

BEFORE THE BOARD OF INQUIRY

IN THE MATTER of the Resource Management Act 1991

AND

IN THE MATTER of applications for resource consent and notices of requirement by Transpower New Zealand Limited for the North Island Grid Upgrade Project

**STATEMENT OF EVIDENCE OF ANDREW WILLIAM WOOD IN REBUTTAL FOR
TRANSPOWER NEW ZEALAND LIMITED
(EMF and human health (biophysics))**

SIMPSON GRIERSON
D J S LAING / J G A WINCHESTER
TELEPHONE: +64-4-499 4599
FACSIMILE: +64-4-472 6986
DX SX11174: PO BOX 2402
SOLICITORS
WELLINGTON

J S KÓŠ QC
STOUT STREET CHAMBERS
TELEPHONE: +64-4-472 9026
FACSIMILE: +64-4-472 9027
PO BOX 117
WELLINGTON

Introduction

1. **MY** name is Andrew William Wood. I wish to present rebuttal evidence to the statements of evidence of:
 - (a) Dr Laura Bennet and Mr Adrian Kinsler;
 - (b) Mr Doug Parker on behalf of Hunua and Paparimu Valley Residents' Association Incorporated;
 - (c) Mr McQueen;
 - (d) Dr Allanah Kilfoyle;
 - (e) Mr Bruce Davidson;
 - (f) Mr Gary Orbell on behalf of Matamata-Piako District Council;
 - (g) Mr George Vercoe on behalf of Parahiwi Farm;
 - (h) Mr John Makin; and
 - (i) Mr John Scott.

2. I address the evidence of each submitter below.

Dr Laura Bennet and Mr Adrian Kinsler (Submission number 1085)

3. **THERE** appears to be some confusion in Dr Bennet and Mr Kinsler's submission on the basis of ICNIRP limits. Page 2, paragraph 2, begins: "*There is widespread discussion that thermal limits are outdated ...*". ELF-EMF limits are not based on thermal effects, neither in the ICNIRP nor the IEEE (ICES) guidelines. They are based on the avoidance of neurostimulation. There is also a "Rationale" section in the draft ARPANSA ELF standard which explains this.

4. **THE** ICNIRP Guidelines cover frequencies up to 300 GHz, but make a careful distinction between frequencies up to 100 kHz and frequencies 100 kHz – 300 GHz. Thermal limits are not relevant for the former range and basic restrictions are given in terms of tissue current density "*to prevent effects on nervous system functions*" [1], page 508. This point is also covered in my evidence in chief, at paragraph 19.

5. **REFERENCE 3** (the Bioinitiative Report) is described as being "*an excellent primer on this complex subject*". If the "Summary for the Public", by Ms Cindy Sage, which is Section 1 of the 610-page document, is what the submitters

have in mind, this, in my view, fails to make a proper distinction between the very different ELF and RF forms of EMF, in many instances mixing the two on the same page.

6. **THIS** serves to confuse the lay reader into believing that putative residual health concerns for RF (namely, the possibility of non-thermal effects and the concern over brain tumours) also apply to ELF. Both the IEEE (ICES) and ARPANSA have very deliberately chosen to separate ELF from RF in issuing standards. The same is also true in New Zealand, where the RF standard NZS 2772:(Part 1:1999) does not cover the frequency range below 3 kHz.
7. **THE** Reference 3 report apparently had been written by 14 experts and reviewed by "*another dozen*" who failed to notice the glaring error on page 8, where the "*limit .. in the US*" is given as 904 mG. No ELF limit has, as yet, been adopted in the US and the IEEE limit (which was issued by an international rather than US committee) is 9,040 mG (904 μ T), not 904 mG.
8. **REFERENCES** 4a and 4b in the evidence (which are documents produced by the UK-based Stakeholder Advisory Group on EMFs (SAGE¹) are not government reports: the remit of SAGE is to *provide advice* to the UK government. The Minister for Public Health also received advice from the UK Health Protection Agency, via a letter from the Chief Executive, which I quote in my evidence in chief at paragraph 85. The recommendations of SAGE should also be taken alongside the UK Cross-party Inquiry report², which makes "*recommendations for Government to consider*". To my knowledge, the UK government is as yet not committed to a particular policy on precaution in relation to ELF-EMF.
9. **PAGE** 5 of the statement of evidence of Dr Bennet refers to Reference 3 (the Bioinitiative Report) as providing a "*comprehensive list of papers on the various scientific mechanisms believed to underpin how EMF causes illness*". In my view, the publication lists at the end of each section are selective rather than comprehensive and there is very little discussion on biophysical mechanism. Section 14, by Dr Blackman (in whose laboratory I worked for a 5-month period), speculates on the possible role of modulations, but again this is mainly in the context of possible RF (specifically mobile phone) rather than

¹ not to be confused with Ms C Sage, referred to above.

ELF risk. At paragraphs 54 and 57 of my evidence in chief, I discuss the suggested mechanism involving free radicals at ELF as being unlikely below 50 μ T.

10. **IN** the very last paragraph of Dr Bennet's statement of evidence, an assertion is made that "*even small average electric fields in heterogeneous material can result in local fields that may be biologically significant for individual cells*". This very question was considered by the NRPB (now HPA) in a number of forums (see [2], [3], Appendices A & B) and also by the ARPANSA Working Group on ELF. It is true that the Basic Restriction limits are to be evaluated over a certain region of tissue (1 mm in the case of the draft ARPANSA standard), but their derivation is from observations on phenomena, where the observations have employed a similar averaging distance. The biological significance for individual cells thus signals the levels for which there needs to be concern and therefore the averaged fields for which this occurs. The enhancement effects are thus already built into the limits.

Mr Doug Parker on behalf of Hunua and Paparimu Valley Residents' Association Incorporated (Submission number 0748)

11. **MR** Parker states at page 8 of his revised statement of evidence that "*Transpower have apparently misunderstood the ICNIRP guidelines*". This is not true, in that the ICNIRP 50 Hz reference level for the general Public is 5 kV/m. The basic restriction-derived values of 9 kV/m referred to in the Connell Wagner report are estimates made in [4], not those in the ICNIRP guidelines. There is no mention of a 10 kV/m limit for the General Public in the ICNIRP guidelines.
12. **IN** fact, the 5 kV/m limit is to prevent *indirect effects* (microshock from charge transfer to or from metallic objects). The ICNIRP Guidelines (see [1] p 511) state that 5 kV/m is the value (at 50 Hz) chosen for general public reference levels "*to prevent adverse indirect effects for more than 90% of exposed individuals*". The draft ARPANSA standard has a provision to increase the reference level for the General Public to 10 kV/m under controlled circumstances: the controls including elimination of indirect hazard and the

² <http://www.epolitix.com/NR/rdonlyres/5D7ED218-D9A4-491B-9829-BFBF25D62248/0/Reportsinglesided.pdf>.

appropriate placing of warning signs. However, this draft has no status in informing present policy.

13. **AT** page 21 of his revised statement of evidence, Mr Parker refers to some recently emerging understanding of possible mechanisms (as being a reason for the medical and scientific community not to be dismissive of potential EMF effects). However, what this emerging understanding consists of is not elaborated on by Mr Parker. In my evidence in chief, I refer to my participation in the work of the EHC breakout group, which met in 2005 (see paragraphs 57 - 62).

Dr McQueen (Submission number 1076)

14. **DR** McQueen cites a paper by Henshaw and Reiter signalling his intention to speak to the findings of this paper (among others) at the hearing. This paper, which was given at a symposium in 2004, was subsequently revised and published in Bioelectromagnetics [5]. It is a review rather than a primary study, but purports to show that a mechanism involving melatonin disruption is plausible. It includes reference to a study led by myself [6], so I am familiar with the subject material. The review advances four potential theoretical mechanisms for magnetic fields influencing melatonin. It makes no claim that any of these have been established, although they are described as 'logical'. It acknowledges that experimental support for the proposed mechanisms is incomplete ([5] pS93).
15. **IN** my evidence in chief at paragraphs 54, and 57 - 58, I have argued that the only proposed mechanism which seeks to explain the interaction of magnetic fields with the biological system is the fourth of the theoretical mechanisms in the Henshaw and Reiter review, which is the 'Free Radical Lifetimes' hypothesis, and that this is unlikely to be significant at environmental levels of magnetic fields.
16. **SUBSEQUENT** to this review, the literature was re-examined as part of the EHC review process of neuro-endocrine system effects [7]. The overall conclusion of this group was that "*Overall, these data do not indicate that ELF electric and/or magnetic fields affect the neuroendocrine system in a way that would have an adverse impact on human health and the evidence is thus considered inadequate*" (page 7).

Dr Allanah Kilfoyle (Submission number 0498)

17. **MOST** of Dr Kilfoyle's evidence deals with epidemiological issues, but on slide 7 of her evidence, a point is made that NRPB (now HPA) in 2004 conceded that the 'ionised particles' mechanism was plausible. I take it that this is referring to the NRPB Document entitled '*Particle deposition in the vicinity of power lines and possible effects on health*' [8]. This considered both the effects of ELF fields and of powerline-related corona ions on deposition of airborne particulate pollutants. Whereas this document is supportive of the notion that, in particular, corona ions have a potential effect on health, the overall conclusion is that: '*However it seems unlikely that corona ions will have more than a small effect on the long-term health risks associated with particulate air pollutants, even in the individuals who are most affected*' (page 48).

18. **IT** should also be pointed out that the main health hazards of airborne particulates are cardio-respiratory disease and lung cancer, not childhood leukaemia. At paragraph 90 of my evidence in chief, I refer to the experimental study of Bracken et al. and the epidemiological study of Draper et al., neither of which showed much support to the argument that this phenomenon provides a proven mechanism for health effects. Specifically, Draper et al. state that:

"We have made an initial test of [the corona ion] hypothesis using a simple model suggested by Preece et al (personal communication), assuming the prevailing wind is from the south west. The case-control ratio was no greater downwind than upwind of power lines, so, using this admittedly oversimplified approach, we have no evidence to support this hypothesis" [9], p1293.

19. **THE** paper of Bracken et al. states:

"The magnitudes of the enhanced fields and ion concentrations exceeded the range of upwind (ambient) values only for a small percentage of time under most conditions" [10], page 1692.

"Based on this study, ac transmission lines appear to have a minor impact on potential long-term exposure to space charge (ions and/or charged aerosols) beyond the ROW [Right Of Way], [10], page 1701.

Mr Bruce Davidson (Submission number 0874)

20. **MR Davidson** (at paragraph 4.9 of his evidence) asserts that the easement width for the overhead lines section should be 120 m, based on the recommendations of SAGE, referred to in paragraph 5 above. I re-iterate that the UK HPA do not support the "corridor option" (see paragraph 85 in my evidence in chief). I also note that the SAGE 60 m corridor each side of the centre line is not an easement, it is a distance to the nearest building. I note too that it refers to 275 kV and 400 kV lines in the UK. Thirdly, the SAGE stakeholders could not reach consensus on whether to advise the government to follow the 'corridors for new build' option. This is discussed on page 53 of the SAGE First Interim Assessment.

Mr George Vercoe on behalf of Parahiwi Farm (Submission number 1129)

21. **MR Vercoe** is concerned that because the line is within 450 m of a proposed building site, this would create problems (paragraph 2 of his evidence). At this distance the fields due to the powerline will be minor in comparison to the fields generated within the proposed home. It is also debatable that the health issue is 'proven'. Certainly, the ELF-EMFs have not been shown to be causative of leukaemia. The overall Health Risk Assessment of the EHC review states that "*Thus, on balance, the evidence is not strong enough to be considered causal, but sufficiently strong to remain a concern*" [7], p12. This issue of causality is also covered in Professor Elwood's evidence in chief.

Mr John Makin (Submission number 0781)

22. **AT** page 6 of Mr Makin's evidence, reference is made to Australia not imposing limits on EMF exposure. Australia was in fact one of the first countries worldwide to adopt the former IRPA Guidelines as an Interim Guideline in 1989, which are still available from the ARPANSA website³. These are similar to, but not identical to the ICNIRP limits. The electrical power industry has, in addition, adhered to a policy of 'prudent avoidance' (see [11]). The draft ELF standard⁴ is the result of an extensive review of recent epidemiological and laboratory evidence and rather than reducing the limits set by ICNIRP is in fact, in the

³ <http://www.arpansa.gov.au/pubs/rhs/rhs30.pdf>.

amended version, recommending a three-fold increase as being consistent with the latest science.

Mr John Scott (Submission number 1184)

- 23.** **MR** Scott sets out a number of "reasons for submission" (26 February 2008 email). In his second reason, Mr Scott argues that the 65 m easement width *"would appear to be based on a "least-cost rather than safety scenario"*. However, he provides no substantive argument on why 65m would compromise safety. This width of 65 m is in line with practice for the higher voltage 500 kV lines in Victoria, Australia. To my knowledge there have never been any issues with safety issues due to cable sway etc.
- 24.** **IN** his third reason, he argues that there are conclusions other than Dr Black's regarding health outcomes. The ARPANSA ELF standard working group represent a panel of scientists with an independent view on the status of the scientific evidence on ELF-EMF possible health effects. The view of the working group as represented in the draft ELF Standard (see paragraph 12 above) is very similar to that of Dr Black and indeed of WHO, IEEE and other major international bodies.

Andrew William Wood

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⁴ http://www.arpansa.gov.au/pubs/comment/dr_elfstd.pdf.

References

1. ICNIRP, *Guidelines on limits of exposure to time-varying electric, magnetic and electromagnetic fields (1 Hz - 300 GHz)*. Health Phys, 1998. 74: p. 494-522.
2. McKinlay, A. and M. Repacholi, *Weak electric field effects in the body.*, in *Radiation Protection Dosimetry*, A. McKinlay and M. Repacholi, Editors. 2003. p. 290-400.
3. NRPB, *Review of the Scientific Evidence for Limiting Exposure to Electromagnetic Fields (0 - 300 GHz)*, in *Documents of the NRPB*. 2004, National Radiological Protection Board: Chilton, Didcot, Oxfordshire.
4. Dimbylow, P., *Development of the female voxel phantom, NAOMI, and its application to calculations of induced current densities and electric fields from applied low frequency magnetic and electric fields*. Phys Med Biol, 2005. 50(6): p. 1047-70.
5. Henshaw, D.L. and R.J. Reiter, *Do magnetic fields cause increased risk of childhood leukaemia via melatonin disruption?* Bioelectromagnetics, 2005.
6. Wood, A.W., et al., *Changes in human plasma melatonin profiles in response to 50 Hz magnetic field exposure*. J Pineal Res, 1998. 25(2): p. 116-27.
7. WHO. *Extremely Low Frequency Fields: Environmental Health Criteria Monograph No.238*. 2007 [cited; Available from: http://www.who.int/peh-emf/publications/elf_ehc/en/index.html].
8. NRPB, *Particle Deposition in the Vicinity of Power Lines and the Possible Effects on Health*, in *Documents of the NRPB*. 2004, National Radiological Protection Board: Chilton, Didcot, Oxon, UK. p. 55.
9. Draper, G., et al., *Childhood cancer in relation to distance from high voltage power lines in England and Wales: a case-control study*. Bmj, 2005. 330(7503): p. 1290.
10. Bracken, T., R. Senior, and W. Bailey, *DC electric fields from corona-generated space charge near AC transmission lines*. IEEE Trans Power Delivery, 2005. 20(2): p. 1692-1702.
11. Nuttall, K., P.J. Flanagan, and G. Melik, *Prudent avoidance guidelines for power frequency magnetic fields*. Radiation Protection in Australasia, 1999. 16(3): p. 2-12.