EXHIBIT 10
RF Exposure Guidelines for PCS and Cellular

Applicant: Nortel Networks Inc.

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RF Exposure Guidelines for Cellular, PCS and LMDS Antenna Sites

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1.0 Executive Summary

This document serves as a guideline for the deployment and installation of Nortel Networks' wireless base station equipment with respect to the control of electromagnetic radiation (EMR) exposure. The objective is to provide guidance on where antennas can be deployed, how to calculate power densities and safe distances and how to protect users from excessive exposure to electromagnetic radiation. This guideline is in response to recent regulatory requirements originating in the US aimed at controlling human exposure to EMR.

Safe distance formulae for base stations:

Limits Application	***Uncontrolled r [meters]***	***Controlled r [meters]***
Cellular	$r = 0.300\sqrt{ERP}$	$r = 0.135\sqrt{ERP}$
PCS	$r = 0.228\sqrt{ERP}$	$r = 0.102\sqrt{ERP}$
DCS	$r = 0.228\sqrt{ERP}$	$r = 0.102\sqrt{ERP}$
LMDS	$r = 1$	$r = 0.4$
P-to-P Microwave Radio	$r = 1$	$r = 0.4$

Uncontrolled refers to situations where individuals are either unaware or not in control of their exposure to the electromagnetic fields in question. This typically pertains to the general public.

Controlled refers to situations where individuals are both aware of and in control of their exposure to the electromagnetic fields in question. This typically pertains to trained staff that is in contact with these fields as a result of their employment and have authority to limit their exposure.

Note: This document includes DCS in its examples. If the EU adopts ENV50166, or any other EMR standard, then that document will replace this as the guideline for DCS products. Until that happens, these limits can be used to ensure due diligence on Nortel Networks' behalf.

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2.0 Introduction

Regulatory bodies in the US, Federal Communications Commission (FCC), and Canada, Health Canada, are imposing Maximum Permissible Exposure (MPE) limits. FCC's OET Bulletin #65 (versions in progress) addresses calculation and measurement procedures to determine compliance with the FCC limits which includes the 800 MHz cellular and 1.9 GHz PCS bands. The equipment and its associated deployment must comply with FCC Guidelines, ET Docket No. 93-62, Released August 1, 1996, (FCC 96-326). This standard is largely based on the limits and test methods outlined in IEEE C95.1-1982, NCRP Report No. 86 and C95.3-1982 respectively. The applicable portions of both are summarized in this document to assist in the antenna site planning to ensure compliance.

The exposure limits are currently in effect. The requirement for installers to evaluate the exposure at an installation takes effect on Sept. 1/97. The exposure limits should apply now to all known sites since existing facilities are not exempt or grand fathered from the new rules.

The FCC has determined that certain sites will require "Environmental Evaluations" in order to show compliance to the standards. Adhering to these guidelines can ensure compliance to the standard, and therefore can be the basis for the Environmental Evaluation. Please note that some installations do not require such routine evaluation: exceptions are noted further in this document. Adherence to these guidelines is recommended to promote safety. An installation of equipment that is identified as exempt may require an Environmental Evaluation if the combined energy of other Radio Systems at the site and the new installation could reasonably exceed the safety limits. Environmental Evaluations are kept on hand, as opposed to file with the FCC, unless requested by the FCC for substantiation.

Where Nortel Networks is responsible for installing or engineering base stations, the person in charge should be aware of and have access to documentation for making an Environmental Evaluation. Also, Nortel Networks will need to maintain documentation for assurances to the FCC that Environmental Evaluations have been conducted for each radio station that uses our Experimental Radio License, or STA, where the station transmits at 100 Watt ERP or more.

3.0 Guideline

The objective of the Environmental Evaluation is to ensure that human exposure to RF energy does not exceed the maximum permissible levels stated in the FCC Guidelines, FCC 96-326. Therefore certain sites do not require an evaluation by the nature of its design. It could be that the antennas are placed high enough thereby resulting in extremely low RF fields in areas that would be accessible to people.

Environmental evaluations are required:

- for Paging and Cellular Radiotelephone Services, Part 22 Subpart E and H respectively, and for narrowband PCS, Part 24 Subpart D:

    1. Non-rooftop antennas: height of radiation center < 10m above ground level **and** total power of all channels > 1000 W ERP (1640 W EIRP)

    2. Rooftop antennas: total power of all channels > 1000 W ERP (1640 W EIRP)

- for broadband PCS, Part 24 Subpart E:

    1. Non-rooftop antennas: height of radiation center < 10m above ground level **and** total power of all channels > 2000 W ERP (3280 W EIRP)

    2. Rooftop antennas: total power of all channels > 2000 W ERP (3280 W EIRP)

- for Experimental services > 100 W ERP (164 W EIRP).

An environmental evaluation must be prepared, regardless of the above conditions, should the site be located in any one of the areas mentioned below:

Wilderness Area	Wildlife Preserve
Endangered Species Area	Historical Site
Indian Religious site	Flood Plain (100yrs)
Wetlands	
High intensity lights in residential neighborhoods	

RF energy from other users' equipment must be considered when sharing antenna sites. The total RF must be within the exposure limits. All parties sharing that site are accountable unless the RF energy from their system contributes less than 5% of the total energy. Therefore, when deploying at a shared site, it is recommended that measurements be made at that site prior to its acquisition.

If an Environmental Evaluation shows that the MPE limits are exceeded, the site must be redesigned to ensure compliance. If, however, a redesign is not possible, then an Environmental Assessment must be made and filed with the FCC that justifies why the limits in this case can be exceeded. The FCC would then review this Assessment and make a judgment whether or not it's acceptable.

3.1 MPE Limits

Maximum permissible exposure (MPE) refers to the RF energy that is acceptable for human exposure given the scientific research to date. It is broken down into two categories: Controlled and Uncontrolled.

Controlled limits are used for persons such as installers and designers that are cognizant in control of the hazard and exposed to energy for limited amounts of time per day. As written in FCC 96-326, occupational/controlled limits apply in situations in which persons are exposed as a consequence of their employment provided those persons are fully aware of the potential for exposure and can exercise control over their exposure. Limits for occupational/controlled exposure also apply in situations when an individual is transient through a location where occupational/controlled limits apply provided he or she is made aware of the potential exposure.

Uncontrolled limits are used for general public. General population/uncontrolled exposure apply in situations where 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 exposure or can not exercise control over their exposure**.

The exposure levels can be expressed in terms of power density, electric field strength, or magnetic field strength as averaged over 30 minutes for the general public and 6 minutes for trained personnel. Power density is most commonly used and will be used in this document. The exposure criteria is frequency dependent, and a chart covering the range from 3 kHz to 100 GHz can be found in NCRP No. 86 (reference IEEE C95.1-1982). Below are the limits for the cellular and PCS bands, which fall under two different ranges 300 MHz to 1500 MHz and 1,500 MHz to 100,000 MHz, and Point-to-Point Microwave Radio, and LMDS bands, which are allocated between 15,000 and 40,000 MHz.

Cellular (for frequency range from 300 MHz to 1500 MHz)

Power density S [mW/cm²]

$$\text{MPE Controlled} = \frac{f\,[MHz]}{300}$$

$$\text{MPE Uncontrolled} = \frac{f\,[MHz]}{1500}$$

Worst-case condition is low end of frequency band.

Controlled

MPE for Cellular band S = 870/300 = 2.90 mW/cm^2 (AMPS/TDMA base station)

Uncontrolled

MPE for Cellular band S = 870/1500 = 0.58 mW/cm^2 (AMPS/TDMA base station)

PCS (DCS) (for frequency range from 1,500 MHz to 100,000 MHz)

Controlled

MPE for PCS/DCS band S = 5 mW/cm^2

Uncontrolled

MPE for PCS/DCS band S = 1mW/ cm^2

Point-to-Point Microwave Radio and LMDS (for frequency range from 15,000 MHz to 40,000 MHz)

<u>Controlled</u>

MPE for Point-to-Point Microwave Radio and LMDS bands $S = 5\ mW/cm^2$

<u>Uncontrolled</u>

MPE for Point-to-Point Microwave Radio and LMDS bands $S = 1\ mW/cm^2$

If a facility exceeds the maximum permissible exposures (MPE) for controlled or uncontrolled limit as outlined in this document and remedies are not made to bring the facility into compliance, then an Environmental Assessment must be filed describing why the facility is not a threat to the human environment.

3.2 Safe Distance and Power Density Calculations

Calculations can be made on a site by site basis to ensure the power density is below the limits given above, or guidelines can be done beforehand to ensure the minimum distances from the antenna is maintained through the site planning.

Minimum distance calculation

$$r = \sqrt{\frac{EIRP}{4pS}} = \sqrt{\frac{G_i P_t}{4pS}} = \sqrt{\frac{1.64 G_d P_t}{4pS}} = \sqrt{\frac{1.64 ERP}{4pS}}$$

r = distance from the antenna [m]
EIRP = effective isotropic radiated power [W]
ERP = effective radiated power [W]
P_t = total power at antenna terminals [W]
S = power density [W/m^2] as shown in section 3.1 MPE Limits

Note: $1mW/cm^2 = 10W/m^2$

G_d = antenna gain related to a half wave dipole
G_i = antenna gain related to an isotropic radiator

Note: $G_i = 1.64xGd$
or $G_i[dBi] = 2.15 + G_d[dBd]$

and G[dB] = 10 x logG

It’s important to note that reflections from the ground and nearby fences can increase the power density from the base station by 4 times. This would therefore increase the safe distance by a factor of 2.

The Minimum distance, taking reflections into account, becomes:

$$r = \sqrt{\frac{EIRP}{pS}} = \sqrt{\frac{G_i P_t}{pS}} = \sqrt{\frac{1.64 G_d P_t}{pS}} = \sqrt{\frac{1.64 ERP}{pS}}$$

A typical cellular and PCS / DCS trisectored antenna has a gain of 18.7 dBi. This value has been used in some of the following examples of minimum safe distance calculation.

Note that for Point-to-Point Microwave Radio and LMDS sites, the above equations are not applicable and minimum safe distances are determined as described in section 3.2.1.

3.2.1 Minimum Safe Distance

The following calculations are intended to be guidelines for RF site planners prior to antenna deployment. By ensuring that the **public** is kept at distances greater than those shown below, we can ensure compliance to the requirements. Those distances can be used for Environmental Evaluations should they become necessary. The public can be kept away from antennas by using fences, towers, signs, or other physical barriers.

<u>Cellular</u>

Uncontrolled

$$r = \sqrt{\frac{G_d P_t 1.64}{p\, 5.8}}$$

$$r = 0.300\sqrt{G_d P_t} \quad \text{(eq. 1)}$$

Controlled

$$r = 0.45\left[0.300\sqrt{G_d P_t}\right]$$

$$r = 0.135\sqrt{G_d P_t} \quad \text{(eq. 2)}$$

in our example, if G_i is 18.7 dBi, a trisectored antenna, G_d[dBd] =18.7-2.15=16.55 and after conversion of G_d[dBd] to G_d we get:

$r = \sqrt{\frac{45.18 P_t 1.64}{p 5.8}}$ $r = 0.45\sqrt{\frac{45.18 P_t 1.64}{p 5.8}}$

$r = 2.02\sqrt{P_t}$ $r = 0.91\sqrt{P_t}$

Since the controlled limits for S are 5 times that of the uncontrolled, the distance would be less by 1 over the square root of 5, or 0.45.

Example:
An 800 MHz cellular 57 channel sectorized urban configuration. 19 channels per sector, 12 W ERP ($G_d x P_t$) per channel.

$r = 0.300\sqrt{\langle 19x12 \rangle} = 4.53m$ $r = 0.45(4.53) = 2.04$ m

Therefore, the safe approach distance for the general public is 4.5 meters from the actual radiating source, meaning the antenna. The safe approach distance for installers, operators and service personnel is 2.0 m.

PCS

Uncontrolled Controlled

$r = \sqrt{\frac{G_d P_t 1.64}{p 10}}$ $r = \sqrt{\frac{G_d P_t 1.64}{p 50}}$

$r = 0.228\sqrt{G_d P_t}$ (eq. 3) $r = 0.102\sqrt{G_d P_t}$ (eq. 4)

if G is 18.7 dBi as in our example, assumes a trisectored antenna, we get

$r = \sqrt{\frac{74.13 P_t}{p 10}}$ $r = \sqrt{\frac{74.13 P_t}{p 50}}$

$r = 1.54\sqrt{P_t}$ $r = 0.691\sqrt{P_t}$

Example:

A CDMA Mini BTS 1.9 GHz base station, S111 configuration with an 18.7 dBi gain antenna. One transmitter per sector, 14W into the antenna.

$r = 1.54\sqrt{14} = 5.76$ $r = 0.691\sqrt{14} = 2.59$

Therefore, the safe approach distance for the general public is 5.8 meters from the actual radiating source, meaning the antenna. The safe approach distance for installers, operators and service personnel is 2.6 m.

DCS

Uncontrolled

$$r = \sqrt{\frac{G_d P_t 1.64}{\pi 10}}$$

$$r = 0.228\sqrt{G_d P_t} \qquad \text{(eq. 5)}$$

Controlled

$$r = \sqrt{\frac{G_d P_t 1.64}{\pi 50}}$$

$$r = 0.102\sqrt{G_d P_t} \qquad \text{(eq. 6)}$$

Example:

A GSM S8000 DCS base station, S233 configuration with an 18.1dBi gain antenna. Three transmitters maximum in two of the three sectors, 20W per transmitter.

G_d[dBd] = G_i - 2.15 =15.95 dBd then G_d = 39.35

P_t = 3 x 20 = 60 W

$$r = 0.228\sqrt{39.35x60} = 11.1m$$

r = 0.45(11.1) = 5.0 m

Therefore, the safe approach distance for the general public is 11.1 meters from the actual radiating source, meaning the antenna. The safe approach distance for installers, operators and service personnel is 5.0 m.

LMDS

Due to the frequency bands used for LMDS – 24 to 40 GHz, an analysis of the radiation in the near field has to be performed (as opposed to far field analysis in lower frequency bands) to determine minimum safe distances. The analysis will be done for Nortel's Reunion LMDS product. Basically, the product consists of a Base Station and one or more Customer Premise Equipment associated with the Base Station. For the sake of this analysis, the Base Station Transceiver (BTR) and the Customer Transceiver (CTR) will be considered separately.

BTR (Base Station Transceiver):

- Antenna horn size = 8 cm x 1 cm (approximately)

- Antenna area = 8 cm^2
- Maximum transmitted power, P_{max} = 27 dBm = 500 mW
- Maximum radiation density = 500 mW/8 cm^2 = 62.5 mW/cm^2

Note: The antenna is provided with a radome that prevents access to the horn surface.

- At approximately 23 cm range from the horn surface, the field reduces to the 1 mW/cm^2 safety level (uncontrolled limit) and at 10 cm it reduces to the 5 mW/cm^2 safety level (controlled limit).
- In this near field radiation zone, hot spots may be present due to non-uniform illumination and/or reflections; thus, a safety factor of 4 should be applied. General public access **should not** be allowed within **1 m** of the antenna face to conform to the long-term general public exposure guidelines (1 mW/cm^2), while the safe approach distance for installers, operators and service personnel is at least **0.4 m**.
- Note that a 90° beamwidth antenna has been considered for this analysis.

<u>CTR (Customer Transceiver)</u>:

- Antenna diameter (D) = 30 cm
- Antenna area = Π x $D^2/4$ = 707 cm^2
- Maximum transmitted power, P_{max} = 23 dBm = 200 mW
- Assuming uniform illumination:

  Maximum radiation density = 200 mW/707 cm^2 = 0.28 mW/cm^2
- This is below the 1 mW/cm^2 safety level.
- In this near field zone radiation, hot spots may be present due to non-uniform illumination and/or reflections; thus, a safety factor of 4 should be applied giving a worst case radiation density of 1.12 mW/cm^2, which is above the general public exposure guideline.
- Therefore, the range at which the field is reduced to the 1 mW/cm^2 safety level will be determined assuming the CTR as a point radiation source. At about 15 cm from the horn surface, the field has reduced to the 1 mW/cm^2 level. Applying again a safety factor of 4 leads to a minimum distance of **0.6 m** to conform to the long-term general public exposure guideline.
- The range where the field is reduced to the 5 mW/cm^2 safety level is about 6 cm from the horn surface. Applying a safety factor of 4 leads to a minimum distance of **0.25 m** to conform to the controled exposure guideline applicable to installers, operators and service personnel.

Point-to-Point Microwave Radio

Due to the frequency bands used for Point-to-Point Microwave Radio, 15 to 40 GHz, an analysis of the radiation in the near field has to be performed (as opposed to far field analysis in lower frequency bands) to determine minimum safe distances. The analysis given below is for Nortel Network's iBWA 3000 series products where the transmitter / receiver assembly (Transceiver) is packaged in an ODU (Outdoor Unit) for outdoor or indoor (window sill) mounting.
The worst case that would yield the minimum distance is examined below.

38 GHz Transceiver:

- Antenna diameter (D) = 0.6 m
- Wavelength, λ = 0.079 m
- Maximum transmitted power, P_{max} = 18.2 dBm = 66 mW
- Power density at a distance *r*, of a parabolic antenna is calculated from

$$PD = \frac{P_{\max} \cdot G_i}{4 \cdot p \cdot r^2} \qquad r > 2 \cdot D^2 / l \quad \text{far field}$$

$$= \frac{P_{\max} \cdot G_i}{4 \cdot p \cdot r^2} \cdot NFF \qquad r \le 2 \cdot D^2 / l \quad \text{near field}$$

$$NFF = 26.1 \cdot \left[1 - \frac{16 \cdot X}{p} \cdot \sin \frac{p}{8 \cdot X} + \frac{128 \cdot X^2}{p^2} \left(1 - \cos \frac{p}{8 \cdot X} \right) \right]$$

where

$$X = \frac{R}{2 \cdot D^2 / l}$$

all in self consistent units

- Figure 1, shows the calculated Power Density on Antenna Boresight for distances up to 100 meters. Power density off-boresight is lower than the values shown here.
- In the near field zone which extends to 9.120 meters from the antenna, hot spots may be present due to non-uniform illumination and / or reflections. Applying a safety factor of 4, the minimum distance of 0.35 m for controlled exposure applicable to installers, operators and service personnel, and 0.88 m for long-term general public exposure has been found.

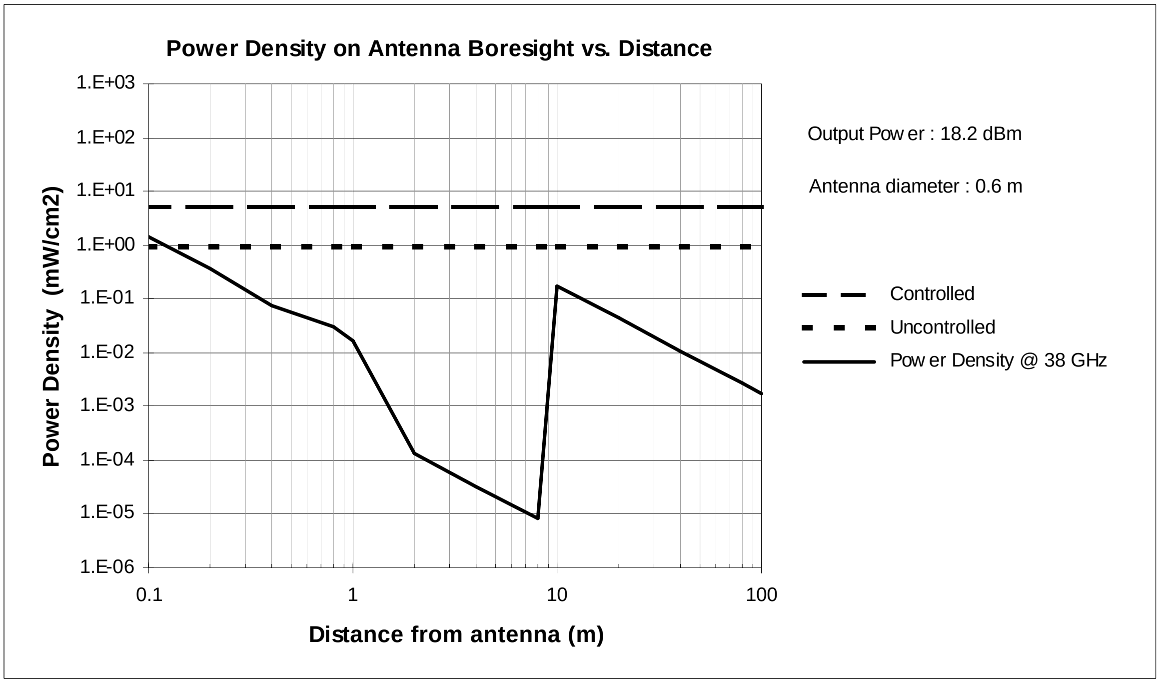

Figure 1: Power Density on Antenna Boresight

Note: The antenna is provided with a cover that prevents access to the radiating element.

3.2.2 Power Density Calculations

For existing sites, or for sites, which were planned prior to using the above guideline, we can ensure safety of the **public** by performing the calculations above, (or calculate the power density at the closest point the public can get to the antennas) and make sure the facility keeps the public at safe distances. The power density can be calculated by,

$$S = \frac{EIRP}{pr^2} \qquad \text{(eq. 7)}$$

EIRP = 1.64xERP

r = closest distance accessible to the public or trained personnel [m].

Example:

Taking the example before, an 800MHz cellular 57 channel sectorized urban configuration, 19 channels per sector, 12 W ERP (G_dxP_t) per channel. In this example, the antennas are placed on a tower 20 m high. Therefore, the power density at the base of the tower, which is the closest place a person can get, is calculated below,

$$S = \langle 1.64x19x12 \rangle / \langle p\, 20^2 \rangle = 0.3W/m^2 \text{ or } 0.03\frac{mW}{cm^2}$$

From section 3.1, the MPE for uncontrolled environments is 0.58 mW/cm^2 for cellular systems. Therefore, we can see that the exposure is about 20 times below the safety limit.

In the case of LMDS systems, the power density in the far field can be calculated with the following equation:

$$S = P_{max} / [\Pi/4 \text{ x Range}^2 \text{ x } 2 \text{ x Tan } (Az_{BW}/2) \text{ x } 2 \text{ x Tan } (El_{BW}/2)] \quad \text{(eq. 8)}$$

P_{max} = Maximum transmitted power in mW

Range = Distance range in cm

Az_{BW} = Antenna beam width in the Azimuth plane

El_{BW} = Antenna beam width in the Elevation plane

Note: The far field starts at about 1.5 m from the BTR and about 6 m from the CTR.

Example:

It will be determined the power density at 20 m from both BTR and CTR antennas. In each case, it is assumed that the point at 20 m falls within the area illuminated by the main antenna beam, which is the worst-case scenario. Lower power density values can be expected outside the main antenna beam.

<u>BTR</u>:

$S = 500 / [\Pi/4 \text{ x } 2{,}000^2 \text{ x } 2 \text{ x Tan } (90^o/2) \text{ x } 2 \text{ x Tan } (9^o/2)]$

$S = 0.0005\ mW/cm^2$

It has been assumed a 90º sector antenna with the following characteristics:

$Az_{BW} = 90^o$

$El_{BW} = 9^o$

<u>CTR</u>:

$S = 200 / [\Pi/4 \text{ x } 2{,}000^2 \text{ x } 2 \text{ x Tan } (2.6^o/2) \text{ x } 2 \text{ x Tan } (2.6^o/2)]$

$S = 0.031\ mW/cm^2$

It has been assumed a 30 cm diameter antenna with the following characteristics:
$Az_{BW} = 2.6^o$
$El_{BW} = 2.6^o$

From section 3.1, the MPE for uncontrolled environments is 1 mW/cm^2. Therefore, in the case of the CTR, where the power density is higher than that of the BTR, the exposure is more than 30 times below the safety limit.

For Point-to-Point Microwave Radio systems, power density level up to 100 m from the antenna is given in Figure 1. The power density decreases monotonically, proportional to the square of the distance beyond 9.120 meters.

3.3 Site Planning

Prior to the installation of a base station, the site desired should be investigated to see if it is a shared site or not.

Shared Site

If it is a shared site, analysis or measurements should be taken to assess the RF energy currently emanating from the shared tower. In general, in mixed or broadband RF fields where several sources and frequencies are involved, the fraction of the recommended limit incurred within each frequency interval should be determined, and the sum of all fractional contributions should not exceed 1.0, or 100% in terms of percentage. For example, consider an antenna farm with radio and UHF television broadcast transmitters. At a given location that is accessible to the general public it is determined that FM radio station X contributes 100 $\mu W/cm^2$ to the total power density (which is 1/2 or 50% of the applicable 200 $\mu W/cm^2$ MPE limit for the FM frequency band). Also, assume that FM station Y contributes an additional 50 $\mu W/cm^2$ (25% of its limits) and that a nearby UHF-TV station operating on Channel 35 (center frequency = 599 MHz) contributes 200 $\mu W/cm^2$ (which is one-half or 50% of the applicable MPE limit for this frequency of 400 $\mu W/cm^2$). The sum of all of the contributions then equals 125%, and the location is not in compliance with the MPE limits for the general public. Consequently, measures must be taken to bring the site into compliance such as restricting access to the area.

If the limits are within the guidelines, we can deploy our equipment provided the contribution from our system will not exceed the limits. Since it is an existing site, it should be known what the nearest distance the public and service personnel could come in contact to the antenna. Therefore, for Cellular, PCS and DCS systems use eq. 7:

$$S = \frac{EIRP}{pr^2}$$

and for LMDS systems, use eq. 8:

$$S = P_{max} / [\Pi/4 \times Range^2 \times 2 \times Tan(Az_{BW}/2) \times 2 \times Tan(El_{BW}/2)]$$

to determine the power density that our equipment would contribute towards the overall system and ensure that this total is still below the MPE limits stated in section 3.1.

Open Site

If it is not a shared site, use the appropriate equations to determine the minimum safe distance for Cellular, PCS or DCS systems (eq. 1 to 6) that apply to both controlled and uncontrolled environments. For LMDS systems, follow the example provided in section 3.2.1. Calculate the distances and ensure that the antenna placement adheres to those distances. Determining the correct antenna height and/or fences can do this. Signs, fences, locked doors or other physical barriers can be used to distinguish between areas accessible by trained personnel versus the public.

If it is necessary for trained personnel to gain access to an area that exceeds the controlled limits, access can still be allowed given the following conditions.

- Mount appropriate warning signs to make sure that they are cognizant of the danger and can therefore take any of the following steps to minimize exposure. An example of such a sign is as follows:

"WARNING. This equipment emits electromagnetic radiation. You should not come into contact with this equipment while it is being operated."

- Use RF shielding.
- Turn off or reduce the transmit power.
- Control time of exposure. The controlled limits are averaged over 6 minutes; therefore one could reduce their exposure by almost 50% if working in proximity for only 3 minutes at a time.
- RF protective clothing could reduce power density levels by as much as 10dB.

4.0 Other Components

Measurements on Nortel cellular, PCS and LMDS base stations show that the incidental radiation, or RF leakage, is minimal and many times fall below the safe limits as defined in section 3.1. Attention should be given to ensure that all connectors are properly terminated and all cables are in good condition. Special attention should be given to wave-guides. The following label should be placed on transmit wave-guides.

"WARNING. Radio frequency radiation hazard. Do not operate radio transmitter with open transmission line."

If any concern still exists, measurements will be required since the emissions pattern cannot be calculated.

It should be noted that handsets also fall within the scope of the FCC guidelines mentioned earlier. The limits are defined in terms of Specific Absorption Rate (SAR) and are not within the scope of this document. Compliance to these handsets is verified prior to achieving FCC certification, which is required for sale and distribution.

5.0 Assumptions

All the calculations throughout this document, with the exception of LMDS systems, use equations that assume a far field region. However, in many instances the region where the limits generally fall under can typically be in the near field. The far field region can be calculated as follows,

far field > $2a^2$ / wavelength

a = aperture of the antenna

In the case of a 1.9 GHz PCS base station, the aperture can typically be 1.3 m, and the wavelength about 0.15 m. Therefore the far field exists beyond,

$2(1.3)^2 / 0.15 = 22.5$ m

Our sample calculations showed safe distances around 5 m, which we can see is not within the far field. However, measurements have shown that using far field equations can lead to higher levels than can be seen with actual measurements, with some exceptions. Therefore using the formulas in this document may tend to give us conservative results and is acceptable according to the IEEE C95.3 document.

If the calculations used in this document show a borderline compliance, or if considerable exposure to people in the near field is anticipated, a more in depth near field measurement or calculation is recommended.

The FCC has also noted that restrictions on induced and contact currents are not being adopted. Therefore this document does not cover those concerns.

Finally, the limits expressed in the NCRP and IEEE documents represents the scientific knowledge to date on what can be considered safe. This document uses those guidelines as the industry-accepted standard.

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7.0 Acronyms

ANSI	American National Standards Institute
EMR	Electromagnetic Radiation
ERP	Effective Radiated Power
EIRP	Effective Isotropic Radiated Power
FCC	Federal Communications Commission
IEEE	Institute of Electrical and Electronics Engineers
LMDS	Local Multipoint Distribution Service
MPE	Maximum Permissible Exposure
NCRP	National Council on Radiation Protection and Measurement
RF	Radio Frequency

SAR Specific Absorption Rate

8.0 Acknowledgment

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