

ITU Workshop on “Practical measurement of EMF exposure”

(Gaborone, Botswana, 25-26 July 2011)

ICNIRP: Scientific approach and protection standards

**Paolo Vecchia
ICNIRP Chairman**

What is ICNIRP

ICNIRP is an independent scientific organization that:

- provides guidance and advice on the health hazards of NIR
- develops international guidelines on limiting exposure to NIR that are independent and science based

Scientific
Research

Data, Risk assessment



Research priorities,
Funding

Health
Protection

Structure of ICNIRP

ICNIRP operates through:

- A Main Commission (14 Members, including a Chairperson and a Vice-chairperson)
- Four standing committees
- Consulting experts

Main Commission 2008 - 2012

P. Vecchia Italy Chairman
R. Matthes Germany Vice Chairman

A. Green	Australia	P. Soederberg	Sweden
M. Feychting	Sweden	K. Schuelmeister	Austria
J. Lin	USA	B. Stuck	USA
R. Matthes	Germany	A. Swerdlow	UK
A. Peralta	Philippines	E. van Rongen	The Netherlands
Z. Sienkiewicz	UK	B. Veyret	France

G. Ziegelberger Germany Scientific Secretary
M.H. Repacholi Switzerland Chairman Emeritus

A multi-disciplinary approach

Individual competences

- Medicine
- Biology
- Toxicology
- Epidemiology
- Physics
- Engineering

Collective evaluation

Standing Committees

- **SC I – Epidemiology**
Chair: Antony Swerdlow (UK)
- **SC II – Biology and Medicine**
Chair: Eric van Rongen (The Netherlands)
- **SC III – Physics and Engineering**
Chair: James Lin (USA)
- **SC IV – Optical radiation**
Chair: Per Söderberg (Sweden)



ICNIRP Statement

**GENERAL APPROACH TO PROTECTION
AGAINST NON-IONIZING RADIATION**

Health Physics 82:540-548 (2002)
www.icnirp.org

Gaborone, Botswana, 25-26 July 2011

Fundamentals of ICNIRP Guidelines

- Procedures and criteria defined *a priori*
- Restrictions are based on science.
- No consideration for economic or social issues
- Only established effects are considered

Development of guidelines

- Critical review of the literature
- Identification of health effects
- Identification of the critical effect
- Establishment of basic restrictions
- Derivation of reference levels

Review of the literature

Consideration of **all** published

Evidence **weighed** based upon:

- Scientific quality
- Replicability
- Consistency

Protection systems

Depending on the effects the appropriate system is chosen:

- **Health threshold based system**

Adequate for established threshold effects

- **Optimization system**

Adequate for no-threshold known hazards

- **Precautionary measures**

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ESTABLISHED EFFECTS OF RF FIELDS



Absorption of EM energy

Increase of body temperature
(general or local)

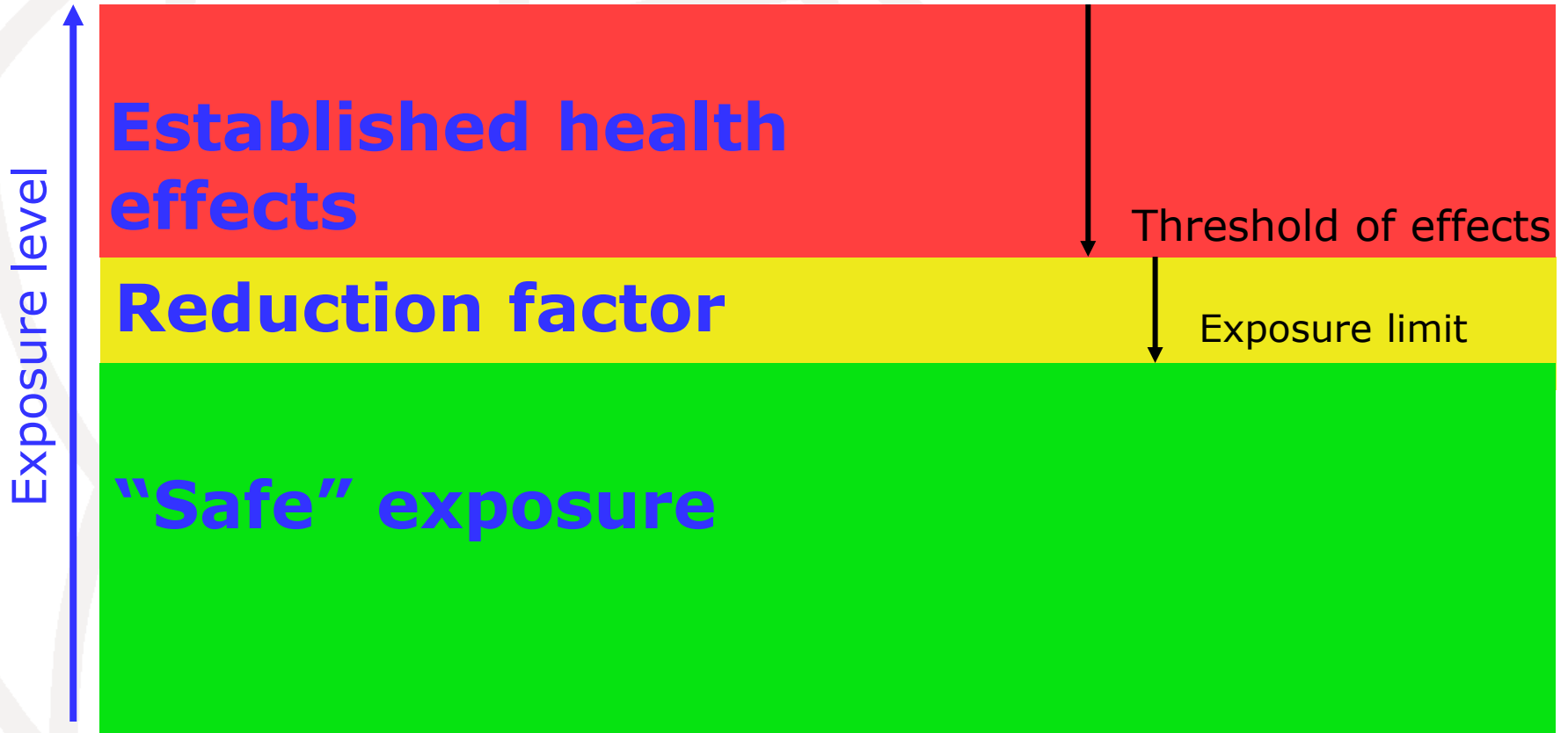
Thermal effects (with threshold)

Biologically effective quantity

Thermal effects are related to **SAR**, i.e. to the energy absorbed per unit time and per unit body mass (W/kg)

SAR is the **biologically effective quantity** for RF fields

Threshold-based approach



The two-level system

Basic restrictions

in terms of biologically effective quantities

Reference levels

in terms of an external exposure metric

The two-level system

Exposure below reference levels ensures compliance with basic restrictions, since the relations between them have been developed under worst-case conditions.

If the reference level is exceeded, the basic restriction is not necessarily exceeded.

Basic restrictions and reference levels

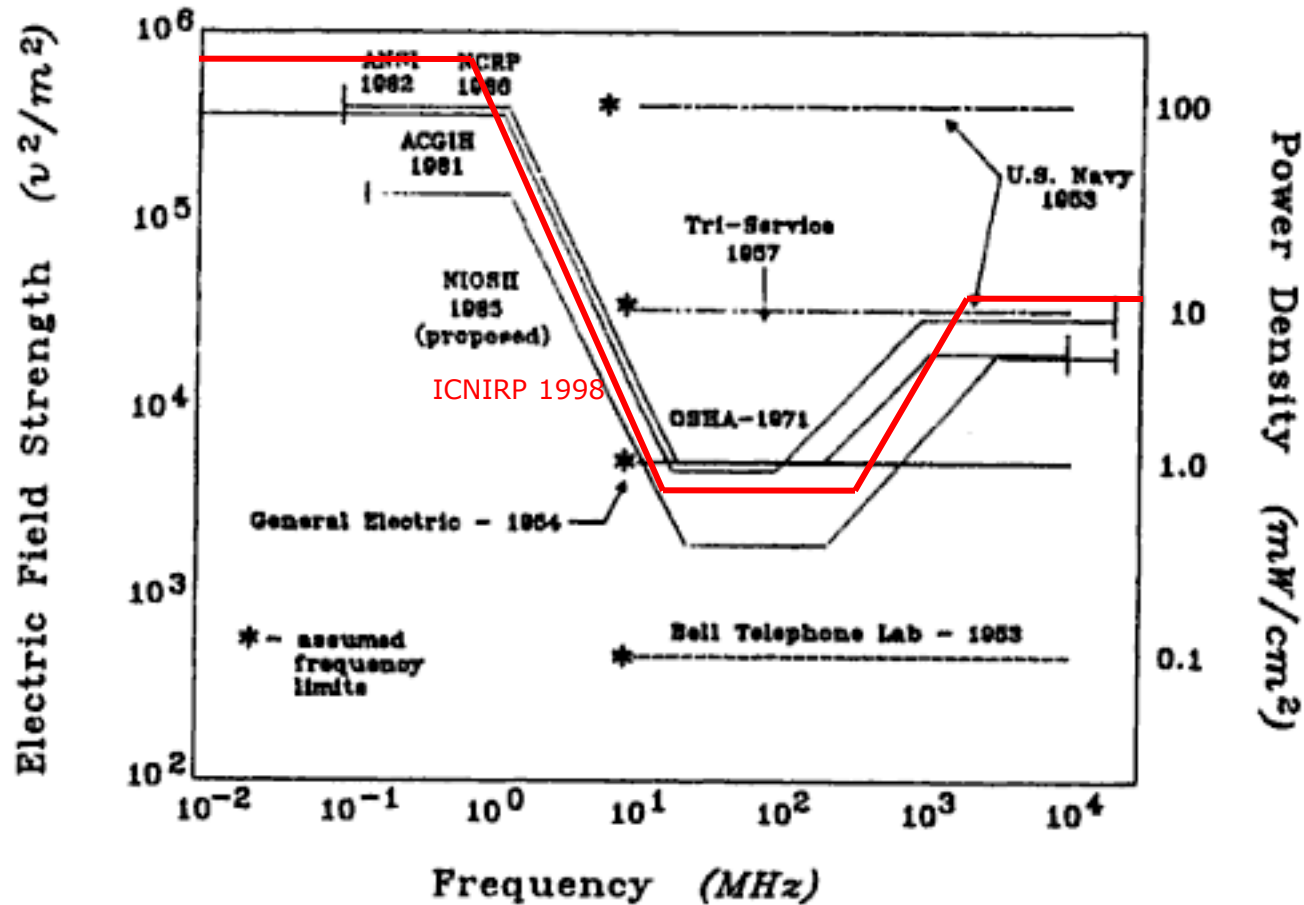
- Basic restrictions (limits of exposure) are set in terms of the biologically effective quantity, **below the threshold for effects**
- Reference levels in terms of measurable quantities are derived by the basic restrictions **assuming conditions of maximum coupling**

Evolution of ICNIRP guidelines

- RF (interim) 1984
- RF 1988
- Time-varying EMF >0 Hz-300 GHz 1998

Basic features of guidelines have not changed over the time

Early standards (1953-1972)



Adapted by Hitchcock and Patterson 1995



ICNIRP Guideline

**GUIDELINES FOR LIMITING EXPOSURE
TO TIME-VARYING ELECTRIC,
MAGNETIC, AND ELECTROMAGNETIC
FIELDS (UP TO 300 GHz)**

Health Physics 74:494-522 (1998)
www.icnirp.org

Gaborone, Botswana, 25-26 July 2011

Basic restrictions on SAR

Workers

Whole body	0.4 W/kg
Local - head and trunk (average on 10 g)	10.0 W/kg
Local - limbs (average on 10 g)	20.0 W/kg

General public

Whole body	0.08 W/kg
Local - head and trunk (average on 10 g)	2.0 W/kg
Local - limbs (average on 10 g)	4.0 W/kg

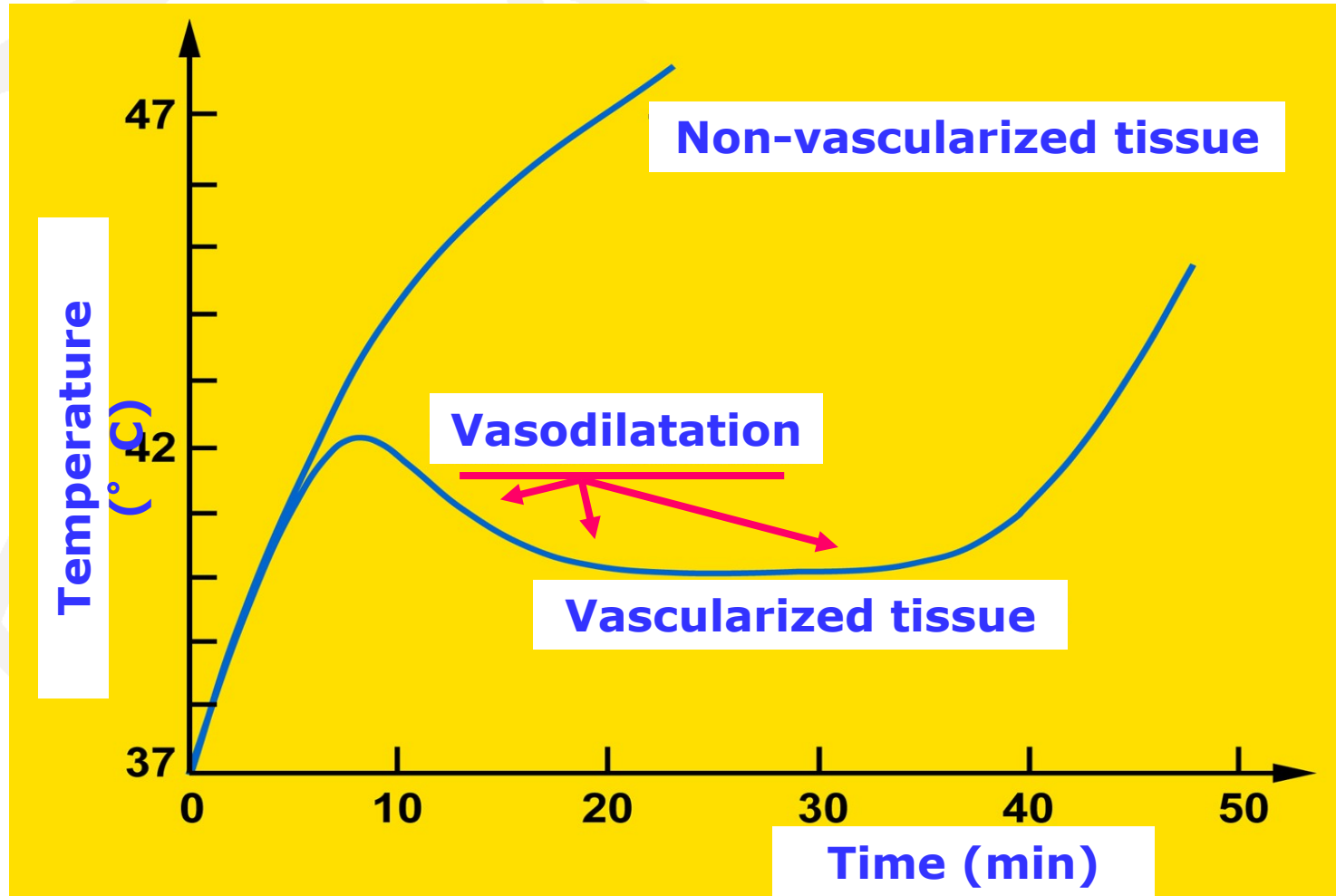
Reduction factors

Threshold for (minor) effects	4	W/kg
Basic restriction for workers	0.4	W/kg
Basic restriction for general public	0.08	W/kg

Why higher limits for workers?

- Adults (18 – 60)
- Healthy
- Informed and trained

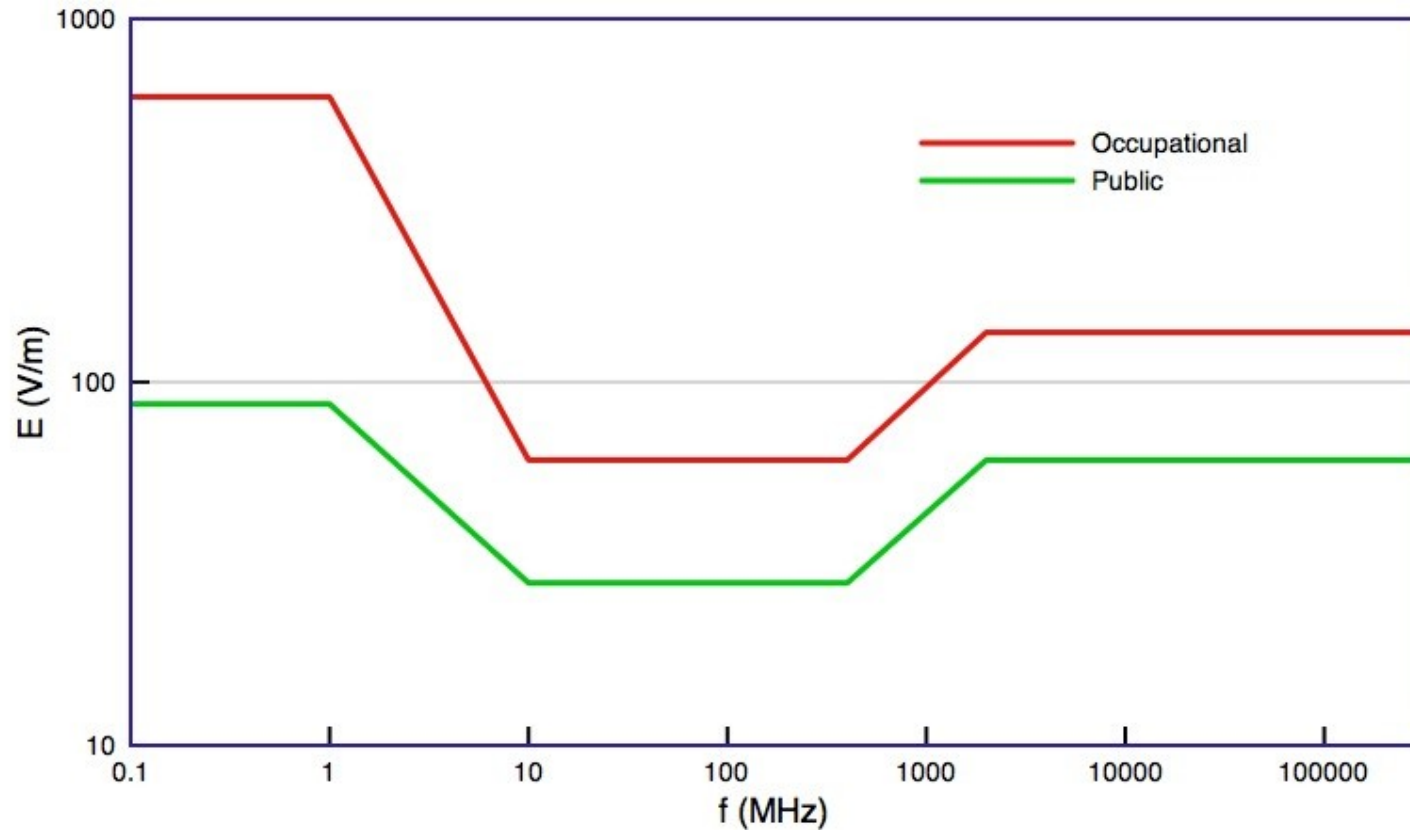
Temperature increase over time



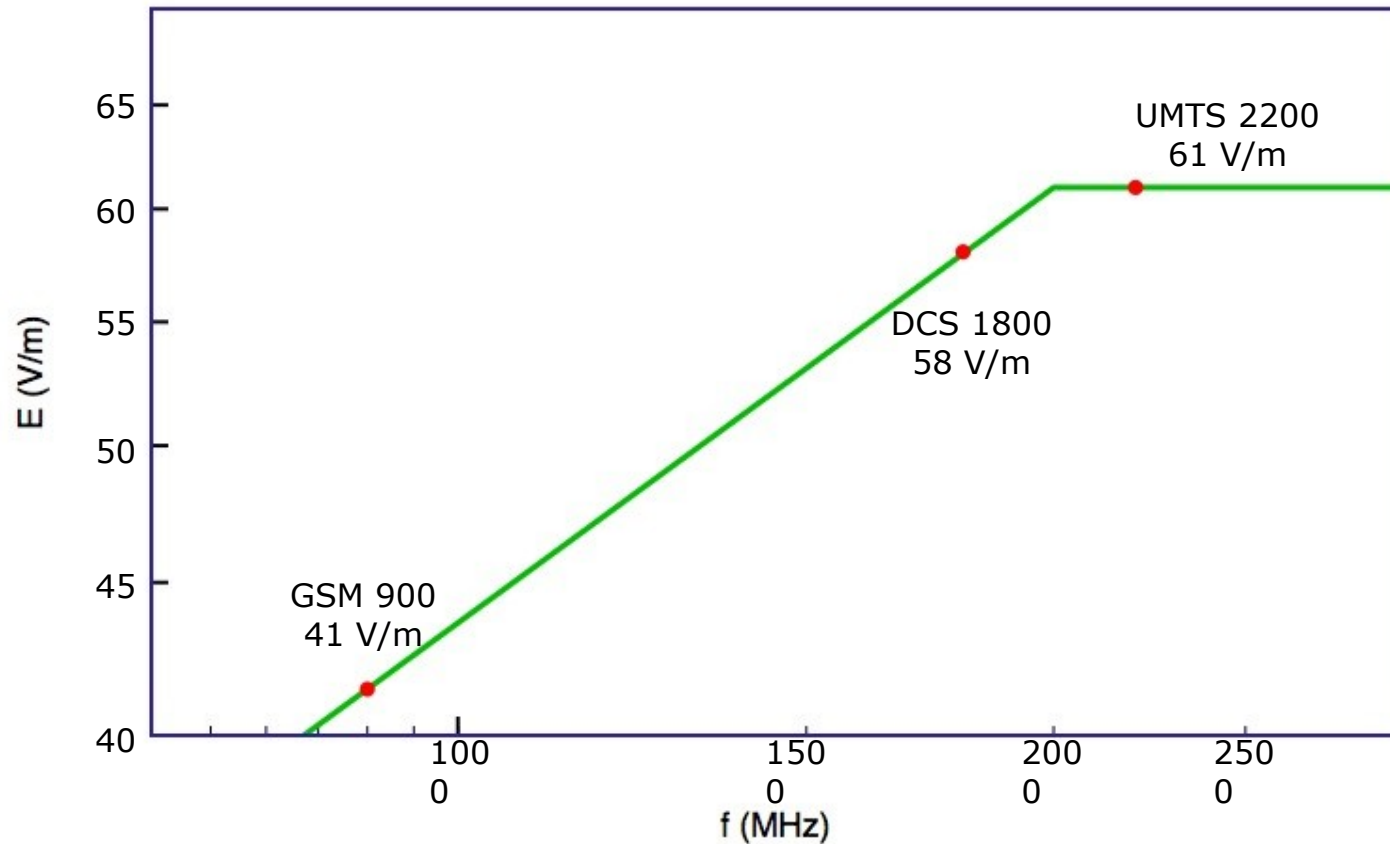
Time average – Basic restrictions

In order to account for the time constant of thermal processes, and for physiological compensation (thermoregulation), all restrictions on SAR values are intended as average values over **any 6-min period**

Reference levels (E-field)



Reference levels for mobile phones

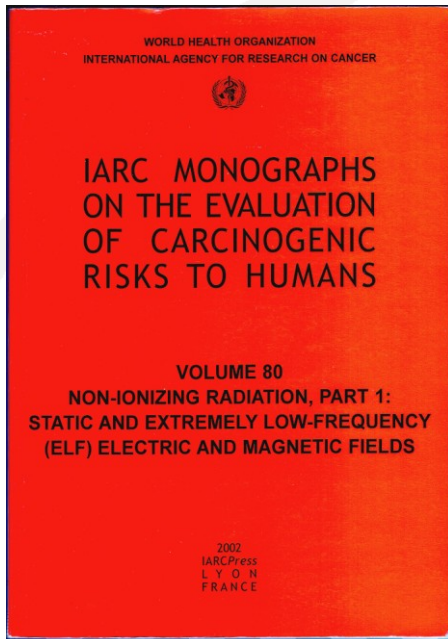


Revision of ICNIRP standards

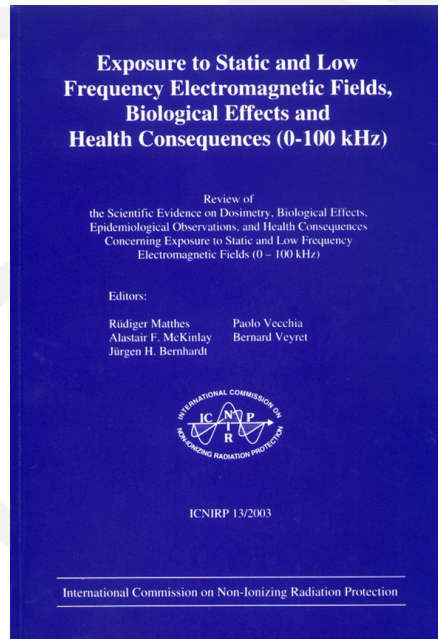
The revision of standards involves different bodies:

- Review of science (Blue book) **ICNIRP**
- Evaluation of carcinogenicity (Monograph) **IARC**
- Global risk evaluation (EHC) **WHO-ICNIRP**
- Update of standards) (Guidelines) **ICNIRP**

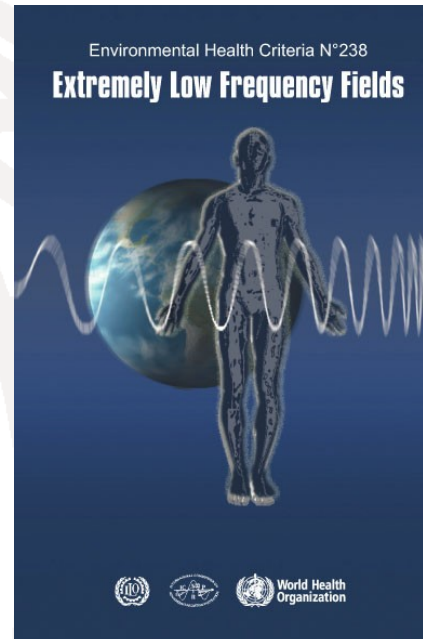
The exemple of ELF fields



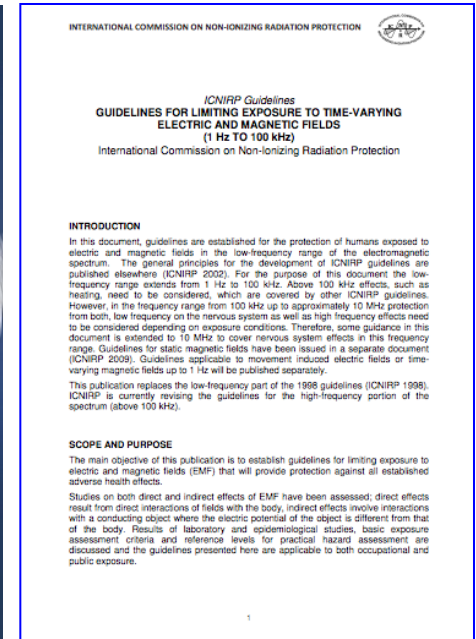
IARC 2002



ICNIRP 2003



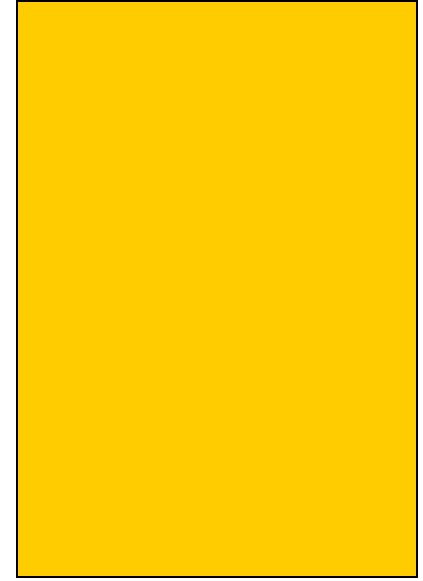
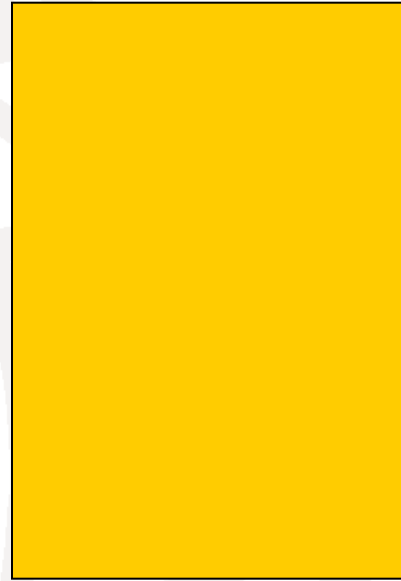
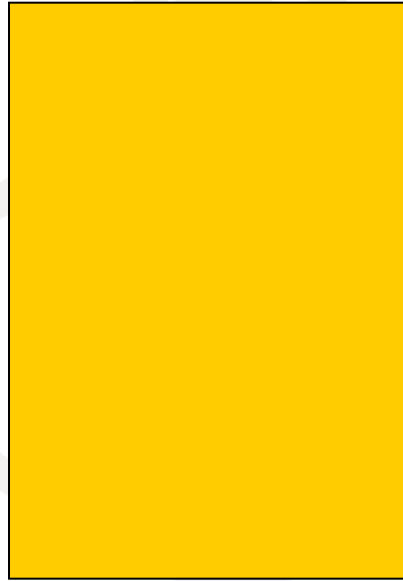
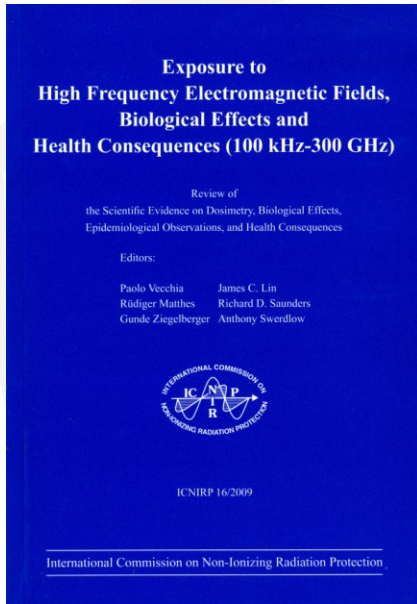
WHO 2007



ICNIRP 2010

Gaborone, Botswana, 25-26 July 2011

RF Fields



ICNIRP 2009

IARC 2011

**WHO 2012
(?)**

**ICNIRP 2013
(?)**

ICNIRP Statement 2009

ICNIRP STATEMENT ON THE “GUIDELINES FOR LIMITING EXPOSURE TO TIME-VARYING ELECTRIC, MAGNETIC, AND ELECTROMAGNETIC FIELDS (UP TO 300 GHz)”

The International Commission on Non-Ionizing Radiation Protection*

INTRODUCTION

SINCE THE publication of the ICNIRP “Guidelines for limiting exposure to time-varying electric, magnetic, and electromagnetic fields (up to 300 GHz)” (ICNIRP 1998) many scientific studies of the effects of such fields have been published. In the frequency range up to approximately 100 kHz several scientific reviews and health hazard assessments have been undertaken by organizations such as the World Health Organization (WHO

effects such as “work stoppage” caused by mild whole-body heat stress and/or tissue damage caused by excessive localized heating (D’Andrea et al. 2007). With regard to non-thermal interactions, it is in principle impossible to disprove their possible existence but the plausibility of the various non-thermal mechanisms that have been proposed is very low. In addition, the recent in vitro and animal genotoxicity and carcinogenicity studies are rather consistent overall and indicate that such effects are unlikely at low levels of exposure. Therefore, ICNIRP

Health Physics
www.icnirp.org

Confirmation of established effects

It is the opinion of ICNIRP, that the scientific literature published since the 1998 guidelines has provided **no evidence of any adverse effects below the basic restrictions** and does not necessitate an immediate revision of its guidance on limiting exposure to high frequency electromagnetic fields.

The “Blue book”: Purpose

The review addresses the current scientific evidence concerning exposure to high frequency EMF and the resulting consequences for health.

It aims at providing input to the health risk assessment undertaken by WHO

It forms a basis for a thorough reevaluation of ICNIRP’s science-based guidance on limiting exposure to EMF.

Available at www.icnirp.org (378 pp.)

The “Blue book”: Main content

Dosimetry of high-frequency EMF

Physical characteristics; Sources and exposures; RF measurement; Mechanisms of interaction; Dosimetry

Experimental studies of biological effects

Biological evidence for interaction mechanisms; Cellular studies; Animal studies; Human studies

Epidemiology of health effects of RF exposure

Studies on occupational exposure; Studies on environmental exposure; Studies on mobile phones and tumor risk

ICNIRP on long-term effects (1998)

Although there are deficiencies in the epidemiological work, such as poor exposure assessment, the studies have yielded no convincing evidence that typical exposure levels lead to adverse reproductive outcomes or an increased cancer risk in exposed individuals.

ICNIRP on long-term effects (1998)

This is consistent with the results of **laboratory research** on cellular and animal models, which have demonstrated **neither teratogenic nor carcinogenic effects** of exposure to athermal levels of high-frequency EMF.

ICNIRP Guidelines 1998

Evaluation of long-term effects (mobile phones, 2004)

ICNIRP recently published a review^(*) of the scientific evidence on the health effects of radiofrequency exposure from mobile phones. We found **the existing evidence did not support an increased risk of brain tumours** in mobile phone users within the duration of use yet investigated.

() A. Ahlbom et al. Epidemiology of Health Effects of Radiofrequency Exposure, 2004*

Evaluation of long-term effects (mobile phones, 2011)

The possibility of a small or a longer term effect cannot be ruled out. Nevertheless, while one cannot be certain, the trend in the accumulating evidence is increasingly against the hypothesis that mobile phone use causes brain tumours.

A. Swerdlow et al. Mobile Phones, Brain Tumours, and the Interphone Study: Where Are We Now?, 2011

The IARC Classification

International Agency for Research on Cancer



World Health
Organization

PRESS RELEASE
N° 208

31 May 2011

IARC CLASSIFIES RADIOFREQUENCY ELECTROMAGNETIC FIELDS AS POSSIBLY CARCINOGENIC TO HUMANS

Lyon, France, May 31, 2011 -- The WHO/International Agency for Research on Cancer (IARC) has classified radiofrequency electromagnetic fields as possibly carcinogenic to humans (Group 2B), based on an increased risk for glioma, a malignant type of brain cancer¹, associated with wireless phone use.

The IARC classification

An extensive Monograph will be published within a few months

However, IARC's evaluation is not in contradiction with the assessments of ICNIRP and other major scientific organizations (such as SCENIHR (EU), HPA (UK), AFSSET (France), ARPANSA (Australia), HCN (The Netherlands), etc.

The IARC classification

A correct knowledge and understanding of the IARC classification, and of the different approach and scope of the different institutions is crucial.



**THANK YOU
FOR YOUR ATTENTION**

paolo.vecchia@icnirp.org