

BEFORE THE HURUNUI DISTRICT COUNCIL

IN THE MATTER of the Resource Management Act
1991

AND

IN THE MATTER of an application by Mainpower
New Zealand Limited for
Resource Consent to Establish
the Mt Cass Windfarm

**STATEMENT OF EVIDENCE OF PHILIP WONG TOO ON BEHALF OF
MAINPOWER NEW ZEALAND LIMITED**

INTRODUCTION

1. Qualifications and Experience

1.1 My full name is Philip Wong Too.

1.2 I am a Senior Engineer with Garrad Hassan Pacific Ltd, and have held that position since 2002. Garrad Hassan Pacific Ltd, is an industry leading independent technical and banks consultancy specialising in wind energy.

1.3 From 1996 to 2002, I was employed in PB Power's Wind Power and Developing Technologies Group, giving a total of 12 years experience in the wind industry.

1.4 I am a Chartered Professional Engineer and have a Bachelor of Engineering degree in Natural Resource Engineering with 1st Class Honours, from the University of Canterbury and a Bachelor of Science degree in Physics, from Victoria University of Wellington.

2. Purpose and Scope of Evidence

2.1 The purpose of my evidence is to discuss the following aspects relevant to the Mt Cass application:

- a. The process used by MainPower New Zealand Ltd (MainPower) to identify potential wind farm sites in their area;
- b. Comparison of the wind farm sites identified;
- c. Layouts and energy calculations on the Mt Cass site;
- d. Benefits of geographic diversity in wind generation;
- e. Response to submissions on fire and mechanical failure risk;

f. Conclusions.

3. **Summary**

3.1 Mainpower has used a systematic approach to identify and progress sites that may be suitable for the generation of electricity from wind energy. This has included desktop surveys, computer modelling and measurement programs.

3.2 A significant number of sites have been analysed by MainPower, including wind measurements at nine sites. Garrad Hassan (GH) has analysed this wind data and concluded that of all the sites where wind data has been collected, the Mt Cass site has the highest wind speed and the greatest wind energy resource.

3.3 GH has been involved with creating wind farm layouts for the Mt Cass site. This is a process that involves balancing many different requirements. Throughout this process, MainPower has been focussed on protecting areas of particular ecological significance wherever possible.

3.4 Analysis performed by GH for the Electricity Commission shows that there are benefits to geographic diversity in wind generation. Mt Cass is geographically distant to established wind farms in New Zealand so will add to the geographic diversity of wind generation.

3.5 Like any piece of mechanical or electrical equipment, wind turbines occasionally fail. However, risks to public safety are low. Paul Gipe, a researcher into deaths and injuries in the wind industry, reports that “no passerby or neighbour has been injured by a wind turbine”.

4. **MAINPOWER’S SITE ASSESSMENTS**

4.1 In 2004, MainPower initiated investigations into the electricity generation opportunities in the North Canterbury area. Garrad Hassan were employed by MainPower to look at the wind generation opportunities. As part of this GH identified a number of potential wind generation sites in the North Canterbury region. The Mt Cass site was one of these.

4.2 MainPower has adopted a systematic approach to evaluating potential sites for wind generation. This has consisted of;

- modelling to identify areas with good wind resource;
- desktop studies of sites looking at a number of site features including, wind resource, access to roads and transmission, size and environmental impact;
- obtaining landowner permission at sites that look attractive;
- installing preliminary 10 metre wind measurement masts;
- where preliminary measurements indicated that the wind resource was attractive, installing taller wind measurement masts.

5. **COMPARISON OF SITES IDENTIFIED**

5.1 GH has conducted a review of the sites where MainPower has conducted wind measurements. The review has concentrated on the wind resource and energy generation at the sites, as this is a particular area of GH expertise.

5.2 The review of the wind resource consisted of evaluating the measurements made, removing any seasonal bias in the measurements, and estimating the long term wind speed at each site at a prospective hub height of 80 metres. Of the ten sites that MainPower has collected wind data, the Mt Cass site has the highest average wind speed, with this average wind speed exceeding that of the next best site by approximately 10%.

5.3 Once the estimated hub height wind speeds were established, GH modelled the wind flow over the prospective wind farm sites, created wind turbine layouts for the sites, and modelled the energy generation

of the sites. Again, the Mt Cass site had the highest energy generation per wind turbine installed of all the sites that MainPower has conducted wind modelling. The margin over the next best site was approximately 10%.

- 5.4 In GH experience, almost all wind farm developments that have proceeded in New Zealand are marginally viable, that is revenue is only likely to exceed cost, including the cost of capital, by a small margin. A 10% decrease in energy translates into a 10% decrease in revenue. Since costs are likely to be largely the same on a per wind turbine basis, this 10% change in revenue is likely to be very significant in terms of project viability.

6. LAYOUT AND ENERGY CALCULATIONS AT MT CASS

- 6.1 GH has assisted MainPower in generating layouts and performing energy calculations for the Mt Cass site.
- 6.2 Creating layouts for wind farms often involves the balancing of multiple factors;
- The wind turbines cannot be placed too closely together or else when the turbines are operating in the wake of another turbine, the turbulence will exceed the allowable limit for the turbine. The spacing required varies with a number of factors including the wind turbine size, and the wind direction distribution.
 - The siting of the wind turbines should be in the areas of the site that have the greatest wind resource, wherever possible. However, wake effects from other turbines, which reduce energy production, also have to be taken into account.
 - There may be areas of a site where the wind conditions are not suitable for the installation of wind turbines, due to excessive turbulence or flow separation.
 - The siting has to take into account practical aspects, such as whether there is available room for wind turbine assembly and whether road access to the wind turbine site is practicable.

- There may be areas that need to be avoided for environmental, cultural or other reasons.

- 6.3 Throughout the siting process, MainPower has been focussed on protecting areas of particular ecological significance, wherever possible. This has involved multiple modifications of the layout so that the impact of the wind turbines and the associated civil works avoids or minimises the impacts on the ecological values of the site.
- 6.4 GH has undertaken energy calculations on the Mt Cass sites. These energy calculations are important for not only calculating the economic viability of the site, but also the positive environmental effects. This is because electricity generated at a wind farm will reduce the amount of electricity that has to be generated by other forms of electricity generation, and in many cases those alternative sources would have resulted in the emission of greenhouse gases and other pollutants.
- 6.5 At the Mt Cass site, GH has used information from MainPower's wind monitoring masts at the site to calculate long term wind energy resources at the hub heights of the various wind turbines that are being considered by MainPower. Wind flow modelling has then been used to project these resources over the site.
- 6.6 Following this the performance of various wind turbines and layouts have been modelled in order to calculate the energy production from the various wind turbine models and layouts under consideration, including the wake effects from the wind turbines. Finally, adjustments have been made to take into account factors such as the expected reliability and electrical losses.
- 6.7 The above process has been used to estimate as closely as possible the realistic, expected energy generation from the Mt Cass site for each of the options under consideration by MainPower.

7. GEOGRAPHIC DIVERSITY

- 7.1 GH has conducted work for the Electricity Commission which looked at different scenarios for the development of wind generation in New Zealand. The report was commissioned as part of the Wind Generation Investigation Project (WGIP). The WGIP was initiated after some events occurred with wind generation in the Manawatu that caused concern to the system operator.
- 7.2 Wind generation in the Manawatu is concentrated with approximately 250 MW of wind generation installed over 15 km on essentially what is a single, broad ridgeline. This means that when the wind changes in this relatively small area, there can be relatively large changes in wind generation output.
- 7.3 GH analysed wind data provided from prospective wind farm sites around New Zealand and found that there was significant benefit in geographical diversity. That is, if wind isn't blowing in one area, it is likely to still be blowing in other areas. In addition generation from geographically spread wind farms is likely to be smoother (less subject to rapid changes in output) than wind farms concentrated in a single area.
- 7.4 The Mt Cass site is a significant distance from established wind farming areas in New Zealand, and so will add to the geographic diversity of wind generation in New Zealand if and when it is constructed.

8. CONCERNS OF SUBMITTERS

- 8.1 A number of submitters have raised concerns regarding the proposed wind farm at Mt Cass. Some of these relate to the fire and mechanical risks that the turbines may pose.
- 8.2 Like any piece of mechanical or electrical equipment, wind turbines may occasionally suffer failure or catch on fire.

- 8.3 In the case of fire, the risk is low. There are approximately 800 commercial sized wind turbines in New Zealand and Australia. Of these, GH is aware of a fire occurring in one wind turbine nacelle, and a ground controller fire in two others.
- 8.4 It is usually not practical to fight the fire in the wind turbine nacelle itself, due to the height of the nacelle, instead fire fighters typically concentrate on putting out ground fires that may be caused by falling debris.
- 8.5 The turbines are under constant supervision by SCADA systems, and there is good road access to wind farms, so in the event of a fire in a wind turbine, firefighters should be able to arrive on the site relatively quickly, and the risk of fire spreading is low. In some cases the presence of wind farms has been thought to assist in controlling fires, as wind farm roads act as firebreaks, and provide access for firefighters.
- 8.6 In the case of mechanical risk, wind turbines are subject to wind turbine safety standards such as IEC 61400-1, with assessment of whether particular wind turbine models meet the standards being administered by third parties such as Germanisher Lloyd and DNV.
- 8.7 Wind turbines are fitted with safety systems that operate independently of the control system and can shut down the wind turbine in events such as excessive speed or vibration being detected. Wind turbines are also required to have independent braking systems which are able to bring the turbine to a safe speed in the event of the other system failing to operate.
- 8.8 Risk is further reduced as most of the mechanical components are located in the nacelle, tower or hub, so that if an item comes loose or is dropped it is very likely to be retained within the wind turbine structure.

- 8.9 There are times of increased risk, when it would be prudent for a wind turbine owner to restrict access in the immediate vicinity of the turbines. These include;
- During wind turbine construction
 - During wind turbine maintenance (due to tools and other items being lifted and used at height)
 - When ice or snow builds up on the wind turbines (due to the risk of ice or snow falling from the turbines)
- 8.10 The public safety record of wind turbines is very good. Paul Gipe a commentator, and researcher of accidents in the wind industry, notes that no passerby or neighbour has been injured by a wind turbine. .

9. CONCLUSIONS

- 9.1 MainPower has been investigating wind generation options in the North Canterbury area for some years now. Throughout they have used a measured, systematic approach.
- 9.2 MainPower has instigated wind monitoring at ten sites in the North Canterbury area. Of these sites, Mt Cass has the highest average wind speed. Analysis carried out by GH also shows that the Mt Cass site would produce the most energy for each wind turbine installed.
- 9.3 GH has been involved in creating layouts and performing energy calculations for the Mt Cass site. There are many factors to consider when designing a layout for a wind farm, and MainPower have emphasised the protection of areas of particular ecological significance whenever possible.
- 9.4 Analysis carried out by GH for the electricity commission shows benefits for geographic diversity in wind generation. The Mt Cass site is geographically distant from existing wind farms in New Zealand and therefore will add to geographical diversity of wind generation.
- 9.5 As with any mechanical or electrical machinery, there is a risk of failure or fire in wind turbines. However, wind turbines have multiple safety and monitoring systems, so the risk is low. No neighbour or passerby is known to have been injured by a wind turbine. Despite this, it would be prudent to restrict access to the wind turbines in certain circumstances.

Phillip Wong Too

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