IN THE MATTER of the Resource Management Act 1991

AND

IN THE MATTER of applications to the **WAIKATO DISTRICT COUNCIL** and **WAIKATO REGIONAL COUNCIL** by **WEL NETWORKS LTD** for resource consents to authorise the establishment, operation and maintenance of 28 wind turbines for the generation of electricity and associated activities on the Wharauoroa Plateau near Te Uku

STATEMENT OF EVIDENCE OF RUSSELL KENNETH SHAW

1. INTRODUCTION

Qualifications and Experience

1.1 My name is Russell Kenneth Shaw. I am the General Manager Operations for WEL Networks Ltd (WEL) a position I have held for over 3 years. In this capacity I am responsible for the overall management of the planning, development, operations and maintenance of the WEL electricity network.

1.2 Prior to that I was a Partner at the UMS Group, a consulting firm specialising in utilities and infrastructure businesses, in the Water Business Unity in both Australasia and the United Kingdom for a total of four years. I have also previously been employed as an engineer and project manager at East Midlands Electricity in the UK, which is a regional electricity company which distributes and retailes power to over 2 million consumers.

1.3 I hold an Honours degree of Electronic and Electrical Engineering (Strathclyde University, 1992) a Masters Degree in Engineering Business Management (Warwick University, 2000) and I am a member of IPENZ and IET.

Expert Witness Code of Conduct

1.4 I had been provided with a copy of the code of conduct for expert witnesses contained in the Environment Court's consolidated practice notes 2006. I have read and agree to comply with that code. This evidence is within my area of expertise, except where I state that I am relying upon the specified evidence of another person. I have not omitted to consider material facts known to me that might alter or detract from the opinions that I express.

Involvement in the project

1.5 In my position at WEL I have been involved with transmission issues relating to the proposed wind farm from the outset. I am familiar with all aspects of the local distribution system and the way in which the wind farm will be integrated into the local distribution system.

1.6 I have been involved with all decisions that have been made by WEL with regard to the connection of the wind farm, ensuring that all works proposed fit as best possible to strategic plans for network development in this area.

Purpose and scope of evidence

1.7 The purpose of my evidence is to comment on areas of WEL's network which are relevant to the Te Uku Wind Park, in particular the manner in which electricity generated by the wind farm will be distributed. In doing so, I have taken note of the issues raised by the Council's energy analyst ("Peer review of benefits and positive outcomes of the proposed WEL' wind farm at Te Uku", dated October 2007) and will address the issues raised in that report, particularly in relation to security of supply and transmission line design.

1.8 Specifically, I will:

(a) Briefly describe the national electricity industry structure and how WEL fits in this structure (Section 3);

(b) Provide an overview of WEL's electricity network, how it operates and how projected demand levels in the region are being accommodated (Section 4);

(c) Describe the Raglan part of the network, extension required to accommodate load growth in this area, and how the proposed wind farm will be connected and increase security of supply (Section 5);

(d) Explain how the electricity generated by the Te Uku Wind Park will be distributed where the electricity generated will be utilised (section 6);

(e) Explain the impact of this generation on transmission losses and connection to the national grid (section 7);

(f) Make specific comments in relation to each of Mr Goldthorpe's points relevant to my evidence (section 8).

1.9 A summary of my evidence is included at section 2.

1.10 My evidence needs to be read with that of three other witnesses, namely:

(a) Dr Julian Elder, Chief Executive of WEL, who comments generally on WEL and WEL's corporate and environmental objectives.

(b) Roger Burchett, who will describe the wind farm and its operations in the context of regional and national electricity supply.

(c) Mike Underhill, who was the chief executive of WEL when the project was conceived and was involved in much of the original decision-making and public consultation.

1.11 I am authorised to present this evidence on behalf of WEL.

2. SUMMARY

2.1 The national electricity industry is comprised of generators, a national transmission system ("the National Grid"), a number of the distribution networks, and electricity retailers. There are 28 distribution networks throughout New Zealand. Most are owned by community trusts and incorporate the residual assets of historic power boards. WEL is the fifth largest of these distribution networks and is Trust owned.

2.2 The WEL network encompasses the mid Waikato from Mount Pirongia in the south, to Meremere and Maramarua in the north, and from the coastline in the west to an eastern boundary just to the west of State Highway 27 The network has 18 - 33/11kV zone substations. From these, some 2,105km of lines and 320km of underground cables convey this voltage to 4,455 distribution transformers. From these, a low voltage network comprised of 1035km of overhead lines and 747km of underground cable supplies end use customers.

2.3 WEL is the Waikato region's largest electricity network operator. WEL's network services over 80,000 connected customers with a maximum demand in 2007 of

231.4 MW and annual energy conveyance of 1166 GWh. WEL's customer base has continued to grow and in the 2006 – 2007 financial year an additional 1654 network connections were made, which accounted for an increased load of 13.2 GWh.

2.4 The performance of WEL's network is now delivering a standard of performance much better than that required by regulation.

2.5 The Central Waikato area that is serviced by the WEL network has experienced considerable growth in recent years with average peak load growth over this period of 5%. Load growth for 2006 was 5.82%, with peak load growth in the same year of 15.8% and also with 15% cumulative growth in the 2007 year. This means that either the network needs to be upgraded to accommodate growth, distributed generation needs to be introduced or a combination of both solutions. To address the significant increase in demand on its network area, WEL is very focused on strategic planning

2.6 Within the strategic plan to address future growth WEL has already invested over $40 million to expand the capacity of its network. This includes the construction of six new zone substations with a combined capacity of 106 MVA, and transformer capacity upgrades.

2.7 The wind farm at Te Uku is planned as an integral part of expansion required to address load growth. The wind park will assist in this regard by improving security at the WEL 33kV Te Kowhai point of supply and also the Raglan supply area.

2.8 At present there is only a single 33 kV circuit for most of the route from the National Grid at Te Kowhai to the old substation at Te Uku. If the wind park does not proceed, a second 33/110 kV circuit will be necessary within 10 years. If the wind park does proceed, the second circuit will be built at the same time as the wind park and will have sufficient capacity for both network and wind park purposes.

2.9 The proposed wind park is conveniently placed to attach to this network expansion with a minor (about 3km) deviation from the route that would otherwise be used. WEL takes the view that as this line will be required at a future stage regardless of the wind park progressing. It is therefore appropriate that this line be consented as part of the broader local reinforcement project. As a result WEL has decided to proceed with the line planning independent of the wind park project.

2.10 The wind park will be connected both to the national grid at TeKowhai and the local network at Te Uku. This connection at Te Uku into the Raglan area has the benefits

of improving security of supply, lowering cost at point of supply and offering renewable energy

2.11 Points raised by WDC Energy Analyst, Mr Goldthorpe report "Peer review of benefits and positive outcomes of the proposed WEL' wind farm at Te Uku" are specifically addressed in the closing conclusions of this evidence.

Goldthorpe conclusion

2.12 In conclusion, with respect to Mr Goldthorpe's questions, the important points presented in this evidence are:

(a) Security of supply is enhanced through implementation of the wind park earlier when compared to the planned 33kV WEL Network upgrades.

(b) Regional Transpower Security is marginally enhanced through implementation of the wind park.

(c) Local security of supply is improved through implementation of the wind park and/or through planned WEL Network upgrades. The single line diagrams presented demonstrate this.

(d) Raglan Area growth is a key driver in network security upgrade and is aided by the wind park.

(e) The assertion that most of the power will be used elsewhere on the WEL network including Raglan area is valid.

(f) Wind park and WEL Network stability management using high speed VAR management and protection schemes for line loss contingent events is planned.

(g) The method of energy delivery is addressed in the single line diagrams presented.

(h) Delivery of sub transmission power at 110kV is considered by WEL Network's and other line companies as an established standard.

(i) The new 110kV line is not part of the National Grid and therefore the Transmission Grid Reliability standards do not apply.

(j) A single circuit 110kV line is an acceptable standard for this project.

3. THE NATIONAL ELECTRICITY INDUSTRY STRUCTURE

3.1 The national electricity industry is comprised of generators, a national transmission system ("the National Grid"), a number of the distribution networks, and electricity retailers. (Refer to Slide 1.)

3.2 The national grid transmission system is owned by Transpower Ltd, a State-owned enterprise, and represents a strategic national infrastructure asset. Its function is to convey electricity throughout the country from generation inputs to the distribution networks. It also has the responsibility of ensuring sufficient generation is at all times available to meet national demand, and that the quality of supply meets required standards.

3.3 The major generators and retailers are integrated companies with a number of minor players on both sides. The major generator/retailers are the State-owned enterprises Meridian, Mighty River Power and Genesis, plus the listed companies Contact Energy, and TrustPower.

3.4 There are 28 distribution networks throughout New Zealand. Most are owned by community trusts and incorporate the residual assets of historic power boards. WEL is the fifth largest of these distribution networks and is Trust owned.

3.5 Until 1998, generation, distribution and retail functions were carried out by integrated electricity companies. The Electricity Industry Reform Act 1998 required the separation of electricity networks from generation and retail functions. The purpose of this Act was to prevent cross subsidisation of retail from monopoly lines business, introduce competition at the retail end, and improve industry efficiency.

3.6 Since then amendments to this Act have been relaxed and network operators can now engage in renewable generation in the marketing of that generation, subject to rules that continue to prevent cross subsidisation. The objectives of this relaxation are to make network expansion cost effective, encourage the wider use of renewable energy and promote competition.

4. THE WEL ELECTRICITY DISTRIBUTION NETWORK

4.1 The WEL network encompasses the mid Waikato from Mount Pirongia in the south, to Meremere and Maramarua in the north, and from the coastline in the west to and eastern boundary just to the west of State Highway 1, as shown in the WEL distribution network map. (Refer to Slide 2.)

4.2 This network connects to the National Grid via substations at Meremere, Huntly, Hamilton East, and Te Kowhai. At each of these grid connections, electricity is transformed from extra high grid voltage of 220kV to a sub transmission voltage of 33kV for core distribution across the network. (Refer to Slide 3.)

4.3 In addition to grid connection, a 50 MVA generator to the north of Hamilton City and a number of minor engine-powered generators (gas and diesel) are embedded within WEL's network.

4.4 The network has 18 zone substations which further reduce voltage to 11kV. From these, some 2,105km of lines and 320km of underground cables convey this voltage to 4,455 distribution transformers. From these, a low voltage network comprised of 1035km of overhead lines and 747km of underground cable supplies end use customers.

4.5 In addition, WEL operates 1005 km of feeders which provide street lighting to the Central Waikato region.

4.6 In short, voltage and capacity reduce from the grid connection to the furthest point of supply within a network. Within any network, distances from grid connections can be long and over time become inadequate to service the load that grows along their length. As a result, reliability and quality on these lines diminish. Planning to accommodate future load growth whilst containing capital expenditure within reasonable limits is a challenge for network companies.

4.7 WEL is the Waikato region's largest electricity network operator. WEL's network services over 80,000 connected customers with a maximum demand in 2007 of 231.4 MW and annual energy conveyance of 1166 GWh. WEL's customer base has continued to grow and in the 2006 – 2007 financial year an additional 1654 network connections were made, which accounted for an increased load of 13.2 GWh.

4.8 Strengthening of a distribution network can be done by either increasing network capacity or by installing generation along the line.

4.9 Increasing network capacity is achieved by upgrading to a higher voltage, e.g. 11kV to 33kV, to enable more electricity which has been generated elsewhere to be conveyed to an area which is experiencing growth. This involves re-insulating and re-conductoring existing lines or building new lines, thus enabling higher demand to be met, and can include the construction of new zone substations.

4.10 Installing generation closer to demand is commonly referred to as distributed generation. This avoids the cost of network upgrades which might otherwise be required and avoids transmission losses associated with conveying electricity from distant generation sources. These are fundamental reasons why Government has relaxed industry rules to permit networks to build generation.

Load Growth

4.11 The central Waikato area that is serviced by the WEL network has experienced considerable growth in recent years. As a result, average load growth over the last seven years has been 3.18% per year, with average peak load growth over this period of 5%. Load growth for 2006 was 5.82%, with peak load growth in the same year of 15.8% and also with 15% cumulative growth in the 2007 year. (Refer to Slide 4.)

4.12 On the basis of these recent growth trends, the Hamilton East point of supply will exceed firm capacity (130MVA) around 2011 to 2012 and the Te Kowhai point of supply is already approaching its firm capacity (110MVA). The recent high growth rates have exacerbated this capacity issue. This means that either the network needs to be upgraded to accommodate growth, distributed generation needs to be introduced or a combination of both solutions. (Refer to Slide 5.)

4.13 To address the significant increase in demand on its network area, WEL is very focused on strategic planning and measures that need to be implemented in a timely way to accommodate these trends. When identifying network investment WEL's consideration includes; but is not limited to, activities such as:

(a) rural uses in the area;

(b) existing and proposed residential development;

(c) district plan for the respective area;

(d) light industrial and commercial activities in the area;

(e) proposed roading development;

(f) any proposed territorial boundary changes;

(g) growth rates

(h) potential generation connections and,

(i) existing network assets.

4.14 The changes in both the HCC district plan and WDC district plan for the respective Rotokauri and Horotiu growth cells to cater for intensive industrial, commercial and residential growth will require specific additional network asset investment.

4.15 Following a major review of medium and long-term security of supply within the Central Waikato region undertaken in 2001, WEL planned to expand and improve its network. This recently included working with Transpower to install a new point of supply west of Hamilton at Te Kowhai to ensure that Hamilton City will have two strong supply routes providing long-term security of supply to the city.

4.16 Within the strategic plan to address future growth WEL has already invested over $40 million to expand the capacity of its network. This includes the construction of six new zone substations with a combined capacity of 106 MVA, and transformer capacity upgrades. (Refer to Slide 6.)

4.17 This programme currently has an annual investment in excess of $20 million a year to improve capacity, security, and reliability. Planning includes investment to accommodate load growth in the initial years with asset replacement increasing in subsequent years. (Refer Slide 7.)

4.18 The wind farm at Te Uku is planned as an integral part of expansion required to address load growth. The wind park will assist in this regard by improving security at the Te Kowhai point of supply and the Raglan supply area.

WEL performance profile

4.19 All distribution networks are subject to stringent overview by the Commerce Commission. They are measured by a series of key technical and financial performance indicators which are published.

4.20 These indicators include network performance measured by outage and response times, and indicators that reflect each network's ability to plan and invest in assets that are required to provide robust supply to their distribution area. The latest comparative results are available for the year 2006.

4.21 In terms of investment, WEL is rated fifth of the 28 network companies, which indicates it is both in a high growth area and is addressing investment required to meet this growth into the future. (Refer Slide 8.)

4.22 WEL was recently benchmarked by the Electricity Commission/Commerce Commission as having the second best asset management plan when compared to the compliance requirements for network companies in New Zealand.

4.23 In terms of network performance, measured by minutes the average customer is without power, the network is measured against a regulatory target. WEL has performed better than target and has shown consistent improvement since the measures were introduced. This indicates that the performance of WEL is now delivering a standard of performance much better than that required by regulation. (Refer Slide 9.)

4.24 The published performance statistics clearly demonstrates that WEL is a competent and prudent operator with performance above the national average. In my opinion, this also demonstrates that WEL is well placed to expand its operations into generation.

5. RAGLAN NETWORK EXPANSION AND PROPOSED WINDFARM CONNECTION

5.1 At present there is only a single 33 kV circuit for most of the route from the National Grid at Te Kowhai to the old substation at Te Uku, although there is a double circuit over the deviation section and a recently installed double circuit from Te Uku to Raglan. However, for 26 kilometres of the 40 kilometres from Te Kowhai to Raglan, it is a single circuit.

5.2 If the wind park does not proceed, a second 33/110 kV circuit will be necessary within 10 years. Until then, supply to Raglan is susceptible to a single circuit supply, i.e. if the line goes down, power will be interrupted and can take some time to restore. This is shown in the diagram. (Refer Slides 10 and 11.)

5.3 If the wind park does proceed, the second circuit will be built at the same time as the wind park and will have sufficient capacity for both network and wind park purposes. To do this, the voltage will be increased from 33 to 110kV. The net effect of the wind park on supply to Raglan is to accelerate the construction of the second line and improve security of supply to this area up to eight years earlier than otherwise would occur.

5.4 With or without the wind farm, the line route from grid connection to the zone substation at Raglan will be more or less the same. Whilst the voltage will need to be increased to accommodate wind farm capacity, the difference between 33 kV and 110 kV poles as proposed is not easily distinguished. The 110 kV poles are one to two metres taller and have different insulators, but the difference is small. (Refer slides 12 and 13.)

5.5 The proposed wind park is conveniently placed to attach to this network expansion with a minor (about 3km) deviation from the route that would otherwise be used. WEL takes the view that as this line will be required at a future stage regardless of

the wind park progressing. It is therefore appropriate that this line be consented as part of the broader local reinforcement project. As a result WEL has decided to proceed with the line planning independent of the wind park project. The same reasoning applies to the substation which would be necessary if the wind park proceeds. Approval for the local reinforcement project will be sought by way of designation, as is the case for other significant WEL network projects, such as substations.

5.6 Local underground 33kV cables within the wind park will connect the wind turbines to the substation. The demarcation point between the wind farm and the substation is the boundary of the substation.

6. TE UKU GENERATION AND ENERGY OUTPUT

6.1 As set out in the schematic diagram attached to my evidence the wind park will be connected both to the grid and the local network.

6.2 WEL's customer energy demand exceeds that of the generated output from the proposed wind farm. As the wind park will be connected directly to WEL circuits coming from Te Kowhai it is expected that most of the electricity generated by the wind park would be used within WEL's network.

7. TE UKU GENERATION AND TRANSMISSION EFFECTS

7.1 The National Grid connects generation to load centres throughout New Zealand. Most generation capacity is in the South Island and most population demand in the North Island. It follows that the link between most generation and most demand is therefore a key component of national transmission.

7.2 Energy is lost in any transmission system. The most common analogy for this loss is to compare it to pressure loss in a water pipeline, however where water losses relate to friction, electricity losses and lines in the main part relate to heat loss.

7.3 It follows therefore that generation close to load is the most cost efficient in that it avoids both the capital cost of transmission and losses associated with transmission.

7.4 In the same way that growth within the network can be overcome with distributed generation, the same generation embedded within a network reduces the cost of supply to that network over the grid by reducing loss factors. This reduction in grid losses should flow directly to customers who take supply from the grid point. So in this case, the connection of Te Uku into the Raglan area has the benefits of

improving security of supply, lowering cost at point of supply and offering renewable energy.

8. COMMENTS ON GOLDTHORPE PEER REVIEW

8.1 In this section of my evidence I will specifically address the points raised by Mr Goldthorpe in "Peer review of benefits and positive outcomes of the proposed WEL' wind farm at Te Uku".

Security of supply:

8.2 Implementation of the wind park will provide increased security of supply to the western area through earlier build of the 110kV when compared to the planned 33kV second circuit. (See comparative single line diagrams.) WEL implements a security of supply standard which is internationally benchmarked. This standard does not guarantee 100% security of supply for any of WEL customers. The majority of outages on the WEL network relate to 3rd party damages e.g. cars hitting power poles.

Regional security

8.3 It was requested that WEL seek confirmation from Transpower as to whether it would enhance Transpower's ability to provide a secure electricity supply at the grid exit points in the Waikato region. WEL has not sought this confirmation because in previous discussions with Transpower it has been clearly communicated to WEL that any additional loading on this line significantly impacts Transpower's ability to maintain a secure supply to Auckland customers. It is WEL's view that the availability of additional capacity of the Wind Park connected either directly to WEL's network or through the Transpower substation will alleviate limited line capacity.

Local security of supply.

8.4 Single line diagrams presented earlier in this evidence demonstrate the change in supply arrangements. (Refer Slides 14 and 15.)

8.5 While the average demand to Raglan is indeed approximately 2.5MW, WEL is required to meet peak demand consumptions. Peak demand for the Raglan area is currently 5MW and rapid growth is being experienced. WDC district plan for Lorenzen Bay Structure Plan and Raglan Structure Plan change and other growth requires network asset investment. This will install upwards of 1200 connections at

the end of this line. The assertion that most of the power will be used elsewhere on the WEL network is valid.

8.6 In terms of the requirements to significantly strengthen the network to ensure that local security of supply is not reduced we do not share the views of the Energy Analyst. As part of the Wind Park installation special provisions are planned for stability management using high speed VAR management and protection schemes for line loss contingent events. These management schemes have been developed and installed at many such generation facilities and as such are viewed as standard network elements. We do not believe that the connection of a wind park will result in increasing failures of electricity distribution equipment.

8.7 The requested information on how the energy will be delivered to consumers from the wind park has already been addressed. Additional infrastructure options are shown in the single line diagram below. Confirmation of these options is subject to detailed design and planning as well as negotiation with Transpower and landowners. (Refer Slide 16.)

8.8 At full Wind Park output and low network load then export of energy may occur. However it is expected that the bulk of transmitted energy will be utilised in the WEL network.

Security of supply west of Hamilton

8.9 Historically distribution voltages were 33kV and 11kV. Recent rapid growth has dictated consideration of higher voltages to increase the volume of energy that can be distributed over the same line. The effect of this is a movement from 33kV to 110kV and from 11kV to 22kV. Counties Power for example is undergoing a significant upgrade project across their network. WEL currently has no 110kV or 22kV assets; however it is a natural progression for WEL to move across to these voltages. This is already planned for some parts of the network, in particular for remote rural consumers.

8.10 New infrastructure is shown in the single line diagram presented above.

Transmission

8.11 WEL can confirm that a new electricity line operating at 110kV will be required to deliver the energy from the Wind Park. This new infrastructure is shown in the single line diagram presented in above.

8.12 WEL was asked to clarify whether the proposed infrastructure would comply with the Grid Reliability Standard. WEL can confirm that the proposed infrastructure will not comply with the Grid Reliability Standard. This is because it is not part of the Grid that to which that standard applies. The Transmission Grid Reliability standards do not apply

8.13 In relation to the connection to the Te Kowhai grid exit point this information has already been covered.

8.14 Connection to the existing 110kV circuits around Hamilton have been considered. However due to the high costs of underground cables in the urban area and as overhead lines are not permitted in the district plan this option was discounted. In our view this would not provide cost effective security enhancements to Hamilton West.

8.15 Single circuit 110kV lines are not as secure as double circuit as there are less conductors. However in this case a single circuit line is an acceptable standard for this project. If the line was to fail, then the wind park generation would be limited to the capacity of the 33kV network connected locally of approximately 20MW. A twin circuit on a tower would provide a greater level of security. However, in our view this marginal increase comes at significant additional cost and environmental impact.

Russell Shaw
November 2007