ICNIRP
INTERNATIONAL COMMISSION ON
NON-IONIZING RADIATION PROTECTION

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A long and winding road:
update of the ICNIRP draft HF guidelines

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Work in progress with draft values only

Please do not cite or quote

Scope

- Limit exposure to high frequency EMFs (100 kHz – 300 GHz)
- Provide protection against adverse health effects under realistic conditions
- Consider occupational and general public exposure
- Consider direct and indirect exposure (contact with charged objects)

- Not included
  - electromagnetic interference
  - exposure for medical purposes
  - compliance issues (measurement protocols)

Methodolgy for setting guidelines

- Identify effects of exposure on biological system
- Determine which effects are
  - adverse to humans
  - substantiated (replicable, good quality, scientifically explicable)
- Identify health effect threshold
  - minimum HF exposure shown to produce harm, or
  - where insufficient HF research, minimum exposure predicted to cause harm from non-HF literature (i.e. *operational* health effect threshold)

Derive Basic Restrictions

- Apply reduction factors to health effect thresholds
  - to account for scientific uncertainty, relative importance of the health effect, variation across the population
  - reduction factors may differ based on these parameters
  - consistency across guidelines unless there is *substantive* reason for variation

- General public reduction factors are higher than for occupational
  - general public may not be aware of exposure
  - no training to mitigate harm
  - variation in sensitivity may be larger in general public

Calculate Reference Levels

- External field strength values derived from basic restrictions

- Provide a practical method for determining compliance with basic restrictions
  - derived to be conservative for all *realistic* exposure conditions
  - but not all *possible* exposure conditions

Scientific rationale used

- Use draft WHO EHC on RF fields plus original papers
  - there is an extensive body of relevant literature
  - from molecular and cellular research to epidemiology
  - no evidence that exposure causes cancer
    - available results of NTP animal study do not change that view
- Only evidence of potentially harmful effects from
  - temperature elevations above threshold
  - microwave hearing
  - electrostimulation
  - electroporation

- **Microwave hearing** can occur with brief pulses (300 MHz-10 GHz)
  - popping, hissing, clicking sound
  - generally requires low ambient noise levels
  - very localized thermal effect
  - not considered harmful, no specific restrictions

- **Electrostimulation** described in ICNIRP (2010)
  - not considered further here

- **Electroporation** occurs when intense electric field pulses cause reversible or permanent dielectric breakdown of cell membranes
  - questionable whether a problem in practice
  - no restrictions necessary

Body Core Temperature

- BCT increase used to indicate health effects
  - also dependent on other factors, like ambient temperature, clothing, work rate
- Mean BCT (approx 37°C) varies over day by ± 0.5 °C
  - thermoregulatory mechanisms used to keep BCT in thermonormal range
  - most health effects induced by hyperthermia (> 38 °C) resolve readily with no lasting effects, but risks of accident and heat stroke increase
- Increase >1 °C in BCT is defined as potentially harmful
  - consistent with ACGIH standard on heat stress at work

- **Theoretical modelling/limited evidence used to determine WBA SAR**

Local temperature

- Excessive localized heat can cause pain and damage cells (>41-43°C)
- Thermonormal temperatures
  - brain and abdomen temp is ~37°C, limbs (including skin and pinna) <36°C
- Local temperatures to be avoided
  - for brain >39°C, rest of body >40°C
- Temperature increases considered potentially harmful
  - >2°C in head and torso, >4°C in limbs

- **Theoretical modelling/extrapolation used to determine local SARs**

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Draft Basic Restrictions

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Parameter	Frequency range	Health effect Threshold Avg time/vol/area	Reduct Factor	Workers	Reduct Factor	General public
Body core temp rise (WBA SAR)	100 kHz-300 GHz	1°C 4 W/kg 30 min, WB	1	0.4 W/kg	50	0.08 W/kg
Local temp rise (SAR in head & torso)	100 kHz-6 GHz	2°C 16-20 W/kg 6 min, 10g	2	8-10 W/kg	10	1.6-2 W/kg
Local temp rise (SAR in limbs)	100 kHz-6 GHz	4°C 32-40 W/kg 6 min, 10g	2	16-20 W/kg	10	3.2-4 W/kg
Local temp rise (penetrating PD in head & torso, limbs)	6-30 GHz 30-300 GHz	4°C 200 W/m^2 6 min, 4 cm^2	2	100 W/m^2	10	20 W/m^2
Local temp rise, rapid (pulsed, SA)	100 kHz-6 GHz	4°C ~ 16 kJ/kg 10 s, 10g	2	~ 8 kJ/kg	10	~ 1.6 kJ/kg
Local temp rise, rapid (pulsed, radiant exposure)	6-300 GHz	4°C 2.5 $t^{1/4}$ kJ/m^2 0- ? s	2	1.25 $t^{1/4}$ kJ/m^2	10	0.25 $t^{1/4}$ kJ/m^2
Contact currents expressed as Guidance levels	100 kHz-110 MHz	Pain 10/20 mA, child/adult, 10 s	1	20 mA	1	10mA

Several issues to be resolved

- Reference levels
  - based on WBA SAR may exceed basic restrictions with small stature people, strange postures
  - based on WBA may cause violations of local basic restrictions
- Averaging time
  - currently 6 min with reduction from 10 GHz to 10 sec at 300 GHz
  - proposed WBA SAR 30 min; local SAR 6 min
  - local pulsed 10 s up to 6 GHz, 0- ?s above 6 GHz

- **Draft for public consultation ready by summer 2018**

Thank you for your attention

and your continued patience