System Operator Reports
April 2015

Contents

SYSTEM OPERATOR

TRANSPOWER

Keeping the energy flowing

System Operator Operational and System Performance Report to the Electricity Authority for April 2015

Purpose of Report

This report summarises Transpower's review of its performance as system operator for April 2015, as required under clause 3.14 of the Electricity Industry Participation Code 2010 (the Code).

Any relevant operational issues are also provided for the information of the Electricity Authority (the Authority). A separate detailed System Performance report will be provided to Authority staff.

1. Summary of Month from an Operational and System Performance Perspective

1.1. Operational

System events

Two loss of supply events occurred during April 2015. The tripping of a transformer at Albury on 9 April 2015 resulted in a 1.6MW loss of supply. While some load was recovered through the distribution network, the outage extended a little over 8 hours.

The second was a short (approx. 5 minute) interruption at Wilton on 17 April 2015 following a transformer tripping, resulting in a 13MW loss.

Outage planning

The most significant operational matter requiring management in April 2015 arose from the planned outage of Arapuni generation between 22 and 27 April 2015. As part of the outage planning process, a number of grid reconfiguration options were considered to alleviate likely constraints on Auckland (and north) generation during the outage. Despite this, northern generation was constrained at various times during the outage and active constraint management was required by the system operator to minimise these constraints.

The outage resulted in increased transmission flows into the Hamilton 110kV region, causing security constraints to bind for seven trading periods between 22 and 24 April 2015. During these periods, prices peaked at $3,500/MWh at Wiri, immediately south of the constraint, and fell as low as -$200/MWh at Otahuhu, immediately north.

These high prices were not forecast in the market schedules leading up to the outage. The system operator is investigating contributing factors, including generation dispatch compliance and industrial load bid accuracy.

Planned grid outages continued at a significant rate during April 2015. The number of planned outages at this time of the year is typically high, in the lead up to winter. A large number of grid owner small asset investment projects were also being delivered during the month, increasing outage activity in what would already have been a busy month.

Frequency Keeping Controls operation

Planned live line work on the HVDC conductors resulted in FKC frequency management being suspended between 20 and 23 April 2015. FKC was also suspended briefly on 19 April 2015 during an unplanned Pole 3 outage.

Work commenced and remains underway on the system operator's review of the FKC trial which ended in March. Completion of a review report is expected in early June.

1.2. Market

There were no outages to the market systems during April 2015 exceeding two hours in duration.

2. Business Performance

Policy Statement Review

The system operator is currently reviewing its Policy Statement. A number of issues have been raised internally and feedback from participants has helped identify specific areas for consideration. The system operator's review includes consideration as to how it can further assist the Authority to achieve its statutory objective in relation to relevant matters covered by the Policy Statement. The review is well underway and is on target to provide a draft for consultation to the Authority in November/December 2015.

Significant Project Update

The Reserves and Frequency Management (RFM) programme is currently progressing as per the schedule agreed between the system operator and the Authority.

The first of the RFM industry engagement group meetings has been scheduled for 13 May 2015. Planning for the second RFM industry forum is underway and is scheduled for 19 June 2015.

Programme component projects are progressing at different stages described below:

- Efficient Procurement of Extended Reserves Implementation – The SO has completed scoping sessions for delivering the next stage of work. Joint planning meetings will enable the development of a joint work and consultation plan with NZX and the Authority.

- Inter-island Instantaneous Reserve Sharing Implementation - A scope change proposal was accepted by the Authority to introduce SIR sharing as part of this interim project. This change is now actively moving forward, with requirements completed, and design work underway. SIR sharing is scheduled to be implemented in early September 2015, following the SO Tools project completion.

- Normal Frequency Management Strategy - The Normal Frequency Management Strategy project (TASC 49) has completed further workshops to define an interim solution for normal frequency management. The system operator's engineering team is continuing benchmarking work, with the outcome analysed to determine a normal frequency performance benchmark. This will serve as an input to define future solution options.

- National Market for Frequency Keeping – Work on this project is on hold pending the outcomes of TASC 49.

- Review of Instantaneous Reserve Markets - Project is on time and budget with the second and final staging post passed. Report writing is underway.

- RMT Study Tool – Stakeholder requirements documentation was reviewed and feedback clarified, with sign-off imminent.

- Security Tool Implementation for New HVDC Controls - The Security Tools project is now planned for completion prior to SCADA project, which enables deployment to meet the 10 September 2015 target.

3. Security of Supply Update

The system experienced a volatile April 2015 in terms of security of supply. At the start of the month conditions were exceptionally dry and system operator took additional actions to manage the situation as it developed. These actions included additional daily reporting focussed on typical dry year issues, providing more detailed information about the current hydro risk curve and instigating regular discussions with industry participants.

However, in late April 2015 a number of significant rainfall events rapidly changed the situation. Consequently the additional reports were ended and industry discussions scaled back. Normal security of supply reporting is now being maintained.

NZ aggregate storage levels are 89% of average for this time of year. The hydro risk meter is currently set at "normal". In the unlikely event of significant equipment failure, the Security of Supply status could change quickly.

4. Compliance Report

There were no breaches of the principal performance obligations during April 2015.

There was one breach of the Code reported to the Authority during April 2015 relating to an incorrect modelling of reserve requirements.

5. Ancillary Services

Last month, we advised of an issue with the allocation of reserve costs resulting from a modelling error in November 2014. We've now confirmed only December 2014 and February 2015 costs were affected by this error. These costs will be washed up via the Clearing Manager's usual wash-up schedule. The System Operator is investigating whether this error is a breach of its Code obligations.

In the course of investigating this issue, we also became aware of two additional errors in the data we use to produce the monthly cost allocation files. These errors resulted in a generator being overcharged dispensation costs (with a consequential undercharging of all other reserve payers) and the Grid Owner being overcharged for its share of the reserve availability costs (with a consequential undercharging of all other reserve payers). All affected participants have been advised and all incorrect amounts expected to be remedied, via wash-up, in August 2015.

The system operator is currently conducting a comprehensive review of its processes to avoid these types of errors from reoccurring in the future.

Ancillary Service Costs

The costs of ancillary services for the month of April 2015 are set out in Appendix A (as required by clause 82.1 of the Procurement Plan).

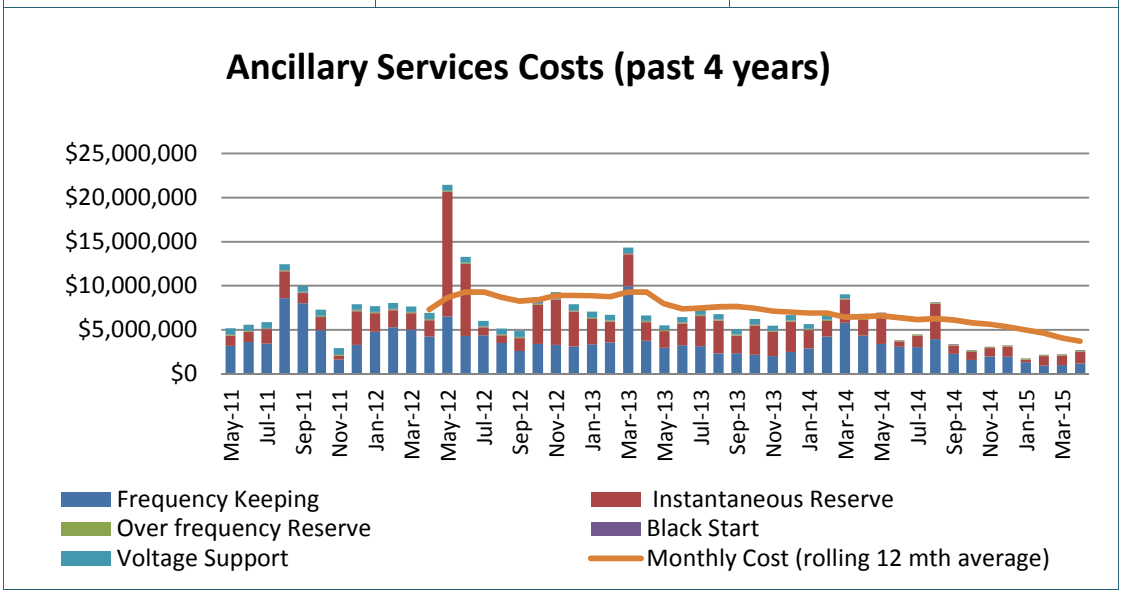
6. Code 7.10: Separation of Transpower Roles

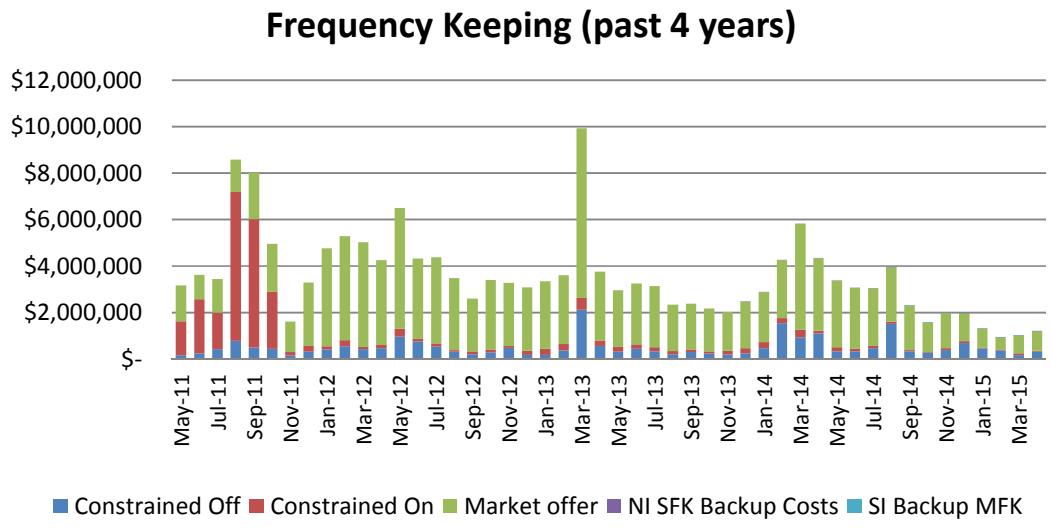
In performing its role as system operator, Transpower has not been materially affected by any other role or capacity Transpower has under the Code or under any agreement.

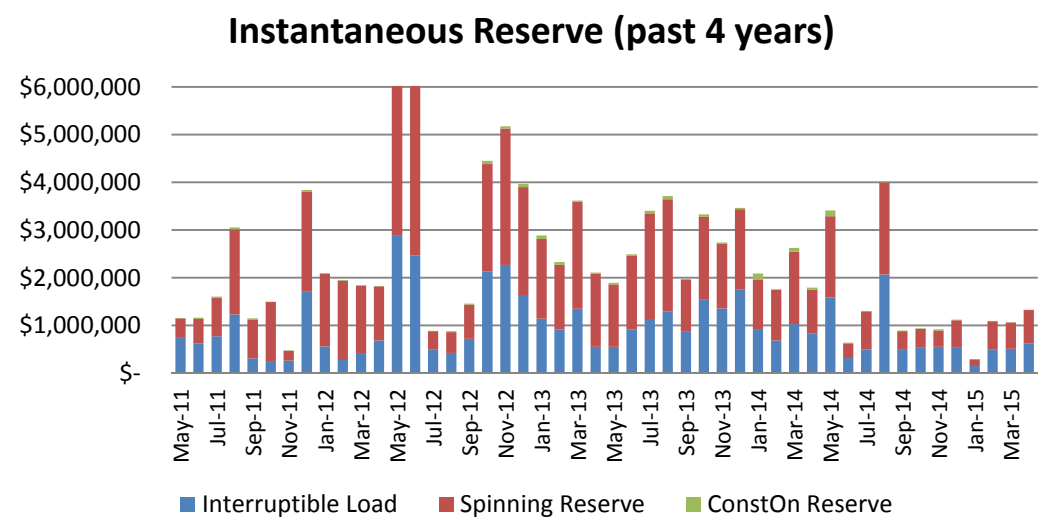
Appendix A – Ancillary Service Costs for April 2015

Note: The scale for the Instantaneous Reserve (Past 4 Years) graph has been reduced to clarify detail. Two months data, May and June 2012, overly influenced the graph scale.

		Cost	
Frequency Keeping	Constrained Off	$	320,309
	Constrained On	$	55,099
	Market offer	$	821,387
	NI SFK Backup Costs	$	2,716.67
	SI Backup MFK	$	2,232.00
	Total monthly Cost	**$**	**1,201,744**
Instantaneous Reserve	Spinning reserve	$	700,784
	Interruptible Load	$	625,074
	Constrained On	$	8,009
	Total monthly Cost	**$**	**1,333,867**
Over Frequency Reserve	**Total monthly Cost**	**$**	**115,229**
Black Start	**Total monthly Cost**	**$**	**52,487**
Voltage Support	**Total monthly Cost**	**$**	**-**
All Ancillary Services	**Total monthly Cost**	**$**	**2,703,327**







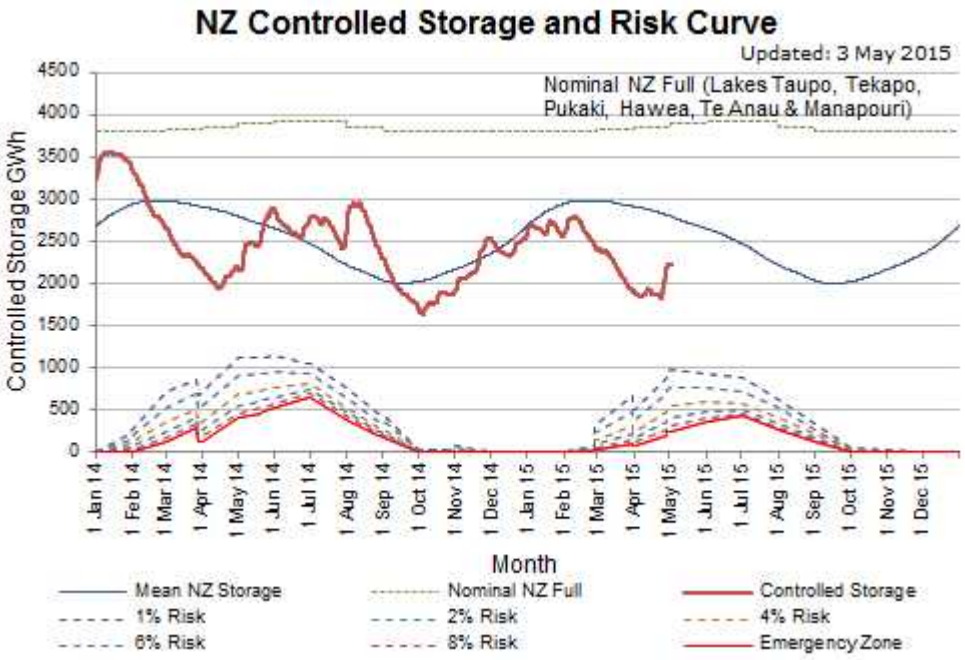
Note: IR Cost May 2012 = 14.129M, IR Cost Jun 2012 = 8.164M

Appendix B – Security of Supply

New Zealand Hydro Storage and Hydro Risk Curves

As at 8 May 2015, aggregate primary New Zealand storage is 89% of average.

The graph below compares New Zealand hydro storage to the hydro risk curves.



Hydro Storage and Generation

North Island inflows during April 2015 were 115% of average.

South Island inflows during April 2015 were 105% of average.

Measurements are based on daily inflow values.

Hydro generation met 54% of demand during April 2015.

System Performance Report

To the Electricity Authority

April 2015

Purpose

This System Performance Report summarises power system performance each month. The detailed reporting of system events is intended to provide an understanding of the nature of system events that occur in the normal course of the real time co-ordination of security and to identify emerging issues in system operation.

SYSTEM OPERATOR

TRANSPOWER

Keeping the energy flowing

Transpower New Zealand Ltd The National Grid

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1. Summary of System Performance

This system performance report covers the month of April 2015.

Principal Performance Obligations

- The system operator met the Principal Performance Obligations during the reporting period.

System Events

- On 5 April 2015 at 09:58 an emergency potline off-load at Tiwai Point Aluminium Smelter resulted in a momentary frequency rise in the South Island to 50.69 Hz.
- On 9 April 2015 at 02:12, Albury supply transformer T2 tripped resulting in a loss of supply to Albury substation. Supply was restored after 488 minutes. Some load was back fed through Alpine Energy's network.

Other noteworthy events occurring during the reporting period:

- On 30 April 2015 six 220 kV circuit auto-recloses occurred on Roxburgh – Three Mile Hill Circuits 1 & 2 over a two hour period. The cause is believed to have been weather related with strong winds and snow flurries reported in the area.

2. Principal Performance Obligations

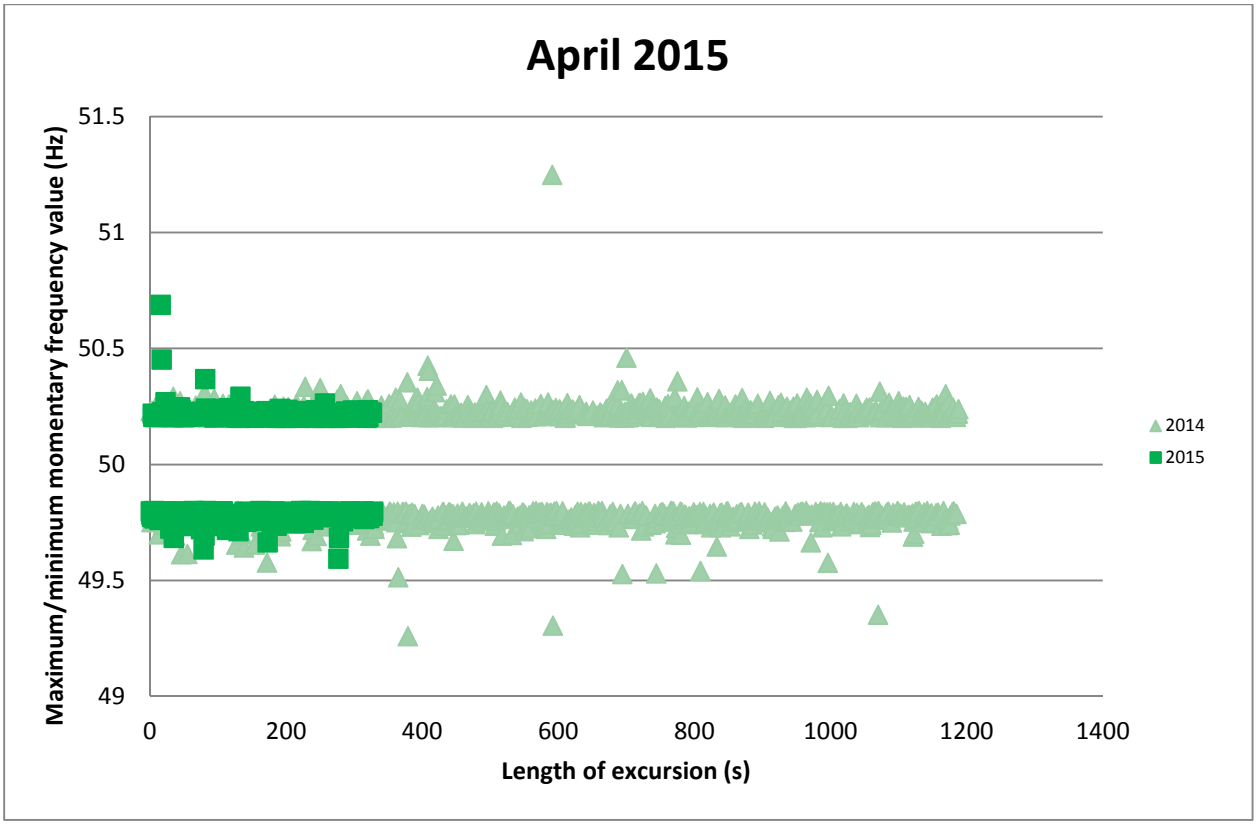
2.1 Avoid Cascade Failure

No instances of cascade failure occurred during the reporting period.

2.2 Frequency

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. The majority of excursions are within 0.4 Hz of the normal band and frequency typically returns to within the normal band within 2 minutes.



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). The reduction in excursions within 0.5-0.2Hz of 50Hz reflect the use of FKC mode on the HVDC.

Frequency Band	May-14	Jun-14	Jul-14	Aug-14	Sep-14	Oct-14	Nov-14	Dec-14	Jan-15	Feb-15	Mar-15	Apr-15	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	1	1	1	1	1		2			1	2	1	**11**	**50**
50.50 > Freq >= 50.20	430	206	336	345	420	244	360	165	26	25	47	153	**2757**	
50.20 > Freq > 49.80														
49.80 >= Freq > 49.50	485	208	452	401	585	351	375	204	24	15	44	174	**3318**	
49.50 >= Freq > 48.75				1		2	5	2	1	1	1		**13**	**60**
48.75 >= Freq > 48.00							1						**1**	**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

- The time error performance criteria are:
- Time error must be managed within +/- 5 seconds.
- Time error must be eliminated at least once every day.

Time Error Compliance Table		May-14	Jun-14	Jul-14	Aug-14	Sep-14	Oct-14	Nov-14	Dec-14	Jan-15	Feb-15	Mar-15	Apr-15
Time Error Management	NI	Yes	Yes	Yes	Yes	Yes	Yes	Yes	Yes	Yes	Yes	Yes	Yes
	SI	Yes	Yes	Yes	Yes	Yes	Yes	Yes	Yes	Yes	Yes	Yes	Yes
Time Error Elimination	NI	Yes	Yes	Yes	Yes	Yes	Yes	Yes	Yes	Yes	Yes	Yes	Yes
	SI	Yes	Yes	Yes	Yes	Yes	Yes	Yes	Yes	Yes	Yes	Yes	Yes

3. Operational Management

3.1 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	May-14	Jun-14	Jul-14	Aug-14	Sep-14	Oct-14	Nov-14	Dec-14	Jan-15	Feb-15	Mar-15	Apr-15
Demand Allocation Notice	-	-	-	-	-	-	-	-	-	-	-	-
Grid Emergency Notice	19	12	5	4	3	7	3	5	1	4	-	2
Warning Notice	1	-	8	21	7	8	11	23	29	27	31	10
Customer Advice Notice	17	4	33	16	10	28	22	20	11	12	12	13

3.2 GRID EMERGENCIES

The following table shows grid emergencies declared by the system operator in the reporting period.

Date	Time	Summary Details	Island
11/04/15	23:15	A grid emergency was declared to allow a 220 kV Pakuranga – Whakamaru Circuit to be removed from service to assist with managing high voltages.	N
17/04/15	13:50	A Grid Emergency was declared to facilitate demand management at Gore necessary to remove an overload on Edendale-Invercargill circuit 1.	S

A summary of grid emergencies that have occurred in the last 12 months is shown in the following table.

Island	Region	May-14	Jun-14	Jul-14	Aug-14	Sep-14	Oct-14	Nov-14	Dec-14	Jan-15	Feb-15	Mar-15	Apr-15	Total
North Island	Northland	-	-	-	-	-	-	-	-	-	-	-	-	**0**
	Auckland	-	-	-	-	-	4	-	-	-	-	-	-	**4**
	Zone 1	8	6	3	1	-	-	-	-	-	-	-	1	**19**
	Waikato	-	-	-	-	2	2	2	4	1	2	-	-	**13**
	Bay of Plenty	-	-	-	-	-	-	-	-	-	-	-	-	**0**
	Hawkes Bay	-	-	-	-	-	-	-	-	-	-	-	-	**0**
	Taranaki	-	-	-	-	-	-	-	-	-	-	-	-	**0**
	Bunnythorpe	-	-	-	-	-	-	-	-	-	-	-	-	**0**
	Wellington	-	-	1	-	-	-	-	-	-	-	-	-	**1**
	North Island (all)	-	-	1	-	-	-	-	-	-	-	-	-	**1**
	Lower North Island	1	1	-	1	-	-	-	-	-	-	-	-	**3**
North & South Islands		-	1	1	1	-	1	-	-	-	-	-	-	**4**
South Island & HVDC	Nelson Marlborough	-	1	-	-	-	-	-	-	-	-	-	-	**1**
	West Coast	-	-	-	-	-	-	-	-	-	-	-	-	**0**
	Christchurch	-	-	-	-	-	-	-	-	-	-	-	-	**0**
	Canterbury	-	-	-	-	-	-	-	-	-	-	-	-	**0**
	Zone 3	9	3	-	1	1	-	1	-	-	-	-	-	**15**
	Otago	-	-	-	-	-	-	-	-	-	1	-	-	**1**
	Southland	-	-	-	-	-	-	-	-	-	1	-	1	**2**
	South Island (all)	-	-	-	-	-	-	-	1	-	-	-	-	**1**
	HVDC	-	-	-	-	-	-	-	-	-	-	-	-	**0**

3.3 Customer Advice Notices (CANs)

Thirteen CANs (Customer Advice Notices) were issued in the reporting period:

- four related to the planned deactivation of HVDC Frequency Keeping Control due to live line work on the HVDC line;
- two related to a short notice outage of the Market Systems on 17 April 2015;
- two related to an unplanned outage of HVDC Pole 3 on 19 April 2015;
- one related to the treatment of Special Protection Schemes during the shoulder rating period;
- one advised of a change in risk classification of Wairakei Power Station;
- one advised a new constraint equation for Wellington Voltage Stability;
- one advised of a potential critical gas contingency on 15 April 2015; and
- one advised of a change to HVDC Under Frequency Reserve Modelling effective from 29 April 2015.

3.4 Standby Residual Check (SRC) notices

No SRC notices were issued during the reporting period based on the SDS (system operator's own load forecasting tool).

3.5 Voltage Management

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

3.6 Outage Management

The following table shows the number of outages over the last 12 months where operational measures (generation agreements, load management agreements or grid re-configurations) were required to allow the outage to proceed. Load agreements generally require the distributor to manage load at one or more grid exit points. Generation agreements are required to ensure that sufficient regional generation is available to provide energy or reactive support during the outage to maintain security standards. Grid re-configurations typically involve splitting the network during the outage to manage post contingency power flows. Security of supply is sometimes reduced by grid re-configuration.

Island	Region	May-14	Jun-14	Jul-14	Aug-14	Sep-14	Oct-14	Nov-14	Dec-14	Jan-15	Feb-15	Mar-15	Apr-15	Total
North Island	Northland	8	6	-	1	2	5	3	3	3	7	6	12	**56**
	Auckland	12	5	2	3	6	4	3	1	1	6	4	8	**55**
	Waikato	12	6	3	5	10	10	9	3	4	10	9	8	**89**
	Bay of Plenty	6	5	5	5	-	6	7	6	3	4	4	6	**57**
	Hawkes Bay	5	-	1	-	-	5	2	2	2	4	6	6	**33**
	Taranaki	2	2	-	1	1	2	7	-	4	4	3	2	**28**
	Bunnythorpe	5	-	-	-	2	7	4	1	5	4	4	8	**40**
	Wellington	12	6	3	4	3	12	9	10	11	9	8	9	**96**
Total		62	30	14	19	24	51	44	26	33	48	44	59	**454**
South Island	Nelson Marlborough	4	7	5	2	4	10	14	8	7	6	4	6	**77**
	West Coast	7	7	10	6	4	10	11	8	8	8	6	5	**90**
	Christchurch	2	5	4	2	4	7	10	6	5	8	7	7	**67**
	Canterbury	2	5	4	4	2	6	7	4	4	5	2	2	**47**
	Otago	4	-	-	2	9	2	4	2	1	3	2	3	**32**
	Southland	8	6	5	5	2	1	3	3	1	2	4	5	**45**
Total		27	30	28	21	25	36	49	31	26	32	25	28	**358**

3.7 CONSTRAINTS

SUMMARY: Security constraints binding during the month

The following table shows the binding constraints during the reporting period.

Additional information on security constraints can be found on the following website address: *http://www.systemoperator.co.nz/security-management#cs-147305*. This information includes constraint equations and a brief summary of their purpose.

Island	Region	Branch	Description	Total
North Island	Auckland	BOB_OTA1.2__BOB_OTA2.2__BOB_OTA2__OTA__LN	This is an SFT generated constraint. Its purpose is to protect Bombay-Otahuhu 1 for a tripping of Bombay-Otahuhu 2.	7
South Island & HVDC	Christchurch	ISL_KIK_1_or_2_or_3_TOP_SOUTH_ISLAND_STABILITY_O_1	The effect of this constraint is to manage flows through the Islington-Kikiwa-1, 2 and 3 circuits for a contingency of either of the two remaining in service circuits. This is to ensure that voltage stability limits are not exceeded during periods when the load at the Top of the South Island is high and Islington-Kikiwa-1, 2 or 3 is out of service.	2
	Southland	EDN_INV.1__GOR_ROX.1__GOR_ROX__INV__LN	This is an SFT generated constraint. Its purpose is to protect Edendale-Invercargill 1 for a tripping of Gore-Roxburgh 1.	15
	West Coast	COL_HOR2.1__COL_HOR3.1__COL_HOR3__COL__LN	This is an SFT generated constraint. Its purpose is to protect Coleridge-Hororata 2 for a tripping of Coleridge-Hororata 3	5
		COL_HOR3.1__COL_HOR2.1__COL_HOR2__COL__LN	This is an SFT generated constraint. Its purpose is to protect Coleridge-Hororata 3 for a tripping of Coleridge-Hororata 2	2
Grand Total				**31**

Constraints binding during last 12 months

The following table shows all binding constraints during the reporting period, which were binding for duration of more than 4 trading periods and any constraints binding for more than 48 trading periods during the previous 12 months.

Island	Region	Constraint	Reporting period		Previous 12 months	
			Number of trading periods that constraint bound	Percentage of trading periods	Number of trading periods that constraint bound	Percentage of Trading periods
North Island	Auckland	BOB_OTA1.2__BOB_OTA2.2__BOB_OTA2__OTA__LN	7	0.49%	1	0.01%
	Hawkes Bay	RDF_T3&T4_S_P_1	0	0.00%	87	0.50%
South Island & HVDC	West Coast	COL_HOR2.1__COL_HOR3.1__COL_HOR3__COL__LN	5	0.35%	50	0.29%
		HOR_KBY_ISL1.2__HOR_KBY_ISL2.2__:S__HOR_ISL2__ISL__LN	0	0.00%	128	0.73%
	Southland	EDN_INV.1__GOR_ROX.1__GOR_ROX__INV__LN	15	1.04%	21	0.12%
	HVDC	BEN_HAYP2max	0	0.00%	120	0.68%

4. System Events

4.1 Significant System Events

The following table shows significant events (frequency excursions and connection point events) which occurred during the reporting period.

Significant frequency excursions

Date	Time	Summary Details	Island	Freq (Hz)
05/04/15	09:58	An emergency shutdown of a Tiwai potline resulted in a momentary rise in frequency in the South Island.	S	50.69

Connection point events

Date	Time	Summary Details	Generation / Load interrupted (MW)	Restoration time (minutes)
09/04/15	02:12	Albury supply transformer T2 tripped resulting in a loss of connection to Albury Substation.	1.6	488

4.2 System Events during reporting period

System events that occurred during the reporting period are summarised below:

Contingent events

Event	Number	Summary
Loss of single AC transmission circuit	13	These related to trippings of • Arapuni-Hamilton 1 (auto reclose) • Arapuni-Hangatiki-Ongarue 1 • Coleridge-Otira 1 (auto reclose) • Fernhill-Waipawa 1 • Fernhill-Waipawa 2 (auto reclose) • Islington-Livingstone 1 (auto reclose) • Roxburgh-Three Mile Hill 1 (3 x auto reclose) • Roxburgh-Three Mile Hill 2 (3 x auto reclose) • Te Kaha-Waiotahi 1 (auto reclose)
HVDC Start/Stop	0	
Supply Transformer	3	These related to trippings of • Albury T2 • Tangiwai T2 • Wilton T3
Loss of grid reactive plant	3	This related to tripping of • Haywards Synchronous Condensers SC3 & SC4 • Marsden Static Synchronous Compensator STC5
Loss of single generation units	6	These related to trippings of • Aniwhenua G1 • Argyle generation • Huntly U5 • Mahinerangi wind generation • Poihippi G1 • Waipori G2A3
Total during reporting period	**25**	

Extended contingent events

Event	Number	Summary
Loss of both HVDC poles	0	
Loss of interconnecting transformer	0	
Loss of bus bar section	2	This related to tripping of • Huntly 220 kV bus coupler circuit-breakers • Bombay 110 kV bus coupler circuit-breaker
Total during reporting period	**2**	

Other events

Event	Number	Summary
Loss of multiple AC transmission circuits	0	
Demand change	1	This related to • Tiwai NZAS Potline 1 Emergency off-load
Generation	0	
Total during reporting period	**1**	

Other disturbances

Event	Number	Summary
Feeder trippings	47	Various locations
Total during reporting period	**47**	

4.3 SYSTEM EVENTS – TREND

	May-14	Jun-14	Jul-14	Aug-14	Sep-14	Oct-14	Nov-14	Dec-14	Jan-15	Feb-15	Mar-15	Apr-15	Total	Average Events per month
Contingent Event – transmission	19	9	16	8	14	19	9	11	13	10	8	13	**149**	12.4
Contingent Event – generation	5	7	23	12	12	1	16	12	19	10	14	6	**137**	11.4
Contingent Event – Supply transformer	4	3	0	2	4	4	1	1	2	3	2	3	**29**	2.4
Contingent Event – Reactive plant	5	2	0	1	9	1	2	1	7	4	2	3	**37**	3.1
Contingent Event - HVDC	1	0	0	0	2	2	7	0	1	0	3	0	**16**	1.3
Extended Contingent Event HVDC	0	0	0	0	0	0	0	0	0	0	0	0	**0**	0.0
Extended Contingent Event Inter-connecting Transformers	1	1	0	0	0	1	0	0	0	0	1	0	**4**	0.3
Extended Contingent Event Busbar	0	1	1	0	0	2	0	1	0	0	1	2	**8**	0.7
Other Event – AC transmission	2	1	1	1	0	2	3	0	2	1	4	0	**17**	1.4
Other Event – Demand	1	1	1	1	2	1	5	0	1	2	1	1	**17**	1.4
Other Event – Generation	0	0	0	1	2	1	1	0	3	1	4	0	**13**	1.1