SO MONTHLY OPERATIONAL AND SYSTEM PERFORMANCE REPORT

FOR THE ELECTRICITY AUTHORITY

Transpower New Zealand Limited
February 2017

Keeping the energy flowing




TRANSPOWER

Transpower New Zealand Limited The National Grid

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Report Purpose

This report is Transpower's review of its performance as system operator for February 2017, in accordance with clause 3.14 of the Electricity Industry Participation Code 2010 (the Code).

Operational issues and a detailed system performance report (Code-obligated) are provided for the information of the Electricity Authority (Authority).

1 Operational and system performance update

Northland and Christchurch fires close to transmission circuits dominated power system operations in February.

Northland

On 5 February a fire under the Marsden-Maungatapere (MDN_MPE) 110 kV line supplying Northland was reported at 17:14. By 17:46 a grid emergency was declared, after an urgent request to remove the circuits from service to ensure the safety of fire fighting activities under the line. A second 110 kV line supplying Maungatapere direct from Henderson was also disconnected at the same time as it has insufficient capacity to support the full Northland load. This resulted in a 130 MW loss of supply, and 21 MW of Ngawha (NGA) generation being disconnected.

The 110 kV supply from Henderson was restored at 18:22 to Maungatapere to reenergise the Northland 110 kV network while fire fighting activities continued under the Marsden line. Permission was given to restore to 15 MWs at 18:37 across the affected grid exit points (Dargaville, Maungatapere, Kensington and Kaikohe). This also allowed NGA to commence generation to enable further load to be restored. The fire was contained and the grid emergency ended at 19:10 when the MDN_MPE line was returned to service and instruction given to restore all load.

Christchurch

At 19:10 on Monday 13 February a fire on the Port Hills (Christchurch) near the 220 kV line which carries the Islington-Bromley (ISL_BRY1) and Ashburton-Bromley (ASB_BRY1) circuits was reported. The line supplies Bromley substation and provides the fourth 220 kV connection from the Waitaki Valley into the upper South Island. It was initially assessed unlikely there would be any issues. The fire subsequently moved away from the vicinity of the lines.

On 15 February the fire again approached the 220 kV lines. Transpower and Orion began planning to move load away from Bromley using grid exit point ties in Orion's network and their 66 kV network across Christchurch city. This included switching to reconfigure the grid at Islington substation to maximise the ability to supply Christchurch demand without the 220 kV connection to Bromley, the fourth connection into the upper South Island and only two of the three 220/66 kV interconnecting transformers in service (ISL T6 was out of service for maintenance and could not be recalled).

At 13:53 due to a wind direction change both circuits on the 220 kV line tripped. This resulted in a loss of 95 MW of supply at Bromley, totalling to approximately 200 MW lost from the upper South Island region. Load was tripped off in the wider region due to voltage transients caused by a series of auto-reclose operations just prior to the final loss of supply at Bromley.

A grid emergency was declared to allow the grid to be reconfigured to enable quick restoration of load at Bromley via Islington. Load was restored quickly, supplied off the reconfigured Islington 66 kV bus via remaining T3 and T7 interconnecting

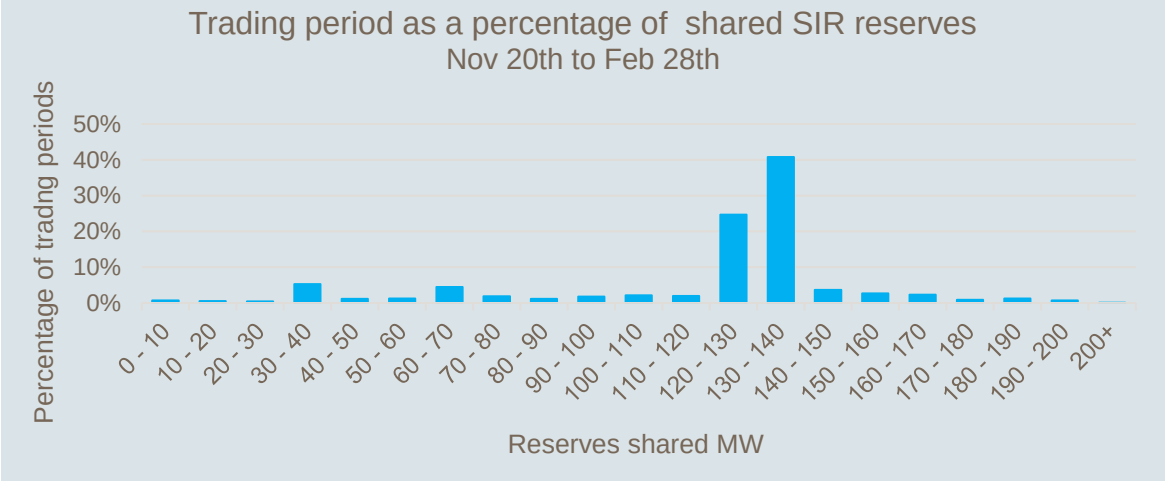
transformers. The operating state of the T7 interconnector under heavier than usual loading was of concern due to a hotspot developing on one of the bushings. Load management using distribution company controllable load was used to mitigate this and contingency plans developed to shed load if it had to be removed from service. On 16 February the Bromley 220 kV lines and Bromley 220 kV grid exit point were successfully restored to service. However, ISL 66 kV system splits remained in place to manage the load on ISL T7 as T6 was still out of service on planned maintenance.

The upper South Island grid configuration returned to normal when ISL T6 and system splits were returned to sevice on 18 February. Repairs to the ISL T7 bushing then started immediately with no impact to system security.

Observations from implementation of NMIR and increased HVDC self cover

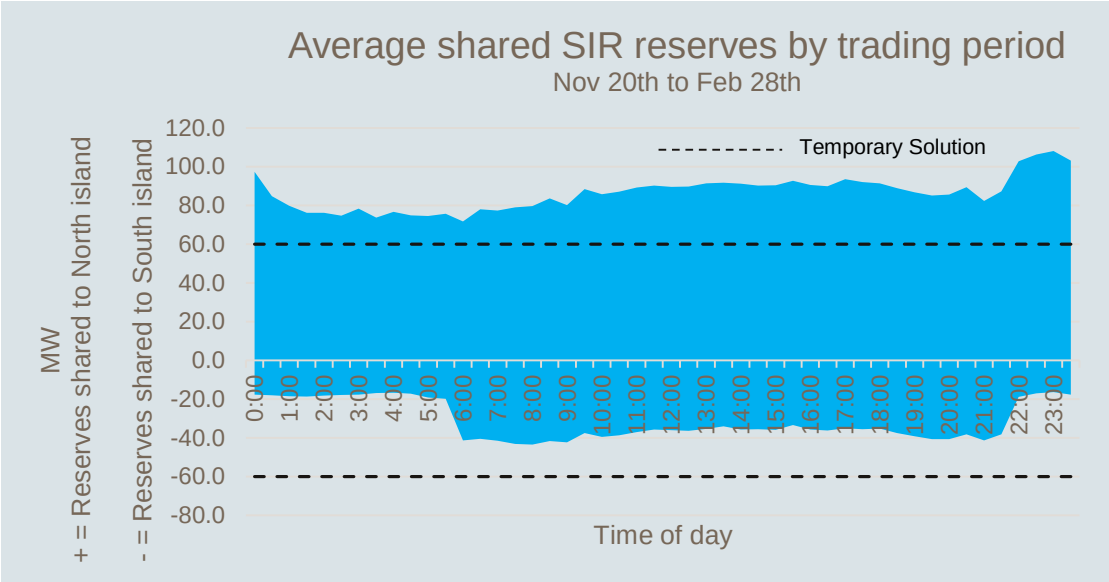
Analysis of the first three months (December to February) of the increased pole overload limit indicates an overall reserve cost saving of around $23,000 . This is expected to increase in the future. This only reflects the direct reserve cost savings and does not consider energy price benefits or the impact of changes in trader behaviour.

Since NMIR was fully implemented on 20 November 2016, shared reserves averaged approximately 117 MW however 75% of the time shared reserves have been greater than120 MW. This is illustrated in the histogram below.



NMIR has had the greatest effect on reserve sharing during peak hours. The graph below compares the average shared reserves under NMIR with the interim sharing solution (60 MW reduction in reserve requirement per island). This demonstrates the greatest sharing between islands is between 06:00 and 22:00, with the North Island

receiving the largest portion of shared reserves due to the lower reserve cost in the South Island.



2 Market design and system enhancement project updates

Progress against in-flight market design and service enhancement projects is included below along with details of any variances from the current Capex Plan.

Efficient Procurement of Extended Reserves – The project completed consultation with industry on the technical requirements schedule which was then published on 14 February. Planning for the remaining work is underway.

Gate Closure – This project will reduce gate closure time from 2 hours to 1 hour in the market system. The Gate Closure project has progressed to the build phase with process changes documented, initial training planned to commence in mid-March, and testing planned for April.

Real Time Pricing – Work has concluded on the current phase of development associated with Real Time Pricing (RTP) with a final report delivered to the Authority on 27 February. Work has commenced on scoping the next phase of work through the consultation period.

National Market for Instantaneous Reserves – This project commissioned on schedule on 20 October with post go-live deployments completed by 8 December. Project close is ongoing.

EDF Phase III – This project will refresh the dispatch functionality within the market system to reduce barriers to entry and enable future dispatch products to be implemented. The investigation project was completed with an initial business case and associated consultation paper delivered to the Authority. The appropriation approval process is now underway. The capital phase of the project is planned to commence in 2017/18.

3 Security of Supply update

Inflows have been above average for February and storage levels were at 91% of total at the end of the month. The hydro risk meter is set to normal.

For the month of February:

- North Island inflows were 120% of average[1]
- South Island inflows were 104% of average[2]
- Hydro generation met 69% of demand.

As at 1 March, aggregate primary New Zealand storage was 115% of average.

The Security of Supply Annual Assessment was published on 28 February.

4 Compliance update

The system operator reported one breach of the Code in February. On 11 January an outage at Arapuni station was modelled such that generation on one half of the station was unable to clear in the forward-looking schedules. The system coordinators identified the issue before real time and made a modelling change. There was no market impact.

Appendix B shows instances where the system operator has applied discretion under 13.70 of the Code.

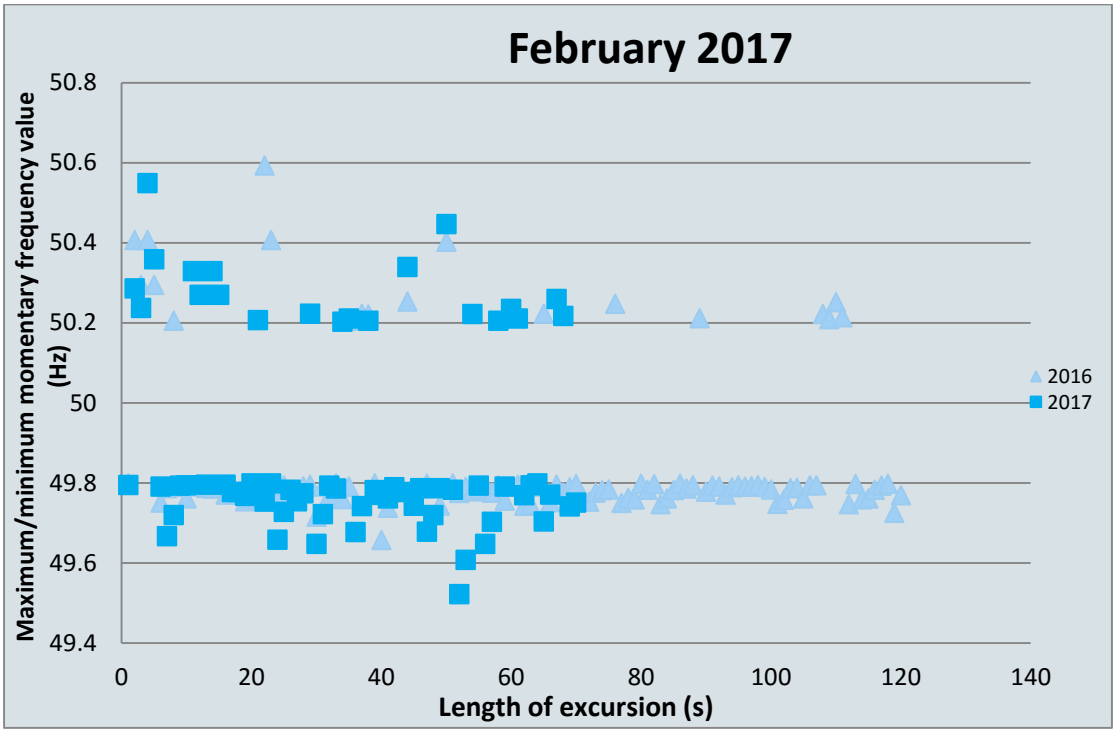
[1] Measurements are based on daily inflow values.
[2] Measurements are based on daily inflow values.

5 Operational management

5.1 Frequency fluctuations

Maintain frequency in normal band and recover quickly from a fluctuation

The chart below shows the maximum or minimum frequency reached and length of each frequency excursion outside the normal band (49.8 to 50.2 Hz) during the reporting period.



Maintain frequency and limit rate occurrences during momentary fluctuations

The table below shows the total number of momentary fluctuations outside the frequency normal band, recorded in both islands, over the last 12 months. The 12 month cumulative totals, grouped by frequency band, are compared to the frequency performance objective (PPO).

Frequency Band	Mar-16	Apr-16	May-16	Jun-16	Jul-16	Aug-16	Sep-16	Oct-16	Nov-16	Dec-16	Jan-17	Feb-17	Annual rate	PPO target
55.00 > Freq >= 53.75														**0.2***
53.75 > Freq >= 52.00														**2***
52.00 > Freq >= 51.25														**7**
51.25 > Freq >= 50.50	3						2			1	1	1	**8**	**50**
50.50 > Freq >= 50.20	31	30	42	29	25	13	32	39	45	32	34	20	**372**	
50.20 > Freq > 49.80														
49.80 >= Freq > 49.50	118	125	106	89	128	102	153	101	101	59	67	49	**1198**	
49.50 >= Freq > 48.75	1		2		1		2	2	3	1	2		**14**	**60**
48.75 >= Freq > 48.00													**0**	**6**
48.00 >= Freq > 47.00														**0.2**
47.00 >= Freq > 45.00														**0.2**

***** South Island

Manage time error and eliminate time error once per day

There were no time error violations in the reporting period.

5.2 Voltage management

Grid voltages did not exceed the Code voltage ranges during the reporting period.

5.3 Security notices

The following table shows the number of Warning Notices, Grid Emergency Notices and Customer Advice Notices issued over the last 12 months.

Notices issued	Mar-16	Apr-16	May-16	Jun-16	Jul-16	Aug-16	Sep-16	Oct-16	Nov-16	Dec-16	Jan-17	Feb-17
Demand Allocation Notice	-	-	-	-	-	-	-	-	-	-	-	-
Grid Emergency Notice	2	2	5	2	3	2	1	2	-	-	-	4
Warning Notice	-	-	3	2	2	5	1	-	-	-	-	-
Customer Advice Notice	19	11	12	3	8	7	5	12	26	7	11	7

5.4 Grid emergencies

The following table shows grid emergences declared by the system operator.

Date	Time	Summary Details	Island
05/02/17	17:46	A grid emergency was declared to allow 110 kV Marsden-Maungatapere Circuits 1 & 2 to be removed from service. This was necessary due to a fire in close proximity to the circuits.	N
15/02/17	13:58	A grid emergency was declared to allow a system reconfiguration to restore supply to Bromley Substation. Supply had been lost after 220 kV circuits Bromley-Islington 1 and Ashburton-Bromley 1 tripped due to a fire in close proximity.	S
18/02/17	08:03	A grid emergency was declared to assist with restoration following the loss of supply to the West Coast and Buller regions following an error during planned switching.	S
20/02/17	09:49	A grid emergency was declared to allow the grid to be reconfigured temporarily following the tripping of 110 kV Balclutha-Berwick-Halfway Bush Circuit 1.	S

6 Ancillary services

We have entered into a new ancillary service contract with Meridian to provide black start services at Aviemore for the next four years. This replaces our previous contract with Meridian at Manapouri.

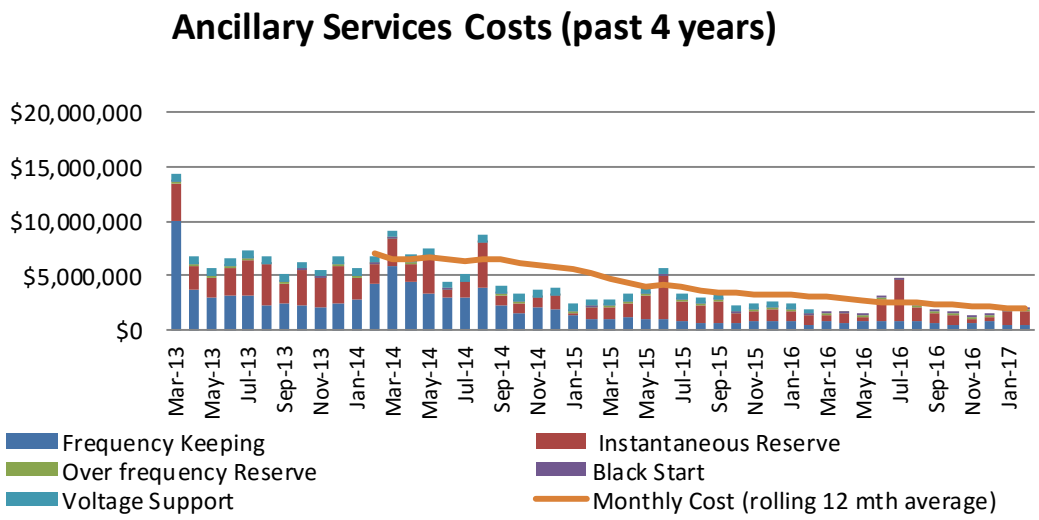
Leading on from this, a South Island Core Grid Restoration simulation exercise took place in February which included the use of the newly contracted station. The exercise tested our system restoration plans by going through a hypothetical scenario where the South Island is entirely without power supply. It involved representatives from Meridian, Contact and the New Zealand Aluminium Smelter. The exercise was a success and demonstrated that our system restoration plans are robust.

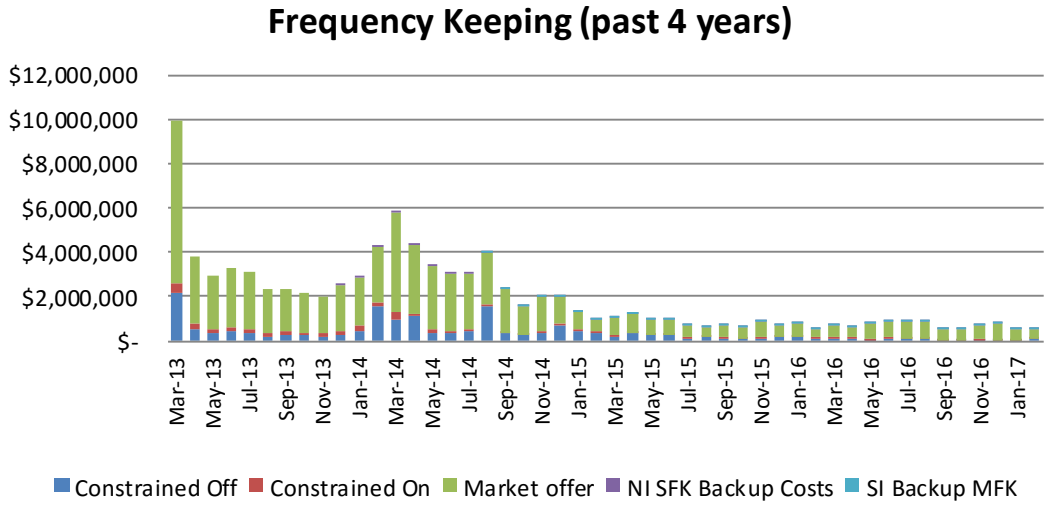
Refer Appendix A for Ancillary Services Graphs.

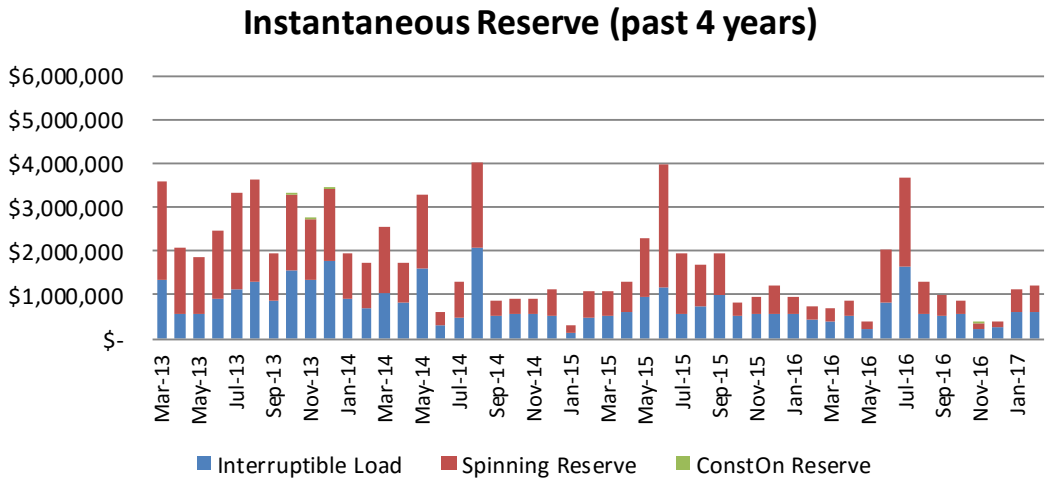
7 Separation of Transpower roles

In performing the system operator role, Transpower has not been materially affected by any other role or capacity Transpower has under the Code or under any agreement.

Appendix A: Ancillary Services Graphs







Note: IR Cost May 2012 = 14.129M, IR Cost Jun 2012 = 8.164M

Appendix B: Discretion

Event Date & Time	Subject	Event Description
4/2/2017 7:50:29 PM	DISCRETION	HIN0331 Discretion Clause 13.70, Part 13 FIR Max : Start: 04-Feb-2017 19:50 End: 04-Feb-2017 20:00 Notes: Last Dispatched: IntF: NULL IntS: 1.5
7/2/2017 9:29:55 AM	DISCRETION	MAN2201 MAN0 Discretion Clause 13.70, Part 13 EN Max : 524 Start: 07-Feb-2017 09:29 End: 07-Feb-2017 10:00 Notes: Extended TWI potline. Line 1. Returning at 09:35. Last Dispatched Mw: 608
10/2/2017 9:17:11 AM	DISCRETION	MAN2201 MAN0 Discretion Clause 13.70, Part 13 EN Max : 554 Start: 10-Feb-2017 09:17 End: 10-Feb-2017 09:30 Notes: Potline Line 1 return Last Dispatched Mw: 738
12/2/2017 12:00:04 PM	DISCRETION	COL0661 COL0 Discretion Clause 13.70, Part 13 EN Max : 30 Start: 12-Feb-2017 12:00 End: 12-Feb-2017 12:30 Notes: Unplanned westcoast split Last Dispatched Mw: 39
24/2/2017 11:48:26 AM	DISCRETION	ARG1101 BRR0 Discretion Clause 13.70, Part 13 ENR Max : 0 Start: 24-Feb-2017 12:00 End: 24-Feb-2017 12:30 Notes: Off for the restoration of the ARG_KIK circuit. Last Dispatched Mw: 10