COU2128 Gallry Road

Zoning Review

Neighborhood Comments

1. Health implications for neighborhood.
    - Reference attached letter from AT&T regarding health and safety issues.

2. Negative effects from the towers electromagnetic radiation.
    - Reference attached letter from AT&T regarding health and safety issues.

3. Better location for the tower; view of Pikes Peak obstructed; It's an eyesore.
    - The stealth design of the tower is designed to blend in with the existing trees and will visually impact the area. Additionally, the location of ground equipment is hidden from the public view.

4. Negative effects on property values.
    - The stealth design of the tower and location of the ground equipment will blend into the current neighborhood. Additionally, the design requires the placement of additional landscape around the stealth tower to further conceal it.

5. Interfere with pacemaker.
    - Reference attached letter from AT&T regarding health and safety issues.

6. Loss of jobs with Ace Hardware and Cheers Liquor Mart.
    - The owners of Ace Hardware and Cheers Liquor Mart have confirmed that the placement of the tower at the proposed location will not impact their current or future workforce.

7. Increase traffic in the area.
    - The design of the stealth tower and related equipment has been done in a way that will not impact the traffic in the adjacent neighborhood. The stealth tower is located on the crest of the hill. However, all other equipment will be located at the bottom of the hill. Access to the equipment will be through the private access at Ace Hardware.

8. Don't want a Cellular Tower in the neighborhood.
    - The location of the stealth tower is determined by the increased wireless usage in the neighborhood.

FIGURE 5

Interference Control and Standards Compliance

Site Name: Galley Rd & N Circle Dr
Site Number: COL02128
FA Location: 12871711

Site Address: 2845 E. San Miguel St., Colorado Springs, CO 80909

AT&T Mobility (AT&T) desires to install/modify a wireless communications facility at the above indicated location. The proposed facility will operate within frequencies lawfully licensed to AT&T by the FCC (Federal Communications Commission).

AT&T will comply with all engineering practices and operational requirements imposed by the FCC pursuant to the relevant rules and regulations applicable to those services and frequencies to be deployed. This includes, but is not limited to, all rules and regulations relating to radio frequency interference, frequency coordination, general technical standards for power, antenna, bandwidth limitations, frequency stability, transmitter measurements, operating requirements; and all other federal statutory and regulatory requirements related thereto.

Due to significant frequency separation, it is expected that AT&T operating frequencies will not unlawfully interfere with any Public Safety systems or any other carriers that operates at a different frequency. If the source of any unlawful Radio Frequency Interference (RFI) to any existing Emergency Communication or Carrier Equipment at the site is found to originate from AT&T equipment, all steps necessary to eliminate any such unlawful interference will be undertaken by AT&T.

Name (Print): Winnie Lai

Title: RMR RAN Design Engineer

Phone: (720)412-9205

Email: wl425p@att.com

Signature 

Date: December 12, 2017

FIGURE 5

RF Measurements Help to Win Lease Approval

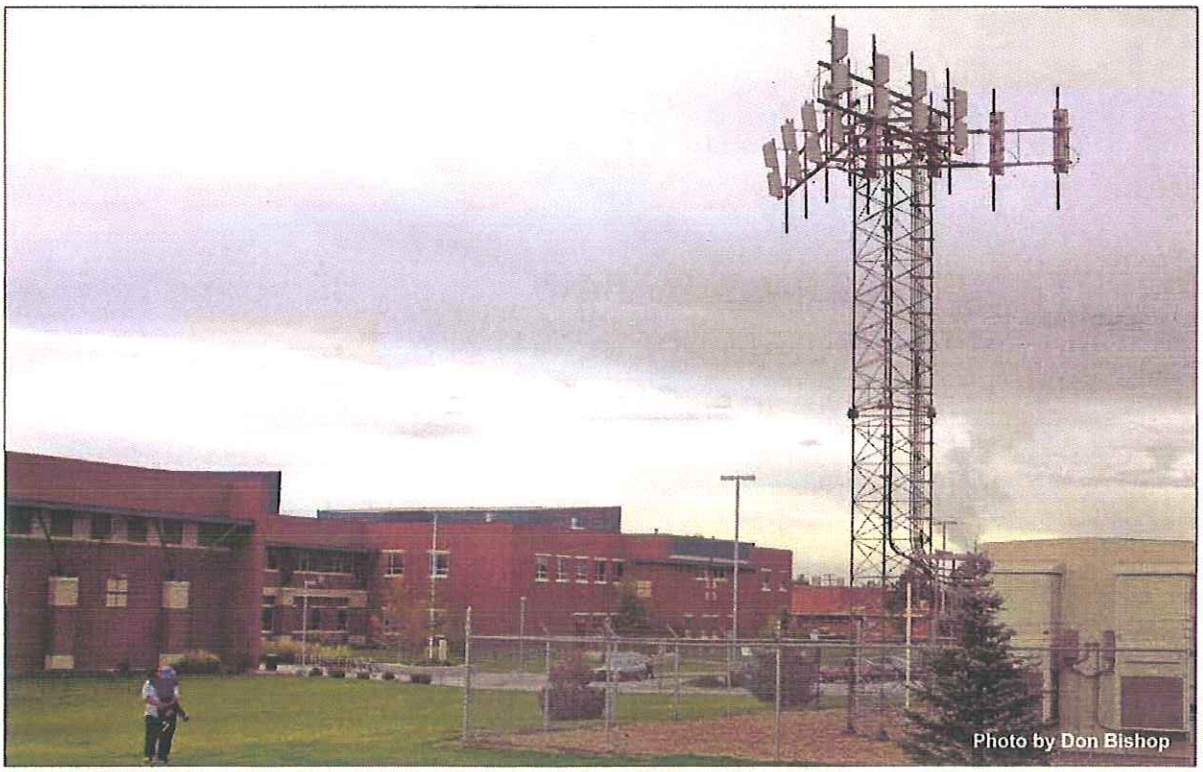
Showing how placing a cell site near a high school would reduce RF emissions from wireless handsets used by students helped to persuade a board of education to leave in effect a previously approved lease for a tower at an athletic field.

***AGL* report**

Members of the Marshalltown (Iowa) Community School District Board of Education voted in the majority to keep in place an agreement with U.S. Cellular for a proposed cell tower that would take the place of, yet resemble, a light pole at the Marshalltown High School football field. The vote, taken on January 5, came about as a result of concerns brought to the board by residents near the school regarding the possible effect upon health that radio-frequency emanations from the tower might have.

Although the Telecommunications Act of 1996 does not allow government agencies to take into account the health effects of RF emitted from cell towers and other radio transmitters when making decisions about site approval, landlords may consider health effects when deciding whether to lease.

U.S. Cellular asked Marv Wessel of Global RF Solutions, Chandler, Ariz., to speak to the board members about the



Cell towers near schools sometimes raise questions about possible health risks.

FIGURE 5

possible health effects. Afterward, *AGL* asked Wessel about his presentation.

Wessel said that in addition to local activists promoting a website against the proposed site, one or more board members and residents made reference to the "BioInitiative Report: A Rationale for a Biologically-based Public Exposure Standard for Electromagnetic Fields (ELF and RF)," which is published on the web at *www.bioinitiative.org*.

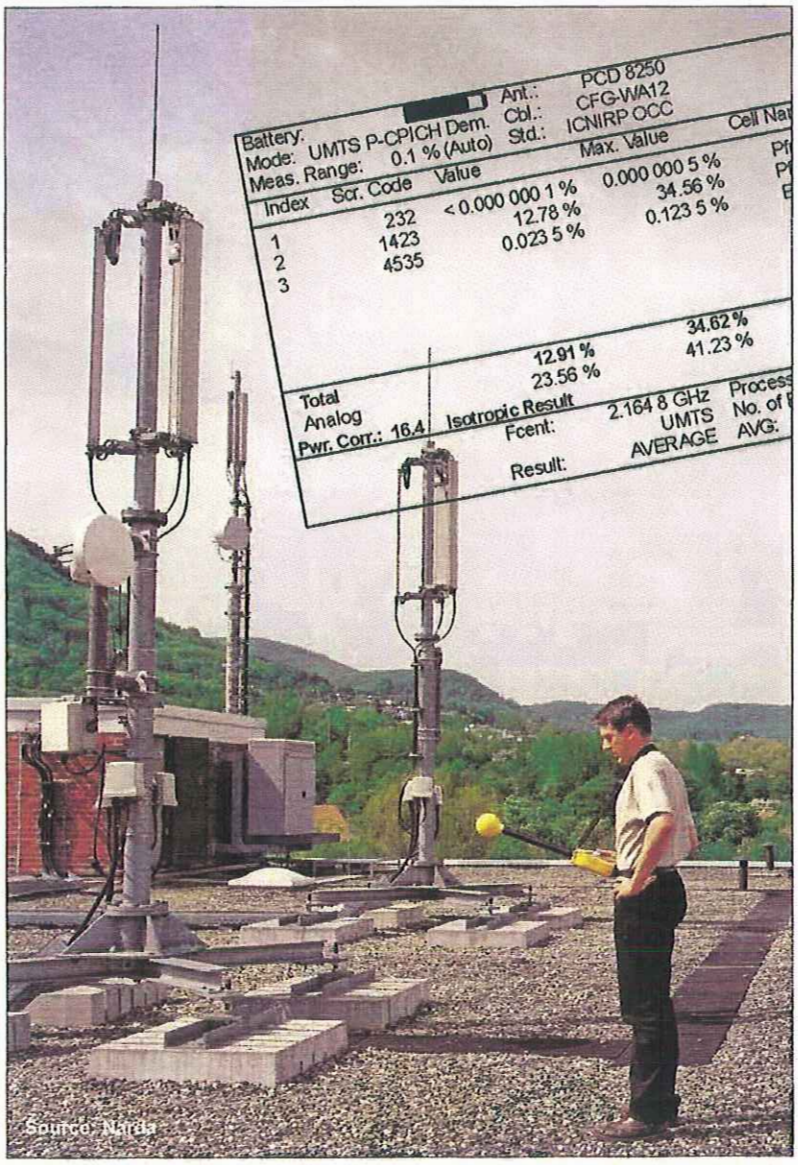
BioInitiative report

"The report claims there is a diverse range of adverse health effects related to RF emissions," Wessel said. "The BioInitiative Report seems to completely dismiss the Nationwide Cohort Study in Denmark by Christoffer Johansen, John D. Boice Jr., Joseph K. McLaughlin, and Jørgen H. Olsen that included 420,095 cell phone users and found no significant link to cell phone use and cancer.

The peculiar thing about the BioInitiative Report is that it suggests that RF exposure limits be reduced to increase the safety margin of the possibility of nonthermal effects on humans. However, it doesn't offer specifics on what these limits should be. It merely suggests that "a precautionary limit of 0.1 $\mu W/cm^2$ (which is also 0.614 volts per meter) should be adopted for outdoor, cumulative RF exposure." The ironic thing, Wessel explained, is that any properly designed cellular and PCS site, which would have antennas at least 10 meters above ground level, already contributes less than what the BioInitiative Report proposes as a precautionary limit to areas surrounding these cellular and PCS sites. However, Wessel pointed out, commercial TV and FM broadcast levels typically exceed this precautionary limit in every major metropolitan location in the country. "Curiously, they choose to ignore an RF source that has been present for several decades," he said.

Better science

Wessel said that although the BioInitiative Report appears to have as its objective making the case for eliminating or reducing wireless communications, in several places the report admits there is no definitive link between cell phones and cancer. As part of preparing for his presentation, Wessel viewed a website built by one of those opposed to the tower. "He had the BioInitiative Report on his site along with other information depicting a one-sided view against cell towers."

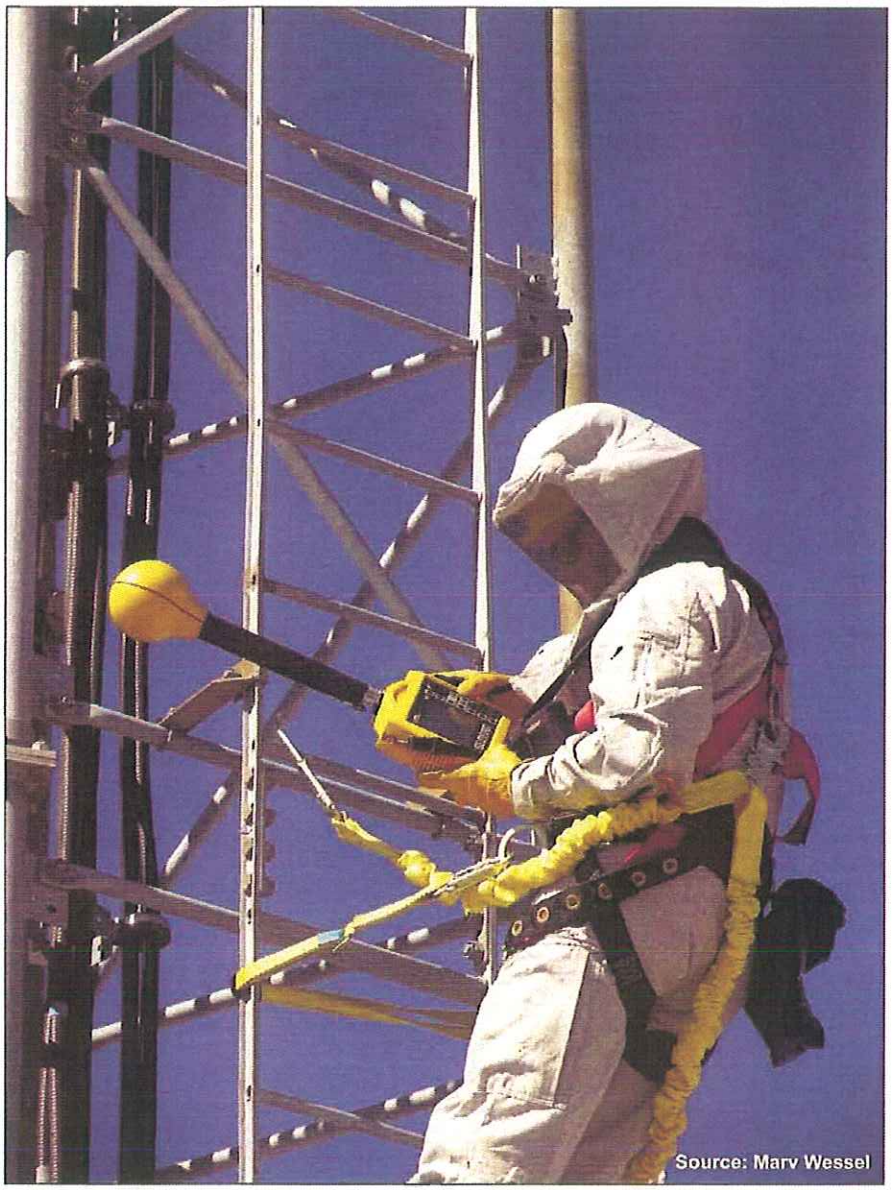


A selective radiation meter such as the Narda SRM-3000 can be used to make safety measurements for RF compliance and to provide evidence that energy levels may be many times less than the safety minimum.

Wessel presented the board a different perspective based on quantitative RF measurements taken with a selective radiation meter, which consists of a spectrum analyzer and an isotropic antenna — the Narda SRM-3000. He said this meter is one of a few portable spectrum analyzers designed and calibrated specifically to make safety measurements for RF compliance.

"It has a dynamic range much greater than broadband equipment specifically designed to perform RF compliance measurements," he said. Additionally,

FIGURE 5



Although a worker on a tower may come close enough to an antenna, especially FM or TV broadcast antennas, to require protection in the form of an RF suit, the inverse-square law shows that the intensity of RF from an antenna rapidly diminishes as the distance from the antenna increases. Away from the tower, energy levels rarely surpass the health limit, especially for cellular antennas. Above, Marv Wessel is shown using a selective radiation meter to take measurements.

"you can discriminate these measurements by frequency from 50 to 3000 MHz. This enables us to specifically measure each license holder's contribution to the overall RF environment."

Wessel also described the RF measurement data that was persuasive for the Marshalltown board. "They were concerned about the RF level that would be present at the high school if they allowed the cell site to be built. Actually, the larger risk of RF exposure comes from the cellular handset itself, even though it's still greatly below the FCC limits. The inverse-square law says that 'the RF energy at a distance from a source drops by the square of the distance from the source.'"

The RF specialist explained that at the Marshalltown school, cellular service is provided by sites a mile or two away, which causes the handsets used at the school to emit their highest RF power output. The reason is because the distant cell site controls the handset power and raises or lowers it according to the received signal (uplink) at the cell site.

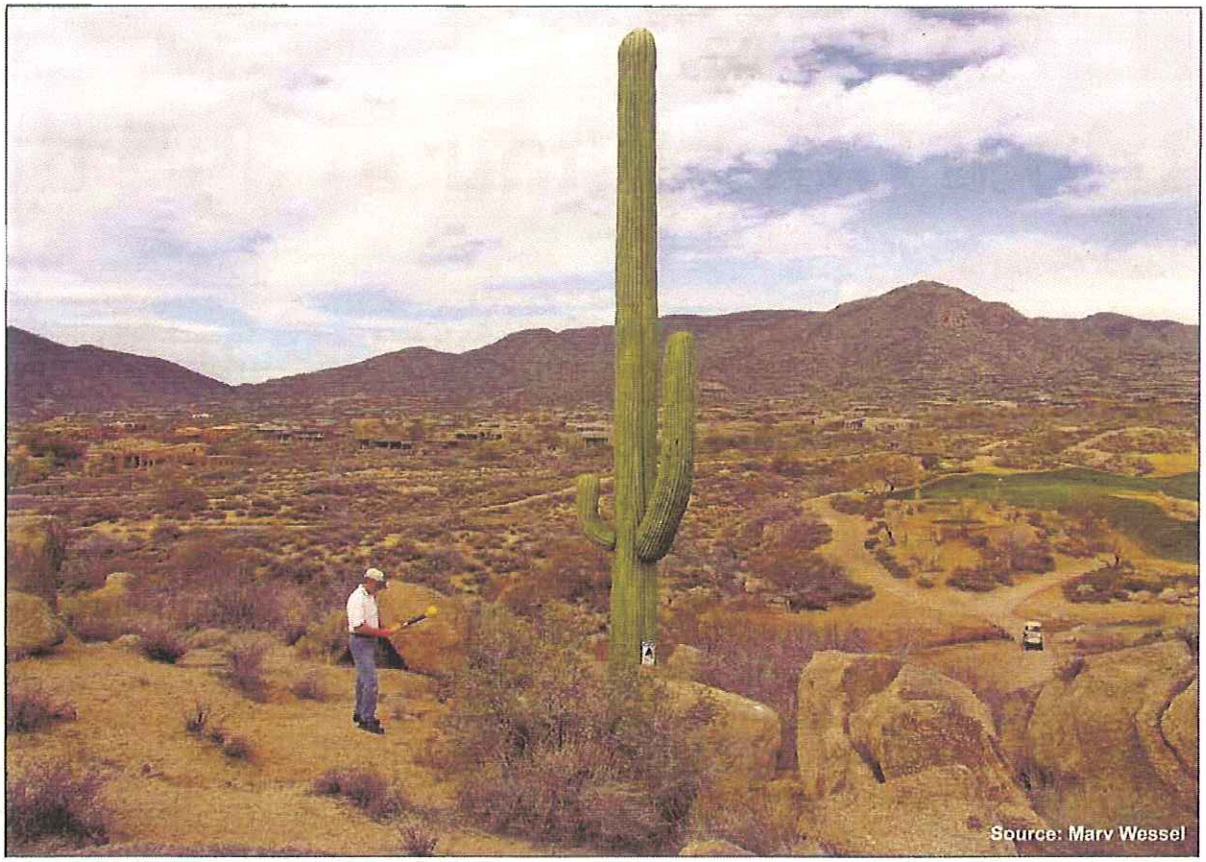
Handsets

"I took measurements at the school, and they indicated the handsets were powered up to full power during a call because of the distance to the serving cell site," Wessel said. "I told the board that it could reduce the RF exposure to students using phones by putting a site nearby because then the handsets would operate at significantly lower power. If you have a quarter-watt handset next to your head, it delivers significantly more energy to the user than does a 100-watt cell site 100 feet away and 100 feet above the ground, because of the inverse-square law."

But, Wessel said, "no one ever looks at it that way. They see the cell site as an RF radiation problem next to the school. But ironically, when you put the cell site next to a high school, where kids are huge users of handsets, the handset's power is significantly reduced by thousands of times. A nearby site actually helps the issue."

Wessel said that one parent made an observation that students have handsets near their heads all the time. "Our measurements proved that with a nearby cell site, RF exposure from the handsets would be reduced from a level

FIGURE 5



Marv Wessel is shown taking RF measurements near a cellular antenna disguised as a saguaro cactus. A person would have to scale the cactus to the antennas hidden near its top to receive unsafe RF exposure.

1,000 times (peak) below the FCC-defined safety limit to a level 1 million times below the safety limit," Wessel said. "A majority of the board members were persuaded by this approach. But some people are never satisfied."

Actual measurements

Wessel said the fact is that the handsets are going to be powered down if the cell site is nearby, and the RF exposure from the handset is the greater risk. He said that despite the evidence, some people don't want to look at the actual measurements. He said their objection sometimes is based on hysteria. "The cell sites look ominous, but the power reaching the ground in the vicinity of the site is insignificant," he said.

Wessel also described measurements he made in a New York City neighborhood where RF energy that reaches the neighborhood from FM and TV broadcast signals is a greater percentage of the overall RF energy than the portion delivered by a cell site across the street. "They don't want to hear that, either," he said, speaking of residents who are in opposition to a neighborhood cell site. "They fear the long-term effects of RF exposure from cell sites, yet FM and TV signals have been on the air for a lot longer than cellular signals, they represent a higher percentage of the overall RF exposure than the cellular signals do, and the total is still well below the safety limit."

Common-sense approach

Wessel said the idea is to present the information in a common-sense approach. "You're never going to change the opinion of a skeptic or of the conspiracy theorists who want to believe that the explosion in cell site growth will cause significant health risks," he said. "They call it new technology, but it's merely a new application of old technology. You can rarely change their minds. You try to present a common-sense approach to people who have become emotional by the surrounding hysteria. The cellular site opponents get people worked up and cite possible children's health effects in an effort to convince them that the cellular sites are harming the kids."

Narrowband selectivity

With measurement equipment capable of narrowband selectivity, Wessel said it is possible to select a frequency and measure the power density levels down to the picowatt per square centimeter level. "It allows you to demonstrate that cell sites are not a big deal," he said. agl

FIGURE 5

American Cancer Society

Prevention and Early Detection

print
close

Cellular Phones

Cellular (cell) phones first became widely available in the United States in the 1990s, but their use has increased dramatically since then. According to the Cellular Telecommunications & Internet Association, there were an estimated 270 million cell phone subscribers in the United States as of December 2008, representing about 87% of the total population.

Based on the large and still growing number of cell phone users (both adults and children), and the fact that cell phones give off radio-frequency (RF) waves, some concerns have been raised about the safety of cell phone use. With respect to cancer, concern focuses on whether cell phones might increase the risk of brain tumors or other tumors in the head and neck area.

How do cell phones work?

Cell phones communicate with nearby cell towers through RF waves, a form of energy located on the electromagnetic spectrum between FM radio waves and microwaves. Like FM radio waves, microwaves, visible light, and heat, they are a form of non-ionizing radiation. They cannot cause cancer by directly damaging DNA. RF waves are different from stronger types of radiation such as x-rays, gamma rays, and ultraviolet (UV) light, which can break the chemical bonds in DNA.

At very high levels, RF waves can heat up body tissues. (This is the basis for how microwave ovens work.) But the levels of energy given off by cell phones are much lower, and the warmth from a cell phone does not damage body tissues.

How are people exposed?

The RF waves from cell phones come from the antenna, which is part of the body of a hand-held phone. The waves are strongest at the antenna and lose energy as they travel away from the phone. The phone is typically held against the side of the head when in use. The closer the antenna is to the head, the greater a person's expected exposure to RF energy.

Many factors can affect the amount of RF energy to which a person is exposed, including:

- The amount of time the person is on the phone
- The model of phone being used: different phones give off different amounts of energy
- Whether or not the person is using a hands-free device
- The distance and path to the nearest cell phone tower: being farther away from the tower requires more energy to get a good signal, as does being inside a building
- The amount of cell phone traffic in the area at the time

Other factors may also affect exposure. For example, older cell phones (analog models) used more energy than newer, digital phones.

FIGURE 5

The amount of RF energy absorbed from the phone into the user's local tissues is known as the *specific absorption rate* (SAR). Different cell phones have different SAR levels. Cell phone makers are required to report the SAR level of their product to the Federal Communications Commission (FCC). This information is sometimes listed inside the battery compartment on the phone. The upper limit of SAR allowed in the United States is 1.6 watts per kilogram (W/kg) of body weight.

Do cell phones cause tumors?

Because cell phones are held near the head when in use, the main concern has been over whether they might cause or contribute to tumors in this area, including:

- Malignant (cancerous) brain tumors such as gliomas
- Non-cancerous tumors of the brain such as meningiomas
- Non-cancerous tumors of the nerve connecting the brain to the ear (acoustic neuromas)
- Non-cancerous tumors of the salivary glands

What do studies in humans suggest?

About 30 studies have looked at possible links between cell phone use and tumors. Most of these studies have focused on brain tumors. Many of these have been case-control studies, in which patients with brain tumors (cases) were compared to people free of brain tumors (controls), in terms of their past use of cell phones.

In general, these studies have yielded similar results:

- Patients with brain tumors do not report more cell phone use overall than the controls. This finding is true when all brain tumors are considered as a group, when specific types of tumors are considered, and when specific locations within the brain are considered. In fact, most of the studies show a trend toward a lower risk of brain tumors among cell phone uses, for unclear reasons.

- Most studies do not show a "dose-response relationship" -- a tendency for the risk of brain tumors to increase with increasing cell phone use, which would be expected if cell phone use caused brain tumors.

- Several studies published by the same research group in Sweden report increased risk of tumors on the side of the head where the cell phone was held, particularly with 10 or more years of use. It is hard to know what to make of these findings because studies by other researchers have not had the same results, and there is no overall increase in brain cancer in Sweden during the years that correspond to these reports.

A large, long-term study following more than 420,000 cell phone users in Denmark between 1982 and 2002 had findings similar to those of the case-control studies. Cell phone use, even for more than 10 years, was not linked with an increased risk of brain tumors or cancer overall, nor was there a link with any brain tumor subtypes or with tumors in any location within the brain. As in the case-control studies, no link was found between brain tumor risk and length of cell phone use, age when a person started using the phone, or type of cell phone used.

Taken as a whole, most studies to date have not found a link between cell phone use and the development of tumors. However, these studies have had some important limitations.

FIGURE 5

First, studies have not yet been able to follow people for very long periods of time. When tumors form after a known cancer-causing exposure, it usually takes decades for them to develop. Because cell phones have been in widespread use for less than 20 years in most countries, it is not possible to rule out future health effects that have not yet appeared.

Second, the studies done so far have focused on adults, not children. Cell phone use is now widespread even among young children. It is possible that if there are health effects, they might be more pronounced in children because their nervous systems are still developing and their lifetime exposure will be greater than adults, who started at a later age.

Third, the measurement of cell phone use in most studies has been crude. Most have been case-control studies. These types of studies have relied on people's memories for information about past cell phone usage, which may or may not be dependable.

Further research is needed to address these limitations. Several large studies now under way, including the 13-country INTERPHONE study, should help provide clearer answers in the near future.

What does the laboratory evidence suggest?

As noted above, the RF waves given off by cell phones don't have enough energy to damage DNA directly. Because of this, many scientists believe that cell phones aren't able to cause cancer. Most studies done in the lab have supported this theory, finding that RF waves do not cause DNA damage.

A number of scientists have reported that the RF waves from cell phones produce effects in human cells (in lab dishes) that might possibly help tumors grow. However, several studies in rats and mice have looked at whether RF energy might promote the development of tumors caused by other known carcinogens (cancer-causing agents). These studies did not find evidence of tumor promotion. Given the widespread use of cell phones, it is important that all reasonable claims be carefully tested by other scientists with expertise in this area.

What do expert agencies say?

In general, expert agencies agree that most evidence to date does not point to cell phone use increasing the risk of tumors, but that more research is needed to look at possible long-term effects.

According to the Food and Drug Administration (FDA), which regulates the safety of radiation-emitting devices such as cell phones in the United States:

> The majority of studies published have failed to show an association between exposure to radiofrequency from a cell phone and health problems.

According to the Federal Communications Commission (FCC):

> There is no scientific evidence that proves that wireless phone usage can lead to cancer or a variety of other problems, including headaches, dizziness or memory loss. However, organizations in the United States and overseas are sponsoring research and investigating claims of possible health effects related to the use of wireless telephones.

According to the Centers for Disease Control and Prevention (CDC):

FIGURE 5

> Although some studies have raised concerns, the scientific research, when taken together, does not indicate a significant association between cell phone use and health effects.

According to the National Toxicology Program (NTP), which is currently conducting studies of the possible health effects of cell phones:

> While the weight of the current scientific evidence has not conclusively linked cell phones with any health problems, the NTP and other scientific organizations conclude that additional data are needed.

According to the National Cancer Institute (NCI):

> Although research has not consistently demonstrated a link between cellular telephone use and cancer, scientists still caution that further surveillance is needed before conclusions can be drawn.

The United States Environmental Protection Agency (EPA), National Toxicology Program (NTP), and the International Agency for Research on Cancer (IARC), 3 of the main agencies that classify cancer-causing exposures (carcinogens), have not classified cell phones as to their cancer-causing potential.

Do cell phones cause any other health problems?

Few other health concerns have been raised about cell phone use. One has been whether the RF waves from cell phones might interfere with medical devices such as heart pacemakers. According to the FDA, cell phones should not pose a major risk for the vast majority of pacemaker wearers. Still, people with pacemakers may want to take some simple precautions to help ensure that their cell phones don't cause a problem, such as not putting the phone in a shirt pocket close to the pacemaker.

Several studies have found that people who use cell phones while driving are more likely to be in car accidents. It is not clear that hands-free phones are any safer than hand-held phones when it comes to driving.

Can I lower my exposure to RF waves from cell phones?

Studies now under way should give a clearer picture of the possible health effects of cell phone use in the future. Until then, there are several things that people who are concerned about RF waves can do to limit their exposure.

Use a hands-free device such as a corded or cordless earpiece. Using an earpiece moves the antenna away from the user's head, which decreases the amount of RF waves that reach the head. Corded earpieces emit virtually 0 RF waves (although the phone itself still emits small amounts of RF waves that can reach parts of the body if close enough, such as on the waist or in a pocket). Bluetooth® earpieces have an SAR value of around 0.001 watts/kg (less than one thousandth the SAR limit for cell phones as set by the FDA and FCC).

Choose a phone with a low SAR value. Different models of phones can give off different levels of RF waves. One way to get information on the SAR level for a specific phone model is to find the FCC identification (ID) number for that model. The FCC ID number is usually somewhere on the phone, sometimes under the battery pack. Once you have the ID number, go to the following Web address: www.fcc.gov/oet/ea/fccid. On this page, you will see instructions for entering the FCC ID number.

FIGURE 5

Limit your (and your children's) cell phone use. One of the most obvious ways to limit exposure to RF waves from cell phones is to limit how much you use them. You may want to use your cell phone only for shorter conversations, or use it only when a conventional phone is not available. Parents who are concerned about their children's exposure may limit how much time they spend on the phone.

For safety reasons, it is especially important to limit or avoid the use of cell phones while driving.

What about cordless phones?

Cordless phones, commonly used in homes, have base units that are plugged into telephone jacks and wired to a local telephone service. They are not considered "cell" phones. The question of health risks from cordless phones, which operate at about 1/600 the power of cell phones, has not been raised.

Additional resources

National organizations and Web sites*

In addition to the American Cancer Society, other sources of patient information and support include:

Federal Communications Commission
RF Safety Program, Office of Engineering and Technology
Web site: www.fcc.gov/oet/rfsafety/

Food and Drug Administration
Radiation-Emitting Products: Cell Phones
Web site: www.fda.gov/Radiation-EmittingProducts/RadiationEmittingProductsandProcedures/HomeBusinessandEntertainment/CellPhones/default.htm

National Cancer Institute
Cellular Telephone Use and Cancer Risk
Web site: www.cancer.gov/cancertopics/factsheet/Risk/cellphones

National Institute of Environmental Health Sciences
Electric and Magnetic Fields
Web site: www.niehs.nih.gov/health/topics/agents/emf/index.cfm

** Inclusion on this list does not imply endorsement by the American Cancer Society.*

The American Cancer Society is happy to address almost any cancer-related topic. If you have any more questions, please call us at **1-800-227-2345** at any time, 24 hours a day.

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FIGURE 5

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FIGURE 5

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Last Medical Review: 01/05/2010
Last Revised: 01/05/2010

FIGURE 5

The Impact of Radiofrequency Transmissions on Public Health

David M. **Hamby, Ph.D.**
November 2006

Dr. Hamby is currently Professor of Health Physics (radiation protection) at Oregon State University and a former professor in the University of Michigan's School of Public Health. He is a graduate of the University of North Carolina's School of Public Health and has spent 20 years studying environmental and occupational health protection, including 6 years working as a research scientist with Westinghouse. He serves on the Scientific Committee #64-23 of the National Council on Radiation Protection and Measurements (NCRP) and Committee N13.60 of the American National Standards Institute (ANSI). Dr. Hamby is on the Editorial Board for the Health Physics journal and the journal of Environmental Monitoring and Assessment. He has also sewed as a technical expert for the International Atomic Energy Agency (IAEA).

Over the past several years, the potential health impacts from exposure to electromagnetic fields have gained widespread interest among the general public. Questions arose originally with regard to extremely low frequency electric and magnetic fields such as those found in the vicinity of electric-power lines. With the continued advancement of personal communications technology, similar concerns have arisen with regard to electromagnetic transmissions in the radiofrequency region, including that used in wireless communications. The following provides an overview of typical exposure levels and current information regarding federal exposure guidelines for radiofrequency electromagnetic waves in the frequency range utilized by PCS and cellular systems.

Biological effects associated with exposure to intense electromagnetic fields, generally the result of thermal heating, are dependent on two characteristics of electromagnetic waves, frequency and power. Using speech as a comparison, the frequency of an electromagnetic wave relates to the pitch at which one speaks, for example treble or bass, and power is described by how loud one speaks. The scientific unit used to describe frequency is the "Hertz", usually abbreviated Hz. The Hertz represents one repetition per second. For example, if one's heart beats 70 times per second, we could say that it beats at a frequency of 70 Hz. Or, a computer chip that operates at 1 **GHz** (gigahertz, giga meaning billion) does 1 billion operations per second. The figure below shows a variety of common uses within the electromagnetic spectrum. PCS, for example, operates in the 1.9 **GHz** frequency range.

The unit used to describe power is typically the Watt, W. The Watt describes the amount of energy transferred during one second. Most of us are familiar with this unit in our everyday lives because we use incandescent light-bulbs; a 100 W light bulb uses twice the energy of a 50 W light bulb. Again, as an example, PCS towers operate at a typical power output in each of three sectors of about 200 Watts.

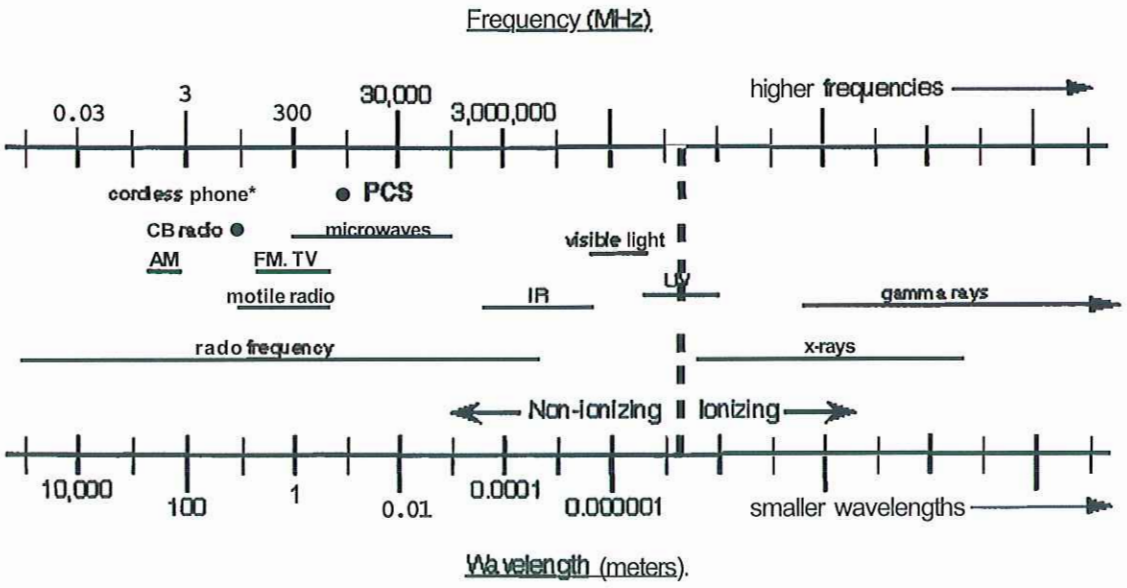
Radiofrequency exposure limits for members of the general public are set into law by the Federal Communications Commission (FCC) based on recommendation from the Institute of Electrical and Electronics Engineers (IEEE), the American National Standards Institute (ANSI), and the National Council on Radiation Protection and Measurements (NCRP). Today's standards identify the amount of energy per second (usually in **milliWatts,** where **1000 milliWatts** equals 1 Watt) that can be transmitted through a square inch or, more typically, a square centimeter.

FIGURE 5

Accordingly, exposure limits are expressed in terms of "power density" and are in units of **mW/cm^2** (**milliWatts** per square centimeter). On August 1, 1996, the FCC suggested standardization of exposure limits and went with the NCRP recommendation of 1 **mW/cm^2.** Regulations within in the past couple of years in Australia and New **Zealand** stipulate identical limits to those of the NCRP, and regulations in the Netherlands allow exposure limits twice this value. The International Commission on Non-Ionizing Radiation Protection (ICNIRP) has also adopted the exposure limit of 1 **mW/cm^2** for members of the general public at frequencies of 2 **GHz** and higher.

These limits can be put into perspective somewhat, by comparison with the metabolic heat production rate for an average human at rest, about 5 **mW/cm^2.** With increased activity, the metabolic heat production rate can naturally rise to as much as 80 **mW/cm^2** depending on a number of physiological parameters such as age, gender, size, and general physical fitness.

ELECTROMAGNETIC SPECTRUM



As stated above, PCS and cellular systems emit electromagnetic waves at frequencies in the **GHz** range with a nominal power of about 200 Watts per sector. Under these conditions, the maximum power density at 100 feet laterally from the antenna element is calculated to be 0.010 **mW/cm^2** or 100 times below the NCRP limit. This estimate assumes that the transmission power is emitted equally in all directions within the focused area (see power density calculation shown below). However, the bulk of the transmitted power is normally aimed only at the horizon, meaning that actual power levels on the ground, 100 feet from the base of the tower are much less than this calculated value. Power densities at this level are much lower than the federal limit and a great deal lower than levels where any type of biological effect has been observed. The

FIGURE 5

heat production rate in our bodies caused by metabolism is thousands of times greater than any heat generated as a result of these transmissions.

Comparison of EMF Transmissions to Other RF Sources. To provide a better understanding of what these power densities mean, we can compare PCS transmissions with the power density levels of other well-known radiofrequency (RF) devices (see the table below). These include, but are not limited to, baby monitors, anti-theft monitors and automatic door openers at department stores, cordless telephones, **police/fire** two-way radios, and television and radio broadcasting stations. For example, standard television and radio towers are generally much taller than PCS or cellular towers, and also emit signals with power levels up to 5 million Watts. A 1,000 foot TV tower holding an antenna that emits 5 million Watts in all directions potentially has a power density at its base of 0.43 **mW/cm^2**, more than 40% of the federal limit for emissions at that frequency. Baby monitor transmitters operate at a power of a few Watts. Therefore, the power density at a distance of 100 feet from a 200 Watt PCS transmitter would be equal to the power density at about four (4) feet from the baby monitor.

Some common radiofrequency sources.

Source	Frequency range (MHz)	Maximum power (Watts)
Anti-theft device	0.003 - 30	0.001
Automatic door opener	10,000	0.01
Hand-held cellular	800 - 900	0.6
Cordless phone	46 - 60	1
CB radio	27	5
Mobile radio	27 - 900	100
PCS	**1,850 - 1,945**	**200**
Microwave oven	915 - 2,450	2000
Satellite communications	100 - 275,000	5,000
AM Radio	0.535 - 1.705	50,000
FM Radio	88 - 108	200,000
LORAN transmitter	0.1	3,000,000
Television	54 - 890	5,000,000

To summarize, the calculated and measured power densities resulting from PCS transmissions are many times lower than the national (and international) RF standard of 1 **mW/cm^2**. The most recent literature on the potential health effects of RF exposure continues to provide a vast majority of studies whose investigators find no statistical difference between exposed and non-exposed persons for various biological effects studied. A few investigators suggest that their data show associations between exposure and biological effect. These studies, however, are generally unable to provide a causal relationship between RF exposure and biological effect.

FIGURE 5

Additionally, studies of effects on rats that are repeated are many times unable to reproduce results. One group of investigators attempted to reproduce their own results by conducting their experiment in triplicate. They showed one positive and two negative findings when looking at a particular biological effect in rats following exposure to radiofrequency radiation. This study, alone shows the variability in research of this type. Scientific studies have failed to demonstrate a human health effect as the result of exposure to low-level radiofrequency electromagnetic fields. The scientific data indicate that health risks from PCS or cellular RF transmissions are negligible.

Calculation of Maximum Power Density. Power density can be calculated at any distance from an electromagnetic source if the source is assumed to be emitted from a single point. The power density is simply the total power emitted divided by the area through which the power is directed. In the case of a typical cell tower, this area is, $4xr^2/6$, the surface-area of a spherical triangle with radius r, a horizontal angle of **120°** and a vertical angle of approximately **90°.** If the power output of the transmitter is 200 Watts (or 200,000 **milliWatts),** then given the shortest urban tower, **i.e.,** a distance of 100 feet (3,048 centimeters), the power density is:

$$\frac{200{,}000 \bullet 6}{4 \bullet 3.14159 \bullet 3048^2} = 0.010 \text{ mW/cm}^2.$$

Because of the inverse-square principle, which applies to electromagnetic emission sources, every time the distance from the tower is doubled, the power density decreases four times. For example, we've shown that at 100 feet horizontally from the top of a cell tower the maximum power density is 0.010 **mW/cm²** (100 times lower than the RF standard). Based on the inverse-square principle we can estimate that at 200 feet away from the source the maximum power density would be four times lower or about 0.0025 **mW/cm²** (400 times lower than the RF standard) and at 400 feet the maximum power density is reduced to 0.00063 **mW/cm²** (1,600 times lower than the RF standard). Therefore, power density drops very rapidly as we move farther and farther away from the emission source.

FIGURE 5