



# **PINNACLE TELECOM GROUP**

*Professional and Technical Services*

## **ANTENNA SITE FCC RF COMPLIANCE ASSESSMENT AND REPORT**

### **HOMELAND TOWERS, LLC**

**SITE "NY171"  
50 VINEYARD ROAD  
PHILLIPSTOWN, NY**

**AUGUST 18, 2017**

# CONTENTS

<b>INTRODUCTION AND SUMMARY</b>	<b>3</b>
<b>ANTENNA AND TRANSMISSION DATA</b>	<b>5</b>
<b>COMPLIANCE ANALYSIS</b>	<b>8</b>
<b>COMPLIANCE CONCLUSION</b>	<b>13</b>
<b>CERTIFICATION</b>	<b>14</b>

**APPENDIX A. BACKGROUND ON THE FCC MPE LIMIT**

**APPENDIX B. SUMMARY OF EXPERT QUALIFICATIONS**

## **INTRODUCTION AND SUMMARY**

At the request of Homeland Towers, LLC, Pinnacle Telecom Group has performed an independent expert assessment of radiofrequency (RF) levels and related FCC compliance for wireless antenna operations on a proposed 180-foot monopole proposed at 50 Vineyard Road in Phillipstown, NY.

Homeland Towers refers to the prospective site as “NY171”, and the proposed pole will accommodate the directional panel antennas of up to four wireless carriers. At this time, Verizon Wireless plans to occupy the highest antenna mounting position on the pole and the Putnam County whip antenna is proposed at 178 feet.

The FCC requires wireless antenna operators to perform an assessment of the RF levels from all the transmitting antennas at a site whenever antenna operations are added or modified, and ensure compliance with the FCC Maximum Permissible Exposure (MPE) limit in areas of unrestricted public access, i.e., at street level around the site.

In this case, the compliance assessment will include the RF effects of a worst-case hypothetical collocation of four wireless carriers' antennas. By worst case, we mean that the carriers whose maximum capacity relates to higher emitted power levels will be hypothetically assumed to occupy the lower mounting positions on the monopole, thus matching higher power and smaller distances to ground-level around the site.

The analysis will conservatively assume all the wireless carriers are operating at maximum capacity and maximum power in each of their FCC-licensed frequency bands. With that extreme degree of conservatism incorporated in the analysis, we can have great confidence that the actual RF effects from any combination of wireless operators, however they might actually be positioned on the pole, would be in compliance with the FCC's MPE limit.

This assessment of antenna site compliance is based on the FCC limit for general population “maximum permissible exposure” (MPE), a limit established as safe for continuous exposure to RF fields by humans of either sex, all ages and sizes, and under all conditions.

The result of an FCC compliance assessment can be described in layman’s terms by expressing the calculated RF levels as simple percentages of the FCC MPE limit. In that way, the figure 100 percent serves as the reference for compliance, and calculated RF levels below 100 percent indicate compliance with the MPE limit. An equivalent way to describe the calculated results is to relate them to a “times-below-the-limit” factor. Here, we will apply both descriptions.

The result of the FCC compliance assessment in this case is as follows:

- At street level around the site, the conservatively calculated maximum RF level caused by the combination of the wireless carriers’ panel antenna operations is 0.7955 percent of the FCC general population MPE limit, well below the 100-percent reference for compliance. In other words, even with calculations designed to significantly overstate the RF levels versus those that could actually occur at the site, the worst-case calculated RF level in this case is still more than 125 times below the limit defined by the federal government as safe for continuous exposure of the general public.
- A supplemental analysis of the RF levels at the nearest residence (approximately 760 feet away) yields a worst-case result of 0.0888 percent of the FCC general population MPE limit – also well below the 100-percent reference for compliance.
- The results of the calculations provide a clear demonstration that the RF levels from as many as four wireless carriers, even under worst-case collocation circumstances, would satisfy the FCC requirement for controlling potential human exposure to RF fields and that the facility will be in compliance at any distance. Moreover, because of the conservative methodology and assumptions applied in this analysis, RF levels actually

caused by any combination of wireless operators' antenna operations at this site will be even less significant than the calculation results here indicate.

The remainder of this report provides the following:

- ❑ relevant technical data on the parameters for the four wireless carriers, as well as on the Putnam County antenna operations;
- ❑ a description of the applicable FCC mathematical model for assessing compliance with the MPE limit, and application of the relevant technical data to that model; and
- ❑ analysis of the results of the calculations, and the compliance conclusion for the proposed site.

In addition, two Appendices are included. Appendix A provides background on the FCC MPE limit, along with a list of key references. Appendix B provides a summary of the qualifications of the author of this report.

## **ANTENNA AND TRANSMISSION DATA**

As described, the proposed 180-foot pole will be able to accommodate as many as four wireless carriers' antennas, along with antenna operations by Putnam County. Verizon Wireless proposed to occupy the highest mounting position on the pole, and this analysis will include an assumption of "worst-case" collocation by three other wireless carriers – AT&T, T-Mobile and Sprint.

The worst-case collocation methodology basically involves taking the carriers with the most available spectrum and the opportunity for higher power levels and hypothetically positioning them at the lower points on the monopole – thus matching the most power with the shorter distances to the ground.

Typically, the vertical spacing between different wireless carriers' antennas on a pole is 10 feet. In this case, the Verizon Wireless antennas will have an antenna centerline of 174 feet, and we will assign antenna centerline heights to the three other assumed wireless collocators at 164 feet, 154 feet and 144 feet.

The transmission parameters for each of the wireless carriers are described below.

Verizon Wireless is licensed to operate in the 700, 850, 1900 and 2100 MHz frequency bands. In the 700 MHz band, Verizon uses as many as two 60-watt channels per antenna sector. In the 850 MHz band, Verizon uses as many as eight 20-watt channels per antenna sector. In the 1900 MHz band, Verizon uses seven 16-watt channels and two 60-watt channels per antenna sector. In the 2100 MHz band, Verizon uses two 60-watt channels per sector.

AT&T is licensed to operate in the 700, 850, 1900 and 2300 MHz frequency bands. In the 700 MHz band, AT&T uses two RF channels per antenna sector and a maximum transmitter power of 40 watts. In the 850 MHz band, AT&T uses four 20-watt channels per sector. In the 1900 MHz band, AT&T uses two 20-watt channels and one 60-watt channel per sector. In the 2300 MHz band, AT&T uses two 50-watt channels per sector.

T-Mobile is licensed to operate in the 700 MHz, 1900 MHz and 2100 MHz frequency bands. In the 700 MHz band, T-Mobile uses one 40-watt channel per sector. In the 1900 MHz band, T-Mobile uses four 20-watt channels and one 40-watt channel per sector. In the 2100 MHz band, T-Mobile uses one 80-watt channel and two 40-watt channels per sector.

Sprint is licensed to operate in the 860, 1900 and 2500 MHz frequency bands. In the 860 MHz band, Sprint uses two 40-watt channels per antenna sector. In the 1900 MHz band, Sprint uses two 20-watt channels and two 40-watt channels per sector. In the 2500 MHz band, Sprint uses four 5-watt channels and four 10-watt channels per sector.

Based on the overall available power levels, we will hypothetically assign the mounting heights (centerlines of the antennas) as follows:

- Verizon: 174 feet
- Sprint: 164 feet

- T-Mobile: 154 feet
- AT&T: 144 feet

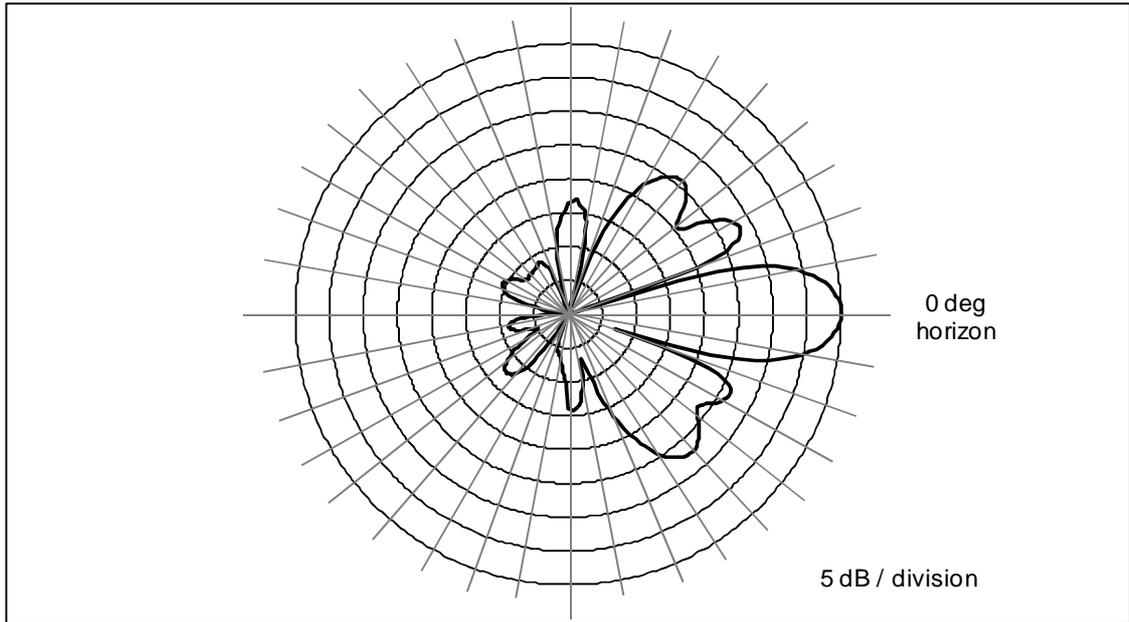
The Putnam County whip antenna – a Sinclair model SC476-HF1LDF, with a frequency range of 746-869 MHz and a maximum gain of 6.5 dBd – is proposed to be mounted at 178 feet on the pole. The transmitter power level has not been specified, but in our analysis we will conservatively apply the manufacturer-specified maximum antenna input power of 500 watts, which will grossly overstate the RF effects of this operation.

The area below the antennas, at street level, is of interest in terms of potential “uncontrolled” exposure of the general public, so the antenna’s vertical-plane emission characteristic is used in the calculations, as it is a key determinant in the relative level of RF emissions in the “downward” direction.

By way of illustration, Figure 1 on the next page shows the vertical-plane pattern of a typical 1900 MHz panel antenna. The antenna is effectively pointed at the three o’clock position (the horizon) and the pattern at different angles is described using decibel units. The use of a decibel scale incidentally visually understates the relative directionality characteristic of the antenna in the vertical plane. Where the antenna pattern reads 20 dB, the relative RF energy emitted at the corresponding downward angle is 1/100<sup>th</sup> of the maximum that occurs in the main beam (at 0 degrees); at 30 dB, the energy is 1/1000<sup>th</sup> of the maximum.

Note that the automatic pattern-scaling feature of our internal software may skew side-by-side visual comparisons of different antenna models, or even different parties’ depictions of the same antenna model.

Figure 1. 1900 MHz Directional Panel Antenna – Vertical-plane Pattern



## COMPLIANCE ANALYSIS

FCC Office of Engineering and Technology Bulletin 65 (“OET Bulletin 65”) provides guidelines for mathematical models to calculate potential RF exposure levels at various points around transmitting antennas.

Around an antenna site at ground level (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 (focusing effect) 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. Our calculations will assume a 100% “perfect”, mirror-like reflection, which is the absolute worst-case approach.

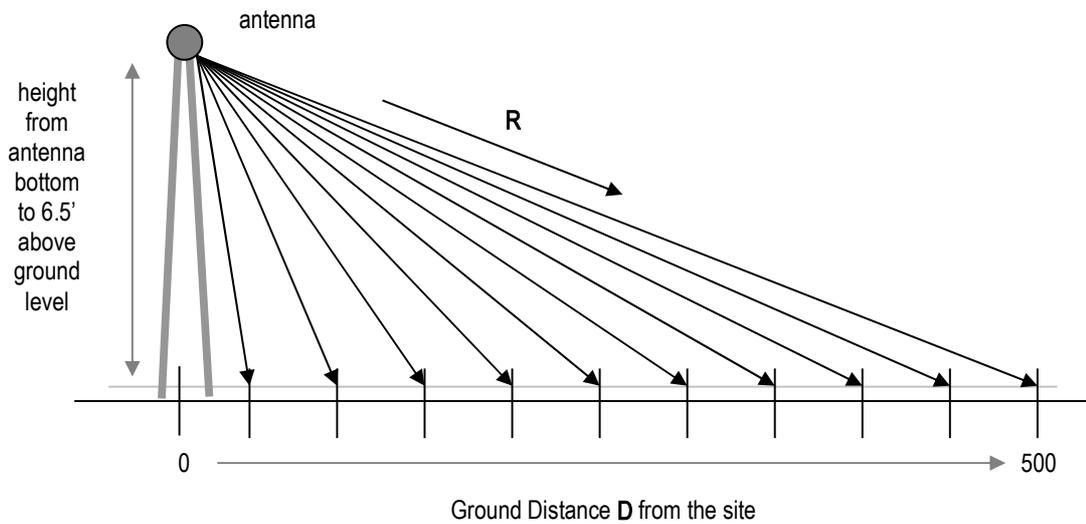
The formula for ground-level MPE compliance assessment of any given wireless antenna operation is as follows:

$$\text{MPE\%} = (100 * \text{TxPower} * 10^{(\text{Gmax}-\text{Vdisc})/10} * 4) / (\text{MPE} * 4\pi * \text{R}^2)$$

where

MPE%	=	RF level, expressed as a percentage of the FCC MPE limit applicable to continuous exposure of the general public
100	=	factor to convert the raw result to a percentage
TxPower	=	maximum net power into antenna sector, in milliwatts, a function of the number of channels per sector, the transmitter power per channel, and line loss
$10^{(G_{\max}-V_{\text{disc}})/10}$	=	numeric equivalent of the relative antenna gain in the direction of interest downward toward ground level
4	=	factor to account for a 100-percent-efficient energy reflection from the 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 normally performed out to a distance of 500 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 on the next page.



**Figure 2. Street-level MPE% Calculation Geometry**

It is popularly thought that the farther away one is from an antenna, the lower the RF level – which is generally but not universally correct. 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 500 feet from the site. As the distance approaches 500 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. In any case, the RF levels more than 500 feet from a wireless antenna site are well understood to be sufficiently low and always in compliance.

FCC compliance for a collocated antenna site is assessed in the following manner. At each distance point away from the site, an MPE% calculation is made for each antenna operation, including the individual components of dual-band operations. Then, at each point, the sum of the individual MPE% contributions is compared to 100 percent, where the latter figure serves as a 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 limit and represent non-compliance and a need to take action to mitigate the RF levels. If all results are below 100 percent, that indicates compliance with the federal regulations on controlling exposure.

Note that 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 RF power – i.e., with the maximum number of channels and the maximum transmitter power per channel.
2. The power-attenuation effects of any shadowing or visual obstruction to a line-of-sight path from the antennas to the points of interest at ground level 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 the antenna.
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.

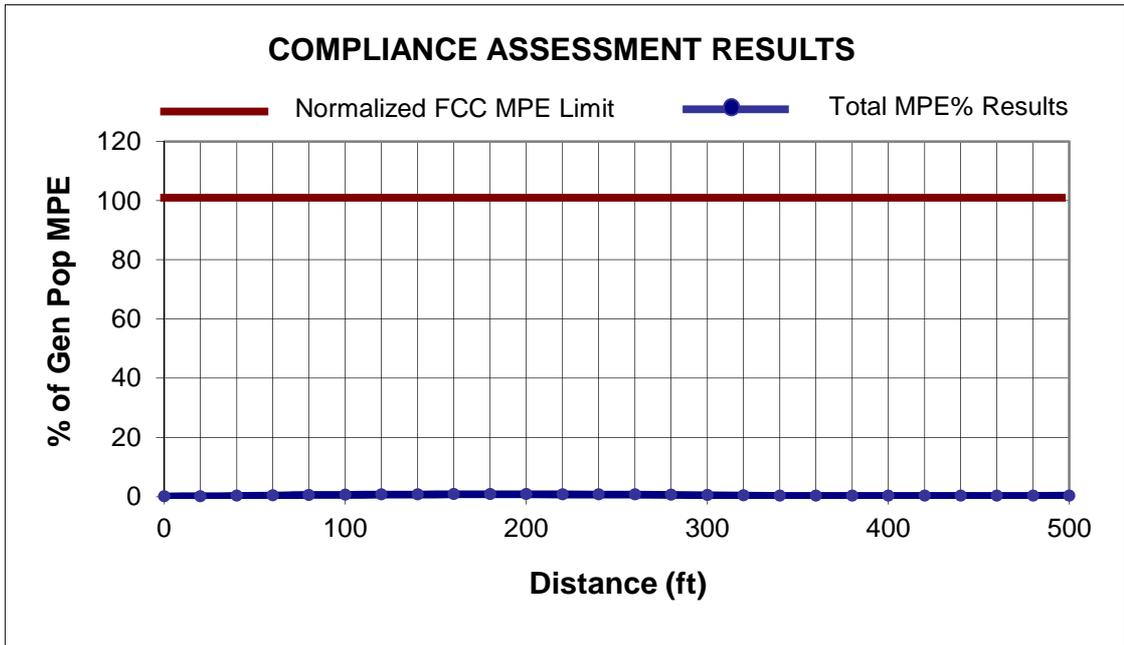
The net result of these assumptions is to intentionally and significantly overstate the calculated RF levels relative to the RF levels that will actually occur – and the purpose of this conservatism is to allow “safe-side” conclusions about compliance with the MPE limit.

The table on the following page provides the results of the MPE% calculations for each operator, with the worst-case overall result highlighted in bold in the last column.

Ground Distance (ft)	Verizon MPE%	Sprint MPE%	T-Mobile MPE%	AT&T MPE%	Putnam County MPE%	Total MPE%
0	0.0369	0.0024	0.0010	0.0273	0.0003	0.0679
20	0.0432	0.0049	0.0011	0.0457	0.0158	0.1107
40	0.0846	0.0034	0.0017	0.1063	0.0538	0.2498
60	0.1503	0.0088	0.0029	0.1310	0.0898	0.3828
80	0.1934	0.0105	0.0187	0.2079	0.1042	0.5347
100	0.2059	0.0129	0.0305	0.2369	0.0770	0.5632
120	0.2483	0.0060	0.0157	0.3695	0.0363	0.6758
140	0.3642	0.0204	0.0240	0.2495	0.0030	0.6611
160	0.3765	0.0213	0.0992	0.2692	0.0145	0.7807
180	0.2896	0.0292	0.1627	0.2660	0.0480	<b>0.7955</b>
200	0.2259	0.0257	0.1938	0.2195	0.0913	0.7562
220	0.2113	0.0377	0.1375	0.2167	0.1291	0.7323
240	0.2156	0.0341	0.0330	0.2632	0.1388	0.6847
260	0.2200	0.0181	0.0199	0.3008	0.1334	0.6922
280	0.2083	0.0139	0.0257	0.2380	0.1173	0.6032
300	0.1746	0.0211	0.0389	0.1126	0.0901	0.4373
320	0.1397	0.0199	0.0416	0.0658	0.0711	0.3381
340	0.1211	0.0139	0.0417	0.0481	0.0417	0.2665
360	0.1059	0.0114	0.0436	0.0512	0.0282	0.2403
380	0.0888	0.0231	0.0450	0.0632	0.0171	0.2372
400	0.0820	0.0370	0.0434	0.0731	0.0099	0.2454
420	0.0829	0.0439	0.0387	0.0767	0.0067	0.2489
440	0.0764	0.0403	0.0355	0.0770	0.0075	0.2367
460	0.0842	0.0372	0.0400	0.0800	0.0126	0.2540
480	0.0952	0.0283	0.0370	0.0739	0.0222	0.2566
500	0.1043	0.0214	0.0516	0.0844	0.0360	0.2977

As indicated, the overall worst-case calculated result is 0.7955 percent of the FCC general population MPE limit – well below the 100-percent reference for compliance, particularly given the significant conservatism incorporated in the analysis.

A graph of the overall calculation results, shown on the next page, provides perhaps a clearer *visual* illustration of the relative compliance of the calculated RF levels. The line representing the overall MPE% results barely rises above the graph’s baseline, and shows a consistent, comfortable margin to the FCC MPE limit.



### COMPLIANCE CONCLUSION

The FCC MPE limit has been constructed in such a manner that continuous human exposure to RF fields up to and including 100 percent of the MPE limit is acceptable and completely safe.

The conservatively calculated maximum RF effect at street level from the assumed worst-case collocation of as many as four wireless carriers is 0.7955 percent of the FCC general population MPE limit. In other words, even with an extremely conservative analysis intended to dramatically overstate the RF effects of any wireless collocation scenario at the site, the calculated worst-case RF level is still more than 125 times below the FCC MPE limit.

The results of the calculations indicate clear compliance with the FCC regulations and the related MPE limit, even for a worst-case collocation scenario the facility will be in compliance at any distance.

Because of the conservative calculation methodology and operational assumptions applied in this analysis, the RF levels actually caused by any more realistic collocation of antennas at this site would be even less significant than the calculation results here indicate, and compliance would be achieved by an even larger margin.

## CERTIFICATION

The undersigned certifies as follows:

1. I have read and fully understand the FCC regulations concerning RF safety and the control of human exposure to RF fields (47 CFR 1.1301 *et seq*).
2. To the best of my knowledge, the statements and information disclosed in this report are true, complete and accurate.
3. The analysis of site RF compliance provided herein is consistent with the applicable FCC regulations, additional guidelines issued by the FCC, and industry practice.
4. The results of the analysis demonstrate compliance with the FCC regulations and limit concerning the control of potential human exposure to the RF emissions from antennas.



---

Daniel Penesso  
Director- RF Engineering  
Pinnacle Telecom Group, LLC

8/18/17

---

Date

## Appendix A. BACKGROUND ON THE FCC MPE LIMIT

As directed by the Telecommunications Act of 1996, the FCC has established limits for maximum continuous human exposure to RF fields.

The FCC maximum permissible exposure (MPE) limits represent the consensus of federal agencies and independent experts responsible for RF safety matters. Those agencies include the National Council on Radiation Protection and Measurements (NCRP), the Occupational Safety and Health Administration (OSHA), the National Institute for Occupational Safety and Health (NIOSH), the American National Standards Institute (ANSI), the Environmental Protection Agency (EPA), and the Food and Drug Administration (FDA). In formulating its guidelines, the FCC also considered input from the public and technical community – notably the Institute of Electrical and Electronics Engineers (IEEE).

The FCC's RF exposure guidelines are incorporated in Section 1.301 *et seq* of its Rules and Regulations (47 CFR 1.1301-1.1310). Those guidelines specify MPE limits for both occupational and general population exposure.

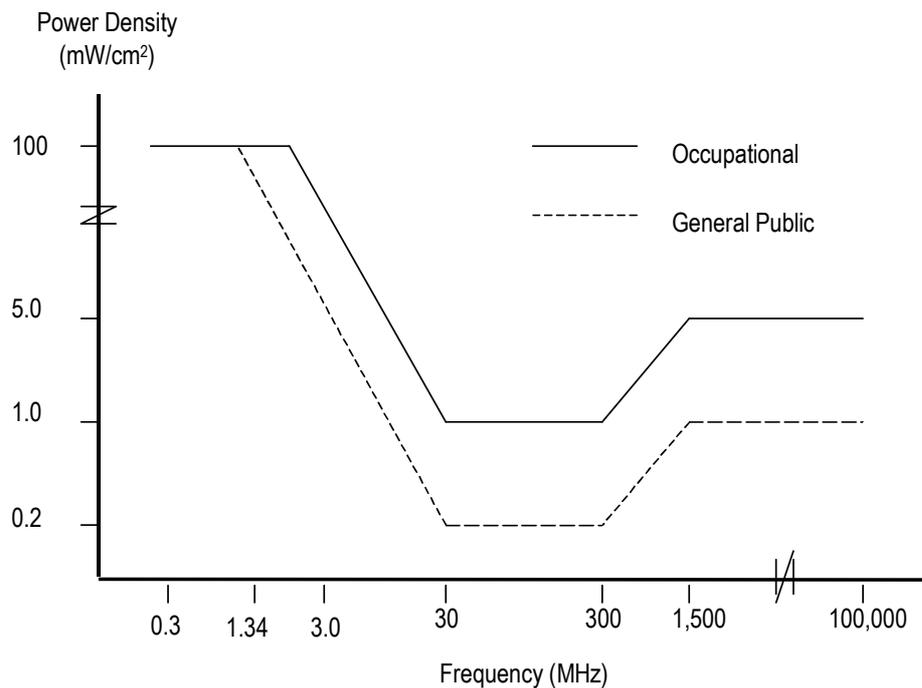
The specified continuous exposure MPE limits are based on known variation of human body susceptibility in different frequency ranges, and a Specific Absorption Rate (SAR) of 4 watts per kilogram, which is universally considered to accurately represent human capacity to dissipate incident RF energy (in the form of heat). The occupational MPE guidelines incorporate a safety factor of 10 or greater with respect to RF levels known to represent a health hazard, and an additional safety factor of five is applied to the MPE limits for general population exposure. Thus, the general population MPE limit has a built-in safety factor of more than 50. The limits were constructed to appropriately protect humans of both sexes and all ages and sizes and under all conditions – and continuous exposure at levels equal to or below the applicable MPE limits is considered to result in no adverse health effects or even health risk.

The reason for *two* tiers of MPE limits is based on an understanding and assumption that members of the general public are unlikely to have had appropriate RF safety training and may not be aware of the exposures they receive; occupational exposure in controlled environments, on the other hand, is assumed to involve individuals who have had such training, are aware of the exposures, and know how to maintain a safe personal work environment.

The FCC's RF exposure limits are expressed in two equivalent forms, using alternative units of field strength (expressed in volts per meter, or V/m), and power density (expressed in milliwatts per square centimeter, or mW/cm<sup>2</sup>). The table on the next page lists the FCC limits for both occupational and general population exposures, using the mW/cm<sup>2</sup> reference, for the different radio frequency ranges.

Frequency Range (F) (MHz)	Occupational Exposure (mW/cm <sup>2</sup> )	General Public Exposure (mW/cm <sup>2</sup> )
0.3 - 1.34	100	100
1.34 - 3.0	100	$180 / F^2$
3.0 - 30	$900 / F^2$	$180 / F^2$
30 - 300	1.0	0.2
300 - 1,500	$F / 300$	$F / 1500$
1,500 - 100,000	5.0	1.0

The diagram below provides a graphical illustration of both the FCC's occupational and general population MPE limits.



Because the FCC's RF exposure limits are frequency-shaped, the exact MPE limits applicable to the instant situation depend on the frequency range used by the systems of interest.

The most appropriate method of determining RF compliance is to calculate the RF power density attributable to a particular system and compare that to the MPE limit applicable to the operating frequency in question. The result is usually expressed as a percentage of the MPE limit.

For potential exposure from multiple systems, the respective percentages of the MPE limits are added, and the total percentage compared to 100 (percent of the limit). If the result is less than 100, the total exposure is in compliance; if it is more than 100, exposure mitigation measures are necessary to achieve compliance.

Note that the FCC “categorically excludes” all “non-building-mounted” wireless antenna operations whose mounting heights are more than 10 meters (32.8 feet) from the routine requirement to demonstrate compliance with the MPE limit, because such operations “are deemed, individually and cumulatively, to have no significant effect on the human environment”. The categorical exclusion also applies to *all* point-to-point antenna operations, regardless of the type of structure they’re mounted on. Note that the FCC considers any facility qualifying for the categorical exclusion to be automatically in compliance.

### ***FCC References on RF Compliance***

47 CFR, FCC Rules and Regulations, Part 1 (Practice and Procedure), Section 1.1310 (Radiofrequency radiation exposure limits).

FCC Second Memorandum Opinion and Order and Notice of Proposed Rulemaking (FCC 97-303), *In the Matter of Procedures for Reviewing Requests for Relief From State and Local Regulations Pursuant to Section 332(c)(7)(B)(v) of the Communications Act of 1934 (WT Docket 97-192), Guidelines for Evaluating the Environmental Effects of Radiofrequency Radiation (ET Docket 93-62), and Petition for Rulemaking of the Cellular Telecommunications Industry Association Concerning Amendment of the Commission's Rules to Preempt State and Local Regulation of Commercial Mobile Radio Service Transmitting Facilities*, released August 25, 1997.

FCC First Memorandum Opinion and Order, ET Docket 93-62, *In the Matter of Guidelines for Evaluating the Environmental Effects of Radiofrequency Radiation*, released December 24, 1996.

FCC Report and Order, ET Docket 93-62, *In the Matter of Guidelines for Evaluating the Environmental Effects of Radiofrequency Radiation*, released August 1, 1996.

FCC Office of Engineering and Technology (OET) Bulletin 65, “Evaluating Compliance with FCC Guidelines for Human Exposure to Radiofrequency Electromagnetic Fields”, Edition 97-01, August 1997.

FCC Office of Engineering and Technology (OET) Bulletin 56, “Questions and Answers About Biological Effects and Potential Hazards of RF Radiation”, edition 4, August 1999.

## Appendix B. SUMMARY of EXPERT QUALIFICATIONS

### *Daniel Penesso, Director – RF Engineering, Pinnacle Telecom Group, LLC*

<b>Synopsis:</b>	<ul style="list-style-type: none"> <li>• 19 years of experience in all aspects of wireless RF engineering, including network design and implementation, interference analysis, FCC and FAA regulatory matters, and antenna site compliance with FCC RF exposure regulations</li> <li>• Have performed RF engineering and FCC compliance work for all the major wireless carriers – AT&amp;T, Verizon Wireless, Sprint, T-Mobile, and MetroPCS, as well as Crown Castle</li> <li>• Have served as an expert witness on RF engineering and/or FCC RF compliance more than 100 times before municipal boards in New Jersey and New York</li> </ul>
<b>Education:</b>	<ul style="list-style-type: none"> <li>• Bachelor of Science in Electrical Engineering, DeVry Institute of Technology, Chicago, IL, 1987</li> </ul>
<b>Current Responsibilities</b>	<ul style="list-style-type: none"> <li>• Manages PTG staff work involving FCC RF compliance for wireless antenna sites, including the provision of math-and measurements-based site compliance reports, related expert testimony in municipal hearings, and compliance-related support in client meetings with prospective site landlords and in town meetings</li> <li>• Provides math-based FCC compliance assessments and reports for PTG’s wireless clients, including AT&amp;T, Verizon Wireless, T-Mobile, Sprint, MetroPCS, and Crown Castle</li> <li>• Responsible for providing client consulting and in-house training on FCC and OSHA RF safety compliance</li> </ul>
<b>Prior Experience:</b>	<ul style="list-style-type: none"> <li>• Have served as senior RF engineer for four of the five national wireless carriers – AT&amp;T, T-Mobile, Sprint, and MetroPCS – in the New York and New Jersey markets</li> <li>• Served as an RF engineer for Metricom, Triton PCS, Alltel Communications, and Western Wireless</li> <li>• Have worked as an RF engineer for several engineering services companies, including Sublime Wireless, Amirit Technologies, Celcite, and Wireless Facilities Incorporated</li> </ul>