ICNIRP Standard Guidelines and Pulse Modulated Electromagnetic Fields

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Abstract

ICNIRP guidelines are inadequate for protection of the general public from amplitude-modulated or pulse-modulated electromagnetic fields (EMF) at extremely low frequencies (ELF — below around 200 Hz).

The grounds for this concern are two-fold:

1. There is a substantial and growing body of peer-reviewed research indicating that confidence in the absence of risk from recognised biological effects from ELF EMF is misplaced.
2. There is a growing awareness among people living in the vicinity of transmission masts that all is not well, and that nothing is being done.

In the absence of any degree of certainty as to safety, transmission masts are rapidly being erected in large numbers in residential areas, close to where people live and work, close to schools and hospitals. This is being permitted by the current planning guidelines, which give no rights to people obliged to receive chronic exposure to the radiation. In this, no precaution is being shown at all. Despite the guidelines from the Office of the Deputy Prime Minister and its Ten Commitments, schools and hospitals are not in practice being protected at all. Even if they were, many thousands of children are today living far closer to masts for 18 hours a day, than for the six hours they spend at school.

Our premise is that ICNIRP guidelines are not suited to the situation of (typically) pulse modulated ELF EMF under long-term exposure, and that the planning guidance offered by the ODPM runs counter to the precautionary principle, even as stated by the Stewart Report (IEGMP, 2000).

Our assertion is that the safety guidelines require proper re-examination and that masts must not be sited near where people live and work.

Guidelines

The problem we wish to present is that current planning guidance from the Office of the Deputy Prime Minister states:

> 'In the Government's view, if a proposed mobile phone base station meets the ICNIRP guidelines for public exposure it should not be necessary for a local planning authority … to consider further the health aspects and concerns about them.'

The ICNIRP guidelines (1988, amended, 1998) say:

> 'Only established effects were used as the basis for the proposed exposure restrictions. Induction of cancer from long-term EMF exposure was not considered to be established, and so these guidelines are based on short-term, immediate health effects such as stimulation of peripheral nerves and muscles, shocks and burns caused by touching conducting objects, and elevated tissue temperature resulting from absorption of energy during exposure to EMF. In the case of potential long-term effects of exposure, such as increased risk of cancer, ICNIRP concluded that available data are insufficient to provide a basis for setting exposure restrictions, although epidemiological research has provided suggestive, but unconvincing, evidence of an association between possible carcinogenic effects and exposure at levels of 50/60 Hz magnetic flux densities substantially lower than those recommended in these guidelines.
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> '*In vitro* effects of short-term exposure to ELF or ELF amplitude-modulated EMF are summarized. Transient cellular and tissue responses to EMF exposure have been observed, but with no clear exposure-response relationship. These studies are of limited value in the assessment of health effects because many of the responses have not been demonstrated *in vivo*. Thus *in vitro* studies alone were not deemed to provide data that could serve as a primary basis for assessing possible health effects of EMF.'

What this means is that, even in 1988 and 1998, these guidelines subsequently adopted by Government to protect the public from adverse reactions and ill-health due to installations emitting oscillating, amplitude-modulated or pulse-modulated electromagnetic fields, specifically exclude:

1. long-term effects of any kind
2. cancer, brain disorders, motor-neurone disease *etc.* (conditions suggested by *in vitro* research) caused not by intensity, but by specific frequencies.

What it means also is that the guidelines *only* apply to short-term acute exposures, based on the premise that only thermal effects of EMFs present any risk to health. In excluding this research, and in misrepresenting research relating cancer to long-term exposure, ICNIRP has been internationally criticised.

Reliance on ICNIRP

These guidelines apply to mobile phones, DECT phones, TETRA handsets, and base stations of any characteristic. From all these sources we experience ELF pulse-modulated signals characterised by frequencies that figure in the scientific research as presenting particular concern through biological interaction. The research has demonstrated repeatedly that exposure at very low levels, and certainly well below the thermal safety guidelines, can cause physiological effects even in the short term. In the case of TETRA two factors are of specific concern:

1. TETRA handsets are pulse modulated at 17.64 Hz
2. TETRA base stations do not employ adaptive power control; they therefore transmit on all four slots per frame at full power, all the time. This in itself creates a background modulated EMF envelope at 70.56 Hz, with a rhythmic 17.64 Hz 'marker' caused by the join in slot 4 of one frame and slot 1 of the next. (See appendix and further notes.) Whilst this has been defined away as not constituting a pulsed waveform by averaging power throughout the waveform, it is similar to the rhythmic pattern of a train's wheels, which are never silent, yet which we all recognise.

The ICNIRP guidelines are therefore applied entirely inappropriately for protection from chronic low-level exposure and athermal biological effects arising from particular frequency windows. (It is for this reason that the TE/7 Committee in Australia, in March 1999, would not approve the ICNIRP guidelines.) *Therefore there is no protection from these effects by adherence to these guidelines.* Yet certification of base stations according to ICNIRP guidelines is expressed as satisfying the 'precautionary approach' in planning decisions and Planning Inquiries in accordance with PPG8.

Dosimetry

Examination of dosimetry research for ELF EMR appears to indicate that it is still in its infancy concerning low-level long-term exposure. Primarily, this appears to be because for thermal effects it is simpler to measure (by absorption) than for athermal effects. Thermal effect dosimetry is proportional to radiation intensity, whereas athermal effect dosimetry must relate equally to the frequency mix. In addition, some effects are paradoxical, *ie* while certain thermal effects decrease with intensity, other effects simultaneously increase towards certain frequencies. So whilst there is any disagreement that athermal effects occur, the dosimetry cannot progress.

Without dosimetry for low-level chronic exposure, there can be no progress on guidelines. Therefore, at the very least it must be acknowledged that the ICNIRP guidelines have no bearing on athermal effects and no basis to suggest they might.

The table below exemplifies the current UK situation regarding dosimetry and base station exposure, but examination of the substance of the dosimetry research reveals that it primarily concerns energy absorption, not frequency response or entrainment.

No. of studies:	**19**
Human studies on biology of mobile phone use:	7
Non-human studies on biology of mobile phone use:	3
Studies on psychology of mobile phone use:	3
Non-health studies of mobile phones:	1
Studies on how to study mobile phone use, *eg* dosimetry:	4
Studies on mobile phone base stations:	1

Studies that include TETRA signals:	**3**
Studies involving human biology and TETRA handsets:	1
Studies involving dosimetry and TETRA handsets:	2
Studies on TETRA base stations:	0

Treatment of the science

Even at the time of the Stewart report in 2000, there were eleven studies of calcium efflux research under ELF EMF available. Seven were positive, four (three by one researcher) were negative. All those on a 450 MHz carrier were positive. Since then a further peer-reviewed study has produced a positive result. The DSTL study has not, it is not published, and is not-peer-reviewed, but it is presented as definitive.

This situation is somewhat carelessly presented by Colin Blakemore as Chair of the Medical Research Council (and contributor to this concern in Stewart), as somehow 'not replicating similar studies of the 1970s', and as having no relevant health implications, whereas calcium assuredly does 'play an important role in many biological processes, especially in the function of nerve cells.' (Blakemore, NRPB, 2001). Whilst the experiments of the 1970s may not have been replicated, all these further studies demonstrate the same effects but by different methodologies.

It is similarly suggested by Government and industry that confirmation of safety in ELF EMF comes from WHO. This is important, because the appeal is that WHO should recommend ICNIRP as a harmonized international standard. WHO, however, in its International EMF project, is far from proving concern unfounded. The same support is attributed to COST281, whereas only in May 2003 their Dublin Conference focused on the practical problems of base station epidemiological study and meaningful dosimetry.

The publication rate of peer-reviewed papers on biological effects of EMFs is now well over 1,000 per annum, also suggesting that the matter is far from settled. However, there is an industry of research in perception management, based, it seems, on the principle that the real problem is unfounded concern in an area of uncertainty. This is echoed in the sentiment expressed quite openly and publicly by

mmO2 that all the public require is to be properly 'educated' and all the problems and anecdotal evidence (see below) will go away.

The question therefore is whether the uncertain science is being treated dispassionately in the face of enormous industry, economic and social/market pressure. Scientists such as Ross Adey, Neil Cherry and Robert Becker, highly respected in their fields, are discredited by those who have a clear need to demonstrate that their work is obstructive. Are these experts (and the many others who report the same findings) completely wrong?

Perhaps this protectionism from unpalatable facts is understandable: what are we to do tomorrow, if today we find our entire electricity and communications infrastructure to be damaging to our health? What if everyone were to learn the same and become fearful? And claim damages for loss of mobility for unsaleable property, or worse, for damages to health? Or if we had to move our pylons, our telecoms masts, and even change our domestic electric alternating frequency? This problem will not go away by compounding it, but can begin to be ameliorated by having adequate respect for the scientific voice and respond accordingly in our infrastructure planning, our health guidance, and our health and safety advice. Why the absence of independent base station research? Why has the Stewart recommendation that mobile phones should only be used by children for essential calls been at best completely neglected, at worst suppressed? To protect a multi-million pound market in gadgets and multi-media content, rather than children's health?

The situation must be compared to asbestos: from compulsory use in buildings to compulsory removal, we have had to face the cost. ELF EMF will not be a smaller problem.

ICNIRP, NRPB and the real environment

Whatever our guidelines, the planning process betrays all precaution. According to the NRPB and ICNIRP, accumulative radiation is treated like two plays of the lottery: both plays are so infinitesimally small that two are no better than one. Mast sharing may reduce damage to the visual environment, but in terms of cumulative radiation, interference, local hotspots and secondary frequencies it is treated very naively. And all of this is in the context that 'low' emissions are only low in relation to short-term heating effects.

Instead of addressing the long-term low-level athermal concern, our whole system is constructed around visual amenity. We know that few people actually like tall metal structures in proximity to their homes, let alone in the middle of the countryside, or on ancient hilltops. But to base all our rights entirely on this as if they were (a) otherwise harmless, (b) resulted in no perception of threat or (c) not something communities should have any say about, is socially quite wrong. It is indeed the triumph of industrial might over common sense and democracy.

The author has confirmed by measurement with the proper radio equipment that certain EMF hotspots occur within his house, adjacent to a number of telecoms masts. The reason for these spots to be investigated was that they quickly cause adverse physiological reactions. As a result of the reactions being caused, there are parts of the house where he will not stand or sit, in order to avoid the guaranteed discomfort. But how is this explained, and what investigation of this far-from-unique experience is there? Plainly something physiological is happening that goes completely against the assertions of ICNIRP, and the pattern of radiation being experienced is in any case entirely non-linear.

The role of observation

It should be of great concern that communities living around telecoms masts are reporting clusters of unexpected effects. These range from a large number of reports of cancer and MND clusters that remain unexamined, to many instances of reported electrical sensitivity, or microwave syndrome, that appear much more quickly. That the experience is not properly named, let alone recognised, is testament to the lack of attention it has received in the UK. It appears in some quarters to be preferable to regard 'nebulous' conditions as psychosomatic, since this is simpler and removes any common cause or source of blame. This approach has been taken to ME (CFS), and Gulf War Syndrome long before EHS. It appears to be reflected in the awarding of EHS research under MTHR disproportionately to university psychology departments. It is interesting that the same researcher (Simon Wessely) who demoted CFS to a psychosomatic disorder was also part of the demoting of GWS similarly, yet only on 16 October 2004, GWS was affirmed as being a real syndrome by Professor Golombe. Simon Wessely's unit is now studying the 'psychobiological effects of using mobile phones'. Understandably, it would be nice to find that however uncomfortable the adverse effects of living near masts was, the cause was purely psychosomatic. But is this likely? And who is accepting the reports and investigating correlation and causation, without predetermining the outcome from the predictive origins of current scientific theory? In other words, it is strongly assumed that if the science cannot predict the displayed outcomes, then those outcomes cannot be valid.

Nevertheless, a pronounced effect during the period of installation of TETRA in the UK, is that particular sensitivity has been raised much more quickly. Whether this is properly EHS is questionable, since the people concerned are not generally also sensitive to sources other than microwave, nor previously sensitive. The Oberfeld, Navarro and Santini studies name this 'microwave syndrome' for this reason.

Example

One investigation in Sussex was completion in October 2004, and shows that out of a sample population of 346 living within 250 metres of a TETRA mast, 58.5 per cent reported a range of symptoms associated with microwave sensitivity since activation of the TETRA mast. 40 per cent have experienced disturbed sleep since it

was switched on. Of seven common symptoms, four are strongly correlated with each other (sleep, headaches, nausea and dizziness). The survey included a question of use of DECT phones, and there is a significant difference in profiles or reported effects between owners and non-owners. The community observed, surrounds five co-located mobile installations (2 x GSM, 2 x UMTS, 1 x TETRA) and a sixth is under construction. For years the residents have accepted the development of the masts, but with TETRA something appears to have 'tipped them over the top'. This is not out of fear or over-awareness, and the effects, whilst obviously not all being attributable to the masts, are beyond the bounds of being entirely psychosomatic where the cause is *not* other than the masts. Perhaps DECT phones have a role to play too? Certainly, they too are covered by ICNIRP, are sold without any warnings of adverse effects (though many people are now experiencing this), and are used in offices, with no guidelines as to appropriate density, siting on desks, or within certain kinds of building structures.

Yet observation of this kind is of no official interest, and is dismissed. The Sussex study was run out of exasperation that no official response could be elicited to apparent but unassessed reports of problems. In a similar area (Isle of Wight), a report was produced by the Director of Public Health to demonstrate that no such study could possibly produce meaningful results — all based on the flawed NRPB and ICNIRP premises.

Where has the role gone of observation giving rise to hypothesis, to investigation and analysis? In situations like these, if the problems had arisen from more physical environmental factors, due investigation would be done, to the air, the water, the local supermarket *etc.*

There certainly appears to be something happening, among people who are not particularly followers of the news or research on masts or phones. These are people who love their phones and trust the government that they must be safe or they would not be allowed. Toys with dangerous eyes are banned at Christmas, after all.

Social acceptability

The author of this paper is not generally electrically sensitive, and never has been. Yet TETRA base station have a curious effect. First, the local one causes a severe sleep disorder, but interestingly, he can feel TETRA masts from a distance. This is not imagined, and is certainly unexplained.

The question about sleep deprivation being not only inconvenient but a long-term danger to health is unquestionable. Whether the physical awareness of TETRA masts is a danger or just a discomfort is quite unknown. But this, as with the people with persistent headaches that they put down to the masts, is surely not an acceptable social cost of the ability to sell and operate more mobile phones with increasing bandwidth.

The current situation is that in many 'mast communities' the effects are clearly being felt, that no-one is interested, that they are being told it is psychological thing, or that, whilst of unidentified source, it somehow cannot be anything to do with the masts. This, despite periodic mast inactivity or by living away, clearly demonstrating that the effects cease. How many people are suffering low-level discomfort from these symptoms, quite unaware that it may be due to their DECT phone, or the local mast? They are uncounted, but if the aware communities are anything to go by, there must be very many more unaware communities, whose well-being is daily being compromised, and whose long-term health is in question.

Reading the WHO: *Establishing a Dialogue on Risks from Electromagnetic Fields*, presents objectors and campaigners as *a priori* wrong, and risk as being absent. The tone of the NRPB response to what they term 'anecdotal reports' is that the real problem is people's sensitivity, not the underlying cause of their sensitivity. It is worth comparing: would smoking related diseases be acceptable if we could cure everyone from the effects, in the process labelling people as tobacco-hypersensitive?

Appropriate response required

The whole situation of the relevance of ICNIRP to pulsed microwave (MW) EMF in wireless technologies is now urgent. The proliferation of networks for mobile phones, of TETRA, DECT, wireless networks, public wi-fi hot-spots, NetRail, the highways project, and the growth of UMTS and bandwidth demand, is rapidly making the real-life assessment of effects too complex ever to separate out and measure.

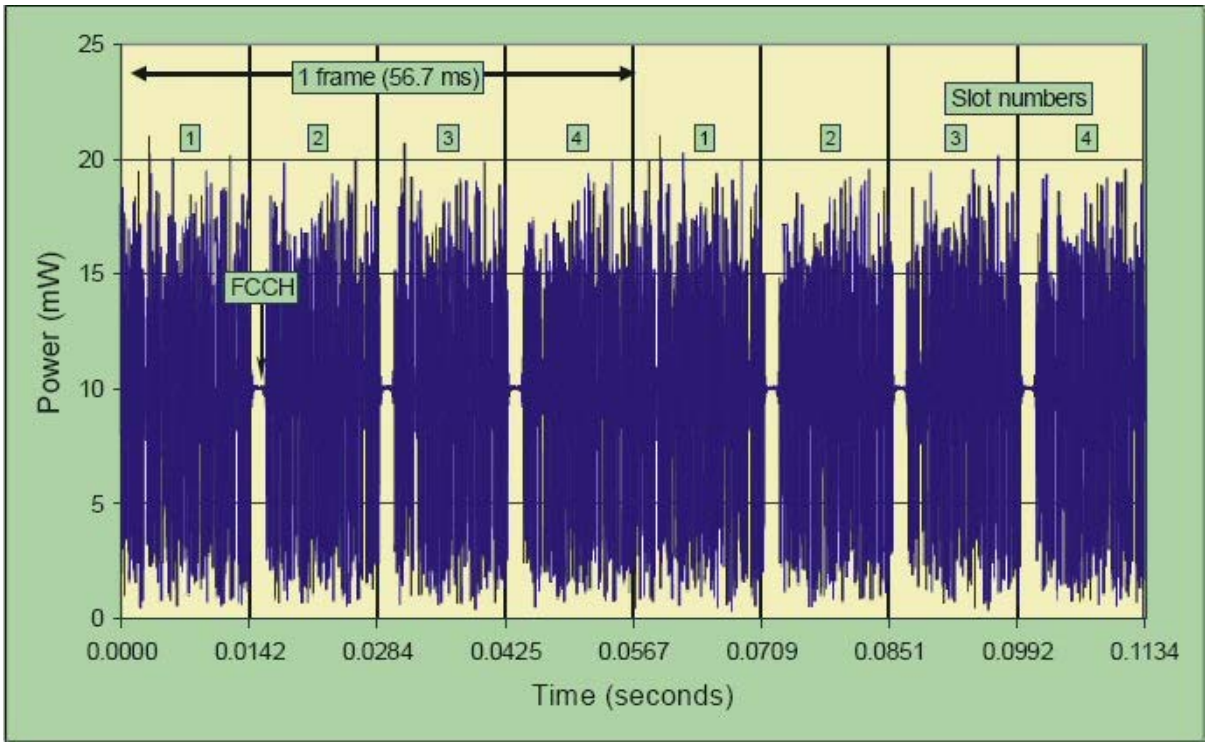
Either this whole argument for precaution is quite unfounded, or there is a possibility that the reports of effects on well-being and health of some people are indeed linked to MW EMF.

If, as seems increasingly apparent, some people are indeed vulnerable to this increasing amount of radiation, they deserve and need public protection. At the very least, transmission masts must not be sited in residential areas, and devices such as DECT, mobile phones and wireless networks need not only to carry SAR ratings with practical explanation, but also obligatory precautionary advice for people sensitive to them, similar to adverse reaction advice provided for food or drugs.

In the meantime a better assessment of dose-effect is required than ICNIRP standards on short-term acute thermal effects.

Appendix: TDMA Concerns of TETRA

The familiar trace of a TETRA base station signal (Source: AGNIR)



Notes:

1. In this TDMA signal, each 'bunch' of modulations is a slot, and there are four slots in a frame. The overall waveform envelope is characterised by 70.56 Hz, marked by a pronounced changes in amplitude modulation. Frames occur at 17.64 Hz, marked by missing changes, (long bursts where slot 4 is joined to the next slot 1). Were this acoustic, the rhythmic pattern 'di-di-dah-di-di-dah' would be quite apparent, and the rhythm of the 'dah' at 17.64 Hz self-evident. The question is whether induced currents in the body from EMF, reflecting this rhythm, are perceived in any way similar to the body's own bioelectromagnetic frequencies.
2. Whilst the 16 Hz concern relating to cellular Calcium efflux underpins one of the issues of TETRA (especially the aggressive handset pulsing), another is that of our underlying beta brain frequencies between 13 and 40 Hz under low but chronic exposure. This may be part of an explanation of the abrupt waking, experienced by many people living near TETRA base stations, at intervals coinciding with the transition from alpha to beta brain activity. Allied to this concern is the one of frequency entrainment, where bioelectromagnetic frequencies 'fall in' with imposed field frequencies.
3. The primary objection to frequency-dependent biological effects is not that this is not borne out by laboratory experiments (which it is), but that there is apparently inadequate understanding of a mechanism in the body whereby these signals can be recognised (*ie* distinguished from the 400 MHz carrier wave). Several mechanisms have been suggested, by Becker, Hyland, Cherry and Coghill, amongst others, but rather than test these hypotheses, the official view seems to be that whatever is seen in the laboratory, in the absence of an established mechanism, coherent signals such as these simply cannot be having an effect. Hence the absence from ICNIRP of coherent frequency effects, continues to be accepted. Effects, such as those on calcium, melatonin production and the blood-brain barrier, however, do present well-defined health risks.

References

This list is highly selective. The intention has not been to create a definitive argument, but to point out the obvious problems in the current approach to ELF EMF safety assurance and protection. The literature on biological effects of ELF EMF is overwhelming; the Cherry paper below, for example cites 461 other papers.

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