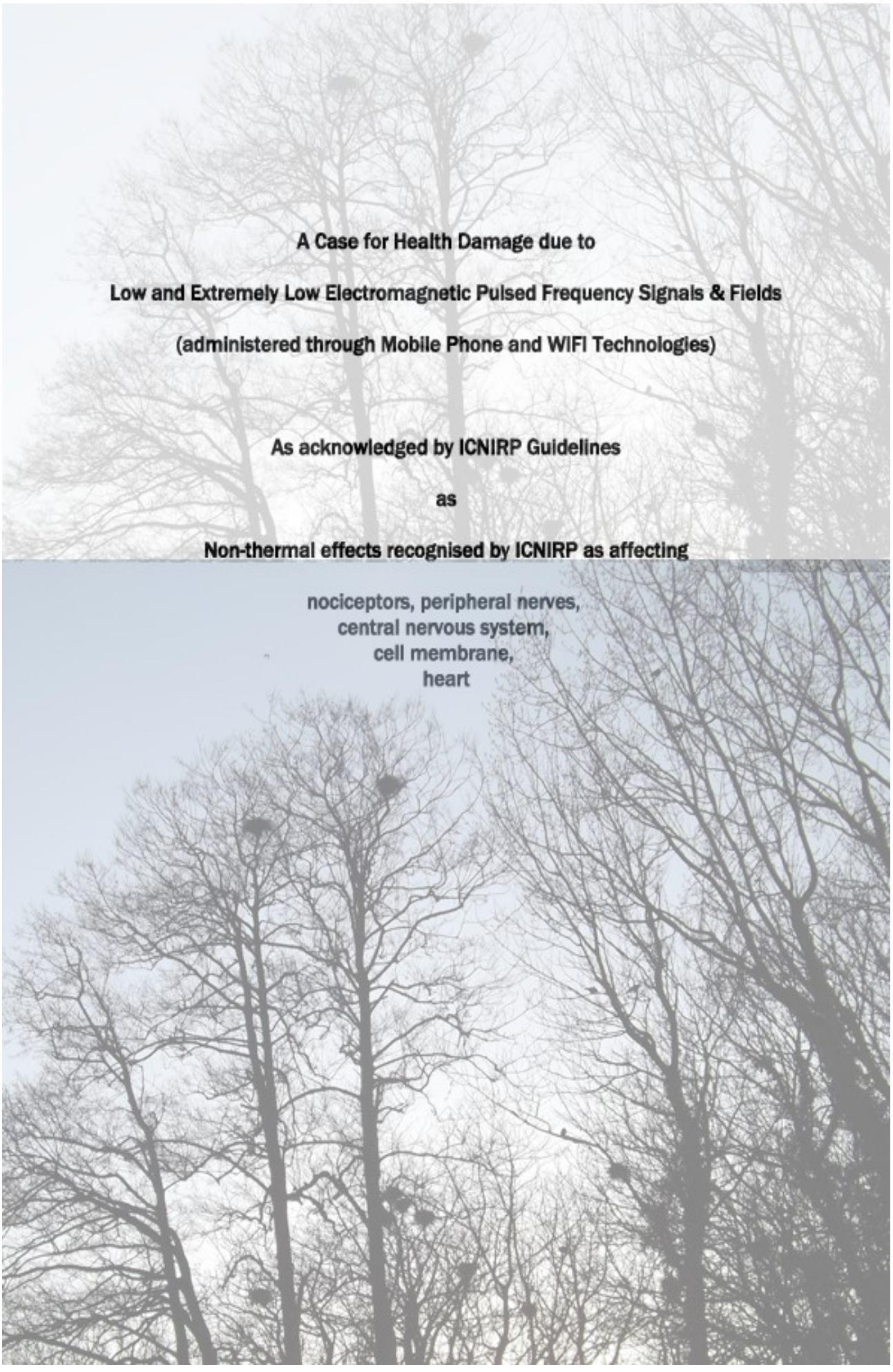


A Case for Health Damage due to

Low and Extremely Low Electromagnetic Pulsed Frequency Signals & Fields

(administered through Mobile Phone and WIFI Technologies)

As acknowledged by ICNIRP Guidelines

as

Non-thermal effects recognised by ICNIRP as affecting

nociceptors, peripheral nerves,
central nervous system,
cell membrane,
heart

It is often misquoted that only effects of radiofrequencies are thermal and that non-thermal effects are not acknowledged by ICNIRP (and other authorities). This is incorrect. Whilst the particular Guidelines which you see with a planning application relate predominantly to thermal effects – non-thermal effects are recognised – but they are logged in separate ICNIRP Guidelines.

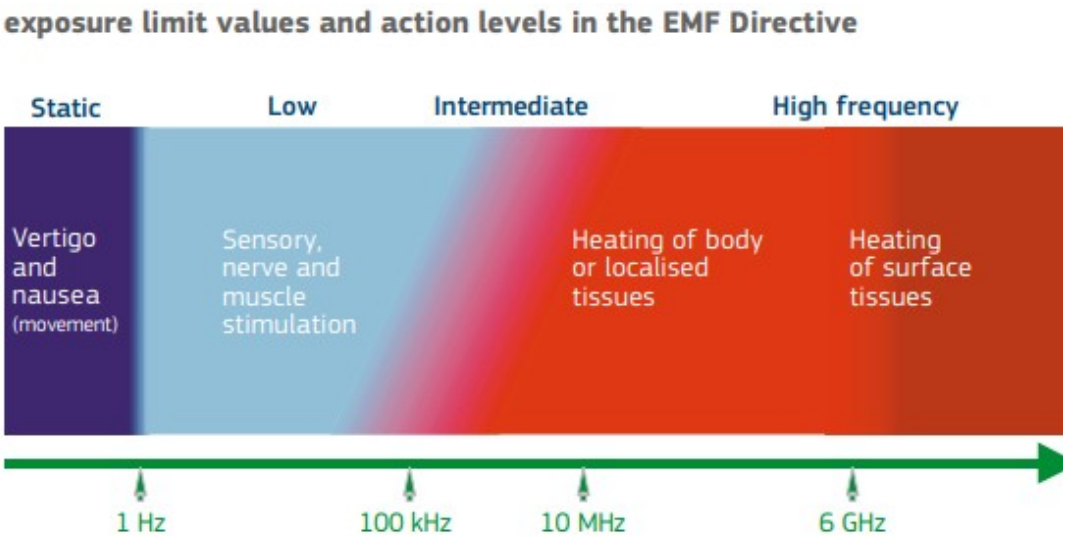


Chart taken from EU Guide on Directive 2013/35/EU Electromagnetic Fields

(another ICNIRP Guideline relating to the working environment)

In fact ICNIRP has a multitude of Guidelines which may overlap.

With reference to the non-thermal effects, these are generally regarded as emanating from low or extremely low frequencies as displayed in the chart above.

These non-thermal effects are considered (by ICNIRP) to operate via the mechanism of nerve stimulation through the lower frequencies (slower cycles per second) recognised as causing stimulation to the peripheral nerves, central nervous system, neurological system, cell membrane permeability and other effects as detailed in sections below and taken from the low frequency Guidelines, linked underneath.

Ref. **https://www.icnirp.org/cms/upload/publications/ICNIRPLFgdl.pdf**

Another misconceptive is that the low frequency guidelines are only concerned with domestic electricity, whereas the guidelines state they cover mobile phones and WIFI and whereas 5G states it uses low, middle and high frequencies. Public Health England confirm that mobile phones use 2.6 Hz, 8.34Hz and WIFI 10Hz whereupon they can be demodulated (uncoupled) from the higher frequencies by a non-linear system. Humans have that non-linear system, which is quantified below.

These LFs and ELFs are further dangerous because they are within the ranges of Delta and Alpha brainwaves (0.5-4Hz and 8-12Hz, respectively). Nerve stimulation is acknowledged as being caused by emfs below 10Mhz (100 kHz to 300 GHz.)..

It is clear that avoiding nerve stimulation is of prime importance

ICNIRP 2004

"Since one of the objectives of the new ICNIRP guidelines is to avoid stimulation of peripheral nerves and muscles..." **1**

Basic restrictions for the ELF range roughly follow the frequency dependence of thresholds of peripheral nerve and muscle tissue stimulation. These are well known between several Hz and about 100 kHz. Field-induced current densities that are unable to stimulate excitable tissues directly may nevertheless affect tissue electrical activity and influence neuronal communication.

Furthermore, the electrical inhomogeneity of living tissue can enhance electric field intensities, and hence induce higher currents at some points in the body **1**

Developing of exposure guidelines

For the purpose of this document, the low-frequency range extends from 1 Hz to 100 kHz. Above 100 kHz, effects such as heating need to be considered, which are covered by other ICNIRP guidelines. However, in the frequency range from 100 kHz up to approximately 10 MHz protection from both, low frequency effects on the nervous system as well as high frequency effects need to be considered depending on exposure conditions. Therefore, some guidance in this document is extended to 10 MHz to cover the nervous system effects in this frequency range.

... in addition to nerve stimulation (Appendix B, 2010), radiofrequency EMFs can affect the body via two primary biological effects: changes in the permeability of membranes and temperature rise

Thresholds for Radiofrequency EMF-Induced Health Effects

Nerve stimulation. Exposure to EMFs can induce electric fields within the body, which for frequencies up to 10 MHz can stimulate nerves (Saunders and Jeffreys 2007). The effect of this stimulation varies as a function of frequency, and it is typically reported as a "tingling" sensation for frequencies around 100 kHz.

Detailed mechanism on molecules and cell membrane

Firstly, the induced electric field in the body exerts a force on both polar molecules (mainly water molecules) and free moving charged particles such as electrons and ions. In both cases a portion of the EMF energy is converted to kinetic energy, forcing the polar molecules to rotate and charged particles to move as a current. As the polar molecules rotate and charged particles move, they typically interact with other polar molecules and charged particles, causing the kinetic energy to be converted to heat. This heat can adversely affect health in a range of ways. Secondly, if the induced electric field is below about 10 MHz and strong enough, it can exert electrical forces that are sufficient to stimulate nerves, and if the induced electric field is strong and brief enough (as can be the case for pulsed low frequency EMFs), it can exert electrical forces that are sufficient to cause dielectric breakdown of biological membranes, as occurs during direct current (DC) electroporation (Mir 2008).

Changes to permeability of cell membranes. When (low frequency) EMFs are pulsed, the power is distributed across a range of frequencies, which can include radiofrequency EMFs (Joshi and Schoenbach 2010). If the pulse is sufficiently intense and brief, exposure to the resultant EMFs may cause cell membranes to become permeable, which in turn can lead to other cellular changes. However, there is no evidence that the radiofrequency spectral component from an EMF pulse (without the low-frequency component) is sufficient to cause changes in the permeability of cell membranes. The restrictions on nerve stimulation in the ICNIRP (2010) guidelines (and used here) are sufficient to ensure that permeability changes do not occur, so additional protection from the resultant radiofrequency EMFs is not necessary

(This appears to be based on emf pulses not containing low frequency components).

> “The most accurate representation would treat all the nodes in the model as nonlinear. However, such treatment can result in excessive computing time, which can be reduced by limiting the number of nonlinear nodes”.

> “The current emanating from the stimulus electrode through the conducting medium causes external voltage disturbances (Ve,J at the nearby nodes. These disturbances force current across the membrae…. In the McNeal [16] representation, the myelin internodes are treated as perfect insulators. This framework could be expanded to include passive myelin properties; however, such expansion would add significantly to the complexity of the model”.

> “Conductivity properties of the excitable membrane are intimately tied to the membrane field; disturbances from the resting condition can lead to profound changes in the membrane's electrical properties. These changes ultimately initiate and sustain the functional responses of nerve and muscle”.
>
> “In electrical stimulation problems, we may be able to calculate the current within the medium containing the neuron, but not necessarily the current crossing the membrane”

Reilly link https://www.jhuapl.edu/Content/techdigest/pdf/V09-N01/09-01-Reilly.pdf

Excerpts taken from J P Reilly, Chief Engineer IEEE Institute of Electrical Engineers

Further to defining models as linear when they are correctly non-linear, there is a

“smoothing out” of the peaks/bursts of signals which would prove difficult to computate but nevertheless exist in reality and experienced on the nerves

> “The maximum electric field quickly decreases when the smoothing algorithm is applied until the smoothing radius is about 3–4 cells, after which the maximum value ‘converges’. Typically the converged maximum value is 150–200% of the 99th percentile value for the uniform exposure (figure 5) and 200–300% for the dipole exposure (figure 6). Without smoothing, the maximum values would be about 250–300% and 300–450% of the 99th percentile for the uniform and dipole exposures, respectively As illustrated in figure 7(a), high maximum values without smoothing can be attributed to just a few voxels with spurious electric field hotspots.
>
> These hotspots disappear when the smoothing algorithm is applied (b, c).”
>
> ...However, when the smoothing algorithm is applied, also the maximum electric fields decrease to values compliant with the basic restriction limit

https://iopscience.iop.org/article/10.1088/0031-9155/57/15/5057

Excerpts from Reducing the Staircase Error

In the low frequency guidelines (ICNIRP 2010) where reference levels for frequencies up to 10 MHz are set to protect against nerve cell stimulations, a reduction factor of 3 was applied to account for uncertainty associated with the numerical modeling of the relation between the external fields and the induced (internal) electric fields. The reason for this is that 2-mm cube-averaged values (within a specific tissue) were evaluated in the low frequency guidelines, which are significantly affected by computational artifact.

Excerpts taken from ICNIRP GUIDELINES FOR LIMITING EXPOSURE TO ELECTROMAGNETIC FIELDS (100 KHZ TO 300GHZ) 2010

Excepts from 1998 ICNIRP Guidelines

Sufficiently intense ELF magnetic fields can elicit peripheral nerve and muscle tissue stimulation directly, and short magnetic field pulses have been used clinically to stimulate nerves in the limbs in order to check the integrity of neural pathways. Peripheral nerve and muscle stimulation has also been reported in volunteers exposed to 1-kHz gradient magnetic fields in experimental magnetic resonance imaging systems. Threshold magnetic flux densities were several millitesla, and corresponding induced current densities in the peripheral tissues were about 1Am22 from pulsed fields produced by rapidly switched gradients. Time-varying magnetic fields that induce current densities above 1Am22 in tissue lead to neural excitation and are capable of producing irreversible biological effects such as cardiac fibrillation (Tenforde and Kaune 1987; Reilly 1989). In a study involving electromyographic recordings from the human arm (Polson et al. 1982), it was found that a pulsed field with dB/dt greater than 104 T s21 was needed to stimulate the median nerve trunk. The duration of the magnetic stimulus has also been found to be an important parameter in stimulation of excitable tissues

It is well established that induced electric current can stimulate nerve and muscle tissue directly once the induced current density exceeds threshold values (UNEP/WHO/IRPA 1987; Bernhardt 1992; Tenforde 1996). Current densities that are unable to stimulate excitable tissues directly may nevertheless affect ongoing electrical activity and influence neuronal excitability. The activity of the central nervous system is known to be sensitive to the endogenous electric fields generated by the action of adjacent nerve cells, at levels below those required for direct stimulation.

https://www.icnirp.org/cms/upload/publications/ICNIRPemfgdl.pdf

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

From simple models of the behavior of single cells in weak fields it has been calculated that an electrical signal in the extracellular field must be greater than approximately 10–100 mV m21 (corresponding to an induced current density of about 2–20 mA m22) in order to exceed the level of endogenous physical and biological noise in cellular membranes (Astumian et al. 1995). Existing evidence also suggests that several structural and functional properties of membranes may be altered in response to induced ELF fields at or below 100 mV m21 (Sienkiewicz et al. 1991; Tenforde 1993). Neuroendocrine alterations (e.g., suppression of nocturnal melatonin synthesis) have been reported in response to induced electrical fields of 10 mV m21 or less, corresponding to induced current densities of approximately 2 mA m22 or less (Tenforde 1991, 1996). However, there is no clear evidence that these biological interactions of lowfrequency fields lead to adverse health effects. Induced electric fields and currents at levels exceeding those of endogenous bioelectric signals present in tissue have been shown to cause a number of physiological effects that increase in severity as the induced current density is increased (Bernhardt 1979; Tenforde 1996). In the current density range 10–100 mA m22 , tissue effects and changes in brain cognitive functions have been reported (NRPB 1992; NAS 1996). When induced current density exceeds 100 to several hundred mA m22 for frequencies between about 10 Hz and 1 kHz, thresholds for neuronal and neuromuscular stimulation are exceeded. The threshold current densities increase progressively at frequencies below several hertz and above 1 kHz. Finally, at extremely high current densities, exceeding1Am22 , severe and potentially lifethreatening effects such as cardiac extrasystoles, ventricular fibrillation, muscular tetanus, and respiratory failure may occur. The severity and the probability of irreversibility of tissue effects becomes greater with chronic exposure to induced current densities above the level 10 to 100 mA m22 . It therefore seems appropriate to limit human exposure to fields that induce current densities no greater than 10 mA m22 in the head, neck, and trunk at frequencies of a few hertz up to 1 kHz

Volunteer studies. Studies by Chatterjee et al. (1986) demonstrated that, as the frequency increases from approximately 100 kHz to 10 MHz, the dominant effect of exposure to a high-intensity electromagnetic field changes from nerve and muscle stimulation to heating. At 100 kHz the primary sensation was one of nerve tingling, while at 10 MHz it was one of warmth on the skin. In this frequency range, therefore, basic health protection criteria should be such as to avoid stimulation of excitable tissues and heating effects.

At frequencies from 10 MHz to 300 GHz, heating is the major effect of absorption of electromagnetic energy, and temperature rises of more than 1–2 °C can have adverse health effects such as heat exhaustion and heat stroke (ACGIH 1996).

Amplitude-modulated fields have also been reported to alter brain electrical activity (Bawin et al. 1974), inhibit T-lymphocyte cytotoxic activity (Lyle et al. 1983), decrease the activities of non-cyclic-AMPdependent kinase in lymphocytes (Byus et al. 1984), and cause a transient increase in the cytoplasmic activity of ornithine decarboxylase, an essential enzyme for cell proliferation (Byus et al. 1988; Litovitz et al. 1992)

In the frequency range from a few Hz to 1 kHz, for levels of induced current density above 100 mA m22 , the thresholds for acute changes in central nervous system excitability and other acute effects such as reversal of the visually evoked potential are exceeded. In view of the safety considerations above, it was decided that, for frequencies in the range 4 Hz to 1 kHz, occupational exposure should be limited to fields that induce current densities less than 10 mA m22 , i.e., to use a safety factor of 10. For the general public an additional factor of 5 is applied, giving a basic exposure restriction of 2 mA m22 . Below 4 Hz and above 1 kHz, the basic restriction on induced current density increases progressively, corresponding to the increase in the threshold for nerve stimulation for these frequency ranges.

Whilst the discussion is about what levels should be used to cover all human nerve threshold levels, the actual nerve threshold level rested upon one human being.

Gowland and Glover, whose candidate was chosen commented

Although we stand by our data, it was a very small study, and the lines on figure 1 of the guidelines have been drawn about single data points from a single subjects at two frequencies (Ziegelberger, 2014). This seems to be a remarkably flimsy basis on which to make international guidelines.

...we are keen to point out that there was a more serious problem…

Crucially ICNIRP apparently failed to realise that this Lorentz force mechanism depends on the amplitude and direction of the field, whereas the induced current mechanism depends on the absolute rate of change of field.

ICNIRP Response

A relevant issue is the relatively short integration time of 3 s, during which the change of the magnetic flux density should not exceed 2 T. In a 7 T field, it would be possible to move into the field in 10 s in order to comply with the guidelines, while the study of Glover et al. (2014) indicates that the adaptation time constant would be approximately 40 s or even longer

Both comments are featured at the end of the guidelines
https://www.icnirp.org/cms/upload/publications/ICNIRPmvtgdl_2014.pdf

In ICNIRP's 2010 Fact Sheet it says

A minimum electric field threshold of about 4-6 Vm^{-1} has been calculated for peripheral nerve stimulation, using a hterogeneous human model and data from volunteer exposure (singular) to the switched gradient fields of magnetic resonance (MR).

This has then been translated, as Gover and Gowland observed, into international guidelines for every human being on exposure to low frequencies concerning nerve stimulation.

It should be noted, however, that Gowland and Glover established the following which discounts rodents as being suitable to base threshold levels for human nerve excitation.

GOWLAND AND GLOVER

Furthermore, the new mechanism explains the previously anomalous observation of apparent vertigo-type effects in small rodents, which are physically too small to be able to develop sufficient current densities in their heads to cause nerve excitation (Houpt and Houpt 2010).

It should also be noted that the guidelines set for nerve stimulation (low frequency guidelines) has only been conducted on one person. One man. (Gower and Glover wrote to ICNIRP saying essentially this wasn't ethical to do so based on their own study). Therefore it is unreasonable to set this for the entire population whereas we all have individual nerve thresholds.

Notwithstanding the historical recognition of mechanism of nerve stimulation…

https://assets.publishing.service.gov.uk/government/uploads/system/uploads/attachment_data/file/333080/RCE-20_Health_Effects_RF_Electromagnetic_fields.pdf

It is not necessary to identify the mechanisms of action of RF-EMFs on living tissue to determine a human health risk. Convincing evidence from biological experiments or *direct observation of adverse health effects in humans may be sufficient to demonstrate risk.* However, identifying mechanisms of action makes it easier to establish causal relationships between the exposure and the observed effects as well as the exposure threshold below which the observed adverse health effects would be prevented. Similarly, it is not necessary to determine the biological or health effects at the cellular or animal level to demonstrate a health risk for humans. However, identifying such effects can help establish causal relationships between exposure to a specific agent and observed health effects in humans. For example, all agents known to cause cancer in humans and that have undergone carcinogenicity studies in animal models gave positive results (IARC, 2006).

However, it should be noted that for the purposes of nerve stimulation, rodents heads are not large enough to display the same current as a human head, as observed by Gowland and Glover (Houpt and Houpt 2010).

Recently ICNIRP adopted guidelines on limits of EMF exposure for frequencies up to 300 GHz (ICNIRP 1998a) (see page 101). While all the scientific literature was reviewed, the only adverse effects on humans that were fully verified by a stringent evaluation were short term, immediate health consequences such as stimulation of peripheral nerves and muscles, functional changes in the nervous system and other tissues, shocks and burns caused by touching conducting objects, and changes in behaviour caused by elevated tissue temperatures. There are also data for chronic low level exposure that indicate that there may also be other health effects. It is, however, ICNIRP's view that in the absence of support from laboratory studies the epidemiological data are insufficient to allow an exposure guideline to be established**.** **1**

Excerpts taken from USE OF THE ICNIRP EMF GUIDELINES 2004

The above statements were written under the 1998 icnirp Guidelines which was replaced in 2010 with guidance that did allow for exposure guidelines for low frequencies as the following document attests to.

EXTREMELYLOWFREQUENCY (ELF) FIELDS

Published under the joint sponsorship of the United Nations Environment Programme, the World Health Organization, and the International Radiation Protection Association

https://apps.who.int/iris/bitstream/handle/10665/39376/9241540958_eng.pdf?sequence=1&isAllowed=y

Experimental findings suggest that the .principal site of interaction between ELF fields and the interior of living systems is the cell membrane (Adey, 1975, 1977, 1980, 1981; Bawin et al., 1975, 1978; Sheppard & Adey, 1979; Adey et al., 1981).

These include a 10 - 20% alteration in the calcium exchange from chick or cat brain tissues exposed to ELF electric fields, either amplitude-modulated radiofrequency (RF) carrier waves of 50, 147, or 450 MHz, or ELF sine wave fields (Bawin et al., 1975, 1978; Blackman et al., 1979, 1980, 1982). The calcium effec t is windowed in frequency, where maximal effects occur for 16 Hz modulation, and in the case of direct ELF exposures, Blackman et al. reported several windows at 15 Hz and its harmonics up to 105 Hz, in fields of less than 100 V/m in air.

A similar narrow amplitude window limits the range in field strength (Bawin et al., 1978; Blackman et al., 1979, 1982). Bawin et al. (1978) found a relationship between the observed effect and the ionic composition of the bathing medium. In the case of the ELF modulation of a magnitude of the effective ELF field (obtained of the RF field envelope) that acts on the sites depends on an unknown efficiency for RF field, the by demodulation calcium-binding a demodu lat ion process occurring at an unidentified site. Assuming complete demodulation, the effective ELF field would correspond to an ELF-only field in air of the order of 100 kV/m (Adey, 1991), though by use of the RF carrier there is no significant heating of tissue (Tenforde, 1980)" and no known artifact (such as spark discharges).

A calcium efflux effect is also reported for in vivo studies on the cat (Adey, 1980). Possible underlying biophysical mechanisms and a relationship to the electric properties of the brain (electroencephalograph waves or EEG waves) are discussed by Grodsky (1976). However, the physiological implication of the calcium efflux phenomenon is not known.

Electric field effects on synaptic transmission and peripheral nerve function in rats exposed for 30 days to a 60 Hz field of effective strength 65 kV/m were studied in replicate (Jaffe et al., 1980, 1981). The exposure apparatus was designed to eliminate the confounding influence of electric shock currents. Neurons of the superior cervica 1 ganglion showed significantly increased excitability compared with the control group, as determined from tests in which the amplitudes of paired compound action potentials were measured (conditioning test response or C-T response). None of several other indices of neural function was altered to a significant extent. The authors interpreted the data as evidence of an effect on pre- or post-synaptic mechanisms, possibly indicating enhanced excitability, and as evidence against a significant effect on nerve conduction mechanisms.

An investigation (Wachtel, 1979) in which invertebrate neurons from the sea hare Aplysia were exposed in vitro to a low-frequency electric field indicated a strong frequency dependence in response to extracellular currents that included synchronization with the applied fie Id. The neuron was most senSl.tl.ve at frequencies below 1 Hz, close to the natural firing rate of Aplysia neurons, and for a particular neuronal orientation with respect to the field. Other data were reported by Sheppard et al. (1980) concerning the ELF field exposure of Aplysia neurons, including transient changes in the firing rate and increased variability during exposure to an electric field of 0.25 V/m rms. Episodic synchronization between the neuron and the applied field was reported at 1.4·10-~ A/cm2 (rms).

In a study by Bawin et al. (in press) on rat brain tissue slices exposed to either 5- or 60-Hz electric fields at field strengths in the range of the EEG, 1 - 10 V/m, evidence was presented of long-lasting changes in neuronal excitability that differed with field frequency and exposure duration. While 5-Hz fields were generally excitatory, brief 60-Hz fields either potentiated or depressed the tissue response - 53 - following field exposure, and prolonged 60-Hz fields depressed the response. Although potentiations (believed to be due to an effect on synaptic mechanisms) can last indefinitely (observations have lasted for as long as 7 h), the depressed response after 60-Hz exposures was transient, lasting about 10 min. In summary, the results of in vitro studies suggest that time-varying ELF electric fields may change the properties of cell membranes and modify cell function. Several theoretical explanations have been proposed (section 4), and it seems conceivable that several parallel mechanisms exist. No comprehensive and experimentally confirmed theory has been proposed. Some of the effects observed on cells and tissues in vitro can be detected in vivo.

jointly published by Springer and the IUPESM in cooperation with the World Health Organization

Matthew, U.O., Kazaure, J.S. Chemical polarization effects of electromagnetic field radiation from the novel 5G network deployment at ultra high frequency. *Health Technol.* 11, 305–317 (2021). https://link.springer.com/article/10.1007/s12553-020-00501-x

The semi-permeable membrane of the human cell contained distinctive concentrations of electrically charged particles (ions) within and outside. Diffusion transports the Potassium ions (K+) and Chloride ions (Cl–) in the paths demonstrated above, pending when the Coulomb force stops additional ionic transmission. This situation will cause the layer of positively charged ionic particles to concentrate on the outside, while the layer of negatively charged ionic particles concentrates on the inside, thereby producing a voltage across the body cell membrane which usually become resistant to Sodium (Na+) ions

Risk
EBU Operating Eurovision and Euroradio
REVIEW OF THE 2020 GUIDELINES OF THE INTERNATIONAL COMMISSION ON NON-IONIZING RADIATION
https://tech.ebu.ch/docs/techreports/tr066.pdf

"One point of clarification that is still needed is the determination of the cumulative effect of the lower frequencies regarding nerve stimulation".

(whilst the ICNIRP certificate deems to cover for higher frequencies, it doesn't certify it covers adverse effects from the lower frequencies i.e. nerve stimulation, experienced by Electrohypersensitive persons and therefore approving a 5G mast would be discriminative to such persons and breach Human Rights/Equality Act 2010).

5G says it uses low middle and high frequencies.

The Council of Europe state…

Provided that adverse health impacts of indirect effects of exposure (such as microshocks) can be avoided and that they are instantaneous…

https://eur-lex.europa.eu/legal-content/EN/TXT/PDF/?uri=CELEX:31999H0519&from=EN

...However, there is no account for long term exposure where instantaneous effects are continuous.

Important relevant studies regarding demodulation. Silny is featured in many ICNIRP Guidelines.

Responses of neurons to an amplitude modulated microwave stimulus

Robert C. Beason1,*, Peter Semm2 Department of Biology, State University of New York, Geneseo, NY 15454, USA Received 30 April 2002; received in revised form 6 August 2002; accepted 7 August 2002 https://pubmed.ncbi.nlm.nih.gov/12429376/

Demodulation in tissue, the relevant parameters and the implications for limiting exposure

Jiri Silny1
Affiliations expand

•PMID: 17495662

•DOI: 10.1097/01.HP.0000244086.36815.7c

https://pubmed.ncbi.nlm.nih.gov/17495662/

Clarification between different Guidelines and confirmation that the 2010 Guidelines includes mobile phones and WIFI

ICNIRP GUIDELINES FOR LIMITING EXPOSURE TO TIME-VARYING ELECTRIC AND MAGNETIC FIELDS (1HZ – 100 kHZ)

Abstract—Radiofrequency electromagnetic fields (EMFs) are used to enable a number of modern devices, including mobile telecommunications infrastructure and phones, Wi-Fi, and Bluetooth. As radiofrequency EMFs at sufficiently high power levels can adversely affect health, ICNIRP published Guidelines in 1998 for human exposure to time-varying EMFs up to 300 GHz, which included the radiofrequency EMF spectrum. Since that time, there has been a considerable body of science further addressing the relation between radiofrequency EMFs and adverse health outcomes, as well as significant developments in the technologies that use radiofrequency EMFs. Accordingly, ICNIRP has updated the radiofrequency EMF part of the 1998 Guidelines. This document presents these revised Guidelines, which provide protection for humans from exposure to EMFs from 100 kHz to 300 GHz. Health Phys. 118(5):483–524; 2020

This publication replaces the low-frequency part of the 1998 guidelines (ICNIRP 1998). ICNIRP is currently revising the guidelines for the high-frequency portion of the spectrum (above 100 kHz).

ICNIRP 2020

SCIENTIFIC BASIS FOR LIMITING RADIOFREQUENCY EXPOSURE 100 kHz to 10 MHz EMF Frequency Range: Relation Between the Present and Other ICNIRP Guidelines

Although the present guidelines replace the 100 kHz to 10 MHz EMF frequency range of the ICNIRP (2010) guidelines, the science pertaining to direct radiofrequency EMF effects on nerve stimulation and associated restrictions within the ICNIRP (2010) guidelines has not been reconsidered here. Instead, the present process evaluated and set restrictions for adverse health effects other than direct effects on nerve stimulation from 100 kHz to 10 MHz, and for all adverse health effects from 10 MHz to 300 GHz. The restrictions relating to direct effects of nerve stimulation from the 2010 guidelines were then added to those derived in the present guidelines to form the final set of restrictions. Health and dosimetry considerations related to direct effects on nerve stimulation are therefore not provided here [see ICNIRP (2010) for further information].

As described in the main document, the operational adverse health effects resulting from the lowest radiofrequency exposure levels are due to heating (nerve stimulation is discussed within the low frequency guidelines, ICNIRP 2010).

...As frequency increases, heating effects predominate and the likelihood of nerve stimulation decreases.

= NERVE STIMULATION EFFECTS ARE ADDRESSED IN 2010 GUIDELINES

GUIDELINES FOR LIMITING RADIOFREQUENCY EMF EXPOSURE As described in the "Scientific Basis for Limiting Radiofrequency Exposure" section, radiofrequency EMF levels corresponding to operational adverse health effects were identified. Basic restrictions have been derived from these and are described in the "Basic Restrictions" section below. The basic restrictions related to nerve stimulation for EMF frequencies 100 kHz to 10 MHz, from ICNIRP (2010), were then added to the present set of basic restrictions, with the final set of basic restrictions given in Tables 2–4. Reference levels were derived from those final basic restrictions and are described in the "Reference Levels" section, with details of how to treat multiple frequency fields in terms of the restrictions in the "Simultaneous Exposure to Multiple Frequency Fields"

Around large radiofrequency transmitters

Guidance for Contact Currents Within approximately the 100 kHz to 110 MHz range, contact currents can occur when a person touches a conducting object that is within an electric or magnetic field, causing current flow between object and person. At high levels these can result in nerve stimulation or pain (and potentially tissue damage), depending on EMF frequency (Kavet et al. 2014; Tell and Tell 2018). This can be a particular concern around large radiofrequency transmitters, such as those that are found near high power antennas used for broadcasting below 30 MHz and at 87.5–108 MHz, where there have been sporadic reports of pain and burn-related accidents.

SUMMARY The only substantiated adverse health effects caused by exposure to radiofrequency EMFs are nerve stimulation, changes in the permeability of cell membranes, and effects due to temperature elevation.

Conversion figures

1 Hz to 100kHz (1 – 1,000,000 Hz)

100kHz to 300 GHz (100 – 300000000 kHz)

Threshold of Evidencem 100 kHz to 300 GHz.

As above shows -

The paragraphs mentioning "nerves" references ELFs & LFs and points to the ICNIRP Low Frequency Guidelines which, they say, covers nerve stimulation by radiofrequencies.

It also says it includes pulsed waves. It is clear from this ICNIRP doc (link below) that the Low Frequency Guidelines also includes radio-waves and not justelectric.

https://www.icnirp.org/cms/upload/publications/ICNIRPrfgdl2020.pdf

This nerve stimulation is acknowledged as an adverse effect and ICNIRP have said that a main reason of their Guidelines is to avoid nerve stimulation.

Collated from ICNITP Guidelines and Research regarding Low and Extremely low frequency signals from mobile phones, WIFI and 5G

VL
for South West for Safe Technologies