

An analysis of risks associated with the proposed Energex Suncoast 132 kV Powerline Project's "option J" in relation to the Hungerford and nearby properties at Forest Glen, Qld.

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I have gone over the information Don Hungerford sent to me in regards to the Energex 132 Kv double circuit transmission line that is proposed to run through his farm via. Option J. The issue of possible health effects from exposure to electric and magnetic fields from powerlines/transmission lines is but one of the issues in this case. The possibility of adverse health effects from low-level electromagnetic fields (EMFs) has been one of the most controversial environmental issues since the 1970s. There is an extensive body of research to draw upon but it is the interpretation of that research which is controversial, as you will see in the following. My primary interest in this area has been that interpretation and the very subjective nature of expert assurances of safety that form the basis of official standards/guidelines. It is my view that the current level of scientific uncertainty due to differing interpretations of the science, differing values on what should be considered in setting health based standards, and the level of conflict of interest in expert assurances of safety, call for the use of a precautionary approach along the lines of the Wingspread Statement on the Precautionary Principle. To quote:

- “We believe existing environmental regulations and other decisions, particularly those based on risk assessment, have failed to adequately protect human health and the environment, as well as the larger system of which humans are but a part.
- We believe there is compelling evidence that damage to humans and the worldwide environment, is of such magnitude and seriousness that new principles for conducting human activities are necessary.
- While we realize that human activities may involve hazards, people must proceed more carefully than has been the case in recent history. Corporations, government entities, organizations, communities, scientists and other individuals must adopt a precautionary approach to all human endeavors.
- Therefore it is necessary to implement the Precautionary Principle: Where an activity raises threats of harm to the environment or human health, precautionary measures should be taken even if some cause and effect relationships are not fully established scientifically.”
- In this context the proponent of an activity, rather than the public bears the burden of proof.
- The process of applying the Precautionary Principle must be open, informed and democratic, and must include potentially affected parties. It must also involve an examination of the full range of alternatives, including no action.”¹

¹ Wingspread Statement on the Precautionary Principle, <http://www.gdrc.org/u-gov/precaution-3.html>, Accessed May 5, 2009.

My background

Before examining these issues I must state my qualifications to write about these matters. For the past 5 years I have been writing a PhD thesis through the University of Wollongong on EMF risk assessment and precautionary approaches specific to standard setting both in Australia and internationally.

My interest in both power frequency electromagnetic field (EMF) and radiofrequency and microwave (RF/MW) standard setting for human health protection dates from the early 1990s when I was doing some research for the late Australian Democrats' Senator Robert Bell from Tasmania. In 1994 Senator Bell asked me if I would be interested in compiling a Senate background paper on electromagnetic radiation (EMR) exposure standards. The Democrats were then involved in a controversial Eastlink powerline inquiry on a proposed 1500 kilometre high voltage power line to link the New South Wales and Queensland electricity grids and wanted a close look at the adequacy of the public safety standards. This report was tabled in the Senate in October 2004 and focused primarily on the standards relevant to powerline exposures and the inadequacies for public health protection. By late 1995 Senator Bell's office was receiving frequent calls from the public over concerns of possible hazards from mobile phones and towers and I was given the task of preparing a background report on what was known on the topic at the time. This was tabled in April 1996 with numerous copies being sent to local governments and other interested organizations. In 1997 I wrote a Senate discussion paper on the melatonin hypothesis (ELF magnetic field effects on melatonin, produced by the pineal gland) and the implications for breast cancer treatment.²

In April 1995, I took up a place on the Standards Australia TE/7 Committee on Human Exposure to Electromagnetic Fields. My position on the committee was to represent the interests of the Consumers' Federation of Australia, the national peak body for consumer groups in Australia. My role in the committee was basically to represent the public interest.

In addition to standard setting, since 1998 I have been involved with the Australian College of Nutritional & Environmental Medicine that mainly runs training and accreditation courses for medical practitioners.³ This involvement grew out my work with a number of doctors who had patients with unusual chronic fatigue syndrome (CFS) symptoms that seemed to have environmental factors, a few of which are summarized on my web site.⁴

In 1998, together with colleagues from Massey University, I followed this with a paper examining whether power frequency electromagnetic fields could be a factor to consider when treating CFS patients.⁵

² D. Maisch, 'Melatonin, Tamoxifen, 50 - 60 Hertz Electromagnetic Fields and Breast Cancer', *Hansard*, 27 Oct. 1997, <http://www.emfacts.com/papers/melatonin.html>.

³ ACNEM home page, http://www.acnem.org/modules/mastop_publish/

⁴ Some of these anecdotal cases are summarised at: <http://www.emfacts.com/papers/case-histories.html>

⁵ D. Maisch, B. Rapley, R.E. Rowland, J. Podd, Chronic Fatigue Syndrome - Is prolonged exposure to environmental level powerline frequency electromagnetic fields a co-factor to consider in treatment? *JACNEM* vol. 17 no. 2 Dec. 1998, pp. 29-35, <http://www.emfacts.com/papers/cfs.html>.

In 1999 I compiled a report titled, "The Ross House Electrical Substation: Workcare compensation case, Victoria, 1991-1992". This was from documents received by the Ross House manager. The report examined the workcare investigation that indicated excessive office building electromagnetic fields were apparently a factor in a number of workers' symptoms of chronic fatigue syndrome. It also examined the work done to mitigate the EMFs in the area.⁶

In 2000 I compiled a report on a condition, termed "pseudo-iron deficiency" repeatedly being found by Hachulla *et al* (2000) in a French hospital that was only observed in residents living near twin 400 kilovolt transmission lines.⁷ (**Appendix A**) The symptoms reported by the hospital were the same as symptoms reported in CFS patients in Australia who were found to have high EMF magnetic field exposures. Interestingly similar findings were reported in a later 2008 survey of similar 400 kV transmission lines in France.⁸ Taken together the French research strongly indicates adverse immune system effects in humans living within 100 metres of high voltage lines and with measured magnetic fields down to a 2 mG level. Hachulla concluded, to quote:

"We speculate that EMFs may modify iron metabolism in populations subjected to 0.2 uT (2 mG) or more with a high bone marrow incorporation of the iron (that would explain the low iron level) and a rapid utilization for the metabolism of hemoglobin, sometimes with non-incorporation of ⁵⁹Fe in the liver."

In February 2002 I gave a copy of the Hachulla study to the Analytical Reference Laboratories in Melbourne and they confirmed that blood tests for "pseudo-iron deficiency" was a relatively straightforward procedure and gave a quotation of \$29.90+ GST per sample.⁹ This is an interesting line of research as it may confirm that a testable biological effect exists for low-level powerline EMF exposure exists.

My interest in power frequency EMF exposure as a possible immune system suppressor led to research grant from ACNEM enabling colleagues from Massey University, New Zealand and I to examine the EMF exposures in a group of CFS patients in Melbourne, Adelaide and Hobart. There were significant indications that excessive EMF exposure in the order of 6 mG did have an adverse influence on the condition.^{10 11}

In 2003, as a result of my previous extensive writings on the EMF issue, particularly on the standard setting area, I was offered a position as a PhD candidate at Wollongong

⁶ A brief summary is available at: <http://www.emfacts.com/papers/ross-house.html>. A full print copy is available from EMFacts.

⁷ E. Hachulla, M-T. Caulier-Leleu, O. Fontaine, L. Mehianoui, P. Pelerin, 'Pseudo-iron deficiency in a French population living near high-voltage transmission lines: a dilemma for clinicians' *European Journal of Internal Medicine*, vol. 11, issue 6, 2000. A 'hard copy' 28 page report compiled on this research is available from EMFacts. Summary at: <http://www.emfacts.com/papers/french.html> .

⁸ C. Pierre Le Ruz, J-C Herriau, 'Citizen's Survey: Living with a very High Voltage Power Line?', RIIIREM, Stop-THT, 2009, http://www.stop-tht.org/IMG/pdf/090219_living_with_a_very_high_voltage_power_line.pdf , Accessed May 2, 2009.

⁹ Analytical Reference Laboratories written quotation No. 14, February 25, 2002. (See Appendix A-last page.)

¹⁰ D. Maisch, J. Podd, B. Rapley, 'Changes in Health Status in a Group of CFS and CF Patients Following Removal of Excessive 50 Hz Magnetic Field Exposure', JACNEM, vol. 21 no. 1 April 2002. pp. 15-19. http://www.emfacts.com/papers/cfs_changes.pdf.

¹¹ J. Podd, D. Maisch, 'Reducing the level of 50 Hz Magnetic Fields Lessens Symptoms of Chronic Fatigue and Improves Sleep'. 2nd International Workshop on "Biological effects of Electromagnetic fields", 7-11 October 2002, Rhodes, Greece. <http://www.emfacts.com/papers/cf-changes2.html> .

University in the Science, Technology in Society (STS) discipline. My thesis, “The Procrustean Approach: Setting Exposure Standards for Telecommunications Frequency Electromagnetic Radiation” examines in detail the foundations of Western telecommunications standards and how vested interests have been able to co-op the process in order to protect their economic interests much to the detriment of adequate public health protections.

In 2006, as part of my thesis inquiry I examined conflicts of interest in the risk assessment procedures of the World Health Organization’s International EMF Project Task Group. This group was evaluating the EMF literature for future power-frequency exposure standards and was found to have significant power industry involvement in contravention to stated conflict of interest policies.¹² (**Appendix B**)

Also in 2006 the BDP Environment Design Guide, the journal of the Royal Australian Institute of Architects commissioned me to write a paper specific to EMFs in the built environment. This paper calls for reduction of excessive EMF in the initial stages of construction – the design phase.¹³

Currently I am on the consultative committee for the proposed new power frequency standard drafted by the Australian Radiation Protection and Nuclear Safety Agency (ARPANSA).

Issues

Having stated my qualifications to advise on the EMF controversy I shall now return to those issues referred to earlier. I have divided them up into 6 discussion points.

- 1) Inadequacy of the standards in relation to assurances of public health protection.
- 2) What is a ‘safe’ level and distance?
- 3) Possible health effects on both people and horses spending large amounts of time under or near the lines.
- 4) Adverse effects on property values.
- 5) Loss of livelihood.
- 6) Occupational Health and Safety (OH&S) risks for workers working under and near the lines.

Issue 1: Inadequacy of the standards in relation to public health protection.

Over the past decade there have been a number of buildings in Australia where concerns have been raised over apparent excess rates of cancer and other illnesses amongst the occupants. A few examples are Ross House (Melbourne), the RMIT Building 108 (Melbourne), the Capalaba Post Office (Queensland), TYCO Electronics, Sydney and Hazelwood Special School (Hobart). In each case, in response to concerns that the illnesses may be due to 50 Hz extremely low frequency (ELF) magnetic fields, reassurance was given that possible health hazards were not possible as the measured levels were well below the National Health & Medical Research Council’s Interim

¹² D. Maisch, ‘Conflict of Interest and Bias in Health Advisory Committees: A case study of the WHO’s EMF task Group’, JACNEM, vol 25, no. 1, Apr. 2006, pp. 15-17. (see Appendix B).

¹³ D. Maisch, J. Podd, B. Rapley, ‘Electromagnetic Fields in the Built Environment – Design for Minimal Radiation Exposure’, *BDP Environment Design Guide*, Aug. 2006. <http://www.emfacts.com/papers/gen76.pdf>

guideline reference level of 1000 milliGauss (mG) for residential exposures. The point here is not that there was any proven connection with illness and EMF exposure in these cases, but that a message was given that as long as exposure levels were below the NH&MRC limits there was no possibility of any adverse health effects, including cancer. With the proposed transmission line through the Hungerford property we see the same message being given by Energex, that as long as exposure levels are under the 1000 mG limit there are no grounds for concern. Unfortunately, whenever the EMF guideline limits (NH&MRC and ICNIRP) are evoked as a guarantee of safety against any 'proven' adverse EMF health effects, the limitations are not mentioned. It is as though the guideline limits are based on a body of pure and certain knowledge that is above reproach. This is not the case as I explain below.

The ELF limit recommendations in the NH&MRC Interim guidelines (1989) are based on the International Radiation Protection Association's (IRPA) interim guidelines which also served as the basis for the current guidelines of the International Commission on Non-Ionizing Radiation Protection (ICNIRP). The same rationale for setting exposure limits applies to the ELF guidelines set by the UK's National Radiation Protection Board (NRPB). The rationale for all these guidelines is based on providing health protection only against **immediate health hazards** from high levels of exposure. This limitation was clearly explained by the predecessor to ARPANSA, the Australian Radiation Laboratory in 1994, in discussing my 1994 Senate report criticising the limitations to the standards. To Quote:

"The criticism of the IRPA interim guidelines (and consequently of the NH&MRC counterpart) derives from their ambiguity about what parts of the available evidence can be used in standard setting at present (and consequently what health effects can be confidently prevented by their implementation) and the expectation of the public. The NRPB has explicitly qualified the scope of their guidelines (based on the same rationale as the IRPA limits). Restriction on exposure to extremely low frequency magnetic fields are expressed in terms of induced current density and are intended to avoid the effects of induced electric currents on function of the central nervous system such as the control of movement and posture, memory, reasoning and visual processing" (McKinlay, 1993)." ¹⁴

The effects mentioned above are immediate health effects arising from high levels of exposure. Similar comments about the limitations and purpose of the NH&MRC guidelines were made in 1991 by Dr. Keith Lokan, from the Australian Radiation Laboratory, in a conference paper published in *Radiation Protection in Australia*.

"One thing which we have done, though it has little direct bearing on the issue of chronic low level exposure, is to adopt the (above) recommendations on field limits. These limits represent plausible field values, below which immediate adverse health effects are unlikely, and as such serve a useful purpose. They are not intended to provide protection against possible cancer induction by continued exposure at the lower field levels implicated in the studies..." ¹⁵

¹⁴ Australian Radiation Laboratory, 'Comments on the Maisch Report, Non-Ionizing Electromagnetic Fields and Human Health', December 1994.

¹⁵ K. Lokan, 'Risk Perception and Regulation-What Should the Regulator Do?' *Radiation Protection in Australia*, vol. 9, no.4, 1991, pp. 134-136.

Inadequacies in the ICNIRP based guideline limits were also mentioned in the Australian Gibbs report (1991).

“Since the guidelines proceed on the basis that adverse human health effects from exposure to ELF electric fields at strengths normally encountered in the environment or in the workplace have not been established, it is apparent that they are not intended to provide protection against any adverse health effects that may be caused by such exposure, and they would not do so. The levels of exposure recommended are many times greater than the levels at which it has been suggested that the fields may create a risk”.¹⁶

The Swiss government has recognized the ICNIRP guideline limitations in a report on EMF standards which explains the short-term limitations of the ICNIRP guidelines and in response have set a precautionary long-term exposure limit of 10mG which is one hundredth of ICNIRP’s 1,000 mG recommendation.¹⁷

As is clearly obvious from the above, a guideline recommendation of 1000 mG is not relevant to the question of possible hazards of prolonged environmental exposure levels influencing cancer and immune system effects. Considering this significant limitation, it is disingenuous to suggest that compliance with these guidelines somehow provides adequate public health protection.

A far more useful level from both a public health and an occupational health and safety viewpoint would be one that is linked with an increased risk of cancer and other adverse health effects in humans. However, the expert interpretation of the science has led to a high level of uncertainty which has been used to delay regulation by insisting on conclusive proof before enacting regulatory changes.¹⁸

I now briefly examine examples of four expert committees that have each reviewed the EMF literature in light of their different interpretations, the factors that may have influenced those interpretations, and how this has contributed to the continuing uncertainty over EMF health hazards. This situation indicates that there are adequate reasons to follow a precautionary approach for possible low-level prolonged-exposure hazards when citing EMF facilities, such as transmission lines.

The NCRP draft ELF review (1995)

The U.S. National Council on Radiation Protection and Measurements (NCRP), a U.S. congressionally chartered organization, was contracted by the Environmental Protection Agency (EPA) in 1983 to conduct a review of the biological effects of Extremely Low Frequency (ELF) EMFs. In early 1995 the draft of the 800 page NCRP report was leaked to the New York based publication Microwave News, which

¹⁶ H. Gibbs, ‘Inquiry into Community Needs and High-Voltage Transmission Line Development’, Report to Minister for Minerals and Energy, New South Wales State Government, Australia, 1991, pp.163.

¹⁷ ‘Electrosmog in the environment’, Swiss Agency for the Environment, Forests and Landscape (SAEFL), June 2005, http://www.bafu.admin.ch/publikationen/index.html?lang=en&action=show_publ&id_thema=8&series=DIV&nr_publication=5801, Accessed May 5, 2009.

¹⁸ The tactic of manufacturing scientific uncertainty has been long used to delay regulation of environmental pollutants. See: D. Michaels, C. Montforton, ‘Manufacturing Uncertainty: Contested Science and the Protection of the Public’s Health and Environment’, American Journal of Public Health, Supplement 1, vol. 95, no. S1, 2005. |

published the report's findings in August 1995.¹⁹ The final report was supposed to be approved and to be publicly available in early 1996, but final approval of the draft has never been acted upon. It is important to note, however, that the membership of the NCRP Committee was made up of expert scientists who do peer review and the draft recommendations reflected their consensus evaluation of the scientific literature in relation to the potential hazards of ELF magnetic fields.

The Committee's membership was described by chairman Dr. Ross Adey as "carefully selected to cover the great majority of societal interests on this scientific problem, including power industry engineers, epidemiologists, public health specialists as well as molecular and cellular biologists". The draft report generally endorsed a 2mG exposure limit. It would have immediately affected new day-care centres, schools and playgrounds, as well as have implications for new transmission lines near existing housing. A somewhat more flexible policy was applied to new housing and offices. For existing facilities, the committee recommended a more gradual approach, with stronger restrictions phased in over time if the evidence of a health risk continued to grow.²⁰

From the Committee's Conclusions:

"In arriving at the proposed guidelines, the committee has considered available laboratory studies on bioeffects and epidemiological reports of health hazards from electric and magnetic field exposure. In key areas of bioelectromagnetic research, findings are sufficiently consistent and form a sufficiently coherent picture to suggest plausible connections between ELF EMF exposures and disruption of normal biological processes, in ways meriting detailed examination of potential implications in human health."²¹

From studies on humans the committee cited evidence for a link between EMF's and:

- childhood and adult cancer, including leukaemia and brain cancer.
- teratological effects and other reproductive anomalies.
- neuroendocrine and autonomic responses which, separately or collectively, may have pathophysiological implications.
- neurochemical, physiological, behavioural and chronobiological responses with implications for development of the nervous system.
- From laboratory studies the committee noted that EMFs:
 1. affect cell growth regulation in animal and tissue models in a manner consistent with tumour formation.
 2. increase tumour incidence and decrease tumour latencies in animals.
 3. alter gene transcriptional processes, the natural defence response of T-lymphocytes and other cellular processes related to the development and control of cancers.
 4. affect neuroendocrine and psychosexual responses.

In relation to the effect of low level EMF's on melatonin and breast cancer, the committee concluded:

¹⁹ L. Slesin, 'Draft NCRP Report Seeks Strong Action To Curb EMFs, Committee Cites 2 mG Limit as Goal', pp. 1, 11 and 'NCRP Draft Recommendations on EMF Exposure Guidelines', pp 12-15, vol. 15, no. 4, Jul./Aug. 1995.

²⁰ *ibid*, p. 1.

²¹ *ibid*, p. 15.

"There has been a strong focus on ELF field actions in the pineal gland, relating to the pineal hormone melatonin, and on a broad series of regulatory functions mediated by this hormone. Melatonin plays a key role in controlling the 24-hour daily biological rhythm. Disturbance of the normal diurnal melatonin rhythm is associated with altered estrogen receptor formation in the breast, a line of experimental evidence now under study, or possible links between ELF field exposure and human breast cancer. Further, melatonin has general properties as a free radical scavenger, with the possibility of a preventative role in oxidative stress, recognized as a basic factor in a broad spectrum of human degenerative disorders, including coronary artery disease, Parkinson's and Alzheimer's diseases, and aging."²²

According to the committee, problematic sources of ELF EMF included local electrical distribution systems, as well as high voltage power transmission systems. Particular appliances, including electric blankets and VDT's also rate highly as problem sources, along with various occupational environments.

The committee stated that the evidence pointed to human health hazards in common exposures to EMFs, particularly magnetic fields exceeding 0.2uT (2 milliGauss) and electric fields at intensities in the range 10-100V/m (volts per metre). They stated:

"[T]here is an implication that a significant proportion of the world's population may be subjected to a low level or risk, but a risk factor with significant societal consequences, by reason of its pervasive nature and the serious consequences for affected individuals."²³

In their interim exposure guideline recommendations the NCRP concluded that "neither laboratory studies nor epidemiological findings can yet establish well-defined thresholds for safety guidelines." Still, it contended: "From available epidemiological and laboratory data, it appears both prudent and responsible to set limits on permissible future exposures". Therefore the NCRP committee called for "interim exposure guides", measures that "fall short of establishing either a standard or guideline, but offer guidance to limit exposure."²⁴

The NCRP committee recommended an "As Low As Reasonably Achievable" (ALARA) policy that over a three year period, ambient exposures in existing homes, schools and offices would be reduced to 10 mG. After six years, there would be an option to establish a guideline of 5 mG. At 10 years a goal of 2mG would be considered, depending upon the scientific evidence at the time. As for future construction, the report recommended a 2mG exposure limit for schools and for new transmission lines near existing housing, with somewhat less strict guidelines for new housing and offices.²⁵

Committee member Dr. David Carpenter, of the School of Public Health at the State University of New York, Albany, said, "In almost any other type of environmental exposures, if the evidence were as strong as the association between EMFs and cancer, there would be extensive government regulation. The major reason that many members

²² *ibid*, p. 13.

²³ *ibid*.

²⁴ *ibid*, p. 12.

²⁵ *ibid*, p. 11.

of the committee were unwilling to set more rigorous standards was that it would be horrendously expensive and unrealistic to enforce them."²⁶

In July 1995 I wrote to the NCRP committee Chairman Ross Adey and asked him in reference to telecommunications, was it advisable to base RF/MW standards solely on thermal effects. He replied, in part: "The laboratory evidence for athermal effects of both ELF and RF/MW fields now constitutes a major body of scientific literature in peer-reviewed journals. It is my personal view that to continue to ignore this work in the course of standard setting is irresponsible to the point of being a public scandal."²⁷

Soon after the NCRP draft report was leaked to the public several other expert U.S. committees issued their own evaluations that contradicted the NCRP evaluation. Considered here are the 1996 NAS/NRC Report and the 1999 NIEHS report.

The 1996 NAS/NRC review

In 1996 the National Academy of Sciences, National Research Council (NAS/NRC) released its review of the EMF literature titled, *Possible Health Effects of Exposure to Residential Electric and Magnetic Fields*. The conclusions of this report were that "there is no conclusive and consistent evidence showing that exposure to residential electric and magnetic fields produces cancer, adverse neurobehavioral effects, or reproductive and developmental defects". Of significance are the words, "conclusive and consistent". Like the more familiar phrase in law, "beyond reasonable doubt", "conclusive and consistent" implies a certain standard of evidence that warrants more serious action. Using that type of reasoning, the NRC Committee concluded that research results do not show that EMF exposure at a residential environmental level causes adverse health effects.²⁸ The NRC/NAS news release was headed: "No Adverse Health Effects Seen From Residential Exposure to Electromagnetic Fields." The release stated:

"To date, they have found no evidence to show that EMFs can alter the functions of cells at levels of exposure common in residential settings. Only at levels between 1,000 and 100,000 times stronger than residential fields have cells shown any reaction at all to EMF exposure. In fact, exposure may actually help the body in some subtle ways, for example by speeding up the healing process after a bone is broken."²⁹

The Electrical Supply Association of Australia's (ESAA) reported the NAS/NRC findings as, to quote:

"In an extensive review of the scientific literature relating to the possible health effects of exposure to residential electric and magnetic fields the (NAS) concluded that "the current body of evidence does not show that exposure to these fields presents a human-health hazard" NAS appointed an expert committee of 16 scientists to review 17 years of research . . . in hundreds of studies on three continents. The present report is the result of that effort . . . It (the NAS report) is an important

²⁶ *ibid.*

²⁷ Correspondence from Ross Adey, July 25, 1995.

²⁸ National Research Council (NRC), *Possible Health Effects of Exposure to Residential Electric and Magnetic Fields*, National Academy Press, Washington, DC, 1996.

²⁹ NRC, 'No Adverse Health Effects Seen From Residential Exposure to Electromagnetic Fields', http://www.peninsula.wednet.edu/conservation/Energy/EMF_health_effects.htm, Accessed May 8, 2009.

benchmark document in the history of the EMF scientific debate against which future research findings will need to be viewed."³⁰

However, an examination of the limitations of the NAS/NRC report shows that it is not what one would expect from an historical benchmark document. Using such restrictive criteria, so many scientific studies were excluded from the "extensive" NAS/NRC report that its conclusions fell far short of a proper review of the scientific literature. The NAS/NRC Committee only considered approximately half the evidence which was available to them. Dr. Kjell Hansson Mild of the National Institute for Working Life in Sweden, asked Dr Stevens, chair of the NRC Committee, how "the report turned out to be so biased in its selection of papers." Mild, past president of the Bioelectromagnetics Society, noted that the report mainly included papers that showed no effect and omitted those that found a biological response.³¹

Excluded from the NAS/NRC findings was the extensive body of occupational studies, such as the Ontario Hydro worker study, which found that workers exposed to high levels of magnetic and electric fields had leukaemia rates that were up to 11 times greater than expected. In fact the committee acknowledged that workplace studies "have increased rather than diminished the likelihood of an association between occupational exposure to [EMFs] and cancer." The NAS committee only did what has been called a "superficial overview" of this literature because the official reason was that it was not directly relevant to the committee's assignment.³²

Also excluded from the findings was the entire body of research into the effect of environmental low level EMF exposure on melatonin, known as the melatonin hypothesis (Low level magnetic field exposures may reduce the pineal gland's production of cancer inhibiting melatonin and the ability of melatonin to suppress breast cancer cells). This hypothesis is supported by at least five in vitro studies, from three major laboratories, as well some human exposure studies finding a reduction in melatonin levels in workers exposed to EMFs. The body of this research implicates prolonged powerline frequency magnetic field exposure in the order of 12mG with possible hormone disruption. Besides melatonin being affected, levels of the stress hormone ACTH may be increased as a consequence.³³

This body of research featured greatly at the Second World Congress for Electricity and Magnetism in Biology and Medicine, held in Bologna, Italy in June of 1997, where over 600 scientific papers on many topics were presented, it was mentioned in the official program bulletin: "A number of experimental studies have been conducted to test the [melatonin] hypothesis. Although the literature is still evolving and consensus is being built, it is fair to say, a) there exists credible scientific support for the hypothesis and, importantly, b) this support encompasses in vitro, in vivo, and epidemiological

³⁰ Electrical Supply Association of Australia (ESAA) newsletter *EMF Update*, January 1997.

³¹ L. Slesin, 'Power Line Talk', (Letter from Dr. Kjell Hansson Mild to Dr. Charles Stevens, chairman of the NAS Committee), *Microwave News*, vol. 17, no. 1, Jan/Feb 1997, p. 2.

³² L. Slesin, 'Views on the News: The NAS-NRC Report', *Microwave News*, vol.16, no. 6, Nov/Dec 1996, p.8.

³³ This evidence was summarised in: D. Maisch, 'Melatonin, Tamoxifen, 50-60 Hertz Electromagnetic Fields and Breast Cancer: A Discussion Paper'. Tabled in the Australian Senate, 29 October 1997, <http://www.emfacts.com/papers/melatonin.html>

research. The melatonin hypothesis, thus, currently represents one of the more well documented / tested interactions in the field of bioelectromagnetics."³⁴

The NAS press release stated: "The committee also called for more research into the relationship between high exposures to EMFs and breast cancer in animals already exposed to other carcinogens, and on reasons why electromagnetic fields seem to affect the levels of the hormone melatonin in animals, an effect not reproduced in humans." This statement gives the impression that there is no evidence that low level EMFs affect melatonin in humans. The NAS can only state this by ignoring the melatonin hypothesis research because it did not meet the committee's strict criteria for admissible evidence.

To be fair to the NAS/NRC report, the meta-analysis of 11 residential epidemiological studies was one of the most thorough to date. What it did find is that there is a reliable statistical association between childhood leukemia and power line proximity, as classified by wire codes. However, because the committee was looking for conclusive evidence of a connection with EMFs, it was able to dismiss all data which failed to meet this strict criterion and therefore could not conclude EMFs were to blame. Epidemiology looks for increases in risk factors, it does not deal with conclusive proof. By setting such an impossible standard, the National Academy of Science was able to dismiss the EMF link with childhood cancer and announce to the world that there was nothing to worry about.

So rather than being a "important benchmark document in the history of the EMF scientific debate against which future research findings will need to be viewed", the NAS /NRC study appears to be designed by its limitations to give an assurance of safety to the public when the evidence does not warrant that conclusion.

The NIEHS 1999 Review

As part of the U.S. EMF-Rapid Program's assessment of possible EMF health hazards, in 1998 a National Institute of Environmental Health Sciences (NIEHS) working group of 30 scientists met to evaluate the weight-of-evidence for the EMF research literature. They concluded that exposure to power frequency EMFs was a "possible human carcinogen" based largely on "limited evidence of an increased risk for childhood leukaemias with residential exposure and an increased occurrence of CLL (chronic lymphocytic leukaemia) associated with occupational exposure." For other cancers and non-cancer diseases the working group saw either weaker evidence or no evidence for a connection with power frequency EMFs.³⁵ In 1999 NIEHS published its final report on the issue that came to very different conclusions than the 1995 NCRP committee's draft report. The NIEHS committee concluded that the "scientific evidence suggesting that ELF-EMF exposures pose any health risk is weak" and in their opinion the findings were "insufficient to warrant aggressive regulatory action". The committee also did 'not

³⁴ F. Bersani (ed.), *Electricity and Magnetism in Biology and Medicine*, Proceedings of the Second World Congress, Bologna, Italy, June 8 - 13, 1997.

³⁵ C Porter, M Wolfe (eds.), *Assessment of Health Effects from Exposure to Power-Line Frequency Electric and Magnetic Fields – NIEHS Working Group Report*, Published by National Institute of Environmental Health Sciences, U.S. National Institutes of Health, U.S. Dept. of Health and Human Services, Public Health Service, 1998.

believe that other cancers or non-cancer health outcomes provide sufficient evidence or a risk to currently warrant concern.”³⁶

However, according to an analysis of the NIEHS decision making process by Louis Slesin, editor of the New York based newsletter *Microwave News*, it appeared that NIEHS senior managers were trying to downplay public concern over EMFs by pushing a viewpoint that any EMF risks were slight.³⁷ Slesin’s analysis suggests that there were subjective elements in the interpretation of the science that influenced the NIEHS views on EMF cancer risks. Whatever the case it is interesting that both the 1996 NAS/NRC report and the 1999 NIEHS Report came to such radically different conclusions than the NCRP even though they had essentially the same scientific data to consider. Henshaw addressed this issue when he observed that “[o]fficial review bodies are usually constrained by their terms of reference and have not been in a position to access the bulk of our scientific knowledge of MF interactions with biological systems....I estimate that such bodies have at most addressed only 10% of the available evidence/data.”³⁸ It is unfortunate that the opinions of expert review bodies are uncritically accepted as sure and certain scientific knowledge by national agencies with no questioning of the limitations of that knowledge. At the same time there is a tendency by agencies to reject outright alternative interpretations of the science. A case in point is the BioInitiative report.

The BioInitiative Report

On August 31, 2007, an international working group of 14 scientists, researchers and public health policy professionals (The BioInitiative group) released an extensive scientific literature review of over 2,000 studies titled the “*BioInitiative Report: A Rationale for a Biologically-based Public Exposure Standard for Electromagnetic Fields (ELF and RF)*”.³⁹ The purpose of the report was to document the information that the report’s authors thought needed to be considered in the debate over the adequacy, or inadequacy, of existing public exposure standards. This included both extremely low frequency (ELF) and radiofrequency/microwave standards. The report includes detailed scientific data, with references, documenting a whole range of chronic low-intensity, non-thermal adverse biological effects that have been established to occur at exposure levels well below ICNIRP limits. The report reviews the risk assessment carried out by IEEE and WHO/ICNIRP that serve as the common basis for the thermally-based (and induced currents at ELF frequencies) standards and documents a systematic filtering out of scientific studies that reported low-level bioeffects and potential health effects. The report specifically examines the limitations and deficiencies of the ICNIRP Guidelines. In calling for new biologically based EMF safety standards the report contains 11 chapters examining key scientific studies and reviews that have identified low-intensity biological effects which provide a scientific basis for new safety

³⁶ NIEHS, Health Effects from Exposure to Power-Line Frequency Electric and Magnetic Fields, May 4, 1999, <http://www.niehs.nih.gov/health/docs/niehs-report.pdf>, Also see:

<http://www.niehs.nih.gov/health/topics/agents/emf/index.cfm>, Accessed May 5, 2009.

³⁷ L. Slesin, ‘NIEHS Spins the News, Downplays the Health Risks’, Downplays the health Risks’, *Microwave News*, vol. 18, no. 4, July/August 1998, pp. 1, 19, www.microwavenews.com/news/backissues/j-a98issue.pdf, Accessed May 7, 2009.

³⁸ Correspondence to Don Hungerford from Dennis Henshaw, May 6, 2009.

³⁹ BioInitiative Report: A Rationale for a Biologically-based Public Exposure Standard for Electromagnetic Fields (ELF and RF), C. Sage, D. Carpenter (eds.), Aug. 31, 2007, <http://www.bioinitiative.org>, Accessed August 31, 2007.

limits based on traditional public health protection approaches. As such, the BioInitiative report represents a direct challenge to the scientific validity of the standards for both ELF and RF/MW that are maintained by ICNIRP and Institute of Electrical and Electronic Engineers (IEEE C95.1).

Criticisms of the BioInitiative report

The fundamental reason for the writing of the report was the increasing concern by a number of bioelectromagnetics researchers, scientists and public policy health experts over the unquestioned acceptance of WHO/ICNIRP claims that only immediate hazards from acute levels of EMF are to be considered as the only “established” health hazards from exposure. Understandably such a departure from standard setting orthodoxy would not escape criticism from organizations that have staked their own credibility on adherence to that orthodoxy.⁴⁰

Australian Centre for Radiofrequency Bioeffects Research

The Australian Centre for Radiofrequency Bioeffects Research (ACRBR), a university research partnership with Telstra criticizes the BioInitiative report as “largely inconsistent with current scientific consensus”. According to ACRBR, to quote:

“Do the BioInitiative Report authors represent an authoritative international body? Often in assessing public health issues, bodies are formed to evaluate evidence and offer recommendations about particular issues. The model that most scientific expert bodies in this area (e.g. World Health Organisation (WHO)) employ is to engage independent experts to provide a review and recommendations on an issue. Independent experts are engaged because it is meant to provide an objective evaluation of the issue. This contrasts strongly with the BioInitiative Report, which is the result of the opinions of a self-selected group of individuals who each have a strong belief that does not accord with that of current scientific consensus.⁴¹

In this statement the ACRBR assures the reader that the WHO (Actually the International EMF Project (IEMFP) at WHO) uses independent experts to do their reviews and make recommendations. Independence is obviously necessary in order to provide an objective evaluation of the issue and ICNIRP emphatically states this requirement.^{42 43}

⁴⁰ Opposition to new scientific claims is a topic explored in some detail in Thomas Kuhn’s classic work, *The Structure of Scientific Revolutions*, Int. Encyclopedia of Unified Science, vol. 2, no. 2, 1962.

⁴¹ ACRBR, <http://www.acrbr.org.au/FAQ/ACRBR%20Bioinitiative%20Report%2018%20Dec%202008.pdf>, Accessed Apr. 24, 2009.

⁴² M. Repacholi, Parliament of Australia, Inquiry into Electromagnetic Radiation, Standing Committee on the Environment, Communications, Information Technology and the Arts, (Australian Senate) May 2001. Testimony of Michael Repacholi,

⁴³ ICNIRP, ‘An Independent Voice In NIR Protection’, <http://www.icnirp.de/what.htm>, Accessed Apr. 30, 2009.

Health Council of the Netherlands

The Health Council of the Netherlands, in its review of the BioInitiative report made a number of fair criticisms of various sections of the report but their main criticism centres around the divergence from the 'official' guidance. To quote in part:

"A report published on 31 August 2007 is playing an increasingly prominent role in the debate on electromagnetic fields and health: the BioInitiative Report: A Rationale for a Biologically-based Public Exposure Standard for Electromagnetic Fields (ELF and RF). The report contains recommendations on establishing limits for exposure to electromagnetic fields that are much lower than the limits that are currently applied in the Netherlands and in many other countries, and is receiving increasing attention from society. Your Ministry has expressed interest in a judgement of the Health Council on the BioInitiative report. In this advisory letter therefore, the Council's Electromagnetic Fields Committee, after consultation of the Standing Committee on Radiation and Health, gives its opinion as to the scientific value of this report.

Method used to compile the BioInitiative report: Scientific advisory reports are usually the result of a process in which a group of experts, using the current state of science, extensively discusses a topic until a consensus is reached. The group is made up of independent experts from the various areas of expertise relevant to the topic. In the case of electromagnetic fields, for example, this would be biologists, epidemiologists, technical experts, physicians and in some cases also psychologists and risk experts. This procedure is followed by bodies such as the World Health Organisation (WHO) and the Health Council, as well as organisations involved in drafting proposals for exposure limits, such as the International Commission on Non-ionizing Radiation Protection (ICNIRP) and the International Commission for Electromagnetic Safety (ICES) of the Institute of Electrical and Electronics Engineers (IEEE). The various experts and the interactions between them, combined with a review of all relevant scientific information, ensure that a balanced judgement on the latest scientific knowledge can be reached. It is of importance that this process is transparent. This multidisciplinary weight-of-evidence method leads to a scientifically sound judgement that is as objective as possible. The BioInitiative report did not follow this procedure."⁴⁴

A major part of my thesis investigation was to examine conflicts of interest in EMF standard setting and how that has influenced the development and maintenance of standards / guidelines. This included ICNIRP, WHO (IEMFP) and ICES. Part of this investigation was a case study on the WHO's EMF task group that was given the task by WHO to evaluate the scientific literature relevant to ICNIRP's power frequency guidelines. What is shown, in contravention to both WHO and ICNIRP assurances that their assessment of adverse health effects and setting of safety factors is free from vested interests⁴⁵, is that power industry influence is endemic to the process and rather than it being an independent objective process as we are urged to uncritically accept, it is a biased interpretation of science by individuals mired in conflict of interest and clear

⁴⁴ Health Council of the Netherlands, <http://www.gr.nl/pdf.php?ID=1743&p=1>, Accessed April 24, 2009.

⁴⁵ ICNIRP, 'Use of the ICNIRP Guidelines', Mar. 31, 1999, <http://www.icnirp.de/documents/Use.htm>, Accessed Apr. 28, 2009.

financial bias. For details of this see Appendix A.

Although not directly relevant to powerline standards the ICES standard setting committee mentioned by the Health Council is predominantly made up of individuals who either represent the interests of the U.S. Department of Defence and industry manufacturers and industry users of radiofrequency and microwave (RF/MW) technology.^{46 47} The ICES peer review process for evaluating papers suitable for inclusion in the weight-of-evidence in RF/MW standard setting (For the U.S. RF/ME standard IEEE C95.1) is primarily made up of these individuals and it has been ordained by ICES in its “guiding principles” that, among other things only established adverse health effects (thermal) can be considered in setting RF/MW standards. Therefore research findings that to not further refine RF/MW thermal understandings are not useful in setting standards regardless of their validity and rejected.

What is clearly evident with the above mentioned standard setting organizations, who are unquestionably relied upon by both state and national Australian government agencies (and the power industry sector) for independent and objective advice, is that financial conflict of interest is endemic to the process. This is a problem addressed in 2003 by the International Committee of Medical Journal Editors (ICMJE). To quote from their “Uniform Requirements for Manuscripts Submitted to Biomedical Journals”:

“Conflicts of interest exists when an author (or the author’s Institution), reviewer, or editor has financial or personal relationships that inappropriately influence (bias) his or her actions...The potential for conflict of interest can exist whether or not an individual believes that the relationship affects his or her scientific judgement. Financial relationships...are the most easily identifiable conflicts of interest and the most likely to undermine the credibility of the journal, the authors, and of science itself.”⁴⁸

Eliot Marshall, writing in *Science* (1992) notes, however, that financial conflict of interest issues are simple when compared to intellectual conflicts of interests which have been an issue scientists have long had to deal with. Marshall explained that scientists are also human beings and “often begin their work with a hypothesis and become deeply invested in it...along the way to proving a thesis...scientists must be sustained by something that approaches faith.” Marshall quoted paleontologist and historian Stephen-Jay Gould: “It is a pervasive fact of human existence as social beings that we find it extraordinarily difficult to step out of our own convictions and see them through the eyes of a detached observer.”⁴⁹ Obviously Marshall and Gould’s observations on the human condition can apply to people on both sides of the EMF debate but it is especially relevant when claims of expert infallibility are made and maintained over the years (as aptly illustrated by the medieval Church for centuries). In this instance scientists and policy advisors who have established their own scientific credibility on supporting and being involved in so-called international expert organizations (i.e.

⁴⁶ L. Steneck, *The Microwave Debate*, MIT Press, Cambridge, Mass, U.S.A., 1984.

⁴⁷ L. Slesin, ‘Industry Rules RF Controlling Research, Setting Standards and Spinning History’, *Microwave News*, Aug. 9, 2004, <http://www.microwavenews.com/IndustryRulesRF.html>, Accessed May 2, 2009.

⁴⁸ Uniform Requirements for Manuscripts Submitted to Biomedical Journals: Writing and Editing for Biomedical Publication, ICMJE, Nov. 2003, p.8, <http://www.icmje.org/index.html#peer>, Accessed Apr. 28, 2009.

⁴⁹ E. Marshall, ‘When Does Intellectual Passion Become Conflict of Interest?’, *Science*, vol. 257, July 31, 1992, pp. 620-623.

WHO's IEMFP, ICNIRP, ICES) would understandably be reluctant to question the advice of those organizations as it would not be in their interests to do so.

It is unfortunate that Australian government agencies which the public relies upon to be guardians of objective science and protectors of public health have abrogated their public responsibility. On one hand, they uncritically accept a version of science promoted by conflicted organizations but on the other hand reject alternative versions because they are not in conformity with orthodoxy.

The Bioinitiative Report can also be said to be biased in the opposite direction because of its stated objective to question official versions of EMF standard setting science, not simply to validate them. The Bioinitiative Report is not necessarily a complete and objective overall evaluation of the science but the same criticisms can be said of the IEMFP and ICNIRP positions as well.⁵⁰ The real value in the Bioinitiative report lies in its various extensive reviews of the scientific literature by a number of prominent researchers well versed in their own fields of research. In the whole, it is a valuable public health resource and a substantial scientific critique of the so-called international EMF standards. It is a persuasive argument for sensible public health policy that embraces a precautionary approach for low-level, chronic exposures to EMFs.

On September 17, 2007, the European Environmental Agency issued a press release that supported the conclusions and recommendations of the Bioinitiative report. The EEA had contributed to this report with a chapter drawn from the EEA study *"Late lessons from early warnings: the precautionary principle 1896-2000"*, published in 2001. Professor Jacqueline McGlade, Executive Director of the EEA, stated the following:

"There are many examples of the failure to use the precautionary principle in the past, which have resulted in serious and often irreversible damage to health and environments. Appropriate, precautionary and proportionate actions taken now to avoid plausible and potentially serious threats to health from EMF are likely to be seen as prudent and wise from future perspectives. We must remember that precaution is one of the principles of EU environmental policy."⁵¹

Although not directly relevant to transmission line issues, on September 4, 2008, the European Parliament voted 522 to 16 to recommend tighter safety standards for cell phones based on growing evidence of a link between brain tumours and cell phone use. In reference to the ICNIRP guidelines, the Parliament stated that "[t]he limits on exposure to electromagnetic fields [EMFs] which have been set for the general public are obsolete". The EU Parliament specifically mentioned that their recommendations were also based on the Bio-Initiative report and the need to "address vulnerable groups such as pregnant women, newborn babies and children."⁵²

On February 23, 2009 the European Parliament Committee on the Environment, Public Health and Food Safety adopted a resolution in a 43-1 vote to urge the European Commission to recognize the growing public and scientific concern over health risks

⁵⁰ D. Maisch, 'The ICNIRP Guidelines: RF risk assessment built on a house of cards', May 2005, http://www.emfacts.com/papers/icnirp_critique.pdf

⁵¹ European Environment Agency, press release, Radiation risk from everyday devices assessed, Sept. 17, 2007, <http://www.eea.europa.eu/highlights/radiation-risk-from-everyday-devices-assessed> , Accessed Sept. 18, 2007.

⁵² C. Sage, The Bioinitiative Working Group press release, <http://www.marketwire.com/press-release/The-Bioinitiative-Working-Group-901580.html> , Accessed Sept.19, 2008.

from EMFs. Part of the 29-point resolution called for a review of the adequacy of the existing EMF limits.⁵³

On April 2, 2009 the full European Parliament adopted a report on avoiding the potential risks of electromagnetic fields with 559 votes in favour, 22 against with 8 abstentions. The report, drafted by Frederique Ries from Belgium, urged the European Commission to review “the scientific basis and adequacy of the EMF limits as laid down in recommendation 1999/519/EC”⁵⁴ which are based on the ICNIRP guidelines.

Additional evidence for a precautionary approach

Considering the epidemiological data, epidemiologist Nancy Wertheimer proposed in 1997 that a 3 mG cut off level be used as a benchmark in future research. She wrote in the September/October 1997 issue of the *Bioelectromagnetics Society Newsletter* that “...taken as a whole, the accumulated evidence from all the studies appears to show quite consistent and significant evidence that increased cancer risk accompanies measured or carefully calculated fields at the very high end of the field range (over about 3 mG). The same studies show little evidence that fields in the 2 to 2.9 mG range are indicators of risk.”⁵⁵

* In 2001 the International Agency for Research on Cancer (IARC) reviewed the scientific evidence on the potential carcinogenicity of ELF - EMFs and using the IARC classification system, classified power frequency EMFs as “possibly carcinogenic to humans”, based on a fairly consistent statistical association between a doubling of risk of childhood leukaemia and ELF magnetic field exposure above 4 mG. However, the IARC found no consistent evidence that ELF magnetic fields increased cancer risk in adults.⁵⁶

* The Advisory Group on Non-Ionizing Radiation (AGNIR) in March 2001 called a 4 mG level as a “relatively heavy” average exposure that is “associated with a doubling of the risk of leukaemia in children under 15 years of age.”⁵⁷

* In an interview with *Microwave News* in May 2001, EMF researcher and epidemiologist Dr. David Savatz, said that he was pessimistic about the value of conducting further epidemiological studies because he did not think that the public health threat was great enough to prioritize EMF work over other research. However, he agreed with recommendations to follow a policy of prudent avoidance – reducing exposures when one can do so at low cost. He felt that “the epidemiological research

⁵³ European Parliament, Motion For A European Parliament Resolution On Health Concerns Associated with Electromagnetic Fields. <http://www.europarl.europa.eu/oeil/file.jsp?id=5680652>, Accessed Mar. 3, 2009.

⁵⁴ European Parliament, Directorate for the Media, Press release, ‘Avoiding potential risks of electromagnetic fields’, Apr. 2, 2009. Full resolution at: <http://www.europarl.europa.eu/sides/getDoc.do?pubRef=-//EP//TEXT+TA+P6-TA-2009-0216+0+DOC+XML+V0//EN>, Accessed Apr. 7, 2009.

⁵⁵ N. Wertheimer, ‘Comment on 2 mG Intensity Cutpoint’, *Bioelectromagnetics Society Newsletter*, Sept/Oct, 1997, <http://www.bioelectromagnetics.org/newsletter/news138.html#NancyComment>, Accessed May 7, 2009.

⁵⁶ L.Slesin, ‘IARC Finds EMFs Are Possible Human Carcinogens’, *Microwave News*, vol. 21, no. 4, July/August 2001, pp. 1-4, www.microwavenews.com/news/backissues/j-a01issue.pdf, Accessed May 7, 2009.

⁵⁷ ‘ELF Electromagnetic Fields and the Risk of Cancer: Report on an Advisory Group on Non-Ionizing Radiation’, Documents of the NRPB, vol. 12, no.1, March 6, 2001.

http://www.hpa.org.uk/webc/HPAwebFile/HPAweb_C/1194947420620, Accessed April 24, 2009.

suggests that limiting exposures to less than 0.4 – 0.5 uT (4 – 5 mG) could have a health benefit.”⁵⁸

* In November 2001 the Queensland Planning and Environmental Court with Judge Tony Skoien presiding, heard a case over a proposed substation next to a predominantly residential area in Logan City, near Brisbane.⁵⁹ On 18th March 2002, the court ruling stipulated that ELF-EMFs from the proposed substation, should not exceed 0.4 microtesla (4 mG). The judge’s precautionary ruling stated the following:

“The issues relating to the placement of the substation are significantly different from those that may have existed in the past, as research now available accepts that a possible risk to the surrounding community may exist. Not only were the magnetic field levels in and around the substation to be taken into account, but recognition of the fields from the infeed and distribution cables had to be limited, by undergrounding, and monitoring, to ensure compliance with the 0.4 microtesla maximum allowed magnetic flux density”.⁶⁰

In the lead up to the court case the Logan City Council was stipulating a magnetic field limit of 2mG. Energex’s response to the Logan City Council solicitors was as follows:

"We do not support the concept of an artificially low magnetic field strength of 2 mG "safe level", which we are advised has no scientific basis. It would also appear that Logan City Council has no formal policy in this regard. The adoption of such a limit may also cause undue and unnecessary concern in the community. We are not aware of any country in the world which has adopted exposure limits differing markedly from the NHMRC (1000mG) guidelines mentioned below."⁶¹

It is somewhat surprising that Energex was not aware that a number of countries have general public ELF exposure limits significantly below that of ICNIRP (as of 2000). This includes the Russian Federation (outdoor 500mG/indoor 100mG)⁶², Switzerland (10mG for new transmission lines)⁶³ and Italy, where it varies between 2 mG and 30mG for new transmission lines, depending on region.^{64 65}

According to Roger Lamb, a Melbourne based electrical engineer who sat in for the five day hearing, the ruling would hopefully provide a model for the resolution of similar

⁵⁸ Savitz D, ‘EMF Epidemiology Has Reached Its Limits’, *Microwave News*, vol. XXI, no. 3, May/June 2001 p. 3, www.microwavenews.com/news/backissues/m-j01issue.pdf, Accessed May 7, 2009.

⁵⁹ Energex Ltd v Logan City Council & Ors, Queensland Planning and Environment Court, case no. 2604 of 2001. Nov. 19-29, 2001.

⁶⁰ As reported in Powerwatch News (UK), March 18, 2002, http://www.powerwatch.org.uk/news/20020506_emf.asp, Accessed Apr. 28, 2009.

⁶¹ Correspondence from the Energex solicitors to the Logan Council solicitors prior to the court case. From *Silent Fields* by Donna Fisher, Chapter 4, p. 40.

⁶² Center for Electromagnetic Safety (Russian Federation) <http://www.tesla.ru/english/protection/standards.html>, Accessed Apr. 28, 2009.

⁶³ ‘Electrosmog in the environment’ op. cit.

⁶⁴ K. Gustavs, ‘Options to Minimize Non-Ionizing Electromagnetic Radiation Exposures (EMF/RF/Static Fields) in Office Environments’, *Env. & Occ. Health Certificate Program*, Univ. Victoria, Nov. 14, 2008, p. 83. http://www.buildingbiology.ca/pdf/2008_low_emr_office_environments.pdf, Accessed Apr. 28, 2009.

⁶⁵ EMF Exposure Standards Applicable in Europe and Elsewhere, Union of the Electricity Industry, Mar 2006, p. 26, <http://www.eurelectric.org/Download/Download.aspx?DocumentID=19100>, Accessed Apr. 28, 2009.

situations in the future. According to Lamb, in response to the level of scientific uncertainty as to the extent of a health hazard the judge stated that "[T]he supply of electricity must not only be reliable, it must be as safe as it reasonably can be."⁶⁶

* In June 1995, the Australian Services Union and library equipment manufacturer RAECO signed an Australia wide agreement that the Union considered necessary to protect ASU library members from exposure to ELF-EMFs associated with some library security systems. The agreement stated that no ASU member should be exposed to a magnetic field of more than 4 mG averaged over a normal working day. As for the justification for using a 4 mG level the agreement stated that:

"Current studies indicate that Extra Low Frequencies (ELFs) increase susceptibility to cancers, they do not generate cancers. It is thought that ELF's "degrade" the immune system. This susceptibility to cancers is only during the period of exposure; it doesn't result in permanent degradation of the immune system. Therefore the longer the exposure, the longer the opportunity for the cancers to take hold. The current understanding is that the greatest exposure risk is to the head and torso. Current evidence suggests health problems could arise with prolonged exposure above 4 mG."⁶⁷

* A relevant development since the *Energex Ltd v Logan City Council & Ors* decision in 2001-2002 has been the decision in 2004-5 by the Dutch Ministry of Housing, Spatial Planning and the Environment to prepare a precautionary policy in setting a 4 mG (0.4 uT) exposure limit for new transmission lines, and banning the construction of buildings and developments that would expose people to prolonged magnetic fields of 4 mG and over.⁶⁸ In response to this precautionary policy, TenneT the administrator of the Dutch electrical grid, in tandem with Holland Railconsult, have designed a new high voltage transmission line concept featuring significantly reduced magnetic field intensity compared to existing lines. This would ensure that the maximum levels at the right-of-way boundary of the new transmission lines would conform to the 4 mG limit⁶⁹ (Appendix B). Importantly, this ruling lends further validity to the earlier precautionary Logan City court decision by Judge Skoien.

If we consider the above sampling of evidence it is apparent that any reference to a 1000mG limit (NH&MRC or ICNIRP) is totally inadequate for the issue of public health risks for residents and workers on the Hungerford farm who will be chronically exposed to EMFs from the proposed Energex transmission line if the Option J route is taken.

I note that in the opinion of Barrister Simon Cilento that in order for the court to grant an injunction, "the threat of injury must be immediate and substantial".⁷⁰ I disagree that the threat must be immediate as the health issues of concern are possible health hazards from prolonged exposures. For example cancer can take many years to become apparent after exposure to an environmental agent. The James Hardy asbestos litigation

⁶⁶ A. Philips, op. cit.

⁶⁷ P. Wilson, 'Agreement to limit EMF levels in libraries sets precedent', *Electromagnetics Forum*, vol. 1, no. 1, Article 14, December 1996. http://www.emfacts.com/forum/issue1/mag_14.html Accessed June 24, 2006.

⁶⁸ <http://www.tennet.nl/english/projects/news/wintrack.aspx> Accessed Sept. 6, 2006.

⁶⁹ http://www.tennet.nl/english/images/050531_Wintrack_UK_DEF_tcm43-9884.pdf Accessed Sept. 6, 2006.

⁷⁰ Statement by Barrister Simon Cilento on the Hungerford case, under the section 'Nuisance', point 60, p. 20.

is very relevant here. I'm sure James Hardy's legal team would have loved to have been able to have successfully inserted a stipulation that "the threat of injury must be immediate and substantial". Cilento's mention of immediacy is apparently in reference to the guidelines which only provide protection from immediate hazards. It is essentially an appeal for the ICNIRP guidelines to be uncritically taken as the final arbiter of scientific expert advice on human health protection. However, as examined in some detail in this section, these guidelines are infested with conflicts of interest leading to bias, subjective interpretations of the science and have failed to follow a precautionary approach for adequate public health protections.

ICNIRP's deceptive precautionary approach.

It has been argued by various organizations and individuals that the ICNIRP guidelines have incorporated a precautionary approach in its limits by setting safety factors below the maximum permissible limits (the guidelines include safety factors of 2 to 5 relative to occupational guidelines) and these provide protection from all known hazards. However, this is all based on "short term, immediate health consequences such as stimulation of peripheral nerves and muscles, functional changes in the nervous system and other tissues, shocks and burns caused by touching conducting objects, and changes in behaviour caused by elevated tissue temperatures." As for low level, prolonged EMF exposures ICNIRP is of the opinion that the scientific evidence is "insufficient to allow an exposure guideline to be established."⁷¹ In other words, a precautionary policy exists with the ICNIRP limits only in respect to providing protection from immediate hazards at high level exposures.

Issue 2: What is a 'safe' level and distance?

There are a number of reasons why a 4mG exposure limit was a more sensible reference level than a 1000mG limit. Those reasons are mentioned herein. A reference level of 4mG not saying it is 'safe' but that aiming at keeping exposures under that level was far more sensible than what the NH&MRC allowed. After all, the NH&MRC's 1000 mG limit is "not intended to provide protection against possible cancer induction" while a 4mG level has been classified as "possibly carcinogenic to humans". In addition, this level would ideally apply to a maximum current (peak) load and not an average measurement over time which allows for higher exposures. According to the U.S. Bonneville Power Administration, averaged load magnetic field levels can be approximately half of that under peak loads.⁷² Thus for 4mG peak load the averaged level would be around 2mG, the recommended limit for new facilities as proposed by the NCRP in 1990.

I read on page 15 of Energex's booklet "*Understanding Electric and Magnetic Fields*" that the 4mG level is dismissed as merely an epidemiological boundary or cut off point to define exposed groups in studies. This ignores the fact, as I mention above, that there are consistent findings in the epidemiological literature that at the 4mG range there is a marked increase in the risk of childhood leukaemia. It is deceptive to try and dismiss this fact by suggesting that this level is merely an artificial study cut off point divorced

⁷¹ ICNIRP, Use of the ICNIRP Guidelines, op. cit.

⁷² *ibid*,

from reality. To give Energex credit, however, they have stated that “Energex generally designs to this level [4mG] for new infrastructure as a matter of course.”⁷³ I assume, however, that Energex’s 4mg policy is one averaged over a number of months as established by judge Skoien in the Logan City substation case. If so, that limit could be significantly exceeded under peak loadings.

In my building survey work I advise that a precautionary 2mG and under is an acceptable room level under high current loading with an additional safety factor of 0.5mG for sleeping areas. As for the 2mG limit, besides the 2mG recommendation of the 1995 NCRP draft report mentioned previously, there are at least eleven studies of human populations finding that magnetic fields as low as 2mG depress nocturnal production of melatonin, a hormone produced at night by the pineal gland.⁷⁴ Melatonin is a powerful antioxidant and free radical scavenger that acts as a natural anti-cancer agent and reduced levels of the hormone are associated with depression and the onset of neurodegenerative diseases. The so-called melatonin hypothesis postulates that melatonin suppression may be a factor leading to an increased risk of cancer.⁷⁵

Mr Hungerford’s residence is about 200 metres from the line and at that distance magnetic and electric fields from the line should be well under 2mG even at peak loads.⁷⁶ There is a possibility of corona ion particulate pollution if the home is downwind of the lines when spraying is taking place in the strawberry fields. (See page 26-27 for more details on this.)

As for what magnetic field levels may be encountered in the two rental homes on Mr. Hungerford’s property at approximately 40 metres from the proposed easement they may well exceed 4mG at peak loadings. As a very general observation I have seen that at 60 metres transmission line magnetic field levels are below 4 mG at peak load times. For comparisons, the Swiss government’s ONIR standard indicates that, for a 110 V transmission line levels may approach 10mG up to 30 metres from the line and for 220 kV this would be up to 55 metres⁷⁷. In the U.S. a 115 kV line can reach 3.6 mG at peak load at 30 metres and for a 230 kV line at that distance 14.5mG at peak loading⁷⁸. Note that Powerlink in north Queensland has a policy that “no sensitive site” is less than 150 metres from transmission lines. This policy acknowledges perceived concerns on part of the community and is aimed at minimising those concerns.⁷⁹ At 150 metres the magnetic field would be well less than 1 mG. If such a policy were applied by Energex Option J would obviously not be feasible. For these two homes, and the occupants, there is also the problem of corona ion particulate air pollution (page 26-27). In my opinion 40 metres is too close to the lines to assure safety if the evidence I cover herein is taken into account.

⁷³ Energex response to D, Hungerford, Nov. 4, 2008, p. 3, para. 3.

⁷⁴ S. Davis, W. Kaune, D. Mirick, C. Chen, R. Stevens, ‘Residential magnetic fields, light-at-night, and nocturnal urinary 6-Sulfatoxymelatonin concentration in women’, *American Journal of Epidemiology*, vol. 154, pp. 591-600.

⁷⁵ D. Henshaw, R. Reiter, R. J., ‘Do magnetic fields cause increased risk of childhood leukaemia via melatonin disruption?’ *Bioelectromagnetics Supplement 7*, 2005 pp. S86-S97.

⁷⁶ J. Lee, et al, ‘*Electrical and Biological Effects of Transmission Lines: A Review*’, Bonneville Power Administration, Dec. 1996. ch. 1, p. 17, Figure 1.24.

⁷⁷ ‘Electrosmog in the environment’ op. cit. p. 27.

⁷⁸ Lee, 1996, op. cit.

⁷⁹ Community Concerns Raised In Consultation for Draft EIS Kareeya – Innisfail Powerline replacement (2002), <http://www.powerlink.com.au/data/portal/00005056/content/29182001151023586633.pdf>, Accessed May 1, 2009.

As for the horse stables and work areas either within or immediately adjacent to the 40 metre wide easement, Option J is unacceptable for a number of reasons, as follows.

Issue 3: Possible health effects on both people and horses spending large amounts of time under or near the lines.

Effects on workers

It is important to note that for all people working in close proximity to the transmission lines (Option J), either around the horse stables, exercise areas and strawberry fields their estimated occupational magnetic field exposures (32mG +)⁸⁰ would be in excess of the range of the highest median magnetic field exposure exposures received by electrical substation workers (10.56 mG / 1.056uT)⁸¹. The U.S. Electric Power research Institute found that electrical workers can have exposures up to 16.6mG.⁸² Interestingly, an epidemiological study by Dr. De-Kun Li at the Kaiser Permanente research division in California found up to a six-fold increased risk of spontaneous abortions among women exposed to peak magnetic fields of 16mG and more. For time weighted averages (TWA) of 3mG and more there was no increased risk. In an interview with Microwave News, Li said that “ [w]ith TWAs you are diluting any possible effect because you are combining relevant with irrelevant exposures”.⁸³ A sensible precaution here for the Hungerford farm would be not to allow pregnant women to work under or near the lines.

There certainly are a number of occupational studies that did not find any apparent connections between adverse health outcomes and EMF exposure, but a number have indicated there may be adverse health effects. In its review of the epidemiological literature by the U.S. Bonneville Power Administration the authors found that overall the research findings “although not conclusive, suggests that residential and occupational exposure to EMF increases the risk of cancer”⁸⁴.

Milham (1985) found statistically significant elevated brain cancer risks for electrical workers and electricians, based on death certificates.⁸⁵ In an earlier death certificate study , this time on adult leukaemia deaths, Milham reported a significant association between electrical workers and leukaemia.⁸⁶ This was reconfirmed in a 1989 re-analysis.⁸⁷

⁸⁰ I would assume that this is an averaged estimation over a period of time. If so, then at peak loads this figure can be significantly exceeded.

⁸¹ Lee, 1996, op. cit., ch. 2, p. 6.

⁸² EPRI Resource Paper, Occupational EMF Exposure Assessment, Feb. 1994, quoted in the Bioinitiative Report, p. 179.

⁸³ L. Slesin, ‘ Maximum EMF Exposure Emerges As Strong Miscarriage Risk’, *Microwave News*, vol. 21, no. 3, May/June 2001.

⁸⁴ Lee, 1996, op. cit., ch. 3, p. 33.

⁸⁵ S. Milham, ‘Mortality in workers exposed to electromagnetic fields’, *Environmental Health Perspectives*, vol. 62, 1985, pp. 297-300, <http://www.pubmedcentral.nih.gov/articlerender.fcgi?artid=1568699>, Accessed May 5, 2009.

⁸⁶ S. Milham, *Occupational Mortality in Washington State 1950-1979*, U.S. Department of Health and Human Services, 1983.

⁸⁷ S. Milham, *Occupational Mortality in Washington State 1950-1989*, U.S. Department of Health and Human Services, <http://www.cdc.gov/Niosh/pdfs/96-133.pdf>, Accessed May 5, 2009.

A study specific to electrical utility workers that I examined as a thesis project is of relevance here. It is the 1994 Hydro-Quebec electrical worker study by Dr Gilles Theriault et al. from McGill University. My interest in this study stemmed from it being an apparent case of suppression of potentially damaging scientific data by those who funded the study. In this epidemiological study, funded by Hydro-Quebec, the initial analysis of the data collected from three electric utilities found that workers who had the greatest exposures to magnetic fields had twelve times the expected rate of astrocytomas, a type of brain tumour, based on a small number of cases.⁸⁸ In a later re-analysis of the data, this time looking at high frequency transients (HFT), the McGill University team found up to a 10-fold increased risk of developing lung cancer amongst highly exposed utility workers, with a “very clear” exposure-response relationship.^{89 90} When Theriault requested to further analyze the HFT data for other associations, Hydro-Quebec, which funded and therefore owned the collected data, refused further access to that data. Even though a number of researchers saw the data as having important implications it has been suppressed from further analysis by Hydro Quebec.⁹¹ (Further examined in Appendix B.)

Another high EMF occupationally exposed group are industrial seamstresses who were found to have exposure levels usually over 10mG for much of the workday. This occupation is also found to consistently be at higher risk of Alzheimers’ disease and female breast cancer, two diseases that have an apparent link with ELF magnetic field exposure.⁹²

Considering the above epidemiological evidence it must be said that the workers on Mr. Hungerford’s property who spend a sizeable amount of time working near or under the lines may be at increased risk of cancer and other diseases. This increased risk is outside the scope of both the NH&MRC or ICNIRP guidelines.

Ground currents/stray voltage effects on farm animals

Research in the U.S. has found that high 50 or 60 Hz magnetic fields can be commonly generated in buildings due to electrical current flow on copper and steel water pipes, earth wires and neutral lines that creates an alternative electrical path for return or neutral currents. This creates an unbalanced electrical load in the building with resultant elevated magnetic fields.^{93 94} One landmark study by Wertheimer et al (1995) concluded that, “The associations of cancer with conductive plumbing...suggest that cancer risk is increased among persons with elevated magnetic field exposure from

⁸⁸ G. Theriault, et al. ‘Cancer Risks Associated with Occupational Exposure to Magnetic Fields Among Electric Utility Workers in Ontario and Quebec, Canada, and France: 1970-1989’, *American Journal of Epidemiology*, vol. 139, 1994, pp. 550-572.

⁸⁹ B. Armstrong, et al. ‘Association Between Exposure to Pulsed Electromagnetic Fields and Cancer in Electric Utility Workers in Quebec, Canada, and France’, *American Journal of Epidemiology*, vol. 140, 1994, pp. 805-820.

⁹⁰ L. Slesin, ‘Transients and Lung Cancer: A Strong Association and a “Remarkable Exposure-Response”’, *Microwave News*, vol.14, no.6, Nov./Dec. 1994.

⁹¹ *ibid.*

⁹² Bioinitiative Report, *op. cit.*, pp. 55-56.

⁹³ K Riley, *Tracing EMFs in Building wiring and grounding*, Magnetic Sciences International, 1995.

⁹⁴ S Maurer, ‘Home Magnetic Field Surveys and Water Pipe Ground Currents’, *BENER Digest Update*, vol. 4, no. 3, 1994.

residential ground currents”⁹⁵ (also referred to as stray voltage). In this respect the authors were investigating ground currents running on water piping in residential areas. Another type of ground current flows through the earth itself and may, in some situations be strong enough to be a shock hazard. For example in New York City in 2005 Consolidated Edison recorded 1,241 incidents, including electrocution when a woman stepped on a metal plate and dog stepping on wet cement.⁹⁶ Such drastic incidents should not be an issue with a new Energex line but the problem of low-level shock from metal structures under the lines will most likely be a recurring issue in and around Mr. Hungerford’s stables that will be under or adjacent to the lines if Option J is proceeded with. Besides the ground current potential, the close proximity to the lines will also result in electrical field exposures that can build up an electrical charge on metal surfaces. I saw this some time ago in a survey of a number of new homes with their back yards immediately under transmission lines in East Keilor near Melbourne. Touching metal items, such as a Hills Hoist would impart a small static discharge. There is a body of evidence that constant exposure to such small discharge is distressing to dairy cows. Although I could not find information specific to horses it stands to reason that they too would receive small shocks in similar situations. How this will affect horses remains to be seen. D. Hillman from the Department of Animal Science, Michigan State University has summarized what is known about the effects of low-level electric shock on cattle and how financial conflicts of interest have influenced the interpretation of the science to the benefit of the power industry⁹⁷. **(Appendix C)**

As for dairy farms in the U.S. there have been a number of successful courts decisions against utilities. An Idaho court in 2004 denied an electrical utility appeal against a \$17 million dairy cattle stray voltage judgement.⁹⁸ In Wisconsin in 2007 the Supreme Court upheld a lower court ruling for a number of dairy farmers who claimed stray voltage adversely affected their herd’s health and milk production. Also in Wisconsin in 2003 the Wisconsin Supreme Court upheld another lower court decision that awarded a \$1.2 million claim against an electrical utility for stray voltage damaging the herd of a dairy farm.⁹⁹

A farm worker or horse when standing on a dry surface may feel a tingling sensation when touching a grounded metal object, such as a fence wire attached to metal posts. If the metal is ungrounded a painful shock may be experienced. Shocks will also be felt when coming into contact with vehicles (such as a horse trailer) when parked under the lines.¹⁰⁰ For a worker this may be just an annoying event but for a horse it may be a significant stressor, as the evidence with dairy cattle indicates.¹⁰¹ On the Hungerford farm the horse stables, when completed, will have yards built on both sides, these will have metal gates and the ones on the southern side will be directly under the powerlines.

⁹⁵ N. Wertheimer, D. Savitz, E. Leeper, ‘Childhood cancer in relation to indicators of magnetic fields from ground current sources’, *Bioelectromagnetics*, 1995, vol. 16, no. 2, pp. 86-96.

⁹⁶ H. Cummins, ‘Cows are dying, and farmers think they know’, *Star Tribune*, Jan. 7, 2008. <http://www.rivervalleynewspapers.com/strayvoltage/>, Accessed May 1, 2009.

⁹⁷ D. Hillman, ‘Effects of Electrical Shock on Cattle’, Department of Animal Science, Michigan State University, <https://www.msu.edu/user/hillman/elecshok.htm>, Accessed May 5, 2009. (see Appendix C)

⁹⁸ Cummins, op. cit.

⁹⁹ S. Bauer, ‘Winconsin Supreme Court upholds stray voltage award’, *Associated Press*, Dec. 6, 2007. <http://www.rivervalleynewspapers.com/strayvoltage/>, Accessed May 1, 2009.

¹⁰⁰ Lee, 1996, op. cit., ch. 1, p. 11.

¹⁰¹ Hillman, op. cit.

In the stables on the Hungerford farm there are metal stallion dividers that are separated from the earth by a wooden wall so that a horse's kick in normal circumstances strikes wooden planking and not metal (see photos in Appendix E). In this situation with transmission lines above (Option J) there is the likelihood that when a horse puts its nose on the metal dividers it could receive a shock resulting in a convulsive reaction of panic and kick out. If someone is working on a horse in an enclosed bay when this happens they could be seriously injured as a result. A question here would be who is liable for injury in this situation - Mr. Hungerford as owner of the property or Energex whose lines caused the event? This question is further complicated by the fact that the stables are 4.5 metres high when the Queensland Electrical Act (2002) only allows a structure under transmission lines to be 3.0 meters high, thus contravening the Act. According to Christa Elliott, when she pointed this out to Dennis Cucchiaro, Energex's Network Corridor Manager, he stated, "sometimes we give little concessions."¹⁰² Legal advice is needed on this point as I doubt that Energex can make concessions to contravene the Act.

Will Energex's transmission line, if routed along Option J adversely affect the horses near or in the easement? In order to definitively answer this question a research project could be started in case Option J goes ahead. First, before the lines are activated, the health status (including behavioural) of all animals agisted on the Hungerford and the Kunda Park Pony Club are carefully assessed by an independent veterinary surgeon, including blood tests. Then after the lines are powered up, at regular intervals the health status is re-examined to see if there are any obvious changes to the horses. Such a research project, properly conducted by independent researchers with no conflicts of interests, would go a long way to clarify whether or not there are adverse effects on horses in this situation. A negative outcome (no effects) should be welcomed by Energex as clear evidence their lines are harmless to animals, at least for horses. A positive finding, however, is another matter entirely.

Issue 4: Adverse effects on property values

Quite independent of the health effects issue the visual site of the transmission lines will have a negative affect on the Hungerford property and even more so with the Urban Pacific development subdivision. With Option J the transmission line will apparently have high visibility from many of the allotments and this likely make it harder to sell these properties and may necessitate a lesser sale price if they are to be sold. Following is a brief sampling of overseas research that may be relevant to the situation in Australia.

From a case study in the UK Sims (2002) found that quite separate from the health effects controversy public perception of the possibility of health risks appeared to have a negative effect on the value and desirability of properties near electricity distribution facilities.¹⁰³ In their analysis of powerlines and property values from a number of

¹⁰² Communication with Christa Elliott, 12 May 2009.

¹⁰³ S. Sims, 'The Effect of Public perception on residential property values in Close Proximity to Electricity Distribution Equipment, Pacific Rim Real Estate Society Conference, Jan. 2002, http://www.pres.net/Papers/Sims_Effect_Public_Perception_Values_Electricity_Equipment.pdf, Accessed May 2, 2009.

surveys and studies Bolton and Sick (1998) found that real estate professionals generally concluded that power lines were bad for property values and that “the continuing scientific controversy over the adverse health consequences of EMFs only serves to perpetuate the debilitating effect of power lines on abutting property values.”¹⁰⁴ In one case cited in Bolton & Sick paper a researcher concluded that “the area located within a transmission line easement had a 90% diminution in value due to the presence of the easement.”¹⁰⁵ Elliott & Wadley (2002) examined the stigma of transmission lines on with property values which they saw as “a general phenomenon resulting in price depreciation of land abutting power lines.”¹⁰⁶ Schutt (1996) writing on powerline compensation in the *Florida State University Law Review* argues that what he calls the “majority view” holds that “damages caused by the public’s fear are always compensable”. Schutt wrote that “the majority view is superior to the minority and intermediate views. This part demonstrates that the majority view is essentially a strict liability approach, and suggests that the justifications for imposing strict liability upon an actor also support imposing upon power companies the cost of compensating property owners for losses caused by the public’s fear of EMF health hazards.”¹⁰⁷

The above strongly suggests that the Hungerford property, with part thereof being within the easement, will have a significant reduction in market value. This should also be a concern to the developers of the Urban Pacific subdivision and if Option J proceeds it would be a worthwhile project to survey the effects on the saleability and final sale price of the allotments closest to the transmission live versus those further away.

Issue 5: Loss of livelihood

It stands to reason that, quite separate from the potential for actual hazards (real or imagined) to humans and horses, public perceptions of possible health hazards may have the potential to adversely affect the Hungerford business activities and that of the Kunda Park Pony Club as well. Will people still be willing to agist their horses if they fear a possible hazard exists for their animals? Will parents be willing to have their children practice under the lines? Unfortunately the only way to answer these questions will to see effect on the balance sheets after the line is built and energised. Energex may well have a case to answer if this proves to be the case.

Issue 6: Occupational Health and Safety (OH&S) risks for workers working under the lines.

From Mr. Hungerford’s statement of farming practices (**Appendix D**) two potential health hazards (in addition to the EMF health effects issue) are apparent:

¹⁰⁴ D. Bolton, K. Sick, ‘Power Lines and Property Values: The Good, the Bad, and the Ugly’, Proceedings of the Institute on Planning, Zoning and Eminent Domain, Municipal Legal Studies Center, Dallas, Texas, Nov. 18-20, 1998, <http://www.harriscompanyrec.com/files/articlePowerLines.pdf>, Accessed May 2, 2009.

¹⁰⁵ L Kokel, ‘Impact of Electric Transmission Lines on Value’, (Study prepared for LCRA), 1997. Cited in Bolton & Sick, 1998.

¹⁰⁶ P. Elliott, D. Wadley, ‘The Impact of Transmission Lines on Property Values: Coming to terms with Stigma’, *Property Management*, vol. 20, no.2, 2002, pp. 137-152, http://espace.library.uq.edu.au/eserv/UQ:8095/dw_pm_02.pdf, Accessed May 2, 2009.

¹⁰⁷ A. Schutt, ‘The Power Line Dilemma: Compensation For Diminished Property value Caused By Fear Of Electromagnetic Fields’, *Florida State University Law Review*, vol. 24 no. 125, pp. 125-160, <http://www.law.fsu.edu/Journals/lawreview/downloads/241/schutt.pdf>, Accessed May 2, 2009.

A) The very real danger of inadvertent shock and electrocution when following existing Hungerford farm practices. These practices, although adequate for the present, are incompatible with accepted occupational health and safety practices required for farm work under or near transmission lines¹⁰⁸ (Appendix E) and a number of significant hazards exist that will need addressing. This would necessitate changing existing practices and requiring electrical occupational health and safety training for the Hungerford farm workers. On May 5, 2009 I contacted epidemiologist Sam Milham, mentioned previously, and provided him with the details of the Hungerford farm practices and the likelihood of increased hazards for people working in or near the transmission line easement. Milham replied: "There is a real risk of electrocution on the farm. I'm also concerned about the electric shock potential from induced currents in machinery. The magnetic fields are too high except for all but transient exposures. The workers will be at increased risk of a number of cancers and non-cancers like ALS and Alzheimers".¹⁰⁹

B) The danger of toxic aerosols being created by the water and insecticide spraying under the lines where the generation of corona ions will be highest. There has been a great deal of interest over the past few years over the possible health implications of "corona ions" that are minute charged particles generated by the high electric fields from powerline and transmission lines. Dennis Henshaw and colleagues at the H.H. Wills Physics Laboratory, University of Bristol in the UK have hypothesised that these particles may attract atmospheric pollutants and, because of their charge, could be inhaled deeply into the lungs. They have stated that "[t]he consequence of this is the possibility of increased exposure to environmental airborne pollutants."¹¹⁰ Researchers at the Wills Lab. have shown that up to 3 times as many of these aerosols land under the cables compared to sites further away with a direct relationship to wind direction.¹¹¹

The implications for this body of research are that transmission lines in polluted areas may tend to concentrate the pollutants in fine aerosols with toxic effects on the body. The problem would be greater for older transmission lines where a build up of dirt, dust and other materials on the surface of the lines facilitates increases production of corona ions. The new lines may well be designed to minimise the generation of corona ions but it is an impossibility to eliminate them as the U.K. National Radiation Protection Board has written. To Quote:

"DC and AC high voltage transmission lines are examples of this [corona ion discharges], but are of course designed not to operate under corona discharge conditions because this would result in loss of power, and also produce noise that would cause complaints. However, small local intensification of the electric field at

¹⁰⁸ Bonneville Power Administration, 'Guidelines For The Installation and Operation of Irrigation Systems Near High Voltage Transmission Lines', Feb. 15, 2002, http://www.transmission.bpa.gov/lancom/Guidelines_Installat_Oper_Irriga_Systems_2-15-02.doc, Accessed May 5, 2009

¹⁰⁹ Email correspondence with Sam Milham, May 6, 2009.

¹¹⁰ A.P. Fews, D.L. Henshaw, R.J. Wilding, P.A. Keitch PA., 'Corona ions from powerlines and increased exposure to pollutant aerosols', *International Journal of Radiation Biology*, vol 75 no.12, 1999, pp.1523-1531.

¹¹¹ A.P. Fews, D.L. Henshaw, P.A. Keitch, J.J. Close, R.J. Wilding, 'Increased exposure to pollutant aerosols under high voltage powerlines'. *International Journal of Radiation Biology*; vol. 75, no.12, 1999, pp.1505-1521.

the conductor surfaces can arise at dust and dirt accumulations or at water droplets causing corona discharges to occur”¹¹²

The obvious implications from this is that with the agricultural work on the Hungerford farm, ploughing (dirt, dust), spraying and using insecticides (water and chemical droplets) there is the likelihood that when spraying the strawberries this may result in the creation of aerosol particles containing insecticides that would present a respiratory danger to people in the near vicinity at that time and downwind for up to several kilometres. To quote from the NRPB document again:

“As a consequence of corona discharges, high voltage AC power lines may produce clouds of negative or positive ions that are readily blown downwind. An increase of charge density downwind of power lines is well established and can be measured at distances up to several kilometres¹¹³. The ion clouds charge pollutant particles that pass through them. These particles will already carry some charge because of the naturally occurring ions that exist in the atmosphere but it seems likely that in some regions this will be increased even at ground level as a result of corona discharge... The presence of corona ions could influence the uptake of pollutants by increasing their deposition in the lung or on the skin... The information reviewed suggests that some increase in lung deposition of pollutant particles seems likely as a result of charging by corona ions.”¹¹⁴

The NRPB points out, however, that estimates of the percentage of increased lung deposition is inherently imprecise and the “potential impact of corona ions on health will depend on the extent to which they increase the dose of relevant pollutants to target tissues of the body. It is not possible to estimate the impact precisely, because of uncertainties...” Somewhat surprisingly the NRPB then concludes that “it seems unlikely that corona ions would have more than a small effect on the long-term health risks associated with particulate air pollutants, even in individuals who are most affected.”¹¹⁵ In my opinion this conclusion is not backed up by what is written in the report given the high level of uncertainties mentioned. The Hungerford property is also an unusual case given the use of fine water sprays and insecticides in the easement that would most likely encourage the formation of corona ions and increased pollutant particles. This situation, and the associated level of uncertainty as to the health implications should call for a precautionary approach by ensuring that the easement is kept well away from the strawberry farm.

Considering all the risks I do not agree with Dennis Cucchiaro, Energex’s Network Corridor Manager, who has stated to Mr. Hungerford that it is quite safe to work crops under the transmission lines and around the poles. Hungerford’s farm workers would need to undergo OH&S training to eliminate as much as possible the potential hazards outlined above. An interesting question is who would be legally liable if a field worker

¹¹² NRPB, ‘Particle Deposition in the Vicinity of Power Lines and Possible Effects on Health: report of an independent Advisory Group on Non-Ionizing Radiation and its Ad Hoc Group on Corona Ions’, Documents of the NRPB: vol 15, no.1, 2004, Overall Summary and Conclusions, p. 45, http://www.hpa.org.uk/web/HPAweb&HPAwebStandard/HPAweb_C/1195733757485, Accessed May 9, 2009

¹¹³ In comparison to the NRPB statement it is interesting to note that Energex’s Network Corridor Manager Dennis Cucchiaro considers the corona ion issue as merely “an unproven academic hypothesis” as stated in a letter to Christa Elliott, 13 November 2008.

¹¹⁴ NRPB, op. cit.

¹¹⁵ *ibid*, p. 48

had a momentary lapse of concentration and inadvertently was electrocuted while moving metal irrigation pipes. It stands to reason that working in such close proximity to the proposed lines, if option J is used, will impart an increased hazard risk to all those working in this area.

Conclusion: A revised risk assessment is needed

Going over the material Mr. Hungerford has supplied to me it appears that Energex has failed to consider the above issues in its risk/benefit assessment of the various routes for its easement. I note with concern that the selection of easement routes was undertaken on the basis of desktop mapping, aerial photos “other themes” and road side assessments.¹¹⁶ This leads me to assume that the preliminary route selected (Option J) did not include a detailed analysis of land use of affected properties involving discussions with property owners until after the easement route was already decided upon.

For example, in Energex’s letter to Mrs. Christa Elliott in relation to Option J transecting the Hungerford property, Dennis Cucchiaro stated “in the case of this powerline project, many of the risk issues debated are not relevant owing to the lack of residential, workplace or other permanent people orientated activities within the vicinity of the line.” This is not in agreement with my assessment of the property if Mr. Hungerford’s business is to continue operating in the proposed 132 kV transmission line Option J easement.

Due to the type of activities that take place at the Hungerford farm, including horse management and strawberry farming Option J will have a significant detrimental effect for Mr. Hungerford. It may also have a detrimental effect on Energex for reasons examined herein.

For these reasons I would strongly suggest the Energex reconsider Option J as not the most suitable route for all concerned.

Don Maisch
May 15, 2009

¹¹⁶ Letter from Dennis Cucchiaro to Don Hungerford, November 4, 2008.