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Review of "An Analysis of the Predicted Radiofrequency Environment in the Vicinity of an Existing Wireless Facility"

by
PierCon Solutions, LLC
On behalf of
80-88 West Main Street, LLC

Prepared for the
Borough of Mendham

Prepared by

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Introduction

In preparation for this report, I read the document titled "An Analysis of the Predicted Radiofrequency Environment in the Vicinity of an Existing Wireless Facility" by Daniel Czeck, RF Engineer, PierCon Solutions, LLC, hereafter referred to as "*The Compliance Report."*

I also read and reviewed the following Federal Documents for the basis of the analysis:

*** The FCC Telecommunications Act of 1996

*** Section 1.1310 in Title 47 of The Code of Federal Regulations (47 CFR §1.1310) entitled "Radiofrequency radiation exposure limits" for the FCC limits on Maximum Permissible Exposure (MPE) for radiofrequency radiation in the bands at which both cellular and PCS systems operate.

*** The FCC Office of Engineering Technology Bulletin (OET Bulletin 65, Edition 97-01, August 1997) entitled "Evaluating Compliance with FCC Guidelines for Human Exposure to Radiofrequency Electromagnetic Fields"

Background

Cellular communication[1] is enabled by allowing a handheld or mobile unit to communicate with an antenna site located near the base station at the center of a cell. Both the handheld and the base station must put out sufficient power so that they can "hear" each other. The handheld units are mobile, frequently in cars, and as the handheld crosses from one cell to another there must be a "handoff" or the call will be dropped creating an interruption in service. Consequently, sufficient power must be available not only to communicate within a cell, but also to maintain communication while traversing from cell to cell.

However, cell towers cannot emit too much power since the aim is to confine the signal to the rough borders of the cell. Consequently, the emissions from cell towers are generally low power and since the power from the cell tower degrades exponentially with distance from the tower site, the level of exposure for people on the ground is considered to be safe if the site is in full compliance with FCC standards. For that reason, when a cell site is to be constructed, it is required to produce a compliance report to show that the standards of the FCC have been met.

[1] The term "cellular" in this report will refer to the systems that give a user wireless access to the Public Switched Telephone Network. In this report, the term cellular does not connote any particular frequency band or technology.

The antenna pattern from the antennas on the cell tower tends towards achieving compliant power levels *at 6 feet above the ground* (the assumed height of a human). In the case that there are buildings close to the antenna site, the analysis should also include the exposure levels at the height of the inhabited spaces. The antennas on the tower are "aimed" to the horizon with a minimal amount of down tilt. The main beam of these antennas resembles a woman's fan, about 120 degrees in the horizontal plane and only several degrees in the vertical direction. All antennas have "side lobes" and it is these that provide power on the ground near the antenna tower site. These side lobes in the vertical direction are frequently 1000 times less power than the main beam.

The Current Project

The Compliance Report was commissioned by the developers of a new residential community to be called The Greens at Mendham Village. There is an existing wireless facility on the grounds of the new development. There are currently four users on the facility – Dish, Verizon, AT&T, and T-Mobile.

When it was constructed, the facility would have been required to meet all FCC regulations concerning emissions. Since its construction, I assume that there have been new antennas and radio modifications to keep the facility up to date, but I do not have that information. What has prompted the current review is the new development to be built in proximity to the existing structure.

From The Compliance Report:

> 80-88 West Main Street, LLC is proposing the construction of a new community adjacent to an existing wireless communications facility located at **82 West Main Street, Mendham, NJ 07945.** The existing wireless communications facility is a 144' 6" stealth design structure and supports several carriers in the facility.

To carry out this assessment, Piercon did the following analysis of the existing state of the facility.

> RF information was collected and analyzed using methodology recommended by the Federal Communication Commission's Office of Engineering and Technology in Bulletin 65 *Evaluating Compliance 1vith* FCC *Guidelines far Human Exposure to Radio Frequenry Electromagnetic Fields,* 97-01 (OET Bulletin 65) and of Richard Tell in his *CI1A 's* EME Design and Operation Considerations far Wireless Antenna Sites November 15, 1996.

Opinion

The results of the analysis from the Compliance Report are summarized below.

An analysis was performed using the technical input parameters shown in Section 2.1 in order to calculate the wireless communications site's worst-case% MPE.

Figure 1 shows a graph of the wireless communication site's % MPE versus its distance from the general public.

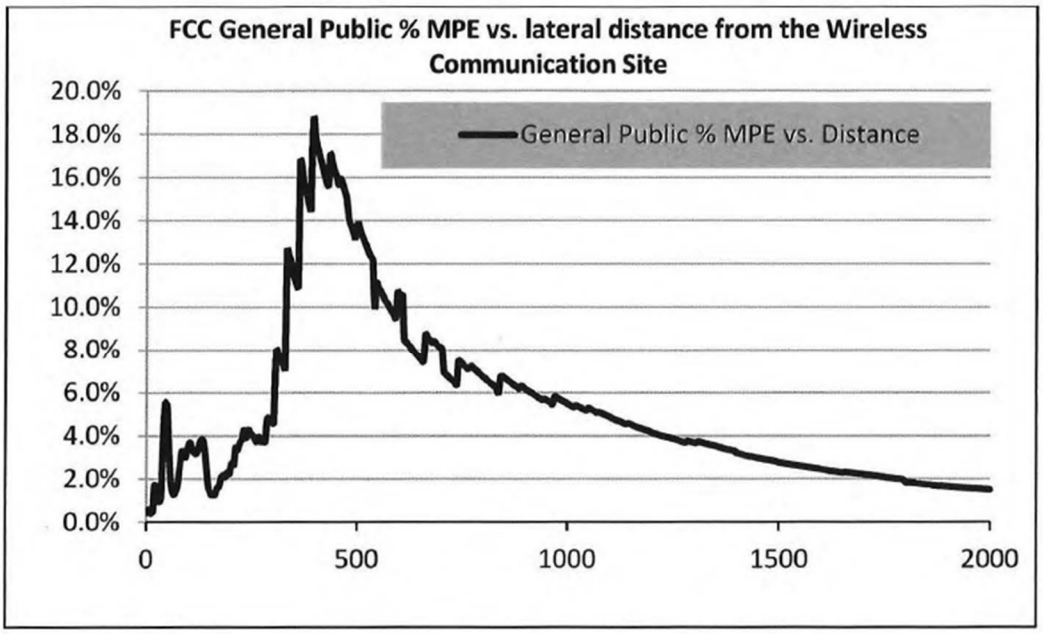


Figure 1 – FCC General Public % MPE vs lateral distance from the existing facility

The worst-case combined general public RF exposures to transmissions was calculated at a height of 29' above ground to account for a 6' tall person standing on the 3rd floor of their home with the window open.

The worst case combined RF exposures to transmissions from existing wireless facility at height of 29' will be:
19.3% of (or 5 times below) the **FCC Maximum Permissible Exposure** limit for General Public. This maximum value was calculated to occur at a distance of **395 feet** from the wireless facility.

3.9% of (or 25 times below) the **New Jersey Maximum Permissible Exposure** Occupational limit. This maximum value was calculated to occur at a distance of **395 feet** from the wireless facility.

An additional study was performed at the closest proposed residence from the facility. This study yielded an exposure limit of **3.7%** of (or 27 times below) the **FCC Maximum Permissible Exposure** limit for the General Public. This calculation was performed at a lateral distance of 90 feet from the wireless facility.

The worst-case combined general public RF exposures to transmissions from the existing wireless facility at a height of 6 feet above ground level is:
5.21% of (or 19 times below) the **FCC Maximum Permissible Exposure** limit for General Public. This maximum value was calculated to occur at a distance of **565 feet** from the wireless facility.

1.04% of (or 96 times below) the **New Jersey Maximum Permissible Exposure** Occupational limit. This maximum value was calculated to occur at a distance of **565 feet** from the wireless facility.

An additional study was performed at the closest distance to the property line from the facility which yielded an exposure limit of **3.9%** of (or 25 times below) the **FCC Maximum Permissible Exposure** limit for the General Public. This calculation was performed at a lateral distance of 60 feet from the wireless facility.

It is my opinion that these studies were conducted properly and in accordance with FCC Bulletin OET-65.

With the condition that all the equipment used in the facility is FCC compliant it is my opinion that the site will remain in compliance when the new development is constructed.

Appendix A

Compliance Analysis

FCC Office of Engineering and Technology Bulletin 65 ("OET Bulletin 65") provides guidelines for mathematical models to calculate the RF levels at various points around transmitting antennas. At street-level around an antenna site (in what is called the "far field" of the antennas), the RF levels are directly proportional to the total antenna input power and the relative antenna gain in the downward direction of interest – and the levels are otherwise inversely proportional to the square of the straight-line distance to the antenna. Conservative calculations also assume the potential RF exposure is enhanced by reflection of the RF energy from the intervening ground.

The calculations below will assume a 100% "perfect", mirror-like reflection, the worst-case approach.

The formula for **street-level compliance assessment** for any given antenna operation is as follows:

$$MPE\% = (100 * Chans * TxPower * 10^{(Gmax-Vdisc/10)} * 4) / (MPE * 4\square * R2)$$

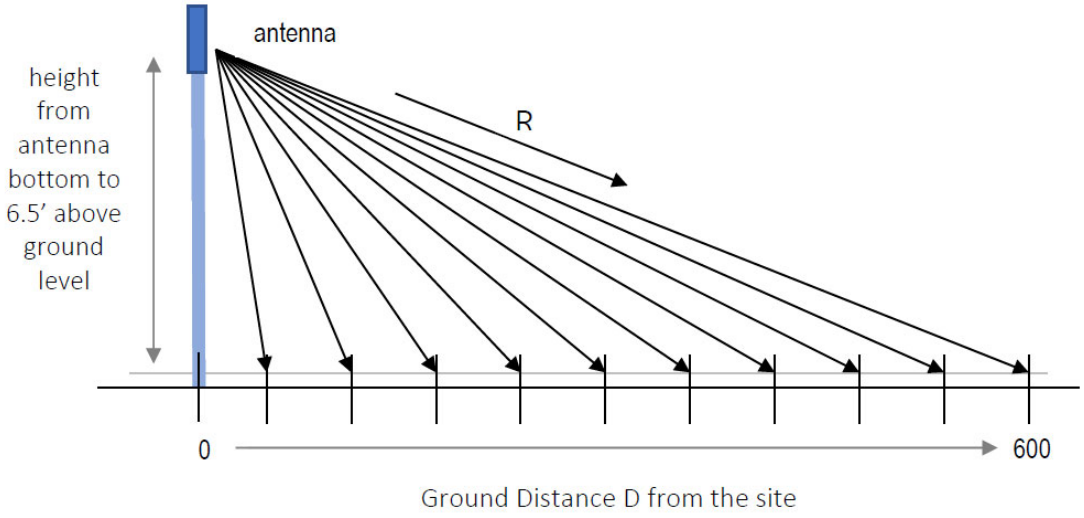
where

MPE%	=	RF level, expressed as a percentage of the MPE limit applicable to continuous exposure of the general public
100	=	factor to convert the raw result to a percentage

Chans	=	maximum number of RF channels per sector
TxPower	=	maximum transmitter power per channel, in milliwatts
$10^{(GmaxVdisc/10)}$	=	numeric equivalent of the relative antenna gain in the downward direction of interest; data on the antenna vertical-plane pattern is taken from manufacturer specifications
4	=	factor to account for a 100-percent-efficient energy reflection from the intervening ground, and the squared relationship between RF field strength and power density ($2^2 = 4$)
MPE	=	FCC general population MPE limit
R	=	straight-line distance from the RF source to the point of interest, centimeters

The MPE% calculations are performed out to a distance of 600 feet from the facility to points 6.5 feet (approximately two meters, the FCC- recommended standing height) off the ground, as illustrated in Figure 2 below.

Figure 2. Ground-Level MPE% Calculation Geometry



It is the case that the farther away one is from an antenna, the lower the RF level. The results of MPE% calculations fairly close to the site will reflect the variations in the vertical- plane antenna pattern as well as the variation in straight -line distance to the antennas. Therefore, RF levels may actually increase slightly with increasing distance within the range of zero to 600 feet from the site.

As the distance approaches 600 feet and beyond, though, the antenna pattern factor becomes less significant, the RF levels become primarily distance - controlled, and as a result the RF levels generally decrease with increasing distance.

Street-level FCC compliance for a collocated antenna site is assessed in the following manner. At each distance point along the ground, an MPE% calculation is made for each antenna operation, and the sum of the individual MPE% contributions at each point is compared to 100 percent, the normalized reference for compliance with the MPE limit.

We refer to the sum of the individual MPE% contributions as "total MPE%", and any calculated total MPE% result exceeding 100 percent is, by definition, higher than the FCC limit and represents non-compliance and a need to mitigate the potential exposure. If all results are consistently below 100 percent, on the other hand, that set of results serves as a clear and sufficient demonstration of compliance with the MPE limit.

Note that according to the FCC, when directional antennas and sectorized coverage arrangements are used, the compliance assessments are based on the RF effect of a single (facing) sector, as the RF effects of directional antennas facing generally away from the point of interest are insignificant.

The following conservative methodology and assumptions are incorporated into the MPE% calculations on a general basis:

1. The antennas are assumed to be operating continuously at maximum power and maximum channel capacity.
2. The power-attenuation effects of shadowing or other obstructions to the line-of-sight path from the antenna to the point of interest are ignored.
3. The calculations intentionally minimize the distance factor (R) by assuming a 6'6" human and performing the calculations from the bottom (rather than the centerline) of each operator's lowest-mounted antenna, as applicable.
4. The potential RF exposure at **ground level** is assumed to be 100-percent enhanced (increased) via a "perfect" field reflection from the intervening ground.

The net result of these assumptions is to significantly overstate the calculated RF exposure levels relative to the levels that will actually occur – and the purpose of this conservatism is to allow very "safe" conclusions about compliance.