

Radio waves and health

Radio base station antenna sites



Radio wave exposure at typical base station antennas sites

This document presents information on radio wave exposure levels from base station antennas in mobile communication networks. Four different typical sites have been selected, which represent the most common locations of base station antennas. These typical sites are:

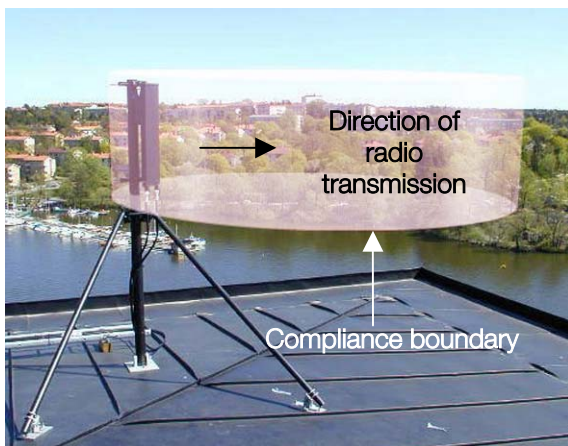
- *Mast mounted antennas*
- *Rooftop mounted antennas*
- *Wall mounted antennas*
- *In-building antennas*

For each typical site, three figures are included; 1) a photograph of a real site, 2) a picture showing the so called compliance boundary, a cylinder-shaped surface outside of which the radio wave exposure has diminished to levels below relevant safety limits, and 3) a picture showing where the exposure is 10% and 1% of the limits.

Data for typical third-generation (3G) WCDMA base stations and the recommended exposure limits from the International Commission on Non-Ionizing Radiation Protection (ICNIRP) have been used in all the examples.

The radio wave exposure information in this document is representative also for similar base station configurations in second-generation (GSM, TDMA, CDMA) networks, as well as for antenna installations on other structures such as chimneys and towers.

However, the information may not be appropriate for sites that differ significantly in terms of output power or antenna configuration from the included examples.



RF exposure limits

Radio frequency (RF) electromagnetic field (EMF) exposure limits are specified in national and international standards and regulations. The limits are generally based on recommendations from the World Health Organization (WHO) and the International Commission on Non-Ionizing Radiation Protection (ICNIRP).

The ICNIRP RF exposure guidelines specify basic restrictions and reference levels. The reference levels, expressed as field strength or power density limits, are provided for the purpose of simple assessments of compliance with the basic restrictions. Compliance with the reference levels assures fulfillment with the basic restrictions, but field strength levels greater than the reference levels do not necessarily mean that the basic restrictions are exceeded.

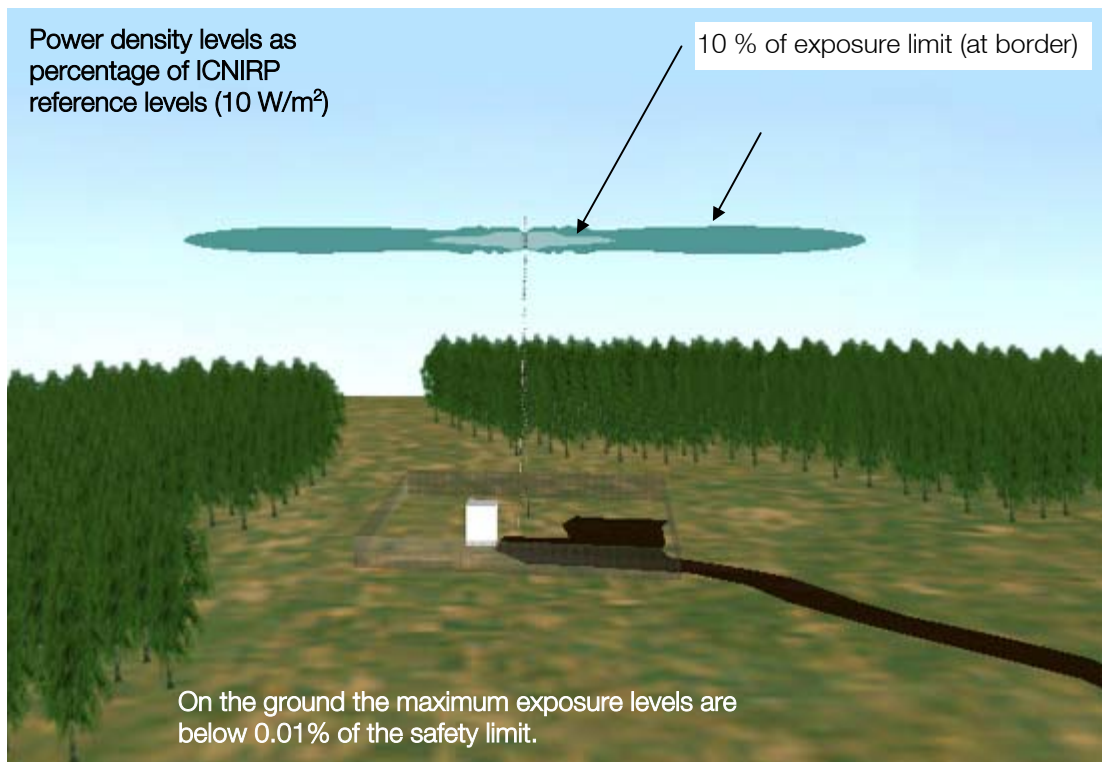
Compliance boundary

A compliance boundary, outside of which the RF exposure from a base station antenna is below the reference levels, can be represented by a cylinder and is described by the following three parameters:

- Diameter of the cylinder
- Height of the cylinder
- Distance to the back of the antenna

In all outdoor antenna examples in this report the height of the cylinder is equal to the antenna height plus 20 cm and the distance to the back of the antenna is 10 cm.

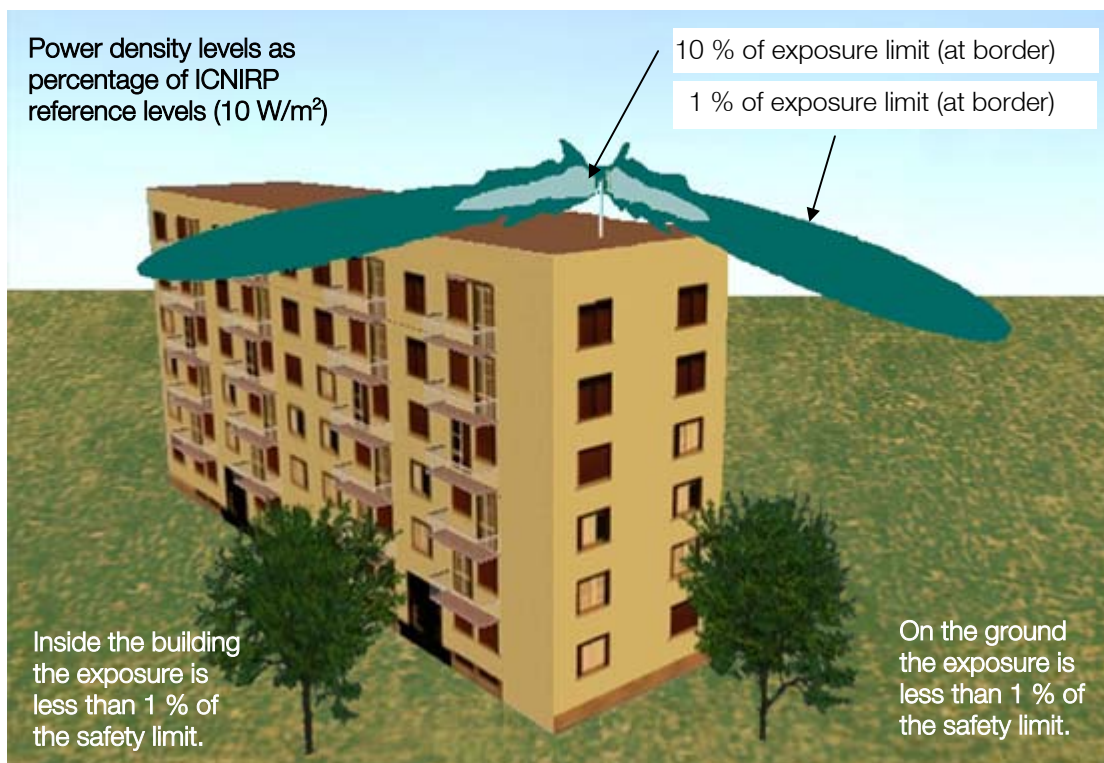
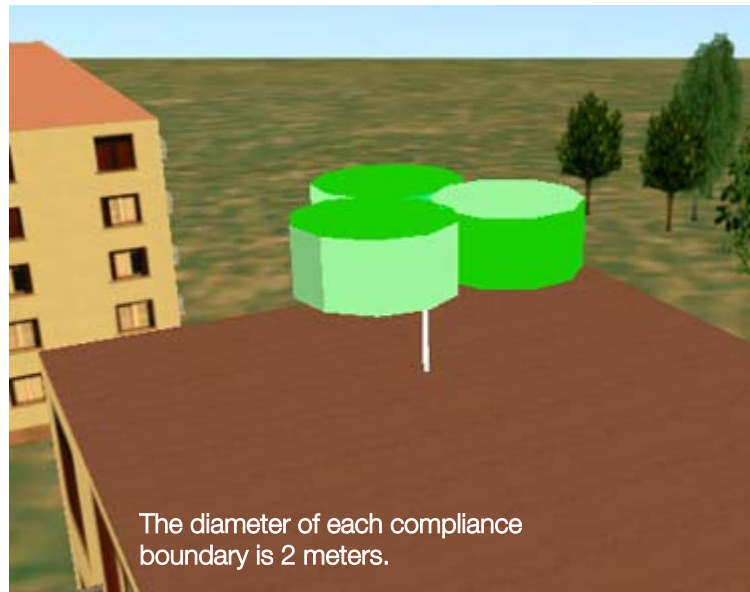
Mast mounted antennas



Three antennas, which are pointing in three directions (0°, 120° and 240°), are positioned at the top of a 30-meter high mast. The input power to each antenna is 20 W, assuming 40 W from the base station cabinet and a total transmission loss of 3 dB (50%).

The diameter of each compliance boundary is 3 meters and on the ground the maximum exposure levels are below 0.01% of the safety limit.

Rooftop mounted antennas

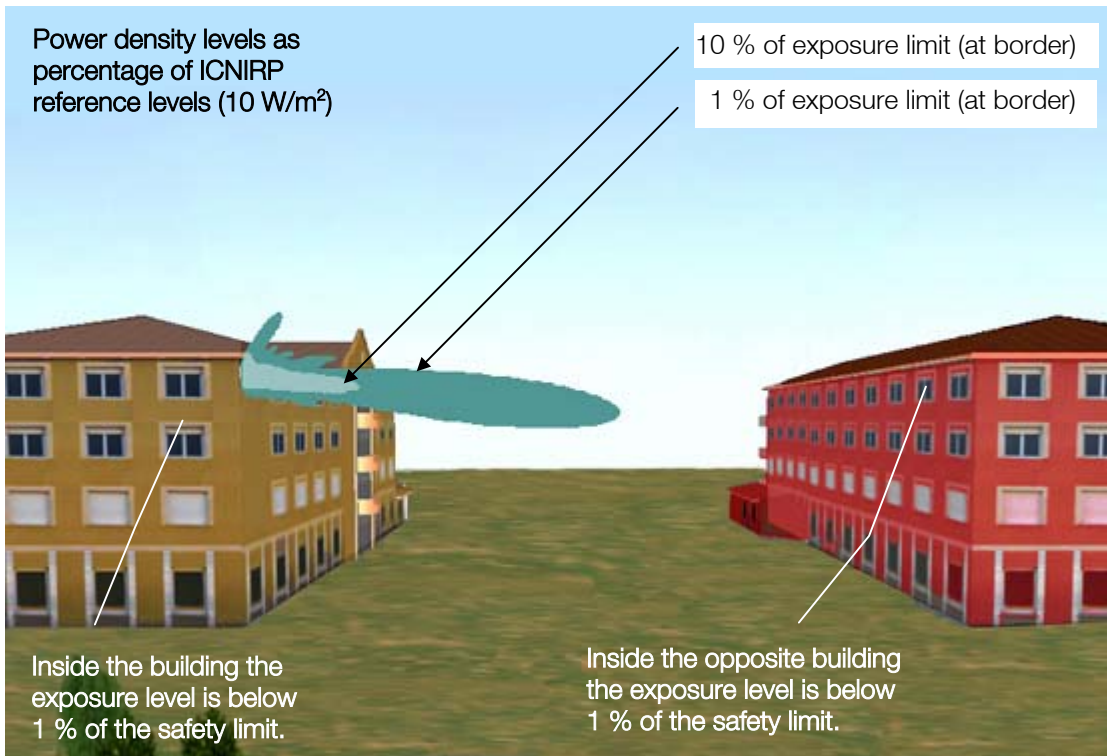
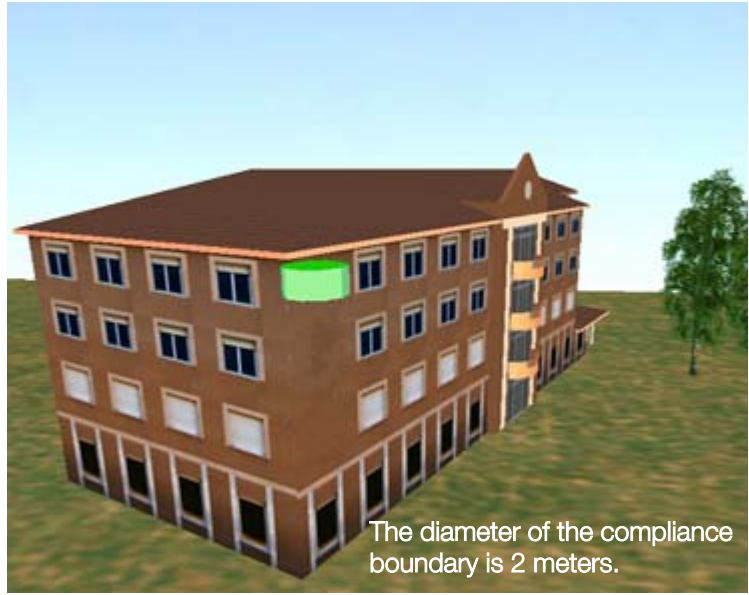


Three antennas, which are pointing in three directions (0° , 120° and 240°) and have a down tilt of 10° , are mounted on a two-meter pole on the roof of an eighteen-meter high building.

The input power to each antenna is 10 W, assuming 20 W from the base station cabinet and a total transmission loss of 3 dB.

The diameter of each compliance boundary is 2 meters and on the ground as well as inside the building the exposure is less than 1 % of the safety limit.

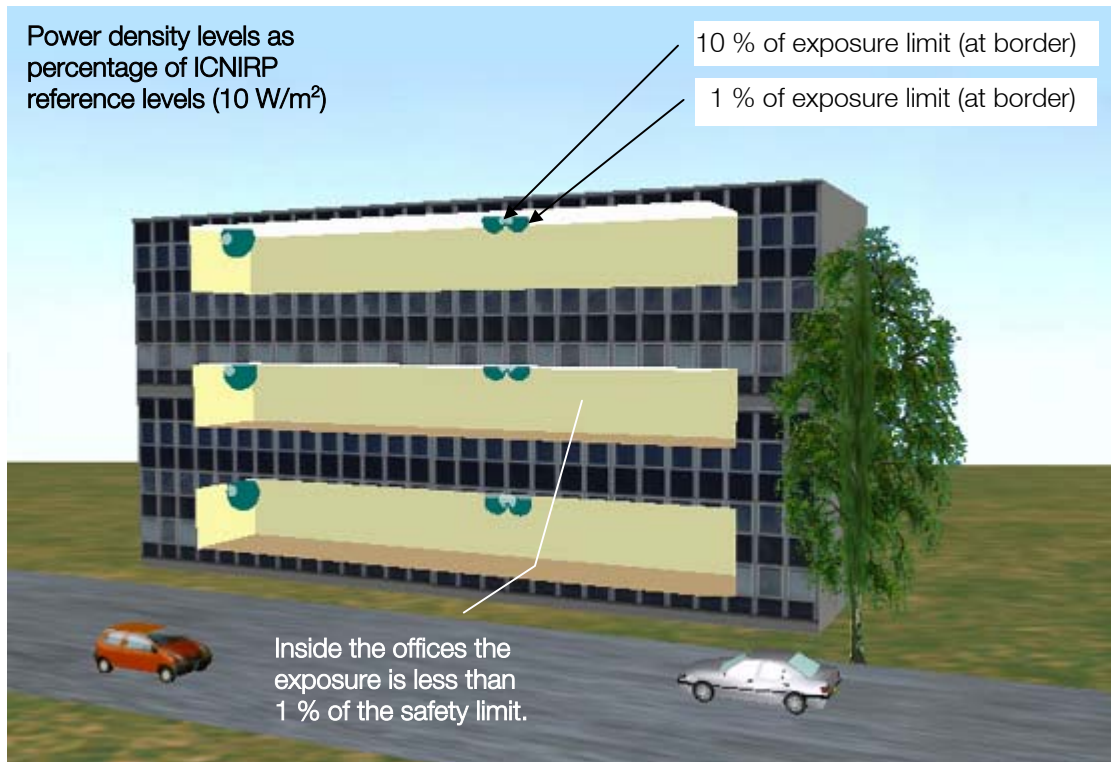
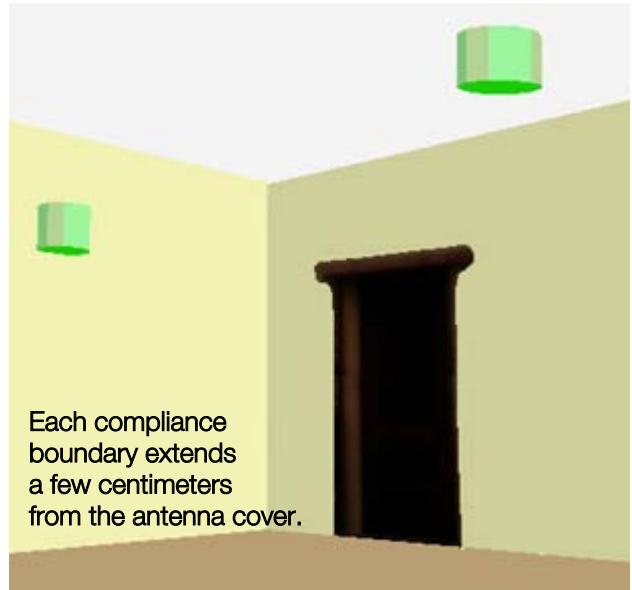
Wall mounted antennas



One antenna is mounted on the façade of a building. The input power to each antenna is 10 W, assuming 20 W from the base station cabinet and a total transmission loss of 3 dB. The antenna has a down tilt of 2 ° and is placed ten meters above ground. The distance to the opposite building is thirty meters.

The diameter of the compliance boundary is 2 meters. Inside the main building as well as the opposite house the exposure is less than 1 % of the safety limit.

In-building antennas



The in-building antennas are mounted in the ceiling and on the walls inside an office building. The output power levels of the antennas are 1 W.

The compliance boundary extends just a few centimeters from the antenna cover.

Inside the offices the exposure is less than 1 % of the safety limit.

Additional information

Ericsson's health and safety web site provides information and statements.

<http://www.ericsson.com/health>

Mobile Manufacturers Forum (MMF) is an international association of radio communication equipment manufacturers. It provides information related to mobile communications and health in several languages.

www.mmfai.org

World Health Organization (WHO) International EMF Project is pooling resources and knowledge concerning electromagnetic fields and health.

www.who.org/emf

References

ICNIRP, "Guidelines for limiting exposure to time-varying electric, magnetic, and electromagnetic fields (up to 300 GHz)", International Commission on Non-Ionizing Radiation Protection (ICNIRP), Health Physics, vol. 74, pp 494-522, April 1998.
www.icnirp.org

Calculation data

The RF exposure calculations have been performed using the EMF Visual software from Antennessa and the FEKO software from EM Software and Systems.

Technology: WCDMA

Frequency band: 2110-2170 MHz

Outdoor antennas

Power: 40 W or 46 dBm per antenna (mast), 20 W or 43 dBm per antenna (roof and wall)

transmitted from the base station cabinet

Losses: 3 dB total transmission and feeder losses

Antenna properties

Size: 1.3 × 0.16 × 0.06 m (mast),

0.70 × 0.17 × 0.06 m (roof, wall)

Gain: 18.5 dBi (mast),

15.5 dBi (roof, wall)

Vertical half power beam width:

6.5° (mast), 15° (roof, wall)

Horizontal half power beam width:

63° (mast), 65° (roof, wall)

Electrical down tilt: 0° (mast),

0-8° (roof, wall)

Indoor antennas

Power: 1 W transmitted from antenna

Antennas properties

Size: height 0.085 m (omni)

0.26 × 0.16 × 0.05 m (directional),

Gain: 2.3 dBi (omni), 7.5 dBi (directional)

Horizontal half power beam width: 90° (directional)

Vertical half power beam width: 78° (omni),

70° (directional)

Applicable ICNIRP reference levels for general public exposure

Frequency (MHz)	Power density (W/m ²)	Electric field strength (V/m)	Magnetic field strength (A/m)
900	4.5	41	0.11
1800	9	58	0.15
>2000	10	61	0.16

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