

Radio Frequency Safety

Buddy Morgan WB4OMG,TS WCF
beamar@aol.com

Radio Frequency Safety

- We all want to be safe.
- Law Enforcement and Fire/Rescue are always talking to us about safety.
- As Amateur Radio operators, we should always be conscience of safety.
- Our radios operate using electricity.
- We should make sure our stations are in compliance with the National Electric Code.

- We climb towers and put up antennas.
- We talk on our radios, while driving.
- We should always be aware of what we, as hams are doing, could be unsafe.
- We also should be aware that the transmissions, from our radios can be deemed unsafe—by Federal Law.
- The health effects of non ionizing emissions (radiation) from radio transmitters comes under the general heading of RF Safety.

RF Safety

- Non-ionizing radiation is any type of electromagnetic radiation that does not carry enough energy to remove an electron from an atom. Examples include Visible Light, Lasers and Radio Waves.
- Ionizing radiation has enough energy to remove an electron from an Atom. Examples include Gamma Rays, X Rays and UV light.

NOTICE



**Radio frequency fields beyond
this point may exceed the FCC
general public exposure limit.**

**Obey all posted signs and site guidelines
for working in radio frequency
environments.**

In accordance with Federal Communications Commission rules on radio
frequency emissions 47 CFR 1.1307(b)

©1997 Richard Tull Associates, Inc.
www.rtausa.com



RF Safety

- The National Environmental Policy Act (NEPA) is a Federal Law that established a United States National policy promoting the enhancement of the environment.
- Introduced in the Senate as S. 1075 by Henry M. “Scoop” Jackson on February 18, 1969.
- Signed into law by President Nixon on January 1, 1970

RF Safety

- The National Environmental Policy Act of 1969 (NEPA) requires all agencies of the Federal Government to evaluate the effects of their actions on the quality of the human environment.
- The quality of life in the United States has been improved as a result of this law.
- Life expectancy has increased slightly.

FCC Implementation of NEPA

- To meet its responsibilities under NEPA, the Federal Communications Commission adopted requirements for evaluating the environmental impact of its actions.
- One of several environmental factors addressed by these requirements is human exposure to RF energy emitted by FCC-regulated transmitters and facilities.

FCC Implementation of NEPA

- In 1985, the FCC first adopted guidelines to be used for evaluating human exposure to RF emissions. (15 years later!)
- Gen. Docket 79-144. The commission merely adopted an existing ANSI standard.
- This was a non event
- Amateur Radio was exempt

FCC Implementation of NEPA

- As a result of further study and a rule-making proceeding initiated in 1993, the FCC revised and updated these guidelines on August 1, 1996
- This time they got serious

FCC Implementation of NEPA

- The 1996 rule making resulted in Federal Communications Commission Office of Engineering & Technology Bulletin 65, as issued in August 1997.
- It took the commission 27+ years to protect our health?
- Now Amateur Radio was included.
- (OET 65 was updated in June of 2001.)

FCC Implementation of NEPA

1997 was the first time I had ever
heard about RF Safety!

So, why do we have to do anything
about RF Safety?

Because it is in the Code of Federal
Regulations

- 47 CFR 1.1307 – Describes actions that may have a significant environmental effect, for which Environmental Assessments (EAs) must be prepared.
- This refers you to 47 CFR 1.1310 - Radiofrequency radiation exposure limits. Which gives mandatory standards of RF exposure levels.
- This takes you to the power table in 47CFR97.13 – which says if a Radio Amateur doesn't comply with this table, he or she has to do a RF Safety Study.

RF Safety

- Until OET 65 was released, in 1997, few, if any, hams even thought about RF Safety.
- As I said, earlier, I am a good example.

So, what is RF Safety all about?

- Heat
- Really there are Thermal and Non Thermal Effects.
- Thermal effects: Every radio transmitter is a microwave oven. This is our primary concern.
- I will ~~briefly~~ cover Non Thermal – which is getting Cancer, from exposure to RF.

Non Thermal Effects

Can I get cancer?

American Cancer Society:

- It isn't clear what effects, if any, RF radiation has at levels of exposure too low to produce heating.
- People who are near microwave radar equipment can be exposed to enough pulsed microwave radiation (a type of RF radiation) that they begin to hear clicking noises. This is sometimes called RF hearing and does not seem to cause long term health problems.

American Cancer Society:

- Although there is concern that people exposed to low levels of microwaves over long periods of time in their jobs could have an increased risk of cataracts or loss of fertility (in men), this has not been seen in large studies.

American Cancer Society:

- Because sources of RF radiation are so common in the modern environment, there is no way to completely avoid exposure to it. It may be possible to lower your exposure to RF radiation by avoiding jobs with increased RF exposure, keeping away from appliances and equipment that use RF, and using devices that allow mobile phones to be used without placing them against the ear. Still, it isn't clear that doing so will be helpful in terms of health risks.

Cellular Telephones

From the American Cancer
Society website:

Because cell phones usually are held near the head when being used, the main concern has been whether they might cause or contribute to tumors in this

Cell Phones, continued

- Malignant (cancerous) brain 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

Cell Phones, continued

- In most studies 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, or when specific types of tumors are considered.
- Most studies do not show a “dose-response relationship,” which would be a tendency for the risk of brain tumors to be higher with increasing cell phone use. This would be expected if cell phone use caused brain

Cellphone Towers

(from the American Cancer Society website)

- Public exposure to radio waves from cell phone tower antennas is slight for several reasons. The power levels are relatively low, the antennas are mounted high above ground level, and the signals are transmitted intermittently, rather than constantly.
- At ground level near typical cellular base stations, the amount of RF energy is thousands of times less than the limits for safe exposure set by the US Federal

Cardiac Pacemakers and RF Safety

It is a widely held belief that Cardiac Pacemakers may be adversely affected in their function by exposure to electromagnetic fields. Tests run by the ARRL show

Low Frequency Energy

Can I get sick from Power
Lines?

Low Frequency Energy

The ARRL says, “There are currently no non-occupational US standards for exposure to low-frequency fields. However, some epidemiological evidence suggests that

Thermal Effects of RF Energy

Although not explicitly stated, this is what the FCC regulations cover.

As I said, earlier, every transmitter is, to some extent or another, a microwave oven.

Diathermy (per Wikipedia)

- Diathermy means "electrically induced heat" the use of radio frequency electromagnetic currents as a form of physical or occupational therapy and in surgical procedures.
- It is commonly used for muscle relaxation.
- Uses transmitters in the HF or VHF frequency range to warm body tissue.

Diathermy (continued)

- Mostly used by Physical Therapists and Chiropractors
- Still around, but pretty well displaced by more modern treatment methods
- 11 Meters (27 MHz) was the main frequency
- Displaced Diathermy Dodgers (DDD)

So, how do we comply?

Frequency range(MHz)	Electric field strength(V/m)	Magnetic field strength(A/m)	Power density(mW/cm ²)	Averaging time(minutes)
<i>(A) Limits for Occupational/Controlled Exposures</i>				
0.3-3.0	614	1.63	*(100)	6
3.0-30	1842/f	4.89/f	*(900/f ²)	6
30-300	61.4	0.163	1.0	6
300-1500			f/300	6
1500-100,000			5	6
<i>(B) Limits for General Population/Uncontrolled Exposure</i>				
0.3-1.34	614	1.63	*(100)	30
1.34-30	824/f	2.19/f	*(180/f ²)	30
30-300	27.5	0.073	0.2	30
300-1500			f/1500	30
1500-100,000			1.0	30

f = frequency in MHz

* = Plane-wave equivalent power density

Note 1 to Table 1: Occupational/controlled limits apply in situations in which persons are exposed as a consequence of their employment provided those persons are fully aware of the potential for exposure and can exercise control over their exposure. Limits for occupational/controlled exposure also apply in situations when an individual is transient through a location where occupational/controlled limits apply provided he or she is made aware of the potential for exposure.

Note 2 to Table 1: General population/uncontrolled exposures apply in situations in which the general public may be exposed, or in which persons that are exposed as a consequence of their employment may not be fully aware of the potential for exposure or can not exercise control over their exposure.

[61 FR 41016 (http://frwebgate.access.gpo.gov/cgi-bin/getpage.cgi?dbname=1996_register&position=all&page=41016), Aug. 7, 1996]

RF Safety

Controlled and Uncontrolled

- The uncontrolled area is where the general public has access and does not have knowledge of the presence of RF Energy.
- The controlled area is where anyone entering the area has knowledge of the presence of RF.

Demonstration

- 10 watts on the 23cm band (1296 MHz)
- Small antenna to maximize power density, 800 mW/cm², ¼" from the antenna
- You have to be very close to feel the heat from the RF
- The Federal Government says this safe, because this less than 200 watts

Demonstration

- At a distance of $\frac{1}{4}$ " , to comply, you have to limit exposure to 2 seconds, every 30 minutes
- From seven inches away, according to 47CFR, this is in compliance for the controlled area, with no time limit
- From three feet away, we are in compliance for the un-controlled area, with no time limit

§97.13 Restrictions on station location.

(a) Before placing an amateur station on land of environmental importance or that is significant in American history, architecture or culture, the licensee may be required to take certain actions prescribed by §§1.1305-1.1319 of this chapter.

(b) A station within 1600 m (1 mile) of an FCC monitoring facility must protect that facility from harmful interference. Failure to do so could result in imposition of operating restrictions upon the amateur station by a District Director pursuant to §97.121 of this part. Geographical coordinates of the facilities that require protection are listed in §0.121(c) of this chapter.

(c) Before causing or allowing an amateur station to transmit from any place where the operation of the station could cause human exposure to RF electromagnetic field levels in excess of those allowed under §1.1310 of this chapter, the licensee is required to take certain actions.

(1) The licensee must perform the routine RF environmental evaluation prescribed by §1.1307(b) of this chapter, if the power of the licensee's station exceeds the limits given in the following table:

Wavelength band	Evaluation required if power ¹ (watts) exceeds
MF	
160 m	500
HF	
80 m	500
75 m	500
40 m	500
30 m	425
20 m	225
17 m	125
15 m	100
12 m	75
10 m	50
VHF (all bands)	50
UHF	
70 cm	70
33 cm	150
23 cm	200
13 cm	250
SHF (all bands)	250
EHF (all bands)	250
Repeater stations (all bands)	<i>non-building-mounted antennas</i> : height above ground level to lowest point of antenna <10 m <i>and</i> power >500 W ERP <i>building-mounted antennas</i> : power >500 W ERP

¹Power = PEP input to antenna except, for repeater stations only, power exclusion is based on ERP (effective radiated power).

(2) If the routine environmental evaluation indicates that the RF electromagnetic fields could exceed the limits contained in §1.1310 of this chapter in accessible areas, the licensee must take action to prevent human exposure to such RF electromagnetic fields. Further information on evaluating compliance with these limits can be found in the FCC's OET Bulletin Number 65, "Evaluating Compliance with FCC Guidelines for Human Exposure to Radiofrequency Electromagnetic Fields."

[54 FR 25857, June 20, 1989, as amended at 55 FR 20398, May 16, 1990; 61 FR 41019, Aug. 7, 1996; 62 FR 47963, Sept. 12, 1997; 62 FR 49557, Sept. 22, 1997; 62 FR 61448, Nov. 18, 1997; 63 FR 68978, Dec. 14, 1998; 65 FR 6549, Feb. 10, 2000]

§97.15 Station antenna structures.

(a) Owners of certain antenna structures more than 60.96 meters (200 feet) above ground level at the site or located near or at a public use airport must notify the Federal Aviation Administration and register with the Commission as required by part 17 of this chapter.

RF Safety Study KF4TPW and WB4OMG Revised 03 12 10

This station is not really set up for multioperator use.

Hence consideration of more than one transmitter operating, at any given time, will not given.

160M~20M: 200 watts Maximum Power - no study required

17M~12M: No antenna that will accept power on these bands.

10M: 200 watts into a vertical dipole @ 75'. Density should be quite low, right under the tower. Looking out 70 ft, to the property line, the density is well below the uncontrolled area limits

6M: 195 watts, into a five element yagi at 35 feet.

Refer to the table on at the top of page 8.62 of “RF Exposure and You” by Ed Hare (ARRL 1998). There is no way that anyone could be exposed to radiation in excess of the uncontrolled limits. This is more than confirmed by using several of the “calculator” websites and programs

2M: 1500 watts into a 18 element yagi @94'. Tight antenna pattern, does not exceed uncontrolled limits at ground level. No two story buildings for miles.

220 MHz: No equipment

70 cm: 50 Watt Power limit in peninsula Florida – no study required

900 MHz: No equipment

23cm: 85 watt maximum power output,–no study required

13cm, 9cm and 6cm: Maximum power is 35 watts–no study required

**Are we really endangering
anyone's health?**

So, why do an RF Safety Study?

If someone asks you, if operating your radio is endangering their health, you need to have a credible sounding answer.

Because if you ever have a problem with a Regulatory Agency, you will probably be asked to furnish one.

RF Safety Resources

- Internet search for RF Safety and RF Safety Calculator
- Visit arri.org and search for RF Safety
- Internet search for FCC OET 65

RF Safety Resources

- http://hintlink.com/power_density.htm
- <http://www.arri.org/rf-exposure>

Skipping to the end of the story:
Complying with RF Safety
regulations is not difficult

Radio Frequency Safety

Buddy Morgan WB4OMG,TS WCF
beamar@aol.com