Australian Government
Australian Radiation Protection and Nuclear Safety Agency

Committee on Electromagnetic Energy
Public Health Issues

Fact Sheet

EME Series No. 1

Electromagnetic energy and its effects

What is RF EME?

Electromagnetic energy (EME) is the energy stored in an electromagnetic field. It is a part of our natural environment, emitted by sources like the sun, the Earth and the ionosphere, as well as artificial sources such as mobile phones and base stations, broadcast towers, radar facilities, and electrical and electronic equipment.

EME is non-ionising radiation, meaning that it has insufficient energy to break chemical bonds or remove electrons (ionisation). In contrast, ionising radiation (such as X-rays) can remove electrons from atoms and molecules thus leading to damage in biological tissue.

Radiofrequency (RF) radiation, which is used mainly for communications purposes, is the transfer of energy by radio waves. RF radiation lies in the frequency range between 3 kilohertz (kHz) to 300 gigahertz (GHz). In these fact sheets, RF and RF EME are interchangeable terms.

Does exposure to RF EME cause adverse health effects?

People have been living with artificial sources of RF electromagnetic fields (EMF) in one form or another for over a hundred years, since Marconi sent the first wireless telegraphs in the 1890s. In the last few decades the EMF environment has changed with the advent of TV and more recently mobile telephony.

For decades researchers have been investigating EME's effects on humans, animals and the environment. It is now well established that exposure to sufficiently high levels of RF EME can heat biological tissue and potentially cause tissue damage. Damage results because the human body is unable to cope with the excessive heat generated by very high RF exposure. Studies have shown that environmental levels of RF EME routinely encountered by the public, however, are far below the levels needed to produce significant heating and increased body temperature. Among other established health effects is electrostimulation of excitable tissue at lower frequencies (between 3 to 100 kHz).

At low levels of exposure to RF EME (ie field intensities lower than those that would produce measurable heating), the evidence for production of harmful biological effects is ambiguous and unproven. Although there have been studies reporting a range of biological effects at low levels, there has been no indication that such effects might constitute a human health hazard, even with regard to long-term exposure.

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The epidemiological (population studies) evidence does not give clear or consistent results that indicate that exposure to RF EME causes disease in people. Although the epidemiological research that has been carried out to date does not give cause for concern, it has too many limitations to give reassurance that there is no hazard. More rigorous long-term studies are being coordinated by the World Health Organization (WHO) and Australia is taking part in this research program.

For further information on current and future research into EME in Australia see fact sheet 3 'Australian research into EME'.

The weight of national and international scientific opinion is that there is no substantiated evidence that exposure to low level RF EME causes adverse health effects. This view is backed by every major review panel on the subject including the Royal Society of Canada (1999), the International Expert Group on Mobile Phones (2000), the French Health General Directorate (2001) and more recently the Health Council of the Netherlands (2002) and ARPANSA's RF Standard Working Group (2002).

How is scientific evidence substantiated?

The criteria that have to be satisfied for substantiating scientific evidence are:

a. the publication of research results in a reputable international scientific journal that includes peer review by appropriately qualified scientists and academics. This ensures that research conforms to high standards of scientific practice and that conclusions may reasonably be drawn from the work undertaken which take into account relevant considerations; and

b. the independent verification of research results. If a research result cannot be repeated by other independent researchers, doubts are raised about the original finding.

Are mobile phone base stations and handsets safe?

The RF emissions from mobile phone base stations can be measured and have been shown to be weak in the everyday environment. Random surveys performed by ARPANSA have shown that base stations operate well below the exposure limits specified in the ARPANSA Radiation Protection Standard "Maximum Exposure Levels to Radiofrequency Fields – 3 kHz to 300 GHz".

At typical levels, mobile phone base station emissions are hundreds of times below the general public exposure limit of around 4.5 watts per square metre (frequency dependent) as set out in the ARPANSA standard or around 5000 times below the level where significant heating can occur.

Mobile phone handsets radiate RF emissions close to the head and produce complex exposure patterns that are difficult to measure. For mobile phone handsets the ARPANSA Standard specifies exposure limits to RF EME that regulate the rate at which the user absorbs energy from the handset. This is known as the specific absorption rate (SAR). The SAR limit for mobile phone handsets in Australia is 2 watts per kilogram of tissue (averaged over 10 grams).

The general consensus of scientific opinion is that there is no association between exposure to RF EME from mobile phone base stations or handsets and adverse health effects. The WHO states:

> *"None of the recent reviews have concluded that exposure to the RF fields from mobile phones or their base stations causes any adverse health consequences."*

For further information on mobile phone base stations or handsets see fact sheets6 & 5 'About mobile phone networks' and 'About mobile phones'.

Are RF EME levels regulated?

The 2002 ARPANSA Radiation Protection Standard "Maximum Exposure Levels to Radiofrequency Fields –3 kHz to 300 GHz" sets public and occupational limits of exposure to EME fields and was developed through a consultative process by the Australian Radiation Protection and Nuclear Safety Agency (ARPANSA), an Agency in the Federal Government portfolio of Health and Ageing. The standard requires the aggregate of the RF EME emitted from all sources to comply with the exposure limit set by the standard. Signals from different sources are identifiable by their frequency.

The Australian Communications and Media Authority (ACMA) has the regulatory responsibility to protect the health and safety of persons exposed to RF EME from radiocommunications transmitters. In order to fulfil this regulatory responsibility the then Australian Communications Authority, now ACMA, adopted the ARPANSA limits into the Radiocommunications (Electromagnetic Radiation - Human Exposure) Standard 2003 and the licence conditions for radiocommunications transmitters.

All manufacturers and importers of mobile and cordless phone handsets, as well as licensees of transmitter installations (like mobile phone base stations) are required to comply with the public exposure limits in the ARPANSA Standard.

For further information on the ARPANSA Standard see fact sheet 4 'The ARPANSA RF exposure Standard'.

Has a precautionary approach been adopted?

Throughout the world there has been a growing movement to adopt a precautionary approach. The WHO defines the Precautionary Principle as a risk management concept that provides a flexible approach to identifying and managing possible adverse consequences to human health even when it has not been established that the activity or exposure constitutes harm to health.

It is the WHO's view that scientific assessments of risk and science-based exposure limits should not be undermined by the adoption of arbitrary cautionary approaches.

The compliance of mobile phone networks and handsets with the ACMA regulations is regarded as a prudent and cautious approach to ensure that the community is not adversely affected by, but benefits from, developments in communications.

The Australian Government's ongoing RF EME program for research and public information is aimed at providing further scientific data to complement

international research or findings on related human health issues, particularly those of relevance to Australians. It recognises public concern, and the need to ensure that standards and public health policies continue to be based on the best available scientific information.

For further information on the Government's program see fact sheet 2 'Government action on electromagnetic energy public health issues'.

(Revised: November 2003*)*

Fact sheets in the EME series are:

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Fact sheet 4:	*The ARPANSA RF Exposure Standard*
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Fact sheet 11:	*Mobile phones and children*

For further information you can visit the ARPANSA web site at:

http://www.arpansa.gov.au