

The Public's Perception of the Safety of Radio Waves

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As Amateur Radio operators we need to be particularly sensitive to the fears of the public. As absurd as it may seem to us, many people believe that RF energy is inherently dangerous. A recent series of news articles illustrates how easy it is for a seemingly innocent statement to lead to misperceptions that are difficult and costly to correct. For example,

“Cell phone manufacturers have acknowledged for the first time that their products pose a health risk to users, according to a story in London's *Independent*. Lawyers claim that the admission will pave the way for civil suits against manufacturers, for conditions ranging from tumors, damage to the immune system, and memory loss”—
<http://www.wired.com>.

Several cellular telephone manufacturers have applied for patents to protect developments that decrease the exposure of humans to the signals transmitted by their phones. These changes are mainly in the antenna designs. Some of the newest techniques include moving the antenna away from the head when the telephone is held to the ear (as implemented in the popular Motorola Startek phone, for example), and driving multiple active elements within the “rubber duck” style antenna (using a phase relationship with the goal of decreasing the amount of energy transmitted in the direction of the user).

To better make their case to the patent office, some of the companies overstated that these developments would “minimize the health risks associated with using mobile phones.” Although this makes for good reading in a patent application, it incorrectly implies that there currently is such a health risk that needs to be reduced.

An immense body of research to date has shown that RF emissions do not pose a health risk if significant heating does not take place in tissue. With a maximum power output of 0.6 W, it is unlikely that a cellular telephone can create such heat. Developments that decrease the amount of absorbed RF energy in the user's tissue are useful, not for health reasons, but to improve the performance of the telephone.

Much of the public has an inherent mistrust of RF energy. People don't know specifically what about radio waves could be

harmful but, nevertheless, they are convinced that the danger exists. One problem is the perception that RF is radiation, partially fueled by the use of the term Radio Frequency Radiation. Although this term is correct—it is the radiation of RF from antennas that allows us to communicate—it incorrectly equates RF with radioactive emissions in the minds of many people. Although both forms of energy are correctly called radiation, their biological effects are vastly different. When the frequency of electromagnetic energy is high enough, the radiated field contains enough energy to cause chemical changes in tissue and the term ionizing radiation is used. If the ionized chemicals are part of critical biological structures such as DNA, bad things can result, including cancer.

Electromagnetic energy at lower frequencies is incapable of ionizing chemicals and, as such, is called nonionizing radiation. The amount of power in an electromagnetic wave is not related to the ability of that energy to cause ionization; it is solely a function of frequency. The frequency at which energy starts to ionize is in the vicinity of ultraviolet light, or about 10^{15} Hz (1,000,000,000,000,000 Hz). The highest radio frequencies used today are about 100 GHz (10^{11} Hz, or 100,000,000,000 Hz); common communications frequencies are less than 1 GHz. Radio waves typically used by hams are more than a million times lower in frequency than the lowest frequency that is classified as ionizing radiation. There is no viable mechanism that science has discovered by which radio signals can cause cancer.

The second thing that breeds mistrust in the minds of the public regarding RF is the microwave oven. Although many people have no idea how these devices work, they do see food get very hot very quickly. Imagine that you are such a person and, as you watch your steak being cooked in minutes by these magical “microwaves,” you are thinking about your neighbor who is transmitting “microwaves” from an antenna that is pointed in your direction. What would you think?

Unlike ionization, RF heating is related to absorption of power. Additionally, as we know from working with different-size antennas, the efficiency of absorption in different-size structures is related to frequency. Heating biological tissue is a real danger that has been dealt with by the FCC in its recent environmental impact regulations for the Amateur Radio Service

(§97.13c and OET Bulletin 65 Supplement B). Based on our current knowledge and exhaustive calculations, when the FCC guidelines are met, Amateur Radio signals pose no danger to people.

We should take the recent faux pas of some of the cellular telephone manufacturers as a lesson. Our hobby is based on a technology that much of the public distrusts. As long as we follow safe RF-exposure practices, the public is safe from our signals. However, it is a good idea to carefully think about how we word discussions of this nature. Decreasing exposure below what is already known to be a safe level does not make it “safer.” It is still just “safe.” In particular, it is a bad idea to joke about this issue, even in private. Such jokes (such as “frying the neighbors”) can only be considered funny because we know them to be false. People who do not understand this will not be laughing.

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