

# **Before the Board of Inquiry into the Upper North Island Grid Upgrade Proposal**

## **Statement of Evidence of Martin David Gledhill on behalf of the Ministry of Health**

### **1 Introduction**

- 1.1 My name is Martin David Gledhill. I have a Master of Arts in Natural Sciences (Physics) from Cambridge University and a Master of Science in Medical Physics from the University of Otago. I am a member of the Australian Radiation Protection Society and the Bioelectromagnetics Society.
- 1.2 I am a scientist at the National Radiation Laboratory (NRL) of the Ministry of Health (MoH), and am authorised to present this submission on behalf of the Laboratory. This evidence also represents the views of the MoH. Where reference is made in this evidence to MoH views, recommendations etc it can be taken as read that these are also those of the NRL.
- 1.3 The NRL's function is to administer radiation protection legislation and provide independent radiation protection advice to central and local government, the public and industry. It is the agent of Government providing independent expert advice on hazards associated with the use of non-ionising radiations; that is ultraviolet, lasers, microwaves, radiofrequency (RF) and low frequency electric and magnetic fields, and ultrasound. In this capacity, we work with other government departments.
- 1.4 I head the non-ionising radiation section of the NRL, and as part of my duties carry out work related to the health effects of low frequency electric and magnetic fields. In the course of my work, I provide advice on health effects to members of the public, industry, and other government agencies, and keep up to date with research in this area. I participate in the Interagency Advisory Committee on the Health Effects of Non-Ionising Fields (which is chaired by the NRL Group Manager, with secretariat services provided by the MoH). I have measured the extremely low frequency (ELF) electric and magnetic fields (EMFs) around a number of transmission lines, and electrical installations in industrial settings and in private homes.

### **2 Scope of evidence**

- 2.1 The purpose of this evidence is to confirm the contents of the original submission from the MoH including the Annex, which I would like to have considered as part of this evidence. I will not repeat matters discussed in the Annex. I will also comment on some matters raised in some other submissions and in evidence submitted by Transpower.

### **3 Matters raised in Transpower's evidence**

#### **My role in the development of Transpower's design parameters**

- 3.1 In paragraph 75 of his evidence on behalf of Transpower, Mr Campbell states:
- “The design parameters [for the North Island 400 kV Investigation Project] were documented and reviewed by the following parties:
- (a) Martin Gledhill, National Radiation Laboratory – technical Electric and Magnet (sic) documentation;”
- 3.2 I would like to clarify my role in this work. In particular, I would like to make it clear that I did not prepare or draft the design parameters, or approve them, or in any way tell Transpower what they should be. Rather, Transpower asked some detailed questions about the International Commission on Non-Ionizing Radiation Protection (ICNIRP) Guidelines and IEEE Standard C95.6 (for example, whether the reference levels were maximum values at any point of the body or were average values over the body) to which I provided a response. I was also shown a draft of the design parameters and provided comments in terms of whether they made technical sense, but not whether I approved of them or not.

#### **Compliance with ICNIRP guidelines**

- 3.3 The MoH submission supported use of the ICNIRP guidelines as a yardstick in assessing the acceptability or otherwise of exposures to ELF EMFs from the proposed upgrade.
- 3.4 I note that Transpower state in their evidence (for example, the evidence of Mr Khot and Mr Mitton) that they have designed the line to comply with the public reference levels in the ICNIRP guidelines under worst case conditions. I consider that the calculations they have carried out are appropriate and that exposures will comply with the ICNIRP guidelines.

#### **Adoption of low/no cost measures to reduce exposures**

- 3.5 So far as I am aware, the State of California has the most formalised approach to the adoption of low/no cost measures to reduce exposures. The approach was developed by the California Public Utilities Commission (the public agency regulating electrical utilities) in the early 1990's, and was reaffirmed (with some minor changes) in 2006 following a review.
- 3.6 I have attached the EMF Design Guidelines for Electrical Facilities dated 21 July 2006 as Appendix A to my evidence<sup>1</sup>.

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<sup>1</sup> The Design Guidelines are available via a link at [www.cpuc.ca.gov/PUC/energy/electric/Environment/ElectroMagnetic+Fields/](http://www.cpuc.ca.gov/PUC/energy/electric/Environment/ElectroMagnetic+Fields/)

- 3.7 The Design Guidelines consider “low cost” to be no more than 4% of the total project cost, and reduction measures to be justified if they achieve a reduction in magnetic fields of greater than 15% at the edge of the utility Right-of-Way (ROW).
- 3.8 The Design Guidelines say that three methods for field reduction may be considered:
- “A) Increasing the distance from electrical facilities by:
- a. Increasing structure height or trench depth.
  - b. Locating power lines closer to the centerline of the corridor [ie the ROW corridor].
- B) Reducing conductor (phase) spacing.
- C) Phasing circuits to reduce magnetic fields.”
- 3.9 These methods are similar to those suggested in the first three dot points of paragraph 18 of the Annex to the MoH submission. (The fourth dot point in that paragraph is effectively equivalent to having the transmission line ROW.)
- 3.10 A utility constructing a new transmission line must prepare a Field Management Plan documenting the consideration of low/no cost measures.
- 3.11 In a presentation to a WHO workshop on “Developing and implementing protective measures for ELF EMF” held in June 2007 (shortly after the release of WHO EHC238), Dr Jack Sahl, Director Environmental Health & Safety for Southern California Edison (an electric utility company) said that the approach has worked well since first implemented, and in practice field reduction costs have been less than 4% of total project costs. He showed examples which included changes in the arrangement of conductors to bring them closer together, and raising the height of conductors (either by making support towers higher, or increasing line tension).
- 3.12 I have included this example of an approach to achieving reduction in exposures through low/no cost measures, not because I believe the proposed upgrade should follow exactly the same process as applied in California, but to show that this is a valid approach to mitigation which has been applied successfully.
- 3.13 Without a formal Field Management Plan of the type used in California I find it difficult to determine the extent to which Transpower has taken measures to reduce fields at nearby properties. (This is not intended as a criticism of Transpower, as there was no requirement on them to produce such a plan.) However, I note from Ms Allan’s first brief of evidence (paragraph 73) that the route selection process included consideration of proximity to dwellings, and from Mr Noble’s evidence (paragraph 36) that avoidance of dwellings was one of the objectives in choosing the final alignment and positioning towers. Whether this was simply to ensure that dwellings were not in the easement, or

whether there was also consideration of exposure reduction by maximising distance from the line or selection of tower sites is not clear.

- 3.14 Mr Khot states that the line will be reverse-phased, which will probably have the greatest effect on reducing fields. He also states (paragraph 262-263) that compact tower designs could not be considered due to the requirement to allow for live line maintenance. While I accept that the ability to carry out live line maintenance work may be an essential requirement, I would welcome more specific details on the actual clearances required and how this would limit the use of compact tower designs.

#### **4 Matters raised in other submissions**

##### **Dr Robin Smart**

- 4.1 Dr Smart discusses some of the health effects research and concludes that the ICNIRP Guidelines are not satisfactory, and that an exposure level of 0.1  $\mu$ T should be applied as being a precautionary approach.
- 4.2 I do not propose to make a detailed analysis of Dr Smart's submission, but will highlight a few main areas to demonstrate why the MoH does not agree with his conclusions.

*Paper Health effects of high voltage transmission lines: a survey of the medical literature December 2004*

- 4.3 As Dr Smart notes in section 4.2 of his submission, this paper was reviewed by the Interagency Advisory Committee on the Health Effects of Non-ionising Fields, which concluded that no change to existing exposure guidelines should be made.
- 4.4 The Interagency Committee commissioned Dr Mark Elwood to review Dr Smart's paper. The Terms of Reference for Dr Elwood's review were that he should examine the validity of Mr Smart's conclusions, and if he agreed with them estimate the possible implications in terms of health risks to the New Zealand public. If he disagreed with them he should provide comment explaining why.
- 4.5 Dr Elwood did not agree with Dr Smart's conclusions, finding that "the choice of studies included in his review appears to be biased in favour of studies that show positive associations; for several of the diseases reviewed, some of the largest and more recent studies are ignored while other studies, some with very limited methods that have been published many years ago, are included." I note that Dr Elwood makes similar comments on Dr Smart's submission in his evidence on behalf of Transpower.
- 4.6 A copy of Dr Elwood's report was sent to Dr Smart.

##### **UK Sage Group**

- 4.7 Dr Smart has summarised the findings of the UK SAGE Group. Whilst his summary of the SAGE recommendations in paragraphs 9.3 and 9.4 is fair, I do

not consider that he fairly represents their recommendations in paragraph 9.5 of his submission.

4.8 The SAGE report<sup>2</sup> notes (page 16) that there are two main viewpoints on health effects of ELF EMF, and that members of the SAGE Group generally identified with one or the other:

- The “WHO/HPA [UK Health Protection Agency] view” – that childhood leukemia is the only endpoint possibly associated with exposure to ELF fields
- The “California viewpoint” – that a range of other outcomes (generally more prevalent than childhood leukemia, including adult cancers and Alzheimer’s disease) may be associated with exposure to ELF fields.

4.9 SAGE identified (in section 5.4) a range of options to reduce exposures by increasing the separation of buildings from lines, including one they considered to be the best available for obtaining significant reduction in exposures: that new lines should be 60 m from existing residential buildings, and no new residential buildings should be constructed within 60 m of existing lines). However, it did not make a recommendation to implement this option as the Group could not agree whether it was supported by cost-benefit analysis. From the “WHO/HPA” viewpoint the costs exceeded any possible benefits by a factor of at least 20, whereas from the “California” viewpoint costs and benefits would be at least comparable. In their conclusions (section 5.5), the SAGE Group said:

“We urge government to make a clear decision on whether to implement this option or not.”

4.10 Dr Smart suggests that the group urged the Government to adopt the option, which is not the case.

4.11 Since publication of the SAGE report, the British Minister of Health requested the Health Protection Agency to provide advice on the report. The HPA responded on 17 October 2007<sup>3</sup> and reaffirmed its agreement with the “WHO/HPA” viewpoint. The HPA also said that:

“HPA supports precautionary measures that have a convincing evidence base to show that they will be successful in reducing exposure, are effective in providing reassurance to the public, and where the overall benefits outweigh the fiscal and social costs.”

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<sup>2</sup> Stakeholder Advisory Group on ELF EMF. First interim assessment: power lines and property, wiring in homes, and electrical equipment in homes. Available for download at <http://www.rkpartnership.co.uk/sage/Public/SAGE%20first%20interim%20assessment.pdf>

<sup>3</sup> See [http://www.hpa.org.uk/radiation/understand/radiation\\_topics/emf/hpa\\_response\\_statement\\_sage.htm](http://www.hpa.org.uk/radiation/understand/radiation_topics/emf/hpa_response_statement_sage.htm)

4.12 Concerning the 60 m separation option, the HPA commented:

“HPA notes that the “corridor option” considered by SAGE for separating new dwellings from high voltage powerlines and vice versa is not supported by the cost benefit analysis, even assuming a causal link between exposure to ELF EMFs and childhood leukaemia. Therefore a decision to implement this precautionary option should be weighed against other health benefits obtainable from the same resources. Nevertheless, HPA recommends that, within the existing government planning framework, the attention of local authority planning departments and the electricity companies be drawn to the evidence for a possible small increase in childhood leukaemia which may result from siting new buildings very close to powerlines, or new powerlines very close to existing buildings.”

### *Response of other countries*

4.13 In section 11 of his submission, Dr Smart outlines responses taken elsewhere.

4.14 It appears to me that some of Dr Smart’s statements in this section (such as the references to countries which do not permit new housing within 100 m of a transmission line) come from material available on the internet with no reference to the source material, and may be incorrect. I would be interested to see more specific references to the actual source documents.

4.15 Dr Smart cites the approaches taken in Italy, Switzerland and the Netherlands, which have adopted lower limits (in the case of Switzerland “installation limit values” as they apply to a limit per installation, rather than an overall exposure limit).

4.16 The MoH agrees with the WHO recommendation that exposure limits should not be lowered arbitrarily in the name of precaution. While epidemiological evidence finds an association (correlation) between children who have long term exposures to time averaged magnetic fields greater than 0.4  $\mu$ T and a small increased risk of leukemia, there is no support for this from laboratory research, and no mechanism established whereby fields of this magnitude could have any effects at all. If there is an effect, it is not clear which aspect of the exposure (time average value, peak value, occurrence of transients, harmonics etc) may be responsible. Arbitrary reduction of the limits undermines their scientific foundation.

4.17 I note that many of the responses cited by Dr Smart propose a “prudent avoidance” type approach recommended by the MoH and the WHO.

## **5 Conclusions**

5.1 The MoH confirms its original submission neither supporting nor opposing the application. While it is clear that exposures at all points reasonably accessible to the public will comply with the ICNIRP guidelines, I consider that further information from Transpower would assist in determining whether adequate low or no cost measures to reduce exposures have been taken. Specifically, this information would give more details on the practical limitations of

compact tower designs, and on the extent to which efforts were made to increase the distance of dwellings from the line in the detailed route selection, rather than just ensuring that dwellings were outside the easement.

A handwritten signature in black ink, appearing to read "M. D. Gledhill". The signature is fluid and cursive, with a horizontal line drawn underneath the name.

Martin David Gledhill

26 February 2008

## **Appendix A**

### **California Public Utilities Commission design guidelines for electrical facilities**