Statement of Donald R. Maisch PhD
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Introduction

I have been asked to provide a scientific opinion on the current telecommunications frequency human exposure standards as they pertain to human exposure to radio frequency/microwave (RF/MW) emissions from FortisBC's proposed Advanced Metering Infrastructure (AMI) Project. This involves the installation of AMI "smart meters" in all homes and businesses of its customers.

Background and qualifications

My name is Donald R Maisch and I reside in Hobart, Tasmania, Australia and I am a citizen of Australia. I have been directly involved in telecommunications standard setting since 1996. From 1998 to 2001, I was a member of the Standards Australia TE/7 Committee: Human Exposure to Electromagnetic Fields. (Radiofrequency standards) which concluded in 2001. From 2004 to 2009 I was enrolled in a PhD research program at the University of Wollongong, New South Wales, Australia. My area of research was examining the health risk assessment process as it applied to the development of Western telecommunications standard setting. In 2010 my thesis, *The Procrustean Approach: setting Exposure Standards for Telecommunications Frequency Electromagnetic Radiation*, passed external review and was accepted by the university. I have included that document as a separate, but essential part of my Statement.

I am currently a consultative committee member on a powerline standards review committee under the auspices of the Australian Radiation Protection and Nuclear Safety Agency (ARPANSA). My CV is attached as an enclosure.

Relevance of my scientific background to the case at hand

As stated above, I have been involved directly in the telecommunications standard setting process since 1996. I have focused my PhD research on the controversy over the level of health protection that is provided by the internationally recognized radiofrequency exposure standards / guidelines. These are the RF standard developed under the auspices of the Institute of Electrical and Electronic Engineers (IEEE C95.1) and the RF guidelines promoted by the International Commission on Non-Ionizing Radiation Protection (ICNIRP). This controversy is very much a central issue with the roll-out of AMI smart meters as an essential part of the proposed Advanced Metering Infrastructure (AMI) Project.

The controversy is over the differing opinions over the official radiofrequency standard limits set by Canada's Safety Code 6 and the level of protection provided for people who may be exposed to AMI meter emissions. By answering the following questions asked of me, I will give my views on this controversy, based on my experience and research on RF standard setting.

Questions

1. Does the state of scientific research sufficiently establish a risk that meters transmitting by radiofrequencies (such as the AMI meters proposed by Fortis) constitute a risk of serious as well as irreversible damage to health, through

biological effects other than those resulting from heat?

DM Response #1: There is no established research of sufficient strength to say with scientific certainty that RF emissions as those given off by the AMI meters (hereafter referred to as smart meters) constitute a serious and irreversible risk to health at non-thermal exposure levels. The problem here, however, that in relation to smart meters this is new technology where no research has yet been conducted specifically addressing human exposure to smart meter emissions. In some situations this exposure may constitute a new and unique exposure situation, which I address in my response to question 2 (below).

If one addresses the question using the established literature base used to set thermally based RF standards (IEEE C95.1, ICNIRP, Safety Code 6) it is a fact that consideration of other possible biological effects not related to heating have not been taken into account in the setting of the exposure limits in these standards. The vast bulk of the historical research effort that serves as the basis of these standards has focused on thermoregulatory studies (how the body handles excessive heat from RF exposure – a thermal effect) and establishing maximum exposure levels to eliminate excessive temperature increases. Much of this research consisted of exposing small laboratory animals to acute short term RF/MW to determine at what level of exposure their body's ability to dissipate heat (thermoregulatory) was breached. The results of these studies were then extrapolated to what was thought would happen to a human. However, for estimating thermal effects for humans this substantial body of RF research was criticized by Adair & Black (2003) while arguing for an increase in the IEEE C95.1 RF standard exposure limits. **It is important to note here that the thermally based standards discussed in this paper, IEEE C95.1, ICNIRP, and Safety Code 6, depend upon the same historical RF research literature base, so the mention of the IEEE C95.1 RF standard, and its formulation, is directly relevant to the science behind both ICNIRP and Safety Code 6.**

To quote in part from Adair & Black (2003):

> Most of the published research on thermophysiological responses in the presence of RF fields has been conducted on laboratory animals, with a heavy emphasis on laboratory rodents (e.g., mice, rats and hamsters). These small animals are poor models for human beings because their physiological heat loss mechanisms are limited.

The authors then go on to claim that "the conclusion is inescapable that humans demonstrate far superior thermoregulatory ability over other tested organisms during RF exposure at, or even above current human exposure guidelines"[1] (Appendix A). However their admission clearly suggests that if the scientific research data-base for thermal biological effects is based on "poor models for human beings", trying to extrapolate that to human RF exposures introduces a large degree of scientific uncertainty. This would be even more so for the case of possible non-thermal effects.

However, if one takes into consideration the body of available peer reviewed and published research, there is evidence that RF levels well below that which causes

[1] E. Adair, D. Black, 'Thermoregulatory Responses to RF Energy Absorption', *Bioelectromagnetics, Supplement 6*, 2003, pp. S17 – S38.
http://journals2.scholarsportal.info/details.xqy?uri=/01978462/v24is6/s17_trtrea.xml

tissue heating may cause adverse biological effects. This was a concern of the U.S. Radiofrequency Interagency Work Group (RFIAWG) a governmental interagency committee working under the House of Representatives' Committee on Commerce. Working group membership included the Food and Drug Administration (FDA), the Center for Device and Radiological Health (CDRH), the National Institute for Occupational Safety and Health (NIOSH), the Environmental Protection Agency (EPA), the Occupational Safety and Health Administration (OSHA), the National Telecommunications and Information Administration (NTIA) and the Federal Communications Commission (FCC)[2] (Appendix B). With this work group membership, a significant difference of opinion was expressed over the adequacy of the thermally based proposed IEEE C95.1 standard revisions, compared to that of the industry make up of the IEEE standard setting committee, SCC-28 subcommittee IV. These differing expert opinions illustrated that differing scientific interpretations of the same scientific literature base was very much according to one's affiliations.

In June 1999 Gregory Lotz, representing NIOSH on the RFIAWG, presented the Chairman of the SCC-28 subcommittee IV a list of issues that RFIAWG considered needed to be addressed in the IEEE RF standard. The list was in response to previous requests from the work group for greater participation in SCC-28 discussions on RF standards.[3] In particular, RFIAWG criticised the biological rationale of the standard on a number of fronts. A fundamental issue was the standard's failure to address chronic (low intensity/prolonged) as opposed to acute (high intensity/short term) exposures. This was seen in the standard's limiting the definition of an "adverse effect level" to only acute exposure situations and the use of time-averaged calculations that were not suitable for prolonged exposure situations and therefore may not adequately protect the public. RFIAWG recommended that a clear rationale needed to be developed to also include chronic exposures. [4]Another concern was the standard's incorrect assumption that all tissues are equally sensitive (other than the eyes and testicles) to RF. This failed to take into consideration the differing sensitivity of human tissue when calculating SAR limits.[5] There was also a concern expressed about failure to include consideration of the body of research on the biological effects of exposure to ELF-modulated and pulse modulated RF that was relevant to public exposures. In addition, the SAR time-averaging calculations as used in the standard hid any biological effects resulting from modulated RF exposures.[6] RFIAWG also questioned the biological validity of the IEEE's two-tier exposure classification, "controlled" vs. "uncontrolled". Besides not being adequately explained, a rationale needed to be given as to why people in uncontrolled environments needed to be protected to a greater extent than persons in controlled environments, when such situations historically were based on biological considerations.[7] Another issue for RFIAWG was the rationale for the relaxation of the exposure limits above 1.5 Ghz that "caused concern that the standard is not restrictive enough for continuous exposures at lower microwave frequencies where new wireless applications for consumers could make this an issue

[2] E. Jacobson, Deputy Director, Center for Devices and Radiological Health, FDA Letter Regarding Cellular Phones, May 5, 1997, http://www.osha.gov/SLTC/radiofrequencyradiation/fda.html
[3] G. Lotz, RFIAWG, RF Guideline Issues: Identified by members of the Federal RF Interagency Work Group, June 1999, letter from Gregory Lotz to Richard Tell, Chair of IEEE SCC28 IV, www.emrpolicy.org/litigation/case_law/docs/exhibit_a.pdf
[4] Lotz, op. cit., p. 1-2.
[5] ibid.
[6] Lotz, op. cit., p. 5
[7] Lotz, op. cit., pp. 3-4

in the future".[8] To address these concerns the working group recommended a comprehensive review of long-term, low- level exposure studies that had relevance to environmental chronic occupational RF exposures and neurological-behavioural effects to better define the adverse effect level for RF, and micronucleus assay studies with relevance to carcinogenesis.[9] (The RFIAWG letter is reproduced in full in Appendix C.)

Despite the concerns raised by the RFIAWG these were simply ignored in subsequent IEEE C95.1 standard revisions, as seem in my Response # 2 (next page) in relation to the IEEE's 12 guiding principles for RF standard setting. The reason for this is examined in detail in chapter 3 of my thesis, The Procrustean Approach and the conclusions of that chapter are reproduced in Appendix D.

Two alternative reviews of the RF literature base, the "Bioinitiative Report"[10] (Appendix E) and the ICEMS report,"Non-Thermal Effects and Mechanisms of Interaction Between Electromagnetic Fields and Living Matter"[11] (Appendix F) are in general agreement with the RFIAWG concerns over limiting public health protection in RF standard setting to thermal considerations only. What the RFIAWG concerns, and these two reviews indicate, is that there is substantial peer reviewed and published research in existence that found scientific evidence of adverse biological effects at exposure levels far below the official standard limits/ guidelines that are based on thermoregulatory considerations.

Considering the above, one should be very cautious about drawing firm conclusions from the "state of scientific research" on the extent of health protection from RF standards that limit health protection to thermal considerations. This includes Health Canada's Safety Code 6, which is based on ICNIRP's thermally based RF guidelines, which, in turn, are founded on the historical development of the IEEE C95.1 RF standard.

2. Regulations for telecommunications, such as Safety Code 6, are based upon avoiding heating of tissue as a result of exposure to electromagnetic radiation. Do you agree with that approach? What additions or modifications, if any, would you recommend to those regulations?

DM Response #2: The ability of RF energy to heat tissue is well established and exposure standards set to limit that exposure are valid for that purpose. Whether or not they are adequate for all thermal situations is questionable considering the limitations as pointed out by Adair & Black, 2003 (see Response 1). Generally speaking, notwithstanding Adair & Black's concern, I agree with that approach for thermal biological effects, which are well known as a result of many years of research.

However, for the issue of possible non-thermal effects I do not agree with that approach as it cuts off from consideration an existing body of peer reviewed research that indicates the existence of low-level biological effects not related to

[8] Lotz, op. cit., p. 6
[9] Lotz, op. cit., p.7
[10] Blackman, C. et al., "BioInitiative Report: A Rationale for a Biologically-based Public Exposure Standard for Electromagnetic Fields (ELF and RF)", Updated Jan. 2013
[11] Giuliani, L. and M. Soffritti (eds), "Non-Thermal Effects and Mechanisms of Interaction Between Electromagnetic Fields and Living Matter", ICEMS Monograph for the European Journal of Oncology, vol. 5, 2010

heating. (As per the RFIAWG concerns in Response #1, and Appendix A)

This problem is illustrated in the 12 "Guiding principles" for setting RF exposure standards that were published in 2003 by the IEEE's International Committee on Electromagnetic Safety's (ICES) Subcommittee 4 (SC4). These 'principles' were referred to as "a valuable reference on the subject for many years to come"[12] They state in part that standard exposure limits should be based on established adverse effects, that the thermal effect is the only established adverse effect and that non-thermal effects are not established (Appendix G). Setting such a firm principle on scientific inquiry for years to come is ill advised as it can limit the scope of future scientific research to what is already "established".

I applaud the writers of Safety Code 6, however for their acknowledgement of scientific uncertainty and the possibility of unexpected problems. To quote from the Preface:

> "In a field where technology is advancing rapidly and where unexpected and unique problems may occur, this Code cannot cover all possible situations and blind adherence to rules cannot substitute for the exercise of sound judgment. Consequently, specifications and recommendations in this Code may require some modifications under certain circumstances."

Considering the anecdotal reports of possible health effects, it is possible that the mass introduction of AMI meters on homes and businesses may constitute a situation where "unexpected and unique problems may occur". In such a situation thermal considerations alone may not be adequate for public health protection. Currently there is no research data that I know of specific to possible biological effects from smart meter emissions.

If there are such effects, which still awaits a proper research effort, I would expect them to be connected to prolonged close proximity to an active smart meter. For example, anecdotal reports of health effects, such as insomnia and tinnitus are now being reported in Victoria, Australia, where smart meters are being rolled-out. These are predominantly from people who are sleeping within 3 metres of a newly installed smart meter located externally on a bedroom wall. These reports are anecdotal but, in my opinion, the possibility of this being a "unique problem" is of concern and should call for an urgent research effort to determine if the reports are real or imagined. Until such research is carried out by qualified independent research organisations and the results published, it is impossible to say with any scientific confidence that it is a real effect. As for any modifications to Safety Code 6 in relation to smart meters this could only be done when more research data is available to identify if this is a unique problem. Anecdotal reports of health effects alone are insufficient to alter standards but strongly suggest the need to consider this possibility as an important research priority.

3. Please provide whatever comments you may have on the validity of the statements/assumptions contained in the Exponent Report (Exhibit B-1, Appendix C-5) and, in particular, its characterization of the relevant scientific research and review material.

[12] C-K. Chou, J. D'Andrea, 'Reviews of the Effects of RF Fields on Various Aspects of Human Health: Introduction', *Bioelectromagnetics, Supplement 6*, 2003, pp. S5-S6.

DM Response #3: Considering the totality of existing scientific literature, the Exponent Report focuses on literature reviews by expert groups that have established the thermal effect as the only adverse biological effect to consider in recommending exposure limits. These are primarily based on the ICNIRP guidelines. A number of studies reporting effects are mentioned in the Exponent report such as Hardell et al (2006a,b, 2011), Milham (1985), Szmigielski (1996) Hocking et al (1996) but then dismissed for one reason or another. At the same time studies or reviews that did not find any effects are accepted.

In my own thesis assessment of the RF standard setting process, primarily looking at the IEEE and ICNIRP risk assessment processes, what is apparent is that the process is very much influenced by the reviewer's affiliations. (Appendix D)

This is seen, for example, where the Exponent report dismisses the Hardell group's work largely on assessments by Ahlbom et al, (2009) and Swerdlow et al, (2011) (page 28). This may seem persuasive until the reviewer's financial conflicts of interest are considered, and which have the potential to influence their expert opinion. For example, Anders Ahlbom is co-founder of "Gunnar Ahlbom AB" a Brussels-based lobby firm aiming to assist the telecom industry on EU regulations, public affairs and corporate communications (Appendix H). [13] Then Anthony Swerdlow, who is also on the Main Commission at ICNIRP, and in this position is supposed to be free of industry connections, holds shares in the telecoms companies Cable and Wireless Worldwide and Cable and Wireless Communications. Swerdlow's wife holds shares in the BT group, a global telecommunications services company[14] (Appendix I).

So, is this a problem? It is according to the International Committee of Medical Journal Editors. In their "Uniform Requirements" for medical journals they state:

> Conflict of interest exists when an author (or the author's institution), reviewer, or editor has financial or personal relationships that inappropriately influence (bias) his or her actions (such relationships are also known as dual commitments, competing interests, or competing loyalties). These relationships vary from being negligible to having great potential for influencing judgment. Not all relationships represent true conflict of interest. On the other hand, the potential for conflict of interest can exist regardless of whether an individual believes that the relationship affects his or her scientific judgment. Financial relationships (such as employment, consultancies, stock ownership, honoraria, and paid expert testimony) are the most easily identifiable conflicts of interest and the most likely to undermine the credibility of the journal, the authors, and of science itself[15] (Appendix J).

A more recent analysis of Hardell's work and the Interphone study has been published in *Pathophysiology*. This was a meta-analysis of previous data on research on brain tumour risk and the use of cell phones. The paper concludes with the following:

> Certainly results from the Hardell-group as well from the Interphone group

[13] http://www.monanilsson.se/document/AhlbomConflictsIARCMay23.pdf
[14] http://ehp03.niehs.nih.gov/article
[15] ICMJE, Uniform Requirements for Manuscripts Submitted to Biomedical Journals: Ethical Considerations in the Conduct and Reporting of Research: Conflicts of Interest, http://www.icmje.org/ethical_4conflicts.html

show an increased risk for glioma associated with long term mobile phone use. Also use of cordless phones increases the risk when properly assessed and analysed. The risk is highest for ipsilateral exposure to the brain of RF-EMF emissions. Adolescents seem to be at higher risk than adults. IARC concluded that RF-EMF emissions overall, e.g., occupational and from wireless phones, are 'possibly carcinogenic to humans', Group 2B[16] (Appendix K).

It would certainly be beyond the scope of the Exponent report to try to address conflict of interest in its review. It is simply reporting on the prevailing scientific opinion as expressed by a number of national and international bodies.

However, in my opinion, the Exponent report is remiss in not mentioning opposing reviews of the literature, such as the Bioinitiative and ICEMS reports mentioned in my Response # 1. At the very least the Exponent report should have mentioned these reviews and then given considered reasons why Exponent thought that they are in error. To avoid mention of them altogether is an omission for a review of the RF science.

Considering the above examples, I do not consider the Exponent report a complete review of the available published literature.

4. Please provide whatever comments you may have on the validity of the statements/assumptions contained in Safety Code 6 (Exhibit B-1, Appendix B-6) and, in particular, its characterization of the relevant scientific research and review material.

DM Response #4: The references for Safety Code 6 are very much limited to RF standards and standard setting groups (ICNIRP, IEEE C95.1 -1991, 1999, ANSI C95.3-1991 (Measurements), AS 2772-1998 (Australia), etc., which base their maximum exposure limits on acute short/ term RF exposures. This is very much the same for the other individual research papers in the references section. Being very much grounded in the thermal approach Health Canada's response to what safety Code 6 termed: "unexpected and unique problems" may be limited and incapable of objectively assessing possible bio-effects not related to thermal heating as it lies outside the parameters of the standard. I note that in Safety Code 6's "APPENDIX VIII Definitions", no mention is made of non-thermal, athermal or even thermal effects.

5. Please provide any comment you may have on the statements/assumptions contained in the attached Health Canada document "It's Your Health" dated December 2011. Particularly, indicate, with reasons, whether you agree with the conclusion stated therein, i.e.:
Survey results have shown that smart meters transmit data in short bursts, and when not transmitting data, the smart meter does not emit RF energy. Furthermore, indoor and outdoor survey measurements of RF energy from smart meters during transmission bursts were found to be far below the human exposure limits specified in Health Canada's Safety Code 6.
Based on this information, Health Canada has concluded that exposure to RF energy from smart meters does not pose a public health risk.

[16] M. Carlberg, L. Hardell, On the association between glioma, wireless phones, heredity and ionising radiation, *Pathophysiology*, Vol. 19, Issue 4, Sept 2012, pp. 243-252.

DM Response #5: The statement does not address the fact that smart meters are transmitting on a brief but regular basis over a 24-hour time frame. True, they only transmit actual power usage data 4 to 6 times daily, but as Table 1 [17] illustrates, there are many thousands of other transmissions for network management and keeping in communication with other meters in the network[18] (Appendix L). These are extremely brief transient emissions but as I have anecdotally seen in numerous interviews in Victoria, Australia, where smart meters are being rolled-out, when someone is sleeping in close proximity (up to 3 metres) to an active smart meter, anecdotal reports of sleep disruption and tinnitus (or microwave hearing) are common complaints. This type of exposure may constitute a new and novel exposure for many people and may qualify for what Safety Code 6 mentions "where unexpected and unique problems may occur". As for smart meter emissions being far below the human exposure limits in safety Code 6 that is true. However, these limits are limited to providing protection against acute thermal bio-effects and not chronic exposure to sub-thermal RF emissions, such as which are emitted by smart meters.

As for the possibility that smart meters pose a public risk, if one exists, the risk and exposure may be small for the individual, depending on the location of the smart meter in their homes, but considering the millions of Canadians who would be exposed, a small risk for the individual may equate to a significant public health risk for the overall population. This possibility could be clarified by research to gauge the extent of that risk and whether or not the location of the meters on buildings needs to be taken into consideration.

TABLE 1

Electric System Message Type [a]	Transmission frequency Per 24-Hour Period: Average [b]	Transmission frequency Per 24-Hour Period: Max. (99.9th Percentile) [c]
Meter Read Data	6	6
Network Management	15	30
Time Synch	360	360
Mesh Network Message Management	9,600	190,000
Weighted Average Duty Cycle	45.3 Seconds	875.0 Seconds

Note: This table is only for the 900 mhz radio in the smart meter. There is also a 2.4 GHz radio in the meter that will be in use once home appliances are replaced with new smart appliances with wi-fi connectivity. Once this is in use the total transmission frequency will be further increased. (Appendix L)

6. What is your understanding of the term electromagnetic hypersensitivity ("EHS")? What is the range of medical perspectives on EHS? What is your view in that regard?

DM Response #6: This condition, also sometimes referred to as idiopathic environmental intolerance, has been of interest to me for some time as science writer for the journal of the Australasian College of Environmental & Nutritional Medicine. One perspective on this condition is that is primarily a psychosomatic disorder and

[17] Pacific Gas and Electric Co., Ref 20. http://emfsafetynetwork.org/wp-content/uploads/2011/11/PGERFDataOpt-outalternatives_11-1-11-3pm.pdf

[18] According to Pacific Gas and Electric, "this typical cumulative communication period is comprised of thousands of very brief communications", page 3: http://emfsafetynetwork.org/wp-content/uploads/2011/11/PGERFDataOpt-outalternatives_11-1-11-3pm.pdf

not related to EMF exposure. It has been suggested that this is actually a manifestation of the nocebo effect, caused by some people reading scare stories in the media and making themselves sick with worry as a result. This is illustrated in a January 2012 Montreal newspaper article on the roll-out of smart meters by Hydro-Quebec. The reporter attributed the mounting public opposition to their introduction to an "unjustified panic" that was being "carefully cultivated" by environmentalists[19] (Appendix M).

A reason for dismissing possible smart meter health effects from RF exposure has been reliance on the findings of previous provocation studies to evaluate the reality of EHS. This type of study simply consists of exposing subjects who have identified themselves as electrosensitive to electromagnetic radiation (EMR) to see if they can feel when the field is turned on or off. These tests have generally found that the subjects failed to distinguish whether the field was present or not - leading to a conclusion by the researchers that the fields were not the cause of their reported symptoms and therefore the problem may be psychosomatic.

Central to EMR provocation studies is the hypothesis that if a person is sensitive to EMR they should be able to feel when the exposure is taking place. If not, it must then be a psychological problem. For example, Rubin and colleagues from Kings College, London reviewed over 40 provocation studies on EHS volunteers and concluded that, overall, people with EHS did not react to EMR exposure any differently from the way subjects react to a sham exposure. Thus, the authors suggested that EMR was not the cause of their condition[20] (Appendix N).

Central to the nocebo claim with EMR exposure (including power frequency magnetic fields) is the proposition that without a conscious pre-existing worry there would be no symptoms at all – it's all in the mind.

It is important to acknowledge that the nocebo effect is a well-recognized human condition and can have a role in many situations, including patient's concerns over medications, as examined in a paper (A. Barsky et al, 2002) published in JAMA[21] (Appendix O).

It is inevitable that worry over possible health effects from an environmental exposure to an agent (such as smart meter RF emissions) will cause a stress response and illness in some people – the nocebo effect. However, this fact in no way invalidates the possibility that there may also be real adverse health effects not related to psychological factors. This is where research is called for.

Obviously in conducting population based research the effects of both the placebo and nocebo effect are important considerations. For this reason, in an Australian CFS/EMF exposure study (Maisch, et al, 2002) that examined residential exposures to mains power magnetic fields in a group of medically diagnosed chronic fatigue patients,[22] (Appendix P) a decision was made at the onset to avoid subjects who had any pre-conceptions that their illness may be caused by electromagnetic field (EMF) exposure. In other words, none of the participants were worried about EMF, thus

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[19] F. Cardinal, 'Double discours', *The Montreal Daily La Presse*, Jan. 27, 2012, http://www.cyberpresse.ca/debats/editorialistes/francois-cardinal/201201/26/01-4489772-double-discours.php

[20] GJ. Rubin, Electrosensitivity: A Case for Caution with Precaution, http://archive.radiationresearch.org/conference/downloads/011555_rubin_extra.pdf

[21] Arthur J. Barsky, MD; Ralph Saintfort, MD; Malcolm P. Rogers, MD; Jonathan F. Borus, MD, Nonspecific Medication Side Effects and the Nocebo Phenomenon, *JAMA*. 2002, Vol. 287 No. 5, pp. 622-627.

[22] D. Maisch, J. Podd, B. Rapley, Changes in Health Status in a Group of CFS and CF Patients Following Removal of Excessive 50 Hz Magnetic Field Exposure, *JACNEM*, Vol. 21, No. 1; April 2002, http://www.emfacts.com/download/cfs_changes.pdf

ruling out a nocebo effect as far as possible. One of the findings was that reducing exposure to 'excessive' night-time ELF magnetic fields significantly improved fatigue symptoms and quality of sleep[23] (Appendix Q). Interestingly, one of the symptoms reported, tinnitus, especially at night, disappeared after removal of the source of exposure.

The absence of any nocebo effect was also seen in a Workcare Compensation case that took place in Melbourne Victoria in 1991-1992. In this case a number of women who had worked in an office directly over an electrical substation all had remarkably similar symptoms that ceased when they no longer worked in the area. None of the women had any idea that there were high power-frequency magnetic fields in the office. Common symptoms were: chronic tiredness/fatigue; insomnia; stress; prone to virus infections; an inability to concentrate; depression; facial rashes; headaches. One woman summed it up as "a permanent severe case of jet lag". The symptoms disappeared once the women moved to other workplaces [24] (Appendix R).

The absence of a nocebo effect was also seen in a study of population effects of a short-wave RF transmitter facility at Schwarzenburg, near Berne, Switzerland (Altpeter, et al, 1995). Because of persistent health complaints in the population near the transmitters a study was conducted in the early 1990s. Their findings were "highly suggestive of a direct effect of the radio shortwave transmitter on sleep quality" (disturbances in falling asleep and maintaining sleep). Other effects found were restlessness; joint pain; disturbances in concentration; general weakness and tiredness. Sleep disturbance was associated with a maximum exposure of 18.5mW/m² with a mean nocturnal exposure of less than 7.0 mW/m². [25]
The researchers specifically looked for a nocebo effect which they called a"health-worrying personality" but found no evidence of it. This was highlighted when the transmitter was turned off unexpectedly, and unknown to the residents, in the middle of the study. Affected sleep patterns recovered until the transmitter was turned on again, when they deteriorated again[26] (Appendix S). Of relevance to the current controversy over the adequacy of the current thermally based RF standards, an expert group at the Swiss Federal Office for Environment, Forests and Landscape (known by its German acronym, (BUWAL) admitted that severe sleep disorders were correlated with RF/MW exposures, even though the IRPA limits (later ICNIRP's) were never exceeded[27] (Appendix T).

As for the possible prevalence of EHS, the American Academy of Environmental Medicine has released a statement that some patients are being adversely impacted by EMF (power frequency) and RF fields and are becoming more electromagnetically sensitive. The AAEM recommended that physicians consider patients' total electromagnetic exposure in their diagnosis and treatment, as well as

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[23] J. Podd, D. Maisch, Reducing the level of 50 Hz Magnetic Fields Lessens Symptoms of Chronic Fatigue and Improves Sleep, 2nd International Workshop on "Biological effects of Electromagnetic fields", 7-11 October 2002 , Rhodes, Greece, http://www.emfacts.com/download/Reducing50.pdf

[24] The Ross House Electrical Substation Workcare compensation case, Melbourne, Victoria, 1991-1992. A report on the investigation of a worker's compensation claim for "chronic tiredness arising from excessive exposure to high levels of electromagnetic radiation due to a substation located at place of work", EMFacts Consultancy, Feb. 1999. http://www.emfacts.com/download/The_Ross_House_Electrical_Substation.pdf

[25] ES Altpeter et al, Study on Health Effects of the Shortwave Transmitter Station of Schwarzenburg, Berne, Switzerland, The Federal Office of Energy, *BEW Publication Series* Study No. 55, Aug. 1995.

[26] N. Cherry, Swiss shortwave transmitter study sounds warning, *Electromagnetics Forum*, Vol. 1, No. 2, Article 10, http://www.emfacts.com/forum/issue2/mag_9.html

[27] L. Slesin, More on the Swiss Shortwave Transmitter study, *Microwave News*, Sept/Oct 1996, page 14

recognition that EMF and RF fields exposure may be an underlying case of a patient's disease process[28] (Appendix U).

Summing up, it is my view on EHS that :

- There can be an element of the nocebo effect in EHS but this doesn't rule out the possibility that it is a real ailment caused by chronic EMF or RF exposure at non-thermal levels.
- Limiting the definition of EHS to people who have self identified themselves as electrosensitive is over restrictive as it ignores the possibility that there may also be people who have the symptoms of EHS but have no idea what is causing their ill health.
- The provocation study assumption that if people have EHS they should be able to feel when they are being exposed is very questionable. From my observations this is generally not the case.
- It is more likely than not that some the symptoms being reported by people after smart meters have been installed on their homes may be the result of RF exposure and not the result of psychological factors.
- Considering the numbers if smart meters now being rolled out in Canada, urgent research to clarify the EHS controversy in relation to smart meter emissions is called for.

7. Do you agree with Fortis' response to CSTS IR#1 - 7.1 as set out:

7.1 Would Fortis BC expect the referenced customer health concerns to exist with respect to non-RF communication technology?
Response:
FortisBC does not consider that there are health concerns founded on accepted science regardless of whether the AMI system uses RF or non-RF technology.

DM Response #7: I disagree. FortisBC is relying on assurances of safety based on the accepted science literature base that only considers thermal effects from acute exposures as the only established adverse health effect. As smart meters cannot give acute exposures there will be no thermal biological effect. As for possible non-thermal effects that is the big uncertainty that can only be clarified by focused research and not just relying on past research that is irrelevant to the issue.

8. Fortis' response to CSTS IR#2, question 20.2 is set out as follows:
20.2 What is meant by "the relevant scientific literature"? How has relevance been determined?
Response: FortisBC was aware of scientific literature on the topic of radiofrequency fields and health summarized by Health Canada and provincial health and regulatory authorities. Relevance was determined by the frequency range of radiofrequency signals associated with the FortisBC advanced meters.
In your view, does Fortis' awareness of "scientific literature on the topic of radiofrequency fields and health summarized by Health Canada and provincial health and regulatory authorities" constitute an awareness of the relevant scientific literature?

DM Response #8: This has largely been answered in my previous responses in this paper. The "relevant scientific literature" is only relevant for thermal effects. The

[28] AAEM, July 11, 2012, http://aaemonline.org/AAEMEMFmedicalconditions.pdf

range and consistency of ill-health effects from smart meters now being reported in Canada and internationally may constitute what Safety Code 6 has termed "unexpected and unique problems". In this situation the Code acknowledges that "blind adherence to rules cannot substitute for the exercise of sound judgment". FortisBC appears to be relying on blind adherence to rules that may be not suitable for this particular health controversy.

9. What comments do you have, if any, regarding Fortis' response to CSTS IR#2, question 21.1, in terms of its reference to "grossly similar" "laboratory studies"?

DM Response #9: I do not consider the term "grossly similar" to be a valid scientific term. In order to determine if there is a particular feature of human exposure to smart meter emissions such as frequency of emissions, a replication of smart meter emissions would have to be achieved to determine if there is something "unexpected and unique" with these emissions. This calls for focused research and not just looking back at previous research that may not be relevant, as I have stated preciously. I note that FortisBC refers back to the Exponent report in reference to those 'grossly similar" studies where Exponent claims that they are aware of *"laboratory studies that have involved exposures to RF signals of similar frequencies, on/off 'speeds', and generally higher intensities and longer duration duty cycles."*
I would like to see the original references to all these studies that Exponent is aware of in order to verify if they are at all relevant to smart meter emissions. I question the relevance of studies using higher intensity exposures and longer duty cycles to smart meter emissions.

10. What comments do you have, if any, regarding Fortis' failure to provide copies of the studies referenced in the Exponent Report for reason of copyright, as reference in Fortis' response to CSTS IR#1, question 25.0 as follows:
25.1 Produce a digital PDF copy of each and every report, review and/or study referenced and/or discussed in the Exponent report. Response:
Copies of published scientific papers cannot be distributed because of copyright restrictions. Links to publically available studies and to abstracts of studies (in the Pub Med data base) subject to copyright are provided below...

DM Response #10: I agree with FortisBC that published scientific papers are subject to copyright restrictions and so the proper way to provide the information is by referencing the paper and journal, or providing an abstract/link.

11. What comments, if any, do you have in relation to Fortis' response to CSTS IR#2 question 22.1 with respect to Fortis' statement that it "has not considered following an unofficial 'standard' that has not been accepted by Health Canada or provincial health agencies"?

DM Response #11: The problem here is that FortisBC is bound to follow national official standards, such as Safety Code 6. Ultimately it is the responsibility of Health Canada, as a public health agency, to consider adopting alternative standard recommendations, and base their own recommendations on an objective assessment of the science. That is not the responsibility of FortisBC.

12. What comments, if any, do you have in relation to Fortis' response to CSTS IR#2 question 23.1, with respect to the statement:
This minority opinion is not shared by scientists who have performed reviews for national and international health and scientific agencies as explained in the

response to 1.1.1.2.

DM Response #12: This question is largely addressed in my Response #3.

From what I have seen in my examination of many of these expert review committees, especially ICNIRP, membership is not an open process. Members are selected according to their adherence to the prevailing viewpoint that the only established health consideration that can be given in RF standards is protection against heating from short-term, acute RF exposures. Until the standard setting process is opened up to include other perspectives this viewpoint will prevail.

13. What comments do you have, if any, regarding Fortis' response to CSTS IR#2, question 25.1?

DM Response #13: This is answered in my Response #3 and directly above for the Exponent statement "These studies [non-thermal findings] have been reviewed by scientific and regulatory agencies, which have not accepted this data as reliable…"

14. What comment if any do you have to Fortis' response to CSTS IR#2 - 43.1 as set out:
43.1 Has FortisBC studied any independent, peer reviewed, non- industry funded studies of the research on non-ionizing RF radiation and its biological effects? If so, which studies?
Response: FortisBC has not undertaken its own interpretation of individual studies; rather FortisBC relies upon regulations, e.g., Health Canada's Safety Code 6, and guidance from Health Canada and British Columbia including the Provincial Health Services Authority, the BC Centre for Disease Control, and the BC Cancer Agency that have reviewed and considered published research literature on radiofrequency fields and health. The conclusions of these sources regarding radiofrequency fields and health are similar to those of other national and international health agencies.

DM Response #14: FortisBC, being a private corporation with its prime allegiance being to its investors, is only obliged to follow the relevant Canadian RF standards. Until these standards are changed it is unrealistic to expect FortsBC to do anything further. I keep coming back to the standard setting bodies. That is where change must happen and it is not the role of FortisBC to undertake its own assessment.

15. What comments do you have, if any, regarding Fortis' response to CSTS IR#2, question 44.1, regarding the utility of *in vitro* studies?

DM Response #15: On this point I agree with Exponent, ICNIRP and AGNIR that animal and human studies are of more relevance than in vitro studies for the question at hand: Is there an adverse biological effect from smart meter emissions? However, rather than limit the scientific inquiry to just going over and over the past RF literature base to try to get answers, what is needed is new and focused research. I will address this further in my conclusions.

16. What comments do you have, if any, regarding Fortis' response to CSTS IR#2, question 44.4 as set out?
44.4
Does exposure assessment, as discussed in the Exponent Report at pages 8, 9 & 47, take into consideration cumulative effects of prolonged exposure to low doses?

Response:
The evaluation of potential health effects of any exposure considers the duration of exposure with regard to the potential for biological changes or health effects to evolve over time. Safety Code 6 addresses the potential cumulative build-up of heat in tissues by time-averaging exposure to radiofrequency fields and so prevents adverse effects of exposure.

DM Response #16: FortisBC does not answer the question. The question is whether or not the Exponent report's mention of exposure assessment takes into consideration "cumulative effects of prolonged exposure to low doses". This is referring to possible non-thermal bioeffects at levels too low to cause heating of tissue.

FortisBC's reply is to refer to Safety Code 6, which is relevant to avoiding thermal effects at acute exposure levels, not "cumulative effects of prolonged exposure to low doses". In addition, Safety Code 6's method of using a 6-minute time average for exposure is not suitable for smart meter emissions since the transient RF spikes that are constantly being emitted by an active smart meter (See table 1) are smoothed out by averaging over 6 minutes - thus eliminating the assessment of maximum peak exposures. If there are unique health effects from smart meter emissions, it might be from those brief but frequent peak exposures. Having said that, however, FortisBC, as mentioned previously, is not obliged to consider possible effects outside of Safety Code 6.

17. What comments do you have, if any, regarding Fortis' response to CSTS IR#2, questions 44.7 and 44.8?
44.7: "Research has not indicated that some people are more vulnerable to the effects of RF exposure than others at levels below the recommended exposure limits. The guidelines that recommend exposure limits have been based on known effects on people, identifying levels where effects are minor, and then further reducing these effects for additional assurance of safety."
44.8: "Children are not more vulnerable to the potential effects of RF exposure at levels below the guidelines. The guidelines have factored in the relative size of children compared to adults. Potential exposures from the proposed AMI meters are far below the recommended exposure limits."

DM Response #17: Fortis' 44.7 response is only relating to known thermal effects at high level exposures, not possible cumulative non-thermal effects. The "assurance of safety" only assures that emissions from a smart meter will not be acute enough to cause thermal biological damage.

44.7: This statement is at odds with the expert opinion of the International Agency for Research on Cancer (IARC) in 2011 when it classified RF radiation as possibly carcinogenic to humans (Group 2B). In its review of the literature the IARC noted, in relation to children's use of mobile phones, that *"when used by children, the average RF energy deposition is two times higher in the brain and up to ten times higher in the bone marrow of the skull, compared with mobile phone use by adults"*[29] (Appendix V).

In 1996 researcher Om Gandhi showed clear evidence that children are exposed to

[29] R.Baan , Y.Grosse ,B. Lauby-Secretan, F.El Ghissassi ,V.Bouvard, L.Benbrahim-Tallaa, N.Guha, F Islami, L.Galichet, K Straif, "Carcinogenicity of Radiofrequency Electromagnetic Fields," *The Lancet Oncology*, June 22, 2011, http://www.thelancet.com/journals/lanonc/article/PIIS1470-2045(11)70147-4,

higher levels of microwaves from cell phones than adults[30] (Appendix W). Figure 1 in his paper show a 5 year old and 10 year old child to have higher Specific Absorption rates (SARs) than adults[31] (Appendix X). For Fortis' to state that "children are not more vulnerable to the potential effects of RF exposure at levels below the guidelines" is not based on the science. The evidence clearly shows that children are receiving higher SAR levels than adults, to state that children are not more vulnerable is untrue.

Conclusions

In my opinion the central issue in the current controversy over the roll-out of FortisBC's AMI "smart meters" revolves around the level of health protection provided in Safety Code 6. This then brings into the discussion similar RF standards that use the same historical literature base (IEEE C95.1 and ICNIRP's RF guidelines) to justify limiting that protection to avoiding established biological damage (tissue heating) from acute exposures. As I have outlined in this statement, the emissions from smart meters, in some situations depending upon the location of the meters in homes, may constitute a possible health hazard that is "unexpected and unique" and where "blind adherence to rules cannot substitute for the exercise of sound judgment." (Quoting from Safety Code 6.)

However, the responses from FortisBC to date firmly support the thermally based standards despite a substantial body of peer reviewed and published research data that questions the relevance of those standards to the smart meter issue.

In my opinion little is to be gained here by continuing to go over the well-worn path of what the standards term "Established effects"(thermal). With the planned roll out of smart meters in many countries, and the number of people who may be exposed, innovative new focused research seems to be an essential requirement to clarify if all those anecdotal ill-health reports are just the result of fear of new technology, or the result a new and unique exposure - or perhaps both.

I have roughly outlined a research proposal that might go a long way to bring some resolution to the controversy and that is included in Appendix Y.

Whatever further information that may be needed from me I am happy to do my best to provide.

Donald Maisch PhD

January 22, 2013

[30] O. Gandhi, Electromagnetic absorption in the head and neck for mobile telephones at 835 and 1900 MHz, *Microwave Theory and Techniques, IEEE Transactions*, Vol. 44, Issue 10, Oct. 1996, pp.1884-1897.
[31] L. Slesin, Children and Cell Phones: Time To Start Talking Sense, Microwave News, May 3, 2010, http://microwavenews.com/children.adults.html

APPENDIX A

Thermoregulatory responses to RF energy absorption

Bioelectromagnetics (January 2003), 24 (S6), pg. S17-S38
Eleanor R. Adair; David R. Black

Abstract

Link: http://journals2.scholarsportal.info/details.xqy?uri=/01978462/v24is6/s17_trtrea.xml

This white paper combines a tutorial on the fundamentals of thermoregulation with a review of the current literature concerned with physiological thermoregulatory responses of humans and laboratory animals in the presence of radio frequency (RF) and microwave fields. The ultimate goal of research involving whole body RF exposure of intact organisms is the prediction of effects of such exposure on human beings. Most of the published research on physiological thermoregulation has been conducted on laboratory animals, with a heavy emphasis on laboratory rodents. Because their physiological heat loss mechanisms are limited, these small animals are very poor models for human beings. Basic information about the thermoregulatory capabilities of animal models relative to human capability is essential for the appropriate evaluation and extrapolation of animal data to humans. In general, reliance on data collected on humans and nonhuman primates, however fragmentary, yields a more accurate understanding of how RF fields interact with humans. Such data are featured in this review, including data from both clinic and laboratory. Featured topics include thermal sensation, human RF overexposures, exposures attending magnetic resonance imaging (MRI), predictions based on simulation models, and laboratory studies of human volunteers. Supporting data from animal studies include the thermoregulatory profile, response thresholds, physiological responses of heat production and heat loss, intense or prolonged exposure, RF effects on early development, circadian variation, and additive drug–microwave interactions. The conclusion is inescapable that humans demonstrate far superior thermoregulatory ability over other tested organisms during RF exposure at, or even above current human exposure guidelines. Bioelectromagnetics Supplement 6:S17–S38, 2003. Published 2003 Wiley-Liss, Inc.

10.1002/bem.10133

APPENDIX B

FDA Letter Regarding Cellular Phones (COVER PAGE ONLY)

Link: http://www.osha.gov/SLTC/radiofrequencyradiation/fda.html

DEPARTMENT OF HEALTH & HUMAN SERVICES Public Health Service
Food and Drug Administration Rockville MD 20857

May 5, 1997

The Honorable Edward J. Markey Ranking Minority Member Subcommittee on Telecommunications, Trade, and Consumer Protection Committee on Commerce
House of Representatives Washington, D.C. 20515 - 2107
Dear Mr. Markey:

This is in response to your letter of April 7, 1997, regarding the status of the Food and Drug Administration's (FDA) oversight and investigation of wireless communication health effects.

Little is known about the possible health effects of repeated or long-term exposure to low levels of radiofrequency radiation (RFR) of the types emitted by wireless communications devices. Indeed, much controversy exists within the scientific community regarding the potential for health effects from any type of low-intensity RFR.

RFR extends from approximately a few kilohertz (kHz) to 300 gigahertz (GHz) on the electromagnetic spectrum. Cellular phones emit RFR at a frequency of about 824-915 megahertz (MHz). The new Personal Communications Systems (PCS) emit at 1850-1910 MHz. In addition, radar systems emit in a band of 100 MHz and 100 GHz. Many other consumer products emit in this range, e.g., AM radios around 1 MHz, CB radios at 27 MHz, televisions at 50-500 MHz and above, and microwave ovens at 2450 MHz (2.45 GHz). Each frequency may have unique properties in terms of potential bioeffects and it may not be possible to extrapolate results found at one frequency with those of another.

The Center for Device and Radiological Health's (CDRH) specific involvement with cellular phones began in early 1993 when the issue of brain cancer and its possible association with cellular phone use was raised via a nationally televised interview with a man who attributed his wife's death from brain cancer to her frequent use of a cellular telephone. In early 993, CDRH requested several meetings with industry to discuss the inadequacy of the data that exists with which to evaluate claims of health risks such as cancer. At the meetings, CDRH presented the need for properly credentialed research, proper labeling, and possible redesigns to address the issues related to potential bioeffects from the radiofrequency energy emitted by hand-held cellular phones. Industry groups represented at the meeting were manufacturers and distributors of cellular phones, communications firms, and related trade associations. In response to an industry request that Federal agencies play a role in directing the necessary research, CDRH offered to explore the possibility of working under a Cooperative Research and Development Agreement. This agreement was ultimately not accepted by the Cellular Telecommunication Industry Association (CTIA) so CDRH's role in the industry program became an advisory one.

The overall industry effort has since evolved to the current program manager by Wireless Technology Research, L.L.C. (WTR), which is funded by industry through a blind trust arrangement. WTR published its research agenda and requests for proposals (RFP) in 1994 and 1995. CDRH discussed detailed comments on the RFP with Dr. George Carlo, Chairman of WTR, and his colleagues from WTR.

As a result of the oversight briefing with the Subcommittee you chaired in February 1993, the Environmental Protection Agency (EPA), together with CDRH, the National Institute for Occupational Safety and Health (NIOSH), the Occupational Safety and Health Administration (OSHA), the Federal Communications Commission (FCC), and the National Telecommunications Information Agency (NTIA) reconstituted a Radiofrequency Inter-Agency Work Group (RFIAWG) in August 1994 to coordinated issues of concern to these agencies, including monitoring RFR from wireless communication. This group has been instrumental in providing a coordinated Federal response to industry's research as recommended in the 1994 GAO Report entitled, "Status of Research on the Safety of Cellular Phones."

WTR met with representatives of the RFIAWG in 1995 and 1996 for the purpose of discussing details

of the WTR research plans and progress. In a March 13, 1997 letter (TAB A), CDRH communicated a statement of RFIAWG research priorities to WTR. CDRH solicited input from the RFIAWG in responding to your specific questions.

Most of the studies of RFR in the published literature have investigated the biological effects of exposure to radiofrequency radiation characteristic of radar or microwave ovens. Many of the published studies involve acute exposure of animals or cells in vitro to short, intense RFR doses which do not use the frequencies or modulations used for cellular phones. Cellular phone exposures are at lower RFR doses and, due to frequent cellular phone use, are chronic. Higher does exposures are thought to produce effects as a result of increased temperature. It is not known whether lower doses produce bioeffects through non-thermal mechanisms or whether they produce cumulative effects. We have included a summary of some recent studies in the enclosed Appendix.

APPENDIX C

DEPARTMENT OF HEALTH AND HUMAN SERVICES
Public Health Service

National Institute for Occupational
Safety and Health
Robert A. Taft Laboratories
4676 Columbia Parkway
Cincinnati OH 45226-1998

Mr. Richard Tell Chair, IEEE SCC28 (SC4)
Risk Assessment Work Group
Richard Tell Associates, Inc.
8309 Garnet Canyon Lane
Las Vegas, NV 89129-4897

Dear Mr. Tell:

The members of the Radiofrequency Interagency Work Group (RFIAWG) have identified certain issues that we believe need to be addressed to provide a strong and credible rationale to support RF exposure guidelines. I am writing on behalf of the RFIAWG members to share these ideas with you and other members of the IEEE SCC28, Subcommittee 4 Risk Assessment Work Group. Our input is in response to previous requests for greater partic ipation on our part in the SCC28 deliberations on RF guidelines. The issues, and related comments and questions relevant to the revision of the IEEE RF guidelines, are given in the enclosure. No particular priority is ascribed to the order in which the issues are listed.

The views expressed in this correspondence are those of the members of the Radiofrequency Interagency Work Group and do not represent the official policy or position of the respective agencies.

The members of the RFIAWG appreciate your consideration of our comments and welcome further dialog on these issues. Feel free to contact me or any member of the RFIAWG directly. A list of the members of the RFIAWG is enclosed, with contact information for your use.

Sincerely yours,

W. Gregory Lotz, Ph.D.
Chief, Physical Agents Effects Branch
Division of Biomedical and
Behavioral Science

Enclosures (2)
cc: N. Hankin
J. Elder
R. Cleveland
R. Curtis
R. Owen
L. Cress
J. Heale

RF Guideline Issues

Identified by members of the federal RF Interagency Work Group, June 1999

Issue: Biological basis for local SAR limit

The C95.1 partial body (local) exposure limits are based on an assumed ratio of peak to whole body SAR; that is, they are dosimetrically, rather than biologically based. Instead of applying a dosimetric factor to the whole body SAR to obtain the local limits, an effort should be made to base local SAR limits on the differential sensitivity of tissues to electric fields and temperature increases. For example, it seems intuitive that the local limits for the brain and bone marrow should be lower than those for muscle, fat and fascia; this is not the case with the current limits which implicitly assume that all tissues are equally sensitive (except for eye and testicle). If no other data are available, differential tissue sensitivity to ionizing radiation should be considered.

If it is deemed necessary to incorporate dosimetric factors into the resulting tissue-specific SAR limits these should be based on up-to-date dosimetric methods such as finite-difference time-domain calculations utilizing MRI data and tissue-specific dielectric constants. For certain exposure conditions FDTD techniques and MRI data may allow better simulation of peak SAR values. Consideration should be given to the practical tissue volume for averaging SAR and whether this volume is relevant to potential effects on sensitive tissues and organs.

Issue: Selection of an adverse effect level

Should the thermal basis for exposure limits be reconsidered, or can the basis for an unacceptable/adverse effect still be defined in the same manner used for the 1991 IEEE guidelines? Since the adverse effect level for the 1991 guidelines was based on acute exposures, does the same approach apply for effects caused by chronic exposure to RF radiation, including exposures having a range of carrier frequencies, modulation characteristics, peak intensities, exposure duration, etc., that does not elevate tissue temperature on a macroscopic scale?

Selection criteria that could be considered in determining unacceptable/adverse effects include:

a) adverse effects on bodily functions/systems
b) minimal physiological consequences
c) measurable physiological effects, but no known consequences

If the adverse effect level is based on thermal effects in laboratory animals, the literature on human studies (relating dose rate to temperature elevation and temperature elevation to a physiological effect) should be used to determine if the human data could reduce uncertainties in determination of a safety factor.

Issue: Acute and chronic exposures

There is a need to discuss and differentiate the criteria for guidelines for acute and chronic exposure conditions. The past approach of basing the exposure limits on acute effects data with an extrapolation to unlimited chronic exposure durations is

problematic. There is an extensive data base on acute effects with animal data, human data (e.g. MRI information), and modeling to address thermal insult and associated adverse effects for acute exposure (e.g., less than one day). For lower level ("non-thermal"), chronic exposures, the effects of concern may be very different from those for acute exposure (e.g., epigenetic effects, tumor development, neurologic symptoms). It is possible that the IEEE RF radiation guidelines development process may conclude that the data for these chronic effects exist but are inconsistent, and therefore not useable for guideline development. If the chronic exposure data are not helpful in determining a recommended exposure level, then a separate rationale for extrapolating the results of acute exposure data may be needed. In either case (chronic effects data that are useful or not useful), a clear rationale needs to be developed to support the exposure guideline for chronic as well as acute exposure.

Issue: <u>One tier vs two tier guidelines:</u>

A one tier guideline must incorporate all exposure conditions and subject possibilities (e.g., acute or chronic exposure, healthy workers, chronically ill members of the general public, etc.). A two tier guideline, as now exists, has the potential to provide higher limits for a specific, defined population (e.g., healthy workers), and exposure conditions subject to controls, while providing a second limit that addresses greater uncertainties in the data available (about chronic exposure effects, about variations in the health of the subject population, etc.). A greater safety factor would have to be incorporated to deal with greater uncertainty in the scientific data available. Thus, a two-tier guideline offers more flexibility in dealing with scientific uncertainty, while a one-tier guideline would force a more conservative limit to cover all circumstances including the scientific uncertainties that exist.

Issue: <u>Controlled vs. uncontrolled</u> (applicability of two IEEE exposure tiers)

The current "controlled" and "uncontrolled" definitions are problematic, at least in the civilian sector, particularly since there are no procedures defined in the document to implement the "controlled" condition. The new guidelines should offer direction for the range of controls to be implemented and the training required for those who knowingly will be exposed (e.g. workers), along the lines of the existing ANSI laser safety standards. This essential element needs to be included for whatever limits are defined, be they one-tier or two-tier. For example, the OSHA position is that the "uncontrolled" level is strictly an "action" level which indicates that there is a sufficiently high exposure (compared to the vast majority of locations) to merit an assessment to determine what controls and training are necessary to ensure persons are not exposed above the "controlled" limit. Many similar "action" levels are part of OSHA and public health standards.
Should this interpretation be incorporated into the IEEE standard as a means to determine the need to implement a safety plan? [The laser standard has a multi-tiered (Class I, II, III, IV) standard which similarly requires additional controls for more powerful lasers to limit the likelihood of an excess exposure, even though the health effect threshold is the same.]

On the other hand, if it is determined that certain populations (due to their health status or age) are more susceptible to RF exposures, then a multi-tiered standard,

applicable only to those specific populations, may be considered.

The ANSI/IEEE standard establishes two exposure tiers for controlled and uncontrolled environments. The following statement is made in the rationale (Section 6, page 23): "The important distinction is not the population type, but the nature of the exposure environment." If that is the case, consideration should be given to providing a better explanation as to why persons in uncontrolled environments need to be protected to a greater extent than persons in controlled environments. An uncontrolled environment can become a controlled environment by simply restricting access (e.g., erecting fences) and by making individuals aware of their potential for exposure. After such actions are taken, this means that the persons who previously could only be exposed at the more restrictive uncontrolled levels could now be exposed inside the restricted area (e.g., inside the fence) at controlled levels.

What biologically-based factor changed for these people? Since the ostensible public health reason for providing greater protection for one group of persons has historically been based on biological considerations or comparable factors, it is not clear why the sentence quoted above is valid.

Issue: Uncertainty factors

The uncertainties in the data used to develop the guideline should be addressed. An accepted practice in establishing human exposure levels for agents that produce undesirable effects is the application of factors representing each area of uncertainty inherent in the available data that was used to identify the unacceptable effect level. Standard areas of uncertainty used in deriving acceptable human dose for agents that may produce adverse (but non-cancer) effects include

(1) extrapolation of acute effects data to chronic exposure conditions,
(2) uncertainty in extrapolating animal data to humans in prolonged exposure situations,
(3) variation in the susceptibility (response/sensitivity) among individuals,
(4) incomplete data bases,
(5) uncertainty in the selection of the effects basis, inability of any single study to adequately address all possible adverse outcomes.

If guidelines are intended to address nonthermal chronic exposures to intensity modulated RF radiation, then how could uncertainty factors be used; how would this use differ from the historical use of uncertainty factors in establishing RF radiation guidelines to limit exposure to acute or sub-chronic RF radiation to prevent heat-related effects?

There is a need to provide a clear rationale for the use of uncertainty factors.

Issue: Intensity or frequency modulated (pulsed or frequency modulated) RF radiation

Studies continue to be published describing biological responses to nonthermal ELF-modulated and pulse-modulated RF radiation exposures that are not produced by CW (unmodulated) RF radiation. These studies have resulted in concern that

exposure guidelines based on thermal effects, and using information and concepts (time-averaged dosimetry, uncertainty factors) that mask any differences between intensity-modulated RF radiation exposure and CW exposure, do not directly address public exposures, and therefore may not adequately protect the public. The parameter used to describe dose/dose rate and used as the basis for exposure limits is time-averaged SAR; time-averaging erases the unique characteristics of an intensity-modulated RF radiation that may be responsible for producing an effect.

Are the results of research reporting biological effects caused by intensity-modulated, but not CW exposure to RF radiation sufficient to influence the development of RF exposure guidelines? If so, then how could this information be used in developing those guidelines? How could intensity modulation be incorporated into the concept of dose to retain unique characteristics that may be responsible for a relationship between exposure and the resulting effects?

Issue: Time averaging

Time averaging of exposures is essential in dealing with variable or intermittent exposure, e.g., that arising from being in a fixed location of a rotating antenna, or from moving through a fixed RF field. The 0.1 h approach historically used should be reassessed, but may serve this purpose adequately. Time averaging for other features of RF exposure is not necessarily desirable, however, and should be reevaluated specifically as it deals with modulation of the signal, contact and induced current limits, and prolonged, or chronic exposure. These specific conditions are discussed in a little more detail elsewhere.

If prolonged and chronic exposures are considered to be important, then there should be a reconsideration of the time-averaging practices that are incorporated into existing exposure guidelines and used primarily to control exposure and energy deposition rates in acute/subchronic exposure situations.

Issue: Lack of peak (or ceiling) limits for induced and contact current

A recent change in the IEEE guidelines allows for 6 minute, rather than 1 second, time-weighted-averaging for induced current limits. This change increases the concern about the lack of a peak limit for induced and contact currents. Will the limits for localized exposure address this issue, i.e., for tissue along the current path?

Issue: Criteria for preventing hazards caused by transient discharges

The existing IEEE recommendation states that there were insufficient data to establish measurable criteria to prevent RF hazards caused by transient discharges. If specific quantitative criteria are still not available, can qualitative requirements be included in the standard to control this hazard (e.g., metal objects will be sufficiently insulated and/or grounded, and/or persons will utilize sufficient insulating protection, such as gloves, to prevent undesirable transient discharge.)?

Issue: Limits for exposure at microwave frequencies

Concerns have been expressed over the relaxation of limits for continuous exposures at microwave frequencies above 1500 MHz. The rationale provided in the current

guideline (Section 6.8) references the fact that penetration depths at frequencies above 30 GHz are similar to those at visible and near infrared wavelengths and that the literature for skin burn thresholds for optical radiation "is expected to be applicable." The rationale then implies that the MPE limits at these high frequencies are consistent with the MPE limits specified in ANSI Z136.1-1986 for 300 GHz exposures. This is apparently the rationale for "ramping up" to the MPE limits for ***continuous*** exposure of 10 mW/cm2 at frequencies above 3 GHz (controlled) or 15 GHz (uncontrolled). The rationale should be given as to why this ramp function has been established at relatively low microwave frequencies (i.e., 1500 MHz and above), rather than being implemented at higher frequencies that are truly quasi-optical. For example, one option could be two ramp functions, one beginning at 300 MHz, based on whole- or partial-body dosimetry considerations, and another at higher frequencies (say 30-100 GHz) to enable consistency with the laser standard. Such a revision should help reduce concern that the standard is not restrictive enough for continuous exposures at lower microwave frequencies where new wireless applications for consumers could make this an issue in the future.

Issue: Replication/Validation

Published peer-reviewed studies that have been independently replicated/validated should be used to establish the adverse effects level from which exposure guidelines are derived. The definition of "replicated/validated" should not be so restrictive to disallow the use of a set of reports that are scientifically valid but are not an exact replication/validation of specific experimental procedures and results.

Peer-reviewed, published studies that may not be considered to be replicated/validated, but are well done and show potentially important health impacts provide important information regarding uncertainties in the data base used to set the adverse effect level (e.g., incomplete data base).

Issue: Important Health Effects Literature Areas:

Documentation should be provided that the literature review process included a comprehensive review of the following three areas:

1) long-term, low-level exposure studies (because of their importance to environmental and chronic occupational RFR exposure);
2) neurological/behavioral effects (because of their importance in defining the adverse effect level in existing RFR guidelines); and
3) micronucleus assay studies (because of their relevance to carcinogenesis).

Issue: Compatibility of RFR guidelines

Compatibility of national and international RFR guidelines remains a concern. It is important for the IEEE Committee to address this issue by identifying and discussing similarities and differences in a revised IEEE guideline and other RFR guidelines. Compatibility/noncompatibility issues could be discussed in the revised IEEE guideline or as a companion document distributed at the time the revised IEEE guideline is released to the public.

APPENDIX D

Excerpts from The Procrustean Approach: Setting Exposure Standards for telecommunications Frequency Electromagnetic radiation (2010)

Chapter 3 The Development of the IEEE C95.1 RF standard

The weight of evidence approach was used for the [C95.1] standard development. This process includes evaluation of the quality of test methods, the size and power of the study designs, the consistency of results across studies, and the biological plausibility of dose-response relationships and statistical associations.

IEEE RF Safety Standard: Statement from the Inter-American Telecommunication Commission, Organisation of American States, June 2007

The overwhelming [scientific] community commitment to thermal thinking severely limited the creativity of RF bioeffects research. Rather than attempting to learn from reports of athermal effects, the RF bioeffects community by and large devoted most of its attention to clarifying and proving what it already knew or to disproving claims believed to be false. This approach to research encouraged a single-mindedness that rigidly adhered to the thermal solution, a single-mindedness that can be seen in responses formulated when athermal effects were reported.

Nicholas Steneck in *The Microwave Debate*, 1984

Overview

Any analysis on the development of the U.S. RF standard, now under the auspices of the Institute of Electrical and Electronics Engineers (IEEE), would be remiss if it did not acknowledge the significant contribution to the debate by Nicholas Steneck, Director of the Research Ethics and Integrity Program at the Michigan Institute for Clinical and Health Research. Steneck is also Professor Emeritus of History at the University of Michigan and a consultant to the U.S. Federal Office of Research Integrity, Department of Health and Human Services. In 1980 Steneck and colleagues published in *Annals of Science* an analysis of the early research on microwave radiation and in 1984 Steneck published his seminal work, *The Microwave Debate,* that was a case study on the unfolding RF debate over the safety of radiofrequency and microwave technology and the problems involved in assessing and managing possible technological hazards. He raised important questions over conflicting values, the influence of vested interests in influencing the direction of the debate, and the role of scientific uncertainty as it was unfolding in the development and marketing of RF emitting technology. However, Steneck's 1984 analysis stopped before the advent of the mobile phone revolution which had a significant impact on standards development. It also was not able to explore the important later developments on the internationalization of RF standards through the IEEE, the World Health Organisation's International EMF Project (IEMFP) and the International Commission on Non Ionizing Protection (ICNIRP). Another influential books at the time, *The Zapping of America* (1977), *Currents of Death* (1989) and *The Great Power-Line Cover-Up* (1993) by Paul Brodeur played a large part in bringing the public's attention to the microwave controversy but Brodeur's thesis has come under much criticism, including comments from Steneck over shortcomings in Brodeur's analysis and physicist Robert Park (examined later in this chapter). This Chapter draws on Steneck's 1984 work for the early U.S. standard developments because, in this author's opinion, it is the most reliable source available and covers a great deal of historical data not covered in the IEEE's historical review of the standard development.

Another important source of information on U.S. RF standards development used in this chapter is the New York City based newsletter *Microwave News*, edited by Louis Slesin PhD. This newsletter, published bi-monthly, has covered the RF debate since

1981 with extensive personal interviews with the people directly involved in the debate, and direct attendance to a large number of RF related conferences. It has been recognized as a fair and knowledgeable source of information that is not connected with industry or government agencies. Slesin, however, is not without his detractors, for example, physicist Robert Park claimed in his book *Voodoo Science* that *Microwave News* "had given the public a seriously distorted view of the scientific facts". Park's viewpoint needs to be understood in light of his physicist's understanding that while ionising radiation packs enough energy to break chemical bonds and thereby cause DNA damage, non-ionizing radiation does not have sufficient energy to do this. Therefore, according to Park, hazardous EMF biological effects below acute thermal interactions are an impossibility and anyone who claims differently is dabbling in Voodoo Science. [1]In 2003 *Microwave News* ceased a print form of its newsletter to be replaced with an Internet site. *Microwave News* is important for an analysis of the RF debate because much of the detailed information contained in the newsletter is not available elsewhere.

The central feature in the development of the American radiofrequency and microwave (RF/MW - hereafter referred to as RF) exposure standard, from the establishment of the American Standards Association C95 Committee in 1960 to the current C95.1 RF standard sponsored by the Institute of Electrical and Electronics Engineers (IEEE), has been that the only hazardous biological effect[2] from RF exposure to humans is tissue heating at high level exposure. The basis for this concept arose from previous medical experience with the use of RF as a therapeutic medium that was considered at the time to have beneficial effects through selectively heating human tissue. When a number of adverse health effects from RF emitting apparatus were observed, it seemed reasonable to attribute them to excessive heating of tissue from over-exposure to RF. By the mid 1930s the prevailing medical view was that the only biological effect of RF physical therapy (diathermy) treatments was tissue heating and that claims for other biological effects that were not related to heat were without foundation. This concept, or the "thermal-effects-only" school of thought, was given further scientific validity in the 1950s through the writings of Biophysicist Herman Schwan whose calculations indicated that an RF level of 10 milliWatts per square centimetre (10mW/cm2) was a safe level of exposure to avoid excessive tissue heating. This level was adopted by the U.S. Air Force (USAF) and later became the basis for the first American National Standards Institute (ANSI) C 95.1 RF standard of 1966. Acceptance of the thermal concept was also significantly boosted by the emerging Cold War between the U.S. and the Soviet Union.

In 1957 the Soviet Union had a number of spectacular satellite launches that translated into a capability to launch nuclear missiles deep into America. This presented the U.S. military with an urgent imperative to develop high power early warning radar systems to be able to detect a possible Soviet attack. This coincided with the first military RF research program in America, the Tri-Services Program (1957-1960) which essentially had the task establishing 'ground rules' for the development of worker and personnel RF exposure standards that would not threaten the development of new high-power radar systems. By the conclusion of the Tri-Services Program Schwan's 10mW/cm2 thermal limit had been accepted by the majority of interested parties, (the military and manufacturers)

as the only scientifically justifiable end-point for standard setting. Subsequent standards development, under the later sponsorship of the industry body, the IEEE, continued the work of further refining the understanding of thermal interactions with human tissue. This also saw the increasing exclusion of any other possible interactions not related to heating as outside the realm of accepted science used in standard setting.

It is important to note that this discussion on the development of the IEEE C95.1 RF standard is not intended to be a critique of the validity of the scientific data-base that underlies the standard. What can be said in defence of C95.1 is that its data base is quite extensive and well researched in relation to the known and well established thermal biological effects of exposure to RF, based on over half a century of laboratory animal research. In this respect C95.1 provides a useful purpose in providing a significant level of protection against thermal biological damage from acute short-term exposures. In its latest (2003) review of over 1,300 research papers the scientific committee overseeing IEEE C95.1 set out a number of "guiding principles" that they followed in their evaluation of the scientific literature base in setting exposure limits. They concluded, in part, that the thermal effect is the only established adverse effect and that only this should be used to base maximum exposure limits on. In relation to non-thermal RF biological effects the committee considered they were not established.

This chapter explores reasons why the thermal paradigm came to be the primary focus in RF standard setting while other possible biological effects were arbitrarily rejected for reasons other than scientific quality control. Seen in the development of the IEEE C95.1 RF standard are how military and corporate interests (users and makers of the technology) were able to assume control over the standard setting debate right from the very beginning and establish faulty risk assessment and science evaluation procedures. These were to their mutual benefit to assure that setting exposure limits would never become a threat to the development of new RF emitting technology, be it for military or commercial purposes.

The contribution of this chapter to the RF standard setting debate is to use the C.95.1 standard development process to argue that hazard risk assessments did not fully evaluate the scientific literature or "weight of evidence" for standard setting in situations where organisations responsible for the creation of the risk to be regulated, effectively control the process. This can also apply to other environmental issues with the central problem on how ensure that conflicts of interest do not bias regulatory outcomes remaining unresolved.

[1] Park, 2000, *Voodoo Science, The Road from Foolishness to Fraud*, Oxford Univ. Press, Chapter 7, Currents of Fear pp. 140-161. [2] Other than obvious electroshock and burns from direct contact with a high power RF transmitting source. See: M. Stock, 'Technical Note 124: RF Shock and Burn: Notes from the research side', LBA Group, http://www.lbagroup.com/associates/lbatn124.php , accessed Feb 4, 2009.

Conclusions from Chapter 3 of the Procrustean Approach: The Development of the IEEE C95.1 RF standard.

Common to all the standards and guidelines examined in this chapter is a scientific assumption that the only hazardous biological effect from RF exposure is thermal in nature. This viewpoint was originally established by just a few individuals charged with setting an American military exposure standard in the 1950s during the Cold War, when the Soviet Union appeared to be winning the nuclear arms race. The

overriding problem confronting standard-setting military planners at the time was the need to provide health protection to personnel developing and working on new high power radar systems while at the same time not restrict the development of the technology that was considered essential for national survival in the event of a possible Soviet nuclear attack. Considering this, and the urgency to quickly come up with a workable standard in the midst of an escalating nuclear arms race, the best fit for addressing the problem was to rely on the already existing medical opinion that had built up since the late 1920s that as long as thermal increases to body temperature were restricted to tolerable limits, no adverse or irreversible biological effects were possible.

Initial exposure standards based on this thermal model fit the planner's problem nicely. Radar development could continue while assurances of safety could be given. Research could be conducted to further understand the thermal-regulatory capacity of the body (both animal and human) when exposed to RF/MW, thus strengthening the literature base that, in turn, supported the standard. Standards could then be updated and refined to provide protection against thermal biological damage without restricting the development of new technology being developed by both the military and private corporations. When there were questions in later years over the standard limits providing adequate protection against newly developed higher frequency technology, such as mobile phones, there was room available to further relax the standard's thermal limits to accommodate increasing exposure levels from that technology. All this was in general agreement with what was historically known about acute RF exposure levels – it could heat up tissue and thereby cause obvious biological damage.

Although early assumptions on RF biological hazards (heating) may be somewhat justified during the 1950s Cold War conflict with the Soviet Union, those assumptions quickly became a paradigm that excluded considerations of possibly adverse biological effects not related to heating. As seen in the ANSI/IEEE C-95.1 – 1996 RF standard, industry concerns over possible cell-phone compliance issues have led to adopting measures that allow increasing the limits in order to accommodate technological operational requirements while relegating research into non-thermal biological interactions with RF as operating on a level of "beliefs and speculations" an therefore being "extra-scientific". This relegates research that questions the thermal paradigm as somewhat tainted and beneath serious consideration.

With members linked to the 'military-industrial complex' firmly in control of the IEEE's RF standards committees right from the beginning, their continuing task was essentially to further refine the thermal paradigm by encouraging research to further add validity to the thermal theory and not to test its basic assumptions. It is apparent that those actively involved in revising the latest 2005 C95.1 standard, writing various research papers for an updated risk-assessment of RF as well as those conducting peer review of papers for consideration have been thoroughly trained in the paradigm to the extent that any other non-thermal biological interactions with RF were well beyond consideration.

This chapter has tracked the development of the IEEE C95.1 RF standard from its foundations in the early 1950s and through various revisions by IEEE standard setting committees to illustrate the continual resistance to acknowledging the

possibility of non- thermal effects in setting exposure limits. This resistance is linked to committee members' ties to industrial and military organizations with a vested interest in maintaining the thermal paradigm. This paradigm has been challenged on a number of occasions by knowledgeable experts and government agencies but without success. As is seen in the various IEEE standards committee meetings the central arguments over standard revisions are technical, such as increasing the averaging volume of tissue to assure cell phones can safely meet compliance testing. These technical changes are seen in the light of working within the thermal paradigm to assure that the standard is always in compliance with the needs of the technology. What is apparent from this continuing situation is that an essential ingredient for the maintenance of the thermal paradigm is for supporters of that paradigm to control the standard setting process through their membership on RF standard setting committees. In this regard, conflict of interest has long been an essential policy to block the possibility of change inimical to those who control the process. The importance of this chapter is to expose the subjective nature of the existing RF standard setting process as it has played out in the U.S.

APPENDIX E

Bioinitiative Report Press Release

University of Albany, New York– August 31 / 2007

Serious Public Health Concerns Raised Over Exposure to Electromagnetic Fields (EMF) from Power Lines and Cell Phones

An international working group of scientists, researchers and public health policy professionals (The BioInitiative Working Group) has released its report on electromagnetic fields (EMF) and health. It raises serious concern about the safety of existing public limits that regulate how much EMF is allowable from power lines, cell phones, and many other sources of EMF exposure in daily life.

Electromagnetic radiation from such sources as electric power lines, interior wiring and grounding of buildings and appliances are linked to increased risks for childhood leukemia and may set the stage for adult cancers later in life. A report from the BioInitiative Working Group (www.bioinitiative.org) released on Friday, August 31, 2007 documents the scientific evidence that power line EMF exposure is responsible for hundreds of new cases of childhood leukemia every year in the United States and around the world.

The report provides detailed scientific information on health impacts when people are exposed to electromagnetic radiation hundreds or even thousands of times below limits currently established by the Federal Communications Commission (US FCC) and International Commission for Non-Ionizing Radiation Protection in Europe (ICNIRP). The authors reviewed more than 2000 scientific studies and reviews, and concluded that the existing public safety limits are inadequate to protect public health. From a public health policy standpoint, new public safety limits, and limits on further deployment of risky technologies are warranted based on the total weigh of evidence.

The report documents scientific evidence raising worries about childhood leukemia (from power lines and other electrical exposures), brain tumors and acoustic neuromas (from cell and cordless phones) and Alzheimer's disease. There is evidence that EMF is a risk factor for both childhood and adult cancers.

Public health expert and co-editor of the Report Dr. David Carpenter, Director, Institute for Health and the Environment at the University of Albany, New York asserts:

"This report stands as a wake-up call that long-term exposure to some kinds of EMF may cause serious health effects. Good public health planning is needed now to prevent cancers and neurological diseases linked to exposure to power lines and other sources of EMF. We need to educate people and our decision-makers that "business as usual" is unacceptable".

Health questions about power line EMFs were initially raised by Nancy Wertheimer, a Colorado public health expert and Ed Leeper, an electrical engineer in 1979. Wertheimer noticed that children were twice or three times as likely to have leukemia tended to live in homes in the Denver, CO area close to power lines and transformers. Now, there are dozens of studies confirming the link, but public health response has been slow in coming, and new standards to protect the public are necessary.

Brain tumor specialist Dr. Lennart Hardell, MD, PhD and Professor at University Hospital in Orebro, Sweden is a member of the BioInitiative Working Group. His work on cell phones, cordless phones and brain tumors is widely recognized to be pivotal in the debate about the safety of wireless radiofrequency and microwave radiation. He states:

"The evidence for risks from prolonged cell phone and cordless phone use is quite strong when you look at people who have used these devices for 10 years or longer, and when they are used mainly on one side of the head".

Brain tumors normally take a long time to develop, on the order of 15 to 20 years. Use of a cell or cordless phone is linked to brain tumors and acoustic neuromas (tumor of the auditory nerve in the brain) and are showing up after only 10 years (a shorter time period than for most other known carcinogens). "This indicates we need research on more long-term users to understand the full risks" says Dr. Hardell.

Dr. Hardell's work has been confirmed in other studies on long-term users. A summary estimate of all studies on brain tumors shows overall a 20% increased risk of brain tumor (malignant glioma) with ten years of use. But the risk increases to 200% (a doubling of risk) for tumors on the same side of the brain as mainly used during cell phone calls. He adds:

"Recent studies that do not report increased risk of brain tumors and acoustic neuromas have not looked at heavy users, use over ten years or longer, and do not look at the part of the brain which would reasonably have exposure to produce a tumor".

Wireless technologies that rely on microwave radiation to send emails and voice communication are thousands of times stronger than levels reported to cause some health impacts. Prolonged exposure to radiofrequency and microwave radiation from cell phones, cordless phones, cell towers, WI-FI and other wireless technologies have linked to physical symptoms including headache, fatigue, sleeplessness, dizziness, changes in brainwave activity, and impairment of concentration and memory. Scientists report that these effects can occur with even very small levels of exposure, if it occurs on a daily basis. Children in particular are vulnerable to harm from environmental exposures of all kinds.

Co-editor of the report, Cindy Sage of Sage Associates states:

"Public health and EMF policy experts have now given their opinion of the weight of evidence. The existing FCC and international limits for public and occupational exposure to electromagnetic fields and radiofrequency radiation are not protective of public health. New biologically-based public and occupational exposure are recommended to address bioeffects and potential adverse health effects of chronic exposure. These effects are now widely reported to occur at exposure levels significantly below most current national and international limits."

Biologically-based exposure standards are needed to prevent disruption of normal body processes. Effects are reported for DNA damage (genotoxicity that is directly linked to integrity of the human genome), cellular communication, cellular metabolism and repair, cancer surveillance within the body; and for protection against cancer and neurological diseases. Also reported are neurological effects including changes in brainwave activity during cell phone calls, impairment of memory, attention and cognitive function; sleep disorders, cardiac effects; and changes in immune function (allergic and inflammatory responses).

Sage says:
"The Working Group recommends a biologically-based exposure limit that is protective against extremely-low frequency (power line) and radiofrequency fields which, with chronic exposure, can reasonably be presumed to result in significant impacts to health and well-being".

Contributing author Dr. Martin Blank, Columbia University professor and researcher in bioelectromagnetics, wrote the section on stress proteins for the BioInitiative Report. He points out:

"Cells in the body react to EMFs as potentially harmful, just like to other environmental toxins, including heavy metals and toxic chemicals. The DNA in living cells recognizes electromagnetic fields at very low levels of exposure; and produces a biochemical stress response. The scientific evidence tells us that our safety standards are inadequate, and that we must protect ourselves from exposure to EMF due to powerlines, cell phones and the like".

A PDF version of this press release is available in PDF at:
www.bioinitiative.org/press_release/index.htm

Report: available at www.bioinitiative.org
Title: BioInitiative: A Rationale for a Biologically-based Public Exposure Standard for Electromagnetic Fields (ELF and RF)

APPENDIX F

ICEMS Monograph: "Non-Thermal Effects and Mechanisms of Interaction Between Electromagnetic Fields and Living Matter"

"Non-Thermal Effects and Mechanisms of Interaction Between Electromagnetic Fields and Living Matter", a monograph edited by Livio Giuliani and Morando Soffritti for the "European Journal of Oncology" – Library Vol. 5 of the National Institute for the Study and Control of Cancer and Environmental Diseases "Bernardo Ramazzini", Bologna, Italy, 2010, Part I and Part II.

Download Part I http://electromagnetichealth.org/wp-content/uploads/2010/11/ramazzini_library5_part1.pdf

Download Part II http://electromagnetichealth.org/wp-content/uploads/2010/11/ramazzini_library5_part2.pd

Excerpt from Summary:

8. Implications of biology for current safety guidelines and test methods

Current guidelines on EMF safety from IEEE and ICNIRP (endorsed by the EU) are only based on short term EMF exposures that are high enough to cause thermal effects. These are inadequate to provide protection to the public against long term effects from lower levels of exposure. **Neither do they account for the pulse-like exposures modulated at low frequencies that are common from the modern 2G and 3G appliances**. (p. 314)

Blackman of the US EPA has observed elsewhere that: 'These (current) standards rely primarily on biological responses to intensities within an arbitrarily defined engineering based frequency bands, not biologically based response bands, and are solely based ion energy deposition determinations. Current standards have ignored modulation as a factor in human health impacts and thus are inadequate in the protection of the public in terms of chronic exposure to some forms of ELF modulated RF signals…particularly new technologies that are pulse modulated and heavily used in cellular telephony'.

The biological evidence concerning the non thermal effects of EMF (indications of head cancer, permeability of the brain/blood barrier (p. 319, 333); expression of shock proteins; genotoxic damage, neurological, and possibly reproductive effects), though still limited and controversial,
is sufficient, on a precautionary basis, to justify biologically based and lower safety limits for the public. Such evidence also justifies more realistic test methods for RF absorption from RF.

Recommendations for such lower limits have been proposed by the BioIntiative group; the Selatun Scientific Panel and others. These have been adopted in some cities and regions of Europe.
Whilst the state of the science does not predict obvious choices of particular lower limits it does allow the choice of pragmatically based and more biologically relevant limits which would provide better protection of health.

David Gee, Feb 24th 2011

APPENDIX G

Bioelectromagnetics Supplement 6:S5 - S6 (2003)

Reviews of the Effects of RF Fields on Various Aspects of Human Health: Introduction

C-K. Chou* and J.A. D'Andrea{
Co-Chairs of Subcommittee 4, International Committee on Electromagnetic Safety, Institute of Electrical and Electronics Engineers, Piscataway, New Jersey

Link: http://onlinelibrary.wiley.com/doi/10.1002/bem.10178/pdf

The IEEE Standard for Safety Levels with Respect to Human Exposure to Radio Frequency Electromagnetic Fields, 3 kHz to 300 GHz, C95.1-1991, was published in 1991, reaffirmed in 1997, and amended in 1999 with no changes in the exposure limits. A complete revision of the standard by the subcommittee we co-chair, now in progress, will be based on the peer reviewed literature identified by the Literature Surveillance Working Group.

More than 1300 relevant research papers have been evaluated by two randomly selected members of the subcommittee's Engineering Evaluation Working Group and by two members of the appropriate Biological Evaluation Working Group (in vitro, in vivo, and epidemiology). Summaries of the working group evaluations are forwarded to the Risk Assessment Working Group (RAWG) to evaluate the levels of possible risk to humans and define the lowest threshold SAR above which potentially adverse effects are likely to occur. A Mechanisms Working Group works in parallel with the RAWG to evaluate possible mechan- isms of interaction, both nonthermal and thermal mechanisms. In addition, review papers have been prepared on cancer, reproduction, calcium efflux, behavior, thermoregulation, nervous system, ocular and auditory effects, homeostasis and metabolism, survival, epidemiology, and in vitro studies.

During the 2002 U.S. Air Force Research Lab- oratory Workshop ''Setting a Science-Based Standard for Safe Human Exposure to RF Electromagnetic Fields: A Tribute to Dr. Eleanor R. Adair,'' held in Quebec City, Que., Canada, 14 review papers were presented to a large audience. These 14 papers were commissioned by Subcommittee 4 (SC4) of the IEEE International Committee on Electromagnetic Safety (ICES) to assist with the Working Group's assessment of the extensive RF bioeffect literature database. Except for the epidemiology paper, each paper was written by SC4 members who were experts in the subject matter, and all subcommittee members were encouraged to work with the lead authors. Dr. Mark Elwood, an Australian epidemiologist, wrote the epidemiology paper at the request of the Co-Chairs of SC4.

After the workshop, the available preliminary papers were posted on the ICES SC4 public web- site (http://grouper.ieee.org/groups/scc28/sc4), soliciting comments prior to completion of the manuscripts. Thirteen papers were submitted to Bioelectromagnetics for publication; 12 of these technical papers are included in this special issue. The subjects of the two papers that are not included are calcium efflux and one- vs. two-tier standard. These two manuscripts may appear in future regular issues of the Journal.

Some topics in the Literature Surveillance Working Group database (posted on the ICES website http://grouper.ieee.org/groups/scc28/) are not covered in this special issue. For example, electrostimulation by low frequency RF current is not included. However, the final published standard will include an ''Informative Annex (Annex B)'' that summarizes all topics covered in the database. In addition to Annex B, Annex A describes the approach adopted during the revision and Annex C explains the rationale of the revision. Other annexes include a bibliography and practical applications of the standard. The exposure limits are set forth in the normative section of the standard.

At this writing, SC4 still has work to do to complete the revision of IEEE Standard C95.1-1991. On January 19, 2002, SC4 adopted 12 criteria to focus the work of the subcommittee and help move the revision process forward. At that time, the literature review was ongoing and review papers were not completed. Therefore, based on our understanding at that time and pending the conclusion of the literature review and the review paper process, the consensus of the Revision Working Group and SC4 was as follows.

1. The RF safety standard should be based on science.
2. RF safety standard revision should be derived from peer reviewed publications and documents that are reviewed by the SC4.
3. The adverse effect level remains at 4 W/kg subject to revision following completion of the literature evaluation and review papers.
4. The maximum exposure limits should be based on established adverse effects after inclusion of an appropriate safety factor(s).
5. Safety factor(s) should consider uncertainties in the biological database (e.g., measurements, environmental conditions, exposure duration, individual variability, and other factors.)
6. Nonthermal RF biological effects have not been established and none of the reported nonthermal effects are proven adverse to health (does not apply to electrostimulation). Thermal effect is the only established adverse effect.
7. The microwave hearing effect is not adverse and should not be used for setting the peak power limit.
8. The shape and size of the averaging volume and the peak SAR limit are still to be determined. The important end point is the temperature change. [During Revision Working Group meeting held on September 9–10, 2002, ''temperature change'' was revised to ''absolute temperature.'']
9. The RF standard should be harmonized with other international standards to the extent where scientifically defensible.
10. Rationales must be documented for all changes relative to the current standard.
11. The editorial committee will add in the informative section a paragraph dealing with potentially sensitive subpopulations, such as children.
12. Reconsider the two tier approach (whole body average SAR 0.4 and 0.08 W/kg, the peak SAR value and the averaging volume.

The above 12 criteria remain the guiding principles of the revision. The first criterion is that the standard must be based on science, and the Revision Working Group is committed to explaining the scientific rationale of the standard. Although all relevant biological effect papers are reviewed, the emphasis is on adverse effects as stated in revision criterion #4. The Revision Working Group defined an adverse effect as ''A biological effect characterized by a harmful change in health. For example, such changes can include organic disease, impaired mental function, behavioral dysfunction, reduced longevity, and defective or deficient reproduction.'' In general, the ''weight of evidence'' approach used by the National Toxicology Program, Environmental Protection Agency, and other health and regulatory agencies world-wide is used in our review and assessment processes. The weight of evidence approach was used to determine whether or not an adverse effect has been established. An adverse effect is considered ''established'' when there are consistent findings published in peer reviewed scientific literature from independent laboratories, and there is consensus that the effect occurs for the specified ex exposure conditions. For safety standards setting, only established adverse effects should be considered. As technology progresses, it is our duty as scientists and engineers to continually review and monitor new findings and to update and revise our safety standards accordingly. In this issue, Osepchuk and Petersen describe how IEEE standards are developed. The process requires consensus of at least 75% of the 122 members of SC4 and of the 109 members of the parent committee (after recirculation of negative ballots to allow members to reconsider their original votes); this process will assure that the standard is the best we can produce. The papers in this special issue provide comprehensive reviews of the biological effects of exposure to radiofrequency energy. Based on this in- formation and other subjects summarized in Annex B of the forthcoming revised standard, ICES is committed to the development of a science-based RF safety standard that is protective of public health, unambiguous, and practical to implement. We would like to congratulate Dr. Eleanor Adair for her distinguished contributions in Bioelectromagnetics and thank Dr. Michael Murphy for arranging for the U.S. Air Force Research Laboratory for sponsoring the Workshop and underwriting the publication cost of this special issue. We would like to especially thank the Editor in Chief of Bioelectromagnetics, Dr. Ben Greenebaum, for his great efforts in selecting the reviewers to obtain balanced reviews and final editing. We appreciate the anonymous reviewers for their valuable comments and suggestions to improve the quality of these papers. The authors deserve a round of applause for their voluntary time and effort to write these extensive reviews. This special issue not only serves in large measure as a scientific basis for the IEEE C95.1 standard revision, but also will be a valuable reference on the subject for many years to come.

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APPENDIX H

OFFICIAL PRESS RELEASE 23rd May 2011 FROM MONA NILSSON:
Link: http://www.monanilsson.se/document/AhlbomConflictsIARCMay23.pdf

Leading expert Anders Ahlbom linked to the Telecom Industry.

CONFLICT OF INTEREST AT THE WHO

Professor Ahlbom, who is appointed to chair the expert group on epidemiology at the upcoming IARC evaluation of the carcinogenicity of mobile phone radiation, is the co-founder of "Gunnar Ahlbom AB" a Brussels-based lobby firm aiming to assist the telecom industry on EU regulations, public affairs and corporate communications.

Professor Ahlbom created the lobby firm in 2010 together with his brother and sister in law who live in Brussels. The brother, Gunnar Ahlbom, is a telecom lobbyist in Brussels since the early 90's, and was already active in this field in 1998 when Professor Ahlbom participated in the setting of the controversial ICNIRP standards on radiation from different sources of non ionizing radiation like wireless devices and cell towers.

- Anders Ahlbom's link to the Telecom Industry through his brother and their common company is a straight-forward explanation of his systematic denial of health risks, says Mona Nilsson, Swedish author and investigation journalist.
-

The International Agency for Research on Cancer (IARC) is part of the World Health Organisation (WHO), and publishes Monographs to identify environmental factors that can increase the risk of human cancer. The preparation of the IARC Monographs on *"Non- Ionizing Radiation, Part II: Radiofrequency Electromagnetic Fields [includes mobile telephones]*" will start this week in Lyon, France (24-31 of May). The result of the review is of utmost importance to the telecom industry, which is sending three observers to the meeting: Mays Swicord, CTIA (the wireless association), Joe Elder, the Mobile Manufacturers Forum (MMF) and Jack Rowley, the GSM Association.1

The members of the IARC scientific committee have to submit a declaration of interest. Professor Ahlbom has not reported his involvement in the lobby firm, nor his close family relation to a mobile phone industry lobbyist (Gunnar Ahlbom).2

The IARC has already banned a scientist from the committee. Dr Alexander Lerchl from the German Radiation Protection Board, has been questioned regarding his relations to the German mobile industry, and was finally not accepted in the committee as "*an IARC Monograph is an exercise that demands complete independence from all commercial interests, and from advocates who might be perceived as advancing a pre-conceived position*.3

"Industry-loyal scientists have seized the interpretation privilege"

The present revelation doesn't come as a surprise to Mona Nilsson who has been investigating Prof Ahlbom's statements and whereabouts for many years.

The industry-loyal scientists are easy to recognize. They systematically repeat a set of policy

messages that counter the results of independent scientists and coincide with the interests of the industry. This is crystal clear in the case of Professor Ahlbom, who has dismissed all studies indicating health risks or biological effects whenever he has chaired an expert panel on this subject. He even denies the results of his own research if it indicates a health risk.[4] There is no doubt he speaks to the benefit of the industry.

Research and contact : Mona Nilsson, investigation journalist, Sweden Author of the books "Mobiltelefonins hälsorisker" (2010) and "Spelet om 3G" (2005)[5] mona@monanilsson.se
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1 Preliminary list of participants: http://monographs.iarc.fr/ENG/Meetings/vol102-participants.pdf
2 Anders Ahlbom interest declaration IARC, received April 2011
3 Letter from IARC to A. Lerchl www.diagnose-funk.ch/downloads/df_bp_who-lerchl_iarc-26oct10.pdf

Further information on Mona Nilsson's investigation is available here:
http://www.monanilsson.se/document/AhlbomConflictsIARCMay23.pdf

APPENDIX I

Environmental Health Perspectives

Link: http://www.medscape.com/viewarticle/753044_7

Mobile Phones, Brain Tumors, and the Interphone Study: Where Are We Now?

Anthony J. Swerdlow, Maria Feychting, Adele C. Green, Leeka Kheifets, David A. Savitz

Environ Health Perspect. 2011;119(11):1534-1538.

Conclusions

Interphone is an impressively large study with multiple indices of exposure. However, it has some methodological deficits, largely inevitable in recall-based case–control studies, which limit interpretation of its findings. Such evidence as it provides, combined with the results of biological and animal studies, other epidemiologic studies, and brain tumor incidence trends, suggest that within the first 10–15 years after first mobile phone use there is unlikely to be a material increase in risk of adult brain tumors resulting from mobile phone use. At present there are no data on risk of childhood tumors.

The deficiencies of exposure measurement, because of recall misclassification in studies such as Interphone, and because of misidentification of users in records-based studies such as the published cohorts, leave it doubtful that either study type could reliably detect a small effect, if one existed. Both for this reason and because research cannot in principle prove the complete absence of an effect but only place limits on its possible magnitude, there is bound to remain some uncertainty for many years to come. The limited duration of data yet available, which is mainly for up to 10 years of exposure and to a lesser extent for a few years beyond this, also leave uncertainty because of the potential for long lag period effects, especially for meningioma, which is generally slower growing than glioma. The possibility of a small or a longer-term effect thus cannot be ruled out. Nevertheless, although one cannot be certain, the trend in the accumulating evidence is increasingly against the hypothesis that mobile phone use causes brain tumors.

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The authors certify that their freedom to design, conduct, interpret, and publish research was not compromised by any sponsor.

A.J.S. holds shares in the telecom companies Cable and Wireless Worldwide and Cable and Wireless Communications. A.J.S.'s wife holds shares in the BT group, a global telecommunications services company. M.F., A.C.G., and A.J.S. are members of the International Commission on Non-Ionizing Radiation Protection, an independent body setting guidelines for nonionizing radiation protection. M.F. and A.J.S. serve as advisers to a number of public advisory and research steering groups concerning the potential health effects of exposure to nonionizing radiation. L.K. has advised electric utilities as well as regulatory and governmental bodies on the potential health effects of exposure to RF exposure. The other authors declare they have no actual or potential competing financial interest. Environ Health Perspect. 2011;119(11):1534-1538.

Uniform Requirements for Manuscripts Submitted to Biomedical Journals: Ethical Considerations in the Conduct and Reporting of Research: Conflicts of Interest

Link: http://www.icmje.org/ethical_4conflicts.html

Public trust in the peer-review process and the credibility of published articles depends in part on how well conflict of interest is handled during writing, peer review, and editorial decision making. Conflict of interest exists when an author (or the author's institution), reviewer, or editor has financial or personal relationships that inappropriately influence (bias) his or her actions (such relationships are also known as dual commitments, competing interests, or competing loyalties). These relationships vary from being negligible to having great potential for influencing judgment. Not all relationships represent true conflict of interest. On the other hand, the potential for conflict of interest can exist regardless of whether an individual believes that the relationship affects his or her scientific judgment. Financial relationships (such as employment, consultancies, stock ownership, honoraria, and paid expert testimony) are the most easily identifiable conflicts of interest and the most likely to undermine the credibility of the journal, the authors, and of science itself. However, conflicts can occur for other reasons, such as personal relationships, academic competition, and intellectual passion.

All participants in the peer-review and publication process must disclose all relationships that could be viewed as potential conflicts of interest. Disclosure of such relationships is also important in connection with editorials and review articles, because it can be more difficult to detect bias in these types of publications than in reports of original research. Editors may use information disclosed in conflict-of-interest and financial-interest statements as a basis for editorial decisions. Editors should publish this information if they believe it is important in judging the manuscript.

Potential Conflicts of Interest Related to Individual Authors' Commitments

When authors submit a manuscript, whether an article or a letter, they are responsible for disclosing all financial and personal relationships that might bias their work. To prevent ambiguity, authors must state explicitly whether potential conflicts do or do not exist. Authors should do so in the manuscript on a conflict-of-interest notification page that follows the title page, providing additional detail, if necessary, in a cover letter that accompanies the manuscript. *(See Section IV. A. 3. Conflict-of-Interest Disclosure.)* The ICMJE developed a uniform disclosure form that ICMJE member journals piloted in 2009. The second version of the form is now available as an accompanying Glossary (PDF). Other journals are welcome to adopt this form.

Authors should identify individuals who provide writing or other assistance and disclose the funding source for this assistance.

Investigators must disclose potential conflicts to study participants and should state in the manuscript whether they have done so.

Editors also need to decide whether to publish information disclosed by authors about potential conflicts. If doubt exists, it is best to err on the side of publication.

Potential Conflicts of Interest Related to Project Support

Increasingly, individual studies receive funding from commercial firms, private foundations, and government. The conditions of this funding have the potential to bias and otherwise discredit the research.

Scientists have an ethical obligation to submit creditable research results for publication. Researchers should not enter into agreements that interfere with their access to all of the data and their ability to analyze them independently, and to prepare and publish manuscripts. Authors should describe the role of the study sponsor, if any, in study design; collection, analysis, and interpretation of data; writing the report; and the decision to submit the report for publication. If the supporting source had no such involvement, the authors should so state. Biases potentially introduced when sponsors are directly involved in research are analogous to methodological biases. Some journals, therefore, choose to include information in the Methods section about the sponsor's involvement.

Editors may request that authors of a study funded by an agency with a proprietary or financial interest in the outcome sign a statement, such as "I had full access to all of the data in this study and I take complete responsibility for the integrity of the data and the accuracy of the data analysis." Editors should be encouraged to review copies of the protocol and/or contracts associated with project-specific studies before accepting such studies for publication. Editors may request a statistical analysis of all data by an independent biostatistician. Editors may choose not to consider an article if a sponsor has asserted control over the authors' right to publish.

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Editors should avoid selecting external peer reviewers with obvious potential conflicts of interest--for example, those who work in the same department or institution as any of the authors. Authors often provide editors with the names of persons they feel should not be asked to review a manuscript because of potential, usually professional, conflicts of interest. When possible, authors should be asked to explain or justify their concerns; that information is important to editors in deciding whether to honor such requests.

Reviewers must disclose to editors any conflicts of interest that could bias their opinions of the manuscript, and they should recuse themselves from reviewing specific manuscripts if the potential for bias exists. As in the case of authors, silence on the part of reviewers concerning potential conflicts may mean either that conflicts exist and the reviewer has failed to disclose them or conflicts do not exist. Reviewers must therefore also be asked to state explicitly whether conflicts do or do not exist. Reviewers must not use knowledge of the work, before its publication, to further their own interests.

Editors who make final decisions about manuscripts must have no personal, professional, or financial involvement in any of the issues they might judge. Other members of the editorial staff, if they participate in editorial decisions, must provide editors with a current description of their financial interests (as they might relate to editorial judgments) and recuse themselves from any decisions in which a conflict of interest exists. Editorial staff must not use information gained through working with manuscripts for private gain. Editors should publish regular disclosure statements about potential conflicts of interests related to the commitments of journal staff.

Pathophysiology. 2012 Sep;19(4):243-52. doi: 10.1016/j.pathophys.2012.07.001. Epub 2012 Aug 28.

Link: http://www.ncbi.nlm.nih.gov/pubmed/22939605

On the association between glioma, wireless phones, heredity and ionising radiation.

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Abstract

We performed two case-control studies on brain tumours diagnosed during 1 January 1997 to 30 June 2000 and 1 July 2000 to 31 December 2003, respectively. Living cases and controls aged 20-80 years were included. An additional study was performed on deceased cases with a malignant brain tumour using deceased controls. Pooled results for glioma yielded for ipsilateral use of mobile phone odds ratio (OR)=2.9, 95% confidence interval (CI)=1.8-4.7 in the >10 years latency group. The corresponding result for cordless phone was OR=3.8, 95% CI=1.8-8.1. OR increased statistically significant for cumulative use of wireless phones per 100h and per year of latency. For high-grade glioma ipsilateral use of mobile phone gave OR=3.9, 95% CI=2.3-6.6 and cordless phone OR=5.5, 95% CI=2.3-13 in the >10 years latency group. Heredity for brain tumour gave OR=3.4, 95% CI=2.1-5.5 for glioma. There was no interaction with use of wireless phones. X-ray investigation of the head gave overall OR=1.3, 95% CI=1.1-1.7 for glioma without interaction with use of wireless phones or heredity. In conclusion use of mobile and cordless phone increased the risk for glioma with highest OR for ipsilateral use, latency >10 years and third tertile of cumulative use in hours. In total, the risk was highest in the age group <20 years for first use of a wireless phone.

5. Conclusions

Certainly results from the Hardell-group as well from the Interphone group show an increased risk for glioma associ- ated with long term mobile phone use. Also use of cordless phones increases the risk when properly assessed and ana- lysed. The risk is highest for ipsilateral exposure to the brain of RF-EMF emissions. Adolescents seem to be at higher risk than adults. IARC concluded that RF-EMF emissions over- all, e.g., occupational and from wireless phones, are 'possibly carcinogenic to humans', Group 2B [8].

APPENDIX L

BEFORE THE PUBLIC UTILITIES COMMISSION OF THE STATE OF CALIFORNIA

Link: http://emfsafetynetwork.org/wp-content/uploads/2011/11/PGERFDataOpt-outalternatives_11-1-11-3pm.pdf

COVER PAGE

Application of Pacific Gas and Electric Company for Approval of Modifications to its SmartMeterTM Program and Increased Revenue Requirements to Recover the Costs of the Modifications (U 39 M)	Application 11-03-014 (Filed March 24, 2011) **(NOT CONSOLIDATED)**
Application of Utility Consumers' Action Network for Modification of Decision 07-04-043 so as to Not Force Residential Customers to Use Smart Meters.	Application 11-03-015 (Filed March 24, 2011) **(NOT CONSOLIDATED)**
Application of Consumers Power Alliance, Public Citizen, Coalition of Energy Users, Eagle Forum of California, Neighborhood Defense League of California, Santa Barbara Tea Party, Concerned Citizens of La Quinta, Citizens Review Association, Palm Springs Patriots Coalition Desert Valley Tea Party, Menifee Tea Party - Hemet Tea Party – Temecula Tea Party, Rove Enterprises, Inc., Schooner Enterprises, Inc., Eagle Forum of San Diego, Southern Californians For Wired Solutions To Smart Meters, and Burbank Action For Modification of D.08-09-039 and A Commission Order Requiring Southern California Edison Company (U338E) To File An Application For Approval of A Smart Meter Opt- Out Plan.	Application 11-07-020 (Filed July 26, 2011) **(NOT CONSOLIDATED)**

PACIFIC GAS AND ELECTRIC COMPANY'S RESPONSE TO ADMINISTRATIVE LAW JUDGE'S OCTOBER 18, 2011 RULING DIRECTING IT TO FILE CLARIFYING RADIO FREQUENCY INFORMATION

Question 1:

What is an average duration (in seconds) that a residential smart meter transmits in a 24 hour period?

Response 1:
Electric: As PG&E has described many times previously, both in this proceeding and publicly, a typical PG&E electric SmartMeterTM communicates intermittently throughout the day for a total cumulative period of approximately 45 seconds per 24-hour period. This typical cumulative communication period is comprised of thousands of very brief communications.

This reflects the findings of a detailed SSN study in which SSN collected actual field data from 88,000 deployed meters and compared the number of transmissions per meter for roughly 30 minutes each in order to determine that half of the meters transmitted for less than 45 seconds- per-day and half of the meters transmitted for longer than 45 seconds-per-day. In the study, a small number of electric SmartMetersTM in the outer range of the population communicated somewhat longer than 45 seconds-per-day, which resulted in an overall mean duration of approximately 62 seconds.[3]

Gas: The PG&E gas SmartMeter Module (MTU) has a single radio that utilizes the licensed 450-470 MHz band. The module is a one way transmitter; i.e., it sends but does not receive signals. The average duration that a gas SmartMeterTM Module transmits in a 24-hour period is 0.676 seconds. This is a calculated value based on observed individual transmission rates of 0.16 seconds each, and the designed transmission frequency of between 4.15 and 4.35 transmissions per day.

Question 1.a.:
How is this average computed or measured?

Response 1.a.:
Electric: SSN supplies PG&E with the "chipset" contained in the electric SmartMetersTM that GE and L+G supply to PG&E. The chipset, referred to as a "Network Interface Card" or "NIC," processes and stores the data and provides the radio communication back to PG&E. SSN has conducted several studies on these data to compute the type and duration of these transmissions.
In the SSN study referenced in Response 1, SSN calculated the median transmission-time by collecting actual field data from 88,000 deployed meters. By checking the number of transmissions per meter for roughly 30 minutes each, SSN computed the length of these

[3] PG&E's electric SmartMetersTM have two radios installed: 1) a radio that utilizes the licensed 902-928 megahertz (MHz) band for connection to the PG&E back office, and 2) a 2.4 gigahertz (GHz) radio to transmit to devices in the customer premises. The transmissions measured and addressed in this Response relate to the 900 MHz radio. Currently, PG&E does not have any SmartMetersTM utilizing the 2.4 GHz radio.

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Double discours **(with Google Translation)**

Link: http://www.lapresse.ca/debats/editoriaux/francois-cardinal/201201/26/01-4489772-double-discours.php

François Cardinal
La Presse

Nous vivons dans un nuage d'ondes électromagnétiques. Cellulaires, GPS, routeurs wifi ou téléphones sans fil, tous ces appareils nous exposent chaque jour à une bonne dose de radiofréquences.

We live in a cloud of electromagnetic waves. Cellular, GPS, wifi routers and cordless phones, these devices we face every day with a good dose of radio frequencies.

Et pourtant, l'installation des compteurs de nouvelle génération d'Hydro-Québec, qui n'ajouteront qu'une infime dose additionnelle à ce cocktail, sème la panique. Une panique injustifiée mais savamment cultivée.

And yet, the installation of counters new generation of Hydro-Québec, which will add a small additional dose to the cocktail, causing panic. Unjustified panic but carefully cultivated.

À ce jour, en effet, aucune étude sérieuse n'a clairement démontré la nocivité de telles ondes. L'écrasante majorité des chercheurs soutiennent que l'exposition à des radiofréquences de faible intensité ne nuit pas à la santé. Et les organisations internationales affirment que la preuve d'un risque de cancer est loin d'être concluante.

To this day, in fact, no serious study has clearly demonstrated the harmfulness of such waves. The overwhelming majority of researchers believe that exposure to low intensity RF does not harm health. And international organizations argue that the evidence of a risk of cancer is far from conclusive.

C'est ce qu'on appelle un consensus scientifique. Et pourtant, certains écologistes s'accrochent au doute et à l'incertitude pour exiger l'application du principe de précaution et donc, l'imposition d'un moratoire sur l'installation des compteurs...

This is called a scientific consensus. Yet some environmentalists cling to doubt and uncertainty to require the application of the precautionary principle and therefore the imposition of a moratorium on meter installation ...

Curieux que l'on accepte le consensus scientifique entourant les changements climatiques, mais que l'on rejette celui qui porte sur les ondes électromagnétiques. Curieux que le consensus mène à l'action dans un cas, à l'inaction dans l'autre. Curieux que les opinions divergentes soient ignorées pour l'un, magnifiées pour l'autre.

Curious that we accept the scientific consensus about climate change, but we reject the one on electromagnetic waves. Curious that consensus leads to action in a case for inaction in the other. Curious that divergent opinions are ignored for one, magnified to the other.

Le double discours est évident: on se désole du peu de respect des conservateurs pour les grandes agences scientifiques internationales... mais on rejette les conclusions de ces dernières quand elles ne font pas notre affaire.

The double talk is obvious: laments the lack of respect for conservatives large international scientific agencies ... but rejects the conclusions of these when they are not our business.

L'Association québécoise de lutte contre la pollution atmosphérique appuie ainsi son argumentaire, non pas sur les recommandations de Santé Canada ou de l'Organisation mondiale de la santé, mais bien sur celles du Conseil de l'Europe, une organisation dont la mission, plus juridique que scientifique, est «la promotion des droits de l'homme»...

The Quebec Association fight against air pollution and support his argument, not on the recommendations of Health Canada or the World Health Organization, but those of the Council of Europe, an organization whose mission more legal science is "the promotion of human rights" ...

Qu'on ne s'étonne pas de trouver «des erreurs factuelles grossières» dans la position de l'AQLPA, comme l'ont souligné trois professeurs de physique de l'Université de Montréal, Richard Leonelli, Normand Mousseau et Michel Côté.

One is not surprised to find "gross factual errors" in the position of the AQLPA, as pointed out three professors of physics at the University of Montreal, Richard Leonelli, Normand Mousseau and Michel Côté.

Vrai, on ne peut éliminer définitivement l'éventualité d'effets nuisibles sur la santé. Ce qui explique qu'on évoque parfois un «possible» risque de cancer, jusqu'à preuve du contraire. Mais la science est ainsi faite: elle peut dire qu'il n'y a aucune preuve de nocivité à ce jour, mais elle ne peut garantir à 100% qu'il n'existe absolument aucun risque.

True, we can not definitively eliminate the possibility of harmful effects on health. Which explains why it sometimes evokes a "possible" risk of cancer until proven otherwise. But science is well made: it can be said that there is no evidence of harm to date, but can not guarantee 100% that there is absolutely no risk.

Une porte très légèrement entrebâillée... que n'ont pas hésité à défoncer l'AQLPA et le syndicat des releveurs de compteurs.

Door very slightly ajar ... that did not hesitate to smash the union AQLPA and meter readers.

Or ces nouveaux appareils sont nécessaires. Parce qu'ils procurent toutes sortes d'avantages au fournisseur et aux consommateurs d'énergie, mais aussi parce que les deux tiers des bons vieux compteurs à roulettes auront dépassé leur durée de vie utile dans 5 ans.

However, these new devices are needed. Because they provide all sorts of benefits to the provider and consumer of energy, but also because two thirds of good old roller counters have exceeded their useful life in 5 years.

On peut certes se désoler des pertes d'emplois qui s'ensuivront ou de certains aspects financiers du projet, mais on ne peut faire appel à la science pour empêcher leur installation.

One can certainly grieve the loss of jobs that will follow or financial aspects of the project, but we can not use science to prevent their installation.

APPENDIX N

Electrosensitivity: A Case for Caution with Precaution

Link: http://archive.radiationresearch.org/conference/downloads/011555_rubin_extra.pdf

G James Rubin (g.rubin@iop.kcl.ac.uk)
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What is Electrosensitivity?

Electrosensitivity is a medically unexplained condition in which sufferers report experiencing adverse symptoms such as headaches, nausea or fatigue which are seemingly triggered by the presence of weak electromagnetic fields (EMF) such as those produced by mobile phones, computers or domestic appliances. The condition is controversial as there is no generally accepted mechanism to explain how these fields could cause short-term symptoms.

The condition is also remarkably diverse. Numerous surveys have asked electrosensitivity sufferers to describe their illness (e.g.[1-4]). These have consistently shown that there is no one discrete cluster of symptoms that typifies it. Instead, regardless of what symptom is asked about, electrosensitivity sufferers as a group tend to experience more of it than people without the condition[1-3;5]. A wide diversity also exists in the types of electrical devices that are reported as triggering these symptoms. While more commonly reported triggers include mobile phones, mobile phone base stations and powerlines[2], not everyone is affected by the same thing and a wide range of different triggers have been reported[2]. The speed with which symptoms come and go also differs dramatically between sufferers: while most say that they experience symptoms within only a few minutes of exposure, a minority report that it can take days before symptoms start to appear[2].

What Can Provocation Studies Tell Us?

The wide diversity in symptoms, triggers and symptom latencies makes electrosensitivity difficult to study. However, a large body of research has now been done, with a particular emphasis on "provocation studies." These are designed to test the basic theory underlying electrosensitivity: that it is exposure to EMF that causes sufferers to feel ill. In a 2005 review paper, my colleagues and I discussed 31 previous provocation studies, all of which followed the same basic pattern[6]. Individuals who reported having electrosensitivity were typically exposed to two conditions, one involving genuine EMF and another consisting of a sham condition in which no EMF was present. In every study, the participant's task was to say how severe their symptoms were after each condition or whether they could tell which condition was which. These studies were all either single- or double- blind. Of the 31 studies we reviewed, only seven found any indication that EMF had an effect on the volunteers. Of these seven, two subsequently could not be replicated even by the original research teams, three appeared to have errors in the way they had analysed their data, and the final two gave conflicting results. Since we conducted our review, at least ten more provocation studies have been published, taking the number of electrosensitive volunteers who have been tested in this way to over a thousand. These more recent additions have supported the general conclusion of our review paper: that overall, people with electrosensitivity do not seem to react to EMF any more than they react to a sham condition.

Inevitably, there has been some debate as to the merits of this type of research. For example, some have suggested that because people with electrosensitivity will naturally be anxious when placed in a laboratory test involving exposure to EMF, they will therefore experience symptoms of anxiety in both the real and sham conditions, making the test results difficult to interpret. Yet because any anxiety-related effects will occur in both conditions, if the presence of EMF has any effect then it should still be detected over and above this. Others have suggested that because people with severe forms of electrosensitivity are often unwilling to take part in these studies, it is unfair to assume that the "less sensitive" volunteers who do take part will be able to detect a difference between the experimental conditions. Again, this argument is flawed. Although it is true that many severely affected sufferers do not want to take part in these studies, those people who do take part typically report getting clear-cut symptoms when exposed to, say, mobile

phone signals in their everyday life. There is no reason why their sensitivity should be impossible to detect under double-blind conditions.This does not mean that provocation studies are perfect, however. Two problems in particular stand out. First, although provocation studies are good at telling us about the possible causes of short-term symptoms, what about the minority of sufferers who say that their symptoms take days to develop? Experimental studies are not ideally suited for that group. Second, what if most people who say that they have electrosensitivity are mistaken, with only a small minority being genuinely sensitive? In that case, studies which test the overall effects of EMF on a group of volunteers who report electrosensitivity may be less effective than studies which repeatedly test single volunteers. To date, most provocation studies have taken the former approach, although some have taken the individual testing route without so far producing any conclusive evidence of electrosensitivity[6].

Is There a Psychological Explanation?

If the overall results of more than 40 experiments suggest that it is not EMF that is responsible for causing the symptoms of electrosensitivity, could another mechanism provide a better explanation? A psychological process referred to as classical conditioning may provide part of the answer. According to this theory, electrosensitivity may begin when an individual, for whatever reason, experiences a negative symptom while also using a mobile phone (or any other electrical device). There is good evidence that if individuals are pre-warned that a substance may be hazardous to health, and then co- incidentally experience symptoms at the same time as being in the vicinity of that substance, they often mistakenly associate the presence of the symptom with the presence of the substance[7]. So in the case of electrosensitivity, given the constant media reporting of the health issues surrounding mobile phones and the advice from the UK Department of Health that we should be cautious about using our mobiles, it becomes perfectly rationale for someone to believe that a headache experienced after making a mobile phone call might be related to the mobile itself, rather than to stress, poor sleep, a minor illness or any of the other multitude of things that can cause headaches. Once this initial tentative attribution has been made, the next time a mobile needs to be used the person will be slightly more anxious about using it and may expect another headache to occur. Much evidence from the psychological literature suggests that both of these factors can create a self-fulfilling prophecy, generating a "nocebo" effect in which psychological processes trigger genuine physical symptoms[8]. Should this occur and a nocebo headache develops, it is likely that this will reinforce the person's belief that it is the mobile phone which is causing the headache. A vicious circle of anxiety, expectations and symptoms can then develop, eventually leading to a belief that one is sensitive to mobile phones and perhaps to other electrical devices as well. This phenomenon has been demonstrated several times before, both in the laboratory, where healthy volunteers can be 'conditioned' into developing symptoms when exposed to a harmless chemical smell[9] and in the real world, for example where cancer patients come to experience nausea when exposed to harmless stimuli that they associate with chemotherapy sessions[10].

In the case of electrosensitivity, evidence that psychological processes may underlie the condition can be found in several places. For a start it can be found in the provocation studies themselves. These consistently show that the type of physical symptoms that people with electrosensitivity experience can be triggered just as readily by a sham exposure as by an EMF exposure[6;11-13], suggesting that the nocebo effect is a sufficient explanation for the real-world symptoms experienced by people with electrosensitivity. Evidence can also be found in experiments with healthy volunteers which show that exposure to fake electrical currents or fields can trigger headaches[14] and in studies in the community which show that worry about 'electrosmog' has a good correlation with the presence of symptoms, even though adequately measured exposure to 'electrosmog' does not[15-17], all of which suggests that concern about EMF is important in the initial attribution of symptoms to electrical devices. Evidence can also be found in studies which have looked at the psychological profiles of electrosensitivity sufferers, which have shown elevations in various factors which are believed to increase the risk of psychosomatic symptoms occurring[18-20]. Finally, evidence can be found, albeit to a lesser extent, in those studies which have demonstrated that psychological and behavioural therapies can be effective as treatments for electrosensitivity[21].

What are the Implications for the Precautionary Principle?

If electrosensitivity is not caused by the presence of EMF, but is instead more related to concern about EMF, what implications does this have for any suggestion that we should apply a more robust form of the precautionary principle with respect to mobile phones, wifi, powerlines and so on? We know from past experience that promoting precaution to the public is often viewed as a sign of danger: people often assume that there is 'no smoke without fire' and studies have consistently shown that providing people with precautionary advice about mobile phones has increased anxiety levels and made mobiles appear more threatening[22-24]. In addition, the type of alarmist media reporting that often accompanies precautionary recommendations has also been experimentally shown to increase the chances that someone will mistakenly attribute physical symptoms to a device or substance[7]. So because precautionary advice exacerbates precisely those psychological variables that may help to trigger electrosensitivity in the first place, it is entirely plausible that increasing the level of precautionary advice that is given out about mobile phones, wifi and related technologies will increase, not decrease, the number of people who come to believe that exposure to those technologies is making them ill. As with all health-related interventions, the precautionary principle is not without its side-effects and these must be taken into account when deciding whether or not to apply it.

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Nonspecific Medication Side Effects and the Nocebo Phenomenon

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ABSTRACT

Patients taking active medications frequently experience adverse, nonspecific side effects that are not a direct result of the specific pharmacological action of the drug. Although this phenomenon is common, distressing, and costly, it is rarely studied and poorly understood. The nocebo phenomenon, in which placebos produce adverse side effects, offers some insight into nonspecific side effect reporting. We performed a focused review of the literature, which identified several factors that appear to be associated with the nocebo phenomenon and/or reporting of nonspecific side effects while taking active medication: the patient's expectations of adverse effects at the outset of treatment; a process of conditioning in which the patient learns from prior experiences to associate medication-taking with somatic symptoms; certain psychological characteristics such as anxiety, depression, and the tendency to somatize; and situational and contextual factors. Physicians and other health care personnel can attempt to ameliorate nonspecific side effects to active medications by identifying in advance those patients most at risk for developing them and by using a collaborative relationship with the patient to explain and help the patient to understand and tolerate these bothersome but nonharmful symptoms.

APPENDIX P

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Changes in Health Status in a Group of CFS and CF Patients Following Removal of ® Excessive 50 Hz Magnetic Field Exposure

Link: http://www.emfacts.com/download/cfs_changes.pdf

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ABSTRACT

In December 1998 a paper published in the ACNEM *Journal* examined the hypothesis that prolonged exposure to excessive 50 Hz (power line frequency) magnetic fields may act as an immune system stressor giving rise to symptoms similar to those reported in Chronic Fatigue Syndrome (CFS) or Chronic Fatigue (CF).[1] This paper was based on a number of case histories, most notably a well-documented Workcare Compensation case (Melbourne, 1991). Here, a group of female office workers developed CFS-like symptoms when working in a room with strong 50 Hz magnetic fields emitted from an electrical substation immediately below the floor.[2]

The present paper briefly reports the results of a small-scale pilot study utilising 49 subjects suffering from CFS or ongoing CF, who were exposed to varying strength magnetic fields in their home environment. Some subjects were found to have prolonged exposure to magnetic fields >2 mG (milliGauss), which was used as a benchmark level. These subjects (Group A) were provided with advice and assistance regarding reducing their exposure level. The remainder of the subjects (Group B: <2 mG exposure level) were given no such advice or assistance. Changes in health status in both groups were recorded over a 6-month period. Results from the data collected at the start of the study showed no relationship between magnetic field strength and CFS/CF symptom severity. However, the majority of Group A subjects reported an improvement in symptoms and a marked improvement in sleep patterns, possibly due to the decrease in exposure. These results are discussed in the context of previous research showing disturbed sleep in the presence of magnetic fields. Such disturbances may come about through the effect of magnetic fields on melatonin secretion, a hormone involved in circadian functioning.

KEY WORDS

Chronic Fatigue Syndrome (CFS); electromagnetic fields (EMF); power line frequency; sleep changes; melatonin.

INTRODUCTION

Clinical CFS is characterised by incapacitating fatigue (experienced as exhaustion and extremely poor stamina) of at least 6 months duration, usually with an abrupt onset accompanied by an ëinfectious- likeí illness. It can affect virtually every major system in the body as neurological, immunological, hormonal, gastro-intestinal, musculoskeletal, and psychological problems have been reported. Many patients with CFS are unable to work, whereas others continue to work at least part-time while drastically curtailing social activities.

Symptoms tend to wax and wane but are often severely debilitating and may last for many months or years. All segments of the population (including children) are at risk, but women under the age of 45 seem to be the most susceptible. As with most diseases, CFS affects people differently. Not everybody reaches the severe end of the CFS spectrum.

CFS is also referred to as CFIDS (Chronic Fatigue and Immune Dysfunction Syndrome), CEBV (Chronic Epstein-Barr Virus), ME (Myalgic Encephalomyelitis), as well as several other designations. It is a complex illness which has been intensively studied for the past 40 years without firm conclusions as to its cause. Diagnosis is largely by exclusion of other possible diseases. In addition to persistent and extreme fatigue, other CFS symptoms identified include the following: substantial impairment in short-term memory and concentration, depression, sore throat, tender lymph nodes, muscle pain, multi-joint pain without joint swelling or redness, unusual headaches, unrefreshing sleep, cognitive function problems (such as spatial disorientation and impairment of speech and/or reasoning), visual disturbances (blurring, sensitivity to light, eye pain), chills and night sweats, dizziness and balance problems, sensitivity to heat and cold, irregular heartbeat, abdominal pain, diarrhoea, irritable bowel, low temperature, numbness or a burning sensation in the face or extremities, dryness of the mouth and eyes (Sicca syndrome), hearing disorders, menstrual problems including PMS and endometriosis, hypersensitivity of the skin, chest pains, rashes, allergies and sensitivities to odours (including chemicals and medications), weight changes without changes in diet, hair loss, light- headedness, fainting, muscle twitching, and seizures. Research suggests that CFS results from a dysfunction of the immune system, involving a disruption of fundamental Central Nervous System (CNS) mechanisms, such as the sleep-wake cycle and the hypothalamic-pituitary-adrenal axis. One study found that more than a quarter of CFS patients had abnormal brain scans and subtle changes were found in the levels of neuroendocrine hormones.[3] Other research has found electrolyte disturbances which sometimes included permanent changes in cell membranesí ability to pass electrolytes, permanent biochemical changes in mitochondrial function, and disturbances

of insulin and T3-thyroid hormone functions.[4]

Unlike CFS, chronic fatigue (CF) is far more prevalent in the community and, as its name suggests, is characterised mainly by an ongoing feeling of fatigue and lack of energy that is not as debilitating as CFS. As there is no clear dividing line between these two conditions, people suffering chronic fatigue can be mistakenly diagnosed as having CFS.
We have hypothesised that exposure to power line frequency magnetic fields in the home and in the work-place may be a co-factor to consider when treating CFS/CF.[3]

The purpose of the present study was to begin the empirical investigation of our hypothesis. We located a number of people currently being treated by a medical practitioner for CFS/CF and then measured their exposure to magnetic fields in their homes. Because field studies of this type are fraught with difficulties and possible confounds, we thought it prudent to begin with a small sample pilot study to better identify any problems and to develop leads for a future, larger investigation.

METHOD Subjects

All subjects were volunteers who initially heard about the pilot study through doctors who are members of the Australasian College of Nutritional & Environmental Medicine (ACNEM), through a notice placed in both the Victorian and South Australian CFS Societiesí newsletters, or from discussions with the Hobart CFS group. Subjects were drawn from Melbourne (Victoria), Adelaide (South Australia) and Hobart (Tasmania). The mean age of the 49 subjects was 44 years, with an age range from 17 to 72 years, consisting of 14 males and 35 females. The inclusion criterion was that all subjects were currently being treated by a medical practitioner for CFS or CF.

Questionnaire

The questionnaire consisted of two parts. First was a two-page questionnaire *(Bioscreen)* that listed 86 symptoms, with a severity scale of 0 to 4. Examples are: headaches, chest or heart pain, tinnitus or other noises in the ear, unrefreshed or prolonged sleep, allergies, forgetfulness, dermatitis, stress from work problems, symptoms of irritable bowel, etc.
The second part consisted of a further two pages that included questions on: length of time living at present address, time since being diagnosed by doctor, length of time with condition, brief description of symptoms felt, was onset gradual or with an initial flu- like illness, any indications from blood tests of low iron levels, trouble sleeping or dreaming, feelings after waking, do symptoms lessen when staying elsewhere. There were also questions on type of employment, if any, use of cordless and mobile phones and time spent using a computer as well as any symptoms felt after the extended use of a computer.

Approximately 180 questionnaires were sent out to doctors who had been previously contacted and had expressed possible interest for some of their patients. Fourteen were sent out to individuals who had contacted us as a result of the notices placed in CFS newsletters or discussions with CFS groups. In addition 8 were sent out as a result of a radio interview in Adelaide. Of the total of approximately 202 questionnaires sent out, 49 responded with no later drop-outs.

Magnetic Field Measurement

All measurements were taken with an F.W. Bell Triaxial ELF magnetic field meter. Where there were indications that the fields may be changing over time, a Trifield meter was left with subjects to check at different times for any fluctuations that might be occurring. Only the measurements taken with the F.W. Bell meter were used in the calculations.
For both Adelaide and Melbourne, two weeks were arranged in each city to conduct the initial magnetic field surveys. Survey times were by spot measurements taken at a pre-arranged time of the day according to each subjectís availability. At each home, measurements were taken first with most appliances and lights off (low power configuration) and then with most appliances and lights on (high power configuration). Measurements were taken in the centre of all main rooms, one meter from the floor. Places where the subject may spend some time, such as a chair, couch or bed were especially checked. The locations of meter boxes in relation to bedheads were noted as well as magnetic fields on water pipes and proximity to power lines.

Out of the initial 14 subjects in group A, the nature of the individual exposure sources made it possible to estimate that in 12 of the subjects their magnetic exposure strength was likely to remain stable over time. For the remaining two, additional measurements were made with the Trifield meter left with them for this purpose.

In several cases where the services of an electrician and/or plumber were required to fix the source of excessive magnetic fields, a later EMF survey was conducted to ensure that the fields were lowered or eliminated.

RESULTS

A detailed statistical analysis of the questionnaire data, carried out at Massey University, New Zealand, found no relationships between the magnetic field strength and the severity of symptoms. In other words, there were no dose-response relationships (a not unusual finding in this type of research). Neither were any symptoms specific to magnetic field exposure identified. However, the later health changes, predominantly in quality of sleep, reported by the subjects did indicate unusual symptoms, such as night time tinnitus, that seemed to be related to excessive magnetic field exposure at night.
Of the 49 subjects, 14 had prolonged magnetic field exposures >2
mG (28%), and of these 14, 9 were over 4 mG (18%). Interestingly, only 2 of the 14 exposure situations were due to proximity to power lines. This is in agreement with the March 2001 British NRPB report that identified internal sources

within the home, not power lines, as being a significant source of exposure.[5]

Sources of exposure for the 14 subjects exposed to <2 mG (Group A):

- one was solely from proximity to power lines (3.6 mG);
- one was from proximity to power lines and conducting water piping (2.4 mG).
- Four were from the bed head next to meter box(4.4/2.9/8.3/3.0mG);
- two were from electrical return currents on metal water pipes (2.2 / 6.6 mG);
- one was from a quartz halogen bedside light (6.2 mG);
- two were from sleeping with an energised electric blanket (8.7/ 20.6 mG);
- one was from a waterbed heater (6.6 mG);
- one was from a phone charger by the bed head and water bed heater (5.0 mG);
- one was from a chair against a wall with high magnetic fields from kitchen appliances on the other side of the wall (9.6 mG).

Three of the above 14 subjects were excluded from all further analyses for a variety of reasons (unable to reduce exposure due to power line proximity, reduction in exposure confounded by introduction of a gluten-free diet, a doubtful case of CFS/CF.) The removal of these 3 left 11 subjects in group A, with a group average exposure of 7.1 mG. Group B (exposure < 2 mG) consisted of 34 subjects, with a group average exposure of 0.67 mG. One subject in Group B was excluded from further analysis due to his just moving into new home; so previous EMF exposure was unknown.

At intervals up to 6 months subjects were contacted and asked about changes in health/fatigue that may have occurred in the interim. These were classified in three categories: no improvement (or worse), slight improvement, and definite improvement.

Table 1: Percentage change in symptoms 6 months after initial contact.

	Group A exposure >2mG, Group B < 2mG.		
	IMPROVEMENT		
	None	Slight	Definite
Group A	45%	0%	55%
Group B	68%	18%	14%

Table 1 shows that 55% of the more highly exposed subjects (Group A) reported definite improvement in their symptoms. These were the subjects given advice and assistance on how to reduce their exposure. Group B subjects (< 2 mG exposure) received no such advice and only 14% reported a definite improvement in health 6 months after initial contact.
The greater improvement in group A is in agreement with recent Swedish research that found in persons apparently hypersensitive to electricity, intensive electrical environments intensified their symptoms, and that a reduction of electromagnetic fields in the living and work-place environment seemed to be highly positive as a means for rehabilitation.[6, 7]

Sleep changes

An unexpected change in this pilot study was a marked improvement in sleep quality for the group A subjects: 64% reported an improvement in sleep while only 12% reported a similar effect in Group B.

Interestingly, 4 subjects (36%) in Group A reported an end to tinnitus at night after reduction of magnetic field levels. No Group B subjects reported this.

It is instructive to examine the comments made by Group A subjects who experienced an improved sleep quality, in a little more detail:

Subject #4: No real change to fatigue but noticed better sleep, less time awake while in bed, sleeps more soundly, easier to get back to sleep. (Bed head was by meter box, 4.4 mG.)
Subject #5: No longer suffers from tinnitus, or buzzing in body at night, better sleep (deeper) and wake in the morning easier. Very sure of an improvement. Not much difference in fatigue though. (Used heated water bed, 6.6 mG.)
Subject #7: Sleeping much better, deeper, waking more refreshed, more energy, headaches less frequent, tinnitus at night ended. (Transformer was by bed head and used heated water bed, 5.0 mG.)
Subject #9: Excellent - back to normal, no longer lying awake at night trying to get back to sleep, no longer has ear-ringing at night, energy returned. (Bed head was by meter box, 8.3 mG.)
Subject #28: Sleeping really well now, longer, dreaming, with less anxiety, less vivid, less fatigue, now sleeps 10 hours a night without waking, hasnít been sick for quite a time now. (Electric blanket left on at night, 20.6 mG.)
Subject #41: Dramatic improvement, feeling better with slight improvement in sleep (more, deeper and longer), energy levels better, slow and steady improvement, overall 70-80% improvement. (Bed head by meter box, 3.3 mG.)
Subject #47: Sleeping better, having vivid dreams, never before remember dreaming, thinking more focused and clear, buzzing and tingling at night gone, no head noises, no foggy feeling, no longer trying to think through cotton wool, do not

need to struggle in order to be clear-headed, still have tiredness, fatigue. (Electrical return currents on water pipes, 6.6 mG.) These changes would seem to be a direct consequence of removal of previous night-time magnetic fields; they do not appear to be directly related to fatigue. In other words, a marked improvement in sleep does not necessarily mean an improvement in fatigue, at least in the short term.

DISCUSSION

The present investigation did not find any dose-response relationships between severity of CFS/CF symptoms and magnetic field strength. Nor were any particular symptoms linked to exposure level. In future studies, attention must be given not only to point exposure levels in the home, but to how long residents are exposed and what other sources of exposure there might be (e.g. the work- place). It is notoriously difficult to establish dose-response relationships in magnetic field research with humans, but before accepting that such relationships are nonexistent, we must be sure of the quality of our exposure measurements.

The most interesting result to come out of this pilot study was the apparent effect of reducing magnetic field exposure on sleep, though it is possible that Group Aís improvement might have been due in part to the fact that they knew that they were being ëtreatedí (i.e. fields reduced). Sleep is not a matter of simply switching off the brain; it is a complex process that involves stages of deep and light sleep that occur over a full sleep cycle of about 8 hours for most adults. The later stages of this cycle are crucial for physical recovery and psychological wellbeing. Any factor that interrupts the cycle can cause physical and physiological effects such as fatigue, dizziness, inability to concentrate, perceptual changes, mood changes, etc.[8]

The question of whether power line magnetic fields can affect sleep was specifically examined in a paper titled: ìA 50-Hz electromagnetic field impairs sleepî, published in the *Journal of Sleep Research* in 1999. The researchers took 18 healthy adults (8 females, 10 males, age range 18-50 years) who were good sleepers and compared their sleep with and without exposure to a 10 mG magnetic field (one night on - one night off). The results clearly showed a significant reduction in total sleep time, sleep efficiency, stages 3 and 4 slow wave sleep, and slow wave activity. Circulating levels of melatonin, growth hormone, prolactin, testosterone and cortisol were not affected. The authors concluded that “commonly occurring low frequency electromagnetic fields may interfere with sleep”.

The authors point out that, as this study was conducted with healthy volunteers using only one night of exposure, patient groups exposed over a longer period might be more sensitive. Furthermore, it is conceivable that increased intensity of the field or of duration of exposure might yield larger effects.[9] The fact that hormone levels were unaffected after the one night’s exposure is in agreement with the findings of Wilson, Stevens and co-workers at the Pacific Northwest National Laboratory, in Washington, USA. Their research, mainly on electromagnetic field effects on melatonin in the home and workplace, indicates that melatonin levels are generally affected over the longer term (30 days or longer) by magnetic field exposure, suggesting effects may be cumulative.[10]

Sleep problems were also reported in a study published in the *European Journal of Internal Medicine* in 2000. Here, it was found that many people living near twin 400 kV transmission lines in Coutiches, France, and exposed to a magnetic field >2 mG, had a modified iron metabolism, which they termed ìpseudo-iron deficiencyî. The authors propose a high bone marrow uptake of iron, explaining the apparent low iron levels in the blood.[11] It was noted that after several months the iron parameters would return to normal when people moved away from the exposed residences.[12] Besides tiredness/fatigue, one of the symptoms commonly reported by subjects (especially children) was an inability to sleep. It was especially noted that the insomnia would disappear when the power level was lower than usual, and return when the level normalised. The children slept normally when sent to grandparent’s or relative’s homes.[13]

If indications are that only one night’s exposure to a 50 Hz magnetic field can cause observable sleep impairment in healthy people, what might be the effects from prolonged exposure (years) on people with compromised immune systems, such as with CFS?

Melatonin

One possible way a magnetic field could affect sleep is by affecting the production of melatonin, a hormone produced by the pineal gland. The pineal gland is the major control gland over this cycle, with melatonin production controlled by signals from the postganglionic sympathetic fibres (neurons) connected to the hormone-producing cells of the pineal gland. The firing rate of the incoming neurons varies according to the phase of the light/dark cycle. At night, these neurons exhibit an increased rate of firing, inducing the release of the neurotransmitter norepinephrine, leading to a rise in melatonin production.[14, 15]

During the day, light falling on photoreceptor cells in the retina produces signals that quell the firing rate of the sympathetic neurons and, as a result, melatonin production and secretion remain low. The differential firing of the neurons between the day and night accounts for the circadian rhythm in melatonin production. The day/night variation in pineal melatonin synthesis is characteristic of all [diurnal] mammalian species, including man.[16]

Shortly after its production, melatonin quickly enters the blood- stream and gains access to all bodily fluids and therefore every cell, and cell nucleus, in the body.[17] The ability to enter every cell in the body is important for melatoninís function as an antioxidant, scavenging highly toxic, oxygen-based free radicals produced as a consequence of the utilization of oxygen by all organisms.[18, 19, 20] Unchecked, free radicals can damage macromolecules such as DNA, proteins and lipids, through a process referred to as oxidative stress.

Besides its role as an anti-oxidant, melatonin is also known for its sleep-enhancing property.[21]

This may explain the phenomenon of jet-lag, where individuals fly through several time zones to end up at a place in which the body's circadian rhythms are temporarily out of phase with the new location's day/night cycle. During the re-adjustment time, humans experience several signs, among them difficulty sleeping, and it is believed that the disturbance of the melatonin rhythm is partially responsible for this.[22]

In a paper on melatonin suppression by static and extremely low- frequency electromagnetic fields, Reiter states: "Epidemiologists should look for other possible changes, including psychological depression, fatigue, sleep inefficiency, chronic feelings of jet lag, endocrine disturbances and other symptoms; all these may result from a chronically low melatonin rhythm".[23] Thus, magnetic field effects might be implicated in a wide range of disorders through their effect on melatonin. There are now several studies which strongly suggest that these very low frequency fields can indeed suppress melatonin.

At a workshop on electromagnetic fields, light-at-night, and human breast cancer (1997), Dr. Scott Davis of the Fred Hutchinson Cancer Research Centre, presented evidence that higher magnetic field levels at night were associated with significantly lower melatonin levels during the same night.[24] This research was published in the *American Journal of Epidemiology* (2001), where the authors concluded that: "These results suggest that exposure to night-time residential 60-Hz magnetic fields can depress the normal nocturnal rise in melatonin".[25]

At the Second World Congress for Electricity and Magnetism in Biology and Medicine (1997), Japanese researchers from the Faculty of Medicine, University of Tokyo, presented research that specifically looked at melatonin levels and electric blanket use. This study set out to determine whether the effects of comparably long-term power line frequency exposure (from electric blanket use) on suppression of the melatonin rhythm in humans, could be replicated. The participants were 9 healthy male volunteers, aged between 23 and 37. It was found that exposure to magnetic fields, of the intensity generated by the electric blanket, suppressed peak value and/or delayed melatonin rhythm in 7 out of 8 subjects. They concluded that: "The present findings may suggest a possibility that exposure to ELF-EMF [extremely low frequency electromagnetic fields] by electric blankets, if magnitude and duration are sufficient, could lead to changes in melatonin production and its rhythm, at least in highly sensitive individuals".[26]
A preliminary study of 60 workers at a Finnish garment factory found "a highly significant effect" of electromagnetic fields in reducing nocturnal melatonin levels. Magnetic field measurements were taken for the two types of machines used in the factory and operators were assigned to high or low exposure groups, based on the type of machine they were using, with average exposures either above or below 10 mG. Non-exposed non-industrial workers were used as controls. The results showed strong effects of both magnetic field exposure and smoking on night-time levels of melatonin. No difference was found in melatonin levels on week nights and Sunday nights, indicating "that the possible suppression caused by magnetic field exposure is chronic, with little recovery during the weekend".[27]

Finally, in a study of 192 electric utility workers, Reif and Burch, from Colorado State University, found that some electromagnetic field exposures are associated with lower levels of melatonin. They found a significant association between magnetic field exposures and lower daytime melatonin levels on the second and third of three days of measurement. The lack of an effect on the first day (following a weekend or equivalent) may indicate a cumulative effect of exposure. Some studies have suggested that electromagnetic effects on melatonin may depend on whether the field is continuous or intermittent. Reif and Burch found that magnetic fields in the home that were "temporally coherent" (less intermittent) had a very significant association with lower melatonin levels at night. They concluded that: "The intensity and temporal characteristics of magnetic fields appear to be involved in melatonin suppression".[28]
In the concluding remarks of the book, *The Melatonin Hypothesis: Breast Cancer and Use of Electric power* (1997) the authors wrote:
"The electromagnetic spectrum, particularly in the visible range, suppresses melatonin synthesis in the pineal gland of all vertebrates, including man. Thus, electromagnetic energy has an important function in controlling the internal milieu of vertebrates". A major challenge of future research is to define the health effects of changes in melatonin production, and to determine whether wavelengths outside the visible range reproducibly alter the circadian synthesis of this important chemical mediator.[29]

In summary, our findings of improved sleep patterns when relatively strong magnetic fields were reduced in the home at night, can be accounted for in terms of an increase in melatonin secretion, which enabled better quality sleep. Of course, at this juncture, such a conclusion is speculative. We hope to incorporate melatonin assays in our future work. Melatonin levels should correlate positively with sleep duration and quality and be negatively correlated with magnetic field intensity and/or duration.

CONCLUSIONS

The present study had quite limited aims, being a pilot for a more ambitious future investigation. That we found no relationship between exposure level and symptom severity was not entirely surprising. Clearly, our method of assessing exposure level and duration of exposure to magnetic fields must encompass more than an assessment of average exposure based on one or two readings. If possible, the full-scale investigation being planned will use meters that can be carried by subjects and which can store many readings across the course of a day. Only then can we be sure that there is no dose-response relationship between CFS symptoms and field levels.

Undoubtedly, the most interesting and exciting finding was that relatively strong magnetic fields may impair sleep. Although

caution is required in drawing conclusions from such a limited sample, the results suggest that it may be worthwhile to directly assess circulating melatonin levels in future studies.

The effects of magnetic fields on the human body and central nervous system are likely to be subtle. Thus, any study in this area must be mindful of sample size. Large samples are required to provide sufficient statistical power to detect what are probably very small effects. That said, even small effects operating as co-factors in a severe illness may be enough to have a devastating impact. Therefore, it seems to us that a carefully controlled, large-scale investigation of magnetic field exposure as a co-factor in CFS and other related disorders is warranted.

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APPENDIX Q

Reducing the level of 50 Hz Magnetic Fields Lessens Symptoms of Chronic Fatigue and Improves Sleep

Poster presentation

2nd International Workshop on "Biological effects of Electromagnetic fields", 7-11 October 2002 , Rhodes, Greece.

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ABSTRACT

Research suggests that people exposed to 50 Hz magnetic fields (MFs) may show symptoms of chronic fatigue (CF) 1. We studied 49 subjects suffering from CF and CFS (Chronic Fatigue Syndrome) who were exposed to mains frequency MFs in their homes. Some highly exposed subjects (>2 mG) were given advice on how to reduce their exposure levels. Those exposed to <2 mG were given no such advice. After 6 months, 64% of those in the high exposure group but only 12% in the low exposure group reported improved sleep quality. It is proposed that the sleep quality changes were due to a reduction in the effects of MFs on melatonin secretion, a hormone known to be involved in the timing and quality of sleep.

INTRODUCTION

Clinically, CFS is characterised by incapacitating fatigue of at least 6 months duration, usually with an abrupt onset accompanied by and infectious-like illness. It can affect every major system in the body. We have hypothesised elsewhere 1, 2 that exposure to power line frequency MFs may be a co-factor to consider in treating CFS/CF. Here, we report some of the results from a pilot study designed to tests this hypothesis.

METHODS

Subjects were drawn from 3 Australian States: Victoria, South Australia, and Tasmania. All were being treated by a medical practitioner for CFS/CF at the time of the study. Through a questionnaire, we collected data on the presence and severity of 86 physical symptoms, CFS/CF symptoms, and a wide range of factors that might influence responses - blood iron levels, sleep patterns, use of a mobile phone, and much more. In all, 202 questionnaires were distributed and 49 subjects responded. Of these, 35 were female and 14 male with an age range of 17 -72 years.

Measurement of the MFs was carried out with an F. W. Bell Triaxial Extremely Low Frequency [ELF] MF meter. Measurements were taken over 2 weeks at times to suit the subjects. Generally, one set of measurements were done with most appliances off and another set with most appliances on. Readings were taken from the centre of a room one meter above the ground. Areas close to meter boxes, wiring concentrations, and water pipes were also monitored.

RESULTS

We found no relationship between CFS/CF symptom severity and the average MF strength subjects were exposed to.

Of the 49 subjects, 11 were clearly exposed to an average MF >2 mG (Group A) and another 34 to an average MF of < 2 mG (Group B). (Some subjects' data could not be included.) Group A was given advice and assistance on how to reduce exposure; Group B was given no such advice. Six months later subjects were again questioned, especially in regard to their CFS/CF symptoms and sleep quality.

TABLE 1

Percentage change in health systems 6 months after initial contact.

Improvement	None	Slight	definite
Group A (>2mG)	45	0	55
Group B (<2mG)	68	18	14

Table 1 shows that those who received advice were more likely to report improvements in their symptoms. Interestingly, 64% of Group A reported a marked improvement in sleep quality, whereas only 12% of Group be reported this change.

Note: Only some of our results are reported here.

CONCLUSIONS

Power line frequency MFs do not seem to be related to CFS/CF symptom severity. However, the point estimates of MF strength we obtained were less than satisfactory. A future study will equip each subject with a portable meter so that MFs can be tracked both in the home and elsewhere.
There is some evidence that reducing MF exposure assists in reducing CFS symptoms and improving sleep quality. Our findings on sleep quality are consistent with those of other researchers who found that a 50 Hz MF interfered with sleep 3. Several investigations show that ELF MFs can suppress melatonin release, a hormone known to be involved in circadian functioning. Reducing MFs may improve sleep quality by enabling a more normal pattern of melatonin secretion.

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The Ross House Electrical Substation
Workcare compensation case, Melbourne Victoria, 1991-1992.

Link: http://www.emfacts.com/download/The_Ross_House_Electrical_Substation.pdf

Workplace Chronic Fatigue Syndrome (CFS) symptoms attributed to exposure to electromagnetic fields (EMF) due to close proximity to an electrical substation

Compiled Jan - Feb. 1999. EMFacts Consultancy

Extract Summary.
Sick Building Syndrome: 4 cases of chronic fatigue symptoms in one office directly above an electrical substation

Workcare Compensation Services, Melbourne Victoria, 1991-1992. The following is taken from the Workcare documentation for this case and interviews with the claimant on January 1999. The claim was for "Chronic tiredness "arising from excessive "exposure to high levels of electromagnetic radiation due to a substation located at place of work.".
At the time of this case, the main woman involved (Mrs X) was 43 years old and had commenced working as a manager with a community services organisation in downtown Melbourne in September of 1989. In August 1990 she moved, with her assistant, into another office on the other side of the building which was located directly above a Melbourne electricity supply sub-station, located in the basement. Not long after moving into this office, she started to develop a feeling of general tiredness and also developed what she described as a cloudiness about the head and other health problems, such as bouts of depression and an overall lack of energy. At that stage she suspected that she may have been affected by a degree of stress due to a heavy workload. She was not overly worried by the condition at the time and thought it would improve with time. She did not relate her symptoms to anything to do with the sub-station. Importantly her assistant was also having similar health problems which only started after moving into the office.

In December 1990 she had a melanoma surgically removed from her left calf muscle. Following surgery she continued working but was still constantly tired. During the Christmas period of 1990, she took two weeks holiday break. During this period her condition improved slightly, but upon returning to work, the general washed-out feeling worsened with severe premenstrual tension. In February 1991 she developed a viral complaint and also an asthmatic condition as a consequence of that. She was prescribed Ventolin.

Shortly afterword she took a six week holiday and visited England and Holland. During this time the general tiredness improved slightly, although not to any significant degree but within three weeks of her returning to work all the conditions affecting her were back in full force. Various medical tests were conducted but nothing could be determined. In the following months there was no improvement and she believed her conditioned worsened to some degree. Her assistant also continued to suffer similar health problems.

In late September 1991, a computer was being installed in the office, but the technician advised the woman that the computer could not be installed due to a very high magnetic field in the room. As a consequence, it was decided to have some tests conducted to determine if there was a problem with electromagnetic fields within the office.A consultant was called in and testing was conducted on October 16, 1991. Electromagnetic field readings indicated very high magnetic fields coming from the sub-station below the office. The average exposure was **31 mG** during the survey period. Peaks measured in the office area were **187 mG** at floor level and **94 mG** at desk level. In contrast her previous office at the other end of the building was only 0.7 to 1.5 mG. As a result of this the office was vacated in October 1991 after 15 months exposure to excessive EMFs. In late 1991 she attended the Peter McCallum Hospital due to soreness in her left leg in the region of the previously removed melanoma. There were two benign growths which were removed. Her symptoms, which developed over the period of 15 months working in the effected office, were as follows:

Chronic tiredness/fatigue Insomnia: waking around 3 am with an inability to go back to sleep **Stress Inability to concentrate Fluctuating hormone levels :** (estrogen/progesterone) diagnosed in November 1991 **Anaemia:** diagnosed in November 1991 (low zinc levels also found) Iron tablets & vitamin C prescribed **A facial rash** which became apparent in August 1991 **Depression Severe premenstrual tension.**

Her assistant who worked in the office also had similar health complaints but to a lesser extent, possibly because her desk was located in a lower field level and she only worked part time. The assistant's health complaints, as detailed in her written statement were:
Constant tiredness A feeling of listlessness Light headedness Insomnia Depression Severe premenstrual tension She described her overall feeling as, "a permanent severe case of jet lag"
Upon moving into another office, the assistant's health gradually improved.

It is significant that most of the above symptoms are described in an occupational health and safety publication, published by the Swedish Union of Clerical and Technical Employees in Industry (Nov. 1996), as due to excessive electromagnetic field exposure in the workplace.

An earlier report by the Swedish National Institute of Occupational Health (1992) found similar health problems and additionally found "more that one employee in seven was hypersensitive to electrical fields."

As of January 1992 Mrs "X' reported some slight improvement in her condition and was still working for her employer in another part of the building. A medical report in May of 1992 found that she still had major symptoms of fatigue and a disturbed sleep cycle. This report concluded that her condition came under the broad category of Chronic Fatigue Syndrome (CFS).

To quote from this medical report:

"In many of these [CFS] patients there is a susceptibility to a diverse range of environmental stressors. There are usually reasons for an exacerbation. The combined effects of a high EMF, other environmental factors and the ongoing stress of being unwell with no explanation can I believe create a fatigue syndrome. . . The mechanism by which [Mrs. "X"] is affected is unclear, though there is evidence to suggest that EMF can have profound effects on the central nervous system (CNS). One area of the CNS, the pineal, is more susceptible that other areas. It controls other areas of the body through the hypothalamus, which regulates rhythms and hormonal responses. This is of considerable importance in her case where abnormalities in this area have been documented."

As of January 1999 Mrs. "X" reported that it was well into 1993 before she had recovered her previous health but had developed various food allergies which she thought may have been a result of the high EMF exposure.

As part of the workers' compensation claim for this case, Workcare solicitors contacted two employees who had previously worked in the office in question. Quotes from their written statements are as follows:

A) A 45 year old female
" When I moved to ____ , I was in good health and was very fit. Within a short period of time after moving to ____ , my health deteriorated. I started to become listless. I developed headaches. I had trouble sleeping and became washed out. My abilities to cope with the job diminished. I couldn't concentrate. I was surprised at the way my health diminished. I couldn't understand what the problem was. In early 1989 I developed a viral infection which weakened me further. I attended my GP in the early part of 1989. He suggested I may have been affected by Chronic Fatigue Syndrome. . . I attended a naturopath, various forms of tablets/herbs [were prescribed]. Over the period of many months, I slowly improved. Every few weeks my health would go downhill for several days at a time. I lost regular time from my work which was unusual for me. There was no significant improvement to my health until I moved out of ____ in early 1990. Within a short space of time, I started to regain my energy. . . . I now enjoy good health and no longer suffer any of those health problems I experienced at ____ . . . . Some of the other girls (in fact everybody) I worked with in the same office developed similar health problems to myself, being chronically fatigued, listless and had trouble concentrating."

B) A 30 year old female
"I was in good health when I started at ____ . I didn't have any history of ill health and was not prone to taking sick days. I was working full within the office. I can't be specific about dates, but for most the entire period of my working at ____, I was troubled by headaches, listlessness, an inability to concentrate for lengthy periods of times and I guess would be described as a washed out feeling. I had no idea what was causing the above. It was unusual for me to feel that way and there definitely was no history of same. Because of my general condition, I took sick days. I seemed more prone to any virus that was going around. I didn't seek medical treatment. Some of my colleagues were affected to varying degrees. We moved out in August 1990 for a number of reasons, part which related to our inabilities to cope with the overall work environment. As soon as I moved from ____ to 155 Lygon Street, my health started to

improve. Within a few months of moving away from ____,
those conditions previously described ceased to affect me and I was back to the good health I'd been in before ____ ."

The office room in question remained vacant for about two years until the sub station was shielded for a cost of $20,000. This measure greatly reduced the fields in the office space but still not to a level suitable for normal occupancy. It is now used for purposes where no one spends prolonged amounts of time in the area.

The full report is available in hard copy only

From Electromagnetics Forum, A News Report on the Health Effects of Electromagnetic Energy.
Volume 1, No. 2. Winter (Australia) 1997

Article 10 pages 23-26

Link: http://www.emfacts.com/download/Forum_2.pdf

Swiss shortwave transmitter study sounds warning

Review by Dr. Neil Cherry

Study on Health Effects of the Shortwave Transmitter Station of Schwarzenburg, Berne, Switzerland (Major Report)

Background:

A short wave transmitter was installed at Schwarzenburg, near Berne, Switzerland, in 1939. An star antenna was added in 1954 with three 150 kW outputs (6.1-21.8Mhz). and a 250 kW LOG PER antenna was added in 1971. The final transmitter is only used occasionally. Since the Seventies, health complaints have been reported by the population in the surroundings of the transmitter, and associated with its activity. On the 2nd March 1990, a petition seeking a scientific evaluation of the health damage allegedly cause by the transmitter was handed by a group of inhabitants to the Swiss Federal Department of Traffic and Energy (SFDTE). In October 1990, the Head of SFDTE commissioned a study. It was carried out by 15 doctors and scientists, primarily from the University of Berne, but also from 4 other agencies. Their report, Altpeter et al. (1995), was published in August 1995.

Altpeter et al. (1995) carried out an extensive evaluation of health affects, using a carefully crafted health diary survey. They found significant changes is various indicators which increased with proximity to the mast and were significantly worse in elderly people. They included nervosity (restlessness), difficulty in falling asleep, difficulty in maintaining sleep, general weakness and joint pains, Figure 1.
Sleep difficulty was especially disturbing. This leads on to increasing fatigue and reduced feelings of well-being. Observed nocturnal sleep changes occurred in association with the nocturnal exposure levels in Table 1. Hence the sleep disturbance is associated with a maximum exposure of 1.85uW/cm2 and a mean nocturnal Zone A exposure of less than 0.7 uAW/cm2.

People living in a mean RF exposure of 3.8 uW/cm2, which is about 100 times higher than an unexposed group, have a significantly elevated level of restlessness, sleep disruption, aches and pains and phlegm problems, all problems which were significantly worse for those aged over 45 years.

There is a clear trend for those over 45 years to show more significant reactions in association with increased shortwave RF exposure from the Schwarzenburg mast. The later six symptoms are added to those which already show a significant Odds Ratio.
The variables "Nervosity and inner restlessness", "General weakness and tiredness" and "Difficulties in falling asleep" are strongly related and therefore collapse into one variable, which could be termed "Chronic fatigue syndrome".

This study reveals statistically significant association between an extremely low intensity RF field (Zone A (High intensity) average = 0.236 uW/cm2) and a wide range of health and well-being variables. While this does not constitute "proof" of effects, in public health epidemiology, a statistically significant association which is not weakened by confounders, is sufficient avoidance action to be taken to reduce or eliminate the risk. Hypochondria was tested for and was not found.

Interim Conclusion:

"Insomnias and joint pains, especially in the elderly, were more frequently reported in Zone A than in Zones B and C. They showed a dose-response relationship with the logistic regression and they were not related to a health-worry personality. Further studies are of need to establish a biophysical mechanism.

The Schwarzenburg Study was extended because of the significance of the initial findings. Melatonin secretion in people and cows was studied in relation to the sleep disorders identified, blood pressure was studied in relation to the health issues raised and the performance of school children was assessed in relation to brain disturbance indication such as difficulty in concentrating.

Sleep disturbance and melatonin:

Sleep difficulty was especially disturbing. Significance was added to the association when the transmitter was turned off unexpectedly and unknown to the residents, in the middle of the study. Affected sleep patterns recovered until the transmitter was turned on again, when they deteriorated again.

Melatonin, a neurohormone produced by the pineal gland to regulate the daily sleep/wake pattern was studied in a sample of people, without finding significant changes, However, saliva melatonin concentrations from exposed cows showed a strong higher nightly peak level compared to the average when nightly peak which the transmissions were on. The overall median melatonin levels for the five tested exposed cows was 17.7 pg/ml (sd=1.25) while it was 19.0 pg/ml (sd=1.32) for the non-exposed ones. This exposed cows had lower melatonin levels but not necessarily significantly lower.

Lower levels of melatonin with exposure to RF radiation would be consistent with depressed nocturnal melatonin observed with ELF exposure, Reiter (1992). In other studies reduced melatonin has also been related to elevated incidence of breast cancer, Demers et al. l (1991).

Blood Pressure Reporting:

A small number of inhabitants reported noticeable changes in heart beat (irregular, palpitations, pounding with effort). Individually these factors were not significant but they indicate a possible, more serious, health issue to do with stresses on the heart. The researchers therefore surveyed for blood pressure differences. When asked about their blood pressure only 55% in Zone Z and 56% in Zone B said they had normal blood pressure compared to 74% in Zone Z. The differences are significant at the p=0.01 level. In addition, arterial hypertension was reported more frequently in Zone A (14%) than in Zones B (8.4%) and C (7.9%).

School children's performance:

Rates of promotion of children in a school near the transmitter were compared with unexposed schools nearby. The number of school children at the highly exposed school is too small for conclusive studies of a probable effect of electromagnetic fields. However, the accumulated promotion from primary to secondary school since the 1950s, is lower in the exposed school than a control school. They conclude: "An effect of the transmitter is a possible explanation, but other influences including socio-economic differences cannot be excluded".
Hence a potential effect on children's performance does exist in association with the RF transmissions from the tower. This is consistent with human brain EEG disruption found by Von Klitzing (1995) and the reported symptom of "difficulty in concentration". "restlessness" and "difficulty of falling asleep" and "maintaining sleep", as reported by significantly more of the adults in Zone A compared to Zones B and C.

Conclusions:

This is a very significant study which records statistically significant associations, with dose-response relationships for many of the factors, factors which are fundamental to human health and well-being, which have adverse effects in association with increased RF shortwave radiation at mean and median exposure levels about 1000 times lower than the so-called "public safety standard". This proves the total inadequacy of the standard for protecting the pubic from the significant disruption to their health and well-being identified in this study. The authors of the Schwarzenburg Study conclude: "Our results indicate a higher frequency of disorders of a neurovegetative nature among residents up to about 1000 m from the transmitter, and are highly suggestive of a direct effect of the radio shortwave transmitter on sleep quality".

APPENDIX T

More on the Swiss Shortwave Transmitter study. (*Microwave News*, Sept/Oct 1996, page 14)

In a letter to the New York based publication Microwave News, Dr. Josef Mayr, a Swiss consultant in electromagnetic compatibility, points out that that the actual risks may have been understated in this study. His letter is partly reproduced as follows:
"The objective of the study was to find possible relationships between RF/MW exposures and health problems - not between living in certain zones and health
problems. Why then did the researchers present nearly all the results in terms of the geographic zones?

Given such misclassification of exposures, much stronger correlations between RF/MW radiation and health problems - for example, irritability, headaches, tiredness and sleep problems - would have to be expected, if the study population had been classified according to field strengths rather than geographic zones. In the meantime, it has been announced that researchers will take a new look at the data and the conclusions.

Nevertheless, the results of the study are sensational. In a May 29, 1996, letter, an expert group at the Swiss Federal Office for Environment, Forests and Landscape (known by its German acronym, (BUWAL) admitted that severe sleep disorders were correlated with RF/MW exposures, even though the IRPA limits were never exceeded.

Sleep disorders and the other complaints reported in the study may seem innocuous compared to the cancers reported in other epidemiological studies. But if such disorders remain for years their long-term effects could be quite serious, particularly among children and the infirm.

The lesson of this study is that the safe level of RF/MW radiation exposure should be lowered to those found between zones B and C. This implies a reduction from IRPA's 0.2mW/cm2 (200uW/cm2) to approximately 0.002uW/cm2 - a reduction by a factor of 100,000.

Another important conclusion is that the grounds on which the IRPA recommendations are based (i.e., neglecting non-thermal effects) are entirely wrong. Exposure limits for low-and high- frequency electromagnetic fields and radiation (0Hz - 300GHz) should be revised."

American Academy of Environmental Medicine

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American Academy of Environmental Medicine Recommendations Regarding Electromagnetic and Radiofrequency Exposure

Physicians of the American Academy of Environmental Medicine recognize that patients are being adversely impacted by electromagnetic frequency (EMF) and radiofrequency (RF) fields and are becoming more electromagnetically sensitive.

The AAEM recommends that physicians consider patients' total electromagnetic exposure in their diagnosis and treatment, as well as recognition that electromagnetic and radiofrequency field exposure may be an underlying cause of a patient's disease process.

Based on double-blinded, placebo controlled research in humans,[1] medical conditions and disabilities that would more than likely benefit from avoiding electromagnetic and radiofrequency exposure include, but are not limited to:

- Neurological conditions such as paresthesias, somnolence, cephalgia, dizziness, unconsciousness, depression
- Musculoskeletal effects including pain, muscle tightness, spasm, fibrillation
- Heart disease and vascular effects including arrhythmia, tachycardia, flushing, edema
- Pulmonary conditions including chest tightness, dyspnea, decreased pulmonary function
- Gastrointestinal conditions including nausea, belching
- Ocular (burning)
- Oral (pressure in ears, tooth pain)
- Dermal (itching, burning, pain)
- Autonomic nervous system dysfunction (dysautonomia)

Based on numerous studies showing harmful biological effects from EMF and RF exposure, medical conditions and disabilities that would more than likely benefit from avoiding exposure include, but are not limited to:

- Neurodegenerative diseases (Parkinson's Disease, Alzheimer's Disease, and Amyotrophic Lateral Sclerosis). [2-6]
- Neurological conditions (Headaches, depression, sleep disruption, fatigue, dizziness, tremors, autonomic nervous system dysfunction, decreased memory, attention deficit disorder, anxiety, visual disruption). [7-10]
- Fetal abnormalities and pregnancy. [11,12]
- Genetic defects and cancer.[2,3,13-19]
- Liver disease and genitourinary disease.[12,20]

Because Smart Meters produce Radiofrequency emissions, it is recommended that patients with the above conditions and disabilities be accommodated to protect their health. The AAEM recommends: that no Smart Meters be on these patients' homes, that Smart Meters be removed within a reasonable distance of patients' homes depending on the patients' perception and/or symptoms, and that no collection meters be placed near patients' homes depending on patients' perception and/or symptoms.

Submitted by: Amy L. Dean, DO and William J. Rea, MD Approved July 12, 2012 by the Executive Committee of the American Academy of Environmental Medicine

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APPENDIX V

International Agency for Research on Cancer (IARC)

Link: http://www.thelancet.com/journals/lanonc/article/PIIS1470-2045(11)70147-4

Carcinogenicity of radiofrequency electromagnetic fields

Robert Baan a, Yann Grosse a, Béatrice Lauby-Secretan a, Fatiha El Ghissassi a, Véronique Bouvard a, Lamia Benbrahim-Tallaa a, Neela Guha a, Farhad Islami a, Laurent Galichet a, Kurt Straif a, on behalf of the WHO International Agency for Research on Cancer Monograph Working Group

In May, 2011, 30 scientists from 14 countries met at the International Agency for Research on Cancer (IARC) in Lyon, France, to assess the carcinogenicity of radiofrequency electromagnetic fields (RF-EMF). These assessments will be published as Volume 102 of the IARC Monographs . 1

"In May, 2011, 30 scientists from 14 countries [the Working Group] met at the International Agency for Research on Cancer (IARC) in Lyon, France, to assess the carcinogenicity of radiofrequency electromagnetic fields (RF-EMF)...

Human exposures to RF-EMF (frequency range 30 kHz–300 GHz) can occur from use of personal devices (eg, mobile telephones, cordless phones, Bluetooth, and amateur radios), from occupational sources (eg, highfrequency dielectric and induction heaters, and high-powered pulsed radars), and from environmental sources such as mobile-phone base stations, broadcast antennas [including tv and radio], and medical applications...

EMFs generated by RF sources couple with the body, resulting in induced electric and magnetic fields and associated currents inside tissues. The most important factors that determine the induced fields are the distance of the source from the body and the output power level...

Holding a mobile phone to the ear to make a voice call can result in high specific RF energy absorption-rate (SAR) values in the brain, depending on the design and position of the phone and its antenna in relation to the head, how the phone is held, the anatomy of the head, and the quality of the link between the base station and phone. When used by children, the average RF energy deposition is two times higher in the brain and up to ten times higher in the bone marrow of the skull, compared with mobile phone use by adults. Use of hands-free kits lowers exposure to the brain to below 10% of the exposure from use at the ear, but it might increase exposure to other parts of the body.

Epidemiological evidence for an association between RF-EMF and cancer comes from cohort, casecontrol, and time-trend studies. The populations in these studies were exposed to RF-EMF in occupational settings, from sources in the general environment, and from use of wireless (mobile and cordless) telephones, which is the most extensively studied exposure source...

The Working Group... reviewed many studies with endpoints relevant to mechanisms of carcinogenesis, including genotoxicity, effects on immune function, gene and protein expression, cell signalling, oxidative stress, and apoptosis. Studies of the possible effects of RF-EMF on the blood-brain barrier and on a variety of effects in the brain were also considered. Although there was evidence of an effect of RF-EMF on some of these endpoints, the Working Group reached the overall conclusion that these results provided only weak mechanistic evidence relevant to RF-EMF induced cancer in humans.

In view of the limited evidence in humans and in experimental animals, the Working Group classified RF-EMF as 'possibly carcinogenic to humans' (Group 2B). This evaluation was supported by a large majority of Working Group members."

IEEE Xplore

Electromagnetic absorption in the human head and neck for mobile telephones at 835 and 1900 MHz

Link:
http://ieeexplore.ieee.org/xpl/login.jsp?tp=&arnumber=539947&url=http%3A%2F%2Fieeexplore.ieee.org%2Fxpls%2Fabs_all.jsp%3Farnumber%3D539947

This paper appears in:
Microwave Theory and Techniques, IEEE Transactions on **Date of Publication:** Oct 1996 **Author(s):** Gandhi, O.P. Dept. of Electr. Eng., Utah Univ., Salt Lake City, UT Lazzi, G. ; Furse, C.M.
Volume: 44 , Issue: 10 **Page(s):** 1884 - 1897 **Product Type:** Journals & Magazines

ABSTRACT

The authors have used the finite-difference time-domain method and a new millimeter-resolution anatomically based model of the human to study electromagnetic energy coupled to the head due to mobile telephones at 835 and 1900 MHz. Assuming reduced dimensions characteristic of today's mobile telephones, the authors have obtained SAR distributions for two different lengths of monopole antennas of lengths $\lambda/4$ and $3\lambda/8$ for a model of the adult male and reduced-scale models of 10- and 5-year-old children and find that peak one-voxel and 1-g SARs are larger for the smaller models of children, particularly at 835 MHz. Also, a larger in-depth penetration of absorbed energy for these smaller models is obtained. The authors have also studied the effect of using the widely disparate tissue properties reported in the literature and of using homogeneous instead of the anatomically realistic heterogeneous models on the SAR distributions. Homogeneous models are shown to grossly overestimate both the peak 1-voxel and 1-g SARs. Last, the authors show that it is possible to use truncated one-half or one-third models of the human head with negligible errors in the calculated SAR distributions. This simplification will allow considerable savings in computer memory and computation times.

From Microwave News, May 3, 2010

Link: http://microwavenews.com/children.adults.html

Children and Cell Phones: Time To Start Talking Sense

May 3, 2010

Fifteen years ago Om Gandhi pointed out that children are exposed to higher levels of radiation from cell phones than adults. He was right then and he is right today. Yet, no one could blame you for thinking otherwise.

In an article published in the May issue of *Harper's,* Nathaniel Rich uses this putative controversy, among a number of other examples, to make the case that confusion reigns in all aspects of cell-phone research. "The brain of a child absorbs a much greater amount of radiation from a cell phone than does the brain of an adult," he writes, adding immediately after, "No, it does not."

The truth is that there should be no controversy. Children do have higher radiation exposures and if cell phones are indeed doing us harm, then children are at greater risk than their parents.

"There is nothing complicated about why children absorb more radiation than adults," Gandhi told *Microwave News* from his office at the University of Utah not long ago. Children have thinner skulls and smaller ears than adults, he explained, and so the radiation has a shorter distance to travel from the phone to the brain. (Every millimeter of separation makes a big difference.) Because more radiation gets to the brain, the specific absorption rate (SAR), the preferred way to measure the radiation dose, increases. That's it. You don't need any complicated equations, or even a computer to see the big picture. "The higher SARs have nothing to do with sophisticated models," Gandhi said, "It's all about separation distance. This is something you can explain to your mother-in-law."

Gandhi's original 1996 graphics showing that 5-year-old and 10-year-old children have higher SARs than adults (reproduced below) have achieved iconic status. Ronald Herberman, the former director of the University of Pittsburgh Cancer Institute, and his colleague Devra Davis fashioned a three-dimensional model of Gandhi's pictures —with Gandhi's assistance— to emphasize the higher SARs and the deeper penetration of the radiation in a child's brain. They have exhibited it at Congressional hearings, on various TV shows and during myriad lectures and presentations. Their message, summarized by Herberman in a memo distributed to the some 3,000 members of the cancer institute's faculty and staff in July 2008, calls for precaution, especially with respect to children (see "Who's for Precaution, Who's Not"). "Do not allow children to use a cell phone, except for emergencies," Herberman advised because, "The developing organs of a fetus or child are the most likely to be sensitive to any possible effects of exposure to electromagnetic fields."

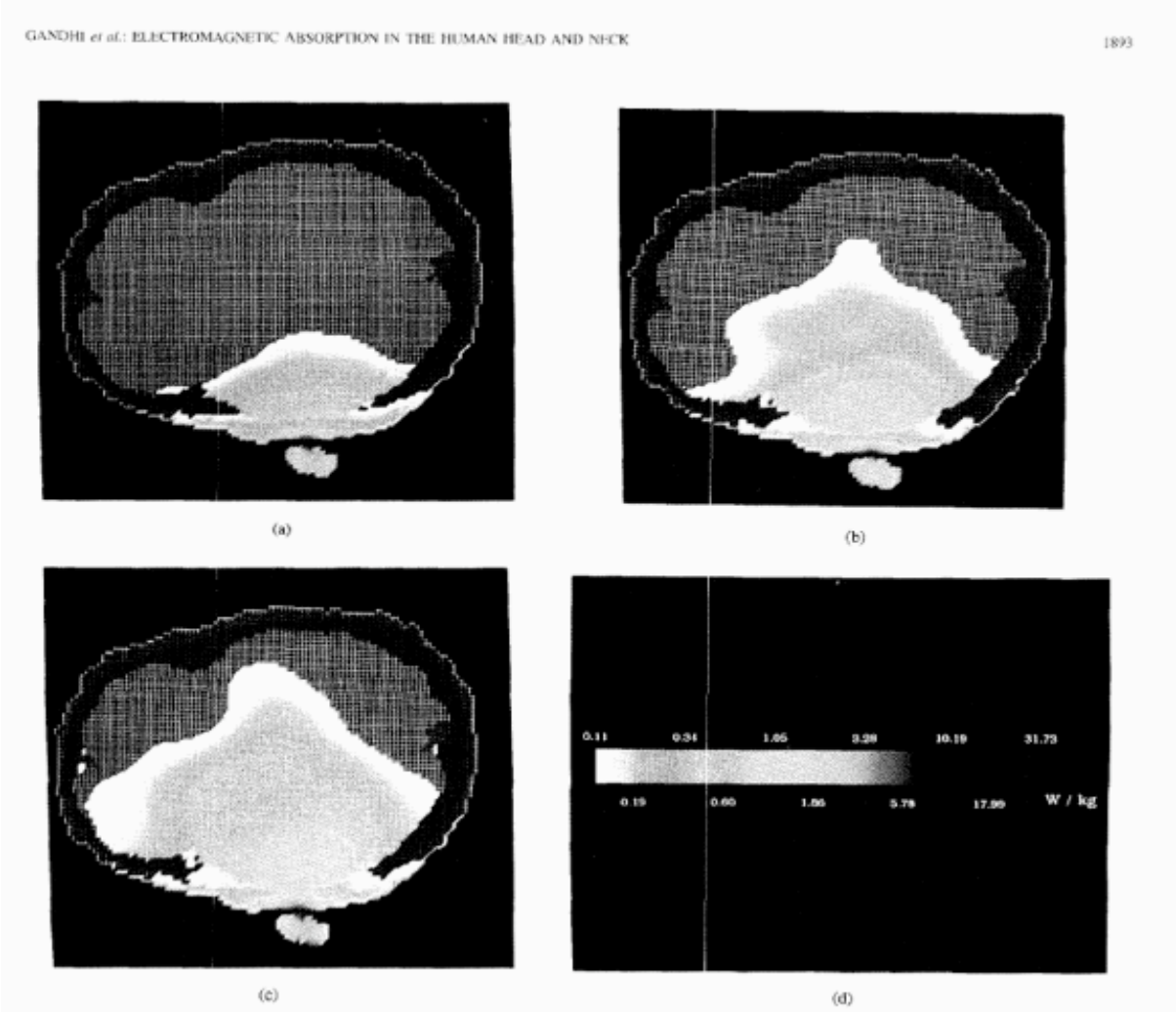

Fig. 2. The SAR distributions for layer no. 34 for models of an adult male and 10-year and 5-year-old children (a)–(c). (d) Scale. This layer contains the feed point and is 2 cells lower than the cross-sectional plane passing through the top of the ear for each of the models. Frequency = 835 MHz. Radiated power = 600 mW.

Figure 1
SAR distributions at 835 MHz for: (a) adult; (b) 10-year-old; (c) 5-year old. (d) is the SAR scale.
Source: O. Gandhi *et al., IEEE Transactions on Microwave Theory and Techniques, 44,* p.1893, 1996

Much of the cell-phone industry is still in denial, however, and disputes the increased risk for children. In a brochure released earlier this year, the Mobile Manufacturers Forum (MMF), a leading cell-phone industry trade group, continues to insist that others have been unable to find support for Gandhi's conclusion. MMF's argument is tautological: It cites Gandhi's 1996 paper as evidence that that same 1996 paper is wrong. Then again, perhaps it does make sense. If industry's objective is to sow seeds of confusion, using Gandhi against Gandhi would be entirely appropriate.

Some of those who should be trying to set the record straight are dragging their feet. Take, for instance, Michael Thun, the American Cancer Society's (ACS) point man on cell phones. Last month, Thun told *Parade* magazine and its 75 million readers that, "If cell phones were harmful, then it is conceivable that children might be more vulnerable." *Conceivable?* No, it's a fact. As Gandhi points out: It's simple high school geometry.

Today, Gandhi has many supporters. Research groups in Brazil, France, Japan, Spain and Switzerland have all published papers showing that children have higher SARs. Joe Wiart of France Telecom, a major mobile-phone operator, should have put the issue to rest two years ago when he announced that he agreed with Gandhi. (The MMF neglects to cite Wiart's paper in its brochure.) "Children are not simply small adults," Wiart told us at the time. "Their skin and their skulls are thinner than those of adults, and their ears are smaller too. Given these differences, the higher SAR for children is not surprising" (see our post of June 22, 2008). The industry does not speak with one voice: One large company says Gandhi is right, while others fight on.

Even Niels Kuster, the director of the IT'IS Foundation in Zurich, who has feuded with Gandhi for more than a decade, has decided that he can no longer turn back the tide (see *MWN*, N/D01, p.8, and *MWN*, M/J02, p.1). Kuster's work is often been cited to make the case that children are no different than adults. One example: The MMF brochure points to two Kuster papers to bolster its argument. Kuster counters that he has been misunderstood. "In the 1990s, we were talking about *compliance*," he told *Microwave News*, "My position was never about whether or not children get more radiation exposure in the brain, but whether the phones meet exposure standards when used by children." Kuster told us that Gandhi's revelation is "trivial" —which is what Gandhi has been saying all along.

Children's Brains Are Different

And there's more: Children also have a greater sensitivity to cell-phone radiation. For years, some have argued that young children are more vulnerable because their brains are still developing. This is Herberman's argument in favor of precaution, and, while plausible, there wasn't much hard data to back it up. Now, Andreas Christ of Kuster's lab has reported that the SAR in the bone marrow of children is more than ten times higher than that in adults. Or, to put it bluntly, the same amount of radiation packs ten times the punch inside a child's bone marrow as in his mother or father's bone marrow. The new paper came out last month in *Physics in Biology and Medicine*.

Christ and Kuster's finding could not have been a big surprise to those who follow the field. Last year, Azadeh Peyman and Camelia Gabriel, another veteran RF researcher who runs MCL Technology Ltd., a testing firm in London, showed that some children's tissues have very different electrical properties than those of adults. These are known as dielectric properties and, in this context, refer to the conductivity (σ) and the permittivity (ε). (The SAR is directly proportional to the conductivity.) Peyman and Gabriel worked with samples from freshly killed pigs of different ages, which, they said, "are regarded as a good substitute for human tissues." They reported that the conductivity of a piglet's bone marrow was ten times higher than that of an adult pig. The reason for the big difference is that bone marrow has a higher water content in early life. The more water, the higher the conductivity, which in turn leads to a higher SAR. Christ and Kuster then used Peyman and Gabriel's new numbers to calculate the relative SARs in children and adults. (Follow this link for a look at the SAR arithmetic.)

If Gandhi's contribution is about the importance of separation distance, the lesson from the Swiss and U.K. groups is about the importance of biophysical properties. Each tells us that the SARs are higher in children.

One remarkable aspect of the Peyman/Gabriel paper is that, having measured the dielectric properties, they did not take the next step and show that the SAR in a child's bone marrow would be higher. Peyman and Gabriel were working under a ~$600,000 (£408,000) research grant from the U.K. mobile phone research program, known as MTHR. They could have done the same SAR calculation as Christ and Kuster, or at least pointed to and compared the conductivities. Yet, Gabriel and Peyman did neither. When asked why not, Gabriel replied that this would have required "speculation." Maybe so, but that was the problem they were hired to study. Another peculiar disconnect is that Peyman and Gabriel only looked at RF exposures from walkie-talkies, not cell phones. This too doesn't make much sense. When was the last time you saw a child talking into a walkie-talkie?

Gabriel and Peyman's decision not to draw the obvious inference about the higher SARs is all the more surprising because they had long known that the dielectric properties of bone marrow change with age. Back in 2001, they had reported a similar change in rat tissues —that time too, they didn't say a word about how it might raise the SARs. Yet, Gabriel realized its significance. "Children are not little adults," she told a meeting in Rome

on children and cell phones the following spring. "We cannot afford not to do more research," she said (see *MWN*, M/J02, p.10).

At about the same time that Gabriel was delivering her talk in Rome, Gandhi published a new paper that showed what Gabriel and Peyman must have already known but had not stated in print: The higher conductivity found in baby rats means higher SARs in young children. Gandhi minced no words about the necessity to follow up. These results point to "an urgent need" to validate the finding for rats in children, he pleaded.

Still, seven years later when Gabriel finally had the better data from pigs to support everyone's long-held suspicions that children might be at greater risk, she once again held back.

While Christ and Kuster have shown that the SAR is higher in a child's bone marrow, we still don't know the dose (the SAR). It may be ten times higher than in adults, but we need the actual number, or at least a range of SARs. "That's coming," Kuster said. "We have a new research grant from the Swiss National Science Foundation to look at SARs induced by phones in specific tissues."

Slicing and Dicing SARs

The SAR is a curious quantity for setting exposure limits because it cannot be directly measured. You can't stick a probe into a live brain, nor can you work with dead tissues —the electrical properties of the tissues change as soon as the organism dies. Instead, one is left with making physical models, called phantoms, or running computer stimulations.

A phantom is a primitive substitute for the human head. It's little more than a plastic shell filled with a liquid designed to mimic the dielectric properties of brain matter. A phantom makes no allowance for variations in types of tissue or for internal structure. Even so, making SAR measurements is more complicated than you might think. A committee of the IEEE spent six years developing a protocol on how they should be done. The protocol is a highly technical and generally impenetrable document that runs 148 pages, replete with opaque assumptions. [Here's a typical sentence: "A simple analytical model of an infinite half-space layered tissue model exposed to a plane wave was utilized to investigate the impact of impedance matching, scattering, standing waves, etc., on the peak spatial-average SAR."] The process was run by industry insiders, who prefer to work out of public sight. Minutes of the committee meetings are secret —even the agendas are password protected. A couple of years ago when *Microwave News* asked to be on the committee's mailing list, representatives from the FDA and Motorola, who chaired the panel, said no.

The protocol includes recipes to make the synthetic brain liquid: Start with deionized water, add salt, sugar, hydroxyethyl cellulose, etc. This gross simplification of what must be the most complex piece of evolutionary engineering is a conceit. As Allan Frey pointed out in 1979: "There is a very real question whether [an SAR] has any relevance to the biological organism." Frey, a well-known RF researcher now semi-retired and living in Potomac, MD, took the RF research community to task for relying on "a concept whose time came and went in the 1950s." Its use, he said, is "grossly misleading and "cannot be justified." No one wanted to hear it. Today, over 30 years later, SARs are by far the most common measure of dose and the same criticisms continue to echo. "The brain is not a giant bowling ball filled with fluid —that's ridiculous," Devra Davis told us recently.

You can see the simplicity of the approach using phantoms in the graphics below, Figure 2, taken from Christ and Kuster's new paper. They show SAR distributions based on measurements carried out under the IEEE protocol. Note how smooth the color contours are. No bumps, no discontinuities. The SARs go steadily down as you move away from the phone just as you would expect. There are a number of reasons why the pictures at 900 MHz and 1800 MHz are not the same: The radiation comes off the phone differently at the higher frequency and the dielectric properties of tissues vary with frequency. (The IEEE offers variations of the brain-fluid recipe for different frequencies.)

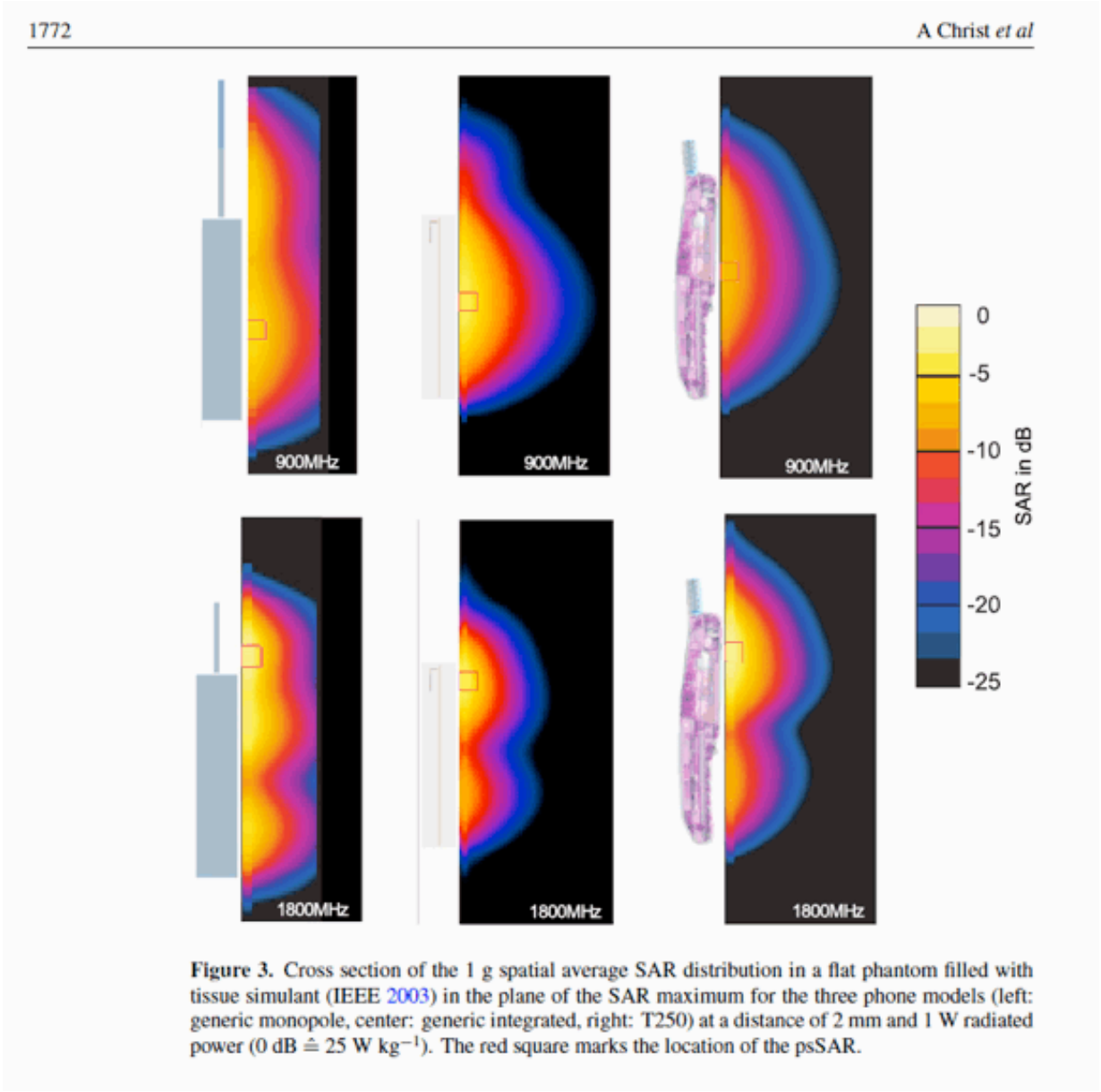

Figure 3. Cross section of the 1 g spatial average SAR distribution in a flat phantom filled with tissue simulant (IEEE 2003) in the plane of the SAR maximum for the three phone models (left: generic monopole, center: generic integrated, right: T250) at a distance of 2 mm and 1 W radiated power (0 dB ≙ 25 W kg^{-1}). The red square marks the location of the psSAR.

Figure 2
The yellow area has the highest SARs, followed by red, mauve and blue.
Source: A. Christ *et al., Physics in Medicine and Biology, 55,* p.1772, 2010

Computer models allow more complexity. By adapting MRI scans, representations of the head can have internal structure with a variety of different tissues, each with its own set of dielectric properties. Compare the Christ/Kuster phantom-based graphics with the pictures from computer models generated by Gandhi, Figure 3 below. He included 15 types of tissues. The simplicity is gone. Note especially the reddish areas inside the yellow zones in (b) and (c). They are regions of higher SARs called "hot spots," brought about by the mix of tissues. With phantoms, there are no hot spots.

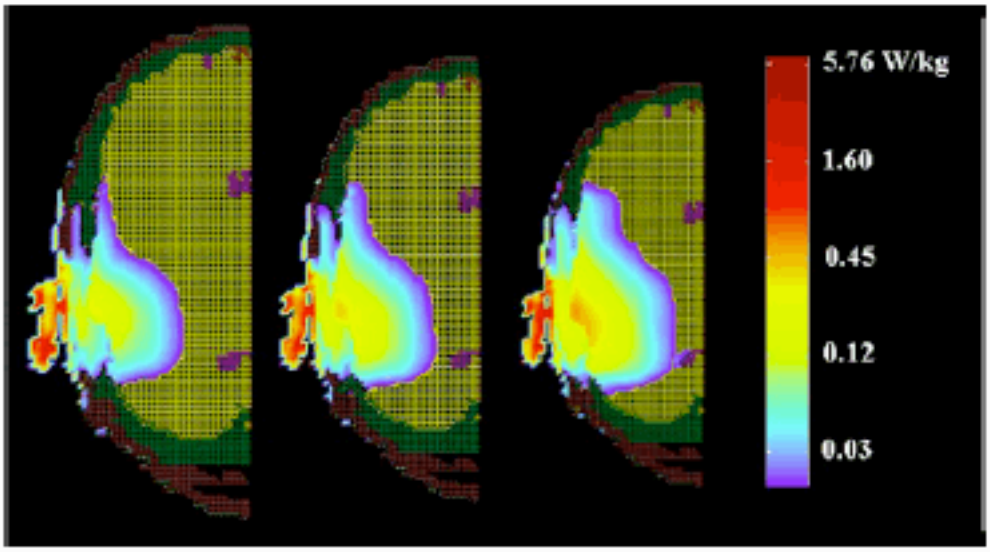

Figure 3. The SAR distribution for layer no 54 (below top of the head) for the scaled larger, average and smaller versions of the Utah head model at 1900 MHz. (a) 11.1% larger head model, (b) average head model and (c) 9.09% smaller head model.

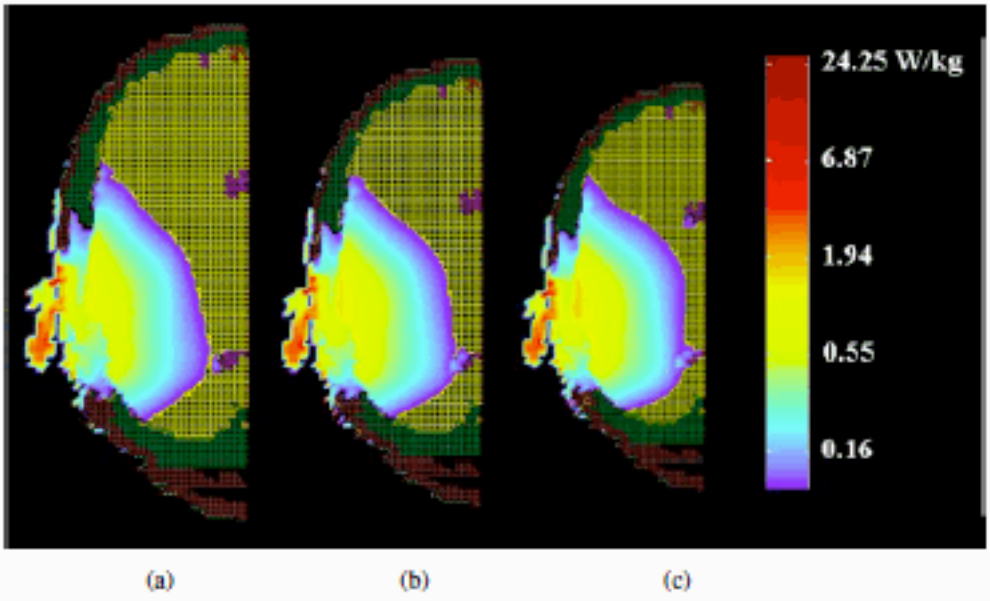

Figure 4. The SAR distribution for layer no 54 (below top of the head) for the scaled larger, average, and smaller versions of the Utah head model at 835 MHz. (a) 11.1% larger head model, (b) average head model and (c) 9.09% smaller head model.

Figure 3
SAR distributions in different sized heads: (a) large); (b) average: (c) small Here the red areas have the highest SARs, followed by yellow, aqua and purple.
Source: O. Gandhi and G. Kang, *Physics in Medicine and Biology, 47*, p.1512, 2002

The SAR is specified in energy per weight or volume of tissue, usually in watts per kilogram (W/Kg). The averaging volume for the SAR is a critical variable. For a given amount of energy, the larger the averaging volume, the smaller the SAR will be. Here's one way to think about it: A bathtub is half-full of cold water when the hot-water tap is turned on for a couple of minutes. What's the temperature of the bath water? It will, no doubt, be much warmer right under the tap than at the other end of the tub. But what about the average temperature? It depends on the averaging volume. A teaspoon of water taken from right under the tap would be quite hot, but the temperature would go down as more and more of the surrounding cold water is included in the averaging volume. If you consider all the water in the bath, the temperature would be about the same whether you measured it before or after the tap was turned on. The reddish spots in the Gandhi graphics would fade away as more of the lower SAR areas (in yellow) are averaged in.

The SAR can be manipulated by changing the averaging volume. The FCC requires that SARs be averaged over 1 g of tissue, while both the IEEE and ICNIRP specify a 10 g average. Why 1 g or 10 g? It's an arbitrary decision with no cogent biological rationale to favor one over the other. Yet, it makes a big difference. A 1 g average SAR is much stricter than a 10 g average, as Jim Lin, the editor-in-chief of *Bioelectromagnetics*, has long pointed out. The 1 g SAR can be twice as high as the 10 g SAR, or even higher (see *MWN*, J/A00, p.8, and *MWN*, N/D00, p.3). One implication of this is that European phones are built to a much looser radiation exposure standard than U.S. phones because their SAR limit is measured over 10 g rather than the 1g in the U.S.

Alvaro de Salles of the Federal University of Rio Grande do Sul in Porto Alegre, Brazil, has put all this together in the table below, taken from a paper he published a few years ago. The influence of the size of the head, the averaging volume and the dielectric properties, or parameters, are readily apparent.

Table 4
SAR—Quarter wavelength monopole (850 MHz), power = 600 mW

Model	Adult	10-year old child	
Electromagnetic parameters	Adult parameters	Adult parameters	Children parameters
		SAR values (W/kg)	
Peak SAR (one voxel)	3.68	5.97	6.20
1 g-SAR	1.8	2.38	2.89
10 g-SAR	1.7	1.74	2.05
Mean SAR (whole head)	0.149	0.193	0.191

Note: A voxel is a 3-dimensional pixel; It's the smallest volume for which an SAR is calculated.
Source: A. De Salles *et al., Electromagnetic Biology and Medicine, 25,* p.357, 2006

Looking down any of the three columns, you can see the powerful diluting effect of increasing the averaging volume: Going from one voxel, the smallest volume for which an SAR is computed, to 1 g and then to 10 g, the SAR decreases by two-thirds or more. The SAR plummets when it's averaged over the whole head. If you look at the individual voxels, the peak SAR can be more than 30 times higher than the average over the entire head. The two columns on the left show how the "Gandhi effect" (the smaller head) raises the SAR. And the two columns on the right show how the higher dielectric properties of children's tissues also raise the SARs. In every case, the SARs for children are higher than their adult counterparts.

In an interview with *Microwave News,* De Salles summed it up this way: "The higher conductivity and higher permittivity in children's brain tissues, together with their thinner skulls and smaller heads, will lead to higher

SARs in their brains compared to adults, as Om Gandhi and others, including myself, have described in many papers."

How can there be any doubt that children face a greater potential risk than adults.

Why Is It Taking So Long?

But that leaves the question as to why something so obvious is taking so long to acknowledge. After 15 years of feuding, a consensus is finally emerging that children have higher SARs. But even now, the MMF stands apart and many others continue to hedge. We can't explain the American Cancer Society's inability to talk sense, but for others, motives are easier to decipher —all you have to do is follow the money. (It's always about the money: see also our piece, "Industry Rules RF".)

You need to look no further than the abstracts of the two papers on dielectric properties in children. Here's Peyman and Gabriel's take-home message: "No significant differences between the SAR values for the children of either age or for adults were observed." Gabriel and Peyman make it sound as if they didn't find anything of any importance. A more informative conclusion —"Children have higher SARs in biologically active tissues"— never made it into print.

And here's the last sentence of Christ and Kuster's abstract: "This study, however, confirms previous findings saying that there are no age-dependent changes of the peak spatial SAR when averaged over the entire head." Frankly, we don't know what that means. What was averaged over the entire head? (We asked both Christ and Kuster —twice each— for clarification and, though they were kind enough to respond, we are still as confused as ever, maybe more so.) Whatever they are trying to say, their message, like Peyman and Gabriel's, is that there's nothing much new to report.

Magicians call it misdirection. The facts are right, but the emphasis is all wrong. Gabriel and Kuster are fixated on the peak SAR, a/k/a, the peak spatial SAR. That's the only number that counts as far as industry is concerned. The peak SAR determines whether a phone complies with a prescribed exposure limit (1.6 W/Kg over 1g in the U.S. and 2.0 W/Kg over 10 g in Europe) and is allowed on the market. All the measurements and calculations on a given phone end up boiling down to this single number; you'll find it in fine print buried in the user's manual or on the manufacturer's Web site. According to the prevailing dogma, if the maximum SAR is below the limit, the phone is safe. And industry insists on a corollary: A phone that is safe for adults, is equally safe for kids. The possibility that some internal tissues may be more sensitive is left out. Could higher SARs in bone marrow mean a greater health risk for children? That question is never addressed.

In order to understand how the misdirection works, we need one final, if technical, piece of the SAR story: The peak SAR will just about always be in the tissues closest to the phone. (Or, going back to the bathtub analogy, the temperature will always be highest under the tap.) That means that as long as compliance is the only objective, there is never any incentive to look at what might going on deeper in the brain. When the head is modeled as a homogeneous mass, like a liquid in a phantom, the peak will always be in the skin layer —it's a straightforward case of the radiation attenuating with distance from the transmitter. You can see this in the Christ/Kuster graphics above (Figure 2); The small red squares mark the spots with the peak SARs. All six are at the interface of the phantom and the phone. Even if you consider variations in the dielectric properties of the tissues and run computer calculations, the maximum SARs will, except in the most unusual circumstances, be in the skin and nearby tissues. Gandhi's calculations show this too (see Figure 3; his maxima are in red), as do Peyman and Gabriel for walkie-talkies.

Peyman and Gabriel show their focus is on compliance in the final sentence of their paper. "[T]he peak 10 g averaged SAR in the child head phantoms caused by a walkie-talkie is calculated to be within the safety limits," they wrote. The impact of their new dielectric constants on the peak SAR is "marginal," they said. It had to be: The maximum SAR from the walkie-talkie is near the nose. The 10 g volume contains cartilage, skin and some air in the nasal cavity. While the dielectric properties of skin do change with age, the variation is much smaller than for bone marrow (40% vs. 1,000%).

The U.K. and the Swiss studies were funded by each government's mobile phone research program. But Gabriel and Kuster's bread and butter is servicing the telecom industry. Gabriel's MCL Technology Ltd. sells the phantoms and brain-tissue liquids used for compliance testing. As for Kuster, in addition to running the IT'IS Foundation, he is also the president of SPEAG, a high-tech, for-profit company that sells equipment (the DASY System) for measuring the fields inside a phantom, as well as phantoms and associated brain liquids. This does not run cheap. A single DASY set-up can cost north of $100,000. SPEAG also has a software package, SEMCAD, that can calculate the SAR in tissues; Both Peyman/Gabriel and Christ/Kuster used SEMCAD.

When they work on research projects for health agencies, Gabriel and Kuster must walk a fine line between the needs of their funders and those of the industry. A research grant is a one-off affair, while the cell phone companies are long-term clients. Even IT'IS, which is a non-profit research outfit, has close ties to the industry. MMF's Secretary General, Mike Milligan, is on its board of directors. Over the years, representatives from Alcatel, Ericsson, Motorola and Sunrise have all served on the board at one time or another.

Given this context, the final conclusions in the Gabriel and Kuster abstracts are not so surprising. They are using their special code to be able to say that there's nothing to worry about and most outsiders are not going to understand the context. That helps assuage Gabriel and Kuster's long-term industry clients and associates. Christ and Kuster do point out that the SAR in bone marrow is ten times higher in children but then they throw in a few seeds of confusion (the bit about "no age-dependent changes.") As one close observer who has long worked in this field told us, "Those are the conclusions for the industry." (The person asked that his name not be used so that his work can continue.)

The entire cell phone health controversy is so riddled with industry money that only a few dare to address the implications for public health. We asked Alasdair Philips, a long-time activist, for his opinion. "My first thought after reading the new Christ/Kuster paper was for those youngsters, who use hands-free sets," he told us. "That's what the U.K. government advises and, though few actually listen, those who do and who carry their phones in their trouser pockets, might inadvertently be trading one risk for another," he said. "I would be concerned about the exposure of the long bones in their legs, as well as in their pelvises, because these have much larger amounts of marrow than the skull. A lot of important biology goes on in the bone marrow, and that includes producing blood cells." Philips is the founder of Powerwatch and an adviser to Children with Leukaemia, a charity.

Then we posed the same question to Henry Lai at the University of Washington in Seattle, another long-time microwave researcher. He took Philips's concerns one step further. "We should be looking at the SARs in each voxel," he said. "That's a much smaller volume than 1g or 10g, but there could still be up to 100,000 cells in each voxel. If the target is bone marrow, then the radiation is hitting red and while blood *and* stem cells. One small change may be all it takes."

In an e-mail exchange with *Microwave News,* Gabriel emphasized that, in fact, she is on the same track. "The exposure of the bone marrow is the single most important issue that needs to be pursued, not just for exposure to the head," Gabriel said. "I would like to see the exposure of the bone marrow in the limbs of children investigated."

APPENDIX Y

A preliminary research proposal

From a public health perspective, the anecdotal evidence that smart meter RF emissions may be having an adverse health impact calls for an urgent research effort. Even if the number of affected people is small, the sheer number of people possibly exposed (depending upon the location of the smart meter in relation to bedroom / living areas) represents a potential significant public health risk. To simply dismiss this possibility as just a nocebo effect without a serious research effort is ill-advised.

One way to proceed with this research is to take the 'worst case scenario' – when a bedhead is next to a smart meter on the outside of the wall and design a study to determine if smart meter emissions affect sleep patterns. This should be done as a double blind study, through an independent sleepcentre with no financial ties with companies that have an interest in promoting the technology. Such a study would consist of setting up a sleeping room with a functioning smart meter close to the bedhead on the other side of the wall so that it is not seen by the participants. As it might be difficult to set up an operating smart meter in a laboratory situation, it may be easier to use an existing residence with a bed placed by an existing smart meter that has been modified to be able to be switched on and off at random times. Smart meter emissions would be recorded throughout the study using suitable equipment to determine if there is a correlation between recorded sleep patterns and emissions.

Subjects could be healthy volunteers (equal numbers of males and females) who are willing to spend a few nights sleeping in the room, while collecting EEG (electroencephalogram) data to gauge sleep and brain wave patterns, etc. The meter would be switched on and off for some of the volunteers but neither the volunteers nor the people overseeing the experiment will know whether or not the smart meter is active or not. A questionnaire would also be used to assess subjective feelings, such as depression, stress, anxiety levels, and tinnitus, for example.

A second part of the study would be to also call for volunteers who claim to be adversely affected by smart meter emissions to see if their symptoms correlate with the times the meter is emitting. A provocation study could be included here to see if these subjects could sense whether or not the meter was active while awake.

If at the end of the study the volunteers show no differences in sleep patterns, even when sleeping next to an active smart meter that would go a long way internationally to assure the public that smart meters are safe.

If on the other hand, clear differences in sleep patterns are seen, that would call for a reassessment of the present type of wireless smart meter being used and positioning in relation to bedroom/living areas.