PINNACLE TELECOM GROUP
Consulting and Engineering Services

ANTENNA SITE FCC RF COMPLIANCE ASSESSMENT AND REPORT

OMNIPOINT COMMUNICATIONS

SITE NJ-07-150L
89 ROUTE 46
BUDD LAKE, NJ

FEBRUARY 5, 2009

14 RIDGEDALE AVENUE - SUITE 209 • CEDAR KNOLLS, NJ 07927 • 973-451-1630

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Introduction and Summary

At the request of Omnipoint Communications (also known as T-Mobile), Pinnacle Telecom Group has performed an independent assessment of radiofrequency (RF) levels and related FCC compliance for a proposed wireless base station operation involving a monopole to be constructed at 89 Route 46 in Budd Lake, NJ. Omnipoint refers to the site by the code "NJ-07-150L".

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, while the antenna structure may be designed to accommodate future collocation, at this point there are no other specifically planned antenna operations to include in this compliance assessment. Note that FCC regulations require any future collocators to specifically assess and assure continuing compliance based on the RF effects of all existing and then-proposed antennas at the site.

This report describes a mathematical analysis of RF levels around the site at ground level that will result from the proposed antenna operations. The compliance analysis employs a standard FCC formula for calculating the effects of the antennas in a very conservative manner, in order to overstate the RF levels and ensure "safe-side" conclusions regarding compliance with the FCC limit for safe continuous exposure of the general public.

The results of a compliance assessment can be described in layman's terms by expressing the calculated RF levels as simple percentages of the FCC MPE limit. If the normalized reference for that limit is 100 percent, then calculated RF levels higher than 100 percent indicate the MPE limit is exceeded and there is a need to mitigate the potential exposure. On the other hand, calculated RF levels consistently below 100 percent serve as a clear and sufficient demonstration of compliance with the MPE limit. We can (and will) also describe the overall worst-case result via the “plain-English” equivalent “times-below-the-limit” factor.

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

- The maximum calculated RF level from the proposed antenna operation at the site is 0.0630 percent (i.e., less than 1/10th of one percent) of the FCC MPE limit; in other words, the worst-case calculated RF level – intentionally and significantly overstated by the calculations – is more than 1,580 times below the FCC limit for safe, continuous exposure of the general public.
- The results of the analysis provide a clear demonstration that the RF levels from the proposed antenna operations at this site will satisfy the criteria for controlling potential human exposure to RF fields, and the antenna operation will be in full compliance with the FCC regulations and limits concerning RF safety. Moreover, because of the conservative methodology and operational assumptions applied in the analysis, RF levels actually caused by the antennas will be even less significant than the calculation results here indicate.

The remainder of this report provides the following:

- relevant technical data on the proposed Omnipoint antenna operation at the site;
- a description of the applicable FCC mathematical model for assessing MPE compliance at street level around a site, and application of the relevant technical data to that model; and
- analysis of the results of the calculations against specified the FCC MPE limit, and the compliance conclusion for the site.

In addition, three Appendices are included. Appendix A provides background on the FCC MPE limit, as well as that of the State of New Jersey (see later). Appendix B provides a list of key FCC references on MPE compliance, and

Appendix C provides a summary of the qualifications of the expert certifying FCC compliance for this site.

We recognize that the State of New Jersey also has its own MPE limit, embodied in the *Radiation Protection Act*. However, the State's limit is less protective of the general public (by a factor of five) than the FCC limit. Thus, it is more appropriate to apply in the exposure assessment the more protective FCC limit. Compliance with the FCC's limit automatically ensures compliance with the State's limit, in this case by a factor of more than 7,900.

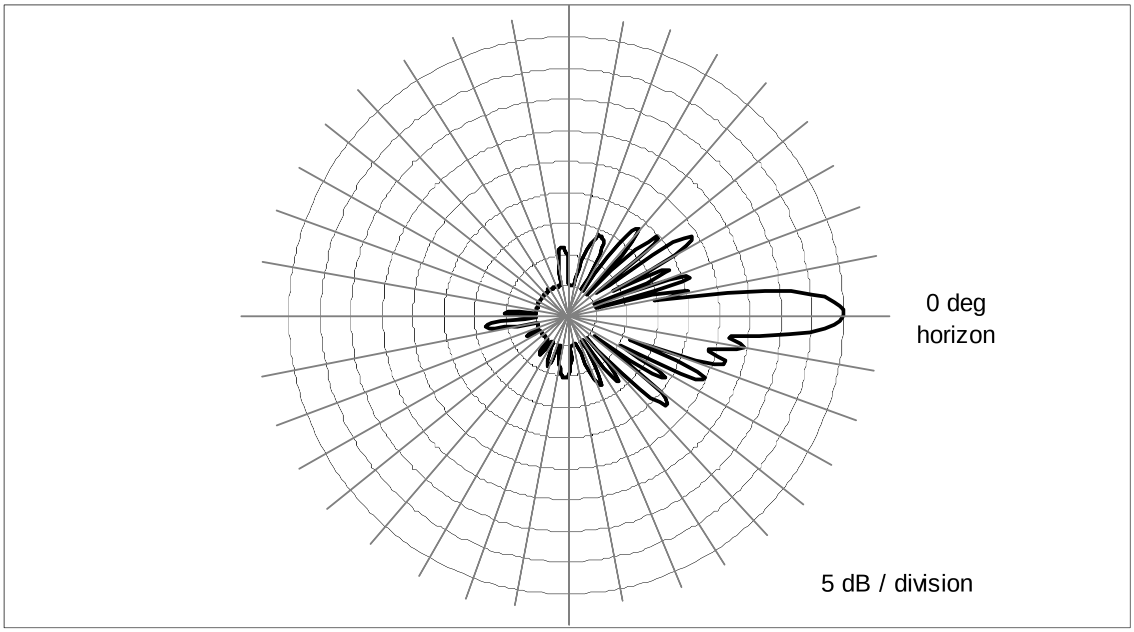
Antenna and Transmission Data

The table below summarizes the relevant technical data for the proposed Omnipoint antenna operation.

Technical Data - Omnipoint	
Frequency Band	1900 MHz PCS
Service Coverage Type	Sectorized – with identical transmission and compliance-related parameters
Antenna Type	Directional Panel
Antenna Manufacturer & Model	RFS APX16DWV-16DWV-S-E-A20 (or equiv.)
Maximum Antenna Gain	18.4 dBi
Antenna Height AGL	120 ft. (to top)
RF Channels per Sector	8
Transmitter Power / RF Channel	20 watts
Antenna Line Loss	Conservatively ignored (assumed 0 dB)

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 of the relative amount of RF emissions in the "downward" direction. Figure 1 on the following page shows the vertical-plane radiation pattern of the antenna model proposed here by Omnipoint. In these antenna radiation pattern diagrams, 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.

Figure 1. RFS APX16DWV-16DWV-S-E-A20 Panel Antenna - Vertical-plane Radiation Pattern



Mathematical Compliance Analysis

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

At street level around an antenna site (in what is called the "far field" of the antennas), the RF levels are directly proportional to the total antenna input power and the relative antenna gain in the downward direction of interest – and the levels are otherwise inversely proportional to the square of the straight-line distance to the antenna. Conservative calculations also assume the potential RF exposure is enhanced by reflection of the RF energy from the ground. Our calculations will assume a 100% "perfect" reflection, the worst-case approach.

The FCC's formula for street-level MPE compliance calculations for 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 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; pattern data is taken from the antenna manufacturer specifications
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 Figure 2 on the next page.

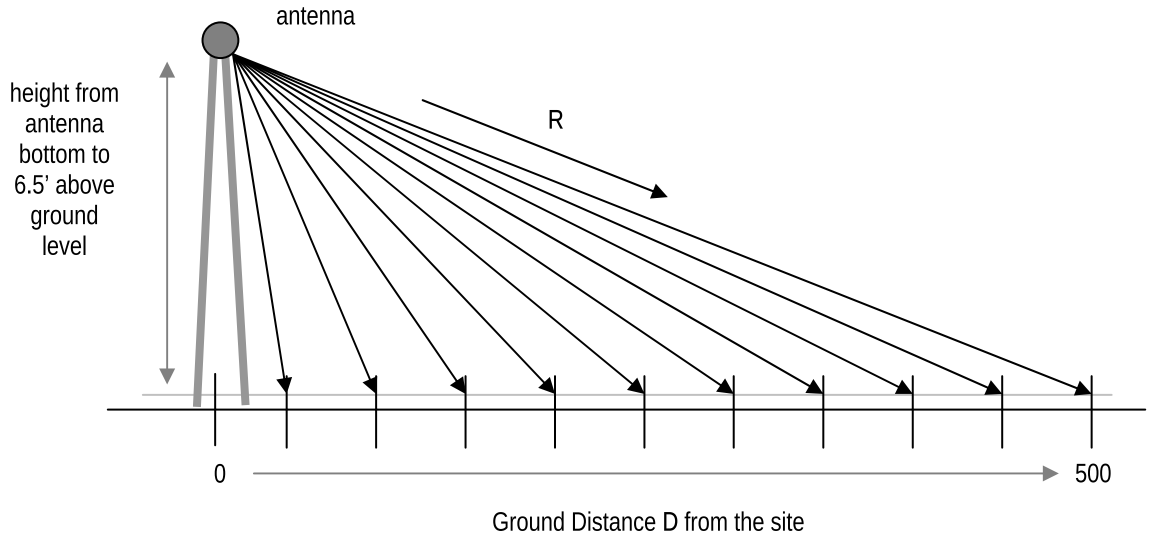


Figure 2. Street-level MPE% Calculation Geometry

It is popularly understood 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.

According to the FCC, when directional antennas such as panels are involved, compliance assessments are based on the RF effect of a single, facing, antenna sector – because the RF contributions of directional antennas facing away from the point of interest are considered insignificant.

FCC compliance is assessed in the following manner. At each distance point along the ground, an MPE% calculation is made, and the result at each point is compared to 100 percent, which serves as the normalized reference for the FCC MPE limit. Any calculated MPE% result exceeding 100 percent is, by definition, higher than the FCC limit and represents non-compliance and a need to mitigate the RF levels. If, on the other hand, all results are below 100 percent, that set of results serves as a demonstration of compliance with the MPE limit.

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

1. The antennas are assumed to be operating continuously at maximum power, and the power-attenuation effects of antenna cabling ("antenna line loss") are ignored wherever possible.
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.

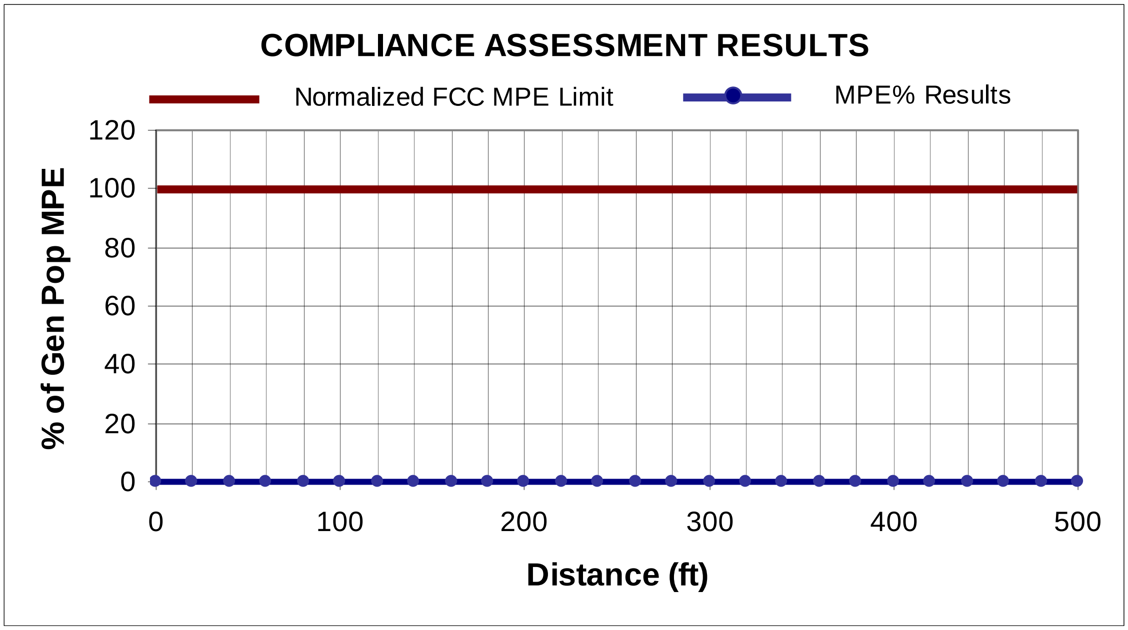
The net result of these assumptions is to intentionally and significantly overstate the calculated RF levels relative to the levels that will actually result from the antenna operations – and the purpose of this conservatism is to allow very "safe-side" conclusions about compliance.

The table on the next page provides the results of the MPE% calculations, with the worst-case result highlighted in bold.

Ground Distance (ft)	**Omnipoint MPE%**
0	0.0099
20	0.0014
40	0.0020
60	0.0092
80	0.0071
100	0.0017
120	**0.0630**
140	0.0182
160	0.0153
180	0.0146
200	0.0023
220	0.0434
240	0.0494
260	0.0314
280	0.0017
300	0.0040
320	0.0174
340	0.0322
360	0.0397
380	0.0362
400	0.0253
420	0.0153
440	0.0140
460	0.0130
480	0.0120
500	0.0187

As indicated in bold in the last column, the worst-case overall calculated result is only 0.0630 percent (i.e., less than 1/10th of one percent) of the FCC MPE limit.

A graph of the calculation results, on the next page, provides perhaps a clearer *visual* illustration of the insignificance of the calculated RF levels. The line representing the calculation results does not visibly rise above the graph's baseline, and shows an obviously clear, consistent 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 safe.

As described, the maximum calculated RF level from the combination of proposed and existing antenna operations at this site is only 0.0630 percent i.e., less than 1/10th of one percent) of the FCC MPE limit. In other words, even with the significant degree of conservatism incorporated in the analysis, the worst-case calculated RF level is still more than 1,580 times below the FCC MPE limit (and, correspondingly, more than 7,900 times below the MPE limit specified in the New Jersey *Radiation Protection Act*).

The results of the calculations indicate clear compliance with the FCC MPE limit, as well as with that of the State of New Jersey. Moreover, because of the conservative calculation methodology and operational assumptions applied in this compliance analysis, the RF levels actually caused by the antennas will be even less significant than the calculation results here indicate.

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*), as well as the related provisions of the State of New Jersey's *Radiation Protection Act* (N.J.S.A 26:2D *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 subject antenna operations will be in full compliance with the FCC regulations concerning potential human exposure to the RF emissions from antennas.

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

2/5/09
Date

Appendix A: The FCC and State of New Jersey MPE Limits

FCC Rules and Regulations

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.

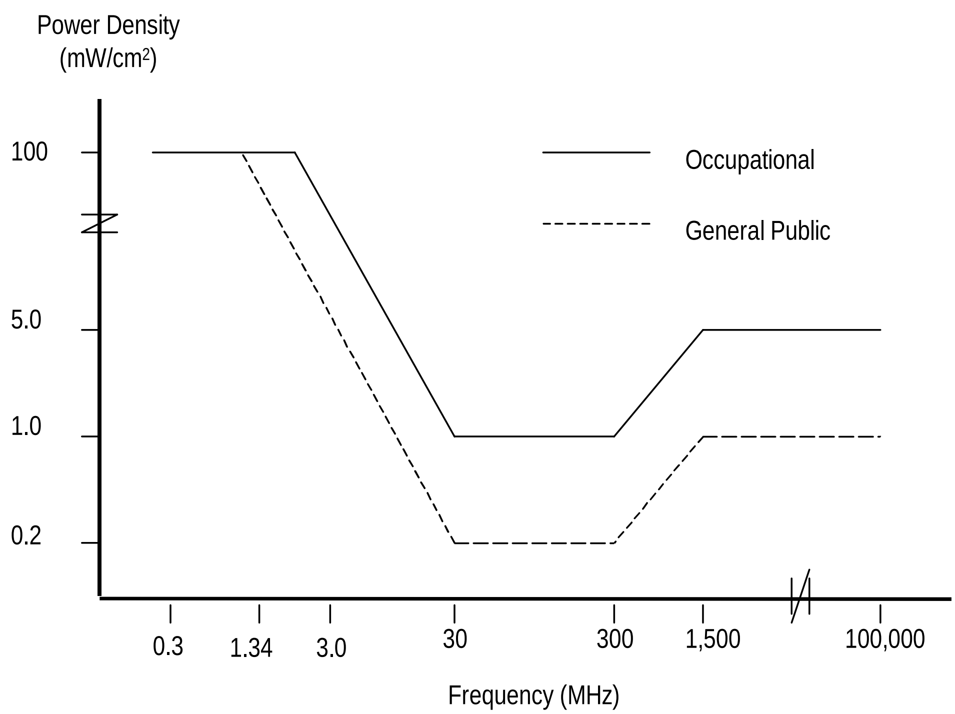
The specified continuous exposure MPE limits are based on known variation of human body susceptibility in different frequency ranges, and a Specific Absorption Rate (SAR) of 4 watts per kilogram, which is universally considered to accurately represent human capacity to dissipate incident RF energy (in 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/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.

New Jersey's Radiation Protection Act

The State of New Jersey's *Radiation Protection Act* (N.J.S.A 26:2D *et seq*) includes virtually identical language to the FCC's regulations regarding potential human exposure to RF fields.

There is, however, one critical difference between the respective MPE limits described in each source. While the FCC describes two tiers of MPE limits – one for "uncontrolled" exposure of the general population, and one five times less strict for "controlled" occupational exposure – the New Jersey Radiation Protection Act only describes one limit, applicable to all circumstances, and that limit is identical to the FCC's "controlled" occupational exposure.

Therefore, since the limit chosen in New Jersey matches the FCC's occupational limit but applies to exposure of the general public as well, the New Jersey limit is less protective of the general public by a factor of five, relative to the FCC's limit for the general public.

Appendix B: FCC References on MPE Compliance

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 C: Expert Qualifications

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

Synopsis:	• 36 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 12,000 antenna sites since the latest FCC regulations went into effect in 1997 • Has provided testimony as an RF compliance expert more than 1,200 times since 1997 • Have been accepted as an FCC compliance 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 Management Association (NSMA) – former three-term President and Chairman of the Board of Directors; was founding member, twice-elected Vice President, 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