



# **Dayton Hamvention®**

## **RF Safety Forum**

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# RF Safety Overview

• **How Do We Know What is Safe?**

• **How You Can Make Sure Your Station Meets the Safety Guidelines**

# How Do We Know What is Safe?

## ⊗ Standards

- History
- Types of Research

## ⊗ Myths

- RF cannot hurt you
- RF always hurts you
- Harmful athermal effects

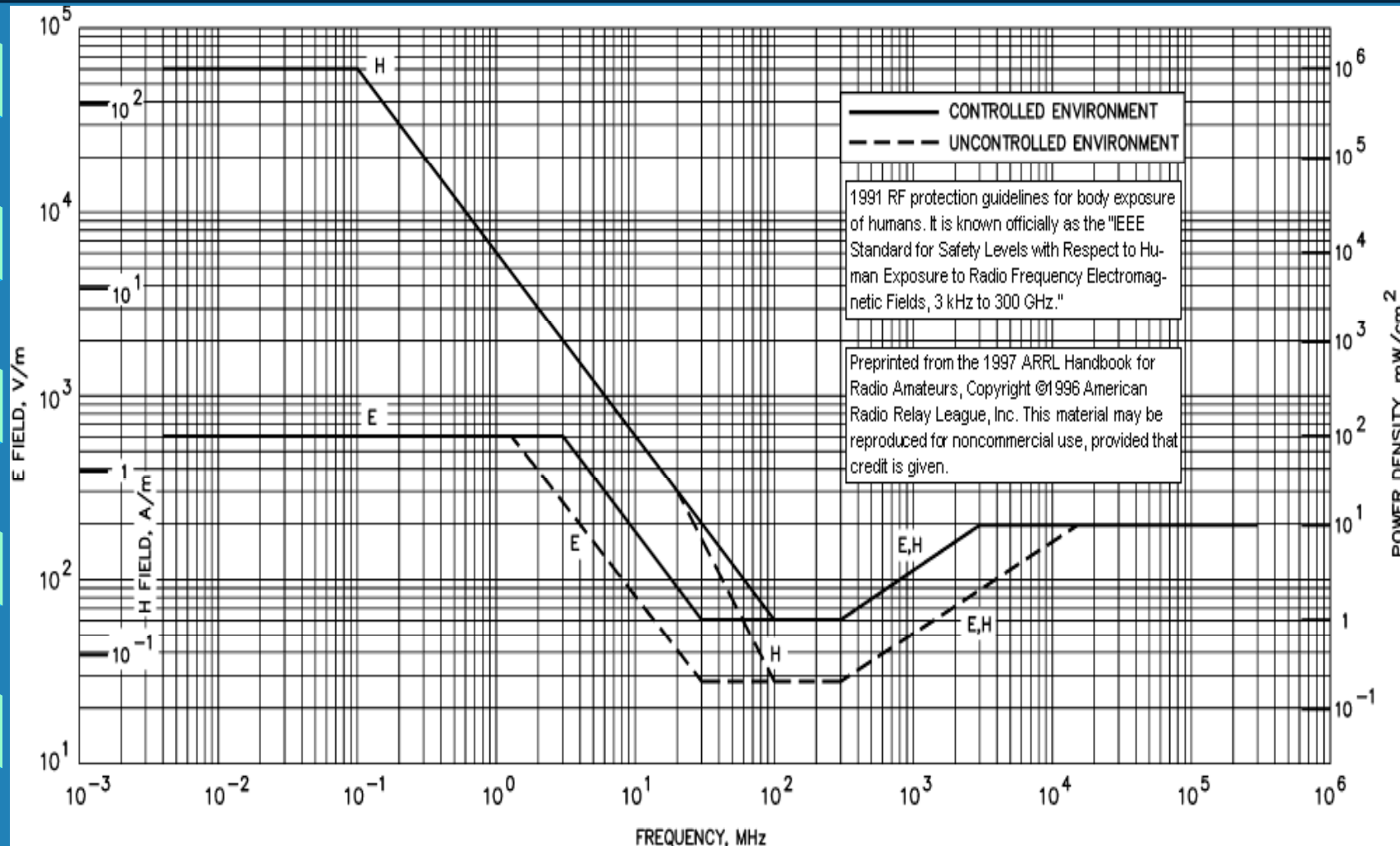
# RF Safety Standards

- **In the U.S., we have three standards bodies concerned with RF Safety:**
  - **Institute of Electrical and Electronics Engineers**
    - **IEEE C95.1-version, updated about every 10 years**
  - **American National Standards Institute**
    - **Adopts each version of IEEE C95.1 to be ANSI/IEEE C95.1**
  - **National Council for Radiation Protection**
    - **NCRP Report No. 86, updated in 1986**

# History of RF Safety Standards

- **First RF Safety Standard was made in the 1950s, equal to the incident energy needed to heat 1 gram of water by 1°C (10 mW/cm<sup>2</sup>).**
- **In the 1982, 1991, and 1999, IEEE developed standards based on actual absorption (SAR), which is a combination of incident energy, wavelength, and tissue size and type.**

# ANSI/IEEE C95.1-1992 Limits



# Types of Research

## • **Epidemiological Research**

- **Study of populations over lifetimes**
- **Tries to match groups with similar exposures**
- **Cannot control for all exposures**

## • **Laboratory Research**

- **Short duration studies relative to a lifetime**
- **Good control of exposures**

# Quality of Studies

- ❁ **To include research in a standard, the quality of the study must be assessed.**
- ❁ **Good studies define every possible variable.**
- ❁ **All reputable research should demonstrate that it can be independently replicated.**
- ❁ **The relationship between health and a laboratory effect is usually not clear.**



# Myth #1: RF Can't Hurt You

- **I hear this from a lot of Hams:  
“I’ve been doing this all my life and I’ve never been hurt.”**
- **Too many real-life examples say otherwise**
  - **RF Burns**
  - **Microwave Ovens**
  - **RF used to kill cancerous tumors**

# Myth #2: RF Always Hurts You

- ❁ **No evidence of this, either from Epidemiology or Laboratory studies.**
- ❁ **Many people confuse RF with ionizing radiation, such as X-Rays or Gamma Rays.**
- ❁ **RF is invisible, tasteless, and odorless. It is easy to believe the scary rhetoric that is flying around these days.**

# Myth #3: Standards Only Prevent Tissue Heating

- ❁ **All current standards are based on verifiable research.**
- ❁ **Exposure limits are set to be lower than levels that were shown to cause any effect in laboratory studies.**
- ❁ **Many exposure limits are based on observed behavioral changes.**

# Myth #4: Athermal Effects are Hurting Us

- ❁ **Athermal effects that have been seen have all been reversible.**
- ❁ **Studies of behavioral effects have been questionable at athermal exposures.**
- ❁ **Studies of cellular processes have not been related to any ill effects.**

# FCC Environmental Regulations

- **Required by the Environmental Protection Act.**
- **Directly based on ANSI/IEEE and NCRP standards.**
- **Uses Occupational Exposure and General Population groups, as suggested by the standards.**
- **Uses averaging times, as suggested by the standards.**

# Multiple Transmitters

- **RF absorption from multiple sources is additive.**
- **If you calculate the exposure at one location to be more than half of the exposure limit from one transmitter and more than one is operating simultaneously, you have exceeded the limit.**
- **Look out for cellular telephone, many of which operate near their safety limit. Adding an Amateur transmission may push the phone user over the limit.**

# Some Recent Headlines and the Real Stories Behind Them

- **Headlines that appear in the popular press often misrepresent the science.**
- **Shocking stories lead to increased readership.**
- **Some reporters see themselves as the protectors of the public.**
- **Reporters are incapable of distinguishing between good and bad science.**

# Misinterpreting Results

## The Story

### **Research Finds Kids More Susceptible to Phone Radiation**

Young children absorb up to 50% more radiation than adults when using mobile phones, says new research from the University of Utah. According to new research, radiation from a phone penetrates half-way through the brain of a 5 year-old child, compared with 30% for a 10 year-old child. Penetration levels for adults, meanwhile, tend to be limited to a very small area around the ear. Despite the figures, researchers continue to assert that no conclusive proof has yet been found to link mobile phone use to cancer.



# Misinterpreting Results

## The Real Science

*Gandhi used an FDTD model of a man and without changing its shape, decreased the voxel size proportionally so that it had about the same volume for various age humans from adults to kids. He then published the graphs with coordinates in units of voxels (not cm). Thus the depth of penetration in terms of voxels appears to increase with diminishing head size. If the head SAR distributions are plotted in terms of cm, the depth of penetration is the same. Kuster (ETH, Zurich) indicated that there wasn't much difference in the absorption between adults and children using true shaped head models in both experimental measurements and FDTD calculations.*

# Policy from misinterpreted science

## The Story

**UK government ministers are to order urgent new guidelines restricting children's use of mobile phones following a report from leading scientists suggesting they could be at risk.**

A government-commissioned study will say children should be discouraged from using mobiles because they are more vulnerable to radiation emissions. Sir Liam Donaldson, chief medical officer, will be asked to work with the author of the report, Sir William Stewart, of Tayside University, to draw up new guidelines on mobile phone use.

# Policy from misinterpreted science

## The Real Science

Although the report stresses there is no evidence currently available that mobiles damage health, it raises a number of concerns. It recommends much more research, especially on the little-understood “non-thermal” effects of mobiles.

There are two motivations behind the policy:

1. The mistakenly assumed “deeper penetration” of RF in children.
2. Children are more susceptible to things that cause cancer since their rate of cell division is higher than that of adults.

# Figures don't lie, but liars can figure The Story

## Mobile phone users 'at greater risk of brain tumour'

People who used mobile phones for two hours a day in the 1980s and early 1990s have a "significantly raised" risk of developing a brain tumour, a Swedish scientist has found. The study by Lennart Hardell, a cancer specialist at Orebro University in Sweden, is a landmark piece of research in the debate over whether the microwave radiation put out by mobile phone handsets can cause cancer. It is due to be published later this year. His research compared 1,600 people who survived brain tumours with 1,600 healthy people. He found that those who had used mobile phones for more than five years were 26 per cent more likely, and those who used them for more than a decade were 77 per cent more likely, to develop a brain tumour than those who did not. The tumours were 2.5 times more likely to be on the same side of the head as the phone was usually held.

# Figures don't lie, but liars can figure

## The Real Science

*Hardell reported an Odds Ratio of 2.42 with a 95% Confidence Interval of 0.97-6.05 and an N of 13 for cell phone users. Of all the people that Hardell looked at, he had people with brain tumors that had used cell phones, people with brain tumors that had not used cell phones, people without brain tumors that had used cell phones and people without brain tumors that had not used cell phones. Of all those people, only 13 cell phone users had brain tumors - kind of small, thus explaining the very large CI.*

# Where'd you hear that one?

## The Story

A paper appeared in the Feb 2002 issue of Bioelectromagnetics (23:113-126) by authors Tice, Hook, Donner, McRee and Guy entitled Genotoxicity of Radiofrequency Signals.

1. Investigation of DNA Damage and Micronuclei Induction in Cultured Human Blood Cells.

The abstract concludes: "This research demonstrates that, under extended exposure conditions, RF signals at an average SAR of at least 5.0 W/kg are capable of inducing chromosomal damage in human lymphocytes."

# Where'd you hear that one?

## The Real Science

*In the paper conclusion: "One potential mechanism for the induction of micronuclei by microwave radiation is hyperthermia. Although the temperature measured at the location of the cells never exceeded 37.5 °C, the variation in absorption reported by Guy et al. [1999] is such that higher localized temperatures could have been produced.*

*Hyperthermia, defined as 40 °C or higher, is capable of inducing micronuclei in proliferating cultured cells, including human lymphocytes, and in vivo in mouse bone marrow." The paper concludes with the oft-present "need for additional research."*

# Propagate the Errors

## The Story

**Researchers Test Mobile Phone Link to Alzheimer's**  
STOCKHOLM, Sweden (Reuters) - A possible link between mobile phone radiation and Alzheimer's disease is being tested on laboratory rats, the leader of a Swedish university research team said Friday. The tests, the second of their kind at Lund University, show that albumin proteins leak through the brain blood barrier in animals exposed to the microwaves, neurosurgery professor Leif Salford told Reuters.



# Propagate the Errors

## The Real Science

*The original study was highly flawed and concluded the opposite of several similar studies performed years earlier. The results were never accepted by experts in the field of brain circulation, so Salford published it in a chemistry journal, where no one knows about this subject. After several years he treats his results as the truth and few people remember that they aren't. Then he starts using his faulty research to generate more research.*

# Faulty Study after Faulty Study

## The Story

### Cell phones harm memory, study finds UW researcher tested rats and radiation exposure

According to a University of Washington study done on rats, it could be the cell phone itself making it harder for you to remember things. "When you use a cell phone, that part of the head gets a very high concentration of radiation," said Dr. Henry Lai, a UW bioengineer. Lai reports that rats suffered significant memory loss after exposure to an hour of the same kind of pulsed microwave radiation used for cell phones. "We also found DNA damage," he said.

# Faulty Study after Faulty Study

## The Real Science

*The method that Lai uses to expose rats to RF is one that he doesn't understand and, according to the person who designed it, "the rat exposures in the system exceeded even those from human exposure to a high power radars. I indicated that a person standing directly in front of a high power Air Force radar would experience less absorption of energy." This statement was made to the reporter who wrote the Lai story but it never made it into print.*

# Sometimes they are even-handed

## The Story

### **No risk from microwave radiation, radar: report**

Korean War Navy veterans exposed to high levels of microwave radiation emitted from radar equipment were no more likely than other men to develop most forms of cancer--including lung, brain and testicular cancers--over a 40-year period, according to a recent report. In fact, men with the highest exposure to radar waves--those who repaired and tested the radar equipment--were 35% less likely to die during the follow-up than men in the general US population. "We found little, if any, evidence of adverse health effects resulting from microwave frequencies," one of the study authors, Dr. Robert E. Tarone of the National Cancer Institute in Bethesda, Maryland, told Reuters Health. One exception reported by Tarone and his colleagues, however, was that aviation electronics technicians, one group of highly exposed veterans, were more than twice as likely as other men to develop a type of cancer called non-lymphocytic leukemia. However, the authors note that if radiation from radar was to blame, other highly exposed veterans would demonstrate the same increased risk.



# And again The Story

By Christopher Wanjek  
Special to The Washington Post

If cellular phones do cause brain cancer, it's not obvious, nor will it become obvious any time soon. That's about all that can be concluded from the two most recent major health studies on the topic, published in December. The two multiyear cellular phone studies, one industry-funded and one by the National Cancer Institute (NCI), were published in the Journal of the American Medical Association (JAMA) and the New England Journal of Medicine, respectively. Both studies examined the relationship between cellular phone use and brain tumors in hundreds of human subjects. Both studies found no association.

# Conclusions

- **RF is safe, if we treat it properly.**
- **The exposure limits are based on good science and should be heeded.**
- **As we add wireless devices to our environment, we should be aware of the total exposure that people receive.**
- **Don't fall for the hype - it has no scientific backing.**