

Xcel Power Line Through the City of Mendota Heights

Jack Vitelli Rationale and Position Statement

February 19, 2002

1. HEALTH ISSUE IN GENERAL (Statements from major institutions)

1.1. American Physical Society (1995) “Power Line Fields and Public Health”

The scientific literature and the reports of reviews by other panels show no consistent, significant link between cancer and power line fields. This literature includes epidemiological studies, research on biological systems, and analyses of theoretical interaction mechanisms. No plausible biophysical mechanisms for the systematic initiation or promotion of cancer by these power line fields have been identified.

Furthermore, the preponderance of the epidemiological and biophysical/biological research findings have failed to substantiate those studies which have reported specific adverse health effects from exposure to such fields. While it is impossible to prove that no deleterious health effects occur from exposure to any environmental factor, it is necessary to demonstrate a consistent, significant, and causal relationship before one can conclude that such effects do occur. **From this standpoint, the conjectures relating cancer to power line fields have not been scientifically substantiated.**

These unsubstantiated claims, however, have generated fears of power lines in some communities, leading to expensive mitigation efforts and, in some cases, to lengthy and divisive court proceedings. The costs of mitigation and litigation relating to the power line/cancer connection have risen into the billions of dollars and threaten to go much higher. The diversion of these resources to eliminate a threat which has no persuasive scientific basis is disturbing to us. More serious environmental problems are neglected for lack of funding and public attention, and the burden of cost placed on the American public is incommensurate with risk, if any."

1.2. National Academy of Sciences, National Research Council (1999)

Results of the EMF-RAPID program do not support the contention that the use of electricity poses a major unrecognized public-health danger.

No finding from the EMF-RAPID program alters the conclusions of the previous NRC review on the Possible Effects of[EAF] on Biologic Systems (NRC 1997). In view of the negative outcomes of EMF-RAPID replication studies, **it now appears even less likely that [EMF] in the normal domestic or occupational environment produce[s] important health effects, including cancer.**

The report “recommends that no further special research program focused on possible health effects of power frequency magnetic fields be funded.”... “unless a biologic effect that can be used to plan the studies” is identified.

1.3. National Academy of Sciences, National Research Council (1997), Possible Health Effects of Exposure to Residential Electric and Magnetic Fields

Based on a comprehensive evaluation of published studies relating to the effects of power frequency electric and magnetic fields on cells, tissues, and organisms (including humans), the conclusion of the committee is that the current body of evidence does not show that exposure to these fields presents a human health hazard. Specifically, no conclusive and consistent evidence shows that exposures to residential electric and magnetic fields produce cancer, adverse neurobehavioral effects, or reproductive developmental effects.

The committee reviewed residential exposure levels to electric and magnetic fields, evaluated the available epidemiologic studies, and examined laboratory investigations that used cells, isolated tissues, and animals. At exposure levels well above those normally encountered in residences, electric and magnetic fields can produce biologic effects (promotion of bone healing is an example), but these effects do not provide a consistent picture of a relationship between the biological effects of these fields and health hazards. An association between residential wiring configurations (called wire codes) and childhood leukemia persists in multiple studies, although the causative factor responsible for that statistical association has not been identified. No evidence links contemporary measurements of magnetic field levels to childhood leukemia.

Vitelli Note: Daniel Wartenberg, often referenced by the Power Line Task Force, was a member of the committee that produced this finding.

1.4. National Institute of Environmental Health Sciences (1999)

Background

In 1992 the US Congress instructed the National Institute of Environmental Health Sciences (NIEHS) to direct a program of research and analysis to evaluate the potential for health risks from EMF exposure. In 1999 the NIEHS released their report, "Health Effects from Exposure to Power Line Frequency Electric and Magnetic Fields."

Conclusions

The scientific evidence suggesting that ELF [extremely low frequency] EMF exposures pose any health risk is weak. The strongest evidence for health effects comes from associations observed in human populations with two forms of cancer: childhood leukemia and chronic lymphocytic leukemia in occupationally exposed adults. While the support from individual studies is weak, the epidemiological studies demonstrate, for some methods of measuring exposure, a fairly consistent pattern of small increased risk with increasing exposure that is somewhat weaker for chronic lymphocytic leukemia than for childhood leukemia. In contrast, the mechanistic studies and the animal toxicology literature fail to demonstrate any consistent pattern across studies although sporadic findings of biological

effects (including increased cancers in animals) have been reported. **No indication of increased leukemias in experimental animals has been observed.**

The lack of connection between the human data and the experimental data (animal and mechanistic) severely complicates the interpretation of these results. The human data are in the "right" species, are tied to "real life" exposures and show some consistency that is difficult to ignore. This assessment is tempered by the observation that given the weak magnitude of these increased risks, some other factor or common source of error could explain these findings. However, no consistent explanation other than exposure to ELF EMF has been identified.

Epidemiological studies have serious limitation in their ability to demonstrate a cause and effect relationship whereas laboratory studies, by design, can clearly show that cause and effect are possible. Virtually all of the laboratory evidence in animals and humans and most of the mechanistic work done in cells fail to support a causal relationship between exposure to ELF EMF at environmental levels and changes in biological function or disease status. The lack of consistent, positive findings in animal or mechanistic studies weakens the belief that this association is actually due to ELF EMF, but cannot completely discount the epidemiological findings.

The NIEHS concludes that ELF EMF exposure cannot be recognized at this time as entirely safe because of weak scientific evidence that exposure may pose a leukemia hazard. In our opinion, this finding is insufficient to warrant aggressive regulatory concern. However, because virtually everyone in the United States uses electricity and therefore is routinely exposed to ELF EMF, passive regulatory action is warranted such as continued emphasis on educating both the public and the regulated community on means aimed at reducing exposures. **The NIEHS does not believe that other cancers or non-cancer health outcomes provide sufficient evidence of risk to currently warrant concern.**

The US Congress directed the National Research Council to conduct a follow-up evaluation of the NIEHS EMF RAPID Program (NRC, 1999). In 1999, the NRC determined that the NIEHS research leaves the 1997 NRC conclusions "essentially unchanged from their most recent (1997) review.

1.5. National Institute of Environmental Health Sciences (2001), Review of the Epidemiologic Literature on EMF and Health

ICNIRP (International Commission for Non-Ionizing Radiation Protection) Standing Committee on Epidemiology: **Anders Ahlbom**,¹ Elisabeth Cardis,² Adele Green,³ Martha Linet,⁴ David Savitz,⁵ and Anthony Swerdlow⁶

Vitelli Note: Anders Ahlbom is highlighted because he is referenced by the Power Line Task Force in arguing risks of EMFs but is a member of the commission that authored this report.

Exposures to extremely low-frequency electric and magnetic fields (EMF) emanating from the generation, transmission, and use of electricity are a ubiquitous part of modern life. Concern about potential adverse health effects was initially brought to prominence by an epidemiologic report two decades ago from Denver on childhood cancer. We reviewed the now voluminous epidemiologic literature on EMF and risks of chronic disease and conclude the following:

- a) The quality of epidemiologic studies on this topic has improved over time and several of the recent studies on childhood leukemia and on cancer associated with occupational exposure are close to the limit of what can realistically be achieved in terms of size of study and methodological rigor.
- b) Exposure assessment is a particular difficulty of EMF epidemiology, in several respects:
 - i. The exposure is imperceptible, ubiquitous, has multiple sources, and can vary greatly over time and short distances.
 - ii. The exposure period of relevance is before the date at which measurements can realistically be obtained and of unknown duration and induction period.
 - iii. The appropriate exposure metric is not known and there are no biological data from which to impute it.
- c) **In the absence of experimental evidence and given the methodological uncertainties in the epidemiologic literature, there is no chronic disease for which an etiological relation to EMF can be regarded as established.**
- d) There has been a large body of high quality data for childhood cancer, and also for adult leukemia and brain tumor in relation to occupational exposure. **Among all the outcomes evaluated in epidemiologic studies of EMF, childhood leukemia in relation to postnatal exposures above 0.4 μ T (4 mG) is the one for which there is most evidence of an association. The relative risk has been estimated at 2.0 (95% confidence limit: 1.27-3.13) in a large pooled analysis. This is unlikely to be due to chance but, may be, in part, due to bias. This is difficult to interpret in the absence of a known mechanism or reproducible experimental support. In the large pooled analysis only 0.8% of all children were exposed above 0.4 μ T (4 mG).** Further studies need to be designed to test specific hypotheses such as aspects of selection bias or exposure. On the basis of epidemiologic findings, evidence shows an association of amyotrophic lateral sclerosis with occupational EMF exposure although confounding is a potential explanation. Breast cancer, cardiovascular disease, and suicide and depression remain unresolved. *Key words:* cancer, chronic disease, epidemiology, extremely low-frequency EMF, review. -- *Environ Health Perspect* 109(suppl 6):911-933 (2001).

1.6. Institute of Electrical and Electronics Engineers, Committee on Man and Radiation (1999)

"In recent years concerns have been raised about the biological effects of exposure to electric and magnetic fields at extremely low frequencies (ELF), particularly those associated with

the distribution and utilization of electric power. In 1989, the Institute of Electrical and Electronics Engineers (IEEE) issued an "Entity Position Statement" which stated that "there is not enough relevant scientific data to establish whether common exposure to power-frequency fields should be considered a health hazard" and that "there is general agreement that more research is needed to define safe limits of human exposure to power-frequency fields." **After examination of relevant research reports published during the last ten years, COMAR (Committee on Man and Radiation) concludes that it is highly unlikely that health problems can be associated with average 24-hour field exposure to power frequency magnetic fields of less than 1 microT (10 mG).** Good laboratory evidence shows that magnetic fields 100 to 10,000 times higher than this level, either ELF sinusoidal or pulsed, can induce a variety of biological effects, including beneficial health effects such as bone or tissue healing. **Many of the reports of effects of weaker fields should be considered preliminary, as some observations have not been reproduced in different laboratories, while others, observed in cells, have not been clearly connected to effects in intact animals.** Also, the means of interaction of low-level ELF fields with cells, tissues or laboratory animals is not fully understood; therefore the health impacts of such weak fields on intact animals and humans, if any, cannot be predicted or explained. Further research is needed to confirm or negate reports of effects of weak fields, and to determine mechanisms and relevance of these effects to actual health hazards. Continued study in this complicated area will enhance our understanding of biological systems, as well as help identify levels and types of ELF exposure that may be deleterious to human health."

1.7. University of Minnesota, Gurney, J.G., and van Wijngaarden, E. (1999) Extremely low frequency electromagnetic fields (EMF) and brain cancer in adults and children: Review and comment. *Neuro-Oncology*

Epidemiologic and experimental research on the potential carcinogenic effects of extremely low frequency electromagnetic fields (EMF) has now been conducted for over two decades. Cancer epidemiology studies in relation to EMF have focused primarily on brain cancer and leukemia, both from residential sources of exposure in children and adults and from occupational exposure in adult men. Because genotoxic effects of EMF have not been shown, most recent laboratory research has attempted to show biological effects that could be related to cancer promotion. In this report, we briefly review residential and occupational EMF studies on brain cancer. We also provide a general review of experimental studies as they relate both to the biological plausibility of an EMF-brain cancer relation and to the insufficiency of such research to help guide exposure assessment in epidemiologic studies. We conclude from our review that no recent research, either epidemiologic or experimental, has emerged to provide reasonable support for a causal role of EMF on brain cancer.

1.7.1. Biological Plausibility and Biological Studies (Summary)

Many experimental studies have attempted to demonstrate biological effects of EMF, including those that could be associated with cancer (Portier and Wolfe, 1998). Most efforts have reflected general mechanisms; few were specific to brain cancer. The component of EMF that may be relevant to biological effects remains unknown (Portier and Wolfe, 1998; Valberg, 1996). Current results are extremely hard to compare or evaluate (Moulder and

Foster, 1995) because investigators have employed a wide variety of biological systems, endpoints, and exposure conditions. Additionally, omission of many EMF exposure parameters causes considerable difficulty in interpreting, extrapolating, and replicating experiments (Valberg, 1995). Although reproducibility is crucial for the acceptance of positive results, very few replication attempts of positive studies have been published, and even fewer have been successful (Lacy-Hulbert et al., 1998). A number of pertinent replication studies, however, are currently in process (NIEHS, 1997; Portier and Wolfe, 1998). **In short, despite the large number of experiments conducted, there is yet no consistent scientific evidence in support of a plausible neurocarcinogenic mechanism for 50- or 60-Hz EMF exposure.**

1.7.2. Residential Studies of Adult Brain Cancer

Eight studies have addressed the possible relation of residential EMF exposure to brain cancer in adults (Feychting and Ahlbom, 1994; 1997; Li et al., 1997; Schreiber et al., 1993; Verkasalo et al., 1996; Wertheimer and Leeper, 1982; 1987; Wrensch et al., 1999). Wertheimer and Leeper (1982; 1987) reported from their case-control study that CNS cancer was strongly associated with high-current configuration residential power-line exposure. Six subsequent studies did not find comparable results. In a Dutch retrospective cohort study (Schreiber et al., 1993), study subjects who lived in a residence within 100 meters of high voltage electricity transmission equipment did not have higher mortality from brain cancer than expected from population estimates. (For men the relative risk estimate was 0.65, 95% CI 0.1-3.59; for women it was 1.75, 95% CI 0.20-6.33.) As reflected in the CIs, however, the size of their study was very small. Feychting and Ahlbom (1994) conducted a case-control study of people who had lived in Sweden within 300 meters of a power line. Exposure was estimated by calculating the magnetic field exposure closest in time to diagnosis, calculating cumulative exposure during the 15 years preceding diagnosis, determining magnetic field strength from spot measurements, and measuring the distance from the power line. They observed a relative risk estimate for CNS cancer that was close to unity for all exposure estimates. Again, results were based on a small number of cases. As with all of the residential measures, their exposure assessment ignored sources of magnetic fields other than power lines (occupational exposures, for example), which inevitably results in some degree of exposure misclassification. To try to account for this, Feychting et al. (1997) used the same study base to examine the effects of residential magnetic field exposure in combination with occupational exposure. Their results were almost the same as in the original study, yielding a relative risk estimate of 1.3 (95% CI 0.3-4.8) in the highest exposure category, relative to the lowest. Verkasalo et al. (1996) conducted a nationwide cohort study of cancer in Finnish adults who lived within 500 meters of overhead power lines of 110-400 kV. Exposure assessment took into account historical exposures over a period of 20 years. **They did not find an increase in risk of CNS tumors associated with high magnetic fields. Relative risk estimates were 0.94 (95% CI 0.72-1.22) for men and 0.98 (95% CI 0.81-1.20) for women. A case-control study from Taiwan also did not show an increased risk of brain tumors with elevated residential exposure levels (Li et al., 1997). Relative risk estimates by distance from transmission lines, as well as by calculated magnetic field exposure in the year of diagnosis, were close to unity.** Most recently, Wrensch et al. (1999) conducted a case-control study on residential EMF exposure and adult glioma in the

San Francisco area. Exposure was assessed with wire codes, and with spot measurements at the front door of subjects. The relative risk estimate for longest held residence, coded as high configuration compared with low configuration, was 0.9 (95% CI 0.7-1.3). The risk estimates corresponding to spot measurements of 1 to 2 mG, 2 to 3 mG, or higher than 3 mG, relative to ≤ 1 mG, were 1.0 (95% CI 0.7-1.4), 0.6 (95% CI 0.3-1.1), and 1.7 (95% CI 0.8-3.6), respectively.

1.7.3. Occupational Studies of EMF and Brain Cancer

Lin et al. (1985) conducted the first study on brain cancer that categorized occupation according to assumed degree of EMF exposure. Men working in electricity-related occupations, such as **electricians, electric or electronic engineers, and utility company servicemen**, had a significantly higher proportion of brain tumors than did those in non-electrical occupations, including a positive trend with increasing likelihood of exposure. Many subsequent studies have used job titles or occupational categories as crude measures of exposure to address the potential relation between brain cancer and occupational EMF. A meta-analysis of 29 such studies (Kheifets et al., 1995) and several review articles have been published on these results (Bates, 1991; Miller et al., 1997; Savitz, 1993; Stevens, 1996). **The meta-analysis suggested a small (10-20%) overall increase in brain tumor risk associated with electrical occupations (Kheifets et al., 1995), although no consistent dose-response trend was observed. Two additional cohort studies that used job titles did not find support for the brain cancer-EMF hypothesis (Kelsh and Sahl, 1997; Tynes et al., 1994).**

1.7.4. Summary

The two Denver studies on childhood brain cancer reported moderately elevated risks associated with living in close proximity to a residential power distribution system of high current configuration. Subsequent studies on childhood brain cancer that used wire codes or calculated historical measures found no such association. The evidence on adult brain cancer and exposure to magnetic fields follows a similar pattern. The initial findings of Wertheimer and Leeper (1987) with respect to residential exposure were not confirmed in the six subsequent studies. The weight of evidence from early occupational studies suggests a positive brain cancer association with surrogate exposures such as job title or occupation. Recent studies with more advanced methods of exposure assessment and better control for confounding exposures (for example, solvents, PCBs, or pesticides) have been inconsistent. Of 11 studies involving exposure assessment using field measurements, only three provided some support for a positive association (Floderus et al., 1993; Guénel et al., 1996; Savitz and Loomis, 1995), and a dose-response trend was apparent in only one (Savitz and Loomis, 1995).

1.8. British National Radiological Protection Board (Advisory Group on Non-Ionizing Radiation), UK Childhood Cancer Study: residential proximity to power lines (2000), *From Radiological Protection Bulletin, No 228, December 2000*

The results of the EMF part of the UK Childhood Cancer Study (UKCCS) were published in 1999^{1,2}. **The main conclusion of the case-control study was that there was no evidence that exposure to magnetic fields associated with the electricity supply in the UK augments the risk for childhood leukemia, cancers of the central nervous system, or any other childhood cancer. More recently an important subsidiary analysis has been carried out which focuses on the relationship between childhood cancer and residential proximity to power lines³.** The analysis was made possible because during the course of the study information on electricity supply equipment was collected from the UK electricity companies. NRPB set up an external source database in order to manage the information. The results, recently published in the *British Journal of Cancer*, are consistent with those of the primary analysis, which was based on measurements. **There is no evidence in the UK that either proximity to electrical installations, or the magnetic field levels they produce, is associated with an increased risk of childhood leukemia or any other cancer.**

1.9. British National Radiological Protection Board (Advisory Group on Non-Ionizing Radiation), ELF Electromagnetic Fields and the Risk of Cancer (2001)

Studies reviewed in the earlier report by the Advisory Group suffered from a lack of measurement-based exposure assessments. Since then, considerable advances have been made in methods for assessing exposure, both in the case of experimental studies and in epidemiological investigations. Instrumentation allowing personal exposure to be measured has become widely available and has been used in many of the more recently published studies. This has provided a substantially improved basis for many of the epidemiological studies reviewed by the Group.

1.9.1. Animal and Volunteer Studies

Overall, no convincing evidence was seen from a review of a large number of animal studies to support the hypothesis that exposure to power frequency electro-magnetic fields increases the risk of cancer.

The possibility that the hormone melatonin acts as a natural tumor suppressor is controversial. Nevertheless, a number of studies have investigated the ability of power frequency electromagnetic fields to alter endogenous circadian melatonin rhythms. Most evidence from human volunteer studies suggests that melatonin rhythms are not delayed or suppressed by exposure to power frequency magnetic fields, although one recent study provided preliminary data indicating that exposure prior to the night-time rise in serum melatonin may have had this effect in a sensitive subgroup of the study population. In addition, the evidence for an effect of exposure to power frequency magnetic fields on melatonin levels and on melatonin-dependent reproductive status in seasonally breeding animals is largely negative. The evidence concerning power frequency electromagnetic field induced suppression of rat pineal and/or serum melatonin levels is equivocal and the physiological relevance of any effect (if any is produced) remains unclear.

There is no consistent evidence of any inhibitory effect of power frequency magnetic field exposure on those aspects of immune system function relevant to tumor suppression that have been examined. In addition, two studies were unable to correlate possible electromagnetic field induced changes in tumor incidence with significant changes in immune function.

1.9.2. Residential Exposure

Recent large and well-conducted studies have provided better evidence than was available in the past on the relationship between power frequency magnetic field exposure and the risk of cancer. Taken in conjunction they suggest that relatively heavy average exposures of 0.4 μ T (4 mG) or more are associated with a doubling of the risk of leukemia in children under 15 years of age. The evidence is, however, not conclusive. In those studies in which measurements were made, the extent to which the more heavily exposed children were representative is in doubt, while in those in Nordic countries in which representativeness is assured, the fields were estimated and the results based on such small numbers that the findings could have been due to chance. In the UK, very few children (perhaps 4 in 1000) are exposed to 0.4 μ T or more and a study in the UK, with much the largest number of direct measurements of exposure, found no evidence of risk at lower levels. Nevertheless, the possibility remains that high and prolonged time-weighted average exposure to power frequency magnetic fields can increase the risk of leukemia in children. Data on brain tumors come from some of the studies also investigating leukemia and from others concerned exclusively with these tumors. They provide no comparable evidence of an association. There have been many fewer studies in adults. There is no reason to believe that residential exposure to electromagnetic fields is involved in the development of leukemia or brain tumors in adults.

1.9.3. Occupational Exposure

Study of populations exposed occupationally to electromagnetic fields can include groups exposed generally at much higher levels than members of the public. They may therefore have a greater potential to detect any adverse health effects. **Although recently published studies of occupational exposure to electromagnetic fields and the risk of cancer are, in the main, methodologically sound, and some of them have considerable statistical power, causal relationships between such exposure and an increase in tumor incidence at any site are not established.** The excesses, where they exist, are generally modest and are largely restricted to the two cancers that were noted in the 1992 report of the Advisory Group – that is, leukemia and cancer of the brain. Conflicting evidence exists for the particular cell types of leukemia associated with the greatest risk but acute myeloid leukemia is the most cited. The evidence of any risk for brain cancer is conflicting, even that from the most powerful of the studies.

1.9.4. General Conclusion

Laboratory experiments have provided no good evidence that extremely low frequency electromagnetic fields are capable of producing cancer, nor do human epidemiological studies suggest that they cause cancer in general. There is, however, some epidemiological evidence that prolonged exposure to higher levels of power frequency magnetic fields is associated with a small risk of leukemia in children. In practice, such levels of exposure are seldom encountered by the general public in the UK. In the absence of clear evidence of a carcinogenic effect in adults, or of a plausible explanation from experiments on animals or isolated cells, the epidemiological evidence is currently not strong enough to justify a firm conclusion that such fields cause leukaemia in children. Unless, however, further research indicates that the finding is due to chance or some currently unrecognized artifact, the possibility remains that intense and prolonged exposures to magnetic fields can increase the risk of leukemia in children.

1.10. World Health Organization (1998)

The WHO published a review of EMF health effects; they concluded that additional topic areas for research could be suggested, but that currently available evidence was not persuasive of a health effect:

It was concluded that, while health hazards exist from exposures to ELF at high field strengths, the literature does not establish that health hazards are associated with exposure to low-level (environmental) fields. [High field strengths would be upwards of 50,000 mG, whereas power-line fields are generally less than 100 mG.]

The ICNIRP proposed a “reference level” of allowable continuous EMIF exposure for the general public of 830 mG (which is an order of magnitude higher than typical EMF exposure from electric-power lines).

1.11. World Health Organization, International Agency for Research on Cancer (2001)

Since the first report suggesting an association between residential electric and magnetic fields and childhood cancer, notably leukemia, was published in 1979, dozens of studies have examined this association. Overall, for the vast majority of children who are exposed to residential ELF [extremely low frequency] magnetic fields less than 0.4 microtesla [4 milligauss], there is little evidence of any increased risk for leukemia. There is no evidence that electric fields are associated with childhood leukemia, and there is no consistent relationship between childhood brain tumors and residential ELF electric and magnetic fields. However, pooled analyses of data from a number of well conducted studies show a fairly consistent statistical association between childhood leukemia and power-frequency residential magnetic field strengths above 0.4 microtesla, with an approximately two-fold increase in risk. This is unlikely to be due to chance, but may be affected by selection bias. Therefore, this association between childhood leukemia and high residential magnetic field strengths was judged limited evidence for excess cancer risk in exposed humans.

There is no consistent evidence that residential or **occupational exposures** of adults are related to excess risks of cancer at any site [in the body], although in one Swedish study combined residential and occupational exposures were associated with a significantly increased risk for leukemia subtypes except chronic lymphocytic leukemia. **Evidence for excess cancer risks of all other kinds, in children and in adults, as a result of exposure to ELF electric and magnetic fields was considered inadequate.**

Numerous studies to investigate carcinogenicity of magnetic fields have been conducted in **experimental animals**. These have included long-term bioassays of exposures to magnetic fields alone, and exposures of rats and mice to magnetic fields in combination with known carcinogens. Bioassays of magnetic fields alone generally were negative, although one study that was conducted in both mice and rats of both sexes showed non-exposure related increases in thyroid C-cell tumors in male rats only. **Multistage carcinogenesis studies showed no consistent enhancement of chemically initiated mammary tumors in rats or of skin tumors in mice. Magnetic fields had no effects on the incidence of chemically initiated liver tumors in rats or of leukemia/lymphoma in mice or rats. Overall, evidence of carcinogenicity of ELF magnetic fields in experimental animals was judged inadequate.** No data on carcinogenicity to animals of static magnetic fields, or of static or ELF electric fields, were available to the working group.

Although many hypotheses have been put forward to explain possible carcinogenic effects of ELF electric or magnetic fields, no scientific explanation for carcinogenicity of these fields has been established.

Overall, extremely low frequency magnetic fields were evaluated as possibly carcinogenic to humans (Group 2B), based on the statistical association of higher level residential ELF magnetic fields and increased risks for childhood leukemia. Static magnetic fields and static and extremely low frequency electric fields could not be classified as to carcinogenicity to humans (Group 3)."

*[Note that the term "**possible carcinogen**" is the lowest IARC category for chemicals or agents which have been determined to have the potential to cause cancer (i.e., scientists cannot completely dismiss the possibility that EMF causes cancer even though the evidence is weak].

1.12. World Health Organization, International Agency for Research on Cancer (2001), Fact Sheet -- ELECTROMAGNETIC FIELDS AND PUBLIC HEALTH, Extremely low frequency fields and cancer

This Fact Sheet updates findings of recent reviews on the health effects of static and ELF electric and magnetic fields conducted by IARC (June 2001), by the Health Council of the Netherlands (May 2001), and by an expert Advisory Group of the National Radiological Protection Board in the United Kingdom (AGNIR) (March 2001). This document supplements WHO Fact Sheet 205

In June 2001, an expert scientific working group of IARC reviewed studies related to the carcinogenicity of static and ELF electric and magnetic fields. Using the standard IARC classification that weighs human, animal and laboratory evidence, **ELF magnetic fields were classified as possibly carcinogenic to humans based on epidemiological studies of childhood leukemia. Evidence for all other cancers in children and adults, as well as other types of exposures (i.e. static fields and ELF electric fields) was considered not classifiable either due to insufficient or inconsistent scientific information.**

"Possibly carcinogenic to humans" is a classification used to denote an agent for which there is limited evidence of carcinogenicity in humans and **less than sufficient evidence** for carcinogenicity in experimental animals.

This classification is the weakest of three categories ("is carcinogenic to humans", "probably carcinogenic to humans" and "possibly carcinogenic to humans") used by IARC to classify potential carcinogens based on published scientific evidence. Some examples of well-known agents that have been classified by IARC are listed below:

Classification	Examples of Agents
Carcinogenic to humans (usually based on strong evidence of carcinogenicity in humans)	Asbestos Mustard gas Tobacco (smoked and smokeless) Gamma radiation
Probably carcinogenic to humans (usually based on strong evidence of carcinogenicity in animals)	Diesel engine exhaust Sun lamps UV radiation Formaldehyde
Possibly carcinogenic to humans (usually based on evidence in humans which is considered credible, but for which other explanations could not be ruled out)	Coffee Styrene Gasoline engine exhaust Welding fumes ELF magnetic fields

Do ELF Fields Cause Cancer?

ELF fields are known to interact with tissues by inducing electric fields and currents in them. This is the only established mechanism of action of these fields. However, the electric currents induced by ELF fields commonly found in our environment are normally much lower than the strongest electric currents naturally occurring in the body such as those that control the beating of the heart.

Since 1979 when epidemiological studies first raised a concern about exposures to power line frequency magnetic fields and childhood cancer, a large number of studies have been conducted to determine if measured ELF exposure can influence cancer development, especially leukemia in children.

There is no consistent evidence that exposure to ELF fields experienced in our living environment causes direct damage to biological molecules, including DNA. Since it seems unlikely that ELF fields could initiate cancer, a large number of investigations have been conducted to determine if ELF exposure can influence cancer promotion or co-promotion. Results from animal studies conducted so far suggest that ELF fields do not initiate or promote cancer.

However, two recent pooled analyses of epidemiological studies provide insight into the epidemiological evidence that played a pivotal role in the IARC evaluation. These studies suggest that, in a population exposed to average magnetic fields in excess of 0.3 to 0.4 μ T, twice as many children might develop leukemia compared to a population with lower exposures. In spite of the large number database, some uncertainty remains as to whether magnetic field exposure or some other factor(s) might have accounted for the increased leukemia incidence.

1.13. Japan EMF Research Program (2001)

By the middle of 1999, as mentioned in the EMF RAPID report, there was little evidence for any adverse health effects from EMF exposure. About half of the epidemiological studies have suggested possible health effects, but almost all of the experimental studies with animals have been negative. Thus it appears there is little possibility of finding new adverse health effects from EMF in the future. Very high intensity EMF can have certain biological effects, but they occur only with EMF more than 10,000 times higher than those found in real-world environments. Furthermore, even with the biological indicator which gave the positive results with 400 mT [4,000,000 mG] for 1 hour, elongated exposure with 5 mT [50,000 mG] for 6 weeks did not yield any effect. **We conclude that adverse human health effects as a result of environmental power-frequency EMF either do not occur or that they are undetectable because they occur so rarely they cannot be separated by other processes.**

1.14. National Cancer Institute (1997)

The NCI completed a comprehensive epidemiologic study, published in the *New England Journal of Medicine* (Martha Linet and collaborators). This study tried to replicate earlier (smaller) studies showing an association of childhood leukemia with utility wire configurations outside the home. The authors concluded that their study of 1,258 children showed no EMF effect:

“Our results provide little evidence that living in homes characterized by high measured time-weighted average magnetic field levels, or by the highest wire-code category increases the risk of acute lymphoblastic leukemia in children.”

1.15. Health Canada (1998), Health Effects and Exposure Guidelines Related to Extremely Low Frequency (ELF) 50/60 Hz Electric and Magnetic Fields

Concerns exist over the possibility that exposure to electric and magnetic fields (EMF) of extremely low frequency (ELF) may present a health hazard to workers and the general public. This concern has arisen as a result of the controversial and contradictory findings in the scientific research, especially from epidemiological studies. This overview summarizes recent scientific information on health effects and provides a status report on exposure guidelines that have been developed to date. The information is particularly relevant for government officials in Canada responsible for formulating occupational and public health policies and for providing guidance to interested or concerned persons.

Epidemiology

The strongest source of positive evidence for associated adverse effects has come from epidemiological studies. Such studies have suggested a weak positive association between ELF exposure and leukemia, brain cancers, breast cancer and lung cancer. **Nearly all of these studies were retrospective. Close examination of the methodologies used in early studies show major weaknesses or flaws, such as; number of cases too low to look at cancer subtypes, lack of specificity of exposure, lack of reliability of exposure data, lack of statistical power and lack of control for confounders.**

The majority of positive findings has very small risk magnitudes by epidemiological standards and are unable to rule out other confounding factors or environmental influences such as population mobility and other social/economic factors and traffic pollution. No dose response trends have been established. Recent studies are attempting to address some of these limitations. For example the cross Canada childhood leukemia study whose results were expected to be released in the fall of 1997, has a statistical power to detect a relative risk of 2.

Similarly, the large UK study currently underway (Doll, Richard et al, completion date 1998?) has 1000 childhood leukemia cases. A US study (National Cancer Institute (NCI) and the Children's Cancer Group (CCG) has released results, reference [5], from their study involving 600 acute lymphocytic leukemia (ALL) cases. These studies are able to detect low relative risks with greater certainty. It is generally agreed that the limit of epidemiological power is close to being reached and that it is unlikely that Epidemiology alone will be able to offer convincing proof to resolve this issue. There is no reliable supporting data for an association between residential exposure and cancer risk in the general public.

Overall, while several studies have found correlation between (ELF) and disease occurrence, including cancer, there is little consistency from the data in human studies. Although there is no conclusive evidence from the epidemiological evidence that electric or magnetic fields cause a risk of cancer, in residential or occupational environments, the research holds out a possibility of a weak risk. For residential exposures there is little evidence to support the notion of a risk associated with magnetic field exposure in

children or adults. Whereas, for occupational exposures the issue of leukemia and brain cancer in adults has not been resolved. [11]

Experimental Research

Experimental investigations with cellular systems, tissues and animals have shown that electric and magnetic fields can interact with these biological systems. Of the various kinds of biological effects related to ELF exposure "... no plausible biophysical mechanisms for the systematic initiation or promotion of cancer by these power line fields have been identified. [12]

Summary on Effects

The overall view obtained from the research literature indicates that while some biological effects of exposure to ELF electric and magnetic fields occur, there are no resulting adverse health effects from these exposures. The observed biological effects have not been shown to be significant in terms of a health hazard.

Therefore this lack of cause/effect evidence for disease induction for the exposure levels of concern to workers and the general public prevents the derivation of guidelines for protection against any chronic or long-term effects at typical low levels that most people are exposed to.

1.16. Health Canada (1999)

For a power frequency of 60 Hz, there is at present no Canadian national standard for EMF exposure. We are unsure of what levels of EMFs are safe or unsafe because the existing worldwide scientific evidence is not sufficient to define a level of exposure that can affect human health.

1.17. Health Canada (2001), Review of Lifestyle and Environmental Risk Factors for Breast Cancer

This literature review explores the association between breast cancer and exposure to electromagnetic fields. The authors reviewed epidemiological studies in English, French, and Spanish published between 1966 and 1999.

Epidemiological studies

During the past 20 years, there has been enormous interest in the possible relationship between electromagnetic fields (EMF) and breast cancer. In 1998, the U.S. National Institutes of Health called for greater research on EMF, declaring it a potential human carcinogen, and the International Agency for Research on Cancer stated that there is an urgent need for research on EMF and specific types of human cancers. **A total of 30 articles were identified and subdivided according to whether the studies were used to**

investigate exposure to EMF from occupational sources, residential sources (power lines or appliances) or multiple sources.

Results

The data from these few studies do not provide any persuasive evidence that breast cancer is positively associated with exposure to EMF. One possible explanation of these findings is that EMF does not cause breast cancer.

1.18. British Columbia (Canada) Ministry of Health (2000)

The Ministry of Health of the government of the province of British Columbia in Canada has concluded that (March 2000):

“When the research to date is taken as a whole, the evidence does not support the assumption that fields surrounding power lines, appliances, etc., pose a risk to human health. In recent years, larger, better designed studies have provided firmer evidence that exposure to these fields does not increase the risk of childhood cancer or produce other detrimental health effects.”

1.19. American Cancer Society (ACS)

Electromagnetic radiation at frequencies below ionizing and ultraviolet levels has not been shown to cause cancer. While some epidemiologic studies suggest associations with cancer, others do not, and experimental studies have not yielded reproducible evidence of carcinogenic mechanisms. Low-frequency radiation includes radio waves, microwaves, and radar, as well as power frequency radiation arising from the electric and magnetic fields associated with electric currents (extremely low-frequency radiation).

1.20. California EMF Program Study (2001)

An Evaluation of the Possible Risks from Electric and Magnetic Fields (EMFs) from Power Lines, Internal Wiring, Electrical Occupations and Appliances”, April 2001 as submitted by the Power Line Task Force. The following statements are taken from this study.

The three reviewers agree that statistical studies in the human population suggest there **might** be a problem, while, for the most part, **studies in animals do not**. While there are important differences in the numbers the reviewers selected to represent their degrees of confidence that a problem might exist, the following statements properly capture the range of their judgments:

It is “more than 50% **possible**” that EMFs at home or at work could cause a very small increased lifetime risk of childhood leukemia, adult brain cancer, and amyotrophic lateral sclerosis (ALS, Lou Gehrig’s Disease). **As this phrase implies, there is a chance that EMFs have no effect at all.**

Study Note: A reviewer who is 50% confident that childhood leukemia may be caused by high EMF exposures is NOT saying that a child exposed to high EMFs has a 50% chance of contracting the disease! That reviewer is saying that there is a 50% chance that there is a barely detectable effect and a 50% chance that there is no effect.

It is “more than 50% possible” that EMFs at home or at work could cause a 5-10% added risk of miscarriage, and again, **as this phrase implies, there is a chance that EMFs have no effect at all.**

It is “10-50 % **possible**” that residential or occupational EMFs could be responsible for a small increased lifetime risk of male breast cancer, childhood brain cancer, suicide, Alzheimer’s disease, or sudden cardiac death. **As this phrase implies, there is a chance that EMFs have no effect at all.**

It is “**very unlikely** (2-10% possible) but not impossible,” that residential or occupational EMFs could be responsible for even a small fraction of birth defects, low birth weight, neonatal deaths, or cancer generally.

All of the three reviewers give a degree of confidence of at least “10-50% **possible**” that residential or occupational EMFs **could be responsible** for a **small** increased life time risk of adult leukemia or female breast cancer, and one gave a degree of confidence that was higher.

The reviewers compared the size of possible risks from EMFs to the size of possible risks from chemical and physical agents now being regulated. They agreed that:

With the exception of miscarriage, the added risk (if any) of even a highly EMF-exposed individual getting any of these rare diseases would be such that the vast majority of highly exposed individuals (95%-99.9%) would not get them. Calculations suggest that the fraction of all cases of these conditions for which EMF might be responsible would be **very low**. However, if EMFs really contribute to the cause of these conditions, even these low individual risks and the low fractions of cases could be of concern to regulators. Indeed, when deemed real, theoretical risks smaller than these have triggered regulatory evaluation and sometimes, regulatory control of chemical agents. The uncommon, accumulated high EMF exposures implicated by the evidence on these conditions come from home wiring, nearby power lines, and electrical occupations. There are ways to avoid these uncommon accumulated exposures.

Two new epidemiology studies suggest that a substantial proportion of miscarriages (40%) might be caused by EMFs. Miscarriages are common in any case (about 10-15% of pregnancies) and the theoretical added risk for an EMF-exposed pregnant woman may be 5 to 10%’ according to two studies. If true, this would clearly be of regulatory concern. However, the type of EMF exposures implicated by the new epidemiology studies (short, very high exposures) probably comes primarily from being very close to appliances and indoor wiring, and only rarely from pc lines. Seventy-five percent of the women in the studies had at least one of these exposures during a day, and even one exposure

a day, if typically experienced during pregnancy, seemed to increase the risk of miscarriage. Nonetheless, the vast majority of pregnant women with exposures did NOT miscarry.

For childhood leukemia, the association now seems more consistent with measured 30-300 Hz magnetic fields than with proximity to power lines.

In occupational settings, micro shocks have been invoked to explain the persistent association between magnetic field exposure and ALS.

2. HEALTH ISSUE IN GENERAL (Testimonies received)

2.1. Dr. Martin Blank (Associate Professor, Columbia University) testimony of March 22, 2001

In 1979, Wertheimer and Leeper showed a doubling in the incidence of leukemia in children associated with EM fields, but epidemiology studies since then have not been conclusive. The NIEHS-EMF review panel announced in June 1998 that magnetic fields should be considered a “possible human carcinogen”

Kenneth Olden, the Director of NIEHS, wrote that “ELF-EMF exposure cannot be recognized at this time as entirely safe... passive regulatory action is warranted such as a continued emphasis on educating both the public and the regulated community [i.e., the power companies] on means aimed at reducing exposures.

On page 38 of the Report, the recommendation is more explicit. “The NIEHS suggests that the power industry continue its current practice of siting power lines to reduce exposures and continue to explore ways to reduce the creation of magnetic fields around transmission and distribution lines without creating new hazards.”

Vitelli Note: One could argue that this is exactly what Xcel is doing by double circuiting the power line through Mendota Heights and thereby reducing EMF exposure by 75-85%.

2.2. Dr. Magda Havas (Associate Professor, Trent University) testimony of March 22, 2001

Vitelli Note: While Dr. Havas has numerous publications in the areas of chemical pollution and science education, she has only recently taken an interest in EMF exposures and has only three recent, referenced publications in this area. One was in the Peterborough Examiner (a newspaper of Peterborough, Canada), the second was in the *Environmental Reviews* of the National Research Council of Canada and the third in *USGS Science of the Total Environment*.

Laboratory studies have shown that electromagnetic fields at power frequencies (60 Hertz) do not initiate cancer but rather promote cancer or the growth of cancerous cells already in the body. **Therefore, electromagnetic fields from power lines will not induce leukemia**

but will promote the growth of leukemia (and presumably other forms of cancer) that already exists in the body.

...in some studies very few children were exposed to the high fields (above 2 mG). **For statistical significance of a cancer that has a low frequency we often need a large sample size.**

And finally, we have no “zero” exposure, no true controls because everyone who uses electricity is exposed to electromagnetic fields.

Within the home there are three potentially important sources of electromagnetic fields. They include appliances, indoor wiring and outdoor wiring.

Based on childhood epidemiological studies the bedroom is a particularly important environment. Bedroom electromagnetic fields can be reduced in a number of ways and can go far *in* promoting electromagnetic hygiene. Electric alarm clocks, radios and baby monitors can be moved away from the bed. Electric blankets can be unplugged once they warm up a bed. Beds can be moved away from panel or fuse boxes and electric heaters. Electric heating coils in ceilings and floors generate high magnetic fields. These fields can be reduced by turning down the nighttime thermostat. Some older homes have knob and tube wiring that can also generate high magnetic fields and in other homes an improperly balanced return current can produce high magnetic fields. Although costly, an electrician can update the wiring to current wire codes and can balance the return current and thus reduce magnetic fields associated with indoor wiring. Hence, there is much that individuals can do to reduce their exposure.

If this recommendation of 2 mG or less became part of public policy and was enforced, it would significantly improve the electromagnetic environment in which we all live.

Vitelli Note: In order to achieve this goal, we would have to de-electrify the world.

2.3. Dr. Peter A. Vallberg (Principal, Gradient Corp) testimony of March 22, 2001

Background

Dr. Peter Valberg is Principal at Gradient Corporation and was for 25 years a faculty member in the Department of Environmental Health at the Harvard School of Public Health (HSPH). During his full-time tenure at HSPH, Dr. Valberg researched and taught toxicology, cell biology, environmental health, and public health. His teaching included Human Physiology, Inhalation Toxicology, Risk Assessment, and EMF/RF Case Studies. One of the research programs Dr. Valberg directed at HSPH was “Magnetic Field Effects on Macrophages,” supported by the National Cancer Institute.

Dr. Valberg has served on advisory panels for the National Institutes of Health (NUT), the Health Effects Institute, and the Environmental Protection Agency. He assisted the NIH in reviewing EMIF research proposals that come to the Radiation Study Section for possible funding by NIH. He is a member of the International Society for Environmental

Epidemiology, the Health Physics Society, and the Bioelectromagnetic Society. Through the Harvard Center for Risk Analysis, Dr. Valberg was a member of the “Harvard Advisory Committee on EMF and Human Health” as well as the “Peer Review Board on Cellular Telephones and Human Health.”

Dr. Valberg’s background includes physics, physiology, and public health expertise. He holds advanced degrees both in physics and physiology, and he has served on university faculties both in physics and in public health. Dr. Valberg is the author of over 80 peer-reviewed articles on environmental health and cell biology, and he advises researchers in the physical phenomena associated with EMF/RF, the relevant biology, and the human epidemiology. Dr. Valberg has directed health risk assessments for municipal health departments, utilities, regulatory agencies, government, and industry on evaluation of potential health effects of chemical exposures and of electromagnetic radiation (EMF/RF). He is a member of the Committee on Man and Radiation (COMAR), which periodically reviews RF standards for the American National Standards Institute (ANSI).

Comments

The size of the earth’s magnetic field in the North America is about 570 mG.

Typical toy magnets (“refrigerator-door” magnets) produce 100,000-500,000 mG.

Magnetic resonance imaging (MRI) is a medical diagnostic procedure that puts humans in fields even larger (10,000,000 mG).

EMF are present in the vicinity of all electrical devices, and human society has lived with (and used) electrical devices for over a century.

For residences, typical 60-Hz magnetic fields in the middle of rooms (away from appliances) range from about 0.5 to 2 mG. These fields are, to a large extent, produced by outdoor electricity distribution wiring, electric wiring inside the house, and indoor ground-current return pathways (*i.e.*, currents on the water pipes to which electrical systems are grounded).

Larger magnetic field levels can be found anywhere electricity is used. For example, microwave ovens, refrigerators, fluorescent lamps, electric ranges, clothes washers, toasters, vacuum cleaners, and many other **appliances** produce magnetic fields of **size 40-100 mG at distances of 1 foot.**

The magnetic fields from **personal-care appliances** such as shavers, hair dryers, massagers, electric toothbrushes, and electric blankets can be **many 100’s of mG**. Even though motorized electric appliances produce some of the highest EMFs commonly encountered, such appliances have been used for many years without evidence of ill effects.

...researchers developed a surrogate for past EMF exposures that was based on the proximity, number, and size of electric utility lines near the home. This summary description of the electric power distribution line configuration near a home was called its “wire code.”

It was found that the wire codes were poor surrogates for actual EMF exposure, but rather, were good surrogates for many other non-EMF factors such as traffic density, age of the home, rental vs. ownership, and assessed value of the home. This made it unlikely that the wire code associations with cancer risk were actually an effect of EMF exposure. That is, the EMF exposure was not a “causal” factor in the associations reported.

To date, there is neither an accepted mechanism by which power line EMF can cause disease, nor is there any animal model in which exposure to even large magnetic fields has consistently produced a disease or a pre-disease condition. This means that no one has been able to identify what aspect of EMF is the one we should potentially avoid. If there were bad health effects, would they be due specifically to the frequency of oscillation, the electric fields, the magnetic fields, continuous exposure, intermittent exposure, peak fields, transients, or what? In spite of many years of work, no firm evidence of adverse EMF effects has been found in the laboratory.

In summary, the current scientific evidence available from a considerable amount of EMF research and human experience has yet to identify any particular level of power-line.

What can we conclude about the possibility of EMF health effects?

It is clear that careful reviews of scientific data by panels of experts do not support the claim that EMF from electric-power transmission lines can cause human health effects. To quote Dr. Charles Stevens, the chair of the National Academy of Sciences committee that reviewed EMF research in the 1996 report: *“Science can’t prove that anything is safe. But so far we have failed to find hazard”*

2.4. The Power Line Task Force, in presentation of material to the Mendota Heights Planning Commission, stated that:

“FHA rules prohibit the issuance of insured loans for homes located adjacent to transmission power lines.”

The referenced FHA directive said absolutely nothing about the EMF dangers of power lines. It had only the following paragraph which mentioned power lines:

“J. OVERHEAD HIGH-VOLTAGE TRANSMISSION LINES

No dwelling or related property improvement may be located within the engineering (designed) fall distance of any pole, tower or support structure of a high-voltage transmission line, radio/TV transmission tower. Micro-wave relay dish or tower or satellite dish (radio, TV cable, etc.). For field analysis, the appraiser may use tower height as the fall distance.”

Vitelli Note: While the PLTF’s statement is not technically false, it certainly would mislead the casual reader into believing that the FHA has made a conclusion that power line EMF is dangerous.

2.5. EMF Produced By Common Electrical Apparatus and Occupational Exposure

It is important to understand the EMF present in common electrical appliances, motors and devices as well as the typical exposure in common occupations. The following data was taken from a research study published by Dr. Magda Havas and was presented to the Mendota Heights City Council by the Power Line Task Force. The data were referenced to come from the EPA, Levitt, and the FDA.

Appliance	High mG	Median mG
Electric shaver	600	100
Hair dryer	700	300
Baby monitor	16	6
Electric blanket	39	22
Blender	100	70
Can opener	1500	600
Coffee maker	10	7
Dishwasher	100	20
Electric clothes dryer	10	3
Electric oven	20	9
Electric range	200	30
Food processor	130	30
Garbage disposal	100	80
Microwave oven	300	200
Mixer	600	100
Refrigerator	40	2
Toaster	20	10
Ceiling fan	50	3
Color TV	20	7
Iron	20	8
Vacuum cleaner	700	300
Air cleaner	250	180
Copy machine	200	90
Fluorescent lights	100	40
Electric pencil sharpener	300	200
Computer CRT	20	14
Power drill	200	150
Power saw	1000	200
Electric resistance heater	14000	6000
Desktop cooling fan	1000	

Occupation	Mean mG
Dressmaker	300

Utility lineman	361
Machinist	301
Electrician	156
Cable splicer	150
Power plant operator	143
Railroad engineer	403
Welder	200
Airline pilot	100
Airline passenger	30-3
Electro-galvanizer	4600-1000
Amtrak NY to New Haven	260-35
Amtrak NY to Washington	640-126
Washington DC Metro	146-60

2.6. Research Article “Neurodegenerative diseases, suicide and depressive symptoms in relation to EMF”, Anders Ahlbom, 26 Jan 2001.

It is concluded that for amyotrophic lateral sclerosis, there are relatively strong data indicating that electric utility work may be associated with an increased risk. However, EMF exposure is only one of several possible explanations to this. For Alzheimer's disease the combined data on an association with EMF are weaker than that for ALS.

2.7. Article “The possible association between chronic lymphocytic leukemia and exposure to electric and magnetic fields”, D. Wartenberg, June 1995, Centers for Disease Control and Prevention (CDC) Workshop

Following Wertheimer and Leeper's seminal study of childhood cancer in 1979 (1), many investigators have studied the possible association between cancer and exposure to electric and magnetic fields.

Overall, the studies show a **moderately consistent association between residential proximity to power lines and childhood leukemia.**

Even if magnetic field exposure is a risk factor for chronic lymphocytic leukemia, and if the time weighted average magnetic field is the appropriate measure, **on average the size of the risk is relatively small.**

2.8. Research Article “A Population-Based Prospective Cohort Study of Personal Exposure to Magnetic Fields during Pregnancy and the Risk of Miscarriage” De-Kun Li et al, Epidemiology 2002.

Although the potential mechanisms of a possible MMF effect on the risk of miscarriage are not currently well-understood, early fetuses are known to be sensitive to environmental insults. A disruption of early fetal development at the cellular or molecular level by external MFs could conceivably result in fetal death. **Despite the lack of clear understanding** of the

underlying mechanisms, these findings **raise the question** of a **possible** effect of MMF on early fetal loss.

Vitelli Note: Compare the above statement from the concluding section of the report with the following statement quoted from the same report and presented by the Power Line Task Force.

Our **findings provide strong prospective evidence** that prenatal maximum magnetic field exposure above a certain level (possibly around 16 mG) **may be** associated with miscarriage risk. This observed association is unlikely to be due to uncontrolled biases or unmeasured confounders.

Vitelli Note: What is one to conclude from a report with such contradictory statements?

3. HEALTH ISSUE AND THE XCEL PROPOSAL

3.1. Reduction in EMF with Xcel Proposal

The EMF created by the power line is substantially reduced when the line is double circuited as proposed by Xcel. The table below shows a 73-85% reduction in EMF created mG based on where one is positioned relative to the power line. Note that when one is 100 feet from the base of the power line, the resulting EMF is 1.6 mG, which is less than the very stringent “safe” level recommended by the Power Line Task Force.

	Under Power Line	Edge of 50ft Right-of-Way	100ft from Power Line
Existing Single Circuit Line	132 mG	87 mG	11.2 mG
Proposed Double Circuit Line	36 mG	21 mG	1.6 mG
Reduction in mG Level (%)	-73%	-76%	-86%

Source: “Independent Review of Double Circuiting – Xcel Energy Red Rock-Wilson 115kV Transmission Line” by Commonwealth Associates Inc., (Consultant selected by the Transmission Line Steering Committee) Tables 3-4 and 3-5

Vitelli Note: If health was the key issue, the Power Line Task Force should welcome this substantial reduction in the EMF. In fact, being only 100 feet from the double-circuited line would bring the EMF down below the Dr. Havas recommended level of 2 mG.

3.2. Disadvantages of Other Routes for Second Circuit

If the second circuit were routed along any other route, the current residents along the existing power line route would not see the EMF reductions in the above table. Further,

another entire set of residents would see an **additional** power line within 250 feet of their residences. An **additional** power line would be added to those that we already have in our communities.

**Additional Homes Within 250 ft of Power Line
Second Circuit Routed Elsewhere
(All Affected Communities)**

	Currently	Option A	Option B	Option C	Option D	Option E
Homes	213	304	346	235	341	367
Added Homes		91	133	22	128	154

4. HEALTH ISSUE CONCLUSION (Vitelli)

- 4.1. Very highly respected scientific and health organizations throughout the world have and continue to state that there is **no evidence** the EMFs produced by high voltage power lines cause or promote cancer or other diseases.
- 4.2. The double-circuited power line proposed by Xcel actually **reduces** the EMF created by the existing single circuit by 73-85%.
- 4.3. If any alternate routes were used for the second circuit, the residences along the current circuit would not benefit from the reduced EMF, an additional power line would be erected in our community, and many new residences would then be within 250 feet of the new power line.
- 4.4. For these key reasons, there is no health related basis in fact to deny Xcel the Conditional Use Permit that would allow them to meet anticipated energy needs and double circuit the Red Rock-Wilson line.
- 4.5. **There is insufficient evidence presented on record that would cause denial based on “the effect of the proposed use upon the health, safety, and welfare of the occupants or surrounding lands”.**

5. FINANCIAL ISSUES

5.1. Property values of homes near current power line built in 1928

Virtually all property and homes near the existing power line were purchased or built since the current power line was erected and the right-of-way acquired by NSP. The following economical analysis seems logical:

Jack Vitelli Rationale and Position Regarding Xcel Power Line Through Mendota Heights

- i. If a nearby power line reduces the property/residence value, then the properties/residences purchased since 1928 have been acquired at a reduced value.
- ii. If a nearby power line does not reduce the property/residence value, then the properties/residences have been purchased at normal market value.
- iii. Therefore, the only pertinent effect of the new double circuit line proposed by Xcel would be the difference between the current H-type poles and the new singular tubular poles proposed.

The studies that try to represent the difference in property values with or without a power line nearby seem inappropriate since the power line has existed since 1928.

It appears that a maximum reduction in property value due to a change in the type of power pole would be is likely to be near zero. This does not qualify for the ordinance CUP requirement of “a significant reduction in property value.”

5.2. Burying the Line (Mendota Heights Residents Pay)

The Sunfish Lake Council and Planning Commission as well as the Mendota Heights Planning Commission discussed at length the possibility of burying the entire line. This would certainly improve the aesthetics and potentially further reduce the EMF. However, there is a substantial cost associated with this burial of the line. The cost to bury one circuit through Mendota Heights is estimated (by Xcel) to be \$10M. The cost to bury both circuits is estimated to be \$19M.

5.2.1. Cost to All Mendota Heights Residents

The Public Utilities Commission will likely determine that the residents of Mendota Heights must pay for the incremental cost or burial (Vitelli opinion). If the cost were depreciated over five years at an 8% interest rate, here is the added month surcharge we would all see on our Xcel monthly bill:

Added Utility Bill Cost for ALL Mendota Heights Residents

Bury 1 Circuit Through MHts	\$37 per month
Bury 2 Circuits Through MHts	\$70 per month

5.2.2. Spread the Cost to All Xcel Customers

Some have hoped that all Xcel customers would pay the added cost of burial and it would therefore be a negligible add to their monthly bill. This problem with this dream is that if the Public Utilities Commission ever allowed all Xcel customers to pay the bill for Mendota Heights power line burial, every city in Minnesota would

insist that their lines be buried and, thus, we would eventually see the same rate increase as shown above.

5.2.3. Ecological Issues Created

If the line were to be buried, a 30-foot path would be dug up along the entire line. All trees, plants, wetlands and natural habitat of animals would be destroyed. Further, the line would presumably be routed under Rogers Lake and Lake Augusta. I am not sure how this would be done.

5.3. Cost of Litigation to the Residents of Mendota Heights

5.3.1. Cost to Litigate

If the City of Mendota Heights denies this Conditional Use Permit or attaches any conditions other than perhaps painted the poles, Xcel will with virtual certainty take the issue to litigation. This will cost the City taxpayers and the League of Minnesota Cities together a total of \$100,000 (Vitelli estimate). The taxpayers and the League have already spent about \$50,000 on legal costs as we have legally jostled with Xcel in the past 6 months.

5.3.2. Likelihood of Preventing Double Circuiting of the Line

The probability that Mendota Heights would succeed in preventing the action proposed by Xcel is about zero (Vitelli estimate). Why? Because no respected scientific or health organization has stated that there is a real danger to health by low frequency EMF exposure due to high voltage power lines. Our Minnesota Department of Health says there is no danger. The line will simply not be deterred due to health reasons. In fact, because the line actually reduces the EMF by 75-85%, it actually mitigates the risk of any potentially negative effects on human health.

There is no substantial loss in property values (Vitelli opinion and results of studies) due to changing from H-structured wooded poles to tubular metal poles.

Further, no country in the world has adopted exposure limits for the protection of the general public against alleged long-term health effects of electric and magnetic fields.

On what basis can we argue a case for denial of the CUP?

6. FINANCIAL ISSUE CONCLUSION (Vitelli)

6.1. A power line **already exists** along the 50-foot right-of-way owned by Xcel. Properties are not being affected by the creation of a new power line corridor.

6.2. The only potential effect on property values would be the current wooden double-pole H line that now exists versus a single-pole tubular steel line that would replace it. Granted, the

new poles will be taller, but they will also significantly reduce the EMF along this corridor. I feel that any reduction in property value would be insignificant and would be offset by the improved environment created by the double circuit reduction in EMF.

6.3. I find that we cannot deny the CUP for the reason that it “will seriously depreciate surrounding property value.”

7. VITELLI OVERALL CONCLUSION

It is my recommendation that the CUP be approved along with minor conditions such as:

- 7.1.** Xcel be required to balance the amperage over the double circuits (except when there are system failures or significant changes in demand) so as to minimize the EMFs created by the line.
- 7.2.** Xcel place the new power poles in the same locations as existing H type poles unless the new pole is found to have a fall distance which would include an existing residence.
- 7.3.** Xcel place the new poles at the centerline of the existing 50-foot right-of-way.
- 7.4.** Xcel not be allowed to add RF transmitters to the power poles.
- 7.5.** Xcel comply with the current franchise ordinance of the City of Mendota Heights.
- 7.6.** Xcel secure all required permits by regulating agencies such as the Public Utilities Commission, the Environmental Quality Board, and the Department of Natural Resources.