Electromagnetic Radiation from Mobile Phone Base Stations

Information Document Prepared by
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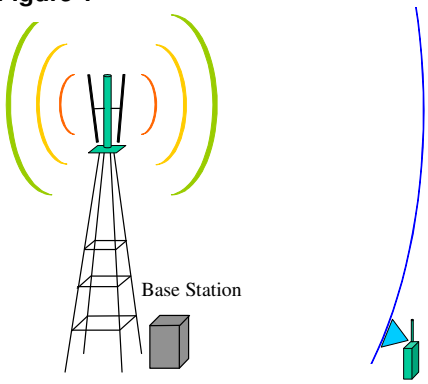
In the past century numerous devices have been designed by scientists and engineers using radio-frequency (RF) electromagnetic fields for communication. These include two-way communication transmitters (for example sea-vessel to shore-base), hand held communication transmitters (walkie-talkies), radio and television transmitters, radars, satellite communication transmitters, and lately mobile phone (or cellular phone) communication transmitters including cellphones and base stations.

The nature of RF communication

In all the cases mentioned above, one *transmitting device* transmits (or radiates) energy in the form of electromagnetic fields carrying the required information (voice, picture, digital data, etc.). A second *receiving device* receives **a very small part** of the radiated energy, enough that the required information can be processed and used.

Figure 1



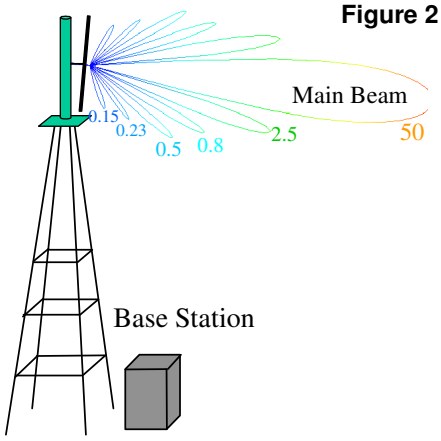
RF communication in cellular phone technology

In the case of cellular phones, two-way communication must be established between the cellphone and the base station. First, the base station acts as the source of radiation and then the cellphone. A simplistic view of RF communication when the base station acts as the radiating source is shown in Figure 1. Here it is demonstrated how the base station antennas radiate RF electromagnetic fields away from the base station in all directions --- like the waves in a pond when a stone is dropped into it. As the radiating field travels away from the base station, the energy it carries is distributed over a larger region (the semi-circles become larger). In one particular direction, energy from the radiating field is ``intercepted'' by a receiving device (cellphone). Only a small percentage of the transmitted energy is available for ``interception''.

Radiation levels around base station antennas

Near a base station, in regions that are accessible to the general public (for example, at the foot of a base station mast), another important factor must be taken into account: A base station antenna radiates most of its energy in a specific direction (called the main beam of the antenna). This is shown in Figure 2. The main beam typically points in the direction of the horizon (actually a few degrees downwards). The result is that only a very small percentage of the radiated energy will be present in the regions outside the main beam (that is, in the regions around the base station masts which are accessible to the general public).

Figure 2



RF radiation and the environment

The consequence of numerous RF devices continuously radiating electromagnetics fields in all directions is that our environment (our suburbs, homes, offices, streets, playgrounds, etc.) is populated by RF electromagnetic fields, all carrying some amount of energy. At the frequencies these devices radiate at (i.e. radio-frequencies), the electromagnetic fields can penetrate relatively easily into our bodies. Our biological tissue material (brain, muscle, bone, fat, etc.) absorbs some of this RF energy.

RF radiation and human health

It is very important to note that there is a significant difference between radio-frequency radiation (at which cellular technology operates) and the well know X-ray and Gamma-ray radiation that can be emitted by radioactive material. X-ray and Gamma-ray radiation are classified as **ionizing** radiation. These are known to be dangerous through the mechanism of ionization (or the direct breaking of chemical bonds in human tissue or cells). Radio-frequency radiation is classified as **non-ionizing** radiation because the energy it carries is too low to cause ionization or the breaking of chemical bonds in human tissue. However, at *sufficiently high energy levels* RF radiation **can** be harmful to humans. All scientists agree on this point and for this reason various international regulating bodies have compiled standards or guidelines for limiting human exposure to radio-frequency radiation.

Guidelines for safe exposure to RF radiation

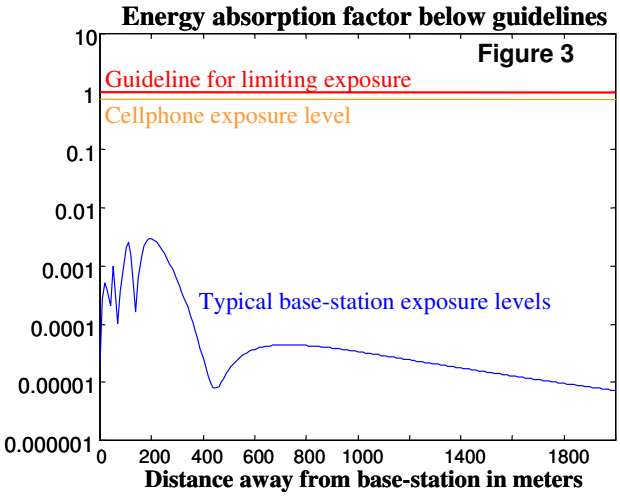
The guidelines for safe exposure have been compiled from the published scientific literature on the topic, and the scientists who have studied the literature agree that the research is adequate for establishing valid safety guidelines. Simplistically stated, the guidelines are established in the following way: Scientists observe that negative health effects *start* to occur in laboratory animals at a certain energy level. They then set the safety guidelines (applicable to the general public) at approximately 50 times below this energy level. In South Africa, the Department of Health (Directorate: Radiation Control) has adopted the International Commission on Non-Ionizing Radiation Protection guidelines of April 1998 (ICNIRP'98).

Prolonged exposure

Research to date indicates that what matters most is the intensity of exposure and not the duration. This has been established through lifelong exposure of rats and mice, and epidemiological studies on military personnel who have worked close to communication antennas and radars (RF devices) for years. The guidelines have thus been set accordingly.

Cellphones and guidelines for safe exposure

With the cellphone as radiator, RF exposure of the human operator is just below the international safety guidelines (see Figure 3). This is due to the very close proximity of the operator to the cellphone. But remember that these guidelines are 50 times below the energy levels where negative health effects have been observed.



Base stations and guidelines for safe exposure

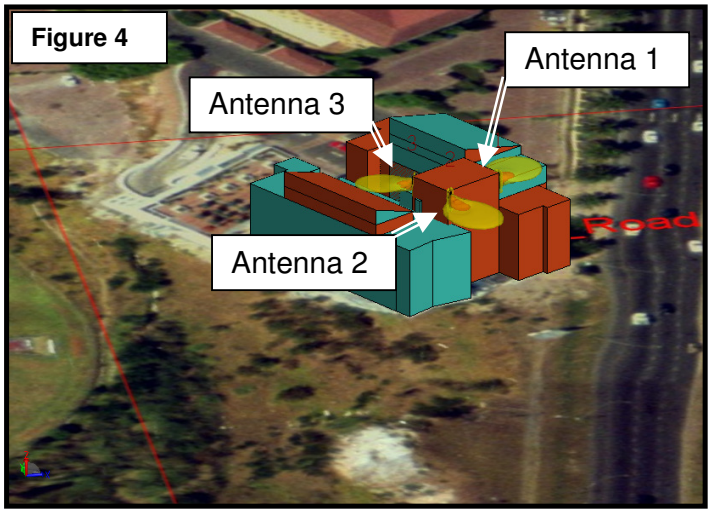
Energy absorption in humans exposed to RF radiation from base stations is typically ***hundreds*** to ***thousands*** of times **below** the international safety guidelines (see Figure 3). This is also true on the ground next to base stations or at any position in the close vicinity of base stations. Only on the top of a base station mast, directly in front and within 10 to 20 meters of the antennas, would the energy absorption levels approach the safety guidelines. The public is usually denied access to these areas.

Base stations on rooftops

Quite often in urban environments, base stations are installed on the rooftops of buildings. In some cases the antennas of the base station site might be installed against the wall of a building. The reason behind these

rooftop installations is to provide cellphone coverage in the area without erecting a mast. Similar to base stations on masts, installations on rooftops lead to public exposure in the immediate vicinity of the building that are **thousands** of times **below** the international safety guidelines (see Figure 3). Exposure right below the installations (on the top floor of a building) or right behind a wall mounted installation is also well below the guidelines. The only extra precaution that should be taken in the case of rooftop installations is that access to the areas **directly in front and within 10 to 20 meters** of the antennas should be controlled, because this is the area where the exposure levels would approach the safety guidelines.

Figure 4 shows a computer representation of a typical rooftop installation. The yellow zones are the boundary area where the exposure approaches the public guideline for safe exposure. As can be seen from this representation, the only area of exposure above the guidelines is right on top of the roof, in front of antenna 1. Access control and signage would be implemented to protect members of the public against accidental entry into this area on the roof. The yellow zones of antennas 2 and 3 are in the air where no person has access. These antennas are thus inherently safe and no special access controls need to be implemented.



Occupational Exposure (RF workers)

Most regulating bodies, including ICNIRP and the Directorate: Radiation Control (South Africa) distinguish between occupational and general public exposure levels. The following direct quotation from the ICNIRP guidelines should yield a clear understanding of what is meant by the concept **occupational** exposure:

> `` *The **occupationally** exposed population consists of adults who, in the normal course of their particular employment, are exposed under generally known conditions and are trained or informed to be aware of potential risks and to take appropriate precautions."*

Guidelines for safe **occupational** exposure are 5 times less stringent. This is still 10 times below the levels at which harmful health effects have been observed, but it can be expected from “aware” and well-trained RF workers that they take precautions to minimize exposure during the course of their work.

The World Health Organization and continuous international research

The available guidelines for safe exposure are deemed to be an accurate health risk assessment based on the current available research data. This is the view of the World Health Organization (see the WHO factsheet on base station exposure at http://www.who.int/mediacentre/factsheets/fs304/en/index.html). Appart from the WHO, a number of independent international expert groups have also reviewed the scientific literature. All concluded that the balance of evidence indicates that exposure **below** the **ICNIRP guidelines** would not cause any negative health effects. Nonetheless, scientific studies on human exposure to radio-frequency fields continue world-wide. These studies are conducted to enable regulating authorities to make *better health risk assessments* as more and more people worldwide are exposed to the radio-frequency radiation from cellular phone and other communication technologies. The majority of scientists in this field concentrate their studies on possible health effects at cellphone levels of radiation and **not** base station levels, because the latter are deemed too low to justify intense investigations.