# 전자기장의 인체노출에 대한 국제동향

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전자기장의 인체 유해성 여부가 명확히 밝혀지지 않음에 따라, 국제조직 혹은 세계 각국은 저마다의 고유한 입장에 처해 있고, 따라서 전자파 정책은 나라별로 모두 다르다. 여기에서는 각국에서 전자기장 혹은 전자파에 관하여 이슈화가 된 것들을 모아 정리하였다. 한국의 상황에 관한 자료 이외에는 모든 자료가 영어로 되어 있어, 원 자료들에서 발췌한 것들을 그대로 실었음을 양해하여 주기 바란다.

## Ⅰ. WHO International EMF Project

The Project[1] commenced in 1996 and is schduled to end in 2005.

### 1-1 Project Objective

- Provide a coordinated international response to concerns about possible health effects of exposure to EMF.
- Assess the scientific literature and make status reports on the health effects.
- Identify gaps in knowledge needing further research to make better health risk assessments.
- Encourage focused, high quality research programmes.
- Incorporate research results into WHO's Environmental Health Criteria monographs where formal health risk assessments will be made of EMF exposure.
- Facilitate the development of internationally acceptable standards for EMF exposure.
- Provide information on the management of EMF protection programmes for national and other authorities, including monographs on EMF risk perception, communication and management, and
- Provide advice to national authorities and others on EMF health and environmental effects and any protective measures or actions needed.

### 1-2 Collaborating Organizations

8 international agencies, over 40 national authorities, 7 WHO collaborating centers.

8 international agencies : ICNIRP, IARC, ILO, ITU, EC, IEC, UNEP, NATO

### 1-3 Home Page

http://www.who.int/emf

### 1-4 Health Risk Assessment Schedule

The classification of carcinogenic potential of static and ELF fields would be made in 2001. A meeting will be held in 2003 to classify the carsinogenic potential of RF fields.

### 1-5 Classification Categories of the Physical Agents

Group 1 : The agent is carcinogenic in humans.
Group 2A : The agent is probably carcinogenic.
Group 2B : The agent is possibly carcinogenic.
Group 3 : The agent is not classifiable as to its carcinogenesity.
Group 4 : The agent is probably not carcinogenic.

WHO will be establishing formal task groups to review static and ELF field effects in 2002 and for RF fields in 2004. IARC will publish the results of their meetings in the IARC monographs and WHO will incorporate the IARC conclusion into the results of the WHO task group meetings and publish them as WHO Environmental Health Criteria monographs.

## Ⅱ. NIEHS ELF Review

US National Institute of Environmental Health Sciences (NIEHS) completed EMF RAPID Program[1] in 1998. Under this program an international working group was convened in Brooklyn Park, Minnesota 16~24 June 1998, to review the literature and use IARC evaluation criteria to classify the casinogenesity of ELF fields. The working group report has been published by NIEHS (CJ Portier and MS Wolfe eds, Assessment of the Health Effects of Exposure to Power-line Frequency Electric and Magnetic Fields, Working Group Report, NIEHS pp 508, 1998) The working group classified exposure to ELF fields as Group 2B, a "possible human carcinogen." This conclusion was based on epidemiological evidence, but this categorization was not supported by the animal studies. In his final report to the US Congress. Dr Ken Olden, Director of the NIEHS, noted that "ELF-EMF exposure cannot be recognized as entirely safe with exposure possibly posing a cancer risk. In our opinion, this finding is insufficient to warrant aggressive regulatory action. However, because virtually everyone in the United States uses electricity and therefore routinely exposed to ELF-EMF, passive regulatory action is warranted such as continued emphasis on educating both the public and the regulated community on means aimed at reducing exposures."

WHO has taken the NIEHS conclusion that there is a need for more focused research to resolve the outstanding questions raised by the epidemiological studies.

## Ⅲ. Precautionary Policies

Because of health concerns by the public, governments are increasingly called on to adopt precautionary approaches to regulating EMF exposures. A wide variety of such policies is possible. They can be either regulatory (mandatory) or non-regulatory (voluntary), or supplement or replace health-based exposure guidelines for EMF (WHO 2000; Foster et al 2000).

Precautionary policies have widespread political support because they address public concerns, but not necessarily effective in addressing health concerns. However, they are difficult to apply in a non-arbitrary way to regulating EMF exposure. The lack of an identified hazard from low-level EMF makes it difficult to comply with these guidelines. Strict application of the Precautionary Principle seems inappropriate for dealing with EMF.

In Europe, precautionary policies are generally framed in terms of the Precautionary Principle,

where the Treaty on European Union is the basis of European environmental policies. In response to citizen's concerns about possible hazards of low-level EMF exposure, several governments have enacted or considered proposals to institute precautionary approaches to regulating public exposure to EMF[2]. Examples include:

### 3-1 Italy, Slovenia, Switzerland

These three countries have recently introduced "cautionary" limits for public exposure to RF that are as low as one hundredth of international guidelines for "sensitive areas" including residential areas and schools. In addition Switzerland has placed limits on new construction in areas in which the precautionary limits are exceeded.

### 3-2 New Zealand

In 1999 this country took a different precautionary approach by issuing RF exposure standards that follow the international guidelines. The Ministries of Health and Environment considered the limits to "provide adequate protection" but noted that community concerns over RF exposure might be addressed by "… minimizing, as appropriate, RF exposure which is unnecessary or incidental to achievement of service objectives or process requirements, provided that this can be readily achieved at modest expense." The government recommended a range of other voluntary measures, including better risk communication with the public.

This approach relies on traditional exposure limits, but supplements them with nonregulatory measures aimed at improving the public acceptability of transmission facilities.

### 3-3 UK (IEGMP 2000)

In May 2000, the Stewart Committee report recommends adoption of ICNIRP exposure guideline as mandatory limits. It also recommends a range of voluntary and mandatory precautionary measures. Mandatory measures include restrictions on siting mobile base stations near schools to reduce RF exposure (without, however, placing numerical limits on the exposure), health warnings on mobile phones, and a national database of mobile telephone base stations. In addition, the report recommends a range of voluntary measures, including discouraging industry from marketing mobile telephones to children.

## Ⅳ. EMF Influence Worldwide

### 4-1 FDA[3]

The FDA (Food and Drug Administration, U.S. Department of Health and Human Services) announced on June 8, 2000 that it will collaborate with the Cellular Telecommunications Industry Association (CTIA) on research into mobile phone safety. Initial researches will include both laboratory studies and studies of mobile phone users focused on wheather RF emissions from mobile phones pose any health risk.

Although research to date does not show that mobile phones pose a significant health hazard, there is not enough information at this point to be absolutely certain that these products are without risk. Certain studies conducted by the Wireless Technology Research, L.L.C. (WTR), on behalf of the

wireless phone industry have raised questions that need further exploration.

FDA will review the WTR research, as well as other cell phone research, identify the scientific questions which merit attention, propose research to address those questions, and provide detailed recommendations on the conduct of the studies.

### 4-2 IEEE[4]

Standard Coordinating Committee 28 (Nonionizing Radiation) develops standards related to human exposure in the range of 0 Hz to 300 GHz.[7]

SC1 : Techniques, Procedures, and Instrumentation,

SC2 : Terminology, Units of Measurements, and Hazard Communication,

SC3 : Safety Levels with Respect to Human Exposure, 0~3 kHz,

SC4 : Safety Levels with Respect to Human Exposure, 3 kHz~300 GHz,

SC 4 are currently reviewing the pertinent scientific literature to assess the need for revision of C95.1, Radio frequency safety standard.

Individual members of the US RF Interagency Work Group (RFIAWG) prepared the list for this SC in response to requests for input. The list has been given as well to ICNIRP. The list of issues[6] are :

- Biological basis for local SAR limit
- Selection of an adverse effect level
- Accute and chronic exposures
- One tier vs two tier guidelines
- Controlled vs uncontrolled
- Uncertainty factors
- Intensity of pulsed or frequency modulated RF radiation
- Time averaging
- Lack of peak limits for induced and contact current
- Criteria for preventing hazards caused by transient discharges
- Limits for exposure at microwave frequencies
- Replication / validation
- Important health effects literature areas
- Compatibility of RFR (RF Radiation) guidelines

SC5 : Safety Levels with Respect to Electro-Explosive Devices.

SCC-34 deals with product standards derived from exposure standards. For further information contact the chair : Ronald C. Peterson, rcpeterson@lucent.com[7].

### 4-3 US Air Force Research Laboratory[8]

Bioeffects research now being conducted at subcellular, cellular, and whole organism levels. In order to examine carcinogenecity potential, some studies expose small laboratory animals to RF radiation (RFR) over virtually their entire life span. Dosimetry models are also strongly studied for these examinations. Other research focuses on the basic mechanisms of RFR bioeffects. Also emphasized are studies on the effects of millimeter wave frequency and high power microwave radiation on ocular and nervous system function. Some new directed energy weapons systems use short, intense pulses of microwave energy to incapacitate opponent electronic systems. A major research effort is focused on determining the biological effects of these novel pulses in

order to establish protection criteria necessary before these systems can be tested and fielded.

### 4-4 Bulgaria[4]

Individuals of hypersensitivity to EMF are registered with files containing their personal complaints, results from measurements at their homes and data about their health status[5].

### 4-5 Canada[4]

The new Health Canada's Safety Code 6 - Limits of Human Exposure to Radio-frequency Fields in the Frequency Range from 3 kHz~300 GHz, was published in Oct 1999.

Industry still faces increasing public opposition to the siting of cellular base stations. Public belief is that Health Canada's Safety Code 6 as well as others do not adequately address the effects of low-level RF fields.

Toronto Public Health has officially released a report, which recommends the City of Toronto to adopt a prudent avoidance policy in the development for siting of base station antennas.

### 4-6 Israel[4]

Latest events in the country was that 18 people injured in violent protests against siting of cellular towers in Druze village near Haifa (Usafiah). Several local municipalities exert pressure to lower EMF exposure limits even below those of the Italian and Swiss governments. Nationwide Master plan for siting RF towers is in progress.

Two bills passed preliminary hearing in Knesset.

1. Forcing cellular phone ads to include a warning about the possibility of them being harmful to health.
2. Establishment of a research fund to conduct cooperative research on the hazards of wireless phones.

### 4-7 France[4]

Within the frame work of "National Network of Radio-Telecommunoications" (RNRT), the Ministry of Research and the Ministry of Industry continue to support with Industry an important program of research. This one incorporate eight projects carried out by both academic and industrial groups. It is funded at the level of 1 million Euros by year, 50% from industry and 50% from public funds. It consists of 3 main topics:

- Dosimetric studies : checking procedures for mobile phones, and studies of cell and animal exposure systems
- Human studies : effects of mobile phone emissions on EEG and hearing evoked potentials
- Animal studies : Effects of GSM microwave on the rat memory and learning, and on the inner ear in guinea pig, and on the permeability of the BBB and headache provocation in rats. Effects of cellular phones on the brain activity in rats and their behaviour, on the brain neurotransmitters in rats.

Bouygues Telecom has funded about:

- Oncological phenomena in animals
- GSM exposure effects on human sleep

Electricite de France (EDF) carried out several programs of power lines effects

- Childhood leukemia epidemiological studies according to residential magnetic field exposure.
- *In vivo* studies : free radical in rats and leukemia in rats by magnetic fields
- Human studies : blood rate of melatonin, antipituitary hormones and main electrolytes in workers chronically exposed to high levels of EMF and implanted pacemaker effects by magnetic fields.

### 4-8 Russia[4]

1999 a standard was prepared and approved in Russia: "Power frequency magnetic field (50 Hz) in occupational environment"

Limit values for power frequency magnetic field 50 Hz (1999)

| Time | Magnetic Flux Density B, uT | |
|---|---|---|
| | Total exposure | Local exposure |
| ≤1 | 2000 | 8000 |
| 2 | 1000 | 4000 |
| 4 | 500 | 2000 |
| 8 | 100 | 1000 |

Non-thermal effects reseraches done past or in the future

1. Cell phone effects on the brain - brain biocurrents and brain bloodcurrents investigation
2. Vestibular (內耳前庭) analyzer effects investigation (for volunteers and animals)
3. Low intensity chronic exposure bioeffects analysis which were used as a basis for Russian standards

### 4-9 Japan

A meeting was held in Tokyo, 7~11 Nov 1998 with Dr Kabuto's team of NIES (National Institute for Environmental Studies) of Environmental Agency and some Research Coordination Committee to assist with the development of a high quality exposure assesssment protocol for this study. The study is due to commence later in 1999[1].

More detail about the research[4] is

1) Epidemiological Study on Childhood Leukemia and Brain Tumors (1999~2001) : 1,000 cases and 3,000 controls for childhood leukemia and 500 cases and 1,500 controls for brain tumors.
2) Human Study on Melatonin.
3) *In vivo* Study on MCF-7 Cells.

### 4-10 MPT (Ministry of Posts and Telecommunications)[4]

Committee of the Study on Human Exposure to EMF has been held under the auspice of Committee Chairman and Professor Shoogo Ueno of The University of Tokyo since 1997 in order to scientifically investigate the effects of electromagnetic waves on the human body.

#### 4-10-1 Past Activities of MPT

a. Investigation into the effects of electromagnetic waves on the human body(blood-brain-barrier

influence study)

b. Hosted a workshop with administrative officials and experts from Japan, Korea and the EU.

4-10-2 Planned Activities for Fiscal 2000 of MPT

a. Epidemiological Survey

Through participation in epidemiological surveys implemented by IARC, Japan will investigate the relationship between cellular phone use and brain tumors. The research will be tentatively begun in Sep 2000 and implement it for a two-year period.

b. Long-term Partial Exposure Experiment

Research of the effects of a two-year period of RF exposure to rats' head.

c. 2nd workshop with Korea and the E.U.

Budget 440 million yen (MPT), and 190 million yen (Communication Research Lab, MPT)

## 4-11 Belgium[4]

During the last year, the research on EMF in Belgium was actively carried out in the field of ELF (50 Hz). The ELF was investigated by the Belgium BioElectroMagnetic Group with the following orientation :

1. Study of EMF on Cell Differentiation *in Vitro*.
2. ELF-EMF effects on Cell Proliferation and the EM Origin of Lipoatrophia Semicircularis.
3. Psychological, Psychophysiological and Neuroendocrine Effects of Human 50 Hz Magnetic Field Exposure and Sensitivity to Electricity.
4. Effects of ELF-EMF (50 Hz) on cultured rat hippocampal cells : study of the impact of ELF EMFs on the modulation of nitric oxideinduced cell death.
5. Effects of EMF on the Intracellular Calcium Signaling.
6. Evaluation of Epidemiological Literature and Participation in the in situ Measurements.
7. Logistic and Technological Support of the Biomedial Teams.

## 4-12 New Zealand[4]

In March 1998 the New Zealand Government directed the Ministry for the Environment, in partnership with the Ministry of Health, to draft national guidelines on managing the health effects of radiofrequency transmission facilities. The discussion document was distributed by the Ministry for the Environment and the Ministry of Health in July 1999.

In the discussion document, the Ministry of Health recommends strict application of the exposure guidelines published in 1998 by the ICNIRP and adopted in the NZ Standard. The Ministry of health considers there are no established adverse effects from exposure to radiofrequency fields which comply with the ICNIRP guidelines and the NZ Standard.

The Ministry of Health has commissioned an independent review of the most recent report by Dr Neil Cherry, a well known scientist and a meteorologist who challenges the scientific consensus on the health effects from exposure to EMF and limits in the ICNIRP guidelines.

## 4-13 Italy[4]

Regulation formulation is under going by the House of Deputies and by the Senate.

- exposure limits of EMF that cannot be exceeded under any circumstance; exposure limits are expected to be set equal (or close) to international standards. 100 $\mu$T for 50 Hz.
- attention levels that cannot be exceeded in residential environments. They are explicitly defined as cautionary values for long-term effects; attention levels are additional limits and actually considered as the true limits by the public, and by the local health authorities. 0.5 $\mu$T for 50 Hz.
- quality goals aimed at precaution, "also with reference to protection from possible long-term effects."; quality goals were similar in some respect to installation limits of the recent Swiss Ordinance.

Quality goals are 0.5 to 5 V/m according to the different local authorities. From base stations, distances are ranging from 50 m to 300 m by various municipalities for quality goals. 0.2 $\mu$T for 50 Hz.

## V. 한국의 상황

### 5-1 인체보호기준 및 측정기준

1) 1999년 5월, <전자기장 노출에 대한 인체보호기준(안)>에 관한 Workshop 개최.
2) 1999년 5월, <전자기장 노출에 대한 인체보호기준>, <인체보호 기준에 관한 전자기장 세기 측정방법>, <인체 보호기준에 관한 전자기장 환경 측정결과> 발표.

노출기준 : ICNIRP, Guidelines for Limiting Exposure to Time-varying

Electric, Magnetic, and Electromagnetic Fields (up to 300 GHz), 1998.

측정기준 : CENELEC

발 표 : 1999년 5월 27일, 정보통신부 회의실(기자회견), 한국전자파학회의 민간권고기준.

### 5-2 국내외 활동

1) 1998년 8월, WHO의 International EMF Project에 가입.
2) 1999년 10월, 제1회 생체 電磁환경 韓-日-EU Workshop.
3) 2000년 10월 18日~19日, 제4회 전자기장의 생체 영향에 관한 Workshop개최.
4) 2001년 Fall, 제2회 생체 電磁환경 韓-日-EU Workshop 예정.
5) 2001년 10월, WHO Asia Regional Meeting 개최 예정.

### 5-3 전자기장 인체보호기준 등에 관한 입법

1) 1999년 4월 10일 : 국회 <환경 포럼>과 <정보통신 포럼> 합동으로, <有害 전자파 공해 문제와 대책>이라는 주제로 토론회 개최.
2) 5월 6일 : <환경정책기본법 中 개정법률안>이 국회 환경 노동위원회에서 발의. 내용 : 전자파를 <환경오염>으로 규정하여, 그 제한치를 두고자 함. 법사위에 회부되지 못함.
3) 5월 6일 : <산업안전보건법 中 개정법률안>이 국회 환경 노동위원회에서 발의. 내용 : 컴퓨터 단말기에 <전자파 차단 또는 중화장치>의 부착을 의무화. 법사위에 회부되지 못함.
4) 1999. 11. 27. : 전파법 개정 案을 정호선 의원 外 19人 발의. 1999. 12. 8. : 과학기술 정보통신위원회 內 법률안 심사 小위원회 심사.

1999. 12. 13. : 국회 법제사법위원회 심사.

1999. 12. 16. : 국회 本 회의 통과.

2000. 1. 22. : 전파법 개정을 행정부에서 공포.

### 5-4 개정된 전파법 제 47조 내용

第5章 電波資源의 保護

第47條 (安全施設의 設置)

無線設備는 人體에 危害를 주거나 물건에 損傷을 주지 아니하도록 情報通信部令이 정하는 安全施設 基準에 의하여 設置하여야 한다.

第47條의 2(電磁波 人體保護基準 등)

① 情報通信部長官은 無線設備 등에서 발생하는 電磁波가 人體에 미치는 영향을 고려하여 電磁波 人體保護基準, 電磁波 强度測定基準, 電磁波 吸收測定基準 및 測定 對象機器·測定方法 등을 정하여 告示하여야 한다.

② 無線設備의 施設者 또는 無線設備의 機器를 製作·輸入하고자 하는 者는 無線設備로부터 輻射되는 電磁波의 强度가 電磁波 人體保護基準을 초과하지 아니하도록 하여야 하며, 그 基準을 초과하는 場所에는 取扱者 외의 者가 出入할 수 없도록 安全施設을 設置하여야 한다.

### 5-5 법제화 작업의 일정

1) 2000년 11월 27일, 정보통신부 주관, 한국전자파학회 및 정보통신정책연구원 주최의 "전자파 인체보호기준 공청회"에서 전파법 제47조 2항 고시案 내용에 관한 공청회 개최[9].
2) 2000년 內에 전파법 제 47조 2항의 정보통신부 장관 告示案 작성 완료 예정.
3) 2002년 1월 1일 이후, 위의 고시안 시행 예정.

## 참고문헌


[1] WHO International EMF Project, Progress Report 1998-1999.

[2] WHO FACT SHEET for REVIEW by IAC, Draft 06/14/00, ELECTROMAGNETIC FIELDS AND PUBLIC HEALTH REGULATION OF PUBLIC EXPOSURE TO EMF.

[3] FDA Talk Paper, June 8, 2000.

[4] 2000, WHO IAC Meeting 때의, 각국이 소개한 自國의 전자기장 인체영향 상황 팜플레트 쉬이트.

[5] WHO Fact Sheet No. xxx June 2000 DRAFT 14-06-00 FLECTROMAGNETIC FIELDS AND PUBLIC HEALTH, Electromagnetic Hypersensitivity.

[6] RFIAWG Issues, June 1999.

[7] IEEE, Standards Coordinating Committee 28 (SCC 28) Brochure.

[8] US Air Force Research Laboratory Brochure.

[9] 전자파 인체보호 공청회 자료집, 2000년 11월 27일.



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