

Activities and Future Plans of the International Commission on Non-Ionizing Radiation Protection (ICNIRP)

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INTRODUCTION, STRUCTURE, AND MEMBERSHIP

ICNIRP is an independent scientific organization chartered by IRPA in May 1992. At that time ICNIRP took over the responsibility for Non-Ionizing Radiation (NIR) protection from its predecessor, the International Non-Ionizing Radiation Committee (INIRC) of IRPA, that commenced its work in 1977. ICNIRP was established for the purpose of advancing non-ionizing radiation protection for the benefit of people and the environment and in particular to provide guidance and recommendations on protection from non-ionizing radiation exposure. Membership of ICNIRP comprises a Chairman, Vice-Chairman and up to twelve additional members.

Members are chosen on the basis of their recognised activity in the fields of radiation protection, physics, health physics, biophysics, biology, medicine and epidemiology, with regard to an appropriate balance of expertise rather than to nationality. The total duration of membership on the Commission should not exceed three terms, where one term is defined as the duration between succeeding IRPA congresses, or the election meetings closest to them. Normally, the elections will be organized at the last Commission meeting before the succeeding IRPA Congress.

The membership until the end of the IRPA 10 Congress is as follows:

J.H. Bernhardt (Chairman)
A.F. McKinlay (Vice-Chairman)

A. Ahlbom	F. de Gruijl	J.A.J. Stolwijk
U. Bergqvist	M. Hietanen	L.D. Szabó
J.P. Césarini	R.D. Owen	M. Taki
M. Grandolfo	D.H. Sliney	T.S. Tenforde

M.H. Repacholi (Chairman emeritus)
R. Matthes (Scientific Secretary)

In addition, ICNIRP is supported by four Standing Committees (SCs) on Epidemiology, Biology, Physics and Optics. The SCs consist of two Commission members and 4 external experts. The terms of reference and the working program include:

- Develop procedures for critically evaluating the scientific merit of relevant publications;
- Provide critical reviews and relevant references for ICNIRP documents;
- Maintain up-to-date files of relevant publications;
- Identify gaps in knowledge and research needs,
- Develop plans and participate in the writing of new ICNIRP documents.

The membership of the Standing Committees is as follows:

SC I Epidemiology: A. Ahlbom (Chairman), J.A.J. Stolwijk, E. Cardis, M. Linet, A. Savitz, A. Swerdlow.

SC II Biology: R.D. Owen (Chairman), T.S. Tenforde, F. de Gruijl, B. Veyret, R. Saunders, L. Verschaeve.

SC III: Physics: M. Grandolfo (Chairman), M. Taki, H. Bassen, K. Jokela, C. Roy, P. Vecchia

SC IV: Optics: D.H. Sliney (Chairman), J.P. Césarini, B. Diffey, M.A. Mainster, B. Stuck, T. Okuno.

ICNIRP'S ROLE IN NON-IONIZING RADIATION PROTECTION

ICNIRP is an independent group of experts established to evaluate the state of knowledge on the effects of NIR to human health and well being, and to provide science based advice on exposure limits and other methods of protection against harmful effects of NIR. ICNIRP, as an international scientific advisory body, does not include political, social and economic considerations in its deliberations. Membership of ICNIRP is limited to experts who are not affiliated with commercial or industrial enterprise. Thus, ICNIRP is free of vested commercial interest.

ICNIRP is the formally recognized non-governmental organization (NGO) in NIR protection for the World Health Organization (WHO), the International Labour Organization (ILO) and the European Union (EU). It maintains a close liaison and working relationship with other international bodies. These include the International Electrotechnical Commission (IEC), the European Committee on Electrotechnical Standardisation (CENELEC), the International Commission on Illumination (CIE), the International Standards Organization (ISO), the US National Council for Radiation Protection and Measurement (NCRP). ICNIRP also enters into consultation with IRPA national radiation protection societies.

In pursuit of its objectives, ICNIRP has published environmental health criteria documents (in co-operation with the WHO) and guidelines on limiting exposure. ICNIRP has also disseminated knowledge on specific topics of importance to NIR protection by means of statements, practical guides (in collaboration with ILO) and symposia.

ICNIRP continuously carries out critical reviews of the scientific literature concerned with the physical characteristics of NIR, its sources and possible biological and adverse health effects. In doing so ICNIRP limits its surveillance to published original reports and review articles that are generally available. ICNIRP performs such critical scientific analysis by evaluating the relevance, scientific quality and credibility of each report (1). In order to assist ICNIRP in this ongoing review process, several Standing Committees were formed whose membership additionally includes non-ICNIRP experts as well as main Commission members. ICNIRP can be seen as a repository of information on the epidemiological, medical, biological, physical and technological aspects of NIR.

ICNIRP recognizes that the acceptability and adoption of a complete system of protection also requires data and evaluations based on social, economic and political considerations. It is ICNIRP's view that these matters like regulations that are best suited to the needs of individual countries are the responsibility of national governments and advisory authorities. ICNIRP may, however, provide background information of importance. This includes the distribution of exposure and the magnitude of possible health impact in a given population.

Whereas, ICNIRP provides general practical information on measurable levels that are derived from basic limits on exposure, it recognizes the need for further technical advice on special exposure situations. This requires physics and engineering expertise to develop practical measures that lead to compliance with ICNIRP exposure guidelines. This includes guidance on the principles and practice of measurements, specific advice, design of equipment and/or shielding to reduce exposure, and, where appropriate, setting emission limits for specific types of devices (product specific standards). ICNIRP considers that the organizations best qualified to carry out such tasks are the international, regional and national technical standards bodies, including IEC, ISO, CIE, and CENELEC. ICNIRP considers that international bodies for technical standardization should develop product standards for specific types of devices to determine compliance with exposure limits.

SUMMARY OF ACTIVITIES

ICNIRP has collaborated with the United Nations Environment Programme and the World Health Organisation on publications in NIR. These include Environmental Health Criteria (EHC) Documents on Ultrasound, Lasers and Optical Radiation, Ultraviolet Radiation, Radiofrequency and Microwaves, Extremely Low Frequency (ELF), and Magnetic Fields. These EHC contain reviews of the biological effects and

assessments of health risks. ICNIRP uses the results of this assessment to draft health-based exposure guidelines. The purpose of the ICNIRP guidelines is to deal with the basic principles of protection against non-ionizing radiation, so that they may serve as guidance to the various international, regional, and national bodies as well as the individual experts who are responsible for the development of regulations, recommendations, or codes of practice to protect workers and the general public.

The following guidelines for the protection of workers, members of the public, patients and the environments as well as statements of selected topics have been published by ICNIRP; or its predecessor:

- Concepts, Quantities, Units and Terminology for Non-Ionizing Radiation Protection;
- Airborne Ultrasound;
- Laser Radiation;
- Ultraviolet Radiation;
- Visible Light and Infrared Radiation;
- Video Display Terminals;
- Fluorescent Lighting and Malignant Melanoma;
- Health Issues of UV-A Sunbeds;
- Protection of the Patient undergoing Magnetic Resonance Imaging;
- Static Magnetic Fields;
- Health Issues of Hand-Held Radio-Telephones and Base Transmitters;
- Time-varying electric, magnetic, and electromagnetic fields (up to 300 GHz);
- Use of the ICNIRP EMF guidelines;
- Safety aspects of laser pointers as well as for Light-Emitting Diodes (LED) and Diode Lasers.

The guidelines and statements up to and including 1990 have also been published in a book. An actualized version of the collected guidelines and statements will be published in May 2000. In 1988, 1992, and 1996, international NIR workshops were held, and the proceedings have been published. The 4th International NIR Workshop will be held in Kyoto immediately after the IRPA 10 Congress.

In collaboration with the International Labour Office, practical guides for the protection of workers have been developed on:

- Occupational hazards from non-ionizing electromagnetic radiation;
- Protection of workers against radiofrequency and microwaves radiation;
- The use of lasers in the workplace;
- Protection of workers from power frequency electric and magnetic fields;
- Visual display units: radiation protection guide;
- Radiofrequency heaters and sealers.

A list of publications is available on ICNIRP's home page (www.icnirp.de; see also (2)). The most important documents can be downloaded as pdf documents.

HIGHLIGHTS

In the period 1996 until 2000 there have been a few issues which deserve special attention: The mobile phone issue, EMF and cancer, ICNIRP's EMF guidelines and the European Council recommendation on limiting EMF exposure.

Safety of mobile telephones and base transmitters

The significant increase in the use of hand-held radio-telephones, together with an extension of the coverage of reception areas with fixed base transmitters, often sited in residential areas, has led to concerns about risks to health, in particular about cancer, from the emission of such devices in the frequency range from about 800 MHz to 2 GHz. The adequacy of current protection limits has also been questioned.

ICNIRP reviewed these scientific publications addressing the health issues related to the radiofrequency radiation emissions from hand-held radiotelephones and base transmitters. A statement was published in April

1996 (3). In the following, the main conclusions of ICNIRP are summarized.

- (1) The results of published epidemiological studies as well as data from laboratory studies relevant to cancer do not provide a basis for hazard assessments in relation to the use of hand-held radiotelephones and base transmitters.
- (2) Limits for human exposure to the fields associated with the use of hand-held radiotelephones and base transmitters should be those of the INIRC for whole-body average SAR (i.e. 0.08 W kg^{-1} for the general public) and those of ICNIRP for localized SAR. For hand-held radiotelephones used by the general public, ICNIRP recommends that the localized SAR in the head be limited to 2 W kg^{-1} averaged over any 10 g mass of tissue in the head (0.02 W absorbed in any 10 g mass of tissue in the head). The localized SARs in the head associated with the use of hand-held radiotelephones must be assessed for each frequency and configuration used.
- (3) There is no substantive evidence that adverse health effects, including cancer, can occur in people exposed to levels at or below these limits.
- (4) It is recognized that, under certain circumstances, RF emissions from hand-held radiotelephones can cause interference with the function of some electrical and electronic equipment. The problem of interference with electromedical equipment, especially life support devices is of concern. It is therefore recommended that the use of radiotelephones is restricted to areas where such interference effects are unlikely to occur (e.g., well away from hospital intensive care departments and similar locations). Manufacturers of electrical equipment are encouraged to design and manufacture equipment that is insensitive to RF interference.

Low-frequency electromagnetic fields and cancer

Whether exposure to electromagnetic fields causes cancer has been vigorously debated for many years and has been one of the most important issues for ICNIRP and its predecessor INIRC/IRPA.

There have been more than a dozen studies of the possible relation between cancer in children and residential exposure to ELF magnetic fields (see also review in 4). Reviews of epidemiological studies suggest that there is weak evidence for a link between exposure to extremely low frequency (ELF) fields from power lines (typically 50/60 Hz) and an increased risk of developing leukaemia in children. Other scientific evidence does not support this conclusion. Recently the US National Institute for Environmental Health Sciences (NIEHS) concluded that „*ELF exposure cannot be recognized as entirely safe because of weak scientific evidence that exposure may pose a leukaemia hazard*“.

Residence in homes near external power lines is associated with an approximate 1.5-fold excess risk of childhood leukaemia. Although the literature is inconsistent, when studies that use various markers of exposure, such as proximity to power lines and calculated magnetic fields from power lines, are combined, the increased risk is statistically significant. Although confounding factors and reporting or case selection bias may have influenced some of the studies they are unlikely to account for the overall pattern of association. Studies examining health outcomes other than childhood cancer do not provide sufficient evidence to support an association between ELF magnetic-field exposure and adult cancers, pregnancy outcome, or neurobehavioral disorders.

Occupational studies have generally used job titles, sometimes in combination with workplace ELF field measurements, to determine whether any association exists between exposure to these fields and cancer. Elevated risks of various cancers have been reported, especially leukaemia, nervous system tumours and breast cancer; but the lack of uniformity of the results has been a major concern. Any excess cancer risk among electrical workers, compared to other occupations, is small and difficult to detect by using epidemiologic methods. Studies have been complicated by the lack of adequate exposure assessment in the workplace and possible confounding factors so far.

Taken together, however, it is ICNIRP's view that in the absence of support from laboratory studies these epidemiological data are insufficient to be used as the basis for exposure guidelines (4). The Commission and ICNIRP's Standing Committee „Epidemiology“ are observing and reviewing the scientific evidence indicating that there are consequences to health from EMF exposure.

Guidelines on limits of exposure to time-varying electric and magnetic fields (up to 300 GHz)

ICNIRP adopted guidelines on limits of EMF exposure for frequencies up to 300 GHz (5). While all the scientific literature was reviewed, the only established effects are short term, immediate health effects such as

stimulation of peripheral nerves and muscles as well as functional changes in the nervous system and other tissues, shocks and burns caused by touching conducting objects, and changes in behavior caused by elevated tissue temperatures.

Limiting values are given as basic restrictions and reference levels. Basic restrictions relate directly to established health effects. Appropriate safety factors are included. Reference levels are derived from the basic restrictions for worst-case exposure situations and are in quantities that can be easily measured. They provide levels that can be used to determine compliance with the basic restrictions. By using the system of basic restrictions and derived reference levels, the new ICNIRP guidelines offer flexibility for many exposure situations.

ICNIRP recommends the use of the reference levels as general guidance for EMF limits for workers and the general public. ICNIRP recognizes that the reference levels are given for the condition of maximum coupling of the field to the exposed individual, thereby providing maximum protection. However, when reference levels are exceeded this does not necessarily mean that the basic restrictions are exceeded. In this case they need to be determined by further investigations. This may cause difficulties in some special exposure situations. Near-field exposure situations, localized and non-uniform field exposures are of special interest. ICNIRP recognizes the need for technical advice in the translation of biologically justified restrictions on human exposure into practical exposure limitations for such special exposure situations. This requires physics and engineering expertise to develop practical measures that lead to compliance with these guidelines. ICNIRP is of the opinion that these tasks are carried out adequately by international, national, and regional technical standards bodies.

A statement (Use of the ICNIRP EMF guidelines, published on ICNIRP's web site) clarifies the way in which the guidelines should be used in a regulatory and legislative context. This statement addresses some concerns about the guidelines and clarifies points such as the criteria used for evaluating scientific studies, the development and practical application of the guidelines, the need for special technical advice, how to consider social and economic aspects and how to handle current research.

Meanwhile, more than 20 countries have accepted the ICNIRP EMF guidelines in their totality or with slight variations.

The European Council recommendation on limiting EMF exposure

The Council of the European Union has passed a recommendation on the limitation of exposure to electromagnetic fields from 0 Hz to 300 GHz. (6.) The Council agreed with the protection concept, which has been developed by the International Commission of Non-Ionizing Radiation Protection (ICNIRP). In the light of new knowledge and development in technology and application of sources and practices the regular reviewing and reassessing is needed.

The objective of this recommendation is the protection of public health, and therefore, it applies to relevant areas, where members of the public spend a long time. Separate occupational exposure protection or EMF interference with active implants are not included in this recommendation. It leaves to the Member States to provide detailed rules concerning the sources and practices giving rise to exposure to EMF.

The protection concept presents two classes of limiting values, the basic restrictions and the reference levels. Basic restrictions (current density, SAR and power density) are based directly on established health effects. Appropriate reduction factors referring especially to long term effects and potentially higher sensitivity in certain population groups were considered, taking account of insufficient information on certain biological effects of EMF exposure and related health consequences. Reference levels are provided for practical purposes of exposure assessment in order to determine whether the basic restrictions are likely to be exceeded. The frequency dependence of the reference field levels is consistent with data on both biological effects and coupling of the fields.

In accordance with the Treaty, the Member States may provide for a higher level of protection than set out in this recommendation. Regarding the state of the art of science and technology, the council recommends revision and updating of the limit levels, taking also into account possible effects which are currently the object of research, including relevant aspects of precaution.

Meanwhile, the European Commission requested in a standardization mandate that the European standards bodies (CEN, CENELEC and ETSI) prepare and adopt harmonized standards describing the test

methods, test equipment and calculation methods needed, and take into account the reference levels and basic restrictions as detailed in the Council recommendation.

COOPERATION WITH INTERNATIONAL ORGANIZATIONS

World Health Organization

The Office of Global and Integrated Environmental Health at WHO established the International EMF Project on "Electromagnetic Fields and Public Health" in which WHO collaborates with IARC, UNEP, ILO, ICNIRP and collaborating institutions in France, Germany, Japan, Sweden, the UK, and the USA. The project is intended to provide health risk assessments of exposure to EMF that will assist ICNIRP to develop international guidelines on exposure limits. The EMF project will not be developing standards on exposure limits, since this is recognized as the province of ICNIRP.

The input of ICNIRP and its Standing Committees in the WHO EMF Project include:

- Special expertise in critical in-depth evaluation of the scientific literature using well established scientific methods;
- Assisting in making recommendations on gaps in scientific knowledge needed to be investigated to improve health risk assessment;
- Advising in updating the WHO - Environmental Health Criteria (EHC) - monographs;
- Assisting and participating in scientific review group meetings needed for review of the relevant literature and for improving a health or environmental risk assessment.

Within this project, WHO and ICNIRP jointly organized several international seminars on

- Non-thermal effects of RF electromagnetic fields (Munich, 11/1996);
- Biological effects of static and ELF electric and magnetic fields and related health hazards (Bologna, 6/1997);
- Risk perception, risk communication and its application to EMF exposure (Vienna, 10/1997);
- Health effects of exposure to EMF in the frequency range 300 Hz - 10 MHz (Maastricht, 6/1999);
- Effects of electromagnetic fields on the living environment (Munich, 10/1999);
- Review of the biological and health effects of pulsed radiofrequency fields (Sicily, 11/1999).

The proceedings of these seminars are published by ICNIRP as well as the working group reports of the meetings are (or will be) published in the Bioelectromagnetics Journal.

WHO Environmental Health Criteria EMF Reviews

EHC publications are the result of in-depth critical reviews conducted by independent, scientific peer-review groups on various topics related to exposure of people, biological systems, and the environment. These reviews are based on excellent reviews already completed and concentrate attention on the major research works already published, as well as the most recent literature.

ICNIRP is developing a complete own review on EMF issues including a health risk assessment. Draft reviews of the physics/engineering, biology, and epidemiology will be prepared by ICNIRP's Standing Committees I to III in conjunction with WHO collaborating institutions. The format will be the same as the EHC documents. There was a general decision to start the work with the low-frequency range and to combine the data of static and time-varying electric and magnetic fields up to 100 kHz in one document.

Deadline for the final drafts of the ELF documents is the year 2000 and they are intended to be published by the end of 2001. For the documents concerning RF the final drafts should be available within 2002 so that publication could occur in 2003. It is intended to prepare separate documents on epidemiology, biology, physics, and a health risk assessment. The health risk assessment should be a joint publication with WHO and finalized by the WHO/ICNIRP task group. Publication of the different reports epidemiology, biology and physics could be possible in journals broadly recognized by different expert groups or as independent ICNIRP reports. The SCs organize their meetings independently as necessary.

International Agency for Research on Cancer

IARC will collaborate with ICNIRP on the International EMF Project, assisting particularly with reviews of the epidemiological studies and the evaluation of the data with respect to carcinogenesis. The IARC Monographs Programme is planning to convene an advisory group of experts.

Commission of the European Communities

The EC currently has many activities related to EMF. These involve the Directorates General: Employment, Industrial Relations and Social Affairs (DG V); Science, Research and Development (DG XII), and Telecommunications, Market Information and Research Exploitation (DG XIII). DG V has supported publications by ICNIRP on EMF protection for many years. DG XIII is interested in research on possible health effects of RF fields, especially of those emitted by mobile telephones. Research projects are now included in the Framework V Programme (1999 - 2001). In addition, DG XIII supports communications among European scientific researchers through the COST 244bis initiative entitled *Biomedical effects of electromagnetic fields*. Within this forum European scientists communicate their research results, suggest research needs, and discuss the results of research through special meetings. Results of the meetings are published as well as in proceedings and in COST 244bis - Newsletters.

The EC, DG V, contracted a panel of experts to investigate the occurrence of electromagnetic hypersensitivity across Europe. The relevant scientific literature was reviewed, and reports of symptoms or adverse health effects were analyzed. The expert group made recommendations to the EC on the status of this field and what action was necessary to alleviate the problem.

DG V asked the European members of ICNIRP for advice concerning the public exposure to EMF fields. The EC wanted to issue a Council Recommendation with the main aim to provide for a commonly agreed framework concerning a high level of protection against exposure of the general public to electromagnetic fields (EMFs) based on the set of basic restrictions and reference levels as published by the ICNIRP. The Council of the European Union issued the recommendation on the protection of the public from EMF exposure in Summer 1999 (see also Chapter „Highlights“)

ICNIRP's WORK PLAN 2000 TO 2004; FINANCIAL SUBSIDIES

From ICNIRP's future work plan the following issues deserve special attention:

- Document on ICNIRP's general approach to protection against NIR: This document which will be published by the end of 2000, summarizes a common framework for the assessment of risk and the development of guidelines from exposure for electromagnetic fields and optical radiation.
- Reviews of the physics/engineering, biology, epidemiology and health effects of static and ELF electric and magnetic fields (2000), of radiofrequency fields (> 100 kHz; 2002) and of visible and infrared radiation. The reviews will contain a detailed health risk assessment and can be used from WHO and IARC for the revision of WHO's health criteria documents.
- Revision of the guidelines on ultraviolet radiation, airborne ultrasound, and electromagnetic fields.
- Revision of the statements on UV sunbeds and on the use of magnetic resonance imaging in medical diagnostics.
- Participation in the process of an international harmonization of EMF Standards within the WHO EMF project.
- Further activities (Seminars and Workshops; reviews of health effects and research needs) within the international EMF and INTERSUN Projects of the WHO.

One problem of the Commission are financial subsidies. ICNIRP owes great gratitude to the German Ministry of Environment for providing resources to maintain the ICNIRP secretariat as well as to IRPA, the French Society of Protection against Radiation (SFRP), and to WHO for grants that allow ICNIRP to continue its independent activities. Unfortunately, the EU stopped its funding in 1998, because of constraints on such ongoing funding of a call-off nature, and further financial subsidies are depending on special activities for the Commission following calls for proposals. ICNIRP has to look for other sources of funding, since additional

working group meetings of ICNIRP's Standing Committees need financial budgets. Also world wide representation of ICNIRP is necessary since, for example, more than 20 countries have accepted the ICNIRP EMF guidelines and other countries need clarifications concerning regulatory and legislative aspects and explanation about special issues like the application of criteria used for evaluating scientific studies and performing risk assessment as well as the development and practical application of the guidelines.

REFERENCES

Most publications mentioned in this paper can be found on ICNIRP's home page (www.icnirp.de). The following citations are referenced in the text:

- 1) J.H. Bernhardt and O. Schulz, *Criteria for Evaluation of Scientific Literature for Risk Assessment*. In: Health Effects of Electromagnetic Fields in the Frequency Range 300 Hz to 10 MHz, (R. Matthes, E. von Rongen, M.H. Repacholi, eds); ICNIRP 8/99. pp7-15. Available from: Scientific Secretary, International Commission on Non-Ionizing Radiation Protection, c/o Bundesamt für Strahlenschutz, Institut für Strahlenhygiene, Ingolstädter Landstrasse 1, D-85764 Oberschleißheim, Germany (1999)
- 2) J.H. Bernhardt and R. Matthes, *Recent and Future Activities of the ICNIRP*. Radiat. Prot. Dosim. 72 (3-4), 167 - 176 (1997)
- 3) International Commission on Non-Ionizing Radiation Protection. *Health Issues Related to the Use of Hand-held Radio-telephones and Base Transmitters*. Health Phys. 70(4), 587 - 593 (1996).
- 4) M.H. Repacholi and B. Greenebaum, *Interaction of Static and Extremely Low Frequency Electric and Magnetic Fields with Living Systems: Health Effects and Research Needs*. Bioelectromagnetics 20, 133 - 160 (1999)
- 5) International Commission on Non-Ionizing Radiation Protection. *Guidelines for limiting exposure to time-varying electric, magnetic and electromagnetic fields (up to 300 GHz)*. Health Physics 74(4); 494 - 522 (1998)
- 6) European Commission. *Council Recommendation 1999/519/EC of 12 July 1999 on the Limitation of Exposure of the General Public to Electromagnetic Fields (0 Hz to 300 GHz)*. Official Journal L 197 of 30 July 1999.