Radiation Protection Services

A Division of the BC Centre for Disease Control

Antenna Awareness

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Introduction

Since the Canadian Radio and Tele-communications Commission opened up competition for the cellular telephone communications industry, the number of service providers has doubled. The introduction of new digital technology has caused some companies to add to their analogue systems, by erecting more antennae. This resulting rapid expansion of the number of cellular and PCS transmitter sites, paging antenna and other wireless communications is responsible for a growing number of co-location or multi-user antenna sites. This has created a concern about radiofrequency and microwave exposure on the part of antenna maintenance and installation crews and others who must in the course of the employment, work in close proximity to various antennae of unknown emission.

To help workers address their concerns the Radiation Protection Branch conducted a limited survey of antenna sites found in the Lower Mainland. For each of the antenna identified in the survey, data was gathered from Industry Canada on the antenna type, frequency, and effective radiation power. Using Health Canada's maximum allowable exposure guidelines we have calculated the "**distance of closest approach for typical antenna (R)**". This is not intended to give **actual** information on specific antenna, but merely general advice relating to typical distances that a worker should maintain near active antennae in order not to exceed Health Canada's Safety Code #6 allowable occupational exposure levels. Whenever possible, measurements should be taken to determine the actual power density present. There are also small personal monitors that workers can wear to alert them to unacceptable power density levels. These are available above from a variety of manufacturers.

Technical Information

Setting the power density on the axis ($\mathbf{W}_{ff}$) to the Safety Code allowable exposure limit, and knowing the transmitter power ($\mathbf{P}_{ave}$), and gain (**G**) for specific examples of antenna types the following formula was used to calculate the "distance of closest approach" for a variety of antenna.

$$W_{ff} = P_{ave}\, G \,/\, 4\Pi R^2$$

"…is a precise statement of the value of the power density on the axis ($\mathbf{W}_{ff}$) as a function of transmitter power ($\mathbf{P}_{ave}$), antenna gain (**G**) , and range (**R**). This equation, the Friss free-space transmission formula, predicts the worst-case envelope of radiated power density from any antenna system. It is technically only accurate for plane-wave, far field conditions, though it can be used successfully as a worst-case predictor to zero range, where (power density) would approach an infinite value."†

† Measurement of Radiofrequency Fields, Dr. John Leonowich, Proceedings 2nd International Non-Ionizing Radiation Workshop, IRPA, May 10-14th, 1992, p110-111.

Paging Antenna

Paging companies use different antennas. Both the VHF (30 - 300 MHz) and UHF (300 MHz -3000 MHz) bands are used for paging. The most popular antennas used are the collinear and exposed dipole array. Of these the exposed dipole array is the more common due to it's ability to provide an omni or directional wave pattern. These services are limited by Industry Canada to a maximum output in the VHF range of Effective Radiated Power (ERP) = 125 Watts and in the UHF range ERP = 250 Watts. In our sample of antennas this maximum power was found for antennae in both frequency ranges, yielding a "distance of closest approach" of R = 1.0 and 1.5 meters (m) respectively.

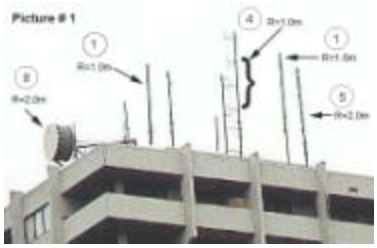
Cellular and PCS Antenna

The output from these antennae, particularly cellular, varies with customer use. Therefore it is not possible to determine a single "distance of closest approach" where a worker would not exceed the allowable exposure levels, at all times. In general workers should avoid the front of active cellular or PCS antenna, within a distance of 3.0 m.

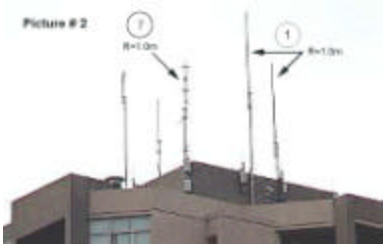
Antenna List (next page)

Antenna #	Picture #	Antenna type	Frequency Band	ERP (watts)	R (m)
①	1, 2, 5	omnidirectional collinear	VHF	50 - 100	1.0
②	5	ground plane antenna	VHF	30	1.0
③	4	exposed dipole array	VHF	80	1.0
④	1, 3	exposed dipole array	VHF	100, 125	1.0
⑤	1, 3	exposed dipole array	UHF	250	1.5 - 2.0
⑥	3	exposed dipole array	VHF	125	1.25
⑦	3	exposed dipole array	UHF	250	1.0
⑧	1, 3, 5	"dish" or "drum"	UHF, SHF	1000 - 1778	1.5 - 2.0
C	6	cellular & PCS of various styles; panel, collinear array, dipole array	UHF	variable	3.0

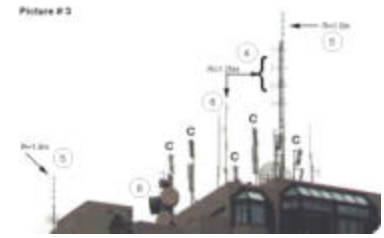
Cautions



- ④ and ⑤ are both exposed dipole array antenna and look similar. The UHF version ⑤ is physically smaller and has a longer R value.

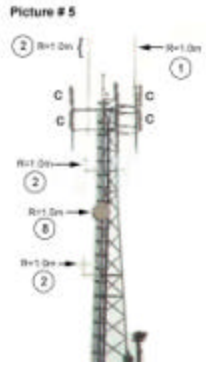


- Omnidirectional antenna ① are VHF, UHF and cellular. R values can be from 1-3 meters.



- Similar types of antenna (e.g. exposed dipole array ⑤) can have different numbers of elements. Antenna ⑤ is in picture #1 with elements and in picture #3 with 4 elements.

- These cellular antenna **C** do not radiate backward but the exposed dipole array ③ do.



- Dish or drum antenna ⑧ do not radiate backward. Some shielding is present inside the tower provided by the tower structure.

- If a multi-antenna site is small and crowded, a pocket dosimeter is useful.