PINNACLE TELECOM GROUP
Consulting and Engineering Services

ANTENNA SITE FCC RF COMPLIANCE ASSESSMENT AND REPORT

prepared for

HOMELAND TOWERS, LLC

PROPOSED MULTI-CARRIER ANTENNA SITE
100 AIRPORT ROAD
ACCORD, NY

MAY 21, 2007

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Introduction and Summary

At the request of Homeland Towers, LLC, Pinnacle Telecom Group has performed an independent assessment of radiofrequency (RF) levels and related FCC compliance for a proposed monopole at 100 Airport Road in Accord, NY. As proposed, the structure will be designed to support the directional panel antenna operations of as many as five cellular service providers, as well as a municipal whip (omnidirectional) antenna operation at the top of the 150-foot pole. While all antenna collocation details have yet to be determined, this report provides an FCC compliance assessment based on a “worst-case” analysis of the RF effects of collocation by the five national cellular service providers – AT&T (also known as Cingular Wireless), Verizon Wireless, Sprint, Nextel Communications, and T-Mobile (also known as Omnipoint Communications) – as well as a worst-case municipal antenna operation.

The worst-case approach applies antenna and transmission parameters that represent the maximum possible RF exposure effects from each of the five cellular operators and a municipal antenna operation. We have also assumed the hypothetical circumstance of all cellular carriers’ antennas being mounted at the lowest height any of those operators would individually be assigned. Given the industry-standard 10-foot vertical spacing of different operators’ antennas, if the highest set of cellular antennas were at 150 feet (to the top of the antennas), the lowest of five cellular carriers’ antennas would be at 110 feet (to the top of the antennas) – and we will conservatively apply that one height in the calculations for all five cellular operations.

This report describes a worst-case assessment of antenna site compliance with the FCC limit for maximum permissible exposure (“MPE”), a limit established as safe for continuous human exposure to RF fields. Because of the extreme conservatism in the worst-case approach we are taking – five cellular collocators (and the municipal whip antenna), plus worst-case technical parameters applied to each operation – the calculation results here will overstate the RF effects of any antenna collocation condition that will develop at this site.

The results of an FCC compliance assessment are most clearly described when the calculated RF levels are expressed 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. 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 results of the FCC compliance assessment in this case are as follows:

- The conservatively calculated maximum RF level caused by the combination of all five cellular carriers' antennas (all hypothetically assumed to be mounted at 110 feet) – along with a municipal whip antenna at the top of the pole – is only 2.6870 percent of the FCC MPE limit. In other words, even with calculations designed to significantly overstate the RF levels versus those that could actually occur, the worst-case calculated RF level in this case is still 37 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 any combination of cellular antenna operations at this site (along with a municipal whip antenna), even under worst-case 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 cellular antennas (along with a municipal whip antenna) 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 each of the five cellular service provider's antenna operations, along with the worst-case technical parameters for a municipal whip operation;

- 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;
- analysis of the results of the calculations, and the compliance conclusion for the site.

In addition, three Appendices are included. Appendix A provides background on the FCC's MPE limit, along with key references. Appendix B provides a copy of the FCC's official position on the potential exposure from cellular and PCS transmitters, to wit, that it is insignificantly low and has no effect on the human health environment. Appendix C provides a summary of the qualifications of the expert certifying RF compliance for this site.

Antenna and Transmission Data

As described, the proposed 150-foot monopole is being planned to support as many as five cellular providers' antenna operations. Specific height assignments have not been made, but we can hypothetically position all parties' antennas at the lowest height, which facilitates a conservative analysis of RF levels and overall antenna site compliance. As it is a standard industry guideline to maintain a 10-foot vertical separation between different operators' antennas, if the highest set of cellular antennas were at 150 feet (to the top), the lowest would top out at 110 feet. Therefore, we will apply that antenna height to all five cellular operators.

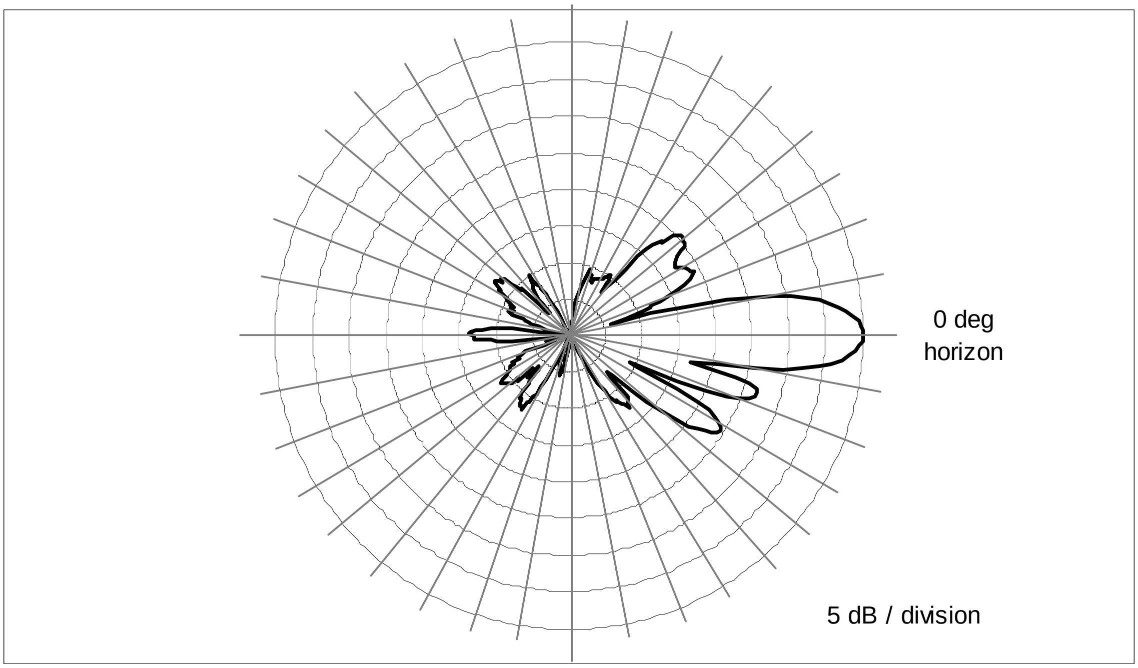
The key transmission parameters for the five carriers are summarized in the table on the next page. In each case, the parameters selected represent worst-case conditions in terms of potential ground-level exposure effects. Note that all cellular operators employ directional panel antennas arranged for sectorized service coverage. Note, too, that although Sprint and Nextel have merged, the operations in each band may still employ separate antennas, and we can conservatively treat the operations separately.

Carrier	*Freq Band(s)*	*RF Channels per Sector*	*Transmitter Power per RF Channel*	*Maximum Effective Antenna Gain*
AT&T	800 MHz 1900 MHz	9 3	20 watts 16 watts	15 dBi 19 dBi
Verizon	800 MHz 1900 MHz	7 3	20 watts 16 watts	15 dBi 19 dBi
Sprint	1900 MHz	6	16 watts	19 dBi
Nextel	851 MHz 935 MHz	12 12	6 watts 6 watts	15 dBi 16 dBi
T-Mobile	1900 MHz	8	20 watts	19 dBi

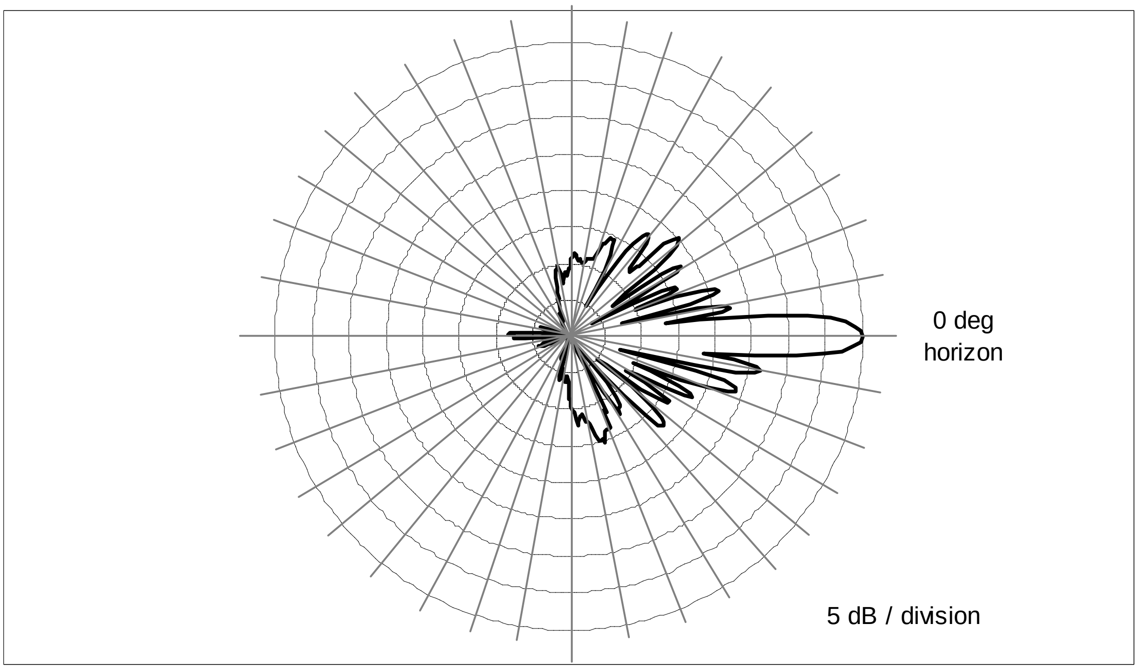
The area below the antennas, at ground level, is of interest in terms of potential exposure of the general public, so the antenna's vertical-plane emission pattern is used in the calculations, as it is a key determinant in the relative level of RF emissions in the "downward" direction.

By way of illustration, diagrams on the next page shows the vertical-plane patterns of two typical directional panel antennas – one in the 800 MHz band and the other in the 1900 MHz band. In this type of antenna pattern diagram, the antenna is effectively pointed at the three o'clock position (the horizon) and the relative strength of the pattern at different angles is described using decibel units. Note that the use of a decibel scale to describe the relative pattern at different angles actually serves to significantly understate the actual focusing effects of the antenna. 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 only 1/1000th of the maximum.

800 MHz Panel Antenna – Vertical-plane Emission Pattern



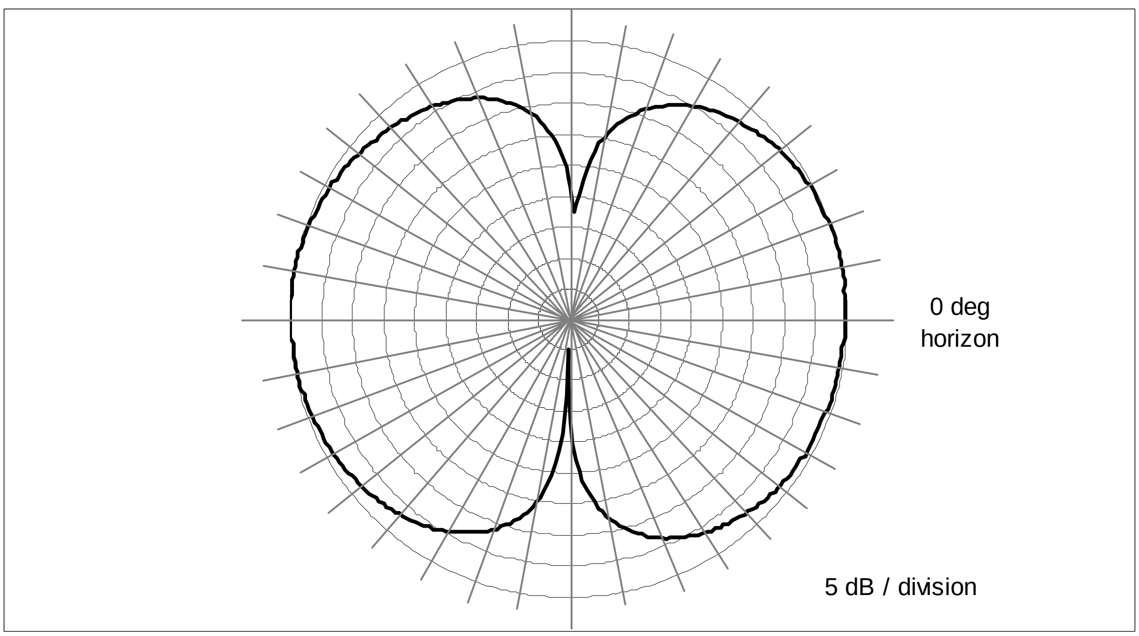
1900 MHz Panel Antenna – Vertical-plane Emission Pattern



As mentioned, we will also include in this analysis the hypothetical collocation of a worst-case municipal whip antenna operation at the top of the proposed 150-foot monopole. The parameters we will apply include the following:

- an operating frequency range subject to the strictest (lowest) MPE limit (frequencies between 30 and 300 MHz are subject to a limit of 0.2 mW/cm^2);
- an antenna input power matching the maximum any antenna manufacturer specifies for any whip antenna, 500 watts; and
- the worst-case antenna vertical-plane pattern in terms of RF emissions in the "downward" direction – that of a "unity-gain dipole antenna", for which the pattern is shown below.

Unity-Gain Dipole Antenna – Vertical-plane Emission Pattern



Note that while the assumptions regarding frequency band and antenna characteristics are conservatively but not overly unrealistic, the assumption of 500 watts antenna input power grossly overstates the 25- to 100-watts power levels typically used with whip antennas.

Whether the whip antenna is operated by a municipality or another entity, the worst-case parameters described here would still apply. The same is true for the parameters described for the cellular operations, which are effectively independent of the particular licensees' names.

Technical 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 ground. Our calculations will assume a 100% "perfect" reflection, the absolute worst-case approach.

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

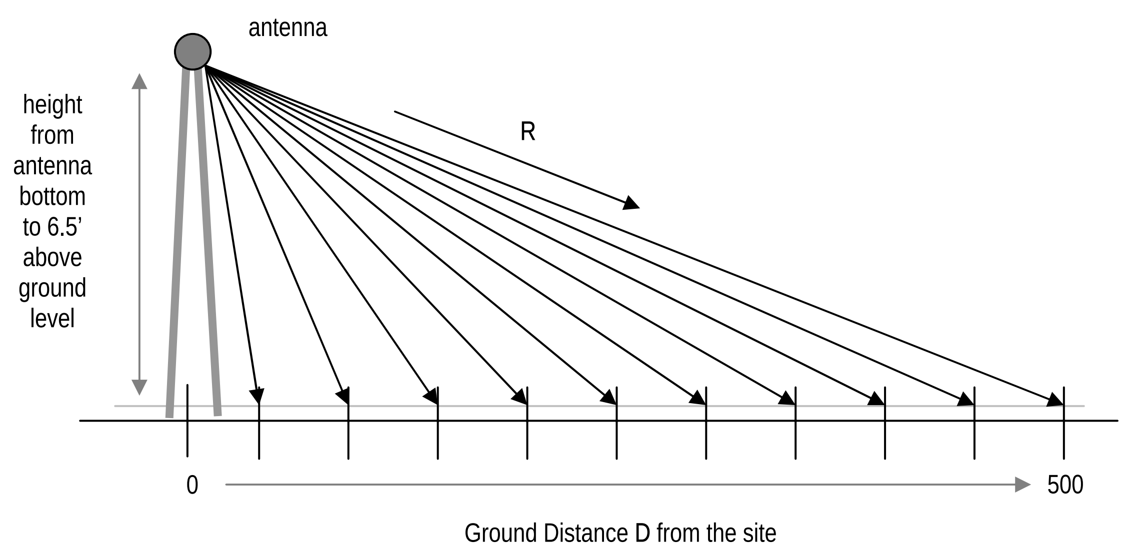
$$MPE\% = (100 * TxPower * 10^{(Gmax-Vdisc)/10} * 4) / (MPE * 4\pi * R^2)$$

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
$10^{(Gmax-Vdisc)/10}$	=	numeric equivalent of the relative antenna gain in the downward direction of interest

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 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 the diagram below.



MPE% Calculation Geometry

It is commonly 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 to always be in compliance.

FCC compliance for a collocated 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.
2. The directional antennas are hypothetically assumed to be pointed directly overhead any and all points of interest at ground level, ignoring the effects of antenna discrimination in the horizontal plane.
3. 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.
4. 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.
5. The potential RF exposure at ground level is assumed to be 100-percent enhanced (increased) via a “perfect” field reflection from the ground itself.

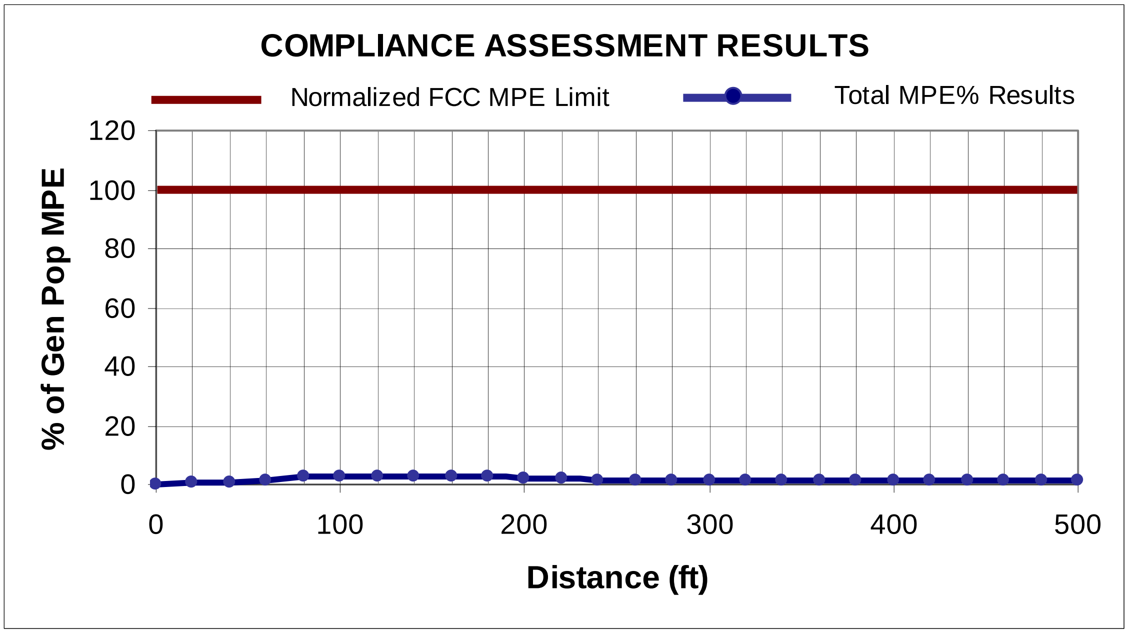
The net result of these assumptions is to intentionally and significantly overstate the calculated RF levels relative to the levels that will actually occur – and the purpose of this conservatism is to allow “safe-side” conclusions about compliance with the MPE limit.

The table below provides the results of the MPE% calculations for distance points out to 500 feet from the site, with the worst-case overall result highlighted in bold. Note that the results listed for the dual-band cellular operators reflect the overall effects of both frequency bands.

Ground Dist (ft)	**Cingular MPE%**	**Verizon MPE%**	**Sprint MPE%**	**Nextel MPE%**	**T-Mobile MPE%**	**Muni Whip MPE%**	**Total MPE%**
0	0.0292	0.1095	0.0187	0.0026	0.0005	0.0024	0.1629
20	0.0754	0.1265	0.0351	0.0025	0.0004	0.2068	0.4467
40	0.1243	0.0360	0.0535	0.0023	0.0204	0.7268	0.9633
60	0.2712	0.0052	0.0039	0.0075	0.0210	1.2704	1.5792
80	0.5323	0.0673	0.0098	0.0255	0.0115	1.7635	2.4099
100	0.4928	0.0863	0.0714	0.0084	0.0237	2.0044	**2.6870**
120	0.1277	0.0415	0.0131	0.0273	0.0240	2.1559	2.3895
140	0.0831	0.0058	0.0278	0.1671	0.0718	2.1551	2.5107
160	0.2852	0.0300	0.0231	0.2011	0.0655	2.0561	2.6610
180	0.4804	0.0723	0.0071	0.1225	0.0030	1.8767	2.5620
200	0.3869	0.0627	0.0369	0.0227	0.0256	1.7186	2.2534
220	0.2774	0.0398	0.0195	0.0038	0.0276	1.5446	1.9127
240	0.1965	0.0230	0.0035	0.0414	0.0034	1.4271	1.6949
260	0.1458	0.0141	0.0140	0.0703	0.0011	1.2652	1.5105
280	0.0567	0.0148	0.0589	0.1232	0.0325	1.1535	1.4396
300	0.0263	0.0263	0.0655	0.1222	0.0466	1.0325	1.3194
320	0.0336	0.0485	0.0544	0.1166	0.0476	0.9500	1.2507
340	0.0872	0.0851	0.0322	0.0974	0.0380	0.8579	1.1978
360	0.1800	0.1499	0.0113	0.0681	0.0248	0.7780	1.2121
380	0.2937	0.1840	0.0009	0.0397	0.0199	0.7082	1.2464
400	0.2668	0.1671	0.0008	0.0361	0.0181	0.6621	1.1510
420	0.3706	0.2416	0.0081	0.0150	0.0262	0.6070	1.2685
440	0.4548	0.2676	0.0268	0.0063	0.0417	0.5582	1.3554
460	0.4179	0.2459	0.0246	0.0058	0.0383	0.5149	1.2474
480	0.4735	0.3137	0.0403	0.0134	0.0499	0.4764	1.3672
500	0.4378	0.2901	0.0373	0.0124	0.0461	0.4419	1.2656

As indicated, the overall worst-case result is only 2.6870 percent of the FCC limit, which is well below the 100-percent reference for MPE compliance. (Note, too, that the most significant contributor to this result is the municipal whip antenna, for which extremely conservative operational assumptions were applied.)

A graph of the calculation results, shown below, provides perhaps a clearer *visual* illustration of the relative insignificance 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

As described, the calculated RF levels in this case – calculated on an extremely conservative basis – are comfortably below the FCC limit for safe, continuous human exposure to RF fields.

The calculated maximum RF level from the combination of all five cellular providers' antenna operations (each with worst-case parameters and hypothetically mounted at 110 feet), along with a worst-case municipal whip antenna operation, is only 2.6870 percent of the FCC MPE limit.

In other words, even with an extremely conservative analysis intended to dramatically overstate the RF effects of any collocation scenario at the site, the calculated worst-case RF level is still more than 37 times below the 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.

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

It is the policy of Pinnacle Telecom Group that all FCC RF compliance assessments are reviewed, approved, and signed by the firm's Chief Technical Officer, who 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 indicate that the RF emissions at the subject site will be in full compliance with the FCC regulations concerning RF exposure.

5/21/07

Daniel J. Collins
Chief Technical Officer

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.

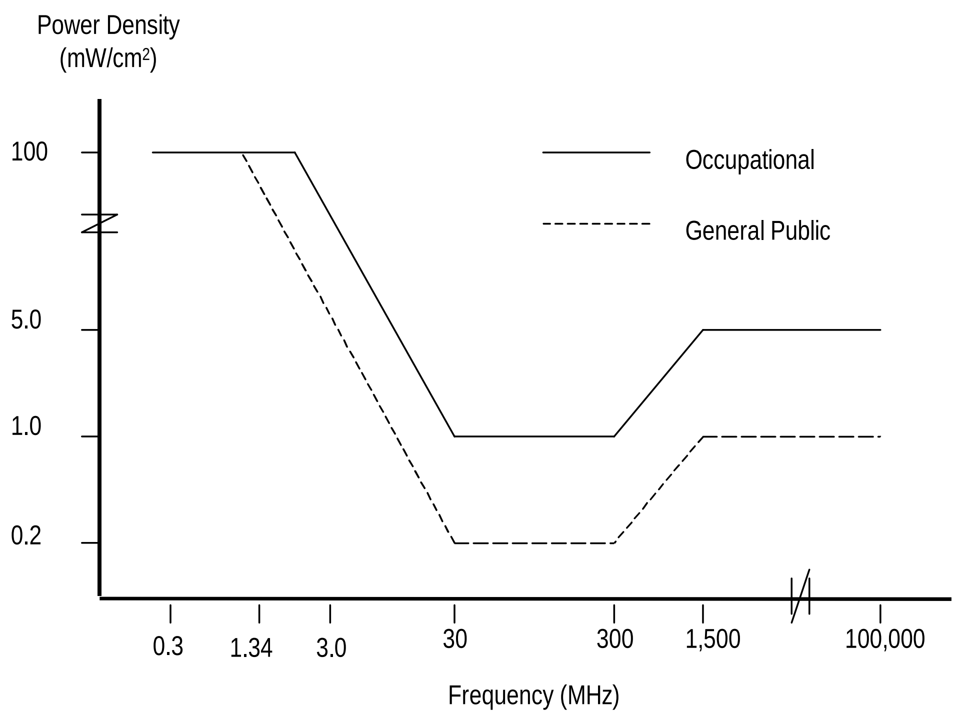
The specified continuous exposure MPE limits are based on known variation of human body susceptibility in different frequency ranges, and a Specific Absorption Rate (SAR) of 4 watts per kilogram, which is universally considered to accurately represent human capacity to dissipate incident RF energy (in 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^2). The table on the next page lists the FCC limits for both occupational and general population exposures, using the mW/cm^2 reference, for the different radio frequency ranges.

Frequency Range (F) (MHz)	Occupational Exposure (mW/cm2)	General Public Exposure (mW/cm2)
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.

FCC References

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

47 CFR, FCC Rules and Regulations, Part 22 (Public Mobile Services).

47 CFR, FCC Rules and Regulations, Part 24 (Personal Communications Services).

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: FCC Position on Cellular and PCS Transmitters

FEDERAL COMMUNICATIONS COMMISSION
OFFICE OF ENGINEERING & TECHNOLOGY
WASHINGTON, D.C. 20554

January 1998

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INFORMATION ON HUMAN EXPOSURE TO RADIOFREQUENCY FIELDS FROM CELLULAR AND PCS RADIO TRANSMITTERS
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(1) <u>Cellular and PCS base stations</u>

Radio frequencies constitute part of the overall electromagnetic spectrum. Cellular communications systems use frequencies in the 800-900 megahertz (MHz) portion of the radiofrequency (RF) spectrum (frequencies formerly used for UHF-TV broadcasting), and transmitters in the Personal Communications Service (PCS) use frequencies in the range of 1850-1990 MHz. Primary antennas for cellular and PCS transmissions are usually located on towers, water tanks and other elevated structures including rooftops and the sides of buildings. The combination of antennas and associated electronic equipment is referred to as a cellular or PCS base station" or "cell site." Typical heights for base station towers or structures are 50-200 feet. A typical cellular base station may utilize several "omni-directional" antennas that look like poles or whips, 10 to 15 feet in length. PCS (and also many cellular) base stations use a number of "sector" antennas that look like rectangular panels. The dimensions of a sector antenna are typically 1 foot by 4 feet. Antennas are usually arranged in three groups of three with one antenna in each group used to transmit signals to mobile units (car phones or hand-held phones). The other two antennas in each group are used to receive signals from mobile units.

The Federal Communications Commission (FCC) authorizes cellular and PCS carriers in various service areas around the country. At a cell site, the total RF power that could be transmitted from each transmitting antenna at a cell site depends on the number of radio channels (transmitters) that have been authorized and the power of each transmitter. Typically, for a cellular base station, a maximum of 21 channels per sector (depending on the system) could be used. Thus, for a typical cell site utilizing sector antennas, each of the three transmitting antennas could be connected to up to 21 transmitters for a total of 63 transmitters per site. When omni-directional antennas are used, up to 96 transmitters could be implemented at a cell site, but this would be very unusual. While a typical base station could have as many as 63 transmitters, not all of the transmitters would be expected to operate simultaneously thus reducing overall emission levels. For the case of PCS base stations, fewer transmitters are normally required due to the relatively greater number of base stations.

Although the FCC permits an **effective radiated power** (ERP) of up to 500 watts per channel (depending on the tower height), the majority of cellular base stations in urban and suburban areas operate at an ERP of 100 watts per channel or less. An ERP of 100 watts corresponds to an **actual** radiated power of 5-10 watts, depending on the type of antenna used (ERP is not equivalent to the power that is radiated but is a measure of the directional characteristics of the antenna). As the capacity of a system is expanded by dividing cells, i.e., adding additional base stations, lower ERPs are normally used. In urban areas, an ERP of 10 watts per channel (corresponding to a radiated power of 0.5 - 1 watt) or less is commonly used. For PCS base stations, even lower radiated power levels are normally used. The signal from a cellular or PCS base station antenna is essentially directed toward the horizon in a relatively narrow beam in the vertical plane. For example, the radiation pattern for an omni-directional antenna might be compared to a thin doughnut or pancake centered around the antenna while the pattern for a sector antenna is fan-shaped, like a wedge cut from a pie. As with all forms of electromagnetic energy, the power density from a cellular or PCS transmitter decreases rapidly (according to an inverse square law) as one moves away from the antenna. Consequently, normal ground-level exposure is much less than exposures that might be encountered if one were very close to the antenna and in its main transmitted beam. Measurements made near typical cellular and PCS installations have shown that ground-level power densities are well below limits recommended by RF/microwave safety standards.

In 1996, the FCC adopted updated guidelines for evaluating human exposure to radiofrequency (RF) fields from fixed transmitting antennas such as those used for cellular radio and PCS base stations.1 The new guidelines for cellular and PCS base stations are identical to those recommended by the National Council on Radiation Protection and Measurements (NCRP).2 These guidelines are also similar to the 1992 guidelines recommended by the American National Standards Institute and the Institute of Electrical and Electronics Engineers (ANSI/IEEE C95.1-1992).3 The FCC adopted guidelines for hand-held RF devices, such as cellular and PCS phones, that are the same as those recommended by the ANSI/IEEE and NCRP guidelines (see later discussion).

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1 FCC *Report and Order* in ET Docket 93-62, 61 Federal Register 41006 (August 7, 1996); 11 FCC Record 15123 (1997). See also, FCC *Second Memorandum Opinion and Orde*r, ET Docket 93-62, 62 Federal Register 47960 (September 12, 1997), 12 FCC Record 13494 (1997). For more information on these documents contact the FCC’s toll-free number: 1-888-CALL FCC (1-888-225-5322). They may also be viewed and downloaded at the FCC’s Office of Engineering and Technology World Wide Web Site under the "RF Safety" heading at the following address: www.fcc.gov/oet/rfsafety. The FCC’s RF exposure guidelines are based on recommendations made to the FCC by U.S. federal safety and health agencies such as the Environmental Protection Agency (EPA), the Food and Drug Administration (FDA), the National Institute for Occupational Safety and Health (NIOSH) and the Occupational Safety and Health Administration (OSHA).

2 The NCRP is a non-profit corporation chartered by congress to develop information and recommendations concerning radiation protection.

3 The American National Standards Institute is a non-profit, privately-funded, membership organization that coordinates development of voluntary national standards in the United States. The IEEE is a non-profit technical and professional engineering society.

In the case of cellular base station transmitters, at a frequency of 869 MHz (the lowest frequency used), the FCC's RF exposure guidelines recommend a maximum permissible exposure level of the general public (or exposure in "uncontrolled" environments) of about 580 microwatts per square centimeter (µW/cm 2), as averaged over any thirty-minute period. This limit is many times greater than RF levels typical found near the base of typical cellular towers or in the vicinity of other, lower-powered cellular base station transmitters. For example, measurement data obtained from various sources have consistently indicated that "worst-case" ground-level power densities near typical cellular towers are on the order of 1 µW/cm 2 or less (usually significantly less). Calculations corresponding to a "worst-case" situation (all transmitters operating simultaneously and continuously at the maximum licensed power) show that in order to be exposed to levels near the FCC's limits for cellular frequencies, an individual would essentially have to remain in the main transmitting beam (at the height of the antenna) and within a few feet from the antenna. This makes it extremely unlikely that a member of the general public could be exposed to RF levels in excess of these guidelines from cellular base station transmitters.

For PCS base station transmitters, the same type of analysis holds, except that at the PCS transmitting frequencies (1850-1990 MHz) the FCC's exposure limits for the public are 1000 µW/cm 2 . Therefore, there would typically be an even greater margin of safety between actual public exposure levels and the recognized safety limit.

When cellular and PCS antennas are mounted at rooftop locations it is possible that RF levels greater than 1 µW/cm 2 could be present on the rooftop itself. This might become an issue if the rooftop were accessible to maintenance personnel or others. However, exposures approaching or exceeding the safety guidelines are only likely to be encountered very close to and directly in front of the antennas. Even if RF levels were to be higher than desirable on a rooftop, appropriate restrictions could be placed on access. Factoring in the time-averaging aspects of safety standards could also be used to reduce potential exposure. The fact that rooftop cellular and PCS antennas usually operate at lower power levels than antennas on freestanding towers makes excessive exposure conditions on rooftops even less likely. This reason and the significant signal attenuation of a building's roof also minimizes any chance for harmful exposure of persons living or working within the building itself.

(2) <u>Mobile (vehicle-mounted) antennas</u>

Vehicle-mounted antennas used for cellular communications normally operate at a power level of 3 watts or less. These cellular antennas are typically mounted on the roof, on the trunk, or on the rear window of a car or truck. Studies have shown that in order to be exposed to RF levels that approach the safety guidelines it would be necessary to remain very close to a vehicle-mounted cellular antenna. For example, a study done for AT&T Bell Laboratories by the University of Washington documented typical and "worst-case" exposure levels and specific absorption rates (SAR) for vehicle occupants and persons standing close to vehicle-mounted cellular antennas. Worst-case exposure conditions were considered when an individual was at the closest possible distance from the antenna. Several configurations were tested using adult and child "phantom" models.

The results of this study showed that the highest exposure (1900 µW/cm 2) occurred with a female model at a distance of 9.7 cm (3.8 inches) from one of the antennas operating at a power level of 3 watts. Although this level is nominally in excess of the FCC's exposure limits for power density at this frequency, analysis of the data indicated that the antenna would have to be driven to 7 W of power before the limit for *specific absorption rate* (SAR) allowed by the FCC guidelines would be exceeded. The intermittent nature of transmission and the improbability that a person would remain so close to the antenna for any length of time further reduces the potential for excessive exposure.

The University of Washington study also indicated that vehicle occupants are effectively shielded by the metal body. Motorola, Inc., in comments filed with the FCC, has expressed the opinion that proper installation of a vehicle-mounted antenna to maximize the shielding effect is an effective way of limiting exposure. Motorola and other companies have recommended antenna installation either in the center of the roof or the center of the trunk. In response to concerns expressed over the commonly-used rear-window mounted cellular antennas, Motorola has recommended a minimum separation distance of 30-60 cm (1 -2 feet) to minimize exposure to vehicle occupants resulting from antenna mismatch for this type of antenna installation.

In summary, from data gathered to date, it appears that properly installed, vehicle-mounted, personal wireless transceivers using up to 3 watts of power would result in maximum exposure levels in or near the vehicle that are well below the FCC's safety limits. This assumes that the transmitting antenna is at least 15 cm (about 6 inches) or more from vehicle occupants. Time-averaging of exposure (either a 6 or 30minute period is specified) will usually result in still lower values when compared with safety guidelines.

(3) <u>Hand-held cellular telephones and PCS devices</u>

A question that often arises is whether there may be potential health risks due to the RF emissions from hand-held cellular telephones and PCS devices. The FCC's exposure guidelines, and the ANSI/IEEE and NCRP guidelines upon which they are based, specify limits for human exposure to RF emissions from hand-held RF devices in terms of *specific absorption rate (SAR).* For exposure of the general public, e.g., exposure of the user of a cellular or PCS phone, the SAR limit is an absorption threshold of 1.6 watts/kg (W/kg), as measured over any one gram of tissue.

Measurements and computational analysis of SAR in models of the human head and other studies of SAR distribution using hand-held cellular and PCS phones have shown that, in general, the 1.6 W/kg limit is unlikely to be exceeded under normal conditions of use. Before FCC approval can be granted for marketing of a cellular or PCS phone, compliance with the 1.6 W/kg limit must be demonstrated. Also, testing of hand-held phones is normally done under conditions of maximum power usage. In reality, normal power usage is less and is dependent on distance of the user from the base station transmitter.

In recent years publicity, speculation and concern over claims of possible health effects due to RF fields from hand-held wireless telephones prompted industry-sponsored groups, such as Wireless Technology Research, L.L.C. (WTR) and Motorola, Inc., to initiate research programs aimed at investigating whether there is any risk to users of these devices. Past studies carried out at frequencies both higher and lower than those used for cellular and PCS phones have led expert organizations to conclude that typical RF exposures from these devices are safe. However, the Federal Government is monitoring the results of the ongoing industry-sponsored research through an inter-agency working group led by the EPA and the FDA's Center for Devices and Radiological Health.

In a 1993 "Talk Paper," the FDA stated that it did not have enough information at that time to rule out the possibility of risk, but if such a risk exists "it is probably small." The FDA concluded that there is no proof that cellular telephones can be harmful, but if individuals remain concerned several precautionary actions could be taken. These included limiting conversations on hand-held cellular telephones to those that are essential and making greater use of telephones with vehicle-mounted antennas where there is a greater separation distance between the user and the radiating structure.

***NOT*E:** For more information on these and other RF-related topics, you may call the FCC's toll-free number: 1-888-CALL FCC (1-888-225-5322) or contact the FCC's RF Safety Program, in the Office of Engineering and Technology, at (202) 418-2464. Information is also available at the FCC's Office of Engineering and Technology World Wide Web Site under the "RF Safety" heading at the following address: www.fcc.gov/oet/rfsafety.

Appendix C: Expert Qualifications

Daniel J. Collins, Chief Technical Officer, Pinnacle Telecom Group, LLC

Synopsis:	• 35 years of experience in all aspects of wireless system engineering, related regulation, and RF exposure • Has performed or led RF exposure compliance assessments on more than 10,000 antenna sites since the new FCC rules went into effect in 1997 • Has provided testimony as an RF compliance expert more than 1,000 times since 1997 • Have been accepted as an expert in New Jersey, New York, Connecticut, Pennsylvania and more than 40 other states, as well as by the FCC
Education:	• B.E.E., City College of New York (Sch. Of Eng.), 1971 • M.B.A., 1982, Fairleigh Dickinson University, 1982 • Bronx High School of Science, 1966
Current Responsibilities:	• Leads all PTG staff work involving RF safety and FCC compliance, microwave and satellite system engineering, and consulting on wireless technology and regulation
Prior Experience:	• Edwards & Kelcey, VP – RF Engineering and Chief Information Technology Officer, 1996-99 • Bellcore (a Bell Labs offshoot after AT&T's 1984 divestiture), Executive Director – Regulation and Public Policy, 1983-96 • AT&T (Corp. HQ), Division Manager – RF Engineering, and Director – Radio Spectrum Management, 1977-83 • AT&T Long Lines, Group Supervisor – Microwave Radio System Design, 1972-77
Specific RF Safety / Compliance Experience:	• Involved in RF exposure matters since 1972 • Have had lead corporate responsibility for RF safety and compliance at AT&T, Bellcore, Edwards & Kelcey, and PTG • While at AT&T, helped develop the mathematical models later adopted by the FCC for predicting RF exposure • Have been relied on for compliance by all major wireless carriers, as well as by the federal government, several state and local governments, equipment manufacturers, system integrators and other consulting / engineering firms
Other Background:	• Author, Microwave System Engineering (AT&T, 1974) • Co-author and executive editor, A Guide to New Technologies and Services (Bellcore, 1993) • National Spectrum Managers Association (NSMA) – former three-term President and Chairman of the Board of Directors; earlier was founding member and twice-elected as Vice President; served as long-time member of the Board, and was named an NSMA Fellow in 1991 • Listed in Who's Who in the Media and Communication and International Who's Who in Information Technology • Published more than 35 articles in industry magazines