

IN THE MATTER of the Resource Management Act 1991

AND

IN THE MATTER of a Board of Inquiry appointed under s146 of the Resource Management Act 1991 to consider an application by Mighty River Power Limited for resource consents to construct, operate, and maintain a wind farm at Turitea

STATEMENT OF REBUTTAL EVIDENCE OF PHILIP WONG TOO

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1. INTRODUCTION

- 1.1 My name is Philip Wong Too. My qualifications and relevant experience are set out in my evidence in chief. I confirm that I have prepared this rebuttal evidence in accordance with the Environment Court Code of Conduct for Expert Witnesses (July 2006).
- 1.2 I am providing this rebuttal evidence to comment on, and respond to, some of the primary evidence presented in respect of these applications that relate to wind resource matters. In particular, I will comment on the evidence of Ms Molly Melhuish on behalf of the Palmerston North City Council, and Mr Bryan Leyland on behalf of Tararua Aokautere Guardians and Friends of Turitea Reserve.
- 1.3 There are a number of matters from each brief to which I wish to respond, as follows.

2. BRIEF OF EVIDENCE OF MOLLY MELHUIISH

- 2.1 In paragraph 12 Ms Melhuish states that Palmerston North is self sufficient in generation. New Zealand is an island nation that must be electricity energy self sufficient. Options for generating electricity include delivering fuel to point of use, gas, oil, coal or fuel by wire hydro, geothermal, and wind. In the case of the latter the generation must occur at the point the fuel exists. The reality is that if New Zealand is going to achieve its renewable energy targets, those areas that have abundant renewable energy resources, such as wind in the Manawatu, geothermal in the central North Island, or hydro in the lower South Island will have to export to those areas of greater demand that are not so well endowed with renewable energy.
- 2.2 As Ms Melhuish notes in paragraph 52, the most important determinant of wind development costs is the mean wind speed at the location. She goes on to note (in paragraph 53) that New Zealand's wind resource is very large, with some 15,000 MW of generation potential in "Tranche 1" (the most economic tranche). However, as outlined in my evidence in chief, I believe that sites with a wind resource of the quality of that at Turitea are in fact very rare. The Meridian document "*Options Choices Decisions 2009 Update*" to which Ms Melhuish refers in paragraph 66 states that "*There are only a handful of these [best tier 1] sites nationwide with a potential of around 2000 GWh*".¹ As Mr

¹ Options Choices Decisions 2009 Update, Meridian Energy, page 14.

Fraser Clark notes in paragraph of 7.18 of his evidence, the Turitea project would represent half of this high quality capacity.

- 2.3 In paragraph 90, Ms Melhuish makes the assumption that in designing the wind farm, Mighty River Power has simply sought to maximise the utilisation of the resource. I can confirm that this is only one of a number of factors that has influenced the design and layout of the wind farm. Other important factors include environmental, topography and boundary constraints, the variation of the wind resource and the spacing of wind turbines to reduce wake losses, and turbulence from neighbouring wind turbines.
- 2.4 “Also in paragraph 90, Ms Melhuish acknowledges that large turbines will capture far more energy than smaller ones when arranged in a single row. This is true, and I note further that large turbines will generally produce more than small turbines in almost all cases, except that of a very large regular shaped wind farm. The capacity gain from using larger turbines is exhibited to a limited extent at Turitea, in the difference in energy capture of the wind farm comprised of 122 2.3MW turbines, or 112 3MW turbines. In this instance, the greater number of smaller wind turbines does not quite match the capacity or energy generation from a smaller number of large wind turbines.”
- 2.5 In paragraph 93, Ms Melhuish suggests that smaller, closely packed turbines should be used for areas that are some distance from populations and/or which may be screened by intervening ridges. However, in my experience the less visually prominent wind turbines also tend to be located in the areas of least wind resource. For example, in the case of Motorimu, the most visually prominent wind turbines were removed, but these were also the turbines exposed to the greatest wind resource. In my opinion, this has compromised the viability of the site to the extent that it is questionable whether the project, and hence its environmental benefits, will be realised. I therefore strongly disagree with Ms Melhuish’s conclusion (at paragraph 94) that:

“Motorimu is an excellent example of modifying a wind farm proposal to ensure its adverse effects on special amenity landscapes is minimised and thereby ensuring the balance and modulation implicit in the ethic of sustainability is achieved.”

3. BRIEF OF EVIDENCE OF BRYAN LEYLAND

- 3.1 At paragraph 3.5, Mr Leyland notes that wind generation is variable and thus will require an increase in frequency keeping. While this is true, analysis undertaken by Garrad

Hassan shows that this increase is small. Frequency keeping is required to match load and generation within the 5 minute dispatch period; so it is the 5 minute variability of load (and wind generation) which is of importance. Analysis carried out by Garrad Hassan for the Wind Generation Investigation Project showed that the 5 minute deviation in wind farm output with a once per day return period is approximately +/-40 MW for the largest amount of wind generation modelled (Scenario D, being 2000 MW of additional wind in the North Island). This analysis was also based on the conservative assumption that all wind generation in a region is 100% correlated.² The figure for load variability over 5 minutes is approximately +100/-75 MW.³ Combining the wind and load variation gives a slight increase to +105/-80 MW.⁴ The adequacy of frequency keeping arrangements can also be measured by the number of times the frequency deviates outside its normal band. In 2006 the system frequency deviated outside its normal band 3407 times.⁵ In 2008 the figure was an almost identical 3415 times⁶. During this period, wind generation in New Zealand more than doubled. Thus it is apparent that the increase in wind generation has not caused a decrease in frequency performance (and hence an increased need for frequency keeping) in New Zealand over that time.

3.2 In paragraph 5.14, Mr Leyland asserts that the instantaneous reserves maintained by the system operator will be “used up” by wind generation. In my opinion a large drop off in wind generation should be treated similarly to a contingency suffered by a conventional generator. The reserves are held by the system operator and are not “used” until there is a large drop in generation. Wind generation would not “use” the reserve unless its output suddenly dropped. Following “use” of the reserves caused by a HVDC trip, or a generator trip (or potentially a large sudden drop in wind generation) the system operator has 15 minutes to restore such reserves. Even for the most onerous scenario modelled for the Electricity Commission with the most conservative assumptions, the 10 minute change in output of wind generation is of the order of 110 MW for a return period of once per month.⁷ This is significantly less than the North Island reserves held by the system operator.

3.3 In the third unnumbered paragraph below paragraph 5.14, Mr Leyland claims that the only benefit from the wind farm (apart from a small contribution to peak demand) will be saving

² Garrad Hassan report 2479/PR/0F table 3.6.

³ Garrad Hassan report 2479/PR/0F table 3.10.

⁴ Garrad Hassan report 2479/PR/0F table 3.15.

⁵ Transpower System Performance Report December 2006.

⁶ Transpower System Performance Report December 2008.

⁷ Garrad Hassan report 2479/PR/0F table 3.8

in fossil fuels. I agree that a major (but not the only) benefit of wind farms is saving the burning of fossil fuels (with its associated fuel cost and emission reductions savings). However, Mr Leyland's conclusions in this regard appear to rely on an assumption that up to half the generation from wind farms will be spilled. In my opinion, this would be extremely unlikely, as it would imply spill (hydro or wind) for half the year. In reality, hydro stations are presently only forced to spill excess water for a few days a year.

- 3.4 In paragraph 6.4, Mr Leyland claims that "*no wind farm using modern large wind turbines has been in operation more than four or five years*". While this may be true depending on one's definition of "modern" and "large", it is analogous to saying that no modern car has been in operation for more than four to five years. Wind turbines installed in the 1980s in California are still in operation today. The first MW class wind turbines were installed in the late 1990s and the vast majority of these turbines are still in operation today.
- 3.5 In paragraph 7.8 of his evidence, Mr Leyland notes that the longest wind monitoring records for the site (for masts 7 and 9) are a maximum of about 35 months. However, approximately 3 years of data have been collected from the Turitea site as a whole. I have calculated the uncertainty in assuming that this period is representative of the long term as being less than 4%.
- 3.6 In the same paragraph, Mr Leyland states that a number of the masts have much shorter periods of record. I have correlated the records between the masts. Using these correlations I have synthesized records for all the masts for the full recording period at all of the mast locations. The uncertainty associated with this correlation and synthesis methodology is under 2% at all masts, with the exception of Mast 8, where it is 4%, due to the very short measurement period at this mast to date. This uncertainty is expected to reduce over time.
- 3.7 Finally, I note that the implied system costs of 3.4 c/kWh (comprising backup, frequency keeping and system operation costs) Mr Leyland gives in paragraph 8.2 are significantly higher than other commentators. For example, Ms Melhuish (paragraph 88) quotes Strbac at 0.2 c/kWh to 1 c/kWh. For the reasons already outlined in this evidence, I consider that little (if any) additional frequency keeping or instantaneous reserve will be required as a result of the Turitea wind farm (although I accept that additional fast start reserve may be required).

4. CONCLUSIONS

4.1 In summary, nothing in the evidence presented, and in particular that of Ms Melhuish and Mr Leyland, has required me to reconsider my original conclusions that:

- (a) Wind monitoring has been undertaken at the Turitea site for 3 years and there is a high degree of confidence in the wind resource at the site;
- (b) The wind resource of the exceptional quality of that at the Turitea site is rare;
- (c) The wind resource is a key driver in wind energy costs; and
- (d) Utilising low cost wind energy projects will be key in meeting New Zealand's 90% renewable electricity target.

Philip Wong Too

5 June 2009