

PREFILED TESTIMONY OF DR. PETER VALBERG

1. Please state your name, occupation, and address.

My name is Peter A. Valberg. I am a Principal for Environmental Health at Gradient Corporation, an environmental consulting firm specializing in human health risk assessment. My business address is Gradient Corporation, 20 University Road, Cambridge, Massachusetts 02138.

2. Describe your professional credentials and area of expertise.

My training and expertise are in the areas of inhalation toxicology, biological modeling of human exposure to environmental agents, and human health risk assessment. I have extensively researched and studied the links between human health and specific agents such as air pollutants, groundwater contaminants, radio wave frequencies (RF), and power-line electric and magnetic fields (EMF).

My training includes an A.B. degree, *summa cum laude*, in Physics and Mathematics from Taylor University, both M.A. and Ph.D. degrees in Physics from Harvard University, and an M.S. degree in Human Physiology from the Harvard University School of Public Health (Harvard SPH). For 25 years, I served as a faculty member in the Department of Environmental Health at Harvard SPH, where I researched and taught toxicology, cell biology, environmental health, and public health. Among the research grants that I directed at Harvard SPH (funded by the National Cancer Institute) was one on "Magnetic Field Effects on Macrophages" (where 'macrophages' are lung cells that clean the lung of particles deposited there from dust present in the air we breathe).

I have served on advisory panels for the National Institutes of Health (NIH), the Health Effects Institute, and the Environmental Protection Agency (EPA). I am a member of the International Society for Environmental Epidemiology, the Health Physics Society, the Bioelectromagnetics Society, and the Committee on Man and Radiation (COMAR). I am on the Board of Directors of the Bioelectromagnetics Society.

During the period of time when Harvard University (Center for Risk Analysis) had two active committees, namely the "Harvard Advisory Committee on EMF and Human Health" and the "Peer Review Board on Cellular Technology and Human Health," I served on these committees. I assisted the Health Effects Institute (Boston, MA) in determining the feasibility of launching an EMF research program, and I published a summary document on "EMF Mechanisms" in the journal *Radiation Research*.

At the request of the International Congress on Radiation Research ("ICRR"), I organized and chaired a symposium on "Physical aspects of EMF / RF effects on Biological Systems," at the 11th Annual ICRR meeting in Dublin, Ireland. I helped organize a conference in the Boston area on "Childhood Leukemia: Electric and Magnetic Fields as Possible Risk Factors." A summary of this workshop was published in the journal *Environmental Health Perspectives*. I have been working with the World Health

Organization (WHO) (Geneva, Switzerland) on the health effects on EMF as they apply to cellular telephone technology. An article summarizing some of this work for WHO has recently been accepted for publication in *Environmental Health Perspectives*.

Additional details can be found in my CV, which has been provided.

3. Describe the manner you were retained by the Connecticut Siting Council.

In April of 2005 the Connecticut Siting Council (CSC) issued a request for proposal (RFP), which asked for responses from those firms and individuals who had qualifications in the EMF area to respond with plans as to how they would assist the CSC in developing both an EMF background document as well as input to the CSC's Best Management Practices (BMP) policy. Gradient and, I believe, a number of other firms submitted written proposals. Based upon evaluation by CSC of these proposals, I was informed that Gradient was one of the consultants selected for a personal interview, and on June 9, 2005, I traveled to CSC offices in New Britain, CT, for an interview with CSC staff. Gradient was selected by CSC, and was given a contract to begin work on about October 1, 2005.

4. Describe the work task that was requested by the Connecticut Siting Council.

The requested task involved providing a compilation of research on the status of knowledge regarding the potential health effects of power-line magnetic fields, and then assisting CSC with the integration of this knowledge into an updated BMP policy document. The review of the research placed greater emphasis on the more recent time period, and on literature that was likely to be more relevant to the BMP policy, rather than devoting time to reviewing all aspects of EMF research. CSC placed emphasis on making the review straightforward and understandable to non-technical audiences.

5. Describe the methods/research used to accomplish the requested task.

Gradient examined published research literature regarding the science of potential health effects of electric-utility, power-line electric and magnetic fields (EMF). Potentially relevant, peer-reviewed EMF health-effect-research articles were identified through literature searches, and by examining EMF-specific databases. Search engines such as "PubMed" (National Library of Medicine), Science Citation Index, and CSA Illumina were used. In addition, a large EMF database, assembled by *Information Ventures, Inc.* was queried. Gradient also accessed reference lists available online from the World Health Organization (WHO) and compiled as part of their International EMF Project, and from Dr. John Moulder's (Medical College of Wisconsin) "Electromagnetic Fields and Human Health: Power Lines and Cancer Frequently Asked Questions (FAQs)" website. Through professional contacts, meeting, and other activities, I also included any articles I was personally aware of that were relevant to this review. The selection of the articles placed emphasis on potential relevance to health effects of EMF from electric-utility power lines, and on integration of the three main lines of scientific evidence: (A) Epidemiology, (B) Animal Studies, and (C) Mechanisms of Action. A central focus

of the requested literature search was on power-line EMF effects as they may relate to cancer risk, specifically childhood leukemia.

6. Describe the outcome of the work effort.

The outcome of the work included (a) an in-person presentation to CSC, summarizing the findings of Gradient's review, (b) a written document, available on the CSC website, "Current Status of Research & Regulation Regarding Health Effects of Power-Line Electric and Magnetic Fields (EMF)," (c) advisory input to the "Draft 2006 EMF Best Management Practices" dated 9/28/06 and available on the CSC website, and (d) attendance at and response to cross examination during CSC's public hearing on April 20, 2006, which examined the scientific basis of CSC's Best Management Practices for Electric and Magnetic Fields (Petition 754).

7. On what date was your work submitted to the Connecticut Siting Council?

The written EMF report was submitted in January of 2006.

8. Describe your efforts to date to maintain your expertise in issues pertaining to health effects related to EMF.

On a continuing basis, the librarians at Gradient Corporation provide me with an update on a literature search strategy that tracks down articles related to EMF health effects, and I review those publications that are relevant to health risks potentially attributed to power-line EMF exposure. I have been and continue to be a member of the Bioelectromagnetics Society (BEMS), and read their Newsletter, and have subscribed and continue to subscribe to the society's journal "*Bioelectromagnetics*," which publishes articles relevant to EMF health effects. Moreover, I attend the two BEMS meetings that occur annually, the Winter Workshop and the Annual Meeting. I am on the BEMS Board of Directors, and in the course of this work, many developments in the EMF area come to my attention. I am also a member of the Health Physics Society, read their newsletter, and subscribe to their journal "*Health Physics*." Important EMF articles are also published in this journal, and I review each issue as it comes in. Furthermore, through being a member of COMAR, I receive additional updates on developments in the EMF area. I am a member of the Society of Toxicology, and at each annual meeting, I identify and attend any talks or abstracts dealing with EMF. I also subscribe to the society journal, "*Toxicological Sciences*," and review those articles relevant to EMF. I continue to be involved in EMF conferences around the world. In June of 2006 I presented an EMF talk at the Bioelectromagnetics Society Annual Meeting in Cancun, Mexico, and in November 2006, I participated in and gave two invited lectures on EMF at the Cyprus International Institute for the Environment and Public Health symposium on "Electromagnetic Fields: Sources, Health Effects, and Regulations," Nicosia, Cyprus.

9. Summarize any conclusions reached by from regulatory bodies or health organizations related to EMF since the time the Gradient Corporation report was issued to the Council.

In the New England area, the Vermont Department of Health (VDH) has recently produced an EMF evaluation for a pending transmission-line project. In the VDH evaluation, the health department concludes that “the data in the current body of literature is insufficient to establish a direct cause and effect relationship between EMF exposure and adverse health effects.” Although VDH endorses a “prudent avoidance” policy, for numerical, health-based guidelines, they state: “The International Commission on Non-Ionizing Radiation Protection (ICNIRP) established guidelines for exposure of the public to magnetic and electric power frequency fields of 833 mG and 4.2 kV/m, respectively. The Institute of Electrical and Electronics Engineers’ (IEEE) magnetic power frequency field guideline for exposure to the public is 9,040 mG and 5 kV/m for the electric power frequency field.” The VDH uses the ICNIRP standards to compare against calculations of power line EMF, and VDH states that “Most scientific reviews conclude that there is insufficient evidence to prove that EMFs from high voltage power lines cause human health effects, though some show a very weak association.”

In California, a January 2006 decision before the Public Utilities Commission affirmed a “low cost / no cost” policy to mitigate EMF exposure from new utility projects by establishing a benchmark 4% of project costs that could be allocated to this goal, and went on to state that “at this time we are unable to determine whether there is a significant, scientifically verifiable relationship between EMF exposure and negative health consequences.”

A new power-line EMF standard was proposed in December 2006 by the Australian Radiation Protection and Nuclear Safety Agency (ARPANSA). The title of the draft document is: “Radiation Protection Standard: Exposure Limits for Electric & Magnetic Fields – 0 Hz to 3 kHz,” and it can be found at the ARPANSA website:

http://www.arpansa.gov.au/pubs/comment/dr_elfstd.pdf

The ARPANSA proposed value for "General Public" exposure to 60-Hz EMF is 4,166 V/m for the electric field, and is 100 μ T (100 microTesla) for the magnetic field, which is equal to 1,000 mG. Thus, ARPANSA's 1,000 mG is basically the same as the International Commission on Non-Ionizing Radiation Protection [ICNIRP] guidelines, where the general public magnetic-field guideline is 833 mG for 60-Hz EMF.

10. Do any of these findings affect the conclusions presented in the Gradient Corporation report?

No. Regulatory agencies continue to find the EMF epidemiology in isolation to be of insufficient significance or weight for deriving EMF exposure guidelines. The December 2006 draft EMF standard proposed by ARPANSA (1,000 mG) is ten-fold higher than what is proposed in the BMP, and hence endorses the interpretation that the BMP screening level of 100 mG is a highly conservative (*i.e.*, health protective) goal.

11. Have you read the comments submitted by the Connecticut Department of Public Health on May 31, 2006 and October 27, 2006? If so, what response do you have to the Connecticut Department of Public Health’s stated position?

Yes, I have read these DPH comments.

The May 31, 2006, (and to some extent the October 27, 2006) DPH comments propose a guideline of 6 mG “as a means to keep potential risks to a minimum,” and >10 mG as designating “heightened concern.”

However, in neither of the documents does the DPH explain how the “minimum risk” target is consistent with other DPH policies. Any public health agency must strive to maintain risk avoidance policies that are consistent for the broad spectrum of risks that children face. That is, in terms of children’s risks from toys, lead paint, urea formaldehyde, parental abuse, food poisoning, vehicle accidents, drowning, suffocation, home fires, *etc.*, how does the time, energy, and cost of DPH’s “minimum risk” policy for EMF square with the DPH policies adopted in these other areas? Clearly, restricting vehicle traffic to a speed limit of 5 MPH on any residential street where young children live could save lives, and this is for a hazard that is not hypothetical, 100% causal, and speed is a well-understood factor. Although the DPH describes their mG targets for EMF as “reasonable” and “scientifically sound,” no explanation is provided as to how the risk of “100 mG” would be unacceptable in light of DPH policies on other, comparable risks to children’s health and welfare.

The criticisms of the NTP animal bioassay studies of EMF are not well founded. It is claimed that the “complexity” of EMF makes it difficult to test, in comparison to chemicals. However, the nature of EMF is simply “force on charged particles” and is much more fundamental and universal than the nature of chemicals, for which toxicity depends on their 3-dimensional size and shape, which can assume an incredibly wide variety of permutations and combinations. Moreover, the stereo-specific interactions of chemicals with the large number of distinct receptor proteins, enzymes, DNA molecules, and membrane proteins can exhibit a great deal of variability among animal species, which would not be the case for EMF. In any case, it is not only the NTP that relies on animal bioassays, but all other health and regulatory agencies rely heavily on the results of laboratory-animal, chronic-exposure bioassays, including the USEPA, FDA, IARC, and NIH among others.

I do not have the time here to comment extensively on the choice of research literature cited by the DPH, but I offer one example of an unwarranted extrapolation. The May 31 document makes the statement that “[magnetic field exposure] was positive for the promotion of leukemia in mice (Babbitt, *et al.*, 2000).” However the DPH does not tell us that in this experiment the mice were (a) exposed to Cobalt-60 gamma-radiation, and (b) the level of magnetic field (MF) tested was 14,200 mG. Although some small effects on promotion were seen, the authors’ conclusion was that “*Chronic exposure to MFs did not affect the mortality incidence rates and did not change the relative incidences of hematopoietic neoplasia in mice that received the same ionizing radiation treatment, with the exception of a marginally significant reduced relative risk of 0.97 (P = 0.05) for lymphoblastic lymphoma in mice exposed to a magnetic field and treated with 5.1 Gy.*” That is, this research showed, if anything, a reduced leukemia risk, and yet the DPH authors cite it as a key article for “promotion of leukemia.” This is even aside from the fact that the 14,200 mG exposure level is marginal significance to the 100 mG BMP screening level being discussed here.

The May 31 DPH document also states that “testing rodents in early life leads to greater potency, although this concept has not been explored with EMF.” This is not the case. The experiments of Dr. Rosemonde Mandeville and her colleagues at the University of Quebec thoroughly tested the potential carcinogenicity of 60-Hz EMF in young rats, where the exposure began in the prenatal period and continued through lactation and weaning (for a total of 2 years of exposure, 20 hours each day). No effect on tumor risk was found in rodents born and raised under EMF exposures ranging from 20 to 20,000 mG.

Both of the DPH comments place a great deal of weight on the epidemiological associations. Epidemiology investigates the correlations between the timing and location of diseases in populations and the timing and location of [assumed] exposures within populations. If properly conducted, an epidemiological study can establish the existence of a statistically valid association between a [surrogate] exposure and a disease, but such associations are difficult to interpret. Because of their correlative nature, epidemiological results generally cannot by themselves establish a cause-and-effect relationship between an exposure and a disease. The likelihood of a causal interpretation depends on consistency of findings across multiple lines of evidence. In the case of EMF, not only is there an absence of consistency among the various lines evidence, there is actual disagreement, and the null results of animal bioassays must be taken into consideration. Otherwise, a public health agency might be put in the position of fostering unwarranted anxieties, and as DPH full knows, anxiety itself has health consequences.

12. What recommendations can you provide to the Council in regards to establishing an appropriate public policy for the management of EMF?

My opinion is that the scientific nature of EMF and our well-established knowledge regarding how EMF interacts with living and non-living systems require great caution when interpreting the epidemiology of EMF and childhood leukemia. These correlative epidemiological data do not form a reliable basis for predicting robust public-health benefits from mitigation EMF exposures to low levels, in the 3 to 10 mG range. Available health-based EMF exposure guidelines developed by scientific consensus groups give no-effect levels in the range of 800 to 10,000 mG, and thus, selecting a screening value of 100 mG for managing fields at the right-of-way edge is consistent with a highly precautionary interpretation of the state of scientific knowledge.