

PINNACLE TELECOM GROUP

Professional and Technical Services

ANTENNA SITE FCC RF COMPLIANCE ASSESSMENT AND REPORT

HOMELAND TOWERS, LLC

SITE "NY172 – MT. KISCO" MT. KISCO, NY

JANUARY 17, 2019

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CONTENTS

INTRODUCTION AND SUMMARY	3
ANTENNA AND TRANSMISSION DATA	5
COMPLIANCE ANALYSIS	8
COMPLIANCE CONCLUSION	13

CERTIFICATION

Appendix A. BACKGROUND ON THE FCC MPE LIMIT

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 proposed wireless antenna operations on a proposed monopole to be located at 6 Rolling Ridge Court in Mt. Kisco, NY.

Homeland Towers refers to the prospective site as “NY172 – Mt. Kisco”, 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.

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 analyses for two different pole heights (Scenario 1 and Scenario 2), along with the RF effects of a worst-case hypothetical collocation of three 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:

- ❑ **Scenario 1** - At street level around the site, the conservatively calculated maximum RF level caused by the combination of antenna operations is 5.3099 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 18 times below the limit defined by the federal government as safe for continuous exposure of the general public.
- ❑ **Scenario 2** - At street level around the site, the conservatively calculated maximum RF level caused by the combination of antenna operations is 2.2988 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 40 times below the limit defined by the federal government as safe for continuous exposure of the general public.
- ❑ 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. 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;
- ❑ 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, Appendix A provides background on the FCC MPE limit, along with a list of key references.

ANTENNA AND TRANSMISSION DATA

As described, the proposed monopole will be able to accommodate as many as four wireless carriers' antennas. Verizon Wireless proposes 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, Sprint and T-Mobile.

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 mount at a center line of 96 feet (Scenario 1) or 126 feet (Scenario 2). In Scenario 1 we will assign antenna centerline-heights to the three other assumed wireless collocators at 86 feet, 76 feet and 66 feet. In Scenario 2 we will assign antenna centerline-heights to the three other assumed wireless collocators at 116 feet, 106 feet and 96 feet.

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

Verizon Wireless is licensed to operate in the 746, 869, 1900 and 2100 MHz frequency bands. In the 746 MHz band, Verizon uses two 60-watt channels per antenna sector. In the 869 MHz band, Verizon uses eight 20-watt channels per antenna sector. In the 1900 MHz band, Verizon uses three 16-watt channels and two 60-watt channels per antenna sector. In the 2100 MHz band, Verizon uses two 90-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 four 40-watt RF channels per sector. In the 850 MHz band, AT&T uses four 30-watt channels and one 40-watt channel per sector. In the 1900 MHz band, AT&T uses four 30-watt channels and one 40-watt channel per sector. In the 2300 MHz band, AT&T uses four 25-watt channels per sector.

Sprint is licensed to operate in the 800, 1900 and 2500 MHz frequency bands. In the 800 MHz band, Sprint uses two 50-watt channels per antenna sector. In the 1900 MHz band, Sprint uses four 40-watt channels per sector. In the 2500 MHz band, Sprint uses three 40-watt channels per sector.

T-Mobile is licensed to operate in the 600 MHz, 700 MHz, 1900 MHz and 2100 MHz frequency bands. In the 600 MHz band, T-Mobile uses four 40-watt channels per sector. In the 700 MHz band, T-Mobile uses one 40-watt channel per sector. In the 1900 MHz band, T-Mobile uses four 30-watt channels per sector. In the 2100 MHz band, T-Mobile uses one 40-watt channel and two 80-watt channels per sector.

Based on the proposed mounting heights and then followed by overall available power levels, we will hypothetically assign the mounting heights (to the centerline of the antennas) as follows:

- Verizon Wireless

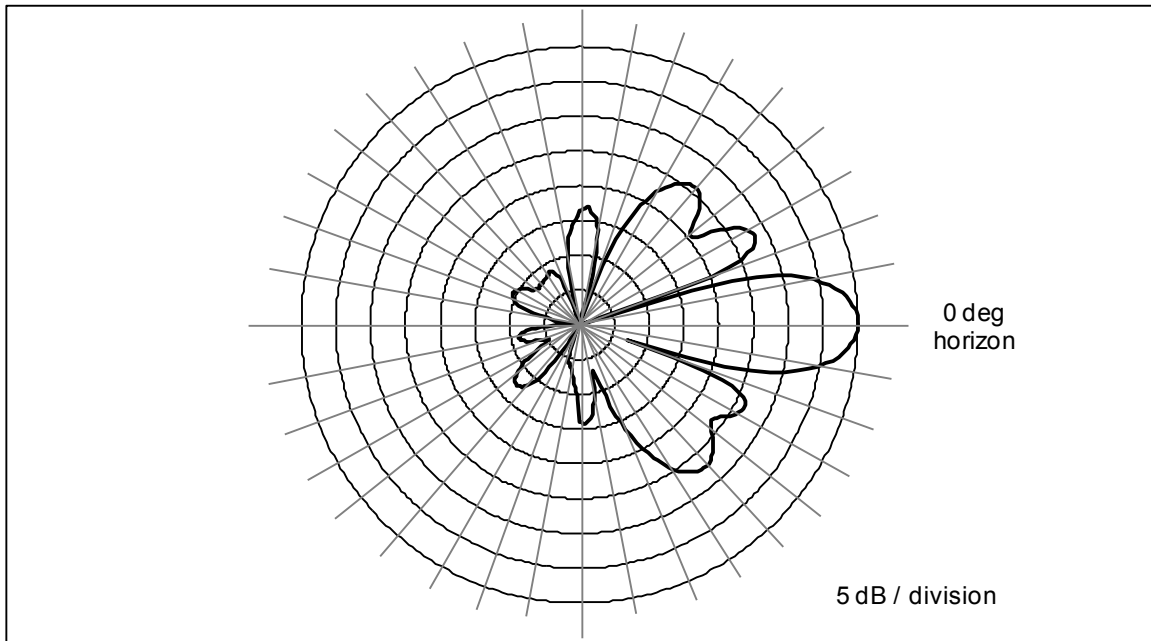
- Sprint
- T-Mobile
- AT&T

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 that follows, 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 in 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 1/100th of the maximum that occurs in the main beam (at 0 degrees); at 30 dB, the energy is 1/1000th 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:

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

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
$10^{(G_{\text{max}} - V_{\text{disc}})/10}$	=	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.

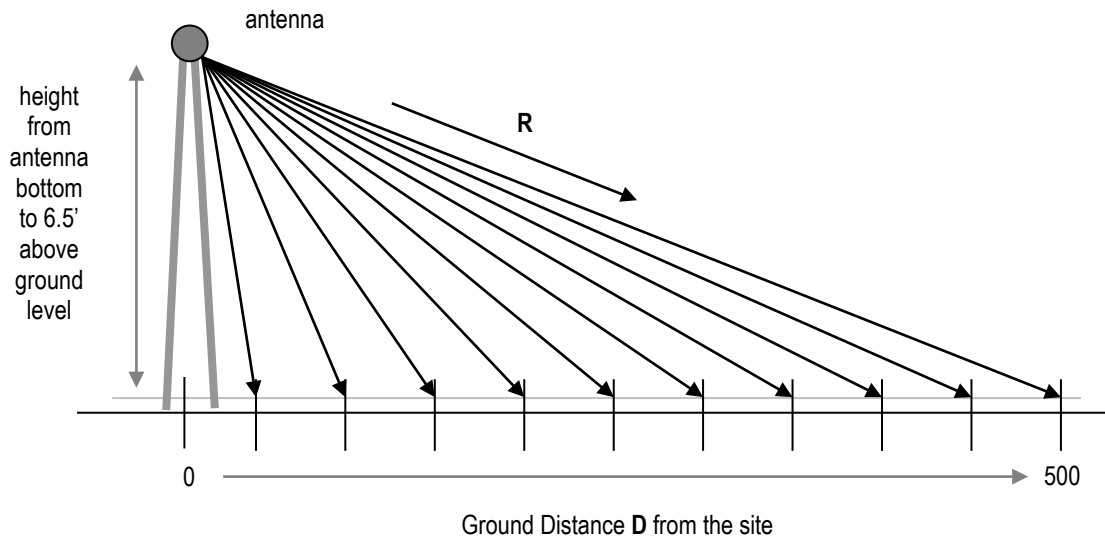


Figure 2. Street-level MPE% Calculation Geometry

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 tables that follow provides the results of the MPE% calculations for each operator, and each scenario, with the worst-case overall result highlighted in bold in the last column.

Scenario 1

Ground Distance (ft)	Verizon Wireless MPE%	AT&T MPE%	Sprint MPE%	T-Mobile MPE%	Total MPE%
0	0.0438	0.2410	0.0670	0.1089	0.4607
20	0.0609	0.5956	0.0301	0.4029	1.0895
40	0.1102	2.6015	0.0977	0.5570	3.3664
60	0.2007	3.3515	0.1736	0.4071	4.1329
80	0.1588	3.7002	0.1581	0.3352	4.3523
100	0.3851	2.4959	0.3660	0.4662	3.7132
120	0.6071	1.5229	0.2677	0.1217	2.5194
140	0.6993	0.4122	0.0863	0.3477	1.5455
160	0.7551	0.3459	0.1416	0.2363	1.4789
180	0.5461	0.5576	0.1700	0.2012	1.4749
200	0.3620	0.9444	0.1941	0.3170	1.8175
220	0.2490	1.1180	0.1776	0.8729	2.4175
240	0.1899	1.3129	0.0577	1.1967	2.7572
260	0.1278	1.5162	0.0371	1.5510	3.2321
280	0.1156	1.7194	0.0687	1.9164	3.8201
300	0.1438	1.9050	0.1211	2.2689	4.4388
320	0.2174	1.6815	0.1585	2.5936	4.6510
340	0.3345	1.8325	0.1779	2.8761	5.2210
360	0.4682	1.6394	0.2477	2.5750	4.9303
380	0.5963	1.7570	0.1911	2.7655	5.3099
400	0.5408	1.5891	0.2710	2.5387	4.9396
420	0.6576	1.7020	0.2466	2.6356	5.2418
440	0.6014	1.5533	0.3509	2.5009	5.0065
460	0.7105	1.4232	0.3219	2.2924	4.7480
480	0.6544	1.5643	0.2963	2.4783	4.9933
500	0.7849	1.4433	0.3820	2.2873	4.8975

As indicated, the overall worst-case calculated result in Scenario 1 is 5.3099 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.

Scenario 2

Ground Distance (ft)	Verizon Wireless MPE%	AT&T MPE%	Sprint MPE%	T-Mobile MPE%	Total MPE%
0	0.0243	0.1037	0.0290	0.0514	0.2084
20	0.0296	0.2492	0.0125	0.0828	0.3741
40	0.0528	0.3806	0.0124	0.4477	0.8935
60	0.0746	1.1312	0.0425	0.2514	1.4997
80	0.1118	1.5058	0.0399	0.2755	1.9330
100	0.1001	1.6202	0.0750	0.1009	1.8962
120	0.1024	1.6935	0.0665	0.2199	2.0823
140	0.3091	1.1154	0.1006	0.2625	1.7876
160	0.3397	1.0454	0.1754	0.0963	1.6568
180	0.3301	0.6728	0.1130	0.0790	1.1949
200	0.3972	0.2943	0.0640	0.1695	0.9250
220	0.4037	0.1306	0.0348	0.1482	0.7173
240	0.3402	0.1532	0.0500	0.1049	0.6483
260	0.2395	0.1863	0.0680	0.0667	0.5605
280	0.1683	0.2313	0.0834	0.1480	0.6310
300	0.1345	0.2915	0.0882	0.2666	0.7808
320	0.1066	0.3715	0.0879	0.4125	0.9785
340	0.0848	0.4689	0.0565	0.5939	1.2041
360	0.0671	0.5825	0.0383	0.7979	1.4858
380	0.0629	0.7069	0.0232	0.7264	1.5194
400	0.0808	0.6411	0.0157	0.9371	1.6747
420	0.1258	0.7632	0.0305	1.1603	2.0798
440	0.1988	0.6979	0.0560	1.0553	2.0080
460	0.1829	0.8106	0.0516	1.2537	2.2988
480	0.2631	0.7466	0.0703	1.1553	2.2353
500	0.2436	0.6374	0.0651	1.3305	1.6392

As indicated, the overall worst-case calculated result in Scenario 2 is 2.2988 percent of the FCC general population MPE limit – well below the 100-percent reference for compliance.

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.

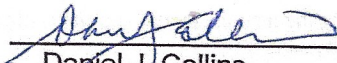
The results of the calculations indicate clear compliance with the FCC regulations and the related MPE limit, even for a worst-case collocation scenario. Because

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.

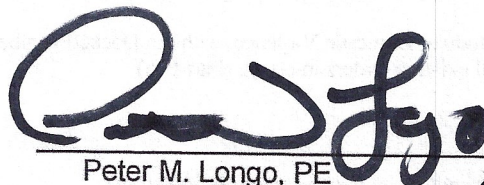
CERTIFICATION

The undersigned certify as follows:

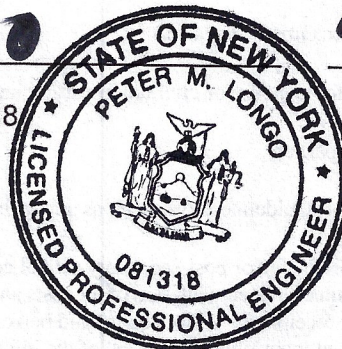
1. We have read and are familiar with the FCC regulations concerning RF safety and the control of human exposure to RF fields (47 CFR 1.1301 *et seq.*).
2. To the best of our knowledge, the statements and information disclosed in this report are true, complete and accurate.
3. The analysis of site RF compliance provided herein is consistent with the applicable FCC regulations, additional guidelines issued by the FCC, and industry practice.
4. The results of the assessment indicate that the subject antenna operations are in full compliance with the FCC regulations concerning the control of potential RF exposure.


Daniel J. Collins
Chief Technical Officer

11/7/19
Date


Peter M. Longo, PE
New York License No. 081318

11/8/19
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.

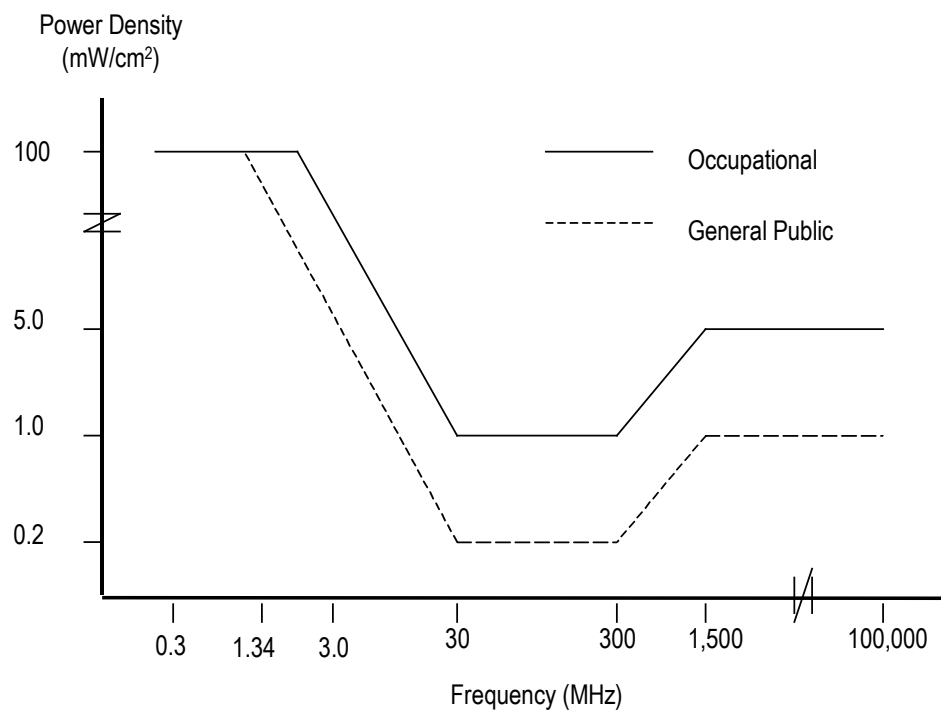
The specified continuous exposure MPE limits are based on known variation of human body susceptibility in different frequency ranges, and a Specific Absorption Rate (SAR) of 4 watts per kilogram, which is universally considered to accurately represent human capacity to dissipate incident RF energy (in 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/cm²). The table on the next page lists the FCC limits for both occupational and general population exposures, using the mW/cm² reference, for the different radio frequency ranges.

Frequency Range (F) (MHz)	Occupational Exposure (mW/cm ²)	General Public Exposure (mW/cm ²)
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.