City of Santa Rosa • RF Exposure Conditions
520 Third Street • Santa Rosa, California

Statement of Hammett & Edison, Inc., Consulting Engineers

The firm of Hammett & Edison, Inc., Consulting Engineers, has been retained by the City of Santa Rosa to evaluate radio-frequency exposure conditions at 520 Third Street in Santa Rosa, California, due to existing radio facilities on the adjacent AT&T (formerly SBC) building at 516 Third Street.

Prevailing Exposure Standards

The U.S. Congress requires that the Federal Communications Commission ("FCC") evaluate its actions for possible significant impact on the environment. In Docket 93-62, effective October 15, 1997, the FCC adopted the human exposure limits for field strength and power density recommended in Report No. 86, "Biological Effects and Exposure Criteria for Radiofrequency Electromagnetic Fields," published in 1986 by the Congressionally chartered National Council on Radiation Protection and Measurements ("NCRP"). Separate limits apply for occupational and public exposure conditions, with the latter limits generally five times more restrictive. The more recent Institute of Electrical and Electronics Engineers ("IEEE") Standard C95.1-2005, "Safety Levels with Respect to Human Exposure to Radio Frequency Electromagnetic Fields, 3 kHz to 300 GHz," includes similar exposure limits. A summary of the FCC's exposure limits is shown in Figure 1. These limits apply for continuous exposures and are intended to provide a prudent margin of safety for all persons, regardless of age, gender, size, or health.

The most restrictive limit for exposures of unlimited duration to radio frequency energy for several personal wireless services are as follows:

Service Type	Approx. Frequency	Occupational Limit	Public Limit
Various Microwave Bands	up to 100 GHz	5.00 mW/cm^2	1.00 mW/cm^2
Personal Communication ("PCS")	1,950 MHz	5.00	1.00
Cellular Telephone	870	2.90	0.58
Specialized Mobile Radio	855	2.85	0.57
Land Mobile Radio	450	1.50	0.30
[most restrictive frequency range]	30–300	1.00	0.20

General Facility Requirements

Antennas for base station use are designed to concentrate their energy toward the horizon, with very little energy wasted toward the sky or the ground. Along with the low power of such facilities, this means that it is generally not possible for exposure conditions to approach the FCC limits without being physically very near the antennas.

Computer Modeling Method

The FCC provides direction for determining compliance in its Office of Engineering and Technology Bulletin No. 65, "Evaluating Compliance with FCC-Specified Guidelines for Human Exposure to Radio Frequency Radiation," dated August 1997. Figure 2 attached describes the calculation methodologies, reflecting the facts that a directional antenna's radiation pattern is not fully formed at locations very close by (the "near-field" effect) and that at greater distances the power level from an energy source decreases with the square of the distance from it (the "inverse square law"). The conservative nature of this method for evaluating exposure conditions has been verified by numerous field tests.

Site Description

The AT&T building located at 516 Third Street was visited by Mr. Weston Lane, a qualified engineer employed by Hammett & Edison, Inc., during normal business hours on February 21, 2007, a non-holiday weekday. Installed on the face of the roof parapet were four groups of three directional panel SMR antennas for use by Sprint Nextel, at an effective height of about 96 feet above ground, and installed on poles above the parapet were three pairs of directional panel PCS antennas for use by T-Mobile, at an effective height of about 105 feet above ground. AT&T has installed nine 10-foot diameter microwave antennas on a 60-foot structure above the roof for backhaul service in the 6 and 11 GHz bands. Figure 3 attached shows the relative positions of these antennas with respect to the subject site at 520 Third Street. AT&T also has several omnidirectional mobile radio antennas installed at the top of the tower, at an effective height of about 193 feet above ground.

Sprint Nextel reports that it has installed Andrew Model DB874G105 antennas in the group oriented toward 520 Third Street and operates with a maximum effective radiated power ("ERP") in that direction of 700 watts. T-Mobile reports that it has installed Andrew Model 961DD90 antennas and operates with a maximum ERP of 1,600 watts. Only one of the omnidirectional antennas is reported to transmit, at an ERP of 360 watts; the others are receive-only. Only one of the microwave antennas is reported to transmit, with a total input power of 15 watts, on the path that passes over the building site at 520 Third Street; the other three on that path are receive-only.

Study Results

The Santa Rosa Redevelopment Agency is considering the acquisition of the building at 520 Third Street without any current plans to make physical changes to the existing building. However, it may in the future propose to refurbish or replace the building, which could result in keeping the building at its present height of 79 feet above ground or increasing the height up to 148 feet above ground. At the lower height, no change in the existing operations at 516 Third Street would be required; RF exposure levels on the roof and within the building would be well below the applicable public limit (0.29% and 0.12%, respectively). Even if the building volume were expanded to include the additional area shown on Figure 3, exposure levels would still be well below the applicable limit (5.2% and 1.9%, respectively, on the roof and within the top floor).

At the taller height, the two T-Mobile antennas closest to the new building may be blocked by the new structure, so the carrier may need to relocate the antennas in order to maintain service in those directions; possible positions are shown in Figure 3. If the building footprint is expanded, as well, the Sprint Nextel antennas facing 520 Third Street would be blocked, so that carrier would need to relocate those antennas; a position such as that shown in Figure 3 would likely be suitable. RF exposure levels in those circumstances would be below the applicable limit for persons on the roof of or inside the new, taller building (68% and 2.4%, respectively, for the existing building footprint, and 68% and 5.4%, respectively, for the expanded footprint).

Conclusion

Based on the information and analysis above, it is the undersigned's professional opinion that a refurbished or new building at 520 Third Street in Santa Rosa, California, can be occupied by business or residential tenants in full compliance with prevailing standards limiting human exposure to RF energy.

Authorship

The undersigned author of this statement is a qualified Professional Engineer, holding California Registration Nos. E-13026 and M-20676, which expire on June 30, 2007. This work has been carried out under his direction, and all statements are true and correct of his own knowledge except, where noted, when data has been supplied by others, which data he believes to be correct.

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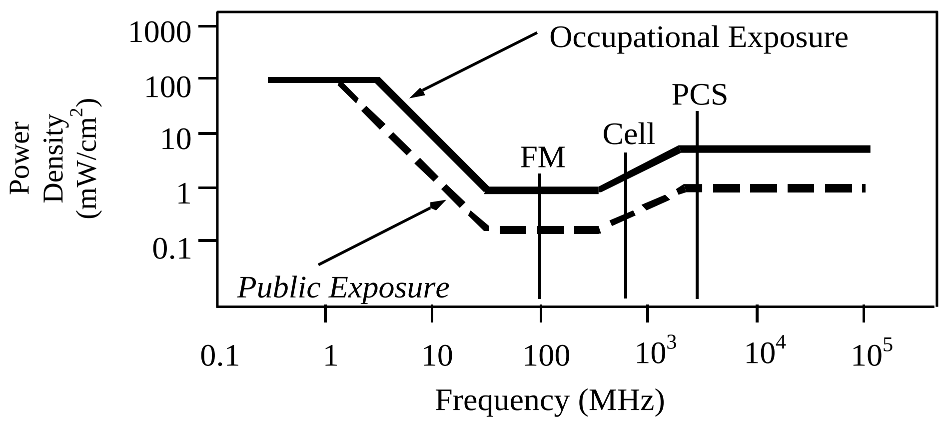
February 23, 2007

FCC Radio Frequency Protection Guide

The U.S. Congress required (1996 Telecom Act) the Federal Communications Commission ("FCC") to adopt a nationwide human exposure standard to ensure that its licensees do not, cumulatively, have a significant impact on the environment. The FCC adopted the limits from Report No. 86, "Biological Effects and Exposure Criteria for Radiofrequency Electromagnetic Fields," published in 1986 by the Congressionally chartered National Council on Radiation Protection and Measurements, which are similar to the more recent Institute of Electrical and Electronics Engineers Standard C95.1-2005, "Safety Levels with Respect to Human Exposure to Radio Frequency Electromagnetic Fields, 3 kHz to 300 GHz." These limits apply for continuous exposures from all sources and are intended to provide a prudent margin of safety for all persons, regardless of age, gender, size, or health.

As shown in the table and chart below, separate limits apply for occupational and public exposure conditions, with the latter limits (in *italics* and/or dashed) up to five times more restrictive:

Frequency	Electromagnetic Fields (f is frequency of emission in MHz)					
Applicable Range (MHz)	Electric Field Strength (V/m)		Magnetic Field Strength (A/m)		Equivalent Far-Field Power Density (mW/cm^2)	
0.3 – 1.34	614	*614*	1.63	*1.63*	100	*100*
1.34 – 3.0	614	*823.8/ f*	1.63	*2.19/ f*	100	*180/ f^2*
3.0 – 30	1842/ f	*823.8/ f*	4.89/ f	*2.19/ f*	900/ f^2	*180/ f^2*
30 – 300	61.4	*27.5*	0.163	*0.0729*	1.0	*0.2*
300 – 1,500	$3.54\sqrt{f}$	*$1.59\sqrt{f}$*	$\sqrt{f}/106$	*$\sqrt{f}/238$*	f/300	*f/1500*
1,500 – 100,000	137	*61.4*	0.364	*0.163*	5.0	*1.0*



Higher levels are allowed for short periods of time, such that total exposure levels averaged over six or thirty minutes, for occupational or public settings, respectively, do not exceed the limits, and higher levels also are allowed for exposures to small areas, such that the spatially averaged levels do not exceed the limits. However, neither of these allowances is incorporated in the conservative calculation formulas in the FCC Office of Engineering and Technology Bulletin No. 65 (August 1997) for projecting field levels. Hammett & Edison has built those formulas into a proprietary program that calculates, at each location on an arbitrary rectangular grid, the total expected power density from any number of individual radio sources. The program allows for the description of buildings and uneven terrain, if required to obtain more accurate projections.

RFR.CALC™ Calculation Methodology

Assessment by Calculation of Compliance with FCC Exposure Guidelines

The U.S. Congress required (1996 Telecom Act) the Federal Communications Commission ("FCC") to adopt a nationwide human exposure standard to ensure that its licensees do not, cumulatively, have a significant impact on the environment. The maximum permissible exposure limits adopted by the FCC (see Figure 1) apply for continuous exposures from all sources and are intended to provide a prudent margin of safety for all persons, regardless of age, gender, size, or health. Higher levels are allowed for short periods of time, such that total exposure levels averaged over six or thirty minutes, for occupational or public settings, respectively, do not exceed the limits.

Near Field.

Prediction methods have been developed for the near field zone of panel (directional) and whip (omnidirectional) antennas, typical at wireless telecommunications base stations, as well as dish (aperture) antennas, typically used for microwave links. The antenna patterns are not fully formed in the near field at these antennas, and the FCC Office of Engineering and Technology Bulletin No. 65 (August 1997) gives suitable formulas for calculating power density within such zones.

For a panel or whip antenna, power density $S = \frac{180}{\theta_{BW}} \times \frac{0.1 \times P_{net}}{\pi \times D \times h}$, in mW/cm^2,

and for an aperture antenna, power density $S = \frac{0.1 \times 16 \times \eta \times P_{net}}{\pi \times h^2}$, in mW/cm^2,

where θ_{BW} = half-power beamwidth of the antenna, in degrees, and
P_{net} = net power input to the antenna, in watts,
D = distance from antenna, in meters,
h = aperture height of the antenna, in meters, and
η = aperture efficiency (unitless, typically 0.5-0.8).

The factor of 0.1 in the numerators converts to the desired units of power density.

Far Field.

OET-65 gives this formula for calculating power density in the far field of an individual RF source:

$$\text{power density } S = \frac{2.56 \times 1.64 \times 100 \times RFF^2 \times ERP}{4 \times \pi \times D^2}, \text{ in mW/cm}^2,$$

where ERP = total ERP (all polarizations), in kilowatts,
RFF = relative field factor at the direction to the actual point of calculation, and
D = distance from the center of radiation to the point of calculation, in meters.

The factor of 2.56 accounts for the increase in power density due to ground reflection, assuming a reflection coefficient of 1.6 (1.6 x 1.6 = 2.56). The factor of 1.64 is the gain of a half-wave dipole relative to an isotropic radiator. The factor of 100 in the numerator converts to the desired units of power density. This formula has been built into a proprietary program that calculates, at each location on an arbitrary rectangular grid, the total expected power density from any number of individual radiation sources. The program also allows for the description of uneven terrain in the vicinity, to obtain more accurate projections.

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Site Plan showing Antenna Locations on Adjacent Building

△ possible alternate locations;
△ see text for explanation

▲ Sprint Nextel SMR
▲ T-Mobile PCS
▲ AT&T Microwave