Pinnacle Telecom Group
Professional and Technical Services
Telecom Consulting

Antenna Site RF Compliance Assessment and Report

Crown Castle

DAS Sites
"East Harlem_13" and "NYD0044"
Fifth Avenue & E. 102nd and E. 103rd Streets
New York, NY

June 22, 2017

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Introduction and Summary

On June 21, 2017, at the request of Crown Castle, Pinnacle Telecom Group (PTG) performed independent expert on-site measurements of potential radiofrequency (RF) exposure at two distributed antenna system (DAS) sites mounted on top of street light poles, one at the intersection of Fifth Avenue and East 102nd Street, and the other at the intersection of Fifth Avenue and East 103rd Street, New York, NY. Crown Castle identifies the site at East 102nd Street as "East Harlem_13", and the site at East 103rd Street as "NYD0044".

The area at street level around the sites is open to the general public; therefore, the site is considered "uncontrolled" and the FCC's "general population" limit for maximum permissible exposure (MPE) is applied in assessing compliance. Measurements of RF levels were performed in normally accessible areas along Fifth Avenue north and south of the sites. Joseph Klem of Crown Castle was present during the measurements, as was Judith Garcia of the New York City Department of Information Technology & Telecommunications and Joseph Menio of PTG. David Collins of PTG performed the measurements.

The results of a compliance assessment such as this can most clearly be explained by describing the RF levels as simple percentages of the FCC MPE limit. If the reference for that limit is 100 percent, then RF levels higher than 100 percent indicate the MPE limit is exceeded, while RF levels lower than 100 percent indicate compliance with the limit.

The results of the on-site measurements are as follows:

- Measurements at street level around the antenna sites indicated a maximum RF level of 2.7805 percent of the FCC general population MPE limit. In other words, the maximum RF level measured at street level at the site was more than 35 times below the most protective limit applicable by law.
- Therefore, the site is clearly in compliance with the FCC requirements for control of RF exposure.

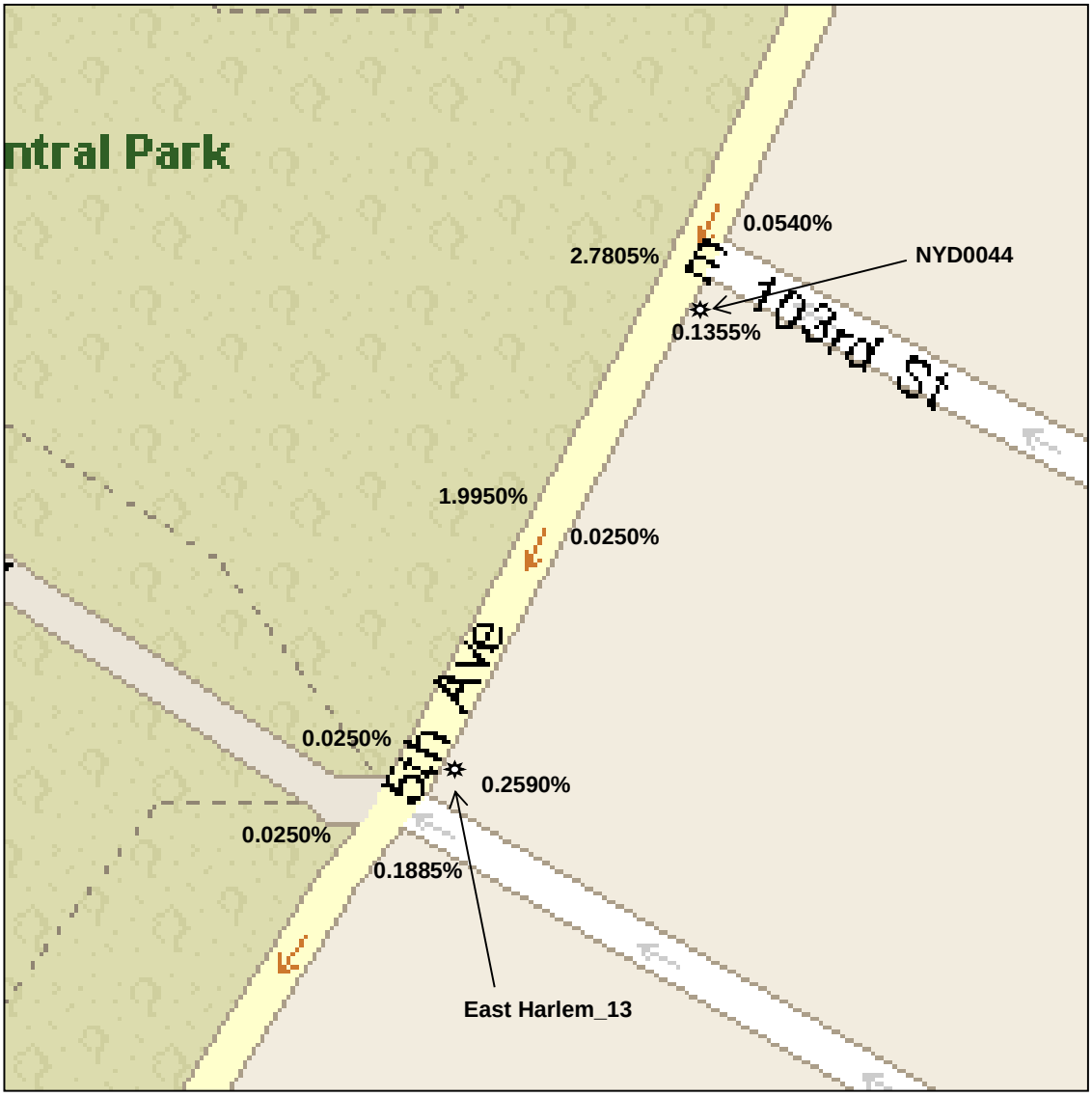
The remainder of this report provides a description of the site, the measurements results and an analysis of those results with respect to RF compliance. Several appendices are included. Appendix A provides photographs of the site. Appendix B provides a description of the measurement equipment and procedures. Appendix C provides background on the FCC limits for RF exposure, along with a list of FCC references on compliance. Lastly, Appendix D provides a summary of the background and qualifications of the individual certifying compliance for the subject antenna site.

Site Description and Antenna Data

Each site consists of one omnidirectional antenna mounted at the top of a street light pole. The "East Harlem_13" site is located on the northeast corner of Fifth Avenue and East 102nd Street. The "NYD0044" site is located on the southeast corner of Fifth Avenue and East 103rd Street.

Measurement Results

The results of the measurements, expressed as a percentage of the FCC general population MPE limit, are overlaid on the map (extracted from Microsoft's *Streets and Trips)* shown on the following page.



As shown, the maximum measured RF level was 2.7805 percent of the FCC general population MPE limit, found at the southwest corner of Fifth Avenue and East 103rd Street.

Compliance Analysis and Conclusion

The results of the on-site measurements indicate that the RF levels at the sites are far below the FCC limit. The highest RF level measured at street level around the site was 2.7805 percent of the FCC general population MPE limit. Therefore, the sites are clearly in compliance with the FCC requirements for the control of RF exposure.

Certification

The undersigned hereby 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. The equipment used to perform the RF measurements described herein is appropriate to the task, and calibration of its accuracy has been performed within the past 12 months as recommended by the manufacturer.
3. The on-site RF measurements described herein were performed in a manner consistent with industry standards.
4. To the best of my knowledge, the statements and information disclosed in this report are true, complete and accurate.
5. The analysis of site RF compliance provided herein is consistent with the applicable FCC regulations, additional guidelines issued by the FCC, and industry practice.

Daniel Penesso

Daniel Penesso
Director – RF Engineering
Pinnacle Telecom Group, LLC

6/22/17
Date

Appendix A. Site Photographs

Photographs of the sites are shown below and on the following page.

NYD0044

Detail view of NYD0044

East Harlem_13

Detail of East Harlem_13

Appendix B. Measurement Equipment and Procedure

RF measurements were performed using a Narda model EA5091 RF probe and Narda model NBM-520 RF meter. Both the probe and meter are capable of broadband RF measurements, covering a range of 300 kHz to 50 GHz. The measuring equipment is designed to automatically register all RF levels within the frequency range and report them as percentages of the FCC's overall occupational MPE limit. Converting the measurement result to reference the general population MPE limit is simply a matter of multiplying the readout by five.

The equipment was calibrated by the manufacturer within the past 12 months.

The measurements were taken in a manner consistent with training provided by the equipment manufacturer, including the “RF Field Measurements for Antenna Sites” videotape, developed by Richard Tell Associates and now included as part of the Narda equipment package.

In order to ensure "safe-side" results, maximum RF spot-levels were measured and reported in all areas. In accordance with guidance shared with us by the FCC staff, sufficient time was spent performing the measurements to gather a “real-world” depiction of RF levels.

Appendix C. Background on the FCC MPE Limits

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.

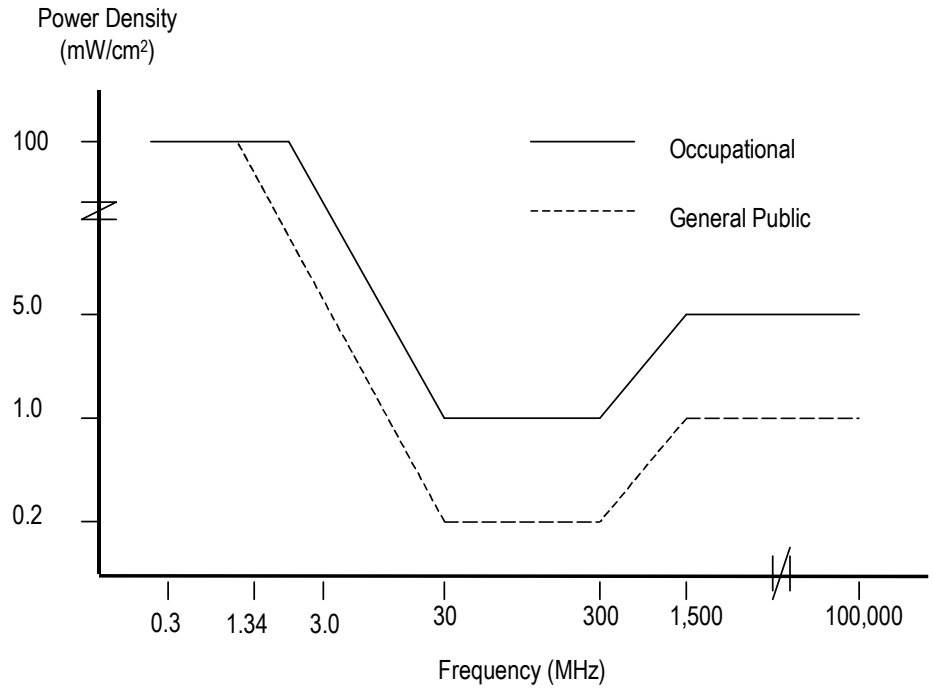
The specified continuous exposure MPE limits are based on known variation of human body susceptibility in different frequency ranges, and a Specific Absorption Rate (SAR) of 4 watts per kilogram, which is universally considered to accurately represent human capacity to dissipate incident RF energy (in 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. Continuous exposure at levels equal to or below the applicable MPE limits is considered to result in no adverse health effects on humans.

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.

References on FCC 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.

“RF Field Measurements for Antenna Sites”, (video), Richard Tell Associates Inc., 1997.

“EME Awareness for Antenna Site Safety”, (video), Motorola (produced in association with Richard Tell Associates Inc.), 1997.

Appendix D. Summary of Expert Qualifications

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

Synopsis:	• 19 years of experience in all aspects of wireless RF engineering, including network design and implementation, interference analysis, FCC and FAA regulatory matters, and antenna site compliance with FCC RF exposure regulations • Have performed RF engineering and FCC compliance work for all the major wireless carriers – AT&T, Verizon Wireless, Sprint, T-Mobile, and MetroPCS, as well as Crown Castle • Have served as an expert witness on RF engineering and/or FCC RF compliance more than 100 times before municipal boards in New Jersey and New York
Education:	• Bachelor of Science in Electrical Engineering, DeVry Institute of Technology, Chicago, IL, 1987
Current Responsibilities	• Manages PTG staff work involving FCC RF compliance for wireless antenna sites, including the provision of math- and measurements-based site compliance reports, related expert testimony in municipal hearings, and compliance-related support in client meetings with prospective site landlords and in town meetings • Provides math-based FCC compliance assessments and reports for PTG's wireless clients, including AT&T, Verizon Wireless, T-Mobile, Sprint, MetroPCS, and Crown Castle • Responsible for providing client consulting and in-house training on FCC and OSHA RF safety compliance
Prior Experience:	• Have served as senior RF engineer for four of the five national wireless carriers – AT&T, T-Mobile, Sprint, and MetroPCS – in the New York and New Jersey markets • Served as an RF engineer for Metricom, Triton PCS, Alltel Communications, and Western Wireless • Have worked as an RF engineer for several engineering services companies, including Sublime Wireless, Amirit Technologies, Celcite, and Wireless Facilities Incorporated