



ALDES Briefing Paper

Cellular Phones & Human Health

1 Introduction

Cellular phones and their associated base stations are low power radio transmitters at frequencies of around 1 or 2GHz (Giga Hertz). There are a number of other sources of radiowaves at these frequencies including television transmitters and microwave fixed links (dishes).

Cellular radio systems involve communications between the cellular phone and a base station. Each base station provides coverage within a small area of between 0.01km² in city centres and 100km² in rural areas. As the user of the mobile phone moves around the system chooses the best base station to maintain communications.

At present there are around 15 million mobile phone users and 25,000 base stations.

2 Exposure Guidelines

Exposure limits for the general public come in two forms: specific absorption rates (SAR) or plane wave power density.

Public exposure guidelines are highly conservative being set at levels that are <2% of the level where biological effects have been reliably observed.

2.1 Specific Absorption Rate

Specific absorption rate is a measure of the rate at which energy is absorbed by a defined mass of tissue.

2.1.1 Handset

All international bodies accept that exposure guidelines for radiowaves should be set to prevent adverse health affects caused by partial or whole body heating. Exposure guidelines for mobile phones are expressed in terms of absorbed energy in the head. The limit set be the National Radiological Protection Board (NRPB) is

0.1 Watt of power absorbed in any 10g of tissue, averaged over six minutes.

Calculations suggest this would result in less than 1°C rise in temperature of the head even after long periods of exposure.

The output from mobile phones in the UK results in only a fraction of this amount of power being deposited in the tissues of the head resulting in only a fraction of a degree rise in temperature. This is similar to the day-to-day variation in body temperature.

2.1.2 Base Station

The fields from a base station are more likely to be uniform over the whole body. The guideline, averaged over the whole body mass, is 0.4 Watts per kilogram averaged over 15 minutes. This limit is only likely to be exceeded if a person where to get within a few metres of a base station transmitter.

Signal strengths at ground level in regions normally accessible to the public are a tiny fraction of the hazard level and produce no measurable heating.

2.2 Plane Wave Power Density

Power density is the power per unit area normal to the direction of propagation of a wave.

The most widely accepted standard for cellular phone and base station antennas was developed by the International Commission on Non-Ionising Radiation Protection (INCIRP), the Institution of Electrical and Electronics Engineers and the American National Standards Institute (IEEE/ANSI), and the National Council on Radiation Protection and Measurement (NCRP).

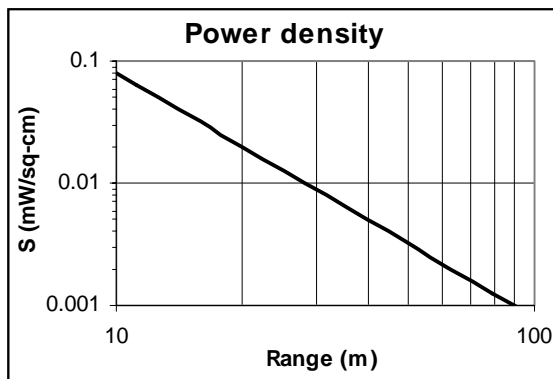
The exposure by the general public is restricted to 0.5 to 1 mW/cm².

The purpose of this briefing note is to present our vision on the future of the internet. It has been prepared for ALDES by Chris Shepherd, but the opinions expressed are his own. If you see errors or have comments, please e-mail chris.shepherd@iee.org

3 Meeting the Safety Standards

With proper design cellular phones and base station antennas meet the safety standards comfortably. A low gain cellular base station antenna mounted 15m off the ground and radiating the maximum power could produce a power density on the ground near the antenna site of approaching $0.02\text{mW}/\text{cm}^2$. More often the power density will be in the range 0.0001 to $0.005\text{mW}/\text{cm}^2$.

When high gain antennas are used higher power densities may be experienced at heights above ground level within about 150m of the antenna. However the levels are still only a few percent of the safety standards outside a range of about 50m. The graph below shows the power density from a 1000W EIRP transmitter versus range.



More detailed information on calculating the power density near base station antennas can be found on the Unisite web site (<http://www.unisite.com>).

4 Athermal Effects

Concerns about athermal effects of exposure to radiofrequency fields have also been raised. These include subtle effects within cells that could affect cancer development or affects on the brain or nervous tissue.

Radiowaves do not have sufficient energy to damage genetic material (DNA) directly and cannot therefore cause cancer. There have been suggestions that the fields can increase the rate of cancer development.

In May 1999 the NRPBs Advisory Group on Non-Ionising Radiation concluded that there was "no human evidence of a risk of cancer resulting from exposure to radiation's that arise from mobile phones."

The evidence from biological studies on possible effects on tumour promotion or progression including tests on animals is not convincing.

Even scientists who think that these types of effects exist would not argue that the low levels found around properly designed base station antennas are hazardous.

5 Research Into Health Effects

Reference 3 gives a comprehensive review of the connection between cell phones and cancer, finding the link to be weak to non-existent. Studies by the Institution of Electrical Engineers (IEE), who review approximately 1400 papers a year, has found no convincing evidence of any hazard.

In 1994 the European Parliament adopted a resolution on combating the harmful effects of non-ionising radiation and called on the Commission to propose regulations and standards to limit the exposure of workers and the public.

6 References

- 1 Background Information on Mobile Phones <http://www.nrpb.org.uk/Nir-is4.htm>
- 2 Proposal for a Council Recommendation on the Limitation of Exposure of the General Public to Electromagnetic Fields 0Hz - 300GHz
European Commission (11th June 1998)
- 3 Cell Phone Antennas and Human Health <http://iago.lib/mcw.edu/gcrc/cop/cell-phone-health-FAQ/toc.html>
- 4 Cell Phones and Cancer: What is the Evidence for a Connection?
J. E. Moulder, et al
Radiation Research 151, 513-531
(available from web site of reference 3)
- 5 World Health Organisation (WHO) fact sheets on Electromagnetic Fields and Public Health http://www.who.int/peh-emf/publications/facts-press/fact_english.htm