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ESTABLISHING A DIALOGUE ON RISKS FROM ELECTROMAGNETIC FIELDS



RADIATION AND ENVIRONMENTAL HEALTH DEPARTMENT OF PROTECTION OF THE HUMAN ENVIRONMENT WORLD HEALTH ORGANIZATION GENEVA, SWITZERLAND 2002

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- Dr Patricia Bonner, Environmental Protection Agency, Washington, DC, USA
- Professor Ray Kemp, Galson Sciences Ltd., Oakham, United Kingdom
- Dr Leeka Kheifets, WHO, Geneva, Switzerland
- Dr Christopher Portier, National Institute of Environmental Health Sciences, North Carolina, USA
- Dr Michael Repacholi, WHO, Geneva, Switzerland
- Dr Jack Sahl, J. Sahl & Associates, Claremont, California, USA
- Dr Emilie van Deventer, WHO, Geneva, Switzerland
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- **Dr William H. Bailey**, Exponent Health Group, New York, New York, USA
- **Dr Ulf Bergqvist**, University of Linköping, Linköping, Sweden (†)
- Dr Caron Chess, Rutgers University, New Brunswick, New Jersey, USA
- Mr Michael Dolan, Federation of the Electronics Industry, London, United Kingdom
- Dr Marilyn Fingerhut, WHO, Geneva, Switzerland
- Mr Matt Gillen, National Institute of Occupational Safety and Health, Washington, DC, USA
- Dr Gordon Hester, Electric Power Research Institute, Palo Alto, California, USA
- Ms Shaiela Kandel, Ministry of the Environment, Israel
- Dr Holger Kastenholz, Centre for Technology Assessment, Stuttgart, Germany
- Dr Alastair McKinlay, National Radiological Protection Board, UK
- **Dr Tom McManus**, Department of Public Enterprise, Dublin, Ireland
- **Dr Vlasta Mercier**, Swiss Federal Office of Public Health, Bern, Switzerland
- Mr Holger Schütz, Research Centre Jülich, Germany
- Dr Daniel Wartenberg, Rutgers University, New Brunswick, New Jersey, USA
- Dr Mary Wolfe, National Institute of Environmental Health Sciences, North Carolina, USA

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FOREWORD

Public concern over the possible health effects from electromagnetic fields (EMF) has led to the preparation of this handbook. Potential risks of EMF exposure from facilities such as power lines or mobile phone base stations present a difficult set of challenges for decision-makers. The challenges include determining if there is a hazard from EMF exposure and what the potential health impact is, i.e. risk assessment; recognizing the reasons why the public may be concerned, i.e. risk perception; and implementing policies that protect public health and respond to public concerns, i.e. risk management. Responding to these challenges requires the involvement of individuals or organizations with the right set of *competencies*, combining relevant scientific

expertise, strong communication skills and good judgement in the management and regulatory areas. This will be true in any *context*, be it local, regional or even national or global.

WHY A DIALOGUE?

Many governmental and private organizations have learned a fundamental, albeit sometimes painful, lesson; that it is dangerous to assume that impacted communities do not want, or are incapable of meaningful input to decisions about siting new EMF facilities or approving new technologies prior to their use. It is therefore crucial to establish a dialogue between all individuals and groups impacted by such issues. The ingredients for effective dialogue include consultation with stakeholders, acknowledgement of scientific uncertainty, consideration of alternatives, and a fair and transparent decision-making process. Failure to do these things can result in loss of trust and flawed decision-making as well as project delays and increased costs.

WHO NEEDS THIS HANDBOOK?

This handbook is intended to support decision-makers faced with a combination of public controversy, scientific uncertainty, and the need to operate existing facilities and/or the requirement to site new facilities appropriately. Its goal is to improve the decision-making process by reducing misunderstandings and improving trust through better dialogue. Community dialogue, if implemented successfully, helps to establish a decision-making process that is open, consistent, fair and predictable. It can also help achieve the timely approval of new facilities while protecting the health and safety of the community.

It is expected that many other public officials, private groups and non-governmental organizations will also find this information useful. This guide may assist the general public when interacting with government agencies that regulate environmental health, and with companies whose facilities may be sources of concern. References and suggestions for further reading are provided for those who seek more information.

ELECTROMAGNETIC FIELDS AND PUBLIC HEALTH THE PRESENT EVIDENCE

Electromagnetic fields (EMF) occur in nature and thus have always been present on earth. However, during the twentieth century, environmental exposure to man-made sources of EMF steadily increased due to electricity demand, ever-advancing wireless technologies and changes in work practices and social behaviour. Everyone is exposed to a complex mix of electric and magnetic fields at many different frequencies, at home and at work.

Potential health effects of man-made EMF have been a topic of scientific interest since the late 1800s, and have received particular attention during the last 30 years. EMF can be broadly divided into *static* and *low-frequency* electric and magnetic fields, where the common sources include power lines, household electrical appliances and computers, and *highfrequency* or radiofrequency fields, for which the main sources are radar, radio and television broadcast facilities, mobile telephones and their base stations, induction heaters and anti-theft devices.

Unlike ionizing radiation (such as gamma rays given off by radioactive materials, cosmic rays and X-rays) found in the upper part of the electromagnetic spectrum, EMF are much too weak to break the bonds that hold molecules in cells together and, therefore, cannot produce ionization. This is why EMF are











Ionizing radiation

ELECTROMAGNETIC FIELDS AND PUBLIC HEALTH: THE PRESENT EVIDENCE

called 'non-ionizing radiations' (NIR). *Figure 1* displays the relative position of NIR in the wider electromagnetic spectrum. Infrared, visible, ultraviolet and ionizing radiation will not be considered further in this handbook.

WHAT HAPPENS WHEN YOU ARE EXPOSED TO ELECTROMAGNETIC FIELDS?

Electrical currents exist naturally in the human body and are an essential part of normal bodily functions. All nerves relay their signals by transmitting electric impulses. Most biochemical reactions, from those associated with digestion to those involved in brain activity, involve electrical processes.

The effects of *external* exposure to EMF on the human body and its cells depend mainly on the EMF *frequency* and *magnitude* or strength. The frequency simply describes the number of oscillations or cycles per second. At low frequencies, EMF passes through the body while at radio frequencies the fields are partially absorbed and penetrate only a short depth into the tissue.

Low-frequency electric fields influence the distribution of electric charges at the surface of conducting tissues and cause electric current to flow in the body (Fig. 2A). Low-frequency magnetic fields induce circulating currents within the human body (Fig. 2B). The strength of these induced currents depends on the intensity of the outside magnetic field and the size of the loop through which the current flows. When sufficiently large, these currents can cause stimulation of nerves and muscles.

At *radiofrequencies* (RF), the fields only penetrate a short distance into the body. The energy of these fields is absorbed and transformed into the movement of molecules. Friction between rapidly moving molecules results in a temperature rise. This effect is used

FIGURE 1. THE ELECTROMAGNETIC SPECTRUM

CELL PHO

in domestic applications such as warming up food in microwave ovens, and in many industrial applications such as plastic welding



or metal heating. The levels of RF fields to which people are normally exposed in our living environment are much lower than those needed to produce significant heating.

BIOLOGICAL EFFECTS AND HEALTH EFFECTS

Biological effects are measurable responses of organisms or cells to a stimulus or to a change in the environment. Such responses, e.g. increased heart rate after drinking coffee or falling asleep in a stuffy room, are not necessarily harmful to health. Reacting to changes in the environment is a normal part of life. However, the body might not possess adequate compensation mechanisms to mitigate all environmental changes or stresses. Prolonged environmental exposure even if

ELECTROMAGNETIC FIELDS AND PUBLIC HEALTH: THE PRESENT EVIDENCE

Complying with exposure limits recommended in national and international guidelines helps to control risks from exposures to EMFs that may be harmful to human health. The present debate is centred on whether long-term, low level exposure below the exposure limits can cause adverse health effects or influence people's well being.

CONCLUSIONS FROM SCIENTIFIC RESEARCH LOW-FREQUENCY FIELDS

Scientific knowledge about the health effects of EMF is substantial and is based on a large number of epidemiological, animal and invitro studies. Many health outcomes ranging from reproductive defects to cardiovascular and neurodegenerative diseases have carcinogenicity of static and extemely low frequency (ELF) electric and magnetic fields. Using the standard IARC classification that weighs human, animal and laboratory evidence, ELF magnetic fields were classified as *possibly* carcinogenic to humans based on epidemiological studies of childhood leukaemia. An example of a well-known agent classified in the same category is coffee, which may increase risk of kidney cancer, while at the same time be protective against bowel cancer. "Possibly carcinogenic to humans" is a classification used to denote an agent for which there is limited evidence of carcinogenicity in humans and less than sufficient evidence for carcinogenicity in experimental animals. "other cancers in children and



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