BEFORE THE CANTERBURY REGIONAL COUNCIL

IN THE MATTER of the Resource Management Act 1991

AND

IN THE MATTER OF the Proposed Canterbury Air Regional Plan (pCARP)

BETWEEN **ORION NEW ZEALAND LIMITED**

AND **CANTERBURY REGIONAL COUNCIL**

STATEMENT OF EVIDENCE OF STEPHEN JOHN GODFREY
ON BEHALF OF ORION NEW ZEALAND LIMITED

18 SEPTEMBER 2015

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1. INTRODUCTION

1.1 My full name is Stephen John Godfrey.

1.2 I am the Energy Projects Manager at Orion and have worked for Orion for over 16 years. In that role I work closely with the Network Asset Management team and have been involved in consenting processes for diesel generators, earthquake emergency management work and planning for low hydro lake levels.

2. CODE OF CONDUCT

2.1 I confirm that I have read the "Code of Conduct for Expert Witnesses' contained in the Environment Court Consolidated practice Note 2014. I agree to comply with this code of conduct. In particular, unless I state otherwise, this evidence is within my sphere of expertise and I have not omitted to consider material facts known to me that might alter or detract from the opinions I express.

3. SCOPE OF EVIDENCE

3.1 My evidence will:

a) provide background on the electricity industry and Orion's place within it;
b) summarise the importance of peak electricity network load management;
c) summarise how peak electricity network load management works;
d) explain why peak electricity network load management benefits the community during emergencies;
e) summarise the emergency times, other than for peak electricity network load management, when generators are valuable to the community; and
f) explain why mobile generation is needed and valued by the community.

4. THE ELECTRICITY INDUSTRY AND ORION'S PLACE IN IT

4.1 The efficient transmission and distribution of electricity plays a vital role in the well-being of New Zealand, its people and the environment.

4.2 In New Zealand, electricity produced by generation companies at various hydro, wind, geothermal etc plants is transmitted by the national grid operator, Transpower, to network operators like Orion.

4.3 Orion operates the local electricity network in Central Canterbury between the Waimakariri and Rakaia rivers. Orion's shareholders are the Christchurch City Council and the Selwyn

District Council.

4.4 Orion takes delivery of the electricity from Transpower's network at various points in Transpower's network known as Grid Exit Points (GXPs). After receipt of electricity at GXPs, Orion then delivers that electricity through its network to homes and businesses on behalf of electricity retailers who purchase the electricity from generators on the wholesale market and sell it to customers.

4.5 Orion's urban Christchurch network has approximately 160,000 customer connections – homes and businesses.

4.6 In recognition of the role Orion plays to ensure distribution of a reliable and secure supply of electricity to Christchurch and Central Canterbury, and Orion's role in keeping the economy running and improving the community's well-being, Orion is a Lifeline Utility as named in the Civil Defense Emergency Management Act 2002 (CDEM Act). The CDEM Act informs the National CDEM Strategy which outlines a vision for a resilient New Zealand and recognises that lifeline utility resilience contributes strongly to community resilience.

4.7 Under the CDEM Act, Orion is required to ensure it is able to function to the fullest possible extent, even though this may be at a reduced level, during and after an emergency.

4.8 In recognition of the importance of its role, Orion has for over 20 years actively participated in the Canterbury Lifelines Utility Group, and in its predecessor group, with one of its senior managers currently Chair of the Group. Orion continues to play an important role in the identification of vulnerabilities to the community.

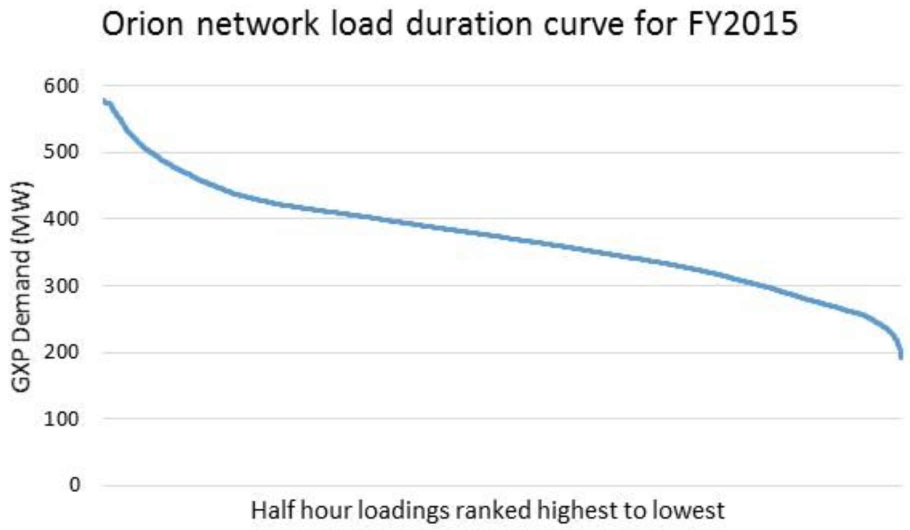
5. PEAK ELECTRICITY NETWORK LOAD MANAGEMENT

5.1 The term 'peak electricity network load management', alternatively called 'load shedding', refers to the ways in which electricity load on the network is reduced at peak times. Orion undertakes load shedding to avoid or delay the need to build new network.

5.2 Peak electrical load on the Orion network typically occurs in the Christchurch urban area and around the high country (Arthur's Pass) during winter, due to additional heating; and in summer over the remainder of Orion's network, due to rural irrigation pumps. Because of this, any load shedding that occurs in the rural area does not contribute to high pollution levels in winter. I shall therefore limit the remainder of my discussion to the urban Christchurch area.

5.3 If electricity demand increases too much in Christchurch in winter, then Orion's electricity network runs the risk of overloading, with a worst case result being an electricity outage.

5.4 High peak electricity demands can be met by increasing the size of Orion's distribution network. This naturally requires capital expenditure which leads to increased costs/prices for electricity consumers. Also the additional assets invested in would only be used for a short period of time, as for the remainder of the year these assets would generally not be utilised. This limited use is because the network only 'peaks' for a limited number of hours each year.



5.5 It is not considered by Orion, or its owners, to be in the public's best interest to spend a significant sum of money for additional assets which will only be utilised for a very short period of time given that load shedding' can be used to avoid network overloading at peak times.

5.6 Load shedding is generally achieved by the following two methods:

i. One method is to turn off 'non-essential' electrical appliances that are on at the time, when the network is heavily loaded. For example, Orion has operated direct control of domestic hot water cylinders for many years. Electrical hot water cylinders connected to Orion's ripple relay system can be turned off for a certain length of time during a peak load period. Orion is able to turn off over approximately 90% of Christchurch's domestic hot water cylinders that would otherwise operate during peak load times.

ii. The second method is to operate generators. Using generators at peak times reduces electrical load on Orion's network (as the generators generate electricity on-site rather than drawing it off Orion's system), thereby *"freeing up"* space on the network.

5.7 Orion only sheds load for a limited period of time (we target 80 to 100 hours per annum, although typically a lessor number of hours occurs*)* because, as discussed in point 5.4, Orion's network only 'peaks' for a limited number of hours per annum.

5.8 Weather conditions typically dictate when Orion's network load peaks, and when we consequently look to load shed. Load shedding typically occurs only in the colder months of May through August, and the majority of load shedding does not occur on 'smoggy days'. This is because Christchurch's coldest winter days are typically days when southerlies hit the city as opposed to the clear still days associated with high air pollution.

5.9 Over the last three years less than 20% of the high air pollution nights[1] have coincided with a day that Orion sheds load via the use of diesel generators. On those days that have coincided, the load shedding has occurred for less than two hours in the morning, and has been finished by 9.30am.

6. HOW LOAD SHEDDING WORKS

6.1 Load shedding occurs when the instantaneous network load for the urban area reaches a predetermined target set by Orion. Once actual network load goes above this level, Orion's load management software switches off domestic hot water cylinders using ripple signals (ripple signals are signals sent out over the power lines and cables).

6.2 If Orion's load management software calculates that domestic hot water control will be insufficient to guarantee that the increasing network load will be maintained at manageable levels, a warning signal is sent to a group of large electricity users or 'major customers' (the signal is sent via ripple control and other means such as text messaging). This warning signal alerts the major customers that a high price period or 'control period' will be starting in a few minutes time. Later a second signal is issued which indicates to major customers that a control period has commenced. Once the network load begins to drop to a level nearing the predetermined target, a final signal is sent indicating that the control period has ended.

6.3 When a control period starts, major customers react in various ways. They may:

i. do nothing

ii. turn off heating, freezers or other *"unnecessary"* electrical loads

iii. switch on alternative fuels, for example some hotels switch on gas heating

[1] As measured at St Albans

iv. turn on generators and generate some or all of their required electricity on-site rather than take electricity off the Orion system

v. turn on generators, and if they generate more electricity than they require, 'export' the excess electricity they generate back into the Orion system.

6.4 Major customers react in these ways because Orion's pricing is very high[2] during control periods; it is significantly greater than the costs of running a diesel generator.

6.5 It is estimated that around 20MW of generation is turned on by major customers during control periods.

6.6 It should be noted that it is generally not economic to operate diesel generators outside of control periods. The normal cost of electricity at times outside of control periods is significantly less than the cost of running a diesel generator.

6.7 It is also not yet economic to use alternatives such as large industrial scale batteries. It is likely to be a number of years, in the most optimistic scenario, before batteries are economic in this situation.

7. LOAD SHEDDING SAVES THE COMMUNITY COST

7.1 If load shedding didn't occur, the businesses that respond to Orion's signals would face higher costs.

7.2 For those businesses, these higher costs will impact upon their profitability, and possibly result in lost orders. This will in turn negatively affect Canterbury from a reduced flow of money in the community and potentially lead to job losses. For those users of generators that are public bodies (such as hospitals, police, university, CCC, Christchurch airport etc) the higher costs associated with not being able to generate during control periods would presumably divert funds from other activities these bodies (or their owners) use their funds for.

7.3 The financial cost to major customers, to effectively pay to expand the network to supply this additional load (estimated at 20MW) if load shedding via generators didn't occur, is conservatively estimated to be approximately $25m.

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[2] The price charged by Orion during control periods is equivalent to the long run marginal cost of delivering electricity to major customers. That is, it approximates the cost of upgrading Orion's network if we have to increase electricity supply to these customers plus 'peak' charges to Transpower.
In simple terms, if a customer uses electricity at peak times Orion can use the received from the customer to build the necessary new network. If the customer chooses not to use electricity, Orion receives no additional revenue but does not have to build new network.

7.4 Of the estimated 20MW of generation that currently operates during control periods, about half is operated by public bodies.

7.5 Given the cost to the community if load shedding via the use of diesel generators wasn't available, and given the low coincidence between load shedding days/hours and high pollution nights, not permitting load shedding would be a very inefficient way to reduce air pollution.

7.6 Orion therefore supports the proposed plan rules in regards to allowing diesel generators to be used for load shedding, or as the plan calls it or 'peak electricity network load management', subject to appropriate conditions.

7.7 We also note that not allowing generators to respond to Orion's load shedding signals, would slightly reduce the reliability of Orion's network for a period of time.

7.8 This is because if load shedding by generators was not allowed, the spare capacity that Orion has on some of its existing equipment that serves both customers that operate the generators as well as homes and businesses, will be reduced. This reduction in spare capacity will bring forward the need to invest in new equipment. Depending on the timing and the length of advance notice Orion have of the removal of load shedding, the reliability of the electricity network will be compromised in the intervening time.

7.9 Network construction is not an instantaneous process as timing depends greatly on what sort of equipment is needed and the order times associated with the delivery of such equipment. For instance the order time for new transformers can be around a year. Orion estimates that the removal of load shedding would negatively affect the reliability of parts of the network for a period of one to two years, namely until we had time to replace load shedding capacity with new network infrastructure.

8. LOAD SHEDDING POSITIVELY AFFECTS EMERGENCY AVAILABILITY

8.1 Orion considers that the importance of available, well maintained synchronised generators in times of emergency is intrinsically linked to the use of generators for load shedding. If generators are not allowed to be used for load shedding then Orion believes that, in the event of an emergency, these generators will be more likely to mechanically fail, thereby seriously jeopardising the wellbeing of the region's constituents (with the possibility of life threatening consequences) and also delay the re-supply of other non-essential loads (eg homes) in an emergency.

8.2 In order for generators to operate effectively in times of emergency they need to be installed, synchronised and carefully maintained. At present, there is a very real, financial incentive for customers to install and maintain synchronised generators. In the absence of a strong yearly financial incentive for customers, it is possible that the requisite time and money will not be invested into maintaining generators solely for times of emergency.

8.3 Aside from providing a financial incentive to properly maintain generators, the use of generators for load shedding results in a different engineering configuration of the generators on-site at a customer premise. If a generator is used for load shedding the generator is synchronised into (i.e. joined in with) Orion's system, and because of this the generator has additional electrical load 'running through' it. If a generator is not used for load shedding it is a standalone system. The benefit of a generator being synchronised is that because the generator has additional electrical load running through it, the generator will typically be more robust and not so prone to malfunction when needed for use. In other words, even if equal maintenance dollars were applied to a synchronised generator and a standalone generator, the synchronised generator would be expected to have less failures when needed for emergency purposes.

8.4 An example of the impact of poor maintenance of generators occurred in Auckland during their 1998 electricity crisis.

8.5 Electricity pricing signals in Auckland, unlike those of Orion, do not give a financial incentive to businesses to operate their generators during times of high electricity demand. As a result Auckland businesses maintain generators only for backup purposes during times of emergency and generators are not synchronised.

8.6 During the 1998 electricity crisis it was found that many users struggled to ensure power was maintained via their generators. For instance one user, who would provide a crucial role in any civil defence emergency, started off the crisis with nine generators. By the end of the crisis it is understood that only four generators were operating. The other five generators had all broken down at some stage.

8.7 Therefore Orion strongly believes that the ability of some generators to operate during emergencies would be affected if load shedding is not allowed. This in turn may seriously jeopardise the wellbeing of the region's constituents (with the possibility of life threatening consequences) and also delay the re-supply of other non-essential loads (e.g. homes) in an emergency.

9. EMERGENCY USE

9.1 The benefit of emergency electricity generation, during times when network electricity supply is not available to a home or business, is reasonable obvious and understandable given the importance of electricity to modern society.

9.2 However, given the nature of the electricity network, locally and nationally, the need for and value of 'emergency electricity generation' is not limited to those times when network electricity supply to the generator user has failed.

9.3 Orion submits that emergency use of generators should be permitted when:

i. There is either a failure in the national grid or the Orion network which means that network electricity supply is not available at the location of the generator

ii. There is either a failure in the national grid or the Orion network which means that network electricity supply is not available at a location that is not the same as the location of the generator

iii. during times when network generation capacity is significantly reduced due to meteorological conditions (i.e. dry lakes), and

iv. during times of natural disaster.

10. GENERATING WHEN NETWORK ELECTRICITY SUPPLY IS STILL AVAILABLE

10.1 As previously mentioned, it is generally not economic to operate diesel generators outside of control periods. The normal cost of electricity at times outside of control periods is significantly less expensive than the cost of running a diesel generator. Major customers generally pay around 10 cents per kWh for energy purchased from an electricity retailer; diesel generation is more like 40 cents per kWh for the marginal cost of running a generator (diesel and maintenance).

10.2 In the future, with the improving sophistication of network management systems, it is possible that Orion, or even another party, may pay a major customer to operate a diesel generator even if network electricity supply is still available to that customer.

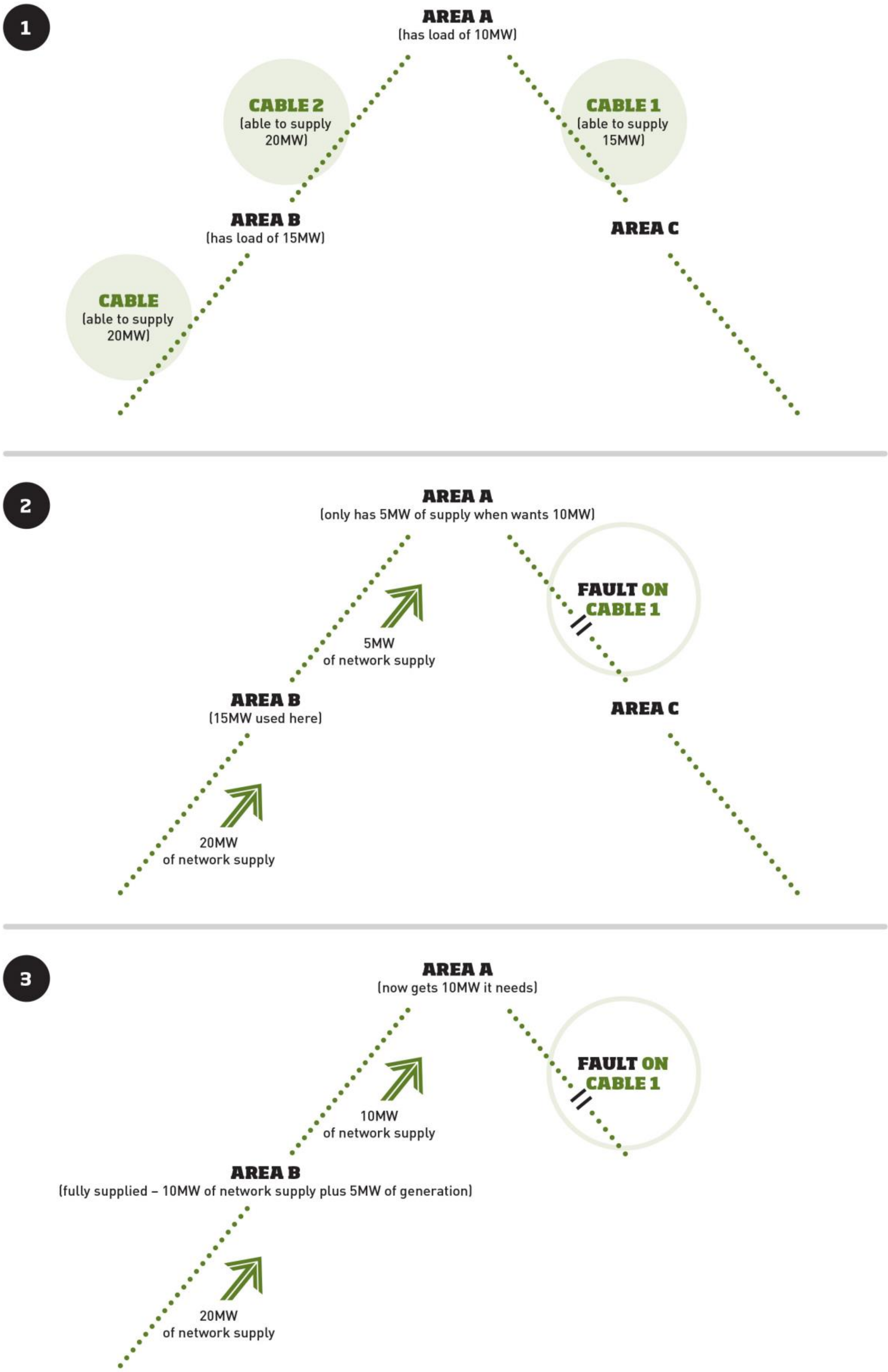
10.3 This is due to the interconnected nature of Orion's urban electricity network. We have designed the high voltage network in what is known as an interconnected ring formation.

10.4 In other words we have designed the urban electricity network so that each 'area' (which may cover one or a few suburbs) of the network has two or more high voltage lines/cables coming into it. This increases the security of power supply as, if one large cable or line fails, supply can continue from another direction. This interconnected ring system helps reduce the impact of any one outage.

10.5 However, with this system, given other possible constraints on the network, it may be beneficial for a diesel generator to run in one part of Orion's network, even if network supply to that customer is unaffected, to help provide electricity to another part of the network that is experiencing a fault. This perhaps best demonstrated graphically.

10.6 The graphic overleaf show a hypothetical situation where diesel generation at Area B, helps Area A have full supply in the event of an outage occurring on a cable that supplies Area A.

10.7 This example hopefully helps show why it may be beneficial for a diesel generator to run in one part of Orion's network, even if network supply to that customer is unaffected. Orion believes the Plan rules should allow for this to happen, without delay due to a need to obtain a consent.


1
AREA A
(has load of 10MW)
CABLE 2
(able to supply 20MW)
CABLE 1
(able to supply 15MW)
AREA B
(has load of 15MW)
AREA C
CABLE
(able to supply 20MW)
2
AREA A
(only has 5MW of supply when wants 10MW)
FAULT ON CABLE 1
5MW
of network supply
AREA B
(15MW used here)
AREA C
20MW
of network supply
3
AREA A
(now gets 10MW it needs)
FAULT ON CABLE 1
10MW
of network supply
AREA B
(fully supplied – 10MW of network supply plus 5MW of generation)
20MW
of network supply

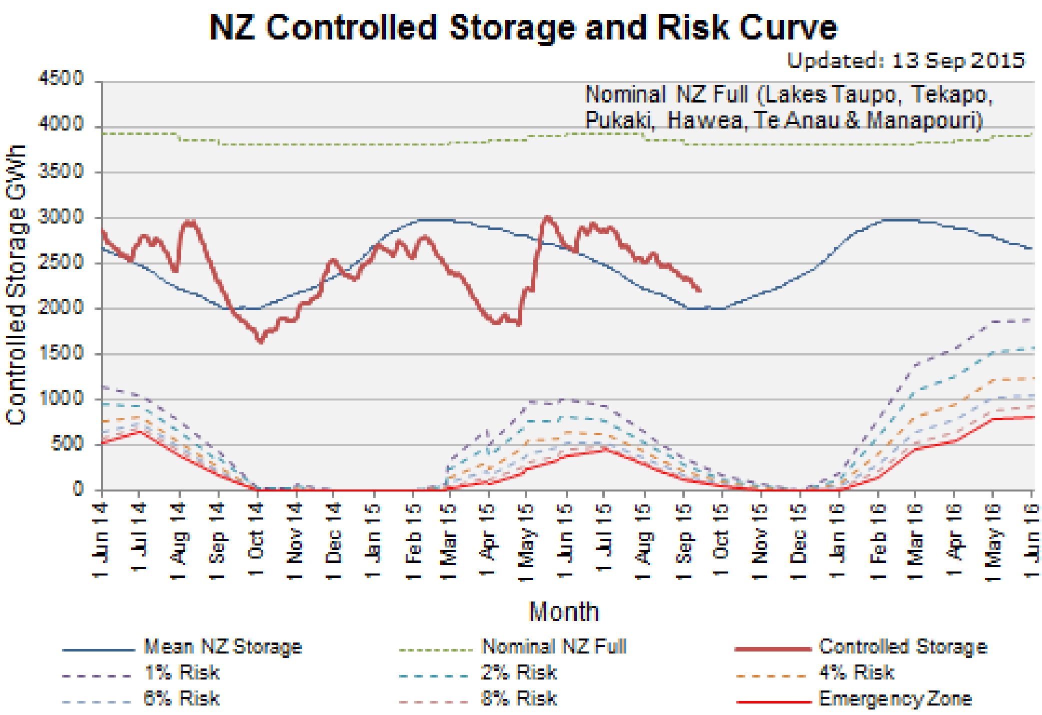
11. DRY LAKES

11.1 Hydroelectric generation contributes around 60% of New Zealand's total electricity supply, with many generators of widely varying sizes distributed throughout the country.

11.2 Inflows (rainfall and snowmelt) can be stored in hydro lakes until needed. The most important are Lakes Pukaki, Tekapo, Hawea, Manapouri, Te Anau, and Taupo. Some lakes have quite limited operating ranges – for technical and resource consent reasons, and each lake's level cannot be lowered below a certain point.

11.3 New Zealand has low hydro storage capacity compared to other countries that also have a high reliance on hydro generation. In the absence of inflows, the lakes can only hold enough water for a few weeks (around five) of winter energy demand.

11.4 Given this susceptibility, the electricity industry regularly monitors short-term security and publishes comparisons of storage in the hydro lakes against 'Hydro Risk Curves' that measure the risk of running out of water (given the uncertainty about inflows to key hydro lakes) and projections of the likely range of changes in hydro lake levels over the months to come. An example of this is shown below which compares recent hydro storage to electricity industry Hydro Risk Curves.



11.5 On the Hydro Risk Curve graph, the amount of potential energy stored in the hydro lakes is shown on the y-axis (in GWh). The x-axis shows the time of year. Storage is tracked over time – as lake levels rise, the trace moves up the graph.

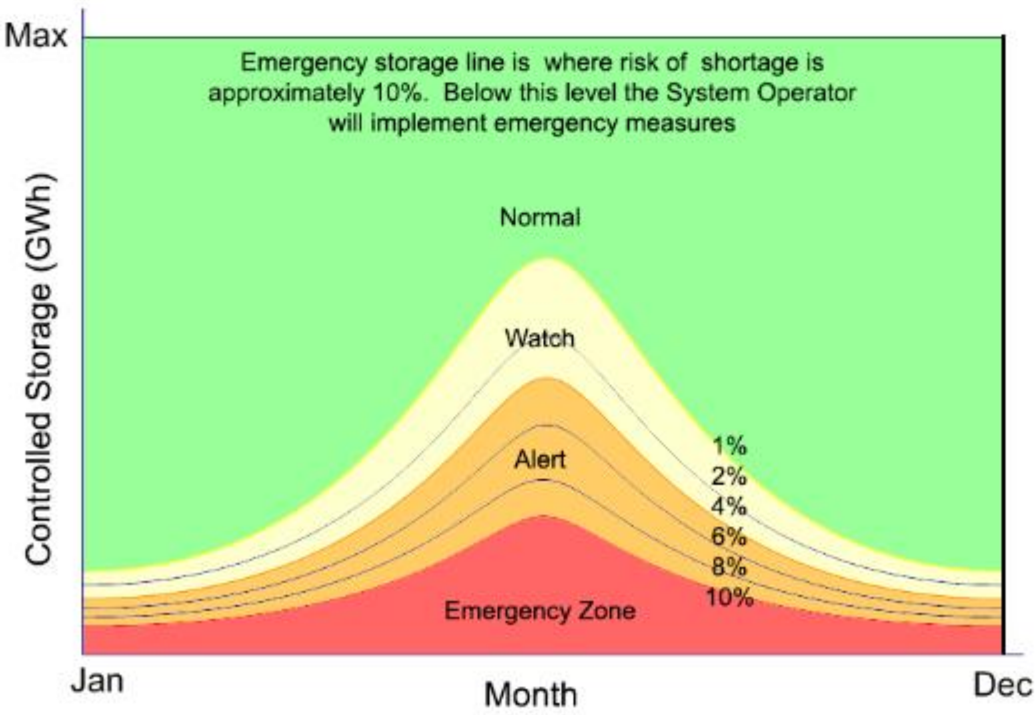
11.6 When storage is above the dashed lines, there is no reason to expect energy shortages in the short to medium term (though the situation can change rapidly if generating plant or transmission equipment fails).

11.7 When the storage trace falls below the top dashed line, the security level changes to reflect increased risk. At the X% line, there is an X% chance of lake storage falling to the zero line later in the season, based on the historical record of lake inflows.

11.8 For instance, if storage falls below the 10% risk curve, one in ten historical inflow sequences from the last 80 years would lead to storage running out.

11.9 In large part, the industry's emergency response plan is based on these risk curves. When storage is above the dashed lines, the status is Security Normal. The 1% line marks Security Watch status, and 4% is Security Alert.

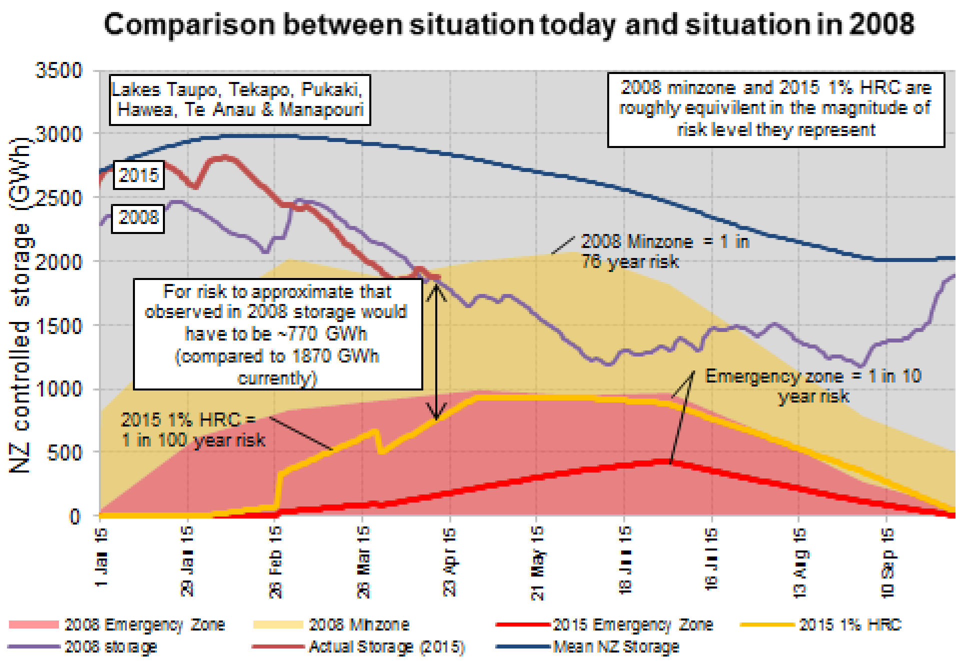
11.10 The 10% risk curve is called the 'emergency zone'. To date it has not been crossed.



11.11 The likelihood of an Emergency Zone breach is minimal, but not zero.

11.12 There have been risks of widespread shortages in some years, as a result of extended periods of low inflows into key hydro lakes. These 'dry years' included 2001, 2003, 2006 and 2008. However, in none of these years have we breached the Emergency Zone.

11.13 The chart overleaf shows, the risk of electricity shortage has dropped significantly since 2008. This is predominantly due to a large amount of base load generation, in the form of geothermal and wind energy, which came online in the last 6-7 years. At the same time electricity demand has remained relatively flat.



11.14 In essence this means the NZ power system is less exposed to the risk of low hydro inflows than it was in 2008. Both geothermal and wind resources are relatively reliable on a month to month basis (yes, even wind) so their increased presence in the power system has reduced the reliance on hydro generation, and diluted the inherent volatility present within the system.

11.15 However this conclusion must be tempered by a number of caveats. First, only a relatively small sample of historical inflows is used in the analysis (83 years, a small sample in probability terms) and therefore underlying inflow probability distribution may not be properly understood. There is always the chance an unprecedented inflow sequence that results in an extremely dry situation can eventuate.

11.16 Secondly, inaccuracies may be present within the input assumptions; demand growth could be underestimated, expectations around how generators will use their fuel sources (including water) could be incorrect or it is possible there are other errors in the input assumptions (which can easily happen when modelling a system as complicated as an electricity system). These issues also mean the projected distribution of storages could be incorrect and the state of the current situation is being underestimated.

11.17 Consequently, we cannot rule out completely the possibility of electricity shortage at some point in the future.

11.18 Without the benefit of a crystal ball, it is difficult to know exactly what the impact of any entry into the Emergency Zone would be. Quite simply as New Zealand has never entered it we do not have any experience to guide us.

11.19 However, obviously if we enter this zone there is the very real likelihood that power cuts (first planned outages and then unplanned) will occur. Rolling 'planned' outages would be used to stave off the possibility of unplanned blackouts occurring. Unplanned cuts could last for days/weeks if the hydro situation continued to deteriorate, particularly in the South Island where we are heavily dependent on hydro storage given the capacity limitations of inter-island electricity transfer.

11.20 Certainly when we last experienced 'dry years', the industry tried to utilise diesel generation capacity as much as possible early on (i.e. before the risk curves were actually breached). This was a prudent approach ('better safe than sorry' when it comes to such an important resource) which I would imagine would occur again in the future if we once again get into a risk of shortage.

11.21 The value of diesel generation in a hydro shortage situation has also increased with the announcements, in the last year or so, of the decommissioning of several large thermal plants in the New Zealand system – Huntly, Otahuhu, and Southdown. The impact of the plants withdrawal on dry-year electricity system management has yet to be fully worked through, but the impact without doubt increases the importance of diesel generation.

11.22 Orion therefore argues that the Plan should allow for generation to be used where network generation capacity is significantly reduced due to meteorological conditions. To not be able to do so easily, and to need to go through a consenting process which would perhaps delay the use of generators and fail to improve the situation, seems overly bureaucratic.

12. NATURAL DISASTERS

12.1 The Canterbury earthquakes demonstrated how vital electricity supply is. The simple reality is that today it is an essential item for the community and availability of it is crucial. Lives depend on it.

12.2 As such, the plan should allow for the use of generation during natural disasters in a clear and un-ambiguous manner.

13. MOBILE GENERATION

13.1 Orion seeks that emergency mobile electricity generation activities are exempt from conditions in relation to the length of time they are able to operate (close to, or away from a sensitive activity).

13.2 Orion's experience heavily points to the public being far more concerned about having power at their property, than being concerned with limited noise/pollution from a nearby generator.

13.3 After the February earthquake, Orion used 28 mobile generators, primarily in the eastern suburbs. We estimate that in total 10,000 people received electricity supply from an Orion mobile generator (be it a truck or containerised generator) at some point.

13.4 The longest a generator was in place was 10 days.

13.5 Nearly all generators were placed next to a sensitive activity – typically residential housing – and nearly always within 50m.

13.6 Despite the number of generators, the length in service and the location near sensitive activities, the only 'complaint' we received about their use was from one neighbour who advised us of a loose exhaust flap. This was promptly tightened up and the neighbour was again happy.

13.7 We found the neighbours directly adjoining the generators to indeed be 'protective' of the generators and they ensured that no-one sought to interfere with the generators nor their fuel supply. They realised the importance of the generators to themselves and the community.

13.8 Whilst, the mobile generators were able to be placed near sensitive activities after the earthquake for significant lengths of time without prior Environment Canterbury consent, this was because a Civil Defence emergency had been called. In the future, there may be an 'emergency' that doesn't reach the Civil Defence benchmark, and consequently we will need to abide by the Air Plan rules.

13.9 Such rules should, Orion considers, therefore reflect the reality that the vast majority of people without power welcome mobile diesel generation, even if placed right next to their property, if it means electricity is again supplied.