# QUALITY PERFORMANCE REPORT 07/08

*Keeping the energy flowing*

TRANSPOWER

Transpower New Zealand Ltd The National Grid

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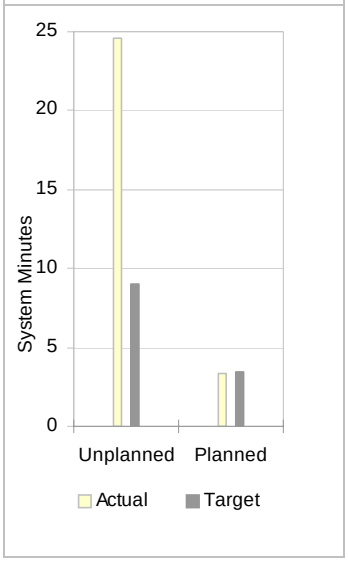
# Highlights

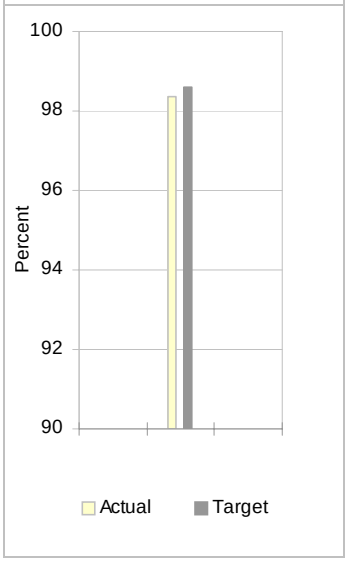
Targets for HVAC and HVDC Availability and Unplanned Supply Interruptions as set out in the Transpower Statement of Corporate Intent and the actual performance for 2007/08 are summarised :-

| | Actual | Target |
|---|---|---|
| **Interruptions to Supply - System Minutes** | | |
| - Unplanned | 24.6[1] | < 9.0 |
| - Planned | 3.3 | 3.4 |
| | | |
| **High Voltage Alternating Current (HVAC) Circuit Availability** | 98.4% | 98.6% |
| | | |
| **High Voltage Direct Current (HVDC) Link Availability** | | |
| Bipole | - %[2] | 91.5% |
| - Pole 1 | - % | 88.9% |
| - Pole 2 | 98.6% | 94.4% |
| **Operating Statistics** | | |
| Energy Injected into the Grid | 39,725 GWh | |
| Energy Supplied from the Grid | 38,272 GWh | |
| Energy Transferred by HVDC link (both directions) | 2,056 GWh | |
| System Maximum Demand | 6,635 MW | |

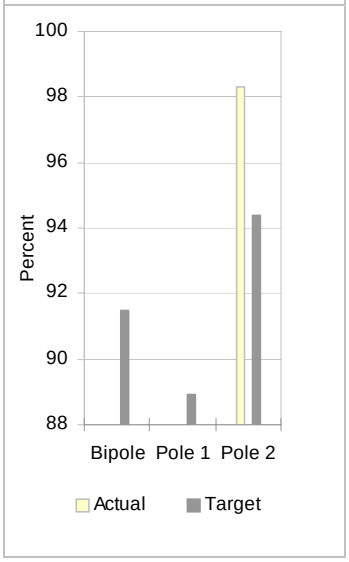
**Interruptions To Supply**




**High Voltage Alternating Current (HVAC) Circuit Availability**




**High Voltage Direct Current (HVDC) Link Availability**




[1] Including 15.7 system minutes for two specific incidents where factors not totally attributable to Transpower had a significant impact.

[2] HVDC Pole 1 was stood down in September 2007. Up until September HVDC Pole 1 Availability was 91.1%. Half of Pole 1 is now available only for grid emergencies.

# Introduction

This is Transpower New Zealand Limited's 17th annual Quality Performance Report. It sets out operational performance data that enables Transpower's stakeholders to make an assessment of the company's performance against measures incorporated in the company's Statement of Corporate Intent.

As in previous years, the 2007/08 report details High Voltage Alternating Current (HVAC) and High Voltage Direct Current (HVDC) availability, performance at specific points of supply on the grid, and accounts for any significant losses of supply. The report also includes performance information that the company is required to disclose as per The Electricity Information Disclosure Requirements 2004 for the 12 months to 30 June 2008.

Although Transpower continued to achieve a high level of overall performance, it did not meet some of its performance measures set out in the 2007/08 Statement of Corporate Intent. The target of 9.0 system minutes for unplanned interruptions was exceeded, primarily because of two major and unusual incidents involving large industrial customers, which contributed 18.0 of the total of 24.6 system minutes. As a result of unusual circumstances related to these two incidents, Transpower considers that 15.7 system minutes of the total were due to factors not totally attributable to Transpower.

HVAC availability of 98.4% did not meet the target of 98.6% because of a greater than expected number of outages required to provide system splits for system security purposes during outages of other equipment. Approximately 0.16% of unplanned unavailability was attributable to outages associated with the failure of an interconnector transformer at Marsden.

In September 2007, HVDC Pole 1 was stood down because of condition-related risk management concerns and therefore the target for HVDC Bipole availability could not be met. However, Pole 2 has performed very well, and with an availability of 98.6% has exceeded its target of 94.4%.

The energy transmitted during 2007/08 increased by 1.5 percent to 39,725 GWh compared to 39,128 GWh for the previous year. The system peak load of 6,635 MW was recorded at 5:30pm on 16 July 2007, and was 1.1 percent lower than the peak of 6,707 MW recorded for 2006/07.

As the result of the low South Island hydro inflows during the year, the net energy transfer across the HVDC link between the North and South Islands was lower than for 2006/07. A total of 1,341 GWh was transmitted northwards across the link compared with the previous year's total of 2,393 GWh. Southwards transfer was 715 GWh in 2007/08 compared to 336 GWh in 2006/07.

While the current reliability of the National Grid remains high, looking out over the next decade substantial investment is required. This is necessary to ensure that the grid efficiently meets the projected growth in electricity demand and to connect renewable generation and support sustainable economic development. Planning and implementing grid enhancements will continue to be a key area for Transpower in future years. Investment is also necessary to replace increasingly aged assets. Transpower has a significant volume of equipment at the end of its life, and major replacement is required to maintain performance.

International benchmarking is an important technique for measuring the performance of the national grid. Transpower participates in such benchmarking every two years, and the results from the 2007 study are included in this Quality Performance Report.

The Quality Performance Report is an important element of Transpower's ongoing commitment to provide a comprehensive information base for electricity market participants. A range of other publications is available via www.transpower.co.nz including the Annual Report, Annual Planning Report, System Security Forecast and the Statement of Corporate Intent.

Patrick Strange / Chief Executive

# 1 Management and Operation of the Transpower System

The transmission assets owned and operated by Transpower are summarised below. The HVAC systems in the North and South Islands form an integrated system, joined by a High Voltage Direct Current (HVDC) link, and managed from two system control centres in Hamilton and Wellington, and three regional operating centres in Otahuhu, Haywards, and Islington.

The management of the system is facilitated by Transpower's communications network, which comprises ultra-high frequency (UHF) and microwave radio links, fibre optic links, and telephone networks supplemented by leased circuits.

Transpower contracts the grid's operational, maintenance and construction fieldwork to specialist contractors. Transpower staff set and manage these contracts to strict standards.

**Table 1: Transpower's Operational Assets as at 30 June 2008**

| Asset | Specification |
|---|---|
| Length of HVAC and HVDC Transmission Lines | 11,803 route-km |
| Number of substations (includes cable stations) | 178 |
| HVAC Transmission Line Voltages – kV | 220, 110, 66, 50, 33, 11 |
| HVDC Transmission Line Voltages – kV | 350, 270 |
| HVDC Link Capacity (Pole 2 only) | 700 MW |
| Length of each Cook Strait Cable | 40 km |

# 2 Unplanned Interruptions to Supply

An important measure of Transpower's performance is the energy not supplied because of unplanned interruptions to supply originating in the Transpower system. Transpower records interruptions to supply (i.e., non-supply of electricity) in system minutes. A system minute is defined as the energy in megawatt-minutes not supplied from the system to consumers divided by the system maximum demand in megawatts for that year. The system maximum demand figure for 2007/08 was 6,635 MW.

An example to demonstrate the non-supply of one system minute would be to imagine Hamilton City (estimated population of territorial authority area approximately 134,000) losing supply during winter at peak demand (around dinnertime) for about 40 minutes.

In 2007/08 unplanned interruptions to supply originating in the Transpower system amounted to 24.6 system minutes. Of this 24.6 system minutes, 18.0 system minutes were the result of two interruptions involving large industrial customers. For both of these incidents Transpower was able to restore connection to most of the feeders at the sites after a relatively short time. However, the customers' dependence on single feeders to carry very large loads resulted in substantially more non-supply than would have occurred in similar circumstances if the customers had been electricity lines businesses. (Diversity and interconnection within an electricity lines business usually provides some resilience against failure of single components.) Approximately 15.7 system minutes out of the total of 18.0 system minutes resulting from these two incidents is considered to be not totally attributable to Transpower.

Also included are 0.7 system minutes of non supply as the result of interruptions at sites where the customer has accepted lower security (N security) and an interruption would have been avoided with N-1 security. It should also be noted that these figures do not include supply interruptions that result from Transpower equipment operating correctly in response to incidents caused by connected parties and their assets.

In 2007/08 there were three significant unplanned incidents. These were:

- At Kawerau two 11 kV busses were removed from service to investigate a bus noise, eventually found to be caused by a faulty current transformer.
- At Westport part of the 11 kV bus exploded following a close in lightning strike.

- At Kinleith a line protection relay failed to operate for a line fault, resulting in interruptions at five points of service.

Table 9 on page 28 lists significant, unplanned interruptions originating on the Transpower system since 1987.

Figure 1 shows performance in terms of the unplanned supply interruptions for the last six years. Incidents resulting in supply interruptions amounting to more than one system minute are categorised as significant, and the remainder are categorised as underlying.

Figure 2 shows monthly performance in terms of underlying unplanned supply interruptions for the 2007/08 year compared to the average of the previous five years. This wide monthly variation is to be expected given the relatively random nature of interruption-to-supply incidents.

Figure 3 illustrates both the number and impact of significant unplanned non-supply incidents for 2007/08 and the preceding five years.

**Figure 1** **Unplanned Supply Interruptions**

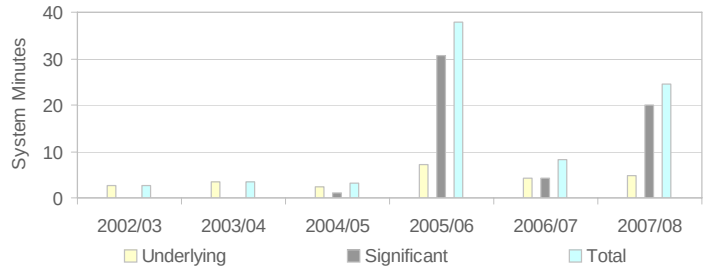



**Figure 2** **Unplanned Supply Interruptions – Underlying Events by Month**

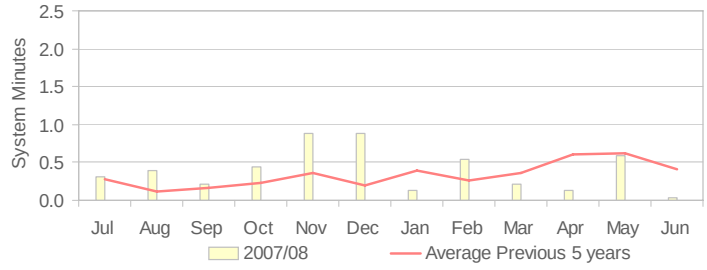
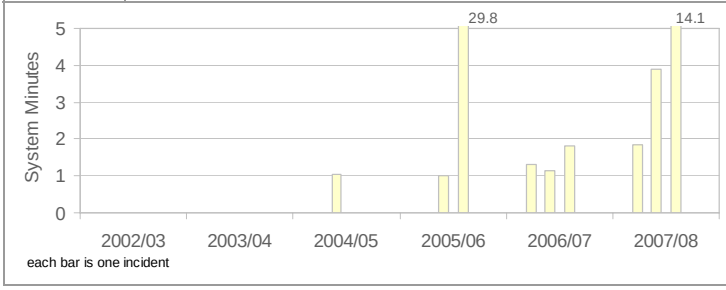



**Figure 3** **Unplanned Supply Interruptions – Significant Events**



# 3 Causes of Supply Interruptions

Table 2 gives a breakdown of supply interruptions originating in the Transpower system for the last five years into the following categories:

### Unplanned

- Environment - lightning, storms, volcanic ash, wind, tree contact, etc.
- Equipment related – caused by inadequate design, installation, or maintenance, or by ageing/wear and tear.
- Human – caused by Transpower staff or contractors.
- Not known. (Mainly transient line faults with no cause found.)
- Miscellaneous – unplanned causes not covered by the above and including non-Transpower human interference.

### Planned

- Planned - outages planned for maintenance, replacement or refurbishment, as well as new construction.

Table 2 also shows the interruptions to supply that resulted when Transpower equipment was tripped but where the cause was attributable to Generators or Supply Customers (excluding feeder trippings for faults in customers' systems).

The interruptions are measured in system minutes and are categorised as being significant or underlying incidents.

The data in Table 2 is presented graphically in Figure 4, Figure 5 and Figure 6.

**Table 2: Causes of Supply Interruptions**

| Cause of Interruption | Annual Performance (System Minutes) | | | | | Significant Incidents (System Minutes) | | | | | Underlying Incidents (System Minutes) | | | | |
|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|
| | 03/04 | 04/05 | 05/06 | 06/07 | 07/08 | 03/04 | 04/05 | 05/06 | 06/07 | 07/08 | 03/04 | 04/05 | 05/06 | 06/07 | 07/08 |
| **TP Unplanned** | | | | | | | | | | | | | | | |
| Environment | 1.1 | 0.4 | 1.8 | 1.0 | 1.1 | 0.0 | 0.0 | 0.0 | 0.0 | 0.0 | 1.1 | 0.4 | 1.8 | 1.0 | 1.1 |
| Equipment | 1.5 | 2.3 | 33.8 | 3.4 | 22.4 | 0.0 | 1.0 | 30.8 | 1.3 | 19.9 | 1.5 | 1.3 | 3.0 | 2.1 | 2.5 |
| Human | 0.7 | 0.4 | 2.0 | 3.2 | 0.9 | 0.0 | 0.0 | 0.0 | 2.9 | 0.0 | 0.7 | 0.4 | 2.0 | 0.3 | 0.9 |
| Miscellaneous | 0.1 | 0.1 | 0.1 | 0.0 | 0.0 | 0.0 | 0.0 | 0.0 | 0.0 | 0.0 | 0.1 | 0.1 | 0.1 | 0.0 | 0.0 |
| Not Known | 0.3 | 0.2 | 0.3 | 0.7 | 0.2 | 0.0 | 0.0 | 0.0 | 0.0 | 0.0 | 0.3 | 0.2 | 0.3 | 0.7 | 0.2 |
| **Total** | 3.6 | 3.3 | 38.0 | 8.4 | 24.6 | 0.0 | 1.0 | 30.8 | 4.2 | 19.9 | 3.6 | 2.3 | 7.2 | 4.1 | 4.7 |
| | | | | | | | | | | | | | | | |
| **TP Planned** | **1.7** | **3.4** | **2.8** | **3.3** | **3.3** | **0.0** | **0.0** | **1.3** | **1.0** | **1.3** | **1.7** | **3.4** | **1.5** | **2.2** | **2.1** |
| **Total Transpower** | 5.3 | 6.7 | 40.8 | 11.6 | 28.0 | 0.0 | 1.0 | 32.1 | 5.3 | 21.1 | 5.3 | 5.7 | 8.8 | 6.4 | 6.8 |
| | | | | | | | | | | | | | | | |
| **Connected Parties** | | | | | | | | | | | | | | | |
| Consumer | 0.3 | 0.9 | 1.6 | 0.4 | 2.8 | 0.0 | 0.0 | 1.2 | 0.0 | 2.6 | 0.3 | 0.9 | 0.3 | 0.4 | 0.3 |
| Generator | 0.0 | 0.0 | 0.2 | 0.0 | 0.0 | 0.0 | 0.0 | 0.0 | 0.0 | 0.0 | 0.0 | 0.0 | 0.2 | 0.0 | 0.0 |
| **Total Connected Parties** | **0.3** | **0.9** | **1.7** | **0.4** | **2.8** | **0.0** | **0.0** | **1.2** | **0.0** | **2.6** | **0.3** | **0.9** | **0.5** | **0.4** | **0.3** |

Notes Minor differences between totals and breakdowns are due to rounding.

Figure 4 shows the system minutes of non-supply by cause for each of the last five years.

Supply interruptions in 2007/08 were dominated by the major incident at Kawerau.

Figure 5 shows the same data as percentages of the total annual system minutes of non-supply in Figure 4.

Figure 6 shows the causes of underlying supply interruptions for the last five years. In this graph significant interruptions (greater than one system minute) have been excluded.

**Figure 4** **Supply Interruptions by Cause**

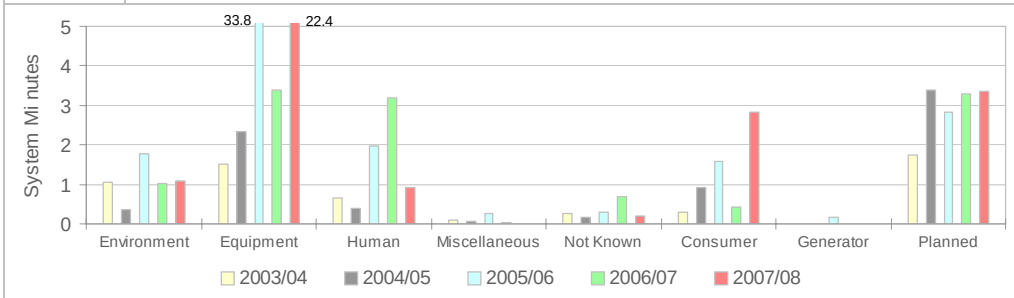



**Figure 5** **Supply Interruptions by Cause - Percentage of Annual Total**

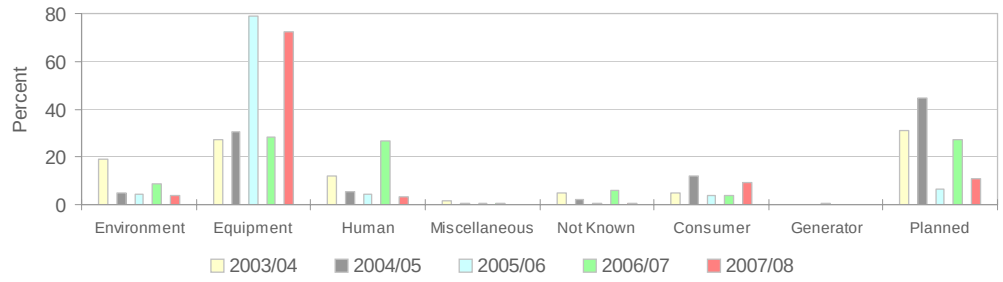
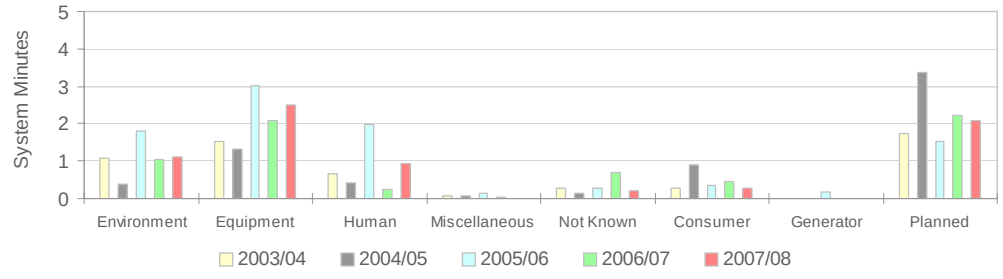



**Figure 6** **Underlying Supply Interruptions by Cause**



# 4 Unplanned Supply Interruptions by Source & Cause

Figures 7 to 10 provide a further breakdown that takes into account the item of equipment that was responsible for the non-supply incident as well as the cause. Note that one incident may cause several interruptions; for example, a double circuit fault on the Inangahua – Kikiwa circuits caused interruptions at a seven different points of supply.

Figure 7 shows the numbers of incidents causing interruptions in 2007/08 and Figure 8 shows the five year average number of incidents. Similarly, Figure 9 and Figure 10 show a similar analysis for the system minutes of non-supply.

The following paragraphs provide brief summaries of performance grouped by circuit breakers, transformers, HVAC circuits, HVDC system, protection, other equipment and human element incidents.

### Circuit Breakers

In 2007/08 there were three incidents caused by circuit breaker failures, a little lower than the five-year average.

Almost all of the relatively high system minutes figure for 2007/08 is the result of the feeder circuit breaker explosion and subsequent interruption at Westport.

### Transformers

In 2007/08 there were four transformer incidents caused by equipment related failures, and this is higher than the average for the last five years. Three of these were caused by oil leaks or oil circulation problems.

The 0.14 system minutes related to transformer outages for 2007/08 was significantly lower than average.

### HVAC Circuits

Generally outages caused by environmental causes dominate circuit performance; the most usual reason being lightning or suspecting lightning, although snow and high winds cause a number of outages. Outages categorised as “not known” are usually transient faults, which cause a circuit to trip, but for which no positive cause or evidence has been found. These may be caused by environmental factors, or possibly by faulty hardware causing intermittent faults.

The number of incidents caused by transmission line faults in 2007/08 was somewhat higher than the five-year average. This is attributable to increases in the number of trippings on the Te Kaha-Waiotahi, Atarau-Inangahua, and Karapiro-Te Awamutu circuits.

The system minutes for 2007/08 are much less that the five-year average. However the five year average for HVAC circuits is dominated by the earthwire failure at Otahuhu on 12 June 2006.

**Figure 7** **Incidents Numbers – 2007/08**

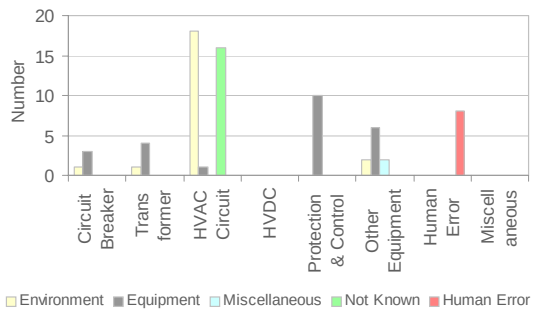
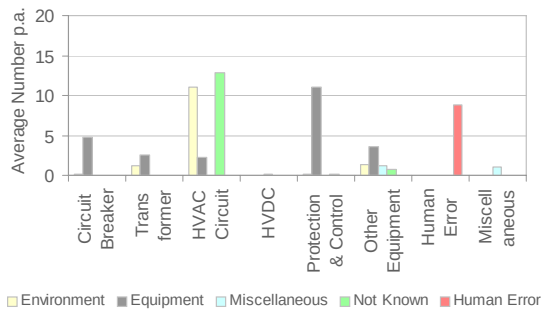



**Figure 8** **Incident Numbers – 5 Years to June 08**



### HVDC Link

In the last five years there has been only one incident originating on the HVDC link which caused supply interruptions (other than to interruptible load). There were no incidents during 2007/08.

### Protection and Control

This category includes interruptions caused by faults on protection, SCADA, and control equipment. The most common causes of incidents in this category are protection and SCADA mal-operations.

The number of non-supply incidents attributable to Protection and Control is slightly below the five-year average for this group.

The system minutes not supplied was somewhat higher than the five-year average. The largest incident in this category in 2007/08 was a line protection maloperation at Kinleith which caused interruptions totalling 1.9 system minutes in that area.

### Other Equipment

The “Other Equipment” category includes interruptions caused by faults on any other equipment, for example disconnectors, current transformers, bus-work. The most common causes of incidents in this category are bus insulator faults and disconnector problems.

The number of non-supply incidents attributable to “Other Equipment” in 2007/08 is three higher than the five-year average for this group.

The system minutes not supplied in the “Other Equipment” category was substantially higher than the five-year average because of the large incident at Kawerau which was caused by a faulty 11 kV current transformer.

### Human Error Incidents

“Human Error” incidents are those caused by Transpower staff and contractors in the course of operating, maintaining, and developing the grid. Incidents caused by external parties, i.e. the public, are included in the miscellaneous category.

For 2007/08 the number of Transpower human error incidents is slightly lower than the five-year average.

The system minutes caused by human error incidents has also decreased relative to the five-year average. The largest human error incident in 2007/08 was the result of a switching error at Takapu Road which resulted in interruptions in the area north of Wellington.

**Figure 9** **System Minutes – 2007/08**

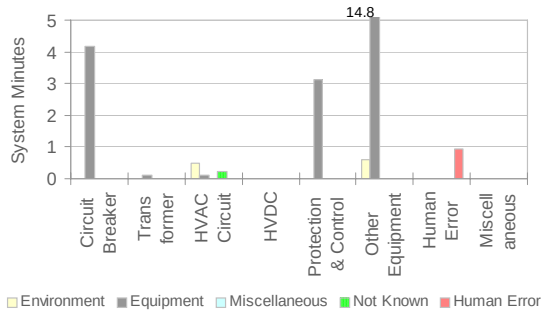
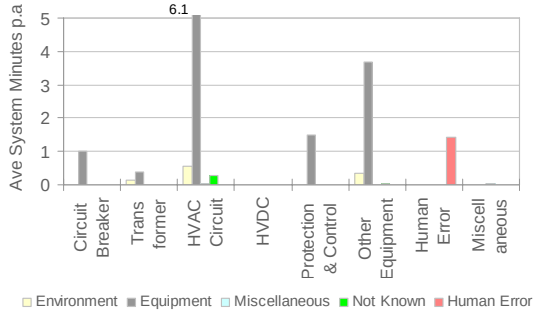



**Figure 10** **System Minutes – 5 Years to June 08**



# 5 Unplanned Interruptions to Generator Connections

Figures 11 to 14 provide a summary of the causes of unplanned interruptions to grid connection for direct connected generators. The categories used are the same as those for Figures 7 to 10.

Figure 11 and Figure 12 show the numbers of incidents causing forced interruptions to connection for direct connected generators for the 2007/08 year, and the five-year average respectively. The figures show that incidents due to HVAC circuit trippings are above the average, while the numbers in the other categories are similar to or better than the five-year average. Most of the HVAC circuit incidents involved the Balclutha-Berwick-Halfway Bush circuit and the Blenheim-Argyle-Kikiwa circuit which suffered from a number of transient faults from unknown causes. In both these cases the generator is reliant on a single circuit connection to the grid.

**Figure 11 Incident Numbers – 2007/08**

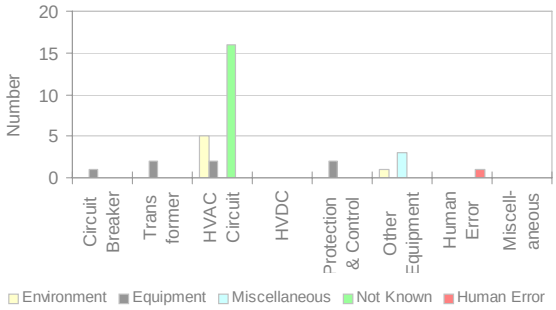



**Figure 12 Incident Numbers – 5 years to June 08**

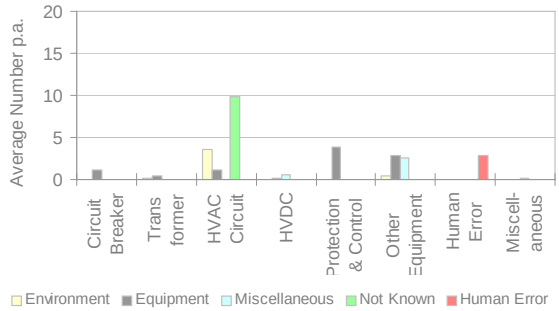



Figure 13 and Figure 14 show the total duration in minutes for forced interruptions to connection for direct connected generators. For 2007/08, the lengthy duration for transformers was caused by a cooling problem on a transformer at Benmore. A 220 kV bus fault which occurred at Maraetai during a thunderstorm caused interruptions to connection at Maraetai and Waipawa.

**Figure 13 Duration of Interruptions – 2007/08**

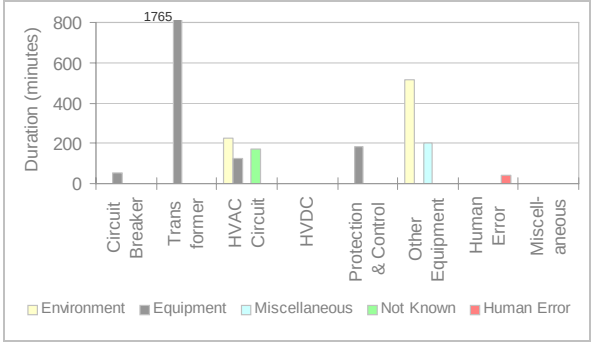
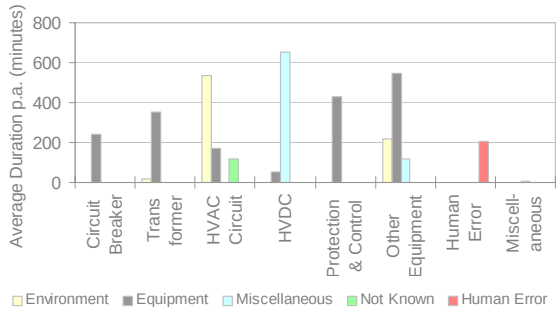


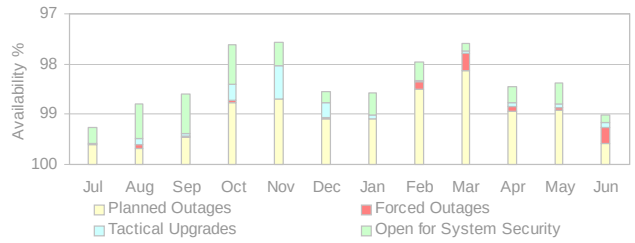

**Figure 14 Durations – 5 years to June 08**



# 6 HVAC Transmission Circuit Performance

The overall availability of HVAC circuits including forced and planned outages was 98.4 percent in 2007/08, but was below the target of 98.6 percent. This was caused by additional circuit outages required for system security reasons which exceeded the allowance in the target by approximately 0.23% of annual unavailability. The largest of these were for the system splits associated with an interconnection transformer failure at Marsden which accounted for 0.16% unavailability.

**Figure 15** **HVAC Transmission Availability 07/08**




## Forced Outages

The following figures summarise all circuit forced outages for any reason including faults on other equipment.

Figure 16 shows the total number of forced[3] outages per 100 route-km by voltage. The number of circuit forced outages in 2007/08 was lower than in 2006/07 for the 220 and 110 kV groups. The higher number for 66/50 kV in 2007/08 was due to forced outages of the Te Kaha- Waiotahi circuit which contributed 43% of the total rate per 100 km of the total. Usually this circuit contributes less than 10% of the total.

Figure 17 shows HVAC circuit performance measured by outage duration per route-km. The 07/08 result for 110 kV is very high because of a long outage of Henderson-Hepburn Road circuit 4 because of a faulty circuit breaker.

**Figure 16** **Number of Circuit Forced Outages**

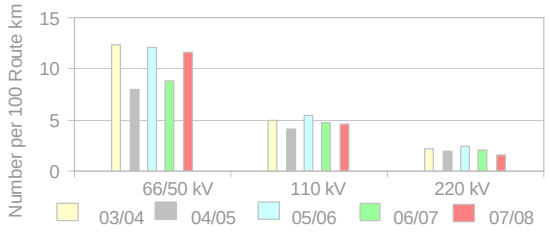
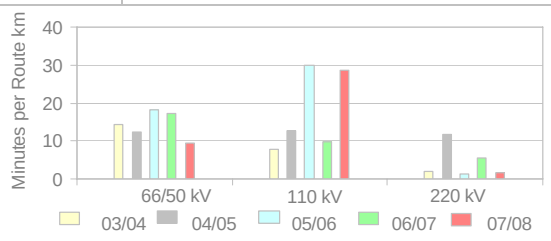



**Figure 17** **Duration of Circuit Forced Outages**




[3] The term “forced” is generally used in relation to HVAC transmission circuit performance reporting. In the context of this report it is equivalent to the term “unplanned” used for system minute interruptions. This includes outages caused by both protection operations and manual intervention.

# 7 Transmission System Utilisation

## HVAC System Utilisation

Figure 18 and Figure 19 show monthly North Island and South Island generation and load for the 2007/08 year, and for comparison the previous year's generation. Annual South Island generation was approximately 1,000 GWh lower than last year, and as a consequence, northwards HVDC transfers were also lower. Because of the decreased HVDC supply from the South Island, North Island generation was approximately 1,700 GWh higher than last year.

**Figure 18 North Island Generation and Load**

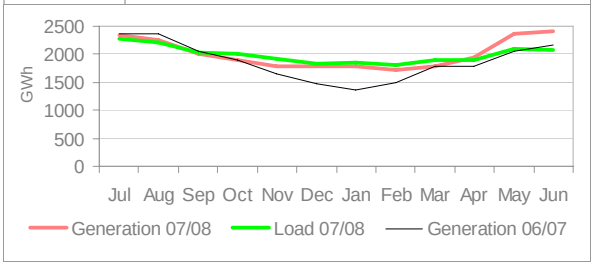
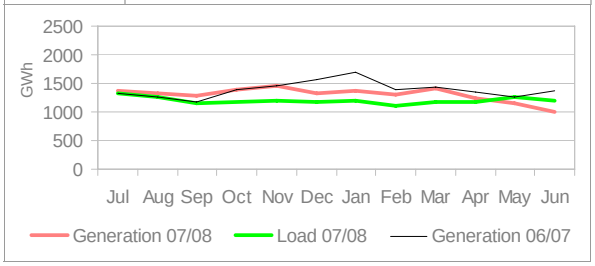



**Figure 19 South Island Generation and Load**




## HVDC Utilisation

The total northward HVDC transfer decreased in comparison to 2006/07, in part because of the low South Island hydro lake levels in the last months of the year. The northwards HVDC transfer (sent from Benmore) for 2007/08 was 1,341 GWh compared to 2,393 GWh in 2006/07 (Figure 20). Correspondingly, the annual southwards energy transfer increased from 366 GWh in 2006/07 to 715 GWh in 2007/08. This year monthly load patterns were relatively flat, except for significant southwards transfers during May and June 2008 (Figure 21).

HVDC Pole 1 was stood down in September 2007 and is now available in a limited mode for Grid Emergencies only. The average utilisation of the HVDC Pole 2 was 43.8 percent for 2007/08 (38.0 percent for 2006/07). Net northwards HVDC link transfers contributed only 2.5 percent of the total energy supplied into the North Island grid for the year; down from 8.3 percent in 2006/07.

**Figure 20 HVDC Link Long Term Energy Transfer**

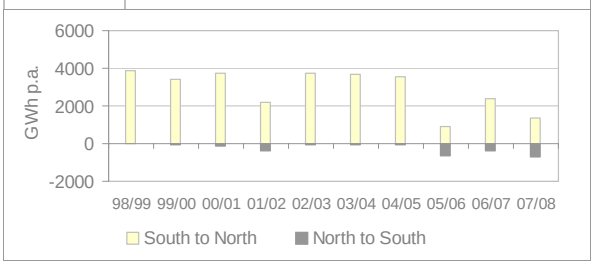
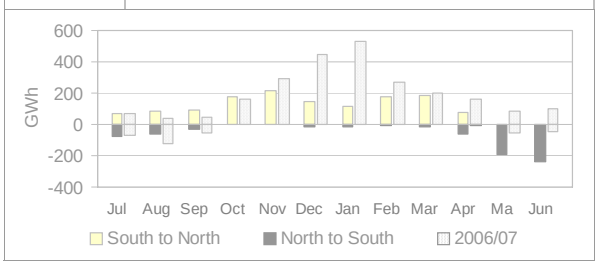



**Figure 21 HVDC Link Energy Transfer 2007/08**



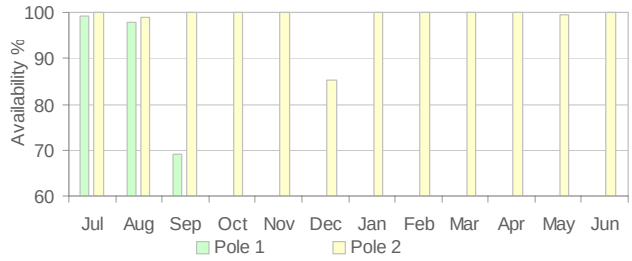
# 8 HVDC Link Availability

## Availability [4]

Pole 1 was stood down in September 2007 to remove the risk of an in-service failure. Therefore the annual target for HVDC Bipole availability of 91.5 percent for 2007/08 could not be achieved. Pole 1 availability was 91.1percent until it was stood down. The availability for Pole 2 was 98.6 percent and bettered the Pole 2 target of 94.4 percent.

The monthly availabilities for Pole 1 and Pole 2 are shown in Figure 22.

**Figure 22** **HVDC Link Availability Poles 1 & 2**




## Unavailability

### *Pole 1*

Prior to being stood down there were a number of short forced outages caused by equipment failures (timing capacitors, high vacuum pump, test/service relay). Southwards transfers caused seven mercury arc valve arcbacks and consequential arcbacks, either while starting or running for southward transfers at Haywards substation. At present, half of pole 1 can be made available for restricted operation only during Grid Emergencies.

### *Pole 2*

Total Forced Unavailability for the year was 0.02 percent for Pole 2 (0.25 percent in 2006/07). Pole 2 had three brief forced outages. One was due to false operation of the converter transformer deluge system. The second was due to forced operation in a reduced voltage mode. The third forced outage was caused by a crash of both SCADA systems.

Figure 23 and Figure 24 show forced and scheduled availability of Pole 1 and Pole 2 by month.

**Figure 23** **HVDC Link Availability – Pole 1**

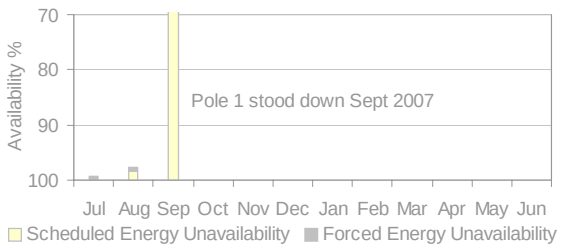
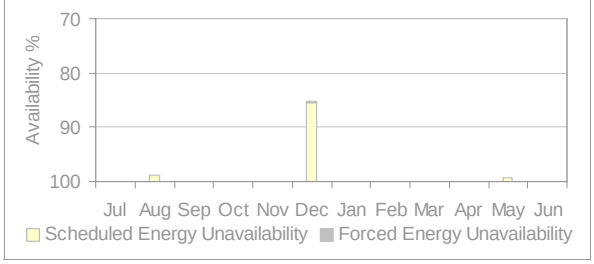



**Figure 24** **HVDC Link Availability – Pole 2**




[4] The term "availability" is used in relation to HVDC link performance to follow the definition of "Energy Availability" used by CIGRE Study Committee 14 Protocol for Reporting the Operational Performance of HVDC Transmission Systems.

# 9 International Comparison of HVDC Links[5]

From January to September 2007 Transpower's Pole 1 was the only mercury-arc valve HVDC scheme still in continuous operation.[6] The only other remaining HVDC scheme of this type is at Vancouver Island and is now on standby for emergencies only. The Vancouver Island HVDC link will be replaced by an AC cable system with phase shifting transformers.

The performance of the thyristor pole (Pole 2) is compared to other HVDC thyristor valve links in Figures 25 to 29. The links chosen for this comparison are high performance systems using similar technology.

Pole 2 availability has decreased compared to the previous year's results (from 98.1 percent to 97.7 percent) primarily due to the scheduled maintenance outages during February and December 2007. Pole 2 availability compares favourably with the availability of the links against which Transpower benchmarks.

Forced energy unavailability for the calendar year 2007 was low at 0.24 percent. The forced outages contributing to this were a converter transformer out of step in April 2007, a faulty control card in June 2007 and a false deluge fire alarm in December 2007.

**Figure 25 Scheduled Energy Unavailability**

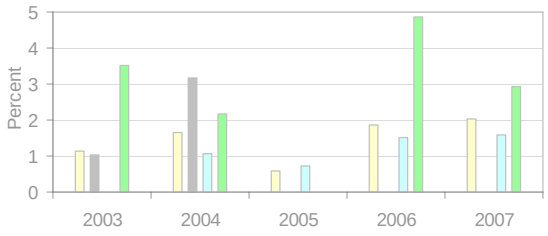



**Figure 26 Forced Energy Unavailability**

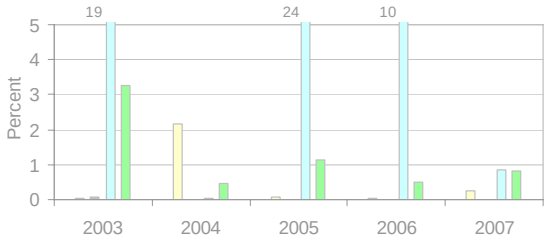



**Figure 27 Forced Outage Count**

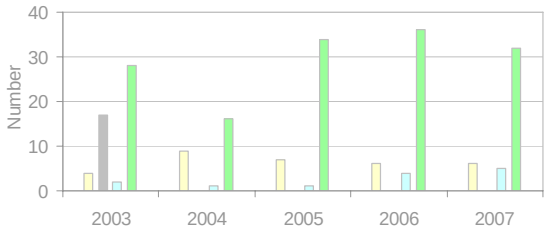



**Figure 28 Availability**

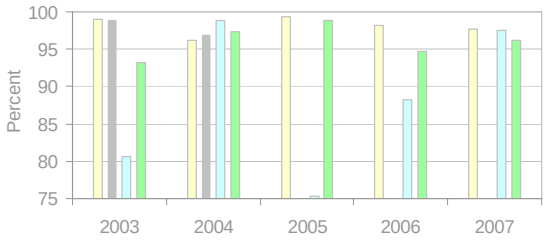
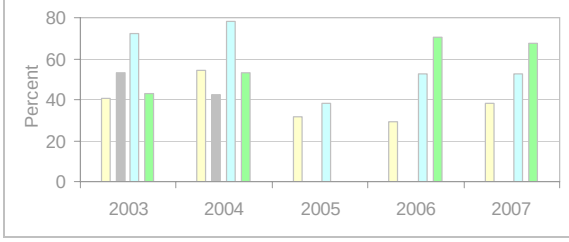



**Figure 29 Utilisation**




**Legend Thristor Valve Links**

- New Zealand
- Konti-Skan 2 (Sweden Denmark) *
- Fennoskan (Sweden Finland)
- Nelson River (Canada)

* No data received for 2005-7

Figs 25,26,27 corrected May09

[5] These figures are based on a calendar year as required by the CIGRE Study Committee 14 Protocol for Reporting the Operational Performance of HVDC Transmission Systems

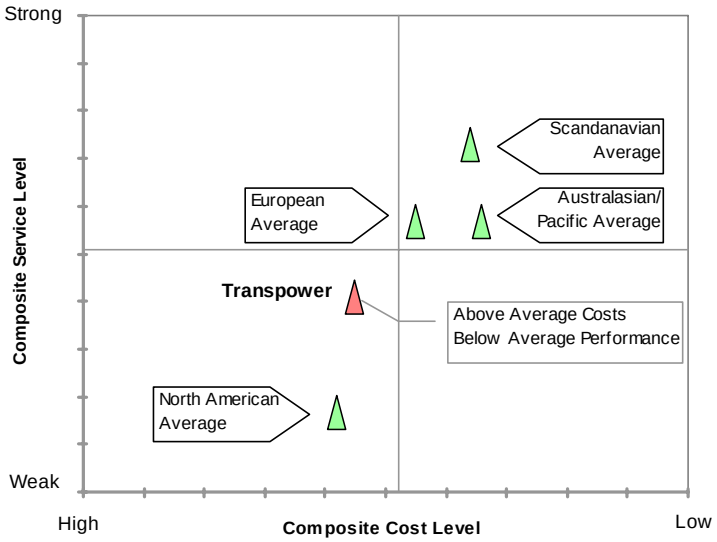
[6] In September 2007 Pole 1 was stood down to minimise the risk of a service failure.

# 10 International Comparison of Transmission Performance

Transpower participates in an international comparison of performance every two years. In 2007 the comparison covered the operation and maintenance of assets operating at 60 kV and above. In previous years assets above 100 kV only have been covered.

The 2007 study involved 29 transmission utilities from North America, Europe, Asia, Australia and New Zealand. International benchmarking provides the opportunity to compare Transpower's performance with some of the world's best and, more importantly, to identify opportunities for improvement. The study compares 12 areas of operations and maintenance activities, covering such things as overhead lines, patrols and inspections, substation equipment and protection systems.

Overall, the 2007 study shows that Transpower performance has declined in relative terms since the 2005 study, and is now lower than the average of the participants. Transpower costs are now above average. The most significant areas of deterioration in performance since 2005 are the forced and fault outage rates of substation equipment.




Transpower is incorporating the results of the 2007 benchmarking project into an overall review of asset management and maintenance strategies that is currently being undertaken.

Initiatives from projects in the areas of disconnector cost and performance and maintenance switching performance undertaken after the 2005 study are expected to result in improvements in these areas in the longer term. New initiatives have already commenced to improve the performance of substation equipment, particularly in the reduction of forced outages resulting from leakage of $SF_6$ gas from outdoor circuit breakers.

# 11 Supply Performance Summary

Figure 30 shows the number and duration of unplanned interruptions to supply originating in the Transpower system. The interruption durations are grouped into five-minute blocks, and are grouped up to a maximum of 175-179 minutes, which includes more than 94 percent of interruptions to supply. The remaining 6 percent are aggregated in the 180+ group at the right of the graph. The vertical bar indicates the spread of results, from the maximum value to the minimum value, over the period July 2002 to June 2007, with the average value indicated. The 2007/08 and 2006/07 results are shown as line graphs. There were 115 unplanned, supply interruptions that originated on the Transpower system during 2007/08.

Interruptions with durations up to approximately 30 minutes are generally those that can be restored remotely, while those of longer durations are typically those which require an operator to attend or where investigations or remedial action is required before equipment is restored.

**Figure 30 Duration of Unplanned Interruptions to Supply**

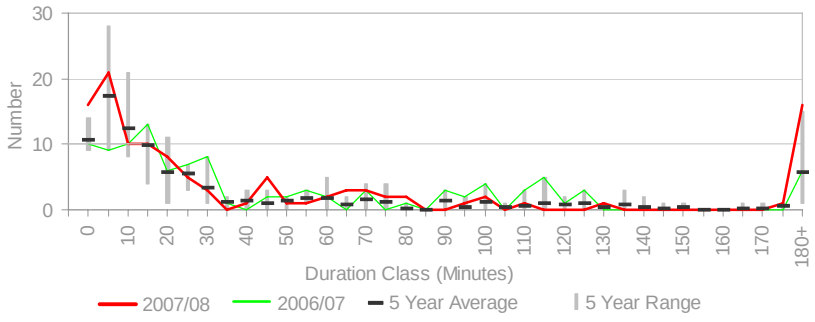


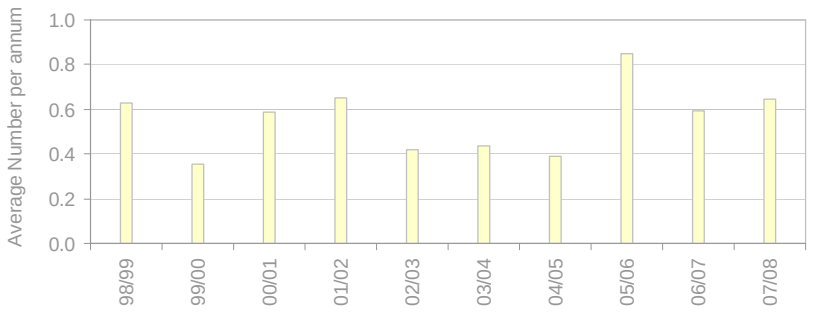

Figure 31 shows the average number of unplanned interruptions per point of service (supply) for the last ten years. In 2007/08 there was an average of 0.65 interruptions per point of service.

There were four events that contributed to the relatively high number for 07/08:

- A line protection fault at Kinleith resulted in 5 separate interruptions,
- A double circuit fault on the Coleridge Otira circuits resulted in 5 interruptions,
- A double circuit fault on the Inangahua Kikiwa circuits resulted in 7 interruptions,
- A broken crossarm and damaged insulators on the Te Kaha Waiotahi circuit resulted in 5 interruptions

Excluding these four events would reduce the average to 0.52 interruptions per point of service.

**Figure 31 Unplanned Supply Interruptions per Point of Service**



# 12 Point of Service Performance

The tables on the following pages summarise performance at individual Points of Service[7]. These measures indicate the impact on service of Transpower-caused unplanned interruptions. These include both partial and full interruptions to connection due to a fault or human interference. The measures are aggregated at each Point of Service, but include interruptions originating anywhere on the Transpower system up to the Point of Connection[8]. The tables cover Points of Service for both supply customers and direct-connected generator customers. The Points of Service listed are those in service as at 30 June 2008.

## Supply Customers

Tables 3 to 6 summarise unplanned interruptions to supply originating in the Transpower system including interference caused by the public. The tables show the number of interruptions, and the unserved energy expressed as a percentage of the total energy that would have been supplied during the year had there not been any supply interruptions.

Data is shown separately for each supply voltage at the station of supply. If two customers are supplied from a station at the same voltage then these are shown separately as Station (A) and Station (B). Separate tables present the data for the North and South Islands, sorted both alphabetically, and by five-year average unserved energy.

## Generator Customers

For direct-connected generator customers, the point of service performance is shown in Tables 7 and 8 as the number of unplanned interruptions to service caused by forced outages and the duration in minutes of the interruptions. The data is shown sorted both alphabetically and by five-year[9] average duration.

[7] Point of Service is a supply bus where a customer takes service.

[8] Point of Connection is a point where customer assets are connected to Transpower assets. One Point of Service will have one or more Points of Connection.

[9] For points of service that have not been in service for five years, the figure given is the average for the number of years (or part years) in service.

# Point of Service Performance - Supply

**Table 3: North Island Supply Points of Service – Unplanned Interruptions (listed alphabetically)**

| Point of Service | 06/07 Number | 07/08 Number | 06/07 Unserved Energy % x100 | 07/08 Unserved Energy % x100 | 5 Yr Average Number | 5 Yr Avg. Unserved Energy % x100 | Point of Service | 06/07 Number | 07/08 Number | 06/07 Unserved Energy % x100 | 07/08 Unserved Energy % x100 | 5 Yr Average Number | 5 Yr Avg. Unserved Energy % x100 |
|---|---|---|---|---|---|---|---|---|---|---|---|---|---|
| Albany 110 kV | 0 | 0 | 0.00 | 0.00 | 0.0 | 0.00 | Meremere | 1 | 1 | 2.08 | 2.53 | 0.6 | 3.04 |
| Albany 33 kV | 0 | 0 | 0.00 | 0.00 | 0.0 | 0.00 | Moturoa | 0 | 0 | 0.00 | 0.00 | 0.2 | 0.46 |
| Bombay 110 kV | 0 | 0 | 0.00 | 0.00 | 0.0 | 0.00 | Mt Maunganui 11 kV | 0 | 0 | 0.00 | 0.00 | 0.0 | 0.00 |
| Bombay 33 kV | 0 | 1 | 0.00 | 1.85 | 0.4 | 0.38 | Mt Maunganui 33 kV | 0 | 0 | 0.00 | 0.00 | 0.2 | 0.52 |
| Bream Bay | 0 | 0 | 0.00 | 0.00 | 0.0 | 0.00 | Mt Roskill 110 kV | 0 | 0 | 0.00 | 0.00 | 0.2 | 1.17 |
| Brunswick | 0 | 0 | 0.00 | 0.00 | 0.0 | 0.00 | Mt Roskill 22 kV | 0 | 0 | 0.00 | 0.00 | 0.4 | 1.02 |
| Bunnythorpe 33 kV | 0 | 0 | 0.00 | 0.00 | 0.0 | 0.00 | National Park | 0 | 3 | 0.00 | 1.49 | 1.6 | 0.63 |
| Bunnythorpe 55 kV | 0 | 0 | 0.00 | 0.00 | 0.0 | 0.00 | Ohaaki | 2 | 1 | 1.38 | 0.78 | 0.8 | 1.03 |
| Cambridge | 0 | 0 | 0.00 | 0.00 | 0.2 | 0.12 | Ohakune (A) | 0 | 1 | 0.00 | 0.27 | 0.8 | 0.30 |
| Carrington St | 0 | 0 | 0.00 | 0.00 | 0.0 | 0.00 | Ohakune (B) | 0 | 1 | 0.00 | 0.22 | 0.8 | 0.42 |
| Central Park 11 kV | 0 | 0 | 0.00 | 0.00 | 0.4 | 0.02 | Ongarue | 1 | 0 | 2.36 | 0.00 | 0.2 | 0.47 |
| Central Park 33 kV | 0 | 0 | 0.00 | 0.00 | 0.4 | 0.20 | Opunake | 0 | 0 | 0.00 | 0.00 | 0.2 | 0.08 |
| Dannevirke | 1 | 1 | 1.48 | 0.70 | 1.2 | 0.53 | Otahuhu | 2 | 1 | 0.07 | 4.11 | 0.6 | 0.84 |
| Dargaville | 0 | 0 | 0.00 | 0.00 | 0.2 | 0.09 | Owhata | 0 | 1 | 0.00 | 6.46 | 0.2 | 1.29 |
| Edgecumbe | 0 | 0 | 0.00 | 0.00 | 0.0 | 0.00 | Pakuranga | 0 | 0 | 0.00 | 0.00 | 0.2 | 1.06 |
| Fernhill | 0 | 0 | 0.00 | 0.00 | 0.0 | 0.00 | Paraparaumu | 1 | 1 | 1.16 | 1.61 | 0.4 | 0.55 |
| Gisborne 50 kV | 0 | 0 | 0.00 | 0.00 | 0.2 | 0.05 | Pauatahanui | 2 | 1 | 2.57 | 1.35 | 0.6 | 0.78 |
| Glenbrook (A) | 0 | 0 | 0.00 | 0.00 | 0.0 | 0.00 | Penrose 110 kV | 0 | 0 | 0.00 | 0.00 | 0.2 | 1.46 |
| Glenbrook (B) | 1 | 0 | 3.04 | 0.00 | 0.2 | 0.61 | Penrose 22 kV | 0 | 0 | 0.00 | 0.00 | 0.2 | 2.00 |
| Gracefield | 0 | 0 | 0.00 | 0.00 | 0.0 | 0.00 | Penrose 33 kV (A) | 0 | 0 | 0.00 | 0.00 | 0.2 | 2.10 |
| Greytown | 0 | 1 | 0.00 | 0.03 | 1.6 | 2.47 | Penrose 33 kV (B) | 0 | 0 | 0.00 | 0.00 | 0.0 | 0.00 |
| Hamilton 11 kV | 0 | 0 | 0.00 | 0.00 | 0.0 | 0.00 | Redclyffe | 0 | 0 | 0.00 | 0.00 | 0.0 | 0.00 |
| Hamilton 33 kV | 0 | 0 | 0.00 | 0.00 | 0.4 | 0.35 | Rotorua 11 kV | 0 | 0 | 0.00 | 0.00 | 0.2 | 0.29 |
| Hamilton 55 kV | 0 | 0 | 0.00 | 0.00 | 0.0 | 0.00 | Rotorua 33 kV | 0 | 0 | 0.00 | 0.00 | 0.4 | 0.25 |
| Hangatiki | 0 | 0 | 0.00 | 0.00 | 0.6 | 0.92 | Silverdale | 1 | 3 | 0.16 | 0.83 | 1.4 | 0.50 |
| Hawera | 1 | 1 | 0.70 | 1.34 | 0.6 | 0.49 | Stratford | 0 | 0 | 0.00 | 0.00 | 0.8 | 0.12 |
| Haywards 11 kV | 1 | 0 | 1.18 | 0.00 | 0.2 | 0.24 | Takanini | 0 | 0 | 0.00 | 0.00 | 0.0 | 0.00 |
| Haywards 33 kV | 0 | 0 | 0.00 | 0.00 | 0.0 | 0.00 | Takapu Road | 1 | 0 | 1.34 | 0.00 | 0.2 | 0.27 |
| Henderson | 0 | 0 | 0.00 | 0.00 | 0.0 | 0.00 | Tangiwai 11 kV | 0 | 0 | 0.00 | 0.00 | 0.2 | 0.04 |
| Hepburn Road | 0 | 0 | 0.00 | 0.00 | 0.4 | 0.41 | Tangiwai 55 kV | 0 | 0 | 0.00 | 0.00 | 0.2 | 0.01 |
| Hinuera | 0 | 1 | 0.00 | 0.08 | 0.6 | 0.37 | Tarukenga | 0 | 0 | 0.00 | 0.00 | 0.0 | 0.00 |
| Huirangi | 0 | 0 | 0.00 | 0.00 | 0.0 | 0.00 | Taumarunui | 4 | 5 | 0.03 | 0.85 | 3.4 | 0.56 |
| Kaikohe | 0 | 0 | 0.00 | 0.00 | 0.2 | 0.39 | Tauranga 11 kV | 0 | 0 | 0.00 | 0.00 | 0.2 | 0.50 |
| Kaitaia | 0 | 0 | 0.00 | 0.00 | 0.2 | 0.28 | Tauranga 33 kV | 0 | 0 | 0.00 | 0.00 | 0.0 | 0.00 |
| Kaiwharawhara | 0 | 1 | 0.00 | 0.24 | 0.4 | 0.06 | Te Awamutu | 1 | 6 | 0.42 | 3.86 | 2.6 | 2.14 |
| Kawerau (A) | 1 | 0 | 0.03 | 0.00 | 0.2 | 0.01 | Te Kaha | 5 | 16 | 8.25 | 23.2 | 6.8 | 13.2 |
| Kawerau (B) | 1 | 1 | 1.32 | 16.1 | 0.4 | 3.49 | Te Kowhai | 0 | 0 | 0.00 | 0.00 | 0.0 | 0.00 |
| Kensington | 0 | 0 | 0.00 | 0.00 | 0.2 | 0.01 | Te Matai | 0 | 1 | 0.00 | 0.28 | 0.6 | 0.74 |
| Kinleith 11 kV (A) | 0 | 2 | 0.00 | 3.00 | 0.6 | 0.61 | Tokaanu (A) | 0 | 0 | 0.00 | 0.00 | 0.2 | 0.14 |
| Kinleith 11 kV (B) | 0 | 1 | 0.00 | 3.77 | 0.2 | 0.75 | Tuai | 0 | 3 | 0.00 | 7.17 | 0.6 | 1.43 |
| Kinleith 33 kV | 0 | 1 | 0.00 | 4.01 | 0.2 | 0.80 | Upper Hutt | 0 | 0 | 0.00 | 0.00 | 0.2 | 0.17 |
| Kopu | 0 | 0 | 0.00 | 0.00 | 0.0 | 0.00 | Waihou | 1 | 1 | 0.10 | 0.10 | 0.4 | 0.04 |
| Lichfield | 0 | 1 | 0.00 | 2.22 | 0.4 | 0.52 | Waikino | 0 | 0 | 0.00 | 0.00 | 0.0 | 0.00 |
| Linton | 0 | 0 | 0.00 | 0.00 | 0.0 | 0.00 | Waiotahi | 0 | 0 | 0.00 | 0.00 | 0.4 | 0.66 |
| Mangahao | 1 | 0 | 2.46 | 0.00 | 0.8 | 0.63 | Waipawa 11 kV | 0 | 0 | 0.00 | 0.00 | 0.0 | 0.00 |
| Mangamaire | 0 | 0 | 0.00 | 0.00 | 0.4 | 0.19 | Waipawa 33 kV | 2 | 0 | 1.23 | 0.00 | 0.8 | 0.32 |
| Mangere 110 kV | 0 | 0 | 0.00 | 0.00 | 0.0 | 0.00 | Wairakei | 0 | 0 | 0.00 | 0.00 | 0.0 | 0.00 |
| Mangere 33 kV | 0 | 0 | 0.00 | 0.00 | 0.2 | 1.08 | Wairoa 11 kV | 0 | 0 | 0.00 | 0.00 | 0.0 | 0.00 |
| Marsden | 0 | 0 | 0.00 | 0.00 | 0.0 | 0.00 | Wanganui | 0 | 0 | 0.00 | 0.00 | 0.2 | 0.43 |
| Marton | 0 | 0 | 0.00 | 0.00 | 0.4 | 0.96 | Waverley | 0 | 0 | 0.00 | 0.00 | 1.2 | 1.05 |
| Masterton | 1 | 0 | 1.49 | 0.00 | 1.2 | 0.79 | Wellsford | 0 | 0 | 0.00 | 0.00 | 0.2 | 0.31 |
| Mataroa | 0 | 0 | 0.00 | 0.00 | 0.8 | 0.37 | Whakatu | 1 | 0 | 0.22 | 0.00 | 0.2 | 0.04 |
| Maungatapere | 0 | 1 | 0.00 | 0.38 | 0.2 | 0.08 | Whirinaki | 0 | 0 | 0.00 | 0.00 | 0.0 | 0.00 |
| Maungaturoto | 0 | 0 | 0.00 | 0.00 | 0.2 | 0.26 | Wilton | 0 | 1 | 0.00 | 0.48 | 0.2 | 0.10 |
| Melling 11 kV | 0 | 0 | 0.00 | 0.00 | 0.0 | 0.00 | Wiri | 0 | 0 | 0.00 | 0.00 | 0.4 | 0.16 |
| Melling 33 kV | 0 | 0 | 0.00 | 0.00 | 0.0 | 0.00 | Woodville | 3 | 0 | 1.57 | 0.00 | 1.0 | 0.90 |

**Table 4: North Island Supply Points of Service – Unplanned Interruptions (listed by 5 year average unserved energy)**

| Point of Service | 06/07 Number | 07/08 Number | 06/07 Unserved Energy % x100 | 07/08 Unserved Energy % x100 | 5 Yr Average Number | 5 Yr Avg. Unserved Energy % x100 | Point of Service | 06/07 Number | 07/08 Number | 06/07 Unserved Energy % x100 | 07/08 Unserved Energy % x100 | 5 Yr Average Number | 5 Yr Avg. Unserved Energy % x100 |
|---|---|---|---|---|---|---|---|---|---|---|---|---|---|
| Te Kaha | 5 | 16 | 8.25 | 23.2 | 6.8 | 13.2 | Haywards 11 kV | 1 | 0 | 1.18 | 0.00 | 0.2 | 0.24 |
| Kawerau (B) | 1 | 1 | 1.32 | 16.1 | 0.4 | 3.49 | Central Park 33 kV | 0 | 0 | 0.00 | 0.00 | 0.4 | 0.20 |
| Meremere | 1 | 1 | 2.08 | 2.53 | 0.6 | 3.04 | Mangamaire | 0 | 0 | 0.00 | 0.00 | 0.4 | 0.19 |
| Greytown | 0 | 1 | 0.00 | 0.03 | 1.6 | 2.47 | Upper Hutt | 0 | 0 | 0.00 | 0.00 | 0.2 | 0.17 |
| Te Awamutu | 1 | 6 | 0.42 | 3.86 | 2.6 | 2.14 | Wiri | 0 | 0 | 0.00 | 0.00 | 0.4 | 0.16 |
| Penrose 33 kV (A) | 0 | 0 | 0.00 | 0.00 | 0.2 | 2.10 | Tokaanu (A) | 0 | 0 | 0.00 | 0.00 | 0.2 | 0.14 |
| Penrose 22 kV | 0 | 0 | 0.00 | 0.00 | 0.2 | 2.00 | Cambridge | 0 | 0 | 0.00 | 0.00 | 0.2 | 0.12 |
| Penrose 110 kV | 0 | 0 | 0.00 | 0.00 | 0.2 | 1.46 | Stratford | 0 | 0 | 0.00 | 0.00 | 0.8 | 0.12 |
| Tuai | 0 | 3 | 0.00 | 7.17 | 0.6 | 1.43 | Wilton | 0 | 1 | 0.00 | 0.48 | 0.2 | 0.10 |
| Owhata | 0 | 1 | 0.00 | 6.46 | 0.2 | 1.29 | Dargaville | 0 | 0 | 0.00 | 0.00 | 0.2 | 0.09 |
| Mt Roskill 110 kV | 0 | 0 | 0.00 | 0.00 | 0.2 | 1.17 | Maungatapere | 0 | 1 | 0.00 | 0.38 | 0.2 | 0.08 |
| Mangere 33 kV | 0 | 0 | 0.00 | 0.00 | 0.2 | 1.08 | Opunake | 0 | 0 | 0.00 | 0.00 | 0.2 | 0.08 |
| Pakuranga | 0 | 0 | 0.00 | 0.00 | 0.2 | 1.06 | Kaiwharawhara | 0 | 1 | 0.00 | 0.24 | 0.4 | 0.06 |
| Waverley | 0 | 0 | 0.00 | 0.00 | 1.2 | 1.05 | Gisborne 50 kV | 0 | 0 | 0.00 | 0.00 | 0.2 | 0.05 |
| Ohaaki | 2 | 1 | 1.38 | 0.78 | 0.8 | 1.03 | Tangiwai 11 kV | 0 | 0 | 0.00 | 0.00 | 0.2 | 0.04 |
| Mt Roskill 22 kV | 0 | 0 | 0.00 | 0.00 | 0.4 | 1.02 | Waihou | 1 | 1 | 0.10 | 0.10 | 0.4 | 0.04 |
| Marton | 0 | 0 | 0.00 | 0.00 | 0.4 | 0.96 | Whakatu | 1 | 0 | 0.22 | 0.00 | 0.2 | 0.04 |
| Hangatiki | 0 | 0 | 0.00 | 0.00 | 0.6 | 0.92 | Central Park 11 kV | 0 | 0 | 0.00 | 0.00 | 0.4 | 0.02 |
| Woodville | 3 | 0 | 1.57 | 0.00 | 1.0 | 0.90 | Kawerau (A) | 1 | 0 | 0.03 | 0.00 | 0.2 | 0.01 |
| Otahuhu | 2 | 1 | 0.07 | 4.11 | 0.6 | 0.84 | Kensington | 0 | 0 | 0.00 | 0.00 | 0.2 | 0.01 |
| Kinleith 33 kV | 0 | 1 | 0.00 | 4.01 | 0.2 | 0.80 | Tangiwai 55 kV | 0 | 0 | 0.00 | 0.00 | 0.2 | 0.01 |
| Masterton | 1 | 0 | 1.49 | 0.00 | 1.2 | 0.79 | Albany 110 kV | 0 | 0 | 0.00 | 0.00 | 0.0 | 0.00 |
| Pauatahanui | 2 | 1 | 2.57 | 1.35 | 0.6 | 0.78 | Albany 33 kV | 0 | 0 | 0.00 | 0.00 | 0.0 | 0.00 |
| Kinleith 11 kV (B) | 0 | 1 | 0.00 | 3.77 | 0.2 | 0.75 | Bombay 110 kV | 0 | 0 | 0.00 | 0.00 | 0.0 | 0.00 |
| Te Matai | 0 | 1 | 0.00 | 0.28 | 0.6 | 0.74 | Bream Bay | 0 | 0 | 0.00 | 0.00 | 0.0 | 0.00 |
| Waiotahi | 0 | 0 | 0.00 | 0.00 | 0.4 | 0.66 | Brunswick | 0 | 0 | 0.00 | 0.00 | 0.0 | 0.00 |
| Mangahao | 1 | 0 | 2.46 | 0.00 | 0.8 | 0.63 | Bunnythorpe 33 kV | 0 | 0 | 0.00 | 0.00 | 0.0 | 0.00 |
| National Park | 0 | 3 | 0.00 | 1.49 | 1.6 | 0.63 | Bunnythorpe 55 kV | 0 | 0 | 0.00 | 0.00 | 0.0 | 0.00 |
| Glenbrook (B) | 1 | 0 | 3.04 | 0.00 | 0.2 | 0.61 | Carrington St | 0 | 0 | 0.00 | 0.00 | 0.0 | 0.00 |
| Kinleith 11 kV (A) | 0 | 2 | 0.00 | 3.00 | 0.6 | 0.61 | Edgecumbe | 0 | 0 | 0.00 | 0.00 | 0.0 | 0.00 |
| Taumarunui | 4 | 5 | 0.03 | 0.85 | 3.4 | 0.56 | Fernhill | 0 | 0 | 0.00 | 0.00 | 0.0 | 0.00 |
| Paraparaumu | 1 | 1 | 1.16 | 1.61 | 0.4 | 0.55 | Glenbrook (A) | 0 | 0 | 0.00 | 0.00 | 0.0 | 0.00 |
| Dannevirke | 1 | 1 | 1.48 | 0.70 | 1.2 | 0.53 | Gracefield | 0 | 0 | 0.00 | 0.00 | 0.0 | 0.00 |
| Lichfield | 0 | 1 | 0.00 | 2.22 | 0.4 | 0.52 | Hamilton 11 kV | 0 | 0 | 0.00 | 0.00 | 0.0 | 0.00 |
| Mt Maunganui 33 kV | 0 | 0 | 0.00 | 0.00 | 0.2 | 0.52 | Hamilton 55 kV | 0 | 0 | 0.00 | 0.00 | 0.0 | 0.00 |
| Silverdale | 1 | 3 | 0.16 | 0.83 | 1.4 | 0.50 | Haywards 33 kV | 0 | 0 | 0.00 | 0.00 | 0.0 | 0.00 |
| Tauranga 11 kV | 0 | 0 | 0.00 | 0.00 | 0.2 | 0.50 | Henderson | 0 | 0 | 0.00 | 0.00 | 0.0 | 0.00 |
| Hawera | 1 | 1 | 0.70 | 1.34 | 0.6 | 0.49 | Huirangi | 0 | 0 | 0.00 | 0.00 | 0.0 | 0.00 |
| Ongarue | 1 | 0 | 2.36 | 0.00 | 0.2 | 0.47 | Kopu | 0 | 0 | 0.00 | 0.00 | 0.0 | 0.00 |
| Moturoa | 0 | 0 | 0.00 | 0.00 | 0.2 | 0.46 | Linton | 0 | 0 | 0.00 | 0.00 | 0.0 | 0.00 |
| Wanganui | 0 | 0 | 0.00 | 0.00 | 0.2 | 0.43 | Mangere 110 kV | 0 | 0 | 0.00 | 0.00 | 0.0 | 0.00 |
| Ohakune (B) | 0 | 1 | 0.00 | 0.22 | 0.8 | 0.42 | Marsden | 0 | 0 | 0.00 | 0.00 | 0.0 | 0.00 |
| Hepburn Road | 0 | 0 | 0.00 | 0.00 | 0.4 | 0.41 | Melling 11 kV | 0 | 0 | 0.00 | 0.00 | 0.0 | 0.00 |
| Kaikohe | 0 | 0 | 0.00 | 0.00 | 0.2 | 0.39 | Melling 33 kV | 0 | 0 | 0.00 | 0.00 | 0.0 | 0.00 |
| Bombay 33 kV | 0 | 1 | 0.00 | 1.85 | 0.4 | 0.38 | Mt Maunganui 11 kV | 0 | 0 | 0.00 | 0.00 | 0.0 | 0.00 |
| Hinuera | 0 | 1 | 0.00 | 0.08 | 0.6 | 0.37 | Penrose 33 kV (B) | 0 | 0 | 0.00 | 0.00 | 0.0 | 0.00 |
| Mataroa | 0 | 0 | 0.00 | 0.00 | 0.8 | 0.37 | Redclyffe | 0 | 0 | 0.00 | 0.00 | 0.0 | 0.00 |
| Hamilton 33 kV | 0 | 0 | 0.00 | 0.00 | 0.4 | 0.35 | Takanini | 0 | 0 | 0.00 | 0.00 | 0.0 | 0.00 |
| Waipawa 33 kV | 2 | 0 | 1.23 | 0.00 | 0.8 | 0.32 | Tarukenga | 0 | 0 | 0.00 | 0.00 | 0.0 | 0.00 |
| Wellsford | 0 | 0 | 0.00 | 0.00 | 0.2 | 0.31 | Tauranga 33 kV | 0 | 0 | 0.00 | 0.00 | 0.0 | 0.00 |
| Ohakune (A) | 0 | 1 | 0.00 | 0.27 | 0.8 | 0.30 | Te Kowhai | 0 | 0 | 0.00 | 0.00 | 0.0 | 0.00 |
| Rotorua 11 kV | 0 | 0 | 0.00 | 0.00 | 0.2 | 0.29 | Waikino | 0 | 0 | 0.00 | 0.00 | 0.0 | 0.00 |
| Kaitaia | 0 | 0 | 0.00 | 0.00 | 0.2 | 0.28 | Waipawa 11 kV | 0 | 0 | 0.00 | 0.00 | 0.0 | 0.00 |
| Takapu Road | 1 | 0 | 1.34 | 0.00 | 0.2 | 0.27 | Wairakei | 0 | 0 | 0.00 | 0.00 | 0.0 | 0.00 |
| Maungaturoto | 0 | 0 | 0.00 | 0.00 | 0.2 | 0.26 | Wairoa | 0 | 0 | 0.00 | 0.00 | 0.0 | 0.00 |
| Rotorua 33 kV | 0 | 0 | 0.00 | 0.00 | 0.4 | 0.25 | Whirinaki | 0 | 0 | 0.00 | 0.00 | 0.0 | 0.00 |
| | | | | | | | **OVERALL AVERAGE** | | | **0.31** | **0.80** | | **0.56** |
| | | | | | | | MIDDLE AVERAGE | | | 0.22 | 0.42 | | 0.37 |
| | | | | | | | *Middle Average excludes highest five and lowest five.* | | | | | | |

**Table 5: South Island Supply Points of Service – Unplanned Interruptions (listed alphabetically)**

| Point of Service | 06/07 Number | 07/08 Number | 06/07 Unserved Energy % x100 | 07/08 Unserved Energy % x100 | 5 Yr Average Number | 5 Yr Avg. Unserved Energy % x100 | Point of Service | 06/07 Number | 07/08 Number | 06/07 Unserved Energy % x100 | 07/08 Unserved Energy % x100 | 5 Yr Average Number | 5 Yr Avg. Unserved Energy % x100 |
|---|---|---|---|---|---|---|---|---|---|---|---|---|---|
| Addington 11 kV | 1 | 0 | 0.28 | 0.00 | 0.2 | 0.06 | Kaikoura | 5 | 1 | 3.10 | 0.07 | 2.2 | 0.79 |
| Addington 66 kV | 0 | 0 | 0.00 | 0.00 | 0.0 | 0.00 | Kikiwa | 1 | 0 | 2.03 | 0.00 | 0.2 | 0.41 |
| Albury | 2 | 3 | 2.03 | 2.20 | 3.2 | 2.54 | Middleton | - | 0 | - | 0.00 | 0.0 | 0.00 |
| Arthur's Pass | 9 | 7 | 3.81 | 14.1 | 5.6 | 23.78 | Motueka | 1 | 0 | 2.14 | 0.00 | 1.0 | 0.59 |
| Ashburton 33 kV | 1 | 2 | 1.77 | 0.43 | 0.6 | 0.44 | Motupipi 66 kV | 3 | 0 | 2.42 | 0.00 | 0.8 | 0.59 |
| Ashburton 66 kV | 0 | 1 | 0.00 | 0.21 | 0.2 | 0.04 | Murchison | 1 | 1 | 3.17 | 0.53 | 0.4 | 0.74 |
| Ashley | 0 | 0 | 0.00 | 0.00 | 0.0 | 0.00 | Naseby | 0 | 0 | 0.00 | 0.00 | 0.4 | 0.10 |
| Atarau | 2 | 6 | 0.00 | 2.09 | 4.0 | 1.05 | North Makarewa | 0 | 1 | 0.00 | 0.47 | 0.2 | 0.09 |
| Balclutha | 0 | 0 | 0.00 | 0.00 | 0.2 | 0.02 | Oamaru | 1 | 0 | 2.31 | 0.00 | 1.2 | 0.91 |
| Blackpoint | 2 | 0 | 0.00 | 0.00 | 2.0 | 0.00 | Orowaiti | 1 | 2 | 2.68 | 2.19 | 0.6 | 0.97 |
| Blenheim | 1 | 0 | 1.76 | 0.00 | 1.2 | 0.43 | Otira | 3 | 3 | 1.17 | 5.82 | 3.0 | 3.82 |
| Bromley 11 kV | 0 | 0 | 0.00 | 0.00 | 0.0 | 0.00 | Palmerston | 3 | 2 | 0.21 | 0.13 | 1.8 | 0.57 |
| Bromley 66 kV | 0 | 0 | 0.00 | 0.00 | 0.0 | 0.00 | Papanui 11 kV | 0 | 0 | 0.00 | 0.00 | 0.0 | 0.00 |
| Brydone | 1 | 0 | 0.48 | 0.00 | 0.4 | 0.35 | Papanui 66 kV | 0 | 0 | 0.00 | 0.00 | 0.0 | 0.00 |
| Castle Hill | 8 | 7 | 1.64 | 12.0 | 5.2 | 16.74 | Reefton | 1 | 1 | 2.16 | 1.44 | 0.7 | 1.20 |
| Clyde | 0 | 0 | 0.00 | 0.00 | 0.0 | 0.00 | South Dunedin | 0 | 0 | 0.00 | 0.00 | 0.0 | 0.00 |
| Coleridge | 1 | 1 | 0.43 | 0.33 | 1.0 | 14.34 | Southbrook | 0 | 0 | 0.00 | 0.00 | 0.0 | 0.00 |
| Cromwell | 0 | 0 | 0.00 | 0.00 | 0.2 | 0.15 | Springston 33 kV | 0 | 1 | 0.00 | 1.22 | 0.6 | 0.31 |
| Culverden | 2 | 0 | 1.94 | 0.00 | 1.0 | 0.45 | Springston 66 kV | 0 | 0 | 0.00 | 0.00 | 0.0 | 0.00 |
| Dobson | 3 | 2 | 2.51 | 2.08 | 2.0 | 1.27 | Stoke | 1 | 0 | 1.09 | 0.00 | 0.8 | 0.82 |
| Edendale | 0 | 0 | 0.00 | 0.00 | 0.0 | 0.00 | Studholme | 1 | 0 | 0.13 | 0.00 | 1.8 | 0.24 |
| Frankton (A) | 0 | 0 | 0.00 | 0.00 | 0.2 | 0.14 | Tekapo A | 2 | 3 | 1.06 | 1.15 | 2.8 | 1.54 |
| Frankton (B) | - | 0 | - | 0.00 | 0.0 | 0.00 | Temuka | 0 | 0 | 0.00 | 0.00 | 2.0 | 0.04 |
| Gore | 2 | 0 | 0.97 | 0.00 | 1.2 | 0.28 | Timaru | 0 | 0 | 0.00 | 0.00 | 0.0 | 0.00 |
| Greymouth | 2 | 3 | 1.04 | 1.67 | 2.4 | 0.99 | Tiwai | 0 | 0 | 0.00 | 0.00 | 0.0 | 0.00 |
| Halfway Bush | 1 | 0 | 0.26 | 0.00 | 0.2 | 0.05 | Twizel (A) | 0 | 0 | 0.00 | 0.00 | 0.0 | 0.00 |
| Hokitika | 3 | 3 | 1.77 | 2.23 | 2.6 | 2.34 | Twizel (B) | 0 | 0 | 0.00 | 0.00 | 0.6 | 29.00 |
| Hororata 33 kV | 0 | 1 | 0.00 | 0.10 | 0.4 | 0.21 | Twizel (C) | 0 | 0 | 0.00 | 0.00 | 0.8 | 0.47 |
| Hororata 66 kV | 0 | 0 | 0.00 | 0.00 | 0.2 | 0.14 | Waipara 33 kV | 1 | 0 | 0.00 | 0.00 | 0.2 | 0.00 |
| Invercargill | 0 | 0 | 0.00 | 0.00 | 0.0 | 0.00 | Waipara 66 kV | - | 0 | - | 0.00 | 0.0 | 0.00 |
| Islington 33 kV | 0 | 0 | 0.00 | 0.00 | 0.4 | 0.07 | Waitaki | 0 | 0 | 0.00 | 0.00 | 0.0 | 0.00 |
| Islington 66 kV | 0 | 0 | 0.00 | 0.00 | 0.0 | 0.00 | Westport | 2 | 2 | 7.07 | 78.7 | 0.8 | 17.17 |
| Kaiapoi | 0 | 1 | 0.00 | 0.03 | 0.6 | 0.10 | | | | | | | |

**Table 6: South Island Supply Points of Service – Unplanned Interruptions (listed by 5 year average unserved energy**

| Point of Service | 06/07 Number | 07/08 Number | 06/07 Unserved Energy % x100 | 07/08 Unserved Energy % x100 | 5 Yr Average Number | 5 Yr Avg. Unserved Energy % x100 | Point of Service | 06/07 Number | 07/08 Number | 06/07 Unserved Energy % x100 | 07/08 Unserved Energy % x100 | 5 Yr Average Number | 5 Yr Avg. Unserved Energy % x100 |
|---|---|---|---|---|---|---|---|---|---|---|---|---|---|
| Twizel (B) | 0 | 0 | 0.00 | 0.00 | 0.6 | 29.00 | Hororata 66 kV | 0 | 0 | 0.00 | 0.00 | 0.2 | 0.14 |
| Arthur's Pass | 9 | 7 | 3.81 | 14.1 | 5.6 | 23.78 | Kaiapoi | 0 | 1 | 0.00 | 0.03 | 0.6 | 0.10 |
| Westport | 2 | 2 | 7.07 | 78.7 | 0.8 | 17.17 | Naseby | 0 | 0 | 0.00 | 0.00 | 0.4 | 0.10 |
| Castle Hill | 8 | 7 | 1.64 | 12.0 | 5.2 | 16.74 | North Makarewa | 0 | 1 | 0.00 | 0.47 | 0.2 | 0.09 |
| Coleridge | 1 | 1 | 0.43 | 0.33 | 1.0 | 14.34 | Islington 33 kV | 0 | 0 | 0.00 | 0.00 | 0.4 | 0.07 |
| Otira | 3 | 3 | 1.17 | 5.82 | 3.0 | 3.82 | Addington 11 kV | 1 | 0 | 0.28 | 0.00 | 0.2 | 0.06 |
| Albury | 2 | 3 | 2.03 | 2.20 | 3.2 | 2.54 | Halfway Bush | 1 | 0 | 0.26 | 0.00 | 0.2 | 0.05 |
| Hokitika | 3 | 3 | 1.77 | 2.23 | 2.6 | 2.34 | Ashburton 66 kV | 0 | 1 | 0.00 | 0.21 | 0.2 | 0.04 |
| Tekapo A | 2 | 3 | 1.06 | 1.15 | 2.8 | 1.54 | Temuka | 0 | 0 | 0.00 | 0.00 | 2.0 | 0.04 |
| Dobson | 3 | 2 | 2.51 | 2.08 | 2.0 | 1.27 | Balclutha | 0 | 0 | 0.00 | 0.00 | 0.2 | 0.02 |
| Reefton | 1 | 1 | 2.16 | 1.44 | 0.7 | 1.20 | Addington 66 kV | 0 | 0 | 0.00 | 0.00 | 0.0 | 0.00 |
| Atarau | 2 | 6 | 0.00 | 2.09 | 4.0 | 1.05 | Ashley | 0 | 0 | 0.00 | 0.00 | 0.0 | 0.00 |
| Greymouth | 2 | 3 | 1.04 | 1.67 | 2.4 | 0.99 | Blackpoint | 2 | 0 | 0.00 | 0.00 | 2.0 | 0.00 |
| Orowaiti | 1 | 2 | 2.68 | 2.19 | 0.6 | 0.97 | Bromley 11 kV | 0 | 0 | 0.00 | 0.00 | 0.0 | 0.00 |
| Oamaru | 1 | 0 | 2.31 | 0.00 | 1.2 | 0.91 | Bromley 66 kV | 0 | 0 | 0.00 | 0.00 | 0.0 | 0.00 |
| Stoke | 1 | 0 | 1.09 | 0.00 | 0.8 | 0.82 | Clyde | 0 | 0 | 0.00 | 0.00 | 0.0 | 0.00 |
| Kaikoura | 5 | 1 | 3.10 | 0.07 | 2.2 | 0.79 | Edendale | 0 | 0 | 0.00 | 0.00 | 0.0 | 0.00 |
| Murchison | 1 | 1 | 3.17 | 0.53 | 0.4 | 0.74 | Frankton (B) | - | 0 | - | 0.00 | 0.0 | 0.00 |
| Motueka | 1 | 0 | 2.14 | 0.00 | 1.0 | 0.59 | Invercargill | 0 | 0 | 0.00 | 0.00 | 0.0 | 0.00 |
| Motupipi 66 kV | 3 | 0 | 2.42 | 0.00 | 0.8 | 0.59 | Islington 66 kV | 0 | 0 | 0.00 | 0.00 | 0.0 | 0.00 |
| Palmerston | 3 | 2 | 0.21 | 0.13 | 1.8 | 0.57 | Middleton | - | 0 | - | 0.00 | 0.0 | 0.00 |
| Twizel (C) | 0 | 0 | 0.00 | 0.00 | 0.8 | 0.47 | Papanui 11 kV | 0 | 0 | 0.00 | 0.00 | 0.0 | 0.00 |
| Culverden | 2 | 0 | 1.94 | 0.00 | 1.0 | 0.45 | Papanui 66 kV | 0 | 0 | 0.00 | 0.00 | 0.0 | 0.00 |
| Ashburton 33 kV | 1 | 2 | 1.77 | 0.43 | 0.6 | 0.44 | South Dunedin | 0 | 0 | 0.00 | 0.00 | 0.0 | 0.00 |
| Blenheim | 1 | 0 | 1.76 | 0.00 | 1.2 | 0.43 | Southbrook | 0 | 0 | 0.00 | 0.00 | 0.0 | 0.00 |
| Kikiwa | 1 | 0 | 2.03 | 0.00 | 0.2 | 0.41 | Springston 66 kV | 0 | 0 | 0.00 | 0.00 | 0.0 | 0.00 |
| Brydone | 1 | 0 | 0.48 | 0.00 | 0.4 | 0.35 | Timaru | 0 | 0 | 0.00 | 0.00 | 0.0 | 0.00 |
| Springston 33 kV | 0 | 1 | 0.00 | 1.22 | 0.6 | 0.31 | Tiwai | 0 | 0 | 0.00 | 0.00 | 0.0 | 0.00 |
| Gore | 2 | 0 | 0.97 | 0.00 | 1.2 | 0.28 | Twizel (A) | 0 | 0 | 0.00 | 0.00 | 0.0 | 0.00 |
| Studholme | 1 | 0 | 0.13 | 0.00 | 1.8 | 0.24 | Waipara 33 kV | 1 | 0 | 0.00 | 0.00 | 0.2 | 0.00 |
| Hororata 33 kV | 0 | 1 | 0.00 | 0.10 | 0.4 | 0.21 | Waipara 66 kV | - | 0 | - | 0.00 | 0.0 | 0.00 |
| Cromwell | 0 | 0 | 0.00 | 0.00 | 0.2 | 0.15 | Waitaki | 0 | 0 | 0.00 | 0.00 | 0.0 | 0.00 |
| Frankton (A) | 0 | 0 | 0.00 | 0.00 | 0.2 | 0.14 | | | | | | | |
| | | | | | | | **OVERALL AVERAGE** | | | **0.83** | **1.99** | | **1.94** |
| | | | | | | | MIDDLE AVERAGE | | | 0.73 | 0.44 | | 0.46 |
| | | | | | | | *Middle Average excludes highest five and lowest five.* | | | | | | |

# Point of Service Performance - Generators

**Table 7: Generator Points of Service – Unplanned Interruptions (listed alphabetically)**

| Point of Service | 06/07 Number | 07/08 Number | 06/07 Duration (mins) | 07/08 Duration (mins) | 5 Yr Average Number | 5 Yr Average Duration (mins) | Point of Service | 06/07 Number | 07/08 Number | 06/07 Duration (mins) | 07/08 Duration (mins) | 5 Yr Average Number | 5 Yr Average Duration (mins) |
|---|---|---|---|---|---|---|---|---|---|---|---|---|---|
| Arapuni | 0 | 1 | 0 | 3 | 0.4 | 3 | Ohaaki | 0 | 0 | 0 | 0 | 0.2 | 67 |
| Aratiatia | 1 | 0 | 52 | 0 | 0.6 | 168 | Ohakuri | 0 | 0 | 0 | 0 | 0.0 | 0 |
| Argyle | 3 | 5 | 204 | 177 | 3.0 | 85 | Ohau A | 0 | 1 | 0 | 6 | 0.2 | 1 |
| Atiamuri | 0 | 0 | 0 | 0 | 0.0 | 0 | Ohau B | 1 | 0 | 59 | 0 | 0.4 | 94 |
| Aviemore | 0 | 0 | 0 | 0 | 0.2 | 21 | Ohau C | 0 | 0 | 0 | 0 | 0.0 | 0 |
| Benmore | 0 | 2 | 0 | 1765 | 2.0 | 1132 | Otahuhu A 110 kV | 1 | 0 | 113 | 0 | 0.4 | 72 |
| Berwick | 9 | 7 | 55 | 47 | 4.4 | 28 | Otahuhu C 220 kV | 0 | 0 | 0 | 0 | 0.4 | 167 |
| Clyde | 0 | 0 | 0 | 0 | 0.0 | 0 | Poihipi | 0 | 1 | 0 | 28 | 1.0 | 92 |
| Cobb | 1 | 0 | 109 | 0 | 1.2 | 92 | Rangipo | 1 | 2 | 147 | 39 | 1.2 | 51 |
| Coleridge | 1 | 1 | 12 | 31 | 1.0 | 371 | Rotorua 110 kV | 0 | 0 | 0 | 0 | 0.0 | 0 |
| Hawera (A) | 1 | 0 | 34 | 0 | 0.4 | 11 | Roxburgh 110 kV | 0 | 0 | 0 | 0 | 0.0 | 0 |
| Hawera (B) | 1 | 0 | 541 | 0 | 0.2 | 108 | Roxburgh 220 kV | 0 | 0 | 0 | 0 | 0.0 | 0 |
| Huntly | 0 | 0 | 0 | 0 | 0.0 | 0 | Southdown | 0 | 0 | 0 | 0 | 0.0 | 0 |
| Kaponga | 2 | 1 | 9 | 11 | 1.2 | 46 | Stratford | 0 | 1 | 0 | 56 | 0.2 | 11 |
| Karapiro | 0 | 0 | 0 | 0 | 1.0 | 124 | Tararua Windfarm C | - | - | - | - | - | - |
| Kawerau Geotherm | - | - | - | - | - | - | Te Apiti Wind Farm | 3 | 3 | 109 | 171 | 3.8 | 154 |
| Kinleith | 0 | 1 | 0 | 176 | 0.2 | 35 | Tekapo A | 1 | 4 | 32 | 155 | 2.6 | 118 |
| Kumara | 3 | 3 | 84 | 95 | 2.2 | 54 | Tekapo B | 0 | 1 | 0 | 0 | 0.6 | 7 |
| Manapouri | 0 | 0 | 0 | 0 | 0.0 | 0 | Tokaanu | 0 | 0 | 0 | 0 | 0.2 | 101 |
| Mangahao | 1 | 0 | 91 | 0 | 0.8 | 27 | Tuai | 0 | 0 | 0 | 0 | 0.0 | 0 |
| Maraetai | 0 | 1 | 0 | 259 | 0.4 | 94 | Waipapa | 0 | 1 | 0 | 259 | 0.2 | 52 |
| Matahina (A) | 0 | 0 | 0 | 0 | 0.4 | 140 | Wairakei | 1 | 0 | 33 | 0 | 0.4 | 19 |
| Matahina (B) | 0 | 0 | 0 | 0 | 0.2 | 3 | Waitaki | 0 | 0 | 0 | 0 | 0.0 | 0 |
| New Plymouth 110 kV | 0 | 0 | 0 | 0 | 0.0 | 0 | Whakamaru | 1 | 0 | 108 | 0 | 0.4 | 28 |
| New Plymouth 220 kV | 0 | 0 | 0 | 0 | 0.8 | 59 | Whirinaki | 0 | 0 | 0 | 0 | 0.0 | 0 |

**Table 8: Generator Points of Service – Unplanned Interruptions (listed by 5 year average duration)**

| Point of Service | 06/07 Number | 07/08 Number | 06/07 Duration (mins) | 07/08 Duration (mins) | 5 Yr Average Number | 5 Yr Average Duration (mins) | Point of Service | 06/07 Number | 07/08 Number | 06/07 Duration (mins) | 07/08 Duration (mins) | 5 Yr Average Number | 5 Yr Average Duration (mins) |
|---|---|---|---|---|---|---|---|---|---|---|---|---|---|
| Benmore | 0 | 2 | 0 | 1765 | 2.0 | 1132 | Mangahao | 1 | 0 | 91 | 0 | 0.8 | 27 |
| Coleridge | 1 | 1 | 12 | 31 | 1.0 | 371 | Aviemore | 0 | 0 | 0 | 0 | 0.2 | 21 |
| Aratiatia | 1 | 0 | 52 | 0 | 0.6 | 168 | Wairakei | 1 | 0 | 33 | 0 | 0.4 | 19 |
| Otahuhu C 220 kV | 0 | 0 | 0 | 0 | 0.4 | 167 | Hawera (A) | 1 | 0 | 34 | 0 | 0.4 | 11 |
| Te Apiti Wind Farm | 3 | 3 | 109 | 171 | 3.8 | 154 | Stratford | 0 | 1 | 0 | 56 | 0.2 | 11 |
| Matahina (A) | 0 | 0 | 0 | 0 | 0.4 | 140 | Tekapo B | 0 | 1 | 0 | 0 | 0.6 | 7 |
| Karapiro | 0 | 0 | 0 | 0 | 1.0 | 124 | Arapuni | 0 | 1 | 0 | 3 | 0.4 | 3 |
| Tekapo A | 1 | 4 | 32 | 155 | 2.6 | 118 | Matahina (B) | 0 | 0 | 0 | 0 | 0.2 | 3 |
| Hawera (B) | 1 | 0 | 541 | 0 | 0.2 | 108 | Ohau A | 0 | 1 | 0 | 6 | 0.2 | 1 |
| Tokaanu | 0 | 0 | 0 | 0 | 0.2 | 101 | Atiamuri | 0 | 0 | 0 | 0 | 0.0 | 0 |
| Maraetai | 0 | 1 | 0 | 259 | 0.4 | 94 | Clyde | 0 | 0 | 0 | 0 | 0.0 | 0 |
| Ohau B | 1 | 0 | 59 | 0 | 0.4 | 94 | Huntly | 0 | 0 | 0 | 0 | 0.0 | 0 |
| Cobb | 1 | 0 | 109 | 0 | 1.2 | 92 | Manapouri | 0 | 0 | 0 | 0 | 0.0 | 0 |
| Poihipi | 0 | 1 | 0 | 28 | 1.0 | 92 | New Plymouth 110 kV | 0 | 0 | 0 | 0 | 0.0 | 0 |
| Argyle | 3 | 5 | 204 | 177 | 3.0 | 85 | Ohakuri | 0 | 0 | 0 | 0 | 0.0 | 0 |
| Otahuhu A 110 kV | 1 | 0 | 113 | 0 | 0.4 | 72 | Ohau C | 0 | 0 | 0 | 0 | 0.0 | 0 |
| Ohaaki | 0 | 0 | 0 | 0 | 0.2 | 67 | Rotorua 110 kV | 0 | 0 | 0 | 0 | 0.0 | 0 |
| New Plymouth 220 kV | 0 | 0 | 0 | 0 | 0.8 | 59 | Roxburgh 110 kV | 0 | 0 | 0 | 0 | 0.0 | 0 |
| Kumara | 3 | 3 | 84 | 95 | 2.2 | 54 | Roxburgh 220 kV | 0 | 0 | 0 | 0 | 0.0 | 0 |
| Waipapa | 0 | 1 | 0 | 259 | 0.2 | 52 | Southdown | 0 | 0 | 0 | 0 | 0.0 | 0 |
| Rangipo | 1 | 2 | 147 | 39 | 1.2 | 51 | Tuai | 0 | 0 | 0 | 0 | 0.0 | 0 |
| Kaponga | 2 | 1 | 9 | 11 | 1.2 | 46 | Waitaki | 0 | 0 | 0 | 0 | 0.0 | 0 |
| Kinleith | 0 | 1 | 0 | 176 | 0.2 | 35 | Whirinaki | 0 | 0 | 0 | 0 | 0.0 | 0 |
| Berwick | 9 | 7 | 55 | 47 | 4.4 | 28 | Kawerau Geotherm | - | - | - | - | - | - |
| Whakamaru | 1 | 0 | 108 | 0 | 0.4 | 28 | Tararua Windfarm C | - | - | - | - | - | - |
| | | | | | | | **OVERALL AVERAGE** | | | | **37** | **68** | |
| | | | | | | | MIDDLE AVERAGE | | | | 43 | 35 | |
| | | | | | | | *Middle Average excludes highest five and lowest five.* | | | | | | |

# 13 The Electricity Information Disclosure Requirements[10]

(For 12 months ending 30 June 2008, 2007, 2006, 2005)

## Part 4

| Energy Delivery Efficiency Performance Measures and Statistics<br>(Disclosure under Requirement 20) | 2007/08 | 2006/07 | 2005/06 | 2004/05 |
|---|---|---|---|---|
| **1. Energy delivery efficiency performance measures** | | | | |
| *(a)* Load factor (%)<br>*Electrical energy entering the transmission system as percentage of maximum demand times hours per year* | 68.35 | 66.60 | 66.50 | 69.70 |
| *(b)* Loss ratio (%)<br>*Transmission losses as percentage of energy entering the system* | 3.66 | 3.74 | 3.63 | 3.76 |
| *(c)* Capacity utilisation (%)<br>*Maximum demand as percentage of total transformer capacity*<br>*Based on Maximum Continuous Ratings* | 48.10 | 50.37 | 51.61 | 49.72 |
| **2. Statistics** | | | | |
| (a) System length, broken down by voltage (km) | | | | |
| Total [a] | 17,333 | 17,334 | 17,248 | 17,045 |
| 350 kV (HVDC) | 611 | 611 | 611 | 611 |
| 270 kV (HVDC) | 611 | 611 | 611 | 611 |
| 0 kV (HVDC earth electrode) | 31 | 31 | 31 | 31 |
| 220 kV (HVAC) | 8,631 | 8,617 | 8,611 | 8,380 |
| 110 kV (HVAC) | 6,298 | 6,299 | 6,219 | 6,073 |
| 66/50/33/11 kV (HVAC) [a] | 1,151 | 1,165 | 1,165 | 1,339 |
| (b) Circuit length of overhead electric lines, broken down by voltage (km). | | | | |
| Total [a] | 17,248 | 17,249 | 17,163 | 16,960 |
| 350 kV (HVDC) | 571 | 571 | 571 | 571 |
| 270 kV (HVDC) | 571 | 571 | 571 | 571 |
| 0 kV (HVDC earth electrode) | 31 | 31 | 31 | 31 |
| 220 kV (HVAC) | 8,631 | 8,617 | 8,611 | 8,380 |
| 110 kV (HVAC) | 6,293 | 6,294 | 6,214 | 6,068 |
| 66/50/33/11 kV (HVAC) [a] | 1,151 | 1,165 | 1,165 | 1,339 |
| NB: HVDC link submarine power cables measure approximately 80km. Broken down by voltage | | | | |
| 350 kV (HVDC) | 40 | 40 | 40 | 40 |
| 270 kV (HVDC) | 40 | 40 | 40 | 40 |
| (c) Total circuit length of underground electric lines (km) | | | | |
| ( 110 kV HVAC) | 5 | 5 | 5 | 5 |
| (d) Transformer capacity (Maximum Continuous Ratings) (kVA) | $13.80 \times 10^6$ | $13.31 \times 10^6$ | $12.88 \times 10^6$ | $12.75 \times 10^6$ |
| (e) Maximum demand (kilowatts) [bc] (kW) | $6.64 \times 10^6$ | $6.71 \times 10^6$ | $6.65 \times 10^6$ | $6.34 \times 10^6$ |
| (f) Total electricity entering the system (before losses) [bc] (kWh) | $39.72 \times 10^9$ | $39.13 \times 10^9$ | $38.73 \times 10^9$ | $38.71 \times 10^9$ |
| (g) Total amount of electricity (in kilowatt hours) supplied from the system (after losses of electricity) during the financial year on behalf of each person that is an electricity generator or an electricity retailer, or both: [bcd] (kWh) | $38.27 \times 10^9$ | $37.66 \times 10^9$ | $37.33 \times 10^9$ | $37.25 \times 10^9$ |
| (h) Total connected customers | 49 | 48 | 47 | 48 |

Notes

a Excludes 61km of circuits leased from others and operated by Transpower, and 34 km owned by Transpower but operated by others.

b To 2 decimal places only, higher accuracy used in calculations.

c For all years, figures for maximum demand kW and kWh injected and supplied include loads on circuits leased by Transpower. The effect of these circuits cannot be measured as metering equipment is not installed at the inter-connection points with Transpower-owned assets, but the difference is estimated to be no more than 0.1% of totals. Loads on Transpower assets leased to others are not included as Transpower does not collect operational data for these assets.

d Including sales to direct connected customers

[10] Electricity Information Disclosure Requirements issued 31 March 2004 as amended by the Electricity Information Disclosure Amendment Requirements 2004 effective 8 May 2004 and the Electricity Information Disclosure Amendment Requirements 2006.

# The Electricity Information Disclosure Requirements

(For 12 months ending 30 June 2008, 2007, 2006, 2005)

## Part 6

| Reliability Performance Measures to be Disclosed by Transpower[a] (Disclosure Under Requirement 21) | 2007/08 | 2006/07 | 2005/06 | 2004/05 |
|---|---|---|---|---|
| **1.** Total number of unplanned interruptions [b] | | | | |
| Resulting from 71 loss of supply incidents in 2007/08 | 115 | 104 | 148 | 67 |
| **2.** Electricity customer interruptions in system minutes [c] | 28.0 [d] | 11.7 | 40.8 | 6.7 |
| Planned | 3.3 | 3.3 | 2.8 | 3.4 |
| Unplanned | 24.6 [d] | 8.4 | 38.0 | 3.3 |
| **3.** Underlying electricity customer interruptions in system minutes [c] | | | | |
| Underlying interruptions are those interruptions of 1 system minute or less duration | 6.8 | 6.4 | 8.8 | 5.7 |
| Planned | 2.1 | 2.2 | 1.5 | 3.4 |
| Unplanned | 4.7 | 4.1 | 7.2 | 2.3 |
| **4.** Average supply reliability (%) | | | | |
| Measured by the energy supplied divided by the sum of the energy supplied and not supplied | 99.9919 | 99.9965 | 99.9879 | 99.9981 |
| **5.** Uneconomic generation due to planned and unplanned transmission system unavailability (%) [e] | - | - | - | - |
| **6.** Uneconomic generation due to HVDC system unavailability (%)[e] | - | - | - | - |
| **7.** Uneconomic generation due to unplanned transmission system unavailability (%)[e] | - | - | - | - |
| **8.** Planned interruption restoration performance (%) | 73.1 | 73.1 | 72.2 | 71.9 |
| **9.** Unplanned interruption response (%) | 100.0 | 99.0 | 100.0 | 100.0 |

Notes

a The information compiled using estimated information includes Part 6 sections 2, 3 and 4. The methodology used to calculate the estimated information is documented and available from Transpower upon request.
The reliability performance measures given in Part 6 do not include the performance of the 34km of circuit leased to other parties because Transpower does not collect operational data for these assets.

b Where two supply voltages, or two customers, at the same station are both interrupted this is counted as two interruptions.

c Any minor differences between the total and the sum of planned and unplanned are due to rounding.
System minutes of interruptions do not include energy made up by backfeed from another point of supply or by embedded generation within a customer's network.

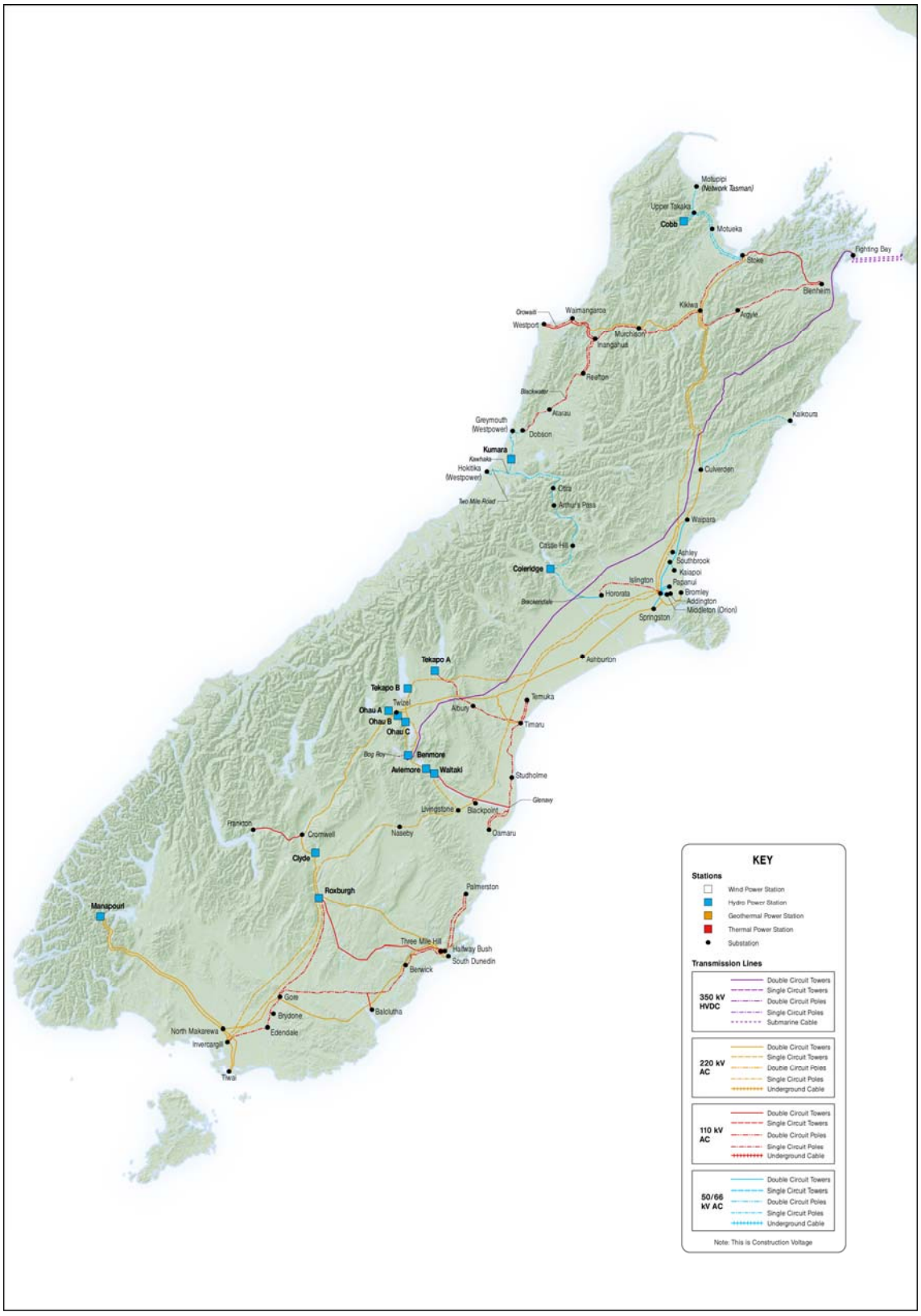
d Transpower considers that approximately 15.7 system minutes out of the total of 24.6 system minutes of unplanned interruptions is not totally attributable to Transpower. This arises from two major incidents during which industrial customers did not have the flexibility in their systems to be able to transfer load to alternative feeders.

e Uneconomic generation (Part 6 sections 5, 6 and 7) is not relevant in the market environment because scheduling is now based on offered price, not economic cost. In the market, 'offers to generate' are made after taking constraints into account and it is not possible to predict what a generator would have offered if the constraint was not present. As a result data is not available to allow a calculation and a null entry has been returned.

# Maps of High Voltage Transmission System

## North Island National Grid and Major Generation Stations

## South Island National Grid and Major Generation Stations



# Significant Events from 1987 to 2008

**Table 9 Significant Events from 1987 to June 2008**

| Date | System Minutes | Cause |
|---|---|---|
| 12/10/07 | 14.1 | Kawerau paper mill shut down to investigate and rectify arc noises on 11 kV bus |
| 07/10/07 | 3.9 | Part of Westport 11 kV bus exploded following a close-in lightning strike |
| 24/09/07 | 1.9 | Protection relay at Kinleith failed to operate for line fault, resulting in interruptions at five points of service |
| 15/10/06 | 1.1 | Kaikohe-Kaitaia line removed from service to repair conductor damage caused by quarry operations |
| 14/09/06 | 1.8 | Earth sticks left on Islington 220 kV bus in error caused 220 kV bus fault and supply interruptions to the north of the South Island |
| 28/08/06 | 1.1 | At Kawerau, a switching error combined with misleading indication resulted in supply being disconnected |
| 25/08/06 | 1.3 | Glenbrook 33 kV bus tripped when a bus insulator failed |
| 12/06/06 | 29.8 | Earthwire failed at Otahuhu causing 110 kV bus fault and widespread loss of load in Auckland area |
| 11/05/06 | 1.0 | Protection relay maloperation at Tarukenga resulted in a Grid Emergency and forced disconnection of load in the Bay of Plenty |
| 16/03/05 | 1.1 | Tapchanger problem caused tripping of both 33kV supply banks at Hamilton |
| 12/04/01 | 4.2 | Mouse caused flashover on 11kV bus at Whirinaki |
| 25-26/09/00 | 4.4 | Heavy wind and snow storm on East Coast, North Island |
| 26/07/98 | 1.5 | Edgecumbe supply transformer damaged as a result of a human error |
| 4/06/97 | 1.1 | Hamilton 11 kV supply transformer tripped because of a tapchanger fault |
| 29/11/96 | 2.2 | Widespread outage in Auckland area following circuits trippings during lightning storm |
| 19/11/96 | 1.3 | Bird proofing netting blown off Kawerau 110 kV bus in high winds |
| 8/10/96 | 2.2 | Human error caused tripping of Islington 66 kV bus |
| 3/03/96 | 2.4 | HVDC pole tripped incorrectly for fault on other pole - due to protection design problem |
| 12/07/94 | 3.9 | Kawerau transformer cable bushing fault |
| 13/01/94 | 3.5 | Tree contacted HVDC lines |
| 9/03/93 | 6.9 | HVDC bipole trip due to communication circuit crossover |
| 23/10/92 | 1.8 | Glenbrook transformer tripped due to pollution flashover |
| 28/08/92 | 11.4 | Heavy snow storms in Canterbury |
| 26/07/92 | 1.1 | Albany transformer tripped due to lightning |
| 6/08/91 | 1.4 | Tower failure on Opunake-Stratford line |
| 16/07/91 | 1.1 | Transformer Buchholz operated during transformer maintenance at Penrose |
| 30/05/91 | 6.1 | Bus fault at Wilton during maintenance activities |
| 28/05/91 | 7.0 | Bus fault at Islington due to a circuit breaker dropper failure |
| 26/04/91 | 1.6 | Supply bank cable fault at Kinleith |
| 10/09/90 | 1.7 | Conductor joint failure on Hinuera-Karapiro line |
| 20/01/89 | 3.5 | Contractor, not associated with Trans Power, felled tree onto Otahuhu-Mt Roskill line |
| 9/12/87 | * | A 110 kV circuit breaker failed to open correctly at Haywards |
| 29/06/87 | * | Circuit breakers Takapu Road failed to trip for a line fault |
| 2/03/87 | * | Bay of Plenty earthquake |

* System minute figures for years prior to 1987/88 are not available