

**An independent commentary:
RMIT Building 108 : An incomplete risk assessment for ELF-EMF**

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June 24, 2006

“Comprehensive tests on floors 16 and 17 and the roof of RMIT University’s Building 108 (239 Bourke Street, Melbourne) have shown no anomalies, according to independent environmental testing consultants.”

RMIT media release, May 25, 2006

Introduction

As widely reported in the Australian media in early May 2006, RMIT University took the unprecedented step of vacating the two top floors of building # 108 at its Bourke Street campus where a number of senior management and lecturers were located. This was in response to five staff members in April and May 2006 being found to have brain tumours, as well as two others in 1999 and 2001. Two were malignant and five were benign. Five of the seven cases worked on the top floor of the building and all but one worked in the building for the past 10 years.^{1 2} The other two cases were apparently located on floors 11 and 14.³ As a result of the two earlier cases, in December 2001 an investigation was conducted on radiofrequency radiation levels and air quality . The results were well within the accepted safety levels.⁴

Concerns were immediately raised by the National Tertiary Education Union (NTEU) and widely reported in the national media that the tumours may have been caused by an array of telecommunications antennas located on the top of a large equipment room on the roof on Building 108.

Dr. Andrew Kaye, Melbourne University’s professor of Surgery and director of neurosurgery at the Royal Melbourne Hospital, called for a thorough scientific investigation to assess whether the tumour cases were linked to the antennas. Taking a more dismissive view, Dr. Mark Elwood, head of the National Cancer Control Initiative at the Cancer Council Victoria thought that coincidence was *“the most likely explanation”* and John Loy, CEO of the Australian Radiation Protection & Nuclear Safety Agency (ARPANSA) said that the scientific evidence indicated that it was *“highly unlikely”* that there was a link between the tumours and antennas.⁵

Whatever the cause, such a cluster of brain tumours is quite unusual according to Lloyd Morgan from the Board of Directors of the Central Brain Tumor Registry of the United States (CBTRUS)⁶. Morgan said that the RMIT brain tumor cluster was extraordinary compared to

¹ Morton A and Rood D, ‘Phone tower cancer fears’, *The Age*, May 12, 2006.

² RMIT Openline, Building 108 Update, <http://www.rmit.edu.au/browse:ID=6ttbfkzr3kk3z> Accessed June 12, 2006.

³ Maritimes Independent Media Centre, ‘RMIT=Brain Tumour Factory!’, <http://maritimes.indymedia.org/news/2006/05/12631.php> Accessed June 12, 2006.

⁴ RMIT Openline, RMIT University Building 108 Health and Safety Update, <http://www.rmit.edu.au/browse:ID=d0i9czgeinxm> Accessed June 21, 2006.

⁵ Nader C, ‘Doctors sceptical about link’, *The Age*, May 13, 2006.

⁶ According to their web site, The Central Brain Tumor Registry of the United States, CBTRUS, is a not-for-profit corporation committed to providing a resource for gathering and disseminating current epidemiologic data on all primary

other clusters that he has seen because of the small time window for the diagnoses and the apparently small common space where they worked.⁷ As for the likelihood of the cluster being a chance event Morgan, using U.S statistics as an example, stated:

"Considering the incidence of all brain tumors [USA statistics], if I just take the 5 cases in one year, this would require a population on the floor 17 of about 34,460 people. If the 5 brain tumors found in one year are all benign, the population would be close to double. The result is basically the same. "This is a quick way of saying that the probability that this cluster is a chance finding is nonexistent." ⁸

By May 19, the Victorian branch of the Electrical Trades Union (ETU), as a result of mounting concerns over the communications antennas, placed a ban on working on or near such equipment. The ETU state secretary Dean Mighell was quoted as saying that *"there was overseas evidence linking tumours to long-term electromagnetic radiation exposure, whether from high-voltage power lines or phone towers."*⁹ The Australian Mobile Telecommunications Association (AMTA) however, called the ETU's ban *"unjustified on health grounds, unwarranted and not backed by the extensive health research on this issue."*¹⁰

In response to the controversy, RMIT commissioned Sustainable Risk Management Australia (SRMA) to oversee an extensive series of environmental surveys for the top floors and roof of Building 108 to determine if there were any environmental factors that could be associated with the brain tumour cluster. The investigation consisted of taking measurements of chemical and microbiological agents, water contamination, ionizing radiation, radiofrequency/microwave radiation and 50- Hz power frequency magnetic fields (not electric fields)¹¹ (in the extremely low frequency band).

At the conclusion of the environmental testing SRMA issued the overall results on 25 May, 2006. The reference level for safety in all testing was the relevant Australian standard or guideline with the inference that compliance with the relevant limits was sufficient to assure safety in relation to the reported brain tumour cases.

The SRMA report concludes that:

"Environmental Measurements conducted on Levels 16, 17 and the roof of RMIT University Building 108 during the period 12 –19 May 2006 are well below the relevant Australian (International) Standards or Guidelines for general public/non-occupational exposure. There were no anomalies identified as a result of the testing. Measures within building 108 are consistent with those typically found to be in buildings in Melbourne." ¹²

brain tumors, benign and malignant, for the purposes of accurately describing their incidence and survival patterns, evaluating diagnosis and treatment, facilitating etiologic studies, establishing awareness of the disease, and ultimately, for the prevention of all brain tumors. **Morgan's statements are his and not from the Central Brain Tumor Registry of the United States per se.** <http://www.cbtrus.org/> Accessed June 12, 2006.

⁷ email correspondence with Lloyd Morgan, June 6, 2006.

⁸ email correspondence with Lloyd Morgan, June 24 and 28, 2006.

⁹ Morton A, 'Electrical union to ban work near phone masts', *The Age*, May 19, 2006.

¹⁰ Anonymous, 'No Worries from Base Station Radiation-report', cellular-news, <http://www.cellular-news.com/story/17471.php> Accessed June 12, 2006.

¹¹ From the use of electric power both electric and magnetic fields are created. Electric fields are a function of the voltage present whereas magnetic fields result from current flow. Together they are referred to as electromagnetic fields (EMFs). In this paper, 50 Hertz (Hz) power frequency EMFs, which are in the extremely low frequency (ELF) band of the electromagnetic spectrum are referred to as ELF-EMF.

¹² RMIT University Environmental Testing Report 06523, Sustainable Risk Management Australia, 25, May 2006,

Overall the risk assessment done on Building 108 is an apparently very thorough evaluation of the various environmental factors investigated. However, when it comes to the assessment of the building's power frequency magnetic fields on levels 16 and 17, as reported in the EMC Technologies field survey, there are several points that urgently need addressing. Until these points are answered, any assurance of safety, or claims that "tests show no anomalies" are disingenuous. To its credit, the EMC report acknowledges its measurement limitations but this has been overlooked in the scramble by various interests to give an all-clear to electromagnetic fields from any source. It is noted however that the EMC report is interim and may change as further information becomes available. Hopefully therefore, the following points will soon be adequately addressed.

A Reliance on the NH&MRC Interim guidelines is deceptive

In the EMC report, page 10, Section 9.3 it is stated that the extra [extremely] low frequency (ELF) magnetic field recommendations set by NH&MRC¹³ for the general population were used as limit recommendations. This is a level of 1000 milliGauss. Individual room ELF magnetic field measurements are given as well as the % of the public limit recommendations.¹⁴ The reader is to assume that compliance with the limits assures safety in relation to cancer and other health hazards.

The ELF limit recommendations in the NH&MRC guidelines are the same as the International Radiation Protection Association's (IRPA) Interim guidelines which 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 and are thus irrelevant to the RMIT brain tumour issue. This limitation has been admitted 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)¹⁵

¹³ NH&MRC Interim guidelines on limits of exposure to 50/60 Hz electric and magnetic fields, Radiation Health Series 30, 1989.

¹⁴ Radiofrequency Fields Survey at RMIT Building 108, EMC Technologies, Interim Report No. M060514_1 Ver 3, <http://mams.rmit.edu.au/ypwsbsrq3q3p1.pdf> Accessed June 12, 2006.

¹⁵ Australian Radiation Laboratory, 'Comments on the Maisch Report, Non-Ionizing Electromagnetic Fields and Human Health', December 1994.

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 . . ."*¹⁶

As cancer takes many years to develop after exposure to an environmental agent, such as asbestos (an obvious example), the NH&MRC ELF limits are clearly not relevant to the RMIT brain tumour controversy. It is therefore deceptive to infer that compliance with such limits removes the risk of cancer from exposure.

Occupational EMF exposures and cancer risk

The primary concerns in Building 108 have been the possibility that radiofrequency / microwave non-ionizing radiation from the roof top antennas may have been the cause in the brain tumour cluster. However EMC's measurements taken to date clearly indicates that the RF fields are quite low on the top two floors and apparently similar to what is commonly found in other buildings in Melbourne. However, the possibility of a connection between the building's internal ELF electromagnetic fields (ELF – EMF) and the brain tumour cluster has not yet been thoroughly evaluated.

The important question here is whether or not there is a body of peer reviewed and published research that finds a connection between cancer (including brain cancer) and occupational exposure to ELF electromagnetic fields. If there is such a body of research that indicates that a connection may exist, that needs to be factored into the risk assessment for ELF - EMFs in Building 108.

A brief search through *Pub Med*, the on-line archives of the National Library of Medicine and the National Institutes of Health (USA) finds a number of studies that suggest a connection may exist. Some examples are as follows:

* A study by Milham (1996) on 410 office workers (263 men and 147 women) who were exposed to strong magnetic fields from three 12 kV transformers located beneath their first floor office over a 15 year time frame found a positive trend of cancer cases with duration of employment in both males and females. An odds ratio of 15.1 was seen in workers employed over 5 years.¹⁷

In correspondence with Milham, he reports that this study showed a clear dose-response relationship between odds ratios and duration of employment, a surrogate for duration of exposure. Average exposures were around 50 mG.¹⁸

¹⁶ Lokan KH, Risk, 'Risk Perception and Regulation-What Should the Regulator Do?' *Radiation Protection in Australia*, Vol. 9, No.4: 134-136, 1991.

¹⁷ Milham S, 'Increased incidence of cancer in a cohort of office workers exposed to strong magnetic fields', *Am. J. Med.*, vol. 3, no.6, pp. 702-4, Dec. 1996.

¹⁸ Email correspondence with Sam Milham, June 1, 2006.

* Another occupational study by Milham (2004), this time investigating a cluster of male breast cancer in a small group of men who worked in a basement office in a multi-story office building. Their office was adjacent to an electrical switchgear room which generated high magnetic fields in their work space (50+ mG). The risk of male breast cancer in this group was increased about 100-fold.¹⁹

* Loomis and Savitz (1990) investigated the relation of brain cancer and mortality from leukemia to electrical occupations in a case-control study based on all deaths in 1985 and 1986 from all states in the U.S. that reported occupational data from death certificates to the national vital statistics registry. The authors found that while there was little evidence for an association with leukemia, their findings corroborated reports of increased mortality from brain cancer among electrical workers.²⁰

* Savitz (1995) did an overview on the epidemiological studies on occupational exposure to ELF magnetic and electric fields and cancer and concluded, among other things, that the brain tumor risk was elevated with some consistency.²¹

* Savitz & Loomis (1996) conducted a historical cohort mortality study on 138,905 men employed at five large electric utilities in the U.S. between 1950 and 1986 with at least 6 months of work experience. They found brain cancer mortality was modestly elevated in relation to duration of work in exposed jobs and much more strongly associated with magnetic field exposure indices. Brain cancer risk increased by an estimated factor of 1.94 per microtesla-year of magnetic field exposure in the previous 2–10 years, with a mortality rate ratio of 2.6 in the highest exposure category. The authors concluded that their study did not support an association between occupational magnetic field exposure and leukemia but did suggest a link to brain cancer.²²

* Savitz, et al (2000) using a refined magnetic field job-exposure criteria to analyze data on brain cancer and leukemia amongst electric utility workers found a positive association with brain cancer mortality based on both cumulative and average magnetic field indices. Such an association was not seen for leukemia.²³

* A French study by Guenel et al (1996) on the incidence of various cancers among a cohort of 170,000 French electric utility workers investigated tumour risks specifically associated with electric fields as distinct from magnetic fields. An odds ratio of 3.08 was observed for all brain tumours (69 cases) but the increased risk could not be linked to a specific type of brain tumour. The authors concluded: *“Our study indicates that electric fields may have a specific effect on the risk of brain tumor, and that this should be taken into account in future analyses on the carcinogenic effects of 50 to 60 Hz fields.”*²⁴

¹⁹ Milham S, ‘A cluster of male breast cancer in office workers’, *Am. J. Med.*, vol. 46, no.1, pp. 86-7, Jul. 2004.

²⁰ Loomis DP, Savitz DA, ‘Mortality from brain cancer and leukemia among electrical workers’, *Br. J. Ind. Med.*, vol. 47, no. 9, pp. 633-8, Sept. 1990.

²¹ Savitz DA, ‘Overview of occupational exposure to electric and magnetic fields and cancer: advancements in exposure assessment’. *Environ. Health Perspect.*, vol. 103 Suppl. 2, pp. 69-74, March 1995.

²² Savitz DA, Loomis DR, ‘Magnetic field exposure in relation to leukemia and brain cancer mortality among electric utility workers’. *Am. J. Epidemiology*, vol. 144, no. 2, pp. 205, Jan 1995.

²³ Savitz DA, Cai J, Wijngaarden E, Loomis D, Mihlan G, Dufort V, Kleckner RC, Nylander-French L, Kromhout H, Zhou H, ‘Case-cohort analysis of brain cancer and leukemia in electric utility workers using a refined magnetic field job-exposure matrix’, *Am. J. Med.*, vol. 38, no. 4, pp. 417-25, Oct. 2000.

²⁴ Guenel P, Nicolau J, Imbernon E, Chevalier A, Goldberg M, ‘Exposure to 50-Hz electric field and incidence of leukemia, brain tumors, and other cancers among French electric utility workers’. *Am. J. Epidemiology*, vol. 146, no. 7, pp. 606-7, Oct. 1997.

* Villeneuve, Agnew et al (2002) investigated the relationship between occupational exposure to magnetic fields and men, categorized according to their estimated average field exposure (< 3 mG, 3 to < 6 mG, and 6 mG +). A non-statistically significant increased risk of brain cancer was seen in among the men who had ever held a job with an average magnetic field exposure above 6 mG relative to those with exposures below 3 mG. However, a significant increased risk was seen among men diagnosed with glioblastoma multiforme with a cumulative weighted. Magnetic field exposures were not associated with astrocytoma or other brain cancers. The authors concluded that their findings “supported the hypothesis that occupational magnetic field exposure increases the risk of glioblastoma multiforme”.²⁵

* Mack et al (1991) investigating a possible association between occupational exposure to ELF electric and magnetic fields and the risk of brain tumours found that the risk of astrocytoma in electrical occupations was as high as the risk of smoking for lung cancer. OR=10.3 (1.3-80.1).²⁶ There was a significant upward trend (P=0.01) of tumor incidence with increasing length of employment.²⁷

* In 2002 an EMF risk evaluation was undertaken by three scientists for the Californian Department of Health Services (DHS) . The scientists were asked to review the literature on possible health problems associated with electric and magnetic fields from power lines, wiring in buildings, some jobs, and appliances. The review did not include radio frequency/microwave radiation from cell phones and towers. The conclusions of the scientists were, in part, that all three were “inclined to believe that EMFs can cause some degree of increased risk of childhood leukemia, adult brain cancer, Lou Gehrig’s Disease, and miscarriage.” For their conclusions on adult brain cancer they reviewed 29 epidemiological studies.²⁸

To be sure, there is a body of occupational studies, such as electric utility worker studies in Denmark and the UK and the US for example that did not find an association with brain tumors and ELF - EMFs. In fact, David Savatz, in an editorial in *Occupational Environmental Medicine* in 2001, wrote about the difficulties in trying to explain and reconcile contradictory findings for occupationally exposed workers and brain cancer. Savitz concluded however, that despite the problems, workers in the electric industry and similarly exposed workers did not seem to be at increased risk from brain cancer.²⁹

The problem of contradictory findings in EMF health research has been seen right from the beginnings in the early 1970’s. Biophysicist Andrew Marino, who was editor of *The Journal of Bioelectricity*, author/co-author of three books on EMF bio-effects and numerous papers and articles on bioelectromagnetics, was interviewed on this problem in *New Ecologist* back in January 1979.

“Negative findings do not vindicate the position of those who claim that the hazards are non-existent: they simply show that under certain conditions, electrical fields [electromagnetic] will not

²⁵ Villeneuve PJ, Agnew DA, Johnson KC, Mao Y, ‘Brain cancer and occupational exposure to magnetic fields among men: results from a Canadian population-based case-control study’, *Int. J. Epidemiology*, vol. 31, no.1, pp. 210-7, Feb. 2002.

²⁶ Email correspondence with Lloyd Morgan, June 28, 2006.

²⁷ Mack W, Preston-Martin S, Peters JM, ‘Astrocytoma risk related to job exposure to electric and magnetic fields’, *Bioelectromagnetics*, vol. 12, no. 1, pp. 57-66, 1991.

²⁸ Executive Summary Of The California EMF Risk Evaluation For Policymakers And The Public, The California Department of Health Services, June 2002. <http://www.dhs.ca.gov/ehib/emf/RiskEvaluation/ExecSumm.pdf> Accessed June 14, 2006.

²⁹ Savitz DA, ‘Editorial: Occupational exposure to magnetic fields and brain cancer’, *Occup. Environ. Med.*, vol. 58, pp. 617-618, Oct. 2001.

induce biological effects. A whole range of different interactions are possible between transmission line fields, people and the environment. They vary from a brief encounter to chronic exposure such as occurs for individuals living very close to the transmission line. The lesson of the literature is that some situations will probably result in biological effects, and others will probably not..... Obviously both conclusions can be true simultaneously, and the truth of one does not imply the falsity of the other. Yet if positive results are found, the warning lights should begin to flash"..... "To ignore them is both intellectually dishonest - and foolhardy." ³⁰

Considering the above brief sampling of the literature it is fair to conclude that, despite the controversy, there is an existing body of evidence linking adult cancers and brain cancers to ELF-EMFs, possibly only under certain EMF exposure conditions.

To return to the case in question at RMIT Building 108, now that the roof top cell phone emissions have apparently been ruled out as a factor, (which is not the topic of this paper) the investigation should continue, this time concentrating on building ELF-EMF fields.

Why taking "normal" workday power load measurements are essential

It is mentioned on page 10, Section 9.3 of EMC's report on building 108 that the spot ELF measurements were taken at a time during which the lights were off and most computers on standby.³¹ This would be because the two top floors were vacated by the RMIT management until such time as testing was completed and some answers were arrived at. As such, the power consumption on the two floors would have been minimal and would have duplicated conditions at night and weekends only. During a typical workday the consumption would be higher and thus the magnetic fields would be higher as well. Thus the ELF magnetic field measurements taken on floors 16 and 17 to date **do not** represent the levels that people normally working there would encounter day after day for the duration of their employment at that location.

Magnetic field levels can fluctuate widely during time of day. This is recognized in ARPANSA's residential building survey protocol. Although the ARPANSA survey protocol is written for residential building surveys the same situation exists in all occupied buildings with an internal electrical distribution system. To quote:

"Conditions at time of measurement (spot measurements only). The amount of electrical power used in the home affects magnetic field levels. Therefore, spot measurements in rooms and external locations of the residence should be made under "low", "high", and "normal" power use conditions in the home." ³²

In the workplace, taking low and high power consumption measurements is usually disruptive and impractical and so spot measurements taken during the normal daily power conditions is the usual procedure if data loggers are not used (for EMF variations over time measurements).

³⁰ Marino A, Interview in *New Ecologist*, January 1979.

³¹ Radiofrequency Fields Survey at RMIT Building 108 (as above), Page 10, Section 9.3.

³² Karipidis KK, 'Measurement of Residential Power Frequency Magnetic Fields, Technical Report 134', ARPANSA, page 8, Section 3.4, March 2002.

The advisability of gathering workplace exposure data under “normal” work conditions is covered in great detail in NIOSH's *Manual for Measuring Occupational Electric and Magnetic Field Exposures*.³³

It is therefore essential that EMC Technologies continue the ELF testing but under the normal workday power consumption with lights, computers and all other equipment normally in use energized. This would probably require RMIT management to call in all people who normally work on the two floors and would obviously need to be at a time when the rest of the building is in the normal workday mode. Until this is done any assurance of safety is premature.

Why 4 mG is preferable as a reference point for Building 108's risk assessment

As explained previously the MH&MRC recommendation of 1000 mG is not relevant to the question of exposure levels and cancer so any reference to it in relation to cancer risk is not justified, to say the least. A far more useful level from both a public health and an occupational health and safety viewpoint would be one that is consistently related with an increase risk or incidence of cancer in humans. A level of 4 mG is recommended for the following reasons.

* On June 24, 1998, the National Institute for Environmental Health Sciences(NIEHS) Working Group voted to classify ELF-EMF as a Group 2B possible carcinogen. The Working Group saw this as *“A conservative, public health decision based on limited evidence for an increased occurrence of childhood leukemia and an increased occurrence of chronic lymphocytic leukemia in occupational settings.”*

The NIEHS Working Group identified a magnetic field level range of **2 –5 mG** as being identified in the scientific research literature as being related to an increased risk of leukemia. They recommended that *“prudence would establish firm EMF limits below 2 mG by some reasonable margin of safety.”*³⁴

* 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 leukemia and ELF magnetic field exposure above 4 mG. However , the IARC found no consistent evidence that ELF magnetic fields increased cancer risk in adults.³⁵

* 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”*.³⁶

* In a summary of the overall evidence, Cindy Sage from Sage Associates, Santa Barbara, California, USA saw an increased risk of both childhood and adult cancers at exposure ranges

³³ ‘Manual for Measuring Occupational Electric and Magnetic Field Exposures’, NIOSH, October 1998, <http://www.cdc.gov/niosh/98-154pd.html> Accessed June 6, 2006.

³⁴ ‘Assessment of Health Effects from Exposure to Power-Line Frequency Electric and Magnetic Fields’, NIEHS EMF Working Group Report, National Institutes of Health, 1998.

³⁵ Slesin L, ‘IARC Panel Finds EMFs Are Possible Carcinogens’, <http://www.mikeholt.com/mojonewsarchive/USEI-HTML/HTML/EMFsPossibleCarcinogens~20020519.htm> Accessed June 15, 2006.

³⁶ ‘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/radiation/publications/documents_of_nrp/abstracts/absd12-1.htm#concs Accessed June 12, 2006.

associated with increased risk of cancer in the order of 2 –5 mG (Time Weighted Average-TWA) and up to 16 mG intermittent exposure levels.³⁷

* In an interview with Microwave News in May 2001, 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 suggests that limiting exposures to less than 0.4 – 0.5 uT (4 – 5 mG) could have a health benefit.”*³⁸ It is concluded in the SRMA report on building 108 that *“There were no anomalies identified as a result of the testing. Measures within building 108 are consistent with those typically found to be in buildings in Melbourne.”*³⁹ This apparently is true in relation to the RF/MW tests taken by EMC Technologies but is not applicable to the ELF magnetic fields on the two top floors of building 108.

* On 18th March 2002, a Queensland judge made a ruling that ELF-EMFs from a proposed substation next to a predominantly residential area, should not exceed 0.4 microtesla (4 mG). Energex, the power supply company named in the case accepted the decision. 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 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”.*⁴⁰

According to *Powerwatch News*, Roger Lamb, an electrical engineer who sat in for the five day hearing, said it would hopefully provide a model for the resolution of similar situations in the future. In response to the level scientific uncertainty as to the extent of a health hazard, which Energex’s expert witnesses couldn’t deny, The judge stated that *“The supply of electricity must not only be reliable, it must be as safe as it reasonably can be”.*⁴¹

* 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

³⁷ Sage CL, Sage SA, ‘Briefing Report on Electromagnetic Fields (Health Effects/Policy/Site Planning’, unpublished, Jan. 2006.

³⁸ Savitz D, ‘EMF Epidemiology Has Reached Its Limits’, *Microwave News*, vol. XXI, no. 3, page 3, May/June 2001.

³⁹ RMIT University Environmental Testing Report 06523 (as above).

⁴⁰ As reported in *Powerwatch News* (UK), March 18, 2002, http://www.powerwatch.org.uk/news/20020506_emf.asp
Accessed June 19, 2006.

⁴¹ Ibid.

*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.*⁴²

I know of no comprehensive surveys in Australia that have yet determined what are typical ELF magnetic fields in Australian buildings but if American estimations are considered only about 4% of the US population is subjected to ELF-EMF levels at or greater than 4 mG.⁴³

So, in response to the concerns of the people working in building 108 which is preferable: a level that *is "not intended to provide protection against possible cancer induction"* or one that has been classified as *"possibly carcinogenic to humans"*?

An anomaly appears at 4 mG

On page 14 of the EMC report the floor plans for floors 16 and 17 are reproduced, with ELF magnetic field test locations identified on each floor. Pages 16 to 21 list all the measured levels in mG, taken at waist height. Taking all room readings over 4 mG it is a simple process to highlight on the floor plans all the rooms and areas over this level. When the location of the equipment building on the roof is superimposed over floor 17 a correlation with those 4 + mG readings and the Northwest wall of equipment building is seen in the rooms immediately below, and to a lesser extent floor 16 as well. (See floor plans, page 15, this paper). These measurements were taken under a low power load situation only and would be expected to be higher under normal workday loads.

Room ELF magnetic field measurements (mG) under low power:

Floor 16: 5.0, 5.1, 4.1, 6.0, 6.7, 6.7, 6.9, 7.8, 7.3, 5.4, 5.6, 5.3, 4.3,

Floor 17: 4.1, 4.5, 10.5, 9.2, 7.7, 7.7, 8.1, 4.9, 4.2, 4.8, 3.9, 4.6, 5.5, 5.7, 11.0

The issue of transients

Transients are large, very brief increases in voltage that last thousandths or millionths of a second that occur during the electrical switching of large inductive loads (such as motors, transformers and electrical drives), or capacitive loads (such as power factor correction equipment).⁴⁴

The argument that powerline EMFs are too weak to possibly affect cellular processes does not necessarily apply to transients. Research by Dr. Antonio Sastre and colleagues indicates that when it comes to powerline EMF transients, the induced signal can rise above the background cellular noise.^{45 46}

⁴² Electromagnetics Forum, 'Agreement to limit EMF levels in libraries sets precedent, vol. 1, no. 1, Article 14, December 1996. http://www.emfacts.com/forum/issue1/mag_14.html Accessed June 24, 2006.

⁴³ Kheifets L, Shimkhada R, 'Review-Childhood Leukemia and EMF: Review of the Epidemiological Evidence', *Bioelectromagnetics Supplement 7*, S51-S59, 2005.

⁴⁴ Furse Electrical Systems Protection, <http://www.furse.com/esp/whatrans.htm> Accessed June 16, 2006.

⁴⁵ Sastre A, et al., 'Residential Magnetic Field Transients: How Do Their Induced Transmembrane Voltages Compare to Thermal Noise?', Paper No. A-33, DOE, 1994.

⁴⁶ Johnston GB, Kavet R, and Sastre A, 'Residential Magnetic Field Transients. Effect of Residential Services on Fields Arising from Distribution Line Capacitor Bank Switching' Paper No. P-130A, BEMS, 1995.

The limitations of only considering field magnitude, while excluding other factors such as transients, was examined in *Science News* in Jan. 1998 in an interview with Dr. Charles Graham, an experimental physiologist at the Midwest Research Institute (MRI) in Kansas City, Mo., USA. To quote from the article:

"What concerns me," Graham says, is that the public "tends to get so worried about the magnitude of a field. The bigger it is, the worse it's supposed to be." In fact, Loscher has found that very high fields, as well as those below a certain strength, have little impact on tumor growth. Only those across a relatively narrow range consistently foster tumors and other negative health effects. "We've seen the same thing in our studies," Graham told Science News.

*Moreover, he says, it's beginning to appear that a field's magnitude matters less than its intermittency or other features, such as power surges called electrical transients. These surges can pack a big burst of energy into a short period of time. They occur whenever lights or other electric devices turn on[or off], when motors or compressors (such as those in refrigerators and air conditioners) cycle on, or when dimmer switches operate. "Being transient doesn't mean they're rare, just quick," Graham notes. Transients are hard to avoid because they may stem from surges elsewhere - in a neighbor's house or even power lines up the street. "*⁴⁷

Recommendations

1. According to the level 17 floor plan the rooftop equipment building would have to house the electrical equipment/motors for 7 or 8 elevators and possibly air conditioning electrical equipment as well as equipment powering the antennas. The contents and location of any such equipment needs to be determined in relation to the offices below. During a normal workday the elevators would be in constant use and the starting and stopping of the electric motors would be generating transient voltage spikes every time any of the elevators are used. Because of the close proximity of a number of office rooms below the equipment room that may expose people located there to prolonged transient spikes this possibility needs to be investigated, using equipment with the ability to capture and measure transient events. This must be done for an adequate period of time during several normal workdays with the elevators in normal use. According to Lloyd Morgan in discussing the RMIT case, the important thing about 'real world' fields are that they are incredibly dynamic (changing continuously). So limiting measurements at a single point in time does not even begin to define their dynamic nature. It is this dynamism that may be one of the important aspects of harm.⁴⁸

2. Record all ELF magnetic field measurements on floors 16 and 17 in the same locations, but this time during a normal workday with occupants on floors 16 and 17 called in to turn on all normally used electrical equipment in their offices. Special emphasis should be given to rooms where the brain tumour cases were located. The recording should be done using a high bandwidth recorder (up to 1 MHz), using a wide bandwidth meter in order to capture transients along with the 50 Hz fields over a period of hours.

3. It would be helpful in determining the extent of a possible ELF-EMF (or transient) correlation with the five brain tumour cases on floor 17 if the room locations, in which these people spent much of their workday, were clearly identified on the floor plans of the EMC Technologies survey report.

⁴⁷ Raloff J, 'EMFs' Biological Influences: Electromagnetic fields exert effects on and through hormones', *Science News Online*, January 10, 1998. http://www.sciencenews.org/pages/sn_arc98/1_10_98/bob1.htm Accessed June 14, 2006.

⁴⁸ Email correspondence with Lloyd Morgan, June 20, 2006.

4. Recording ELF measurements, as in no. 2 above, of the offices of the two other brain tumour cases would be advisable in order to compare with those on floor 17.

5. RMIT has said that it will do further RF surveys on other floors. This should also include ELF magnetic field measurements taken on all floors of the building and wideband recordings made wherever the fields exceed 4 mG.

6. As for the offices on the top two floors of Building 108 which contain rooms with magnetic fields over 4 mG (say group A) and below 4 mG (group B), a survey comparing the historical health status of both groups would be advisable.

Until these steps are taken the possibility of ELF-EMF being linked to the brain tumour cluster cannot be ruled out and any assurance otherwise is not in the best interests of the people working there.

For the owners of the building it must be a concern that there is a public perception that working on the top two floors of their building is hazardous to health, or as one US commentator put it: "*This RMIT building is a 'living laboratory' for producing brain cancer*". If it is found that there is a correlation with the five brain tumour cases and those rooms under the roof top equipment room it would then be possible to mitigate the problem for future occupants. This would include a combination of shielding, electrical load balancing, resolving any net current issues and relocating people from rooms still with high EMF fields to low field rooms. Any rooms unable to be 'fixed' would be designated as storage areas.

A positive example of what can be done (assuming that EMF are ever identified as being linked with the brain tumour cases) is the Ross House substation case as follows:

Case history: The Ross House Substation

In October 1991, the office area of the manager of the Ross House Association, located in Ross House, Flinders Lane, Melbourne, was vacated on the advice of a building consultant, called in to determine the reason for electrical interference with newly installed office computers. The interference was found to be magnetic fields emanating from an electrical substation in the basement immediately below the office. The measured magnetic field levels were in the order of 5.9 to 187 milligauss (mG).

Health complaints suffered by the office manager and her assistant eventually led to a workers' compensation case, lodged by the manager for payment of her ongoing medical treatment for symptoms of chronic fatigue syndrome (CFS) while working in the affected area. In both cases, symptoms began after starting work in the office about 15 months earlier. An investigation by Workcare Victoria included an evaluation of the health status of former employees who had also worked in the same office. All previous employees who were interviewed by the investigators independently reported similar CFS symptoms which disappeared after ceasing to work in the office, or while away on vacation.

As a result of the obvious concerns amongst people working in the area, the Ross House management hired consultants to advise on how to eliminate or reduce the EMF fields. Both spot and extended data-logging of the magnetic fields were undertaken. At no time did the consultants suggest that compliance with the NH&MRC 1000mG limit was relevant to safety. A combination of metallic shielding under the floor carpets as well as having the electrical

loads from the substation balanced (thus reducing magnetic fields) significantly reduced the fields. The area is now roughly around 1/3rd the previous levels and is used as library and reading area where no one spends prolonged amounts of time.

The illness and symptoms reported by employees who had worked in the EMF affected office at Ross House were as follows: Anaemia, fluctuating hormone levels, chronic tiredness, insomnia, feelings of stress, inability to concentrate, facial rash, depression, severe pre-menstrual tension, listlessness, light headedness, "a permanent severe case of jet lag", headaches, increased susceptibility to viral infections.⁴⁹

Conclusion

It was an excellent interim precautionary action on part of RMIT to evacuate the two top floors of Building 108 in response to the highly unusual cluster of 5 brain tumour cases occurring among the staff located on the top floor. RMIT also took quick action in commissioning an investigation to determine if there was anything in the building's environment that may be linked with the cluster.

SRMA then commissioned a number of expert organisations to conduct a range of extensive environmental testing on the two top floors and roof of the building.

Bearing in mind that the concerns being raised were almost exclusively in relation to a possible link with radiofrequency/microwave radiation from mobile phone antennas on the roof, the risk assessment has been a success. From measurements taken by EMC Technologies the levels are typical of what is found in other city office buildings and at levels unlikely to have any connection with the brain tumour cluster. In fact, it could be said that if there were a connection at the measured levels, we would be seeing an epidemic of brain tumours in high rise offices and apartments. Therefore the overall risk assessment has successfully ruled out the rooftop antennas as a likely factor in this case.

Ionizing radiation and possible chemical and biological atmospheric contaminants are also seen as very unlikely given the low levels measured. The interim conclusion of the risk assessment found no known contributing factors for the cancer cluster.

The assessment of the power frequency (ELF) magnetic fields and other possible related factors, such as transients, has not yet been completed, so any assurances of safety for ELF-EMF are premature. This is mainly because of two factors, as follows.

- Historically, the fundamental problem in assessing health impacts of power frequency ELF-EMF in the built environment has been an unquestioned reliance by authorities on simple compliance with the 1989 *NH&MRC Interim guidelines on limits of exposure to 50/60 Hz electric and magnetic fields* to infer health protection from exposure. As explained in this commentary, however, health protection in this case only means "*protection from immediate adverse health effects*". As far as a human exposure standard that addresses the epidemiological evidence for cancer (and other possible adverse health effects) there is none. Unfortunately this significant limitation in the "guidelines" is seldom mentioned and

⁴⁹ Maisch D, 'The Ross House Electrical Substation Workcare compensation case: Chronic Fatigue Syndrome (CFS) symptoms attributed to exposure to electromagnetic fields (EMF) due to close proximity to an electrical substation, Melbourne Victoria, 1991-1992', Compiled Jan - Feb. 1999. Summary at: <http://www.emfacts.com/papers/ross-house.html> Accessed June 12, 2006.

therefore it is all too easy to mistakenly assume that there could be no health issues because actual measured levels are so far below the recommended guideline limits.

- Because of a media “feeding frenzy” about the RMIT situation there was an urgency to get some answers on the part of RMIT management. This was largely successful but as the two top floors in Building 108 had been evacuated it was impossible for EMC technologies to duplicate the normal workday power consumption. As a result the normal procedure to duplicate normal workday magnetic field levels was not able to be done.

Despite the limitations of the ELF magnetic field survey to date, a situation is apparent where a number of offices on floor 17, and to a lesser extent on floor 16, appear to have ELF magnetic fields that a body of epidemiological evidence indicates may be a health hazard for prolonged exposures.

For this reason this commentary recommends that further testing be carried out as a “duty of care” for the health of employees who are expected to work in these areas in the future.

(Floor plans next page)

RMIT Building 108



Floor 16



Floor 17 (Showing approximate location of roof top equipment buildings)

All areas spot measured to be 4 mG and above are shown in blue.