MPE Survey - Bison Media K296AL-FM

November 4, 2017

For Bison Media

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MPE Survey Bison Media K296AL-FM

1.0 Executive Summary

Bison Media, Inc. recently constructed a 99 Watt FM translator station, K296AL-FM, for its AM station, KZNT-AM in Colorado Springs, Colorado. This translator station operates on 101.1 MHz from a hilltop roughly 5 miles northwest of downtown Colorado Springs. This site is also home to three other FM translators operating with ERPs between 19 and 250 Watts. Pericle Communications Company (*Pericle*) was retained to conduct a Maximum Permissible Exposure (MPE) survey to verify compliance with guidance for maximum permissible exposure to radio frequency power densities found in the Code of Federal Regulations, Title 47, Parts 1.1307 - 1.1310 [5]. All measurements collected during the survey were less than the FCC general population exposure limit of 200 $\mu W/cm^2$ (the most stringent exposure limit). The tower employs a climbing guard to prevent unauthorized personnel from climbing the tower. We can therefore conclude that the site complies with FCC rules for exposure to radio frequency energy.

2.0 Introduction

The transmitter site for the Bison Media translator is located approximately 5 miles northwest of downtown Colorado Springs, near the Glen Eyrie Conference Center. Coordinates are 38° 53' 10" N, 104° 53' 26" W (NAD 83) and the site elevation is roughly 7,250' AMSL. The site location is shown on the map of Figure 1.

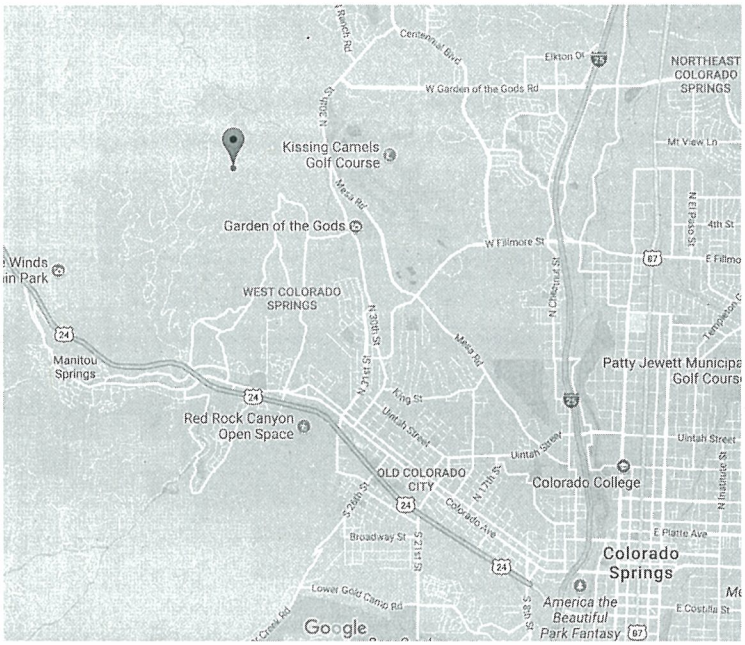


Figure 1 - Transmitter Site Location

Table 1 lists the translator stations operating from this site.

Table 1 - Translator Stations Operating from Site		
Call Sign	**Translator Frequency, MHz**	**ERP, Watts**
K201EC-FM	88.1	99
K234AJ-FM	94.7	19
K248AS-FM	97.5	250
K296AL-FM	101.1	99

The tower and radio shack are shown in Figure 2.

Figure 2 - Tower and Radio Shack

3.0 RF Exposure Standards

The possible health effects associated with exposure to radio frequency energy 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 published radio frequency exposure standards, found in §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). FCC limits are conservative and include a safety factor of roughly 10 for occupational exposure and a safety factor of 50 for general population exposure.

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."

For controlled environments, the FCC sets a limit of 1 mW/cm^2 in the VHF band (30-300 MHz). In the lower UHF band (300 MHz - 1.5 GHz), the FCC limit is a function of frequency and is given by the expression $f/300$ mW/cm^2, where f is the frequency in MHz. Above 1.5 GHz, the controlled environment limit is fixed at 5 mW/cm^2. In the broadcast radio bands (FM and TV) and personal wireless communications bands, the general population limit is exactly a factor of five below the occupational (controlled environment) limit. The FCC exposure limits are plotted as functions of frequency in Figure 3 on the next page.

The human body does not react to 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 working at an FM broadcast site is exposed to a power density of 0.5 mW/cm^2 for a period of four minutes and then enters a field of 1.5 mW/cm^2 for a period of two minutes, the average exposure in the six minute period is 0.83 mW/cm^2 which is below the FCC limit for

controlled environments. In most locations, loiter time is not practical to control and access should be restricted wherever power densities exceed the applicable exposure limit.

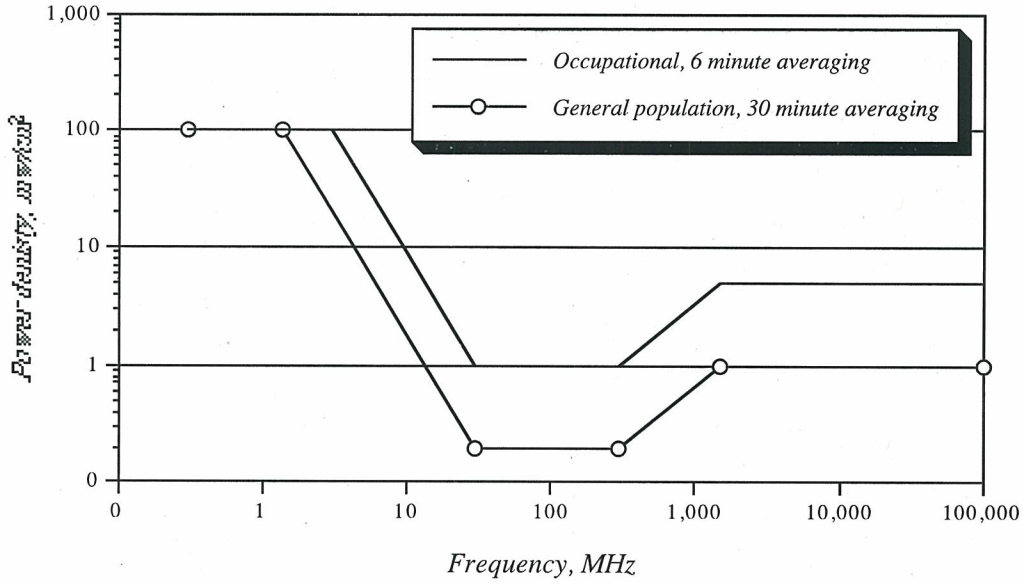


Figure 3 - FCC Exposure Standards
(Plane wave equivalent E-field power density values)

Although other Federal agencies publish RF exposure standards (including 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.

4.0 Ensuring Compliance

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 limit for 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, 2017):

> "(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."

5.0 Measurements

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 2.

Table 2 - Test Equipment Used in Survey

Instrument	Serial Number	Last Calibration (2 yr.)
Wandel & Goltermann (W&G) EMR-300	B-0053	February 24, 2017
Wandel & Goltermann Type 25.1 Probe, 300 kHz - 40 GHz	B-0053	February 24, 2017

Electromagnetic fields on the site are a complex combination of signals from several sources. Reflections from the ground, buildings, tower, and guy wires create standing waves with wide spatial variations. 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 power density 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 used either a vertical straight line method (for levels well below FCC limits) or the zig-zag method (for levels approaching the FCC limit) shown in Figure 4.

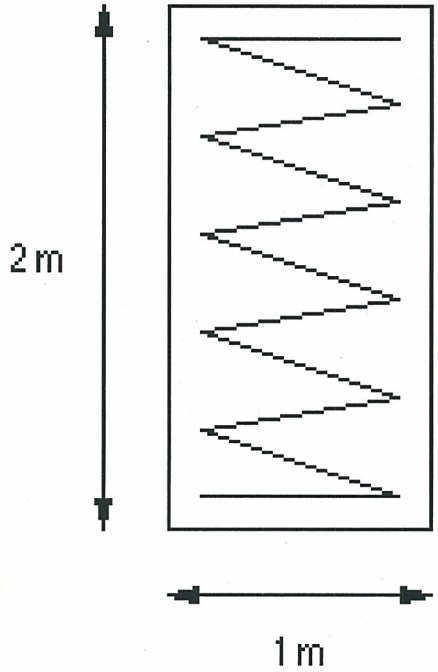


Figure 4 - Zig-zag method for automatic spatial averaging

Measurements are always taken at least 20 cm from reflecting objects in accordance with ANSI C95.3-2002.

The MPE survey was accomplished on November 3, 2017 by James Voige (*Pericle*) with Bison Media chief engineer Lee Roberts present. Numerous measurements were collected both in the immediate vicinity of the tower and farther out to ensure no spatial average "hot spots" were missed. Measurement values (as percent of occupational limit) are shown in Figure 5.

The site is arguably accessible by the public, so the general population limit applies. In the VHF band where the site transmitters operate, the general population limit is a factor of five below the occupational limit. The highest reading on the date of the survey was 9.4% of occupational or 47% of general population, so the site is in compliance with FCC RF exposure guidelines.

Figure 5 - Overhead Satellite View of Site with Measurements Annotated
(Values are Percent of FCC Occupational Limit, 1,000 μW/cm²)

6.0 Conclusions

Measured power densities at the site are well below the general population exposure limit set by the FCC and the tower includes a climbing guard to prevent unauthorized personnel from climbing the tower where they might be exposed to higher power densities than measured on the ground. Therefore, we can conclude that the site complies with FCC rules for exposure to radio frequency energy.

7.0 References

[1] ANSI C95.1-2005, "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 C95.2-1999, "American National Standard radio frequency radiation hazard warning symbol."

[5] Code of Federal Regulations, Title 47, Parts 1.1307 - 1.1310, October 1, 2016.

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

8.0 Engineer's Statement

Glen Eyrie
Colorado Springs, CO

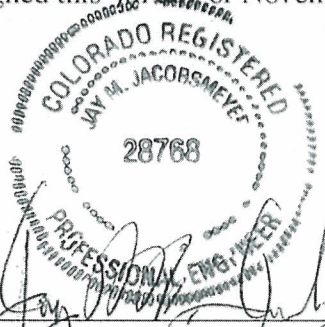
This MPE survey measured electromagnetic radiation in the band 300 kHz - 300 GHz. Fields from extremely low frequency (ELF) sources, such as those emitted by 60 Hz electrical distribution lines, were not modeled. Also, induced and contact radiofrequency currents were not measured or modeled.

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, FCC OET-65 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, ground level power densities may change. The measurement results reported herein are valid as of November 3, 2017.

All representations contained herein are true to the best of my knowledge. I am a radio engineer with over thirty-five 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 4th day of November, 2017.



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