

**Review of Primary Investigation of
Suspected Brain Cancer Cluster in RMIT Building
108, Levels 16 & 17,
Specifically reviewing the following primary
investigators' reports:**

*Medical Investigation of Tumours Detected in RMIT Building 108,
Levels 16 & 17: Final Report, conducted by Southern Medical Services
and
Environmental/Exposure Assessment reports conducted under the
direction of Sustainable Risk Management Australia*

**This Secondary-Level Peer Review was conducted by a Panel of Experts Jointly
Nominated by RMIT University, the National Tertiary Education Union
(NTEU), and the Australian Education Union (AEU):**

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Biographies of Secondary Review Panel Members

Dr. Anthony D. LaMontagne is an Associate Professor in the Centre for Health & Society, School of Population Health, at the University of Melbourne. His background includes a Bachelor of Science (BS *summa cum laude*, 1982) in botany from the University of Massachusetts, a Master's degree (MA) in molecular toxicology from Harvard University (MA, 1987) a Master's degree in science and adult basic education from the University of Massachusetts (MEd, 1988), and a Doctor of Science in occupational & environmental health from the Harvard School of Public Health (ScD, 1994). After completion of his post-doctoral work, he held research appointments in Boston at the Harvard School of Public Health, New England Research Institutes, and the Dana Farber Cancer Institute before relocating to Melbourne in 2000. He was a Senior Lecturer in the Department of Epidemiology & Preventive Medicine at Monash Medical School (2000-2003) before coming to the University of Melbourne in 2003. His research areas of interest include the development, implementation, and evaluation of interventions to improve workplace and worker health. Interventions of interest include hazardous substance exposure controls, worker health & safety training programs, integrated occupational health and health promotion interventions, and national occupational health policies. He has published widely in the peer-reviewed scientific literature and is a contributor to leading texts in occupational and environmental medicine, occupational health, and health promotion. See <http://www.chs.unimelb.edu.au/about/staff/lamontagne.html>

Dr Deborah Glass MA, Cert Ed, MSc, PhD, Dip Occ Hyg, MAIOH, COH graduated from Cambridge University and did a Masters in Occupational Health and Hygiene at Aston and then worked in industry as an occupational hygienist. She joined the Institute of Occupational Health, University of Birmingham as a consultant occupational hygienist, and became a lecturer in Occupational Hygiene doing teaching, research and some survey work. She came to Australia in 1995 and worked on the Health Watch case-control study completing a PhD with Deakin University based on this work. She joined Monash University in 1998 and continues to work in the field of exposure assessment for epidemiology. She also supervised students doing Post Graduate Diploma projects in Occupational Hygiene at Deakin University between 2002 and 2006. She is a member of the Australian Institute of Occupational Hygiene, on Council, and is chair of the Education committee, a member of the British Occupational Hygiene Society, the American Conference of Government Industrial Hygienists (ACGIH) and serves as an expert member on the ACGIH Threshold Limit Value (TLV) committee.

Dr Geza Benke has a BSc (Physics), MAppSc (Environmental Engineering) and a PhD (Epidemiology), and is a Fellow of the Australian Institute of Occupational Hygienists. He is currently Senior Research Fellow with the Centre for Occupational and Environmental Health, Department of Epidemiology and Preventive Medicine, Monash University. Since 1989 Dr Benke has undertaken research in a range of occupational and environmental epidemiology studies. He is currently involved in the Morpheus study, a study investigating Mobile phone exposure and cognitive function in teenagers. This study is funded by the National Health and Medical Research Council through the Australian Centre for Radio Frequency Bioeffects Research. Dr Benke is also a member of the Radiation Advisory Committee to the Minister for the Department of Human Services and a member of International committees,

associations and research groups involved in exposure assessment for cancer and respiratory disease.

Professor Catriona Ann McLean (BSc, MBBS, FRCPA, MD) is currently Head of Department and Professor of Anatomical Pathology at the Alfred Hospital. Her specialist interest is Neuropathology. The hospital has an active neurosurgery unit resulting in many brain biopsies for analysis. She also Chair of the Pathology Board of Education for Monash University MBBS. Since 2002 she has also been director of the National Neural Tissue Resource Centre which is national bank of brain tissues showing a wide variety of neurodegenerative disorders that are all carefully analysed and data banked. Since 1997 she has been the Neuropathologist for the National CJD registry and the State Neuropathology service. Her current research interests involve neurodegenerative diseases, cardiac transplantation and muscle pathology. She has written close to 100 peer-reviewed papers the bulk of which are brain pathology related. In these capacities she has a wide experience on brain pathology and disease pathogenesis.

ABSTRACT

We have been tasked with providing a second-level review of the primary investigation into the suspected brain cancer cluster at RMIT and possible occupational causation thereof. We view our role in this regard as essentially providing a level of peer review to complement the primary investigation.

Most importantly, we agree with the main findings of the medical and environmental investigations, that is:

1. We see no evidence of a brain cancer cluster based on the cases identified in the investigation to date (defined as a statistical excess of brain cancers in the employees working on levels 16 & 17 of Building 108). The cases that initially led to this investigation, however unfortunate, do not constitute a brain cancer cluster, nor is there an excess of malignancies overall. A more definitive assessment could be made by systematically identifying and determining cancer outcomes for all past as well as current employees who worked on levels 16/17;
2. Independent of the presence or absence of a brain cancer cluster, we see no evidence of exposures at or above levels of concern for known or suspected occupational or environmental risk factors for brain cancer.

Detailed reviews of the medical and environmental investigations are provided in turn below, followed by discussion of possibilities for further investigation where indicated.

MEDICAL INVESTIGATION

Brain Cancers and Other Malignancies

We agree with the main findings of the medical investigation conducted by Southern Medical Services (Southern Medical Services Pty Ltd 2006):

- There is no evidence of a cluster of brain cancers on levels 16 and 17 based on the cases identified. The cases that initially led to this investigation, however unfortunate, do not constitute a brain cancer cluster, nor is there an excess of malignancies overall.

It is likely that the methods used to identify tumour or cancer cases were fairly comprehensive, but because this was done informally the percentage of past employees contacted, and the percentage of those contacted who then reported in to the SMS investigation team is not clear. This could affect both the numerator (the number of cases identified, or 'Observed') and the denominator (the number of cases 'Expected' given a defined population at risk) in the assessment of Observed/Expected cases that constitutes the heart of the cluster analysis. This limitation was acknowledged by the SMS team. What is clear, nevertheless, is that the cases initially identified as a suspected cluster *do not constitute a cluster*. It would therefore be reasonable to conclude the investigation at this point.

Should RMIT—in consultation with its employees and their representatives—decide to pursue the matter further, a more definitive cluster investigation could be conducted as follows:

- Identifying from personnel records all individuals who worked for RMIT on Levels 16/17 or in Building 108 for more than a specified length of time (e.g., more than 6 months) since occupancy of the building in 1996. This would provide a more robust denominator than the list of those currently employed as of June 2006 (114 individuals);
- Determining cancer outcomes among those individuals systematically and comprehensively by submitting those names to the Victorian Cancer Registry and the Australian Institute of Health and Welfare (AIHW) (to look at all cancers reported in other states and territories of Australia among former employees who have moved interstate). This is both the best and the most efficient way to do this (e.g., rather than telephone or mail surveys);
- To conduct further investigation of this sort, ethics applications would need to be made to State and Territory Cancer registries and the AIHW. The ethics committees prefer consent forms from all employees but they recognise that this process may not be practicable for past employees. If consent is not obtained, the AIHW will usually agree to provide de-identified data, i.e. the number of cases of each type of cancer. Identified data can be provided where it is felt that the consent process poses too many difficulties and the ethics committees are persuaded that such matching is in the public interest. Obtaining only the numbers of male and female cases by age group may be adequate.
- Should further investigation be conducted, it may be advantageous to include individuals who have worked on any level of Building 108 since 1996 (e.g., to cover the possibility that individuals may have moved between floors). This would also increase statistical power and address potential concerns from other Building 108 employees (working on levels other than 16 & 17).

Benign Tumours

The medical investigation also assessed a potential excess of benign tumours on levels 16 and 17. While this was done for completeness, we have concerns that it may cause unwarranted anxiety among level 16/17 employees. The problem is that benign tumours are not reliably reported to the Cancer Registry (the prime purpose of which is to register *malignancies*), thus there is not good population data for estimating the expected number of benign tumours. Benign tumours are under-reported to the Registry, resulting in estimated Expected numbers that are *under-estimates*. Thus, we have limited confidence in the validity of the finding that the Observed number was significantly greater than Expected.

ENVIRONMENTAL/EXPOSURE ASSESSMENT

We identified known and suspected occupational and environmental risk factors for brain tumours from the current scientific literature, what sort of brain tumours are associated with each risk factor, and determined which might plausibly occur on Level 16/17 of Building 108 (summarised in Appendix table below). All relevant risk factors that we could identify have been assessed (see Appendix). We conclude that most of the current exposures have been measured adequately (see Appendix). The only known association between environmental/occupational exposure and brain cancer is that of ionising radiation (IR). Exposure to IR is well below levels of

concern (see Appendix). All the chemical exposures appear to be well below current occupational or environmental exposure limits (see Appendix).

Chemical Exposure

Though no current chemical exposures were at levels of concern, exposures may have occurred in the past that would be expected to disperse over time and may no longer be measurable. We questioned Mr. Christopher White, RMIT Acting Vice President Resources, about past use of pesticides and refurbishments. Mr. White reported in a letter dated 26th July 2006 that there has been no fumigation or use of pesticides in the area apart from pelletised bait, and that a major renovation occurred in 1996 and another renovation was undertaken in 2001. There may have been higher exposure to substances such as volatile organic compounds (VOCs) and formaldehyde directly after the refurbishments in 1996 and 2001. There was concern expressed following the 2001 renovation about glue smells. VOCs were measured at that time and exposures were found to be within acceptable limits (Letter from Mr C. White).

EMF Exposure Assessment

Some further EMF measurement could be justified to identify the average exposure that a person would experience during their working day. Such measurements should be made during normal working days on a random sample of the staff in the area. This could not be done while levels 16 and 17 were vacated. The exposures that have been measured are well below current occupational and environmental limits. However exposures above the conservative benchmark of 4mG were measured in some offices, but according to current knowledge and research this level of exposure has not been linked to increased rates of brain cancer. The measurements were spot measurements taken at a particular point in time. The benchmark 4mG, however, is a time weighted average exposure. Different equipment emit magnetic fields of different strengths and magnetic field strengths decrease with the square of the distance from the source. This means that small variations in measurement distance can lead to large differences in measured magnetic field strength (see page 5, in <http://www.niehs.nih.gov/emfrapid/booklet/emf2002.pdf>). So as a person moves around during the day, their exposure will change depending on proximity to various sources of EMFs.

“Powered up” vs “Powered down”

The explanatory paragraph for Section 9.3 of the EMC Technology report (EMC Technologies 2006) states that many computers were in standby mode and most of the lighting was off. However, it would have been more informative if the readings had all been taken during normal operating conditions. If this was not possible then identification of which were taken under during normal operating conditions would have been useful. The data are presented in Appendix B3 states that all lights and computers were running when the measurements were taken, but these were for floors 3-15 only.

The health survey (Southern Medical Services Pty Ltd 2006) investigated whether the power status had an effect on measured field strength by drawing data from different tables in the EMC report. This is a useful analysis. They identified some rooms where measurements had been made in “Powered up” and probably in “Powered down” modes and compared the mean field strength. This suggested that powered up or down status had little or no effect of the measurement. A *caveat* is that the

measurements were taken at different heights however, adding another source of variation (in addition to power on/off) to the comparative measurements.

Worst case exposure data

There was a great deal of data on ELF fields but the presentation limited its usefulness. We believe that it is preferable to show all the data collected, if necessary as an appendix, and indicate the circumstances of the measurements. Then, if data points are drawn out for comparison, we can see the pool from which they were drawn.

In the EMC Technology report (EMC Technologies 2006), Tables 7 and 8 list worst case data for floors 3-17 but the size of the data set from which these worst cases is not clearly presented. It is not uncommon for environmental or occupational exposure to present a log-normal exposure distribution, with a tail of occasional high exposures. Thus if the data from floors 3-15 comes from a small data set, and the points from floors 16 & 17 come from large data sets then it is likely that there will be more higher exposures identified from floors 16 and 17. Thus we might incorrectly deduce that exposure to ELF is higher on the 2 higher floors when this may be an artefact of the number of samples.

In an email from SRMA, forwarded by RMIT on 27th July it appears that 2 measurements were taken at diagonal corners of the building on each of floors 3-15, (height of measurement not identified). These data are presented in Appendix B3. The same email states that no other data were available for these floors. If this is so, then the data in Table 8 are 1 of only 2 measurements on each floor.

On Floor 16 and 17 measurements were made at waist height at about 95 and 99 sites respectively and the data presented in Appendices B1 and B2. Where a measurement was found to be over 5 mG further measurements were made at knee level and head height (SRMA email forwarded 27th July). Not all of these data have been reported. The relatively high measurement on level 17 of 14.4 mG does not appear to be in any of the Appendices.

Table 8 is thus comparing 1 of 2 measurements made on each of Floors 3-15 with the highest measurements of 99+22(?) measurements made on Floor 16 and 95+16(?) measurements made on Floor 17; where the 22 and 16 additional measurements which were not reported, were made in higher exposure (>5mG) offices.

In conclusion, more measurements were made where exposures were found to be highest. The highest of these measurements has then been compared to the measurements taken on the other floors.

Variability of EMF Exposure

EMF exposure can clearly vary over time. Some estimate of the variability of the exposure in the offices should be included. In the 2001 report there are 3 EMF measurements that were taken in the offices on floor 17. (EMC Technologies 2001) These were also measured in 2006. Table 11 of the 2006 EMC Report (EMC Technologies 2006) identifies these 3 rooms and attributes the variability to different sensitivities of measurement. It is also possible however that the variation is a result of day to day changes in electric current (e.g., different lighting and computers being

used and/or slight differences in sampling height or position). All the results in the 2006 survey are lower, notably the exposure measurement in room 19 changes from 5 to 1.5 mG. The survey documentation does not allow us to determine whether these measurements were taken with the computers or lights powered up or down.

Table 1 Comparison of measurements made in 2001 and 2006 in mG

Room	Measurement Site Reference		Measurement (mG)	
	2001 Report	2006 Report	2001 Report	2006 Report
108.17.12	A	51	1.5	1.2
108.17.16	B	59	1.8	1.0
108.17.19	D	60	5.0	1.5

Some exposure in powered down offices on floors 16 and 17 have reached or exceeded 4mG. If repeat measurements were made, it is possible that different offices might on occasions exceed this level as a result of day to day variability in the power field when different combinations of electrical apparatus are switched on and off. A repeat survey in a random sample of rooms on floors 16 and 17 might provide a better picture of how often and where this occurs. Since 4mG is a very conservative benchmark based on limited evidence, we are not convinced that this would be a useful investigation.

The Health Report states that there is no correlation between tumour case office location and ELF magnetic fields greater than 4mG. We feel that because exposure measurements may vary over time, a one off measurement should not be over interpreted. It is true to say that there was no obvious relationship between tumour cases and occupancy of an office where a field of over 4mG was recorded in June and July 2006. The same proportion of cases and unaffected staff members were located in offices with measurements over 5 mG. 1/12 staff with tumours vs 24/308 other staff members were located in such offices.

Exposure Standards

The measured exposures to EMF were well below current occupational and environmental standards set by ARPANSA. It seems unlikely that exposures over the relevant workplace limits would have been experienced even under full occupancy and use. However, the ARPANSA standards are set to prevent acute effects. In particular, these acute effects include visual disturbances due to magneto-phosphenes. (WHO 1987) Although there are human epidemiological studies that have investigated the effects of exposure to quantified long term low level EMF, conflicting results have been reported for brain cancer risk. (Doll 2001) The RMIT health study authors have chosen a conservative benchmark for exposure of 4mG, an exposure that has been suggested for an increased risk of leukaemia in children.(Doll 2001) There is no evidence linking exposure at 4mG to brain cancer in children or adults.

APPENDIX: Summary of Known & Suspected Occupational & Environmental Brain Cancer Risk Factors and Exposures Assessed

Brain Cancer Risk Factor (known = K, suspected = S)	Source	Tumour type/histology	Exposure on Levels 16/17 RMIT plausible?	Exposure on Levels 16/17 RMIT assessed?	Assessment of <u>Current Exposure</u> adequate?	Current exposure at level of concern?
Ionising radiation (IR) (K)	(Bondy and Ligon 1996; Preston-Martin et al. 1983)	Meningiomas, Glioma	No, radon typically collects in basements rather than top floors. Perhaps contamination from elsewhere or unidentified X or γ -rays	Yes for radon and ionising radiation.	Yes. For radon and possible X or γ -rays	IR not at levels of concern
ELF/EMF (S)	(Mack et al. 1991)	Astrocytomas	Possible	Yes	Better measured when building in full use.	No. Levels less than reported in (van Tongeren et al. 2004)
RF Broad Band (S)	(Hardell et al. 2005; Moulder et al. 2005; Schoemaker et al. 2005)	Only Hardell showed an association for Acoustic neuromas	Possible	Yes	Better measured when building in full use.	No
Vinyl chloride monomer (K)	(Boffetta et al. 2003)	All, none specifically	No	Yes	Yes	No
Metals (S)	(Schlehofer et al. 2005)	Gliomas	Implausible—if through water then should affect all levels, not just 16 & 17?	Yes	Yes	No
Food industry (S)			No	No	Not applicable	Not applicable
Pesticides (S)	(Hepworth et al. 2006)	Adult brain tumours and acoustic	Pesticides may have been used	No (letter from Chris White, RMIT)	Not applicable	Not applicable

Brain Cancer Risk Factor (known = K, suspected = S)	Source	Tumour type/histology	Exposure on Levels 16/17 RMIT plausible?	Exposure on Levels 16/17 RMIT assessed?	Assessment of <u>Current Exposure</u> adequate?	Current exposure at level of concern?
Solvents (S)		neuromas	Possible from major refurbishments in 1995/6?	Yes	Yes	No
Lead (S)	(Nurminen and Karjalainen 2001)		Implausible—if through water then should affect all levels, not just 16 & 17?	Yes	Yes	No
Aromatic hydrocarbons (S)			Possible from major refurbishments in 1995/6 and 2001	Yes	Yes	No
Precision metalworkers: Metal dusts and fumes, lubricating oils and solvents) (S)			No—except perhaps for some solvents see above.	Yes	Yes	No
Asphalt, welding Significantly associated (S)	(Pan et al. 2005)	ICD-O-2 brain cancers: astrocytoma, glioblastoma, oligodendroglioma, ependymoma and others	No	No	Not applicable	Not applicable
Asbestos, isopropyl oil, mineral/lube oils, wood dust Weak association (S)			No	No	Not applicable	Not applicable
Benzene Weak association (S)			Unlikely	Yes	Yes	No

REFERENCES

- Boffetta, P;L Matisane;K Mundt and L Dell (2003). Meta-analysis of studies of occupational exposure to vinyl chloride in relation to cancer mortality. *Scandinavian Journal of Work, Environment & Health* 29(3): 220-9.
- Bondy, M and B Ligon (1996). Epidemiology and etiology of intracranial meningioma: a review. *J Neuro-Oncol* 29th Hanford Symposium on Health and the Environment: 197-205.
- Doll, RC (2001). ELF Electromagnetic Fields and the Risk of Cancer. Report of an Advisory Group on Non-ionising Radiation. NRPB Documents Didcot Oxford National Radiation Protection Board: 157.
- EMC Technologies (2001). AS/NZ 2772.1 (interim) 1998 Radio Frequency Fields Survey conducted for JCON International Pty Ltd at RMIT Building 108 ,Level 17. Tullamarine: 17.
- EMC Technologies (2006). Electromagnetic Fields Survey at RMIT Building 108 239 Bourke Street Melbourne Vic 3000 for SRM Australia. Tullamarine: 34.
- Hardell, L;M Carlberg and HM K. (2005). Case-control study on cellular and cordless telephones and the risk for acoustic neuroma or meningioma in patients diagnosed 2000-2003. *Neuroepidemiology* 25: 120-8.
- Hepworth, S;A Bolton;R Parslow;M van Tongeren;K Muir and P McKinney (2006). Assigning exposure to pesticides and solvents from self-reports collected by a computer assisted personal interview and expert assessment of job codes: the UK Adult Brain Tumour Study. *Occupational & Environmental Medicine* 63(4): 267-72.
- Mack, W;S Preston-Martin and J Peters (1991). Astrocytoma risk related to job exposure to electric and magnetic fields. *Bioelectromagnetics* 12: 57-66.
- Moulder, J;K Foster;L Erdreich and J McNamee (2005). Mobile phones, mobile phone base stations and cancer: a review. *Int J Radiat Biol* 81: 189-203.
- Nurminen, M and A Karjalainen (2001). Epidemiologic estimate of the proportion of fatalities related to occupational factors in Finland. *Scandinavian Journal of Work, Environment and Health* 27(3): 161-213.
- Pan, S;A Ugnat and Y Mao (2005). The Canadian Cancer Registries Epidemiology Research Group. Occupational risk factors for brain cancer in Canada. *Occupational & Environmental Medicine* 47(7): 704-17.
- Preston-Martin, S;M Yu;B Henderson and e al (1983). Risk factors for meningiomas in men in Los Angeles County. *J Natl Cancer Inst* 70: 863-866.
- Schlehofer, B;I Hettinger;P Ryan;M Blettner;S Preston-Martin;J Little;A Arslan;A Ahlbom;G Giles;G Howe;F Menegoz;Y Rodvall;W Choi and J Wahrendorf (2005). Occupational risk factors for low grade and high grade glioma: results from an international case control study of adult brain tumours. *International Journal of Cancer* 113(1): 116-25.
- Schoemaker, M;A Swerdlow and A Ahlbom (2005). Mobile phone use and risk of acoustic neuroma: results of the Interphone case-control study in five North European countries. *Br J Cancer* 93: 842-8.

- Southern Medical Services Pty Ltd (2006). Medical Investigation of tumours detected in RMIT Building 108. Hawthorn Southern Medical Services Pty Ltd: 47.
- van Tongeren, M;T Mee;P Whatmough;L Broad;M Maslanyj;S Allen;K Muir and P McKinney (2004). Assessing occupational and domestic ELF magnetic field exposure in the UK adult brain tumour study: results of a feasibility study. Radiation Protection Dosimetry 108(3): 227-36.
- WHO (1987). Environmental Health Criteria 69. Magnetic Fields. Geneva, World Health Organisation: 86-106.