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FCC NEPA Compliance study for T-Mobile
PH60907B– PIMA & HAPPY VALLEY TRAFFIC LIGHT

Site number: PH60907B
Site name: Pima & Happy Valley Traffic Light
NAD 83: LAT: 33.712999°/ LONG: -111.890744°

Introduction.

A substantial amount of scientific research conducted all over the world over many years demonstrates that radio signals within established safety levels emitted from mobile telephones and their base stations present no adverse effects to human health. There exist national and international safety guidelines for exposure of the public to radio waves:

- *International Commision on Non- Ionizing Radiation Protection (ICNIRP): Guidelines for limiting exposure to time varying electric, magnetic and electromagnetic fields. Health Physics 1998 74(4): 494-522.*
- *Institute of Electrical and Electronics Engineers (IEEE): IEEE Standard for safety levels with respect to human exposure to radio frequency electromagnetic fields, 3 kHz to 300 GHz. IEEE C95.1-1991 (revision of ANSI C95.1-1982) New York 1992.*
- *CENELEC: Human exposure to electromagnetic fields. High frequency (10 kHz to 300 GHz). European prestandard ENV 50166-2, Brussels 1995.*

The most widely accepted standards are those developed by the International Commission on Non-Ionizing Radiation Protection (ICNIRP) and Institute of Electrical and Electronics Engineers (IEEE). Nokia Base Stations must be installed according to instructions specified by Nokia, as well as taking any country-specific regulations for Non-Ionizing radiation protection into account.

FCC Guidelines for Evaluating Exposure to RF Emissions

In 1985, the FCC first adopted guidelines to be used for evaluating human exposure to RF emissions. The FCC revised and updated these guidelines on August 1, 1996, as a result of a rule-making proceeding initiated in 1993. The new guidelines incorporate limits for Maximum Permissible Exposure (MPE) in terms of electric and magnetic field strength and power density for transmitters operating at frequencies between 300 kHz and 100 GHz. Limits are also specified

for localized ("partial body") absorption that are used primarily for evaluating exposure due to transmitting devices such as hand-held portable telephones.

Implementation of the new guidelines for mobile and portable devices became effective August 7, 1996.

The FCC's MPE limits are based on exposure limits recommended by the National Council on Radiation Protection and Measurements (NCRP)6 and, over a wide range of frequencies, the exposure limits developed by the Institute of Electrical and Electronics Engineers, Inc., (IEEE) and adopted by the American National Standards Institute (ANSI) to replace the 1982 ANSI guidelines.7 Limits for localized absorption are based on recommendations of both ANSI/IEEE and NCRP.

Definitions.

General population/uncontrolled exposure limits apply to situations in which the general
public may be exposed or in which persons who are exposed as a consequence of their employment may not be made fully aware of the potential for exposure or cannot exercise control over their exposure.

Therefore, members of the general public would always be considered under this category when exposure is not employment-related, for example, in the case of a telecommunications tower that exposes persons in a nearby residential area.

The FCC's limits, and the NCRP and ANSI/IEEE limits on which they are based, are derived from exposure criteria quantified in terms of specific absorption rate (SAR). The basis for these limits is a whole-body averaged SAR threshold level of 4 watts per kilogram (4 W/kg), as averaged over the entire mass of the body, above which expert organizations have determined that potentially hazardous exposures may occur. The new MPE limits are derived by incorporating safety factors that lead, in some cases, to limits that are more conservative than the limits originally adopted by the FCC in 1985. Where more conservative limits exist they do not arise from a fundamental change in the RF safety criteria for whole-body averaged SAR, but from a precautionary desire to protect subgroups of the general population who, potentially, may be more at risk.

Tower-mounted ("non-rooftop") antennas that are used for PCS telephone warrant a somewhat different approach for evaluation. While there is no evidence that typical installations in these services cause groundlevel exposures in excess of the MPE limits, construction of these towers has been a topic of ongoing public controversy on environmental grounds, and we believe it necessary to ensure that there is no likelihood of excessive exposures from these antennas.

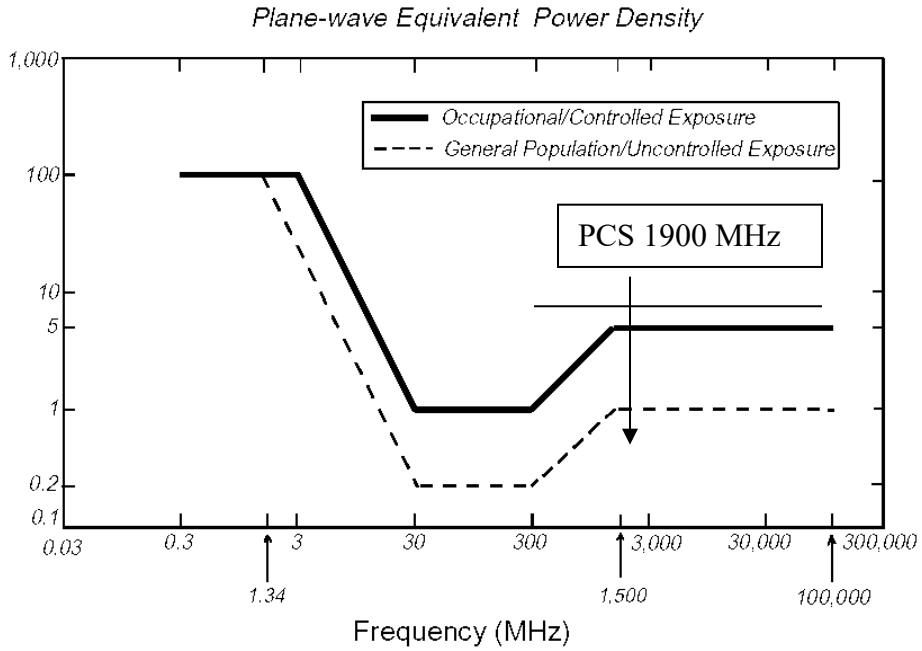
Although we believe there is no need to require routine evaluation of towers where antennas are mounted high above the ground, out of an abundance of caution the FCC requires that tower-mounted installations be evaluated if antennas are mounted lower than 10 meters above ground and the total power of all channels being used is over 1000 watts effective radiated power (ERP), or 2000 W ERP for broadband PCS.

These height and power combinations were chosen as thresholds recognizing that a theoretically "worst case" site could use many channels and several thousand watts of power. At such power levels a height of 10 meters above ground is not an unreasonable distance for which an evaluation generally would be advisable.

For antennas mounted higher than 10 meters, measurement data for cellular facilities have indicated that ground-level power densities are typically hundreds to thousands of times below the new MPE limits.

General population/uncontrolled exposures apply in situations in which the general public may be exposed, or in which persons that are exposed as a consequence of their employment may not be fully aware of the potential for exposure or can not exercise control over
their exposure.

Figure 1. FCC Limits for Maximum Permissible Exposure (MPE)



Limits for General Population/Uncontrolled exposure:
-0.08 W/kg as averaged over the whole-body and spatial peak SAR not exceeding 1.6 W/kg as averaged over any 1 gram of tissue (defined as a tissue volume in the shape of a cube).

Exceptions are the hands, wrists, feet and ankles where the spatial peak SAR shall not exceed 4 W/kg, as averaged over any 10 grams of tissue (defined as a tissue volume in the shape of a cube).

General Population/Uncontrolled limits apply when the general public may be exposed, or when persons that are exposed as a consequence of their employment may not be fully aware of the potential for exposure or do not exercise control over their exposure.

(B) Limits for General Population/Uncontrolled Exposure

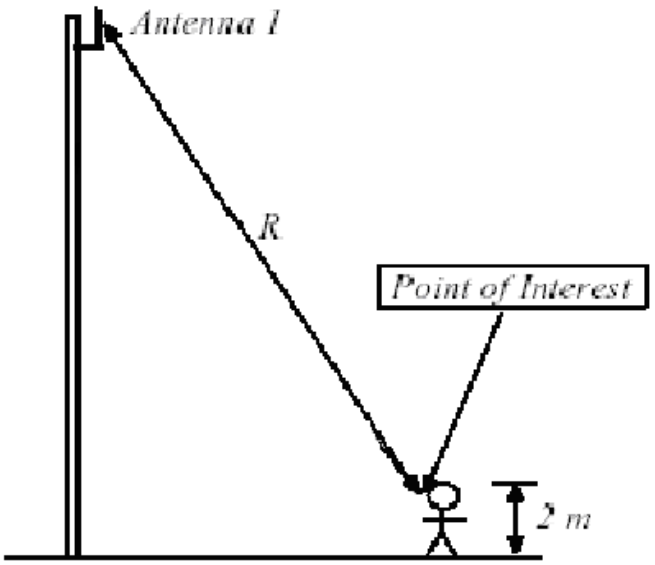
Frequency Range (MHz)	Electric Field Strength (E) (V/m)	Magnetic Field Strength (H) (A/m)	Power Density (S) (mW/cm^2)	Averaging Time $|E|^2$, $|H|^2$ or S (minutes)
0.3-1.34	614	1.63	(100)*	30
1.34-30	824/f	2.19/f	$(180/f^2)$*	30
30-300	27.5	0.073	0.2	30
300-1500	--	--	f/1500	30
1500-100,000	--	--	1.0	30

f = frequency in MHz *Plane-wave equivalent power density

Calculation.

Compliance with SAR limits can be demonstrated by laboratory measurement techniques or by computational modeling, as appropriate. Methodologies and references for SAR evaluation are described in technical publications including "IEEE Recommended Practice for the Measurement of Potentially Hazardous Electromagnetic Fields - RF and Microwave," IEEE C95.3-1991, and further guidance on measurement and computational protocols is being developed by the IEEE and others.

For T-Mobile site PH60907B– PIMA & HAPPY VALLEY TRAFFIC LIGHT, the field situation can be described by the Drawing #1.



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Near-Field Region.

In the near-field, or Fresnel region, of the main beam, the power density can reach a maximum before it begins to decrease with distance. The extent of the near-field can
be described by the following equation (1) having **D** and λ in same units:

$$R_{nf} = \frac{D^2}{4\lambda} \qquad (1)$$

where: Rnf = extent of near-field
D = maximum dimension of antenna (diameter if circular)
λ = wavelength

Therefore,

Value	**ft**
λ =	0.518
D =	5.5
R nf =	**14.6**

(2)

For sector-type antennas, power densities can be estimated by dividing the net input
power by that portion of a cylindrical surface area corresponding to the angular beam width of the antenna. Mathematically, this can be represented by Equation (3) in which the angular beam width, θ _BW, can be taken as the appropriate azimuthal "power dispersion" angle for a given reflector.

$$S = \left(\frac{180}{\theta_{BW}}\right) \frac{P_{net}}{\pi R h} \qquad (3)$$

where:

S = power density
Pnet = net power input to the antenna
θ_BW = beam width of the antenna in degrees
R = distance from the antenna
h = aperture height of the antenna

For example, for the case of a 60-degree azimuthal beam width, the surface area should correspond to 1/6 that of a full cylinder. This would increase the power density near the
antenna by a factor of three over that for a purely omni-directional antenna. For example, a
conservative estimate could be obtained by using the 3 dB (half-power) azimuthal beam width
for a given sectorized antenna. Equation (3) can be used for any vertical collinear antenna, even omni-directional ones.

In case of T-Mobile site PH60907B– PIMA & HAPPY VALLEY TRAFFIC LIGHT, antennas will be installed at 37/28ft+/- above ground level or approx. 1127./853 cm. This distance is more than three times the near field space calculated in table (2). Antenna aperture (vertical dimension) is 8ft or 243.8 cm. Therefore, the formula (3) returns:

Pnet =	28000	mWatt
θ _BW =	50	3dB degree
R =	1127./853	cm
h =	243	cm
MPE=	**0.0794**	mW/cm^2
Exposure limit=	**1.00**	mW/cm^2

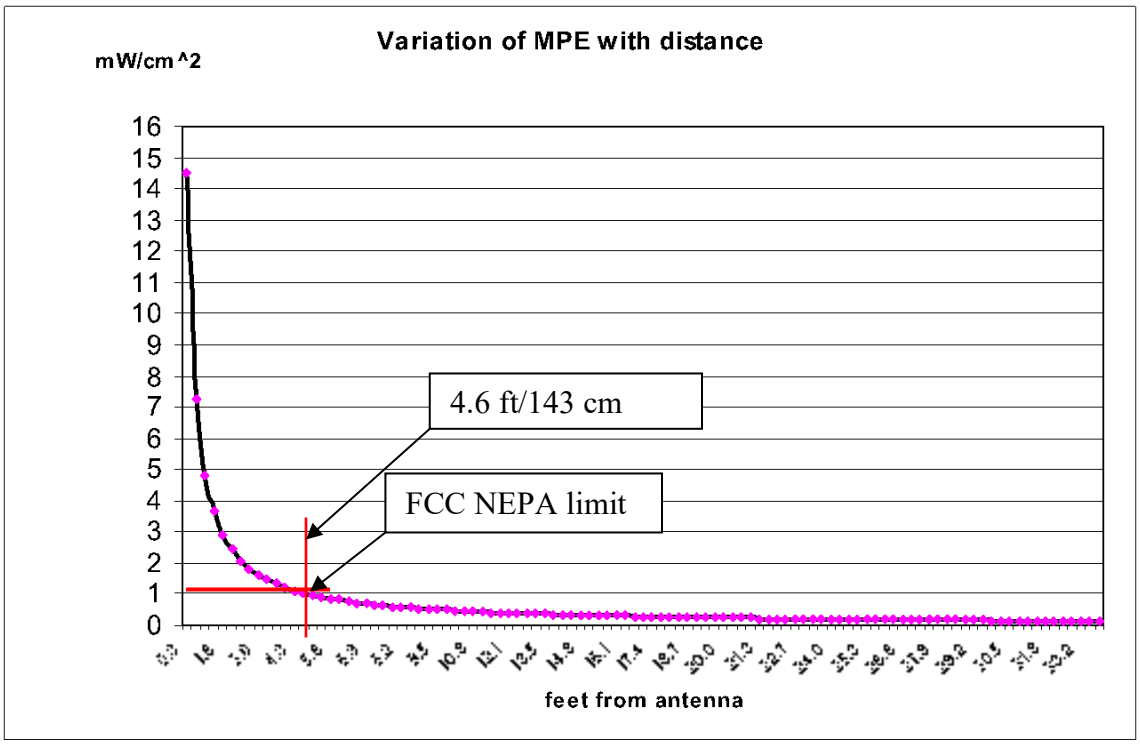
(4)

Fig.1

The results of the analysis indicate that the actual exposure received by an individual standing for 30 minutes at the base of T-Mobile facility will be only 7.5% of the Maximum Permissible Exposure. In order to reach the limit of maximum exposure, an individual must stay strictly at the base of T-Mobile tower for 6.51 continuous hours, which is very unlikely to occur.

Conclusion.

Based on equation (3) the results are plotted to the following graph (5) and will indicate how close to a T-Mobile one sector antenna should be one person placed for more than 30 minutes in order to receive an electromagnetic exposure grater than the MPE specified by FCC rules.



General Population/uncontrolled exposure limits are specified by FCC at a value of 1 mW/cm^2. In order to exceed the above limit one person should be placed closer than 4.7 ft (or 145 cm) in front of the antenna. This situation is very unlikely to occur since T-Mobile antennas are mounted (in case of site PH60907B– PIMA & HAPPY VALLEY TRAFFIC LIGHT) more than 37/28ft above ground level.

T-Mobile RF Department
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