tower may have lower levels than locations farther away that are more in line with the vertical height of the antennas.

The exposure from a cell tower will depend on the type of antennas, the number of antennas, how much the antennas are actually being used, the time of day, etc. The distance needed to reduce exposures down to the [General Public Precautionary Level](#) of 0.010 microwatt per centimeter squared ( $\mu\text{W}/\text{cm}^2$ ) is often around a quarter of a mile (1320 feet) or more. Due to the uncertainty, on-site testing with a [broadband RF test meter](#) is strongly recommended.

A German study reported that people living within 400 meters (1312 feet) of cell towers had over 3 times the normal rate for new cancers (City of Naila 2004). In an Israeli study, the relative risk for cancer was about 4 times greater within 350 meters (1148 feet) of the cell tower (Wolf et al. 1997). Based on findings like these, a minimum safety distance of 1/4 mile (1320 feet) might be considered prudent.

And again, individuals with EMF hypersensitivity or other serious health issues may want to consider a much greater safety distance, perhaps a half mile, or even more.

**Table of Safety Distances from Various EMF Sources...**

The safety distances below are based on Michael Neuert's actual EMF measurements in the San Francisco Bay Area over a 20 year period. The distances shown here are usually far enough away for the majority of cases, but may not be for all. Please always measure with a test meter to be sure. (See notes 1 - 4 at bottom of this page.)

Safety Distances from Various EMF Sources:			
<b>Possible EMF Safety Distances To Consider for Common EMF Sources</b>	<b>ELF Magnetic Fields</b>	<b>ELF Electric Fields</b>	<b>Radio Frequency (RF) &amp; Microwaves</b>
<b>"General Public Precautionary Levels" →</b> <small>(See Note 1)</small>	<b>Distance to 0.5 Milligauss (mG) or less</b> <small>(See Notes 2, 3, 4)</small>	<b>Distance to 0.5 AC Volts on skin (VAC)</b> <small>(See Notes 2, 3, 4)</small>	<b>Distance to 0.010 Microwatts/cm<sup>2</sup> (<math>\mu\text{W}/\text{cm}^2</math>)</b> <small>(See Notes 2, 3, 4)</small>
<b>Power Lines</b>			
High voltage power lines (on metal towers)	700 feet	1000 feet	
Neighborhood distribution power lines (on wooden poles)	10 to 200 feet	10 to 60 feet	
Electric utility transformer (on pole or ground)	10 to 20 feet		
<b>Broadcast Towers</b>			
Cell towers/antennas			1/4 mile
Radio and TV broadcast towers			1/2 mile

<b>Electrical Panels</b>			
Main electric meter/service panel - Unshielded	10 feet		
Main electric meter/service panel - Shielded with MuMetal	5 feet		
Other electrical panels and sub-panels - Unshielded	8 feet		
Other electrical panels and sub-panels - Shielded with MuMetal	4 feet		
Smart Meters (RF emitting electric utility meters)			40 feet
<b>Electrical Wiring</b>			
Romex wiring for 15 and 20 amp circuits	2 feet	6 feet	
Romex wiring for 30 to 60 amp circuits	4 feet	6 feet	
Romex (BX) wiring for 70 to 200 amp circuits	6 feet	6 feet	
MC (BX) wiring for 30 to 60 amp circuits	2 feet	0 feet	
MC (BX) wiring for 70 to 200 amp circuits	4 feet	0 feet	
MC (BX) wiring for 15 and 20 amp circuits	6 feet	0 feet	
<b>Lighting</b>			
Fluorescent light bulbs and fixtures	4 to 8 feet <i>Note 2</i>	6 feet	
Compact fluorescent (CFL) light bulbs and fixtures	2 to 4 feet <i>Note 2</i>	6 feet	
LED light bulbs and fixtures	2 to 6 feet <i>Note 2</i>	6 feet	2 feet
The transformers and fixtures for low-voltage lighting	2 to 6 feet <i>Note 2</i>	6 feet	
Incandescent light bulbs and fixtures	1 foot	6 feet	
120 volt halogen bulbs and fixtures (not low volt halogen)	1 foot	6 feet	
<b>Appliances</b>			
Microwave ovens	8 feet	6 feet	30 feet
Refrigerators	6 feet	6 feet	
Most other electrical appliances	4 feet	6 feet	
Most small plug-in transformers	4 feet	6 feet	
Electric fans	6 feet	6 feet	
Electric heaters	8 feet	6 feet	
Spa & hot tubs - heaters and pumps	8 feet	6 feet	
<b>Electronics</b>			

Most computer hardware (non-wireless)	4 feet	6 feet	
LED and LCD computer monitors	2 feet	6 feet	
LED, LCD, Plasma televisions	4 feet	6 feet	
Stereo equipment, other small electronics	4 feet	6 feet	
<b><i>Wireless Technologies</i></b>			
Cell phones			40 feet
Cordless phones			40 feet
Cordless phone base	4 feet		40 feet
Wireless routers, Wi-Fi routers	4 feet	6 feet	40 feet
Wireless keyboards and mice			10 feet
Baby monitors			40 feet

Note 1 The [General Public Precautionary Level](#) is a precautionary guideline that I sometimes offer to my concerned clients who wish to be proactive with EMFs and protect their health. This guide is only a suggestion based on my own understanding of the EMF research literature and professional experience with clients for over 20 years. For example with magnetic fields, I suggest a safety level of 0.5 mG to provide a margin of safety below the 1.0 milligauss (mG) linked to childhood cancer in the studies. However, for sensitive individuals and those with serious health issues, even lower safety levels and thus greater distances may be appropriate. Please consult with your own health professional to help determine adequate safety levels for your own particular situation. For more information, please refer to our [EMF Safety Guide](#) page.

Note 2 The safety distance from an EMF source is simply the measured distance needed to reduce human exposures down to some desired safety level for most cases. But safety distances are difficult to predict because many factors can cause variations in the actual level of EMFs emitted, and thus variations in the actual safety distances needed. The distances shown here are likely to reduce the EMF exposures to the safety level shown at the top of the chart, for the majority of situations. In many cases, the actual distances needed will be less than shown in this chart — but in some cases an even greater distance may be needed. It is advisable to measure on-site with an EMF test meter to determine the actual safety distance.

Note 3 Individuals with heightened sensitivity to electromagnetic fields — or other serious health issue such as cancer, chronic fatigue or Lyme Disease — may wish to reduce their EMF exposures even further, perhaps down to the stricter [EMF Hypersensitivity Advisory](#) levels. For these kinds of health concerns, you might consider doubling the safety distances shown here. And most important, please listen to your own body, intuition and experience regarding safety levels and distances.

Note 4 The suggestions for safety distances in this chart are generally based on Michael Neuert's professional on-site testing of the various EMF sources in the San Francisco Bay Area since 1992. Actual EMF emissions, and thus the corresponding safety distance, can vary greatly and are difficult to predict. To better determine actual safety distances, it is always advisable to measure the actual EMF levels with an [appropriate EMF test meter](#) whenever possible.

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### What are the Health Effects linked to Electromagnetic Fields?

By MICHAEL R. NEUERT © 2012 Michael R Neuert

#### Cancer & Other Health Risks from EMFs

Published studies from around the world have linked electromagnetic fields (EMFs) to increased risks for several types of cancer, as well as increased stress, suppression of the immune system, important cellular and hormone changes, and even depression and suicide. Well over a thousand scientific studies have reported biological effects related to EMFs.

#### Specific Illnesses linked to EMFs

Some specific illnesses that have been linked to EMFs include leukemia, lymphoma, brain tumors, melanoma, breast cancer, asthma, Alzheimer's disease, Lou Gehrig's disease, miscarriage and birth defects. Anecdotally, EMFs have also been associated with sleep problems, headache, fatigue, anxiety, mental confusion, irritability, memory loss, dizziness, seizures, itchy or burning skin sensations, tinnitus and ringing in the ears, feeling electrically shocked, heart arrhythmias, changes in heart rate and blood pressure, and other health concerns.

#### Controversy about EMF Health Effects

There is still great controversy about the potential health effects from everyday EMF exposures. To offer some assistance, I have provided several EMF safety guidelines to consider on the [What Level is Safe](#) page. Some of the information presented is anecdotal – based on my professional testing work over the last 20 years. So please refer to the proper medical authorities and scientific research literature to make your own decisions regarding EMF health effects and safety levels. See Note 1

#### Electromagnetic Sensitivity

A variety of troubling symptoms are being reported by people with serious health issues related to EMFs that are sometimes being called "Electrical Sensitivity" (ES) or "Electromagnetic Hypersensitivity" (EHS), or other similar terms. [Click this link for more info on ES.](#)

While hundreds of scientific studies have reported definite biological effects from EMFs that might explain these symptoms, Electromagnetic Sensitivity is still not generally recognized or understood by the mainstream medical community in the US. I have worked with many individuals over the last 20 years who have experienced serious symptoms and sensitivities to electromagnetic fields (EMFs).

*Note 1 I am engineer, not a medical doctor, and I cannot diagnose or treat any EMF-related health problems. Please consult with your own doctor or other health professional regarding proper exposure guidelines.*

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