Edmonds, Sarah E.

From: Dale Bickel [Dale.Bickel@fcc.gov]
Sent: Monday, November 07, 2005 11:54 AM
To: Edmonds, Sarah E
Cc: Keane, Ken; astewart@cpr.org
Subject: BPED-20030923ACE / BXPED-20030909ACM - KPRN(FM) - Grand Junction, CO - Program Test Authority

This e-mail is in response to your letter dated November 1, 2005, which requests the reinstatement of automatic program test authority for the main and auxiliary construction permit facilities for KPRN, Grand Junction, CO. You include exhibits to show that the RF conditions on construction permits BPED-20030923ACE and BXPED-20030909ACM at the Black Ridge site have been satisfied using measurements, and that warning signs have previously been posted in those areas where the occupational RF exposure limit is exceeded. Based on the information provided, I conclude that the permittee has satisfied the Commission's RF requirements.

Consequently, by this e-mail, program test authority IS GRANTED to permit KPRN (FM) to commence program tests with the main facilities specified in construction permit BPED-20030923ACE, and with the auxiliary facilities in construction permit BXPED-20030909ACM. Please include a copy of your November 1, 2005 submission with each FCC Form 302-FM license application to cover these permits, and be sure to include a copy of this e-mail to document that the construction permit condition has been satisfied.

This authorization is being sent by e-mail in lieu of a letter for the same purpose in order to get this authority to you as soon as possible. Please print a copy of it and keep it with the station's records. The grant of this program test authority will also be noted in the FCC's CDBS database.

If there are any questions, please contact me at 202-418-2706.

Dale Bickel dale.bickel@fcc.gov 202-418-2706 11/07/2005
Senior Electronics Engineer
Audio Division, Media Bureau, FCC

DuaneMorris®

SARAH E. EDMONDS
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November 1, 2005

VIA EMAIL AND HAND DELIVERY

Federal Communications Commission
c/o Natek Inc.
236 Massachusetts Avenue, N.E.
Suite 110
Washington, D.C. 20002
Attention: Dale Bickel, Audio Services Division

Re: Request for Program Test Authority:
KPRN, Facility ID No. 53774
Permit File Nos. BPED-20030923ACE; BXPED-20030909ACM

Dear Mr. Bickel:

This is to request reinstatement of automatic program test authority on behalf of Public Broadcasting of Colorado, Inc. (Colorado Public Radio or "CPR") for the above-referenced construction permits for KPRN, Grand Junction, CO.

Included herewith are exhibits demonstrating that the Radio Frequency exposure conditions on construction permits BPED-20030923ACE and BXPED-20030909ACM are satisfied. The Pericle study, also attached herewith, was conducted in 2004 before the new KPRN facilities were installed, but has been included for the sake of completeness.

Accordingly, CPR hereby requests Program Test Authority. In the interests of time, kindly send the authorization by e-mail to the undersigned. Any questions regarding this matter may be referred to this office.

Very truly yours,

Sarah E. Edmonds
sedmonds@duanemorris.com

cc: Ken Keane
NATEK

Radio Frequency Exposure Study For KPRN, Grand Junction, CO

September 26, 2005

Prepared by:

Allen A. Stewart
Director of Engineering
For Colorado Public Radio
7409 South Alton Ct.
Centennial, Colorado 80112
(303) 871-9191
astewart@cpr.org

Regarding Construction Permits
BXPED-20030909ACM
And
BPED-20030923ACE

Introduction

The purpose of this study was to satisfy special conditions of FCC construction permits BXPED-20030909ACM and BPED-20030923ACE regarding measurements for human exposure.

Background

KPRN recently made major improvements to its transmission site on the Black Ridge Communications Site near Grand Junction. Its old 31 meter high tower was removed and a new 49 meter tower was erected. The new tower enabled KPRN to move its main antenna to a new higher location and an auxiliary antenna to be mounted. The tower also accommodated other current and new users to share the tower.

An extensive RF Exposure Study was conducted by Pericle Communications Company on the Black Ridge Electronic Site just prior to construction of the new tower and dismantling of the old. A copy of the study is included with this application to demonstrate the background RF situation on the site.

At the time of the Pericle study, the construction of the new tower was imminent and anticipated. Therefore radiation from all the antennas on the new tower was studied and included in the report. Please refer to section 6.0., the analysis portion of the report for methodology and results of the study.

All recommendations found in section 7 of the Pericle study were implemented to bring the site into compliance.

Appendix B of the Pericle study shows data for the new Colorado Public Radio tower occupied by KPRN.

Regarding the measurement values in Appendix A of the Pericle study, measurement points 48,49 & 50 referred to the old tower which no longer exists. However the guy points for the new tower were included in the new measurements.

RF Exposure Compliance Measurements

On September 26, 2005, new RF exposure measurements were conducted to assure compliance regarding the signals radiating from the new tower and their inter-relationship with other signals on the site. At the time of the new measurements, KRMJ, Channel 18 had not moved its operations to the facility under study. KRMJ currently operates from a facility many kilometers away from the facility under test and was not a factor in the results. The area of study included any location where a signal from the tower would be expected to exceed 5% of the occupational limit for human exposure. Please refer to Section 4.0 of the Pericle study explaining why the occupational limit was determined to be the appropriate standard for MPE measurements on the site. Two sets of measurements were taken, one each for each of the facilities described in above named

construction permits. The facilities were each operated sequentially with the parameters described in their respective construction permits. A calibrated Holaday HI 3002 RF survey meter was used to make all measurements.

The results of the RF survey for facility BXPED-20030909ACM indicated no locations within the sphere of influence of the new facility, including the new tower guy points, exceeded the Occupational limit for RF human exposure with the exception of point 60 as described in appendix A of the Pericle study. The measurement value showed little change from the Pericle study. The point already had appropriate warning signs posted per the recommendations of the Pericle study.

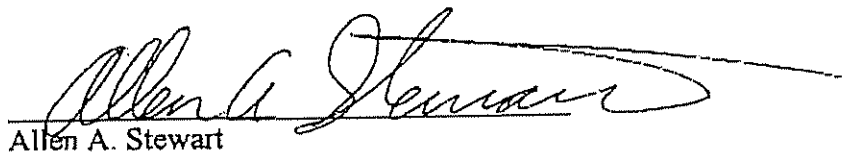
The results of the RF survey for facility BPED-20030923ACE indicated no locations within the sphere of influence of the new facility, including the new tower guy points, exceeded the Occupational limit for RF human exposure with the exception of point 60 as described in appendix A of the Pericle study. Once again, the measurement value showed little change from the Pericle study. The point already had appropriate warning signs posted per the recommendations of the Pericle study.

Based upon the studies conducted, the measurements obtained, and where necessary appropriate corrective action taken, it is concluded that the special conditions regarding Radio Frequency Human Exposure guidelines for BXPED_20030909ACM and BPED020030923ACE have been met.

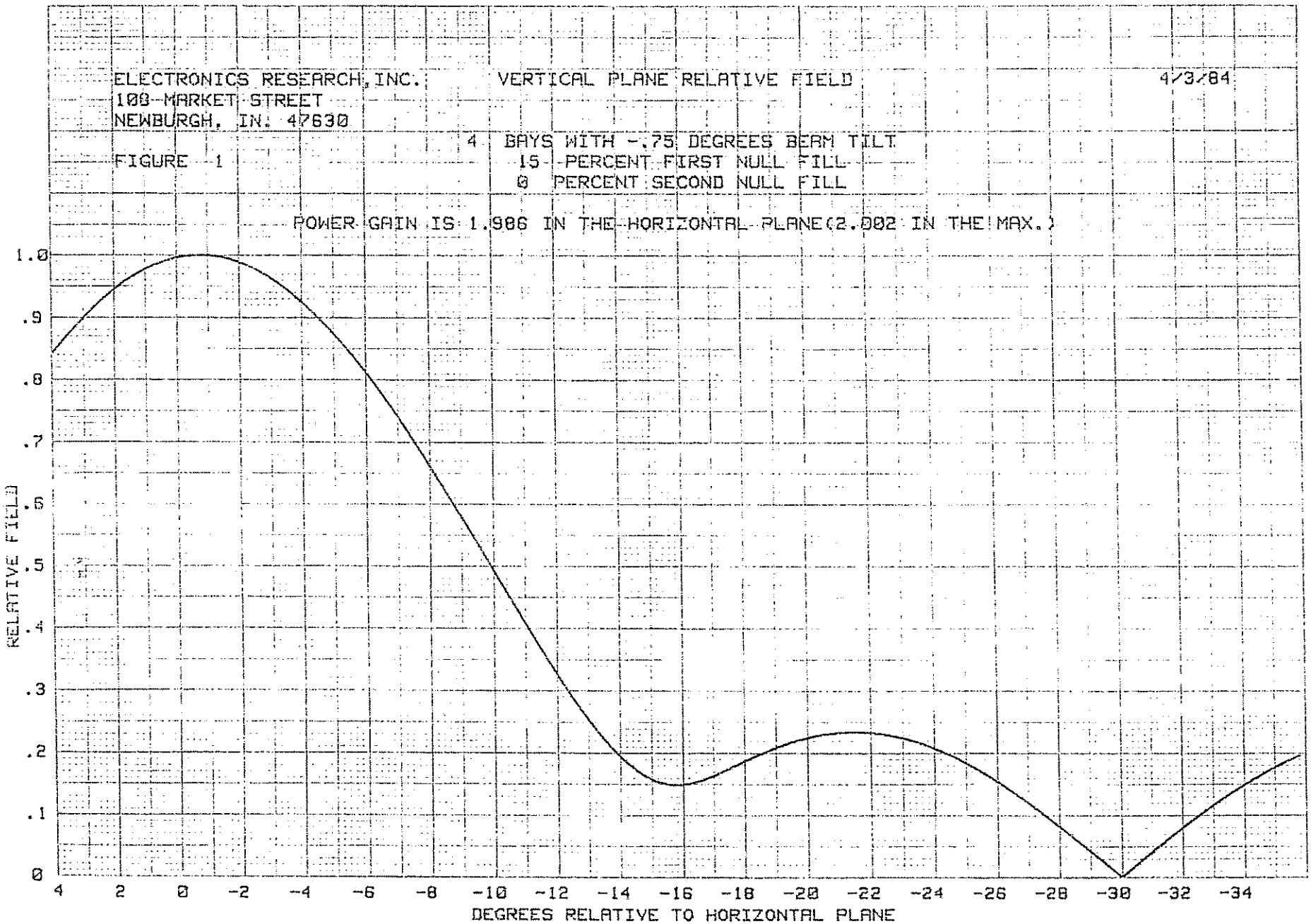
Engineering Certification

I, Allen A. Stewart, certify that all representations herein contained are true and accurate to the best of my knowledge. That I am Director of RF Engineering for Colorado Public Radio, and am familiar with the instruments, procedures and regulations regarding measurement of RF for Human Exposure. I have over 30 years experience with broadcast engineering and my qualifications are a matter of record with the Commission.

Signed this 26th day of October, 2005



Allen A. Stewart
Director of Engineering
Colorado Public Radio


ELECTRONICS RESEARCH, INC.
100 MARKET STREET
NEWBURGH, IN. 47630
VERTICAL PLANE RELATIVE FIELD
4/3/84
FIGURE 1
4 BAYS WITH -.75 DEGREES BEAM TILT
15 PERCENT FIRST NULL FILL
0 PERCENT SECOND NULL FILL
POWER GAIN IS 1.986 IN THE HORIZONTAL PLANE (2.002 IN THE MAX.)
RELATIVE FIELD
1.0
.9
.8
.7
.6
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.4
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.2
.1
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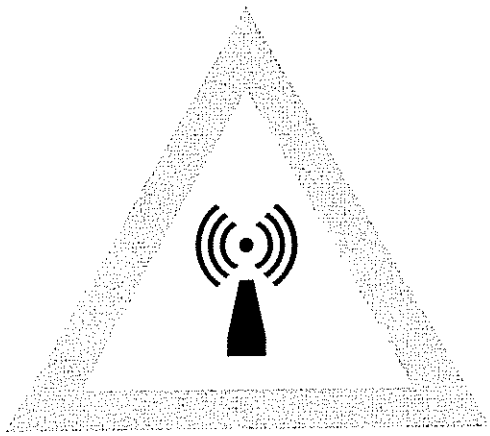
4 2 0 -2 -4 -6 -8 -10 -12 -14 -16 -18 -20 -22 -24 -26 -28 -30 -32 -34
DEGREES RELATIVE TO HORIZONTAL PLANE

Radio Frequency Exposure Study
Black Ridge Communications Site



August 25, 2004

Prepared by:

Jay M. Jacobsmeyer, P.E.

Pericle Communications Company
1910 Vindicator Drive, Suite 100
Colorado Springs, CO 80919
(719) 548-1040
Fax: (719) 548-1211
jacobsmeyer@pericle.com

For:

Black Ridge Users Group
P.O. Box 60341
Grand Junction, CO 81506

Radio Frequency Exposure Study
Black Ridge Communications Site

Executive Summary

The purpose of this study was to conduct a radio frequency (RF) exposure survey of the Black Ridge Communications Site and to recommend corrective actions to bring the site into compliance with the FCC's RF safety guidelines, found in CFR Title 47, Parts 1.1307 - 1.1310. The survey revealed that the site is remote with restricted access and therefore is a controlled environment as defined by the FCC. Measured RF power densities at ground level are below the occupational exposure limit everywhere except at four tower guy anchors where energy from broadcast antennas is re-radiated by the guy anchor steel. These guy anchors should be marked with Caution signs as described in the recommendations section of this report. Other recommendations involve posting signs and placards at each tower and ensuring tower climbers use personal monitors when working above ground. See Section 7.0 for a complete list of recommendations.

1.0 Introduction

The Black Ridge Communications Site is a mountain top radio site serving Grand Junction, Colorado. The site is owned by the Federal Government and managed by the Bureau of Land Management (BLM) in accordance with Public Law 94-579. The coordinates for the approximate center of the site are 39° 03" 59.5" N, 108° 44' 45.3" W (NAD 83). Site elevation is approximately 7,100 feet. The site is primarily a television and FM radio broadcast site and the site's broadcast stations are listed in Table 1. Non-broadcast tenants include Qwest, Northwest Pipeline, Civil Air Patrol, ARINC, Western Colorado Amateur Radio Club, Verizon Wireless, and Tristate Western Gas.

The site operates under the guidance of a Management Plan, last updated on June 21, 2001 [7]. The BLM gets technical support and advice from the Black Ridge Communications SIte User's Association, comprised of current tenants on the site.

The remainder of this report is organized as follows: Section 2.0 introduces the FCC human exposure standards for radio frequency energy. Section 3.0 explains the methods used to ensure compliance when multiple emitters in different frequency bands are present. An explanation of occupational exposure and public exposure is given in Section 4.0. In Section 5.0, we summarize the results of the measurement survey conducted on May 26 and 27, 2004. Section 6.0 presents an analysis of the predicted exposure levels from the proposed Colorado Public Radio (CPR) tower which will be completed this fall. Section 7.0 concludes the report with a list of recommendations to bring the site into full compliance with FCC guidelines.

Table 1 - Black Ridge Broadcast Stations (As of June 1, 2004)			
Call Sign	Frequency (MHz) Or Channel (TV)	Tower	ERP (kW)
KAFM	88.1	Maranatha Old	0.016
KPRN	89.5	CPR	20
KLFV	90.3	KLOVE	3
KMSA	91.3	Maranatha New	3
KJYE	92.3	Maranatha Old	100
KMGJ	93.1	Maranatha New	100
KEKB	99.9	Cumulus	79
KMOZ	100.7	Maranatha Old	42
KMXY	104.3	Cumulus	100
KZKS	105.3	CPR	20
KBKL	107.9	Cumulus	100
KFQX	Channel 4	Channel 4	10.7
KREX	Channel 5	Channel 4	100
KKCO	Channel 11	Channel 11	155
KKCO-DT	Channel 12-DT	Channel 11	5.3
KFQX-DT	Channel 15-DT	Channel 4	5.18
KRMJ-DT	Channel 17-DT	New CPR	65
KRMJ	Channel 18	New CPR	105
K25FZ	Channel 25-LPTV	Maranatha Old	21.4
K63EI	Channel 45-LPTV	Mesa County	0.976
K65CE	Channel 47-LPTV	Mesa County	0.976
K67CJ	Channel 49-LPTV	Mesa County	0.976

2.0 FCC Exposure Standards

The possible health effects associated with exposure to radio frequency fields have been studied for more than half a century. The only established adverse effect is heating of body tissue. To protect the public from harmful exposure, the FCC requires that its licensees comply with its published radio frequency exposure standards, found in Parts 1.1307 through 1.1310 of Title 47 of the Code of Federal Regulations [5]. FCC exposure limits are based on voluntary standards published by the American National Standards Institute (ANSI) and the National Council on Radiation Protection and Measurement (NCRP).

The term radio frequency *radiation* is often used to describe the fields emitted by radio antennas, but we must distinguish between the *non-ionizing* radiation from radio waves and the *ionizing* radiation from much higher frequency sources such as X-rays. It is physically impossible for radio frequency sources to cause ionization in the human body. Consequently, there is no similarity between the biological effects of ionizing radiation (X-

rays) and non-ionizing radiation (radio waves).

We must also distinguish radio frequency fields from extremely low frequency (ELF) fields such as those associated with 60 Hz power lines. ELF fields do not readily radiate from their source and are an entirely different phenomenon.

FCC rules apply different standards for occupational, or *controlled environments* and general population, or *uncontrolled environments*. The definitions of controlled and uncontrolled environments are as follows [5]:

> *Controlled Environment* - "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."
>
> *Uncontrolled Environment* - "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."

By virtue of its rural location, Black Ridge is a controlled environment and the occupational limit applies. For controlled environments, the FCC sets a standard of 1 milliwatt/cm^2 in the VHF band (30-300 MHz). In the lower UHF band (300 MHz - 1.5 GHz), the FCC standard is a function of frequency and is given by the expression $f/300$ milliwatts/cm^2, where f is the frequency in MHz. In the FM and television broadcast bands, the general population limit is exactly a factor of five below the occupational limit. The FCC exposure standards are plotted as functions of frequency in Figure 1.

The human body does not react to high power densities instantaneously and short-term exposure to levels exceeding FCC power density limits does not necessarily exceed the FCC exposure limits. The FCC limits are for whole-body exposure averaged over a period of 6 minutes for controlled environments and 30 minutes for uncontrolled environments [1], [2], [5]. For example, if a radio technician is exposed to a power density of 0.5 milliwatts/cm^2 for a period of 4 minutes and then enters a field of 1.5 milliwatts/cm^2 for a period of 2 minutes, the average exposure in the six minute period is 0.83 milliwatts/cm^2 which is below the FCC limit for controlled environments.

Although other Federal agencies publish RF exposure standards (e.g., OSHA), the governing standard for communications sites is the FCC standard. The FCC has prepared an easy-to-read publication explaining its RF exposure policy [6]. This publication is available from the FCC web site at *www.fcc.gov*.

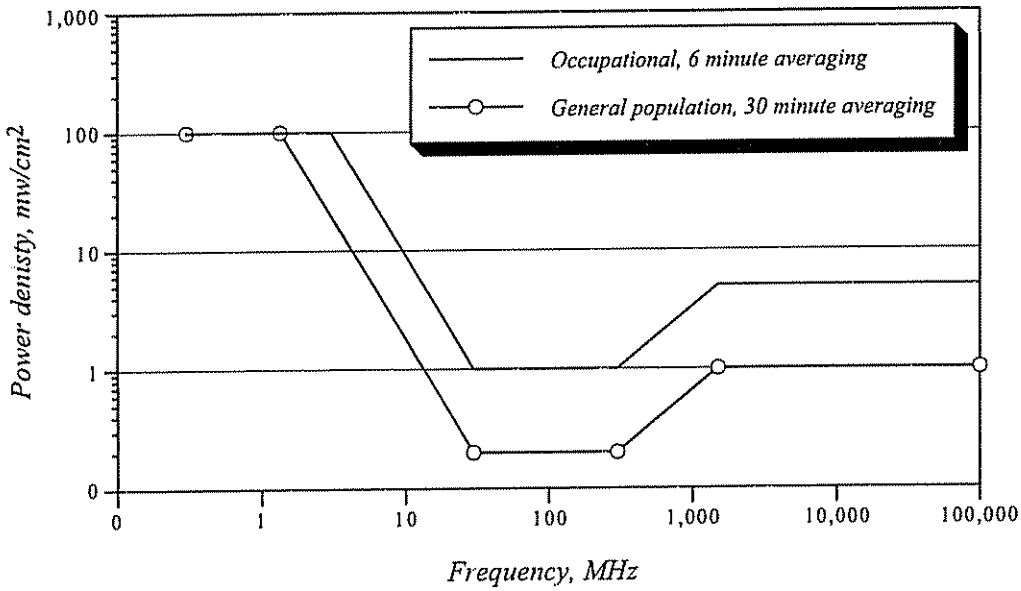


Figure 1 - FCC Exposure Standards
(Plane wave equivalent *E*-field power density values)

3.0 Ensuring Compliance With Multiple Emitters

If the radio site has a single transmitter, one can ensure compliance by comparing the predicted power density with the FCC standard for the transmitter frequency. When the site has multiple transmitters operating over a wide range of frequencies, it becomes more difficult to ensure compliance. For example, if a tower has a paging antenna at 929 MHz and an FM broadcast antenna at 99.9 MHz, which standard do we apply, 3.1 mW/cm^2 or 1.0 mW/cm^2?

In these situations, the FCC directs that a fraction of the standard be computed for each source. If the sum of the fractions is less than 1.0, the site is in compliance. Mathematically, this requirement is stated as

$$Q = \sum_{i=1}^{M} \frac{S_i}{S_{FCC}(f_i)} \leq 1.0 \qquad (1)$$

where M = the number of radiating antennas at the site, S_i = the average power density from antenna i, f_i = the operating frequency of antenna i, and $S_{FCC}(f_i)$ = the FCC power density standard at frequency f_i.

On congested sites, a non-compliance condition may be caused by numerous transmitters belonging to many different licensees. The FCC recognizes that it may be impractical to assign responsibility to every transmitter contributing to the measured power density, so the Commission employs a 5% rule in these situations. In other words, only those stations that contribute 5% or more of the applicable exposure standard are responsible for correcting the problem. This rule is reproduced below from 47 CFR 1.1307(b)(3) (Oct. 1, 2003):

> "(3) In general, when the guidelines specified in Sec. 1.1310 are exceeded in an accessible area due to the emissions from multiple fixed transmitters, actions necessary to bring the area into compliance are the shared responsibility of all licensees whose transmitters produce, at the area in question, power density levels that exceed 5% of the power density exposure limit applicable to their particular transmitter or field strength levels that, when squared, exceed 5% of the square of the electric or magnetic field strength."

4.0 Occupational vs. Public Exposure

When applying the FCC guidelines for RF exposure, one must know whether the exposure is occupational (controlled environment) or public (uncontrolled environment). Black Ridge is a *controlled* environment because the site is remote, has limited access, and the general public can exercise control over their exposure. The site is at the end of a BLM road and access is limited to authorized personnel via a heavy-duty locked gate. All other approaches to the site involve sheer cliffs and there are no hiking trails on or near the site. There are no compelling reasons why the public should be on the site. Thus, the guidelines for occupational exposure apply.

There may be cases where personnel who are not trained in RF safety may require authorized access to the site. Examples include the telephone company technician, air conditioner repairman, propane service technician, fire fighters, etc. Generally, these personnel fall in the public exposure category due to their lack of training and awareness of RF hazards. Consequently, it is not permissible for these personnel to be exposed to levels above the public limit unless two criteria are met:

- They are warned (through Notice signs) that exposure may exceed the public limit
- They can exercise control over their exposure. In other words, it is not necessary for these personnel to work in these areas to accomplish their job.

5.0 Measurements

Pericle Communications Company conducted an RF exposure survey on May 26 and 27, 2004. Prior to conducting the survey, we walked the site and verified FCC license information for the broadcast stations on site. There are sixteen towers on the site.

Relevant tower information is listed in Table 2.

Table 2 - Black Ridge Broadcast Stations
(As of June 1, 2004)

Tower	Tower Name	Type	Owner	Broadcast Tenants\
1	Cumulus Large	Guyed	Cumulus	99.9, 104.3, 107.9
2	Cumulus Small	Guyed	Cumulus	None
3	Qwest	Wood Pole	Qwest	None
4	Mesa County	Self-Support	Mesa County	45, 47, 49 LP
5	Northwest Pipeline	Self-Support	Northwest Pipeline	None
6	ARINC	Guyed	Delta Airlines	None
7	Amateur Radio	Guyed	Amateur Radio	None
8	KLOVE	Self-Support	EMF	90.3
9	Channel 11	Guyed	Eagle III	Ch. 11-TV, 12-DT
10	CPR (old)	Guyed	CPR	89.5, 105.3
11	CPR (new)	Guyed	CPR	89.5, 105.3, Ch. 17-DT, 18-TV
12	Channel 4	Guyed	Harv Reese	Ch. 4-TV, 5-TV, 15-DT
13	Maranatha Old	Guyed	Maranatha Broadcasting	88.1, 92.3, 100.7, Ch. 25-LP
14	Maranatha New	Guyed	Maranatha Broadcasting	91.3, 93.1
15	Verizon Wireless	Self-Support	Verizon Wireless	None
16	Tri-State	Self-Support	Tri-State	None

Measurements were conducted in accordance with the guidelines published in ANSI C95.3-2002 [3] and FCC Bulletin OET-65 [2]. The survey was accomplished with the test equipment listed in Table 3.

Table 3 - Test Equipment Used in Survey

Instrument	Serial Number
Wandel & Goltermann (W&G) EMR-300	B-0053
Wandel & Goltermann Type 25.1 Probe, 300 kHz - 40 GHz	B-0053

Electromagnetic fields on the site are a complex combination of signals from several sources. Reflections from the ground, buildings, towers, and guy wires create standing waves with wide spatial variations. Moving the probe a distance of a few inches can result in significant measured variation. The FCC standard is a whole body average exposure standard, so the measurements must be taken over a volume comparable to that occupied by a standing adult. The W&G probe and meter record field strength as percent of the FCC controlled environment standard. The W&G meter also performs an automatic average as the user sweeps the volume of interest. To perform a spatial average with the W&G meter, we generally use the zig-zag method shown in Figure 2. When reproducible measurements are needed, we measured on a straight line from foot to head.

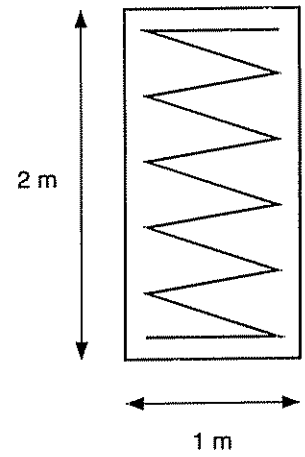


Figure 2 - Zig-zag method for automatic spatial averaging

Measurements were always taken at least 20 cm from reflecting objects in accordance with ANSI C95.3-2002. Magnetic field probes tend to exhibit false readings above 300 MHz. Because sources on Black Ridge include both VHF and UHF transmitters, we did not use a magnetic field probe.

During the survey, we measured the 85 locations shown on the site map in Appendix C. The corresponding measurement values are found in Appendix A.

All measurements are below the occupational exposure limit, except for guy anchors on the two Maranatha Broadcasting towers. These guy anchors will require special Caution signs as described in Section 7.0.

Except for a small area around the Colorado Public Radio tower and several guy anchors (see Appendix A & C) , all ground level measurements are also below the public limit. Note that the public exposure limit is exactly five times below the occupational limit, so a reading of 20% or higher in Appendix A indicates levels above the public limit. Only trained personnel should be working above ground or on guy anchors. Also, the ground level exposure from the colorado Public Radio tower will be eliminated when the new CPR tower is completed this fall. Thus, it should not be necessary to post Notice signs on the site and no extraordinary measures should be be required for escorting personnel.

6.0 Analysis

Soon after this survey was completed, the Colorado Public Radio tower was replaced by a new tower to hold 89.5, 105.3, Channel 18-TV and Channel 17-DT. This tower was under construction at the time of this writing. The two television channels are licensed to Rocky Mountain PBS and were moved from their original broadcast site on Grand Mesa.[1] FM

[1] Channel 18-TV was moved from Grand Mesa. Channel 17-DT is new construction.

stations 89.5 and 105.3 were the original stations on the Colorado Public Radio tower. Because the tower was completed after the survey, it is necessary to use analysis to predict power densities from the new tower and ensure cumulative ground level power densities remain below the occupational limit. The new tower is shown in Figure 3 below. Note that Channel 18 and 17 are combined in a single antenna. The location of 105.3-FM is tentative, but according to CPR, this is a likely worst-case location for their antenna.

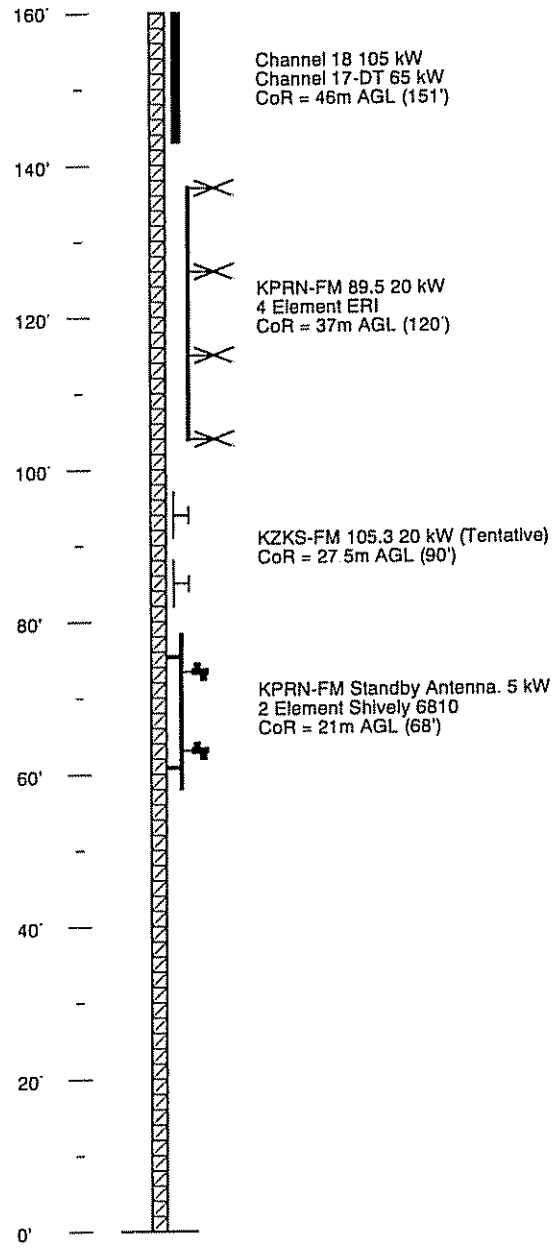


Figure 3 - New CPR Tower (replaces old CPR tower)

A. Approach

Predicted power densities are the sum of two contributions: (1) ambient power densities created by existing stations at the time the new tower is constructed and (2) new power densities created by the stations on the new tower. Because the measurement survey in May, 2004 included two stations that moved to the new tower (89.5 and 105.3), ambient power densities are calculated from the survey values by removing the contribution of each FM station. At the time of the survey, we collected three sets of measurements to support this analysis:

- 89.5 and 105.3 at full power
- 89.5 at half power, 105.3 at full power
- 89.5 at full power, 105.3 off-air

These measurements were taken at eleven locations in the vicinity of the Colorado Public Radio tower. They allow us to calculate the individual contributions of 89.5 and 105.3 and to estimate the ambient levels on the ground. The following general method is used: The value to be calculated is the power density created by the individual station. Denote this value by x. Collect a spatial average at each location with all stations at full power. Denote this value S_1. Reduce the power by a multiplier, a ($a < 1$). Collect a second spatial average at the same location. Denote this value S_2. One can show that the contribution of the individual station is simply

$$x = (S_1 - S_2)/(1-a) \tag{2}$$

Repeat these steps for the second and other stations. The ambient level is the cumulative level, S_1, minus the sum of the contributions of each individual station. For the specific cases of 89.5 and 105.3, the values of a are 0.5 and 0.0, respectively. The spreadsheet in Appendix B lists the collected measurements and calculates the individual contributions of 89.5 and 105.3 and the predicted ambient levels at the eleven measured locations in the near the Colorado Public Radio tower. Note that the highest ambient level is 6% of the occupational limit.

B. Calculations

The analysis for this study follows the guidance found FCC OET-65 [2] and Gailey and Tell [6]. The power density of a plane wave will attenuate as the square of the distance from the source. We can write the power density at a distance d from the source antenna as

$$S = \frac{\text{EIRP}}{4 \pi d^2} \tag{3}$$

where EIRP is the effective isotropic radiated power. Equation (3) is valid when the measurement is taken in the far field and in the main beam of the antenna and there are no reflecting surfaces nearby. In practice, the EIRP must be adjusted to accommodate several factors, including:

- Antenna elevation pattern
- Antenna azimuth pattern
- Near field vs. far field effects
- Ground reflections
- Type of modulation
- Antenna polarization

In this study, we are interested in the power density contributed by both FM and television broadcast antennas. We can write the expression for power density for a broadcast FM station in mw/cm^2 as [2]

$$FM = \frac{g_d\, a_a\, a_r\, [f_h(\phi)^2 \mathrm{ERP(H)} + f_v(\phi)^2\, \mathrm{ERP(V)}]\ (1{,}000\ \mathrm{milliwatts/watt})}{4\,\pi\, d^{\,2} (10{,}000\ \mathrm{cm}^2/\mathrm{m}^2)} \qquad (4)$$

where g_d is the gain of a half-wave dipole = 1.64

a_a is azimuth pattern power factor (the square of the relative field)

a_r is the power reflection factor, $a_r = 4$, worst case

$f_h(\phi)$ is the relative field strength of the antenna pattern in the vertical plane, HPOL

$f_v(\phi)$ is the relative field strength of the antenna pattern in the vertical plane, VPOL

ϕ is the look down angle measured from the horizontal

ERP(H) is the effective radiated power in the horizontal polarization in watts

ERP(V) is the effective radiated power in the vertical polarization in watts

d is the distance between the radiating source and the observation point in meters

The licensed ERP for an FM station is the ERP in the horizontal polarization. By FCC rule, the ERP in the vertical polarization can be as large as the horizontal, but no larger. For the purposes of this study, we make the worst-case assumption that the horizontal and vertical ERP are identical and the total ERP is twice the licensed ERP.

Unlike FM radio, the transmitted power of an analog television visual signal varies with the modulating signal. A good approximation to the root mean square (rms) power level is 40% of the visual ERP [2]. The audio signal is frequency modulated and has constant power. Thus, we can write the expression for power density for a broadcast television station in mW/cm^2 as

$$S_{TV} = \frac{a_r a_a g_d \ f(\phi)^2 \ (0.4 \text{ VERP} + \text{AERP}) \ (1{,}000 \text{ milliwatts/watt})}{4 \pi d^2 (10{,}000 \text{ cm}^2/\text{m}^2)} \quad (5)$$

where $f(\phi)$ is the relative field strength of the antenna pattern in the vertical plane
ϕ is the look down angle measured from the horizontal
VERP is the licensed visual effective radiated power in watts
AERP is the licensed aural effective radiated power in watts (usually 10% of visual)

We have assumed that the signal is horizontally polarized. If the antenna has a vertical component or is circularly polarized, the power in the vertical polarization must be included in the ERP in (5). Digital television is licensed for average power, so the licensed ERP should be substituted in (5) for (0.4 VERP + AERP).

A power reflection factor of 4.0 is very conservative because it assumes worst-case reflection geometry and a perfectly conducting ground. For practical sites, the FCC suggests a reflection factor of 2.56 (60% field reflection) [2]. At distant locations, reflection angles are shallow and reflections are weaker regardless of soil conductivity.

C. Results

The antenna locations are shown in Figure 3 above. Substituting the appropriate values in Equations (4) and (5) and plotting the results as a function of distance from the base of the tower, we get the results of Figure 4. In Figure 4, we have plotted the predicted power density for two cases: (1) all stations and (2) all stations excluding 105.3 since this station may be moved to the Maranatha tower instead.

We see from Figure 4 that 105.3 dominates ground level power densities, but the values are still well below the occupational limit. Furthermore, when these levels are added to the worst-case ambient level near the tower, the total is still well below the occupational limit.

In addition to the three main antennas, we also calculated the power density from the KPRN standby antenna operating at 5 kW ERP. For this antenna alone, the maximum ground-level power density of 12% of occupational occurs roughly 13 meters from the base of the tower.

After summing the predicted levels shown in Figure 4 and the calculated ambient levels from Appendix B at each discrete measurement location, we find that power densities from the new tower should be below both the occupational limit and the public limit on the ground.

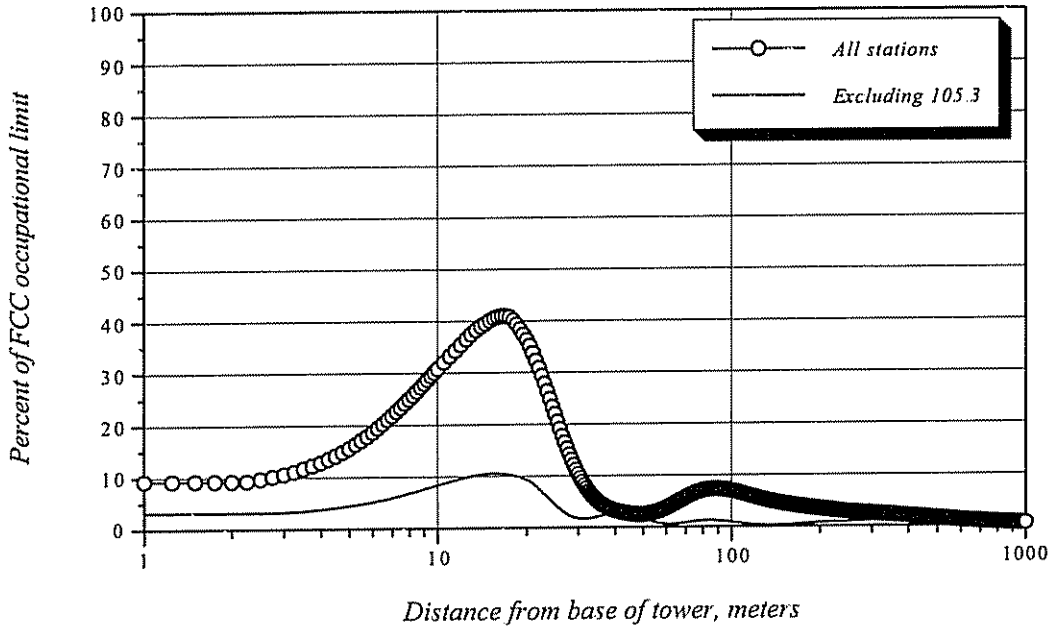


Figure 4 - Predicted Power Density at Ground Level for CPR Tower
(a_r = 2.56, observer at 1.8 meters)

7.0 Recommendations

We make the following recommendations to ensure the site fully complies with FCC guidelines for human exposure to radio frequency energy:

1. Erect warning sign inside gate. Install a warning sign just inside the gate (to minimize vandalism). The warning sign should be approximately 4' x 6', 3/4" marine plywood, painted with a white background. It can be mounted with two 4" x 4" pressure-treated posts or some other durable mounting that will survive high winds. The sign should read as shown in Figure 5 on the next page.

If Dwight Morgan is not the proper contact, please substitute the name and phone number of the correct person. Note that the warning triangle should be ANSI yellow. The "Warning!" letters should be red. A local sign company should be capable of fabricating this sign. Some companies use vinyl letters with an adhesive backing, but other types of lettering are acceptable. If vinyl letters are used, we find they last longer if a coat of clear polyurethane is applied over the letters after they are applied to the sign. We also find that the sign holds up longer if the corners are rounded as shown in Figure 5.

If vandalism at the gate is a problem, the sign can be moved up the hill closer to the radio site. The sign should be placed such that any person entering the radio site will see it before getting to the actual site.

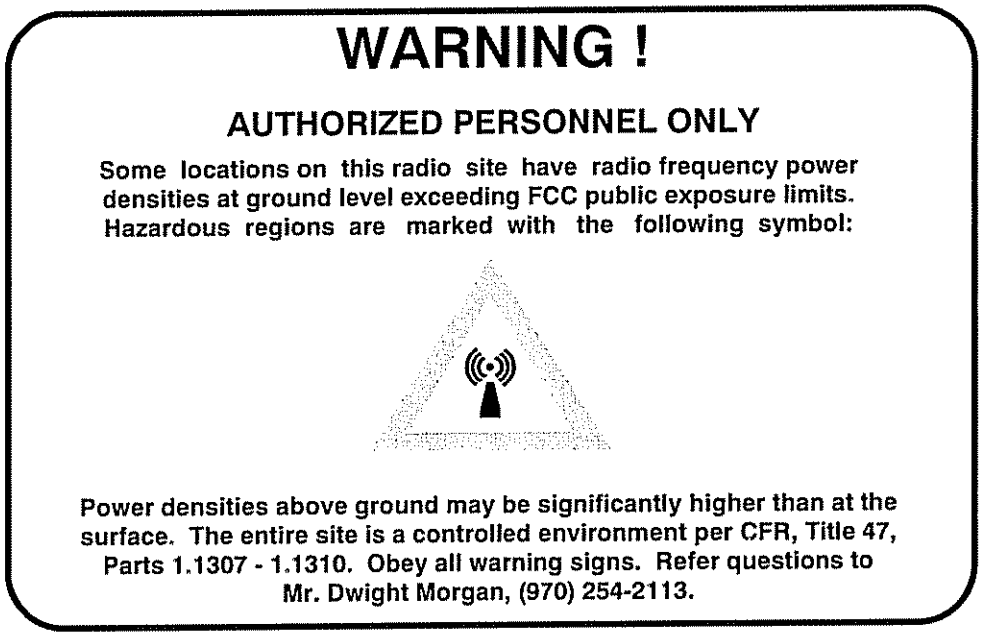


Figure 5 - Warning Sign Inside Gate

2. Install fence on either side of gate. To prevent unauthorized access by motor vehicles, including motorcycles and ATVs, the Users Association should install a fence on either side of the gate from each gate post to a natural boundary, such as the nearest rock ledge. We did not see evidence of unauthorized motor vehicles during the survey, but a fence is still a good preventive measure. This fence should be a galvanized chain link fence, four feet high, with top rail. The existing gate is ideal for this site and requires no modification.

3. Install sign at each tower base. Install the sign shown in Figure 6 at the base of every tower on the site. Posting is optional for the Mesa County tower which was measured and found to be below the public limit even at the tower top. This sign is available from Tessco, (800) 472-7373, P/N 428025, $22.79 each in quantities of 3 or more. Fifteen signs are needed for the towers on site.

4. Install placard inside each equipment shelter. Install the placard shown below in a prominent location inside each equipment shelter or on the outside of the shelter door. Tessco P/N 68796, $12.11 each in quantities of 3 or more. Fifteen signs are needed.

Figure 6 - Caution Sign for Tower Base

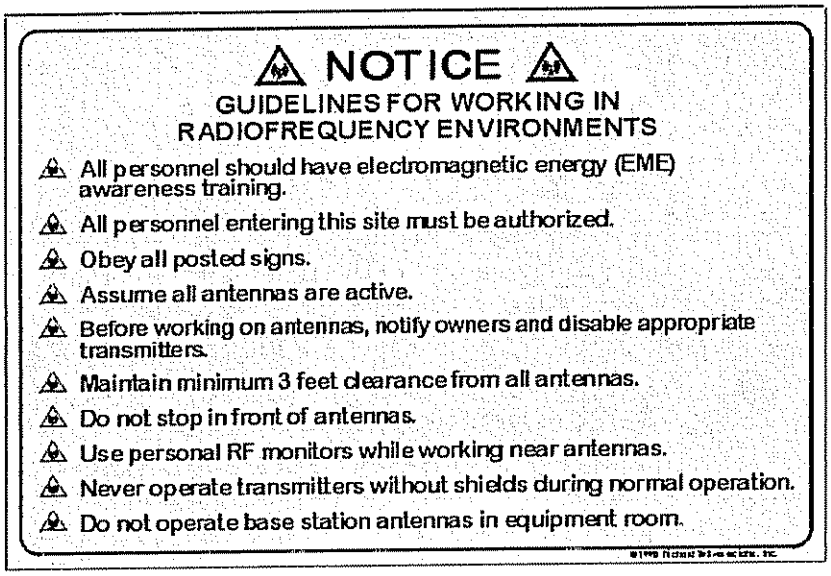


Figure 7 - Placard

5. Install caution signs at selected guy anchors. The following guy anchors re-radiate at sufficient levels to exceed the FCC occupational exposure limit (whole body spatial average):

- Maranatha Old Tower (Trinity), south guy anchor
- Maranatha New Tower (91.3, 93.1), south guy anchor
- Maranatha New Tower (91.3, 93.1), west guy anchor
- Maranatha New Tower (91.3, 93.1), northeast guy anchor

The Users Association or tower owner should install a pair of caution signs on each of these guy anchors (8 signs total). One sign should be attached to each side of the guy anchor. The proper sign is shown in Figure 8. It is available from Tessco, P/N 55241, $22.79 each in quantities of 3 or more. Note that there is no commercially available sign specifying a particular back off distance, but because the levels attenuate rapidly away from the anchor, the "do not touch" sign serves our purpose.

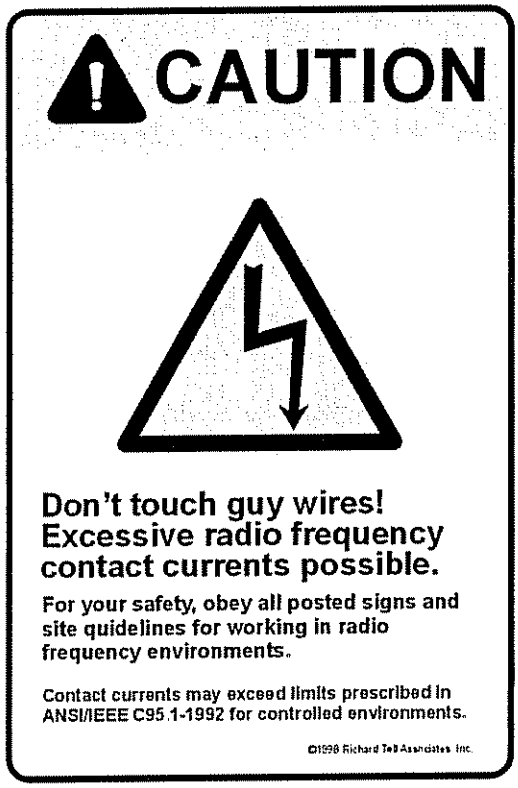


Figure 8 - Caution Sign for Guy Anchors

6. Purchase and/or require personal RF monitors. Tower climbers should always carry a personal RF monitor when working above ground unless all elevations on the tower have been measured and shown to not exceed the FCC occupational limit. Only qualified tower crews with personal RF monitors should be allowed to work on site. Alternatively, the

Black Ridge Communications Site Users Association may purchase a monitor and loan it to tower crews when required. Personal monitors are available from Holaday Instruments and Narda (Nardalert™). Both companies have Internet web sites.

7. Take Transmitters Out of Remote Control. When personnel are working on a tower, it is important that any transmitters that require power reduction be in "local" operation so personnel at the studio cannot raise power while personnel are still on the tower. This problem often occurs despite the best efforts of the station engineer to keep everyone informed.

8. Install sign on gate (optional). Access gates on BLM land generate questions and curiosity when encountered by the public. We find that trespassing and vandalism are minimized (but not eliminated) if a sign is placed on the gate with language similar to the following:

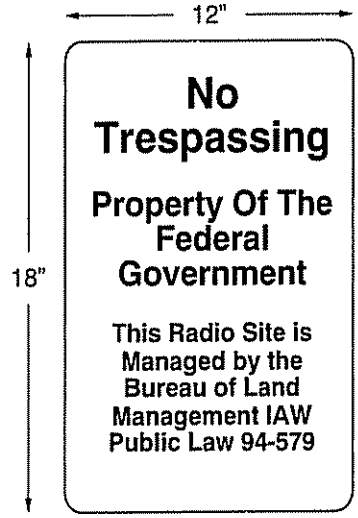


Figure 9 - Optional No Trespassing Sign to be Installed on Gate

Please check with the BLM for approved sign language.

8.0 References

[1] ANSI C95.1-1999, "Safety levels with respect to human exposure to radio frequency electromagnetic fields, 3 kHz to 300 GHz."

[2] OET Bulletin No. 65, FCC, "Evaluating compliance with FCC guidelines for human exposure to radiofrequency electromagnetic fields," Edition 97-01, August 1997.

[3] ANSI C95.3-2002, "Recommended practice for the measurement of hazardous electromagnetic fields - RF and microwave."

[4] ANSI C95.2-1981, "American National Standard radio frequency radiation hazard warning symbol."

[5] Code of Federal Regulation, Title 47, Parts 1.1307 - 1.1310, October 1, 2003.

[6] FCC OET Bulletin 56, 4th Ed., Questions and Answers about Biological Effects and Potential Hazards of Radiofrequency Electromagnetic Fields, August, 1999.

[7] "Black Ridge Communications Site Management Plan," Bureau of Land Management, Grand Junction Field Office, June 21, 2001.

9.0 Engineer's Statement

Black Ridge Communications Site
Grand Junction, CO

This study addressed electromagnetic radiation in the band 300 kHz - 300 GHz. Fields from extremely low frequency (ELF) sources, such as those emitted by 60 Hz electrical distribution lines, were not modeled. Also, induced and contact radiofrequency currents were not measured or modeled.

Tower climbers should carry portable power density meters (e.g., Nardalert™) to verify that transmitter powers have been reduced to safe levels before working in the vicinity of high power transmit antennas.

Measurements were conducted according to procedures described in ANSI Standard C95.3-2002 and the user's manual for the appropriate meter. Our conclusions are limited to those locations actually measured. All measurements were conducted with test equipment assumed to be calibrated and working properly. If new high power transmitters are installed at the site, field strength levels may change. The measurement results reported are valid as of May 28, 2004.

All representations contained herein are true to the best of my knowledge. I am a radio engineer with over twenty years experience. I hold a Bachelor of Science degree in Electrical Engineering from Virginia Tech and a Master of Science degree in Electrical Engineering from Cornell University. I am a corporate officer and stockholder of Pericle Communications Company and a Registered Professional Engineer in the State of Colorado.

Signed this 15th day of August, 2004.

- original signed -

Jay M. Jacobsmeyer, P.E.
President
Pericle Communications Company

Appendix A - Survey Measurements

Radio Frequency Exposure Measurements

Pericle Communications Company

Date:	5/27/04	Engineer:	Jacobsmeyer
Project:	Black Ridge Communications Site		
Test Equipment:	W&G EMR-300	S/N:	B-0053
	Type 25.1 Probe (Shaped)	S/N:	B-0053
Shaped Probe Type	X Controlled		Uncontrolled

No.	Location	Environment †	% of Std.
1	Cumulus tower, south side	C	1%
2	Cumulus tower, north side	C	3%
3	Cumulus building, front door	C	0%
4	Cumulus building, back door	C	1%
5	Qwest building, rear (southwest corner)	C	11%
6	Qwest tower (telephone pole)	C	17%
7	Utility pole guy anchor by Cumulus building	C	4%
8	Utility pole, Cumulus	C	6%
9	Qwest fron door, left side	C	2%
10	Mesa County tower, west side	C	6%
11	Mesa County tower, east side	C	1%
12	Access road, north of Mesa County tower	C	6%
13	Western Pipeline tower, fuel tank west of bldg.	C	2%
14	Western Pipeline tower, front door	C	2%
15	Western pipeline tower, south side	C	1%
16	Mesa County tower platform at top of tower	C	7%
17	Mesa County receive antenna (down hill to south)	C	3%
18	Utility pole south of Mesa County tower	C	2%
19	Fork in road	C	1%
20	ARINC (Delta Airlines) tower	C	1%
21	Amateur radio tower	C	0%
22	Access road	C	0%
23	Access road	C	0%
24	Fork in road	C	0%
25	KLOVE front door	C	1%
26	KLOVE tower	C	0%
27	Channel 11/12-TV tower, south guy anchor	C	5%
28	Channel 11/12-TV tower	C	2%
29	Channel 11/12-TV tower, northeast guy anchor	C	1%
30	Channel 11/12-TV tower, northwest guy anchor	C	1%
31	Channel 11/12-TV front door of shelter	C	0%
32	Fork in road	C	30%
33	Cumulus large tower north guy anchor	C	24%
34	Cumulus small tower north guy anchor	C	56%
35	Cumulus large tower west guy anchor	C	17%
36	Cumulus small tower west guy anchor	C	12%
37	Cumulus large tower southeast guy anchor	C	88%
38	Road	C	1%
39	Channel 4-TV tower southwest guy anchor	C	24%
40	Channel 4-TV tower southeast guy anchor	C	18%
41	Channel 4-TV tower north guy anchor	C	32%
42	Colorado Public Radio tower base	C	8%
43	Colorado Public Radio shelter inside corner	C	6%

† U = uncontrolled environment, C = controlled environment

All measurements are spatial averages.

No.	Location	Environment †	% of Std.
44	Colorado Public Radio front door	C	7%
45	Colorado Public Radio F3 (flag)	C	22%
46	Colorado Public Radio F2 (flag)	C	20%
47	Colorado Public Radio F1 (flag)	C	27%
48	Colorado Public Radio southeast guy anchor*	C	633%
49	Colorado Public Radio north guy anchor*	C	207%
50	Colorado Public Radio southwest guy anchor	C	21%
51	Verizon Wireless tower base	C	1%
52	Verizon Wireless front door	C	0%
53	Tri-State tower base	C	1%
54	Tri-State front door	C	1%
55	Tri-State 2nd shelter front door	C	0%
56	Old Maranatha tower northeast guy anchor	C	46%
57	Old Maranatha tower northwest guy anchor	C	20%
58	Old Maranatha tower south guy anchor	C	181%
59	New Maranatha tower south guy anchor	C	835%
60	New Maranatha tower west guy anchor	C	295%
61	New Maranatha tower northeast guy anchor	C	163%
62	Old Maranatha tower base	C	22%
63	Old Maranatha tower front door	C	2%
64	Satellite dish	C	6%
65	New Maranatha tower base (north face)	C	41%
66	New Maranatha tower front door	C	6%
67	Cumulus small tower, southeast guy anchor	C	40%
68	Communications site (see site map)	C	1%
69	Communications site (see site map)	C	3%
70	Communications site (see site map)	C	7%
71	Communications site (see site map)	C	10%
72	Communications site (see site map)	C	6%
73	Communications site (see site map)	C	11%
74	Communications site (see site map)	C	8%
75	Communications site (see site map)	C	2%
76	Communications site (see site map)	C	1%
77	Communications site (see site map)	C	0%
78	Communications site (see site map)	C	0%
79	Communications site (see site map)	C	0%
80	Communications site (see site map)	C	2%
81	Communications site (see site map)	C	5%
82	Communications site (see site map)	C	3%
83	Communications site (see site map)	C	3%
84	Communications site (see site map)	C	0%
85	Communications site (see site map)	C	1%

† U = uncontrolled environment, C = controlled environment

*This tower was replaced with a new tower soon after the the survey

All measurements are spatial averages.

Appendix B - Analysis for Colorado Public Radio Tower

Colorado Public Radio Tower Exposure Measurements & Analysis

Pericle Communications Company

May 27, 2004

Instrument: W&G EMR300 w/shaped probe (reads as % of FCC occupational)
Engineers: Jacobsmeyer & McGinley
Conditions: Appx. 75° F, sunshine.

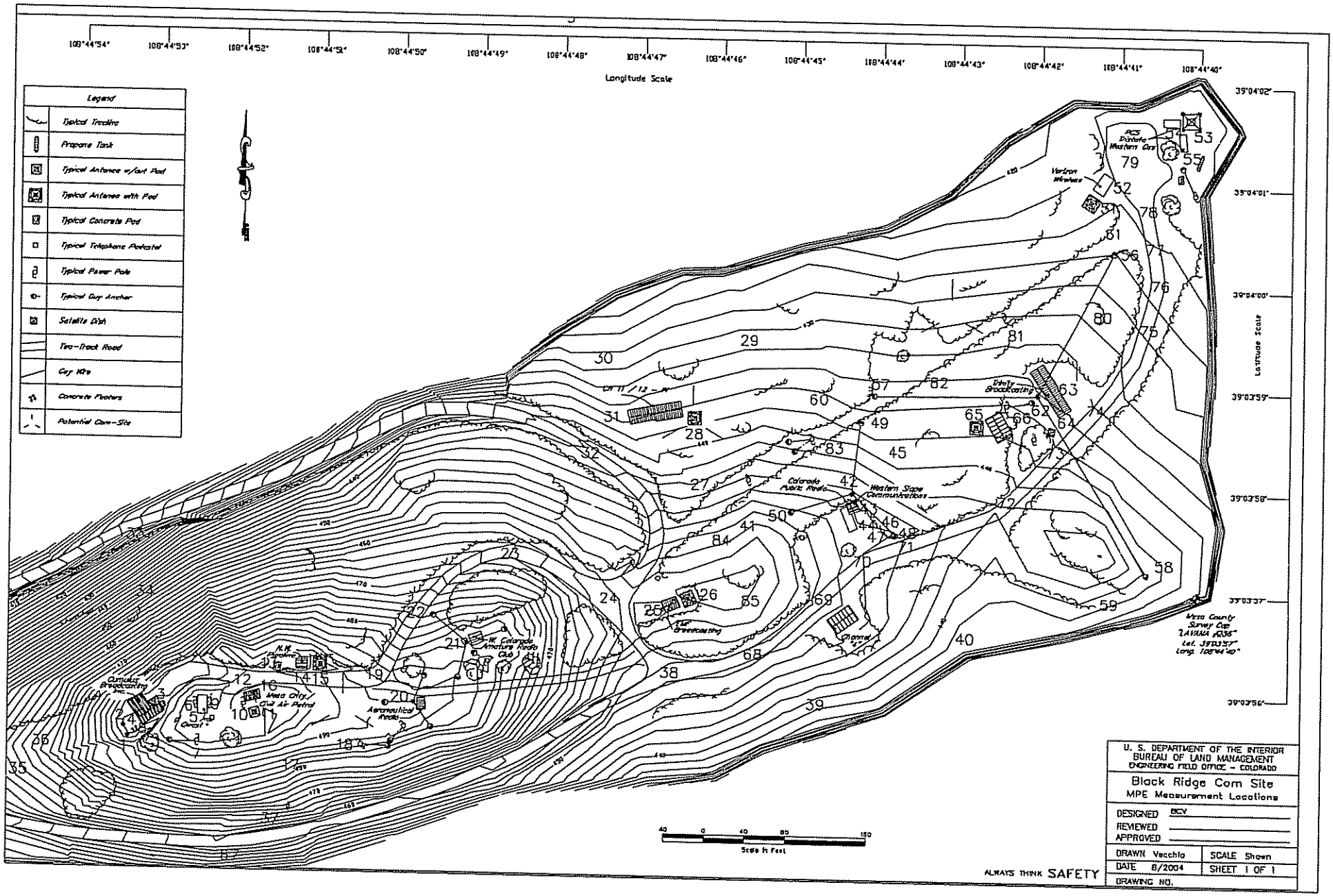
		Readings			Calculations		
Flag	Description	89.5 & 105.3 at Full Power (% of Occupational)	89.5 at 50% Power (% of Occupational)	105.3 at 0% Power (% of Occupational)	89.5 Contribution (% of Occupational)	105.3 Contribution (% of Occupational)	Ambient (% of Occupational)
1	East of tower, see accompanying drawing	22.7	15.7	20.1	14.0	2.6	6.1
2	East of tower, see accompanying drawing	19.3	13.7	10.7	11.0	8.6	0.0
3	East of tower, see accompanying drawing	20.4	13.7	13.5	13.4	6.9	0.0
4	East of tower, see accompanying drawing	24.6	15.0	21.6	19.2	3.0	2.4
5	East of tower, see accompanying drawing	16.9	12.1	14.6	9.7	2.3	4.9
6	New Trinity tower guy anchor*	21.6	23.1	22.4	0.0	0.0	21.6
7	East of tower, see accompanying drawing	11.6	9.7	6.4	3.9	5.3	2.5
8	East of tower, see accompanying drawing	8.1	7.7	2.4	0.9	5.7	1.5
9	East of tower, see accompanying drawing	9.2	9.8	1.8	0.0	7.5	1.8
10	East of tower, see accompanying drawing	9.2	8.0	1.4	2.4	7.8	0.0
11	East of tower, see accompanying drawing	5.9	4.8	1.1	2.1	4.8	0.0

*This location is dominated by guy anchor re-radiation from the New Trinity tower. Contributions from the CPR tower are negligible.

Notes:

1. Measurements taken in this order: CPR tower to observer's left, straight ahead, and to observer's right. Two spatial averages per orientation.
2. Note that normal measurement error and error due to diode effect can result in calculated CPR contribution greater than 100% cumulative measurement.
3. All measurements are spatial averages along a vertical line from ground to head height, 1.8 meters high, in accordance with ANSI C95.3-1992

Appendix C - Site Map with Measurement Locations


108°44'54"
108°44'53"
108°44'52"
108°44'51"
108°44'50"
108°44'49"
108°44'48"
108°44'47"
108°44'46"
108°44'45"
108°44'44"
108°44'43"
108°44'42"
108°44'41"
108°44'40"
Longitude Scale
39°04'02"
39°04'01"
39°04'00"
39°03'59"
39°03'58"
39°03'57"
39°03'56"
Latitude Scale
Legend
Typical Treeline
Propane Tank
Typical Antenna w/Cart Pad
Typical Antenna with Pad
Typical Concrete Pad
Typical Telephone Pedestal
Typical Power Pole
Typical Guy Anchor
Satellite Dish
Two-Track Road
Guy Wire
Concrete Footers
Potential Com-Site
Verizon Wireless
Colorado Public Radio
Western Slope Communications
Mesa County Survey Cap
"LAVANA RD36"
Lat. 39°03'57"
Long. 108°44'40"
Scale in Feet
U. S. DEPARTMENT OF THE INTERIOR
BUREAU OF LAND MANAGEMENT
ENGINEERING FIELD OFFICE - COLORADO
Black Ridge Com Site
MPE Measurement Locations
DESIGNED BCV
REVIEWED
APPROVED
DRAWN Vecchio
SCALE Shown
DATE 6/2004
SHEET 1 OF 1
DRAWING NO.
ALWAYS THINK SAFETY