QUARTERLY SYSTEM OPERATOR AND SYSTEM PERFORMANCE REPORT

FOR THE ELECTRICITY AUTHORITY

Transpower New Zealand Limited
April to June 2018

Keeping the energy flowing

TRANSPOWER

Transpower New Zealand Limited The National Grid

Report Purpose

This report is Transpower's review of its performance as system operator for Q4 (April to June) 2018, in accordance with clause 3.14 of the Electricity Industry Participation Code 2010 (the Code).

As this is the final self-review report of the quarter, additional information is included as per SOSPA clause 12.3. This includes performance against the performance metrics in the year to date, and actions taken in regards to the system operator business plan, statutory objective work plan, participant survey responses, and any remedial plan agreed under clause 14.1 (i). A summary of technical advisory services for the quarter is also provided.

A detailed system performance report (Code obligated) is provided for the information of the Electricity Authority (Authority).

Table of Contents

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Commentary

This section highlights successful management of significant events and operational issues by the system operator. It provides additional commentary (not Code or SOSPA required) relating to aspects of system operator performance or system performance. The remainder of the report provides supporting detail (which is Code or SOSPA required) in two sections:

- System operator performance, and
- System performance.

Operations division organisation structure

Our new organisation structure went live in late April. This change means that much of the system operator role is now delivered as part of a new wider Operations division within Transpower. The new structure brings together the grid operations and system operations functions as part of our real time operating vision. That vision is to deliver an efficient grid and system operating function which focusses on future needs. The change ensures we have a broad pool of operators as a succession plan to the current aging workforce; it also reduces the layers of control operations in New Zealand's small power system.

Recruitment for key roles in this new structure is continuing. One role already appointed is the role of OPTI (Operations Process and Technology Improvement) manager, which Daniel Crawshay has accepted and is effective from 23 July.

There will be no immediate change to the way in which Transpower delivers its operating services and we remain committed to the delivery of the system operator service including our impartiality through compliance processes.

Impartiality of roles

As part of this transition, we have set up a project to address issues identified with the re-alignment, which includes the impartiality of roles. This change has been logged into our Conflict of Interest Register and is being managed through the transition project.

We have taken the opportunity to review of our conflict of interest arrangements, including our training, process and procedures. This independent review will start in July and assess the effectiveness of our measures around role impartiality.

Schedules failing to solve

There were a number of occasions in June when 30-minute forecast schedules failed to solve due to 'time-out' issues. As this error had the potential to occur in the dispatch schedules, the situation was resolved with urgency. A decision tree was put in place to inform the real-time system co-ordinators about a number of different escalation points and actions that should be taken if the forecast or dispatch schedules failed. Following consultation with GE and AIMMS (the software vendors),

an issue was identified within the linear solver which was resolved, and schedule solve times have return to normal.

Security of Supply

During June we sought feedback on the issue of thermal fuel limitations affecting security of supply risk. We have proposed to make no changes to the standard assumptions regarding thermal fuels but will monitor thermal fuel supply more closely, using a broader set of information (including more gas supply information where available).

We have also been working closely with Authority staff during May and June as we prepare joint consultation on the Security of Supply Forecasting and Information Policy, and associated Code clauses (including but not limited to the trigger for an Official Conservation Campaign). This has been a good example of productive and efficient collaboration between the Authority and Transpower.

AUFLS event of March 2017

As agreed at the special System Operator Committee meeting on 24 June, we will be publishing our report on the South Island AUFLS event of March 2017. The report is being readied for release in the second week of July along with details of the actions from the event.

Real Time Pricing

As the capital phase of the Real Time Pricing project is currently on hold pending funding, we are closing the project in a managed fashion to ensure no in-flight activities are left pending. While the project is in this status, we are reviewing, with the Authority, whether we can deliver other standalone development or service maintenance projects to fill the gap.

Te Mauri Hiko

Transpower launched its Te Mauri Hiko (Energy Futures) document in April with scenarios based on significant electrification supplied from renewable sources. System operator resources will assist with future workstreams to better understand the security of supply implications and the dynamic performance of an evolving power system with a greater proportion of variable and intermittent generation.

System Security Forecast

A review of the grid and system changes since the last System Security Forecast (SSF) has been completed. Changes identified were minor and consequently we have concluded that a minor update to the SSF is not warranted. A major SSF review will commence in July and is scheduled for delivery by December 2018.

Outage Planning

In May and June, the work to assess and plan for grid maintenance outages required considerable planning and collaboration to ensure that we can facilitate outages while achieving system security requirements with the higher winter time loads. We are currently assessing outages during the period of the Huntly 5 outages (26 Oct - 11 Dec) and the HVDC bipole outage (24 - 25 Nov) and have moved some conflicting

transmission outages. We are keeping a watch on generation shortfall during this time, however NZGB is currently indicating sufficient generation.

End-of-year asset commissioning has also been a focus for us. The Gore transformer and Hamilton bus projects required substantial input, especially with weather concerns affecting the Hamilton works.

System operator performance

1 Compliance

April

No breaches were reported in April.

May

Two breaches were reported in May by the system operator. The first relates to a change to offer which was not acknowledged correctly and was not then used in the forward-looking schedules, this error reached real time causing a market impact of less than $500. The second relates to a modelling error that removed a generator's offers from the forward-looking schedules, this was identified before real time and corrected before dispatch.

June

Four breaches were reported in June by the system operator. All the breaches related to schedules failing to solve as a result of 'time-out' issues. These occurred over a four-week period and there is one similar breach yet to be reported. We have implemented a fix and continue to monitor the solver.

In addition, we have responded to a fact-finding letter from the Authority concerning the SI AUFLS event, 2 March 2017. We have acknowledged several breaches. The Authority is assessing these and has begun an investigation.

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

2 Market design and system enhancement project updates

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

Governance of the Joint Work Plan continued through the current period. The Joint Work Planning Team met monthly, and the steering team met to review the Joint Work Planning Team Quarterly Report in May.

Efficient Procurement of Extended Reserves

Following Authority Board direction in March, work has been completed on a refresh of the Technical Requirements Schedule. The draft outputs will be provided to the Authority in Early July.

Real Time Pricing

The capital phase of the project is currently on hold pending funding following the Government decision not to proceed in May. We are reviewing, with the Authority, any scope items that could be delivered as standalone projects. This work needs to be replanned once the project is approved, however it presently aligns with the current Capex Plan.

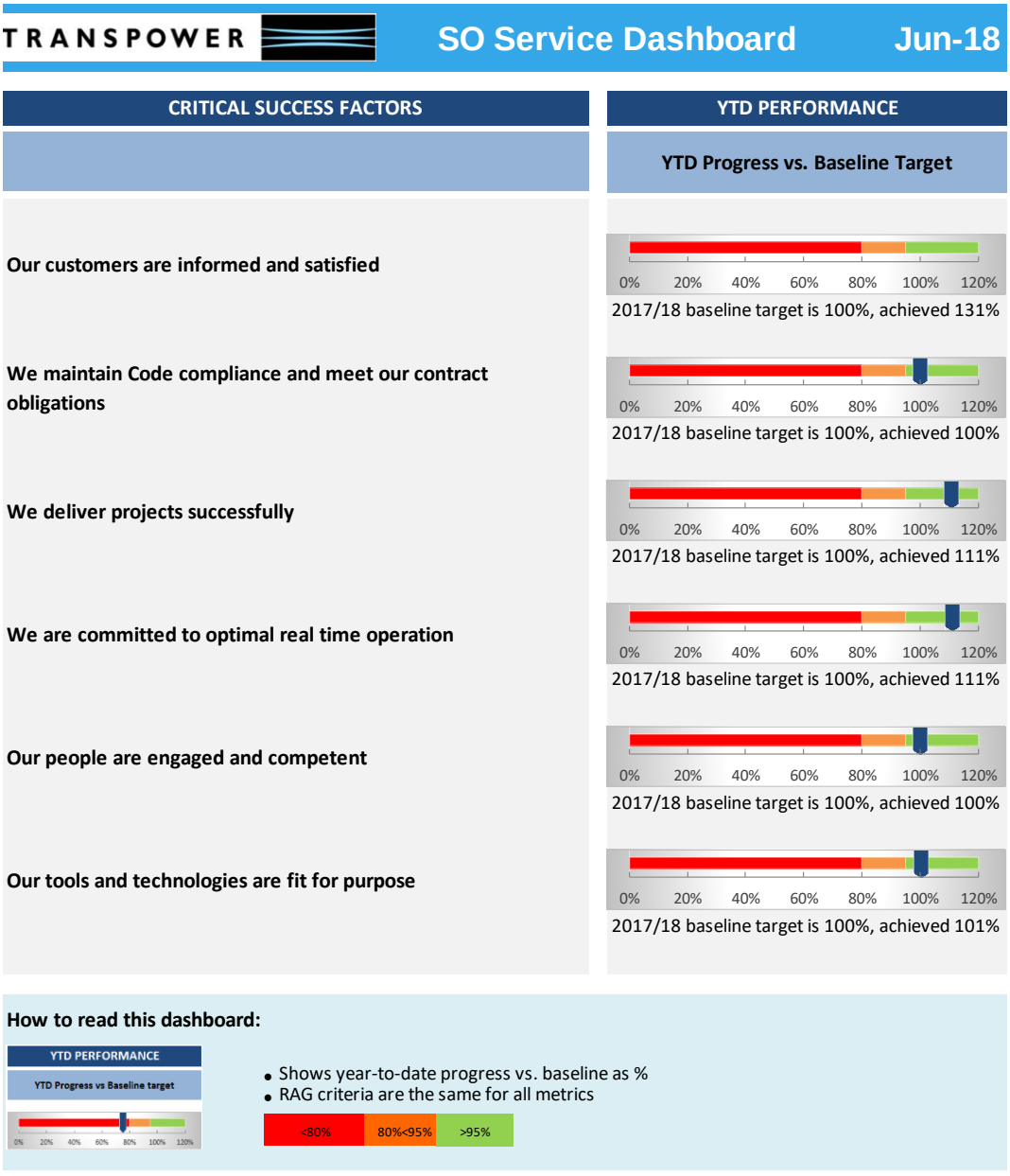
Dispatch Service Enhancement

Transpower received Authority funding approval to commence the Delivery Phase. This approval was obtained one month later than planned and has impacted the planned completion date of the project. The key dates have been updated in the Delivery Business Case which has now been approved within Transpower.

Cost of this work aligns with the current Capex Plan however the completion is planned one month later than the current Capex Plan date due to delays with the project Approval as noted above.

3 Performance metrics

The following dashboard shows system operator performance against the performance metrics for the financial year to date as required by SOSPA 12.3 (a). Overall the system operator has exceeded performance metric targets.



At the end of the financial year, 15 of the 19 agreed metrics associated with these critical success factors have been achieved, with one currently pending.

4 Actions taken

The following table contains a full list of actions taken during Q4 regarding the system operator business plan, statutory objective work plan, participant survey responses and any remedial plan, as required by SOSPA 12.3 (b).

Item of interest	Actions taken
(i) To give effect to the **system operator business plan**:	• Completed a feasibility study to establish the requirement for cost-of-services reporting. • Reviewed and completed the annual participant (customer) survey. • Identified potential engagement opportunities with industry and developed a coordinated approach as a thought leader for emerging technologies. • Reviewed the annual security of supply assessment and made changes, aimed at increasing value to industry. • Began the review of the Procurement Plan. • Worked with the Authority to enable offering of batteries as instantaneous reserve. • Collaborated with Grid and ICT to complete SCADA/EMS Lifecycle Refresh. • Embedded the SO 'bowtie' risk management practices and ensured active management of controls.
(ii) To comply with the **statutory objective work plan**:	**Policy and procedure alignment with CRE** • 88 documents have been reviewed against CRE since the start of the financial year. We achieved 22% against a target of 25%. **Review of SOSFIP** • Draft consultation document was provided to the Authority in March. **Review of the Security Policy – Interconnecting transformers** • Review was completed in June. The final report will be circulated in July. **Implement performance dashboard and review/propose performance metrics for 2018/19** • Implementation of the performance dashboard was completed. • Reviewed the performance metrics (including placeholder metrics) and the proposed metrics for 2018/19 financial year was completed.
(iii) In response to participant responses to any **participant survey**:	The participant survey was completed in May 2018. The original low participation rate was addressed through direct customer conversations with key participants. Feedback was positive, with all performance metrics being met. Two areas of growth have been identified - communications around operations, and promotion and growth of education and information provision.

Item of interest	Actions taken
(iv) To comply with any **remedial plan** agreed by the parties under SOSPA 14.1	N/A – No remedial plan in place.

5 Cost-of-services reporting

The feasibility study into implementing annual cost-of-services reporting to the Authority is required in financial year 2 (SOSPA 12.6). This was completed in September 2017 and a proposed approach submitted to the Authority.

6 Technical advisory hours and services

The following table provides the technical advisory hours for Q4 and a summary of technical advisory services to which those hours related (SOSPA 12.3 (d) refers).

TAS Statement of Work (SOW)	Status	Hours worked during Q3
TAS SOW 71 – Battery storage as a source of ancillary services	Closed	27.50
TAS SOW 72 – EPER Project Support Oct – Dec 2017	Closed	13.00
TAS SOW 73 – Evaluating Options to Improve System Operator Load Forecast	Closed	214.40
TAS SOW 75 – Market System outage impacts on Real Time Pricing	Closed	66.50
TAS SOW 76 – RTP Complete Develop Solution Approach	In progress	833.50
TAS SOW 77 – Review Governor Response changes that have occurred to the normal frequency management	In progress	96.00
TAS SOW 78 – Gen-Lite and DD-Lite Investigation and ROM	Closed	50.50
TAS SOW 79 – Efficient Procurement of Extended Reserve: Technical Requirements Schedule Review Expanded Scope and other support	In progress	689.00
Total hours		**1990.40**

7 Separation of Transpower roles

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

On 30 April the Operations division was established at Transpower. This division now incorporates functions of both the system operator and grid owner role. As part of transition a project is addressing identified issues with the re-alignment. This transition has been logged into our Conflict of Interest Register and is being managed through the transition project. Identified areas for consideration include the compliance process, conflict of interest, operational interactions and outage planning. Reporting against the specific workstreams will be included in future performance reporting.

An updated training module has been completed for conflict of interest across Transpower and was released to staff late June. Transpower's procedure for conflict of interest has also been updated.

We have begun a review of our conflict of interest arrangements, including our training, process and procedures. This independent review will start in July and assess the effectiveness of our measures around role impartiality.

System performance

8 Operational and system events

April

Loss of supply events

On 9 April, a Glenbrook bus fault resulted in a severe voltage disturbance which caused the tripping of some Interruptible Load in the upper North Island.

A severe lightning storm hit the Taranaki region on 10 April with approximately 13,000 lightning strikes recorded and more than 30 circuits tripping. Access to the Grid owner's lightning detection system allowed coordinators to assess the implications of the storm. The circuits tripped impacted generation at Patea and Whareroa and required a grid reconfiguration under grid emergency. The storm also resulted in a tripping of the Opunake 33kV bus. Since Maui gas supply is dependent on this bus, this fault, coupled with coupled with an outage at Kupe resulted in the declaration of a potential critical gas contingency.

During the installation of a lighting pole on 20 April, a section of the pole contacted the Brydone Gore 1 110kV circuit. The circuit remained in service and contactors on site requested the circuit be de-energised. This was done as soon as the Brydone Edendale 1 circuit (on outage) could be returned to service, to avoid loss of supply.

On 29 April, a double circuit tripping of Kawerau Matahina 1 and 2 resulted in a tripping of Matahina generation (19 MW) and 75 MW of load at Kawerau. Aniwhenua generation successfully islanded, maintaining supply to local load.

Grid Emergency

A grid emergency was declared on 10 April for Hawera. This was to reconfigure and de-energise the bus following circuit trippings that islanded Hawera load with Whareroa generation

May

On 14 May the Otahuhu_Roskill_1 & 2 circuits were removed from service because of a climber on one of the towers. The person was talked down and taken to hospital and there were no supply impacts. Following this event, the tower climber procedure has been finalised and formally introduced to clearly guide our grid owner control room staff on the initial response to a call advising of a climbing event.

A widespread, extensive series of storms with significant lightning during the week commencing 18 May resulted in a substantial number of circuit trippings – one of which involved a loss of supply of 35MW to Powerco customers.

June

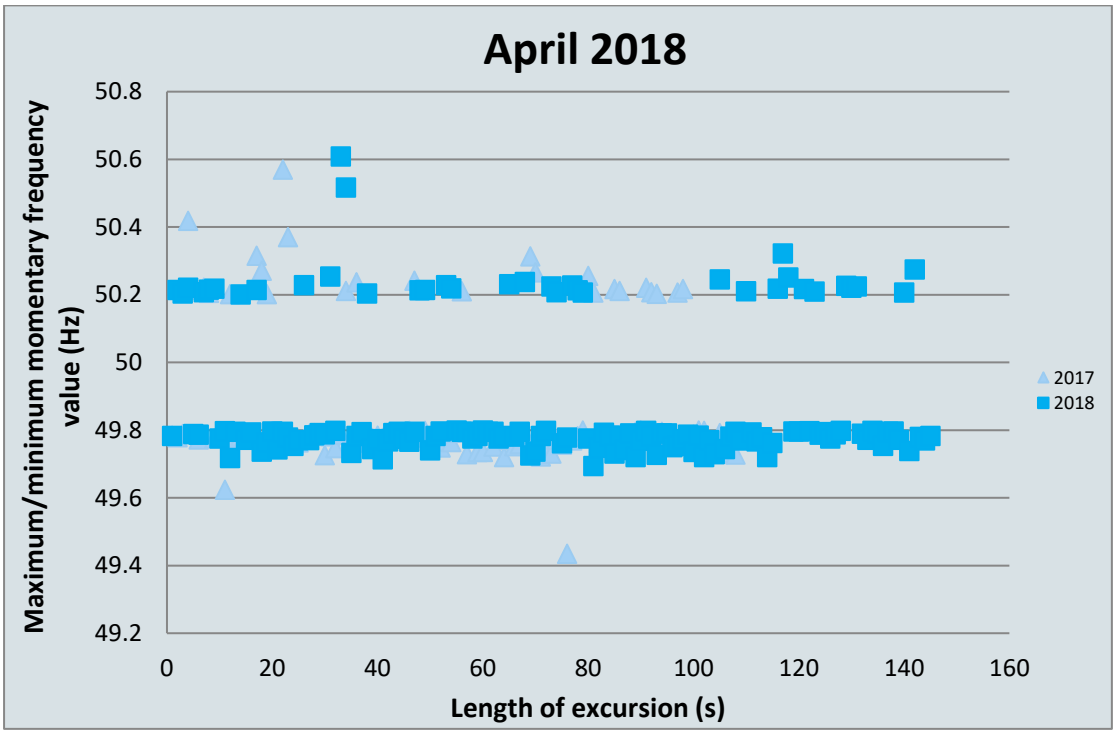
The HVDC pole intertrip operated at 06:30 on 25 June during planned switching for a Haywards Filter 3 outage. Pole 2 was blocked for about 1 minute. No runback occurred, with Pole 3 picking up the full 330MW north transfer. We are investigating this event as a near miss.

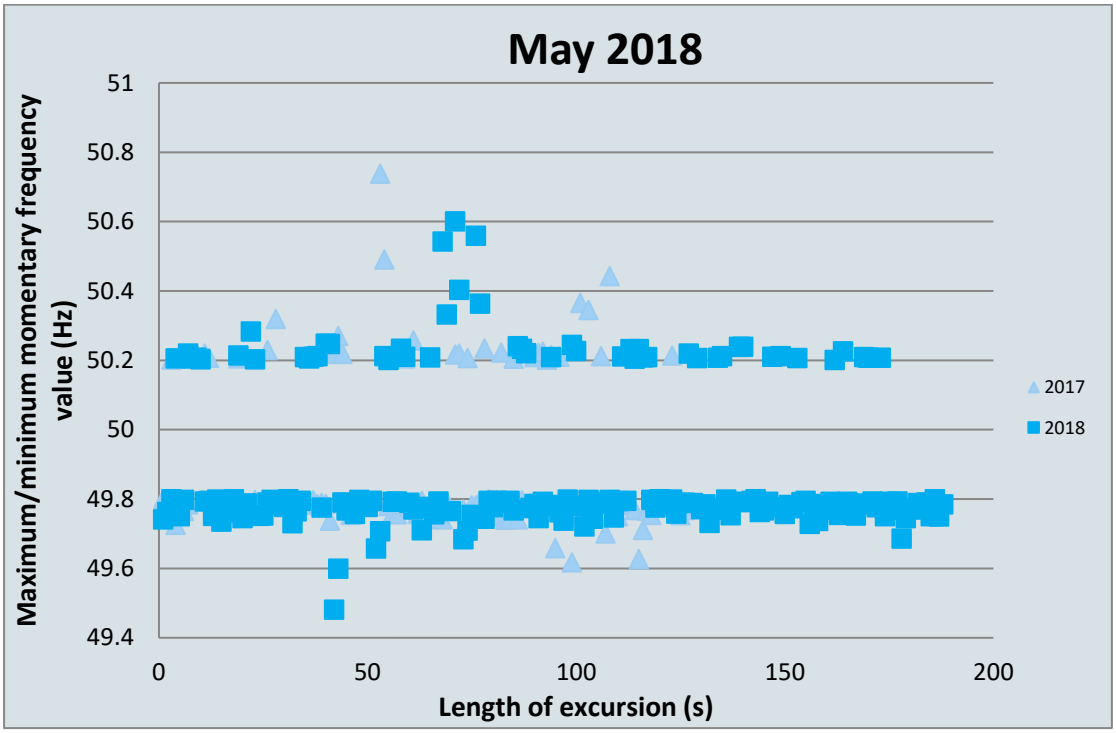
9 Frequency fluctuations

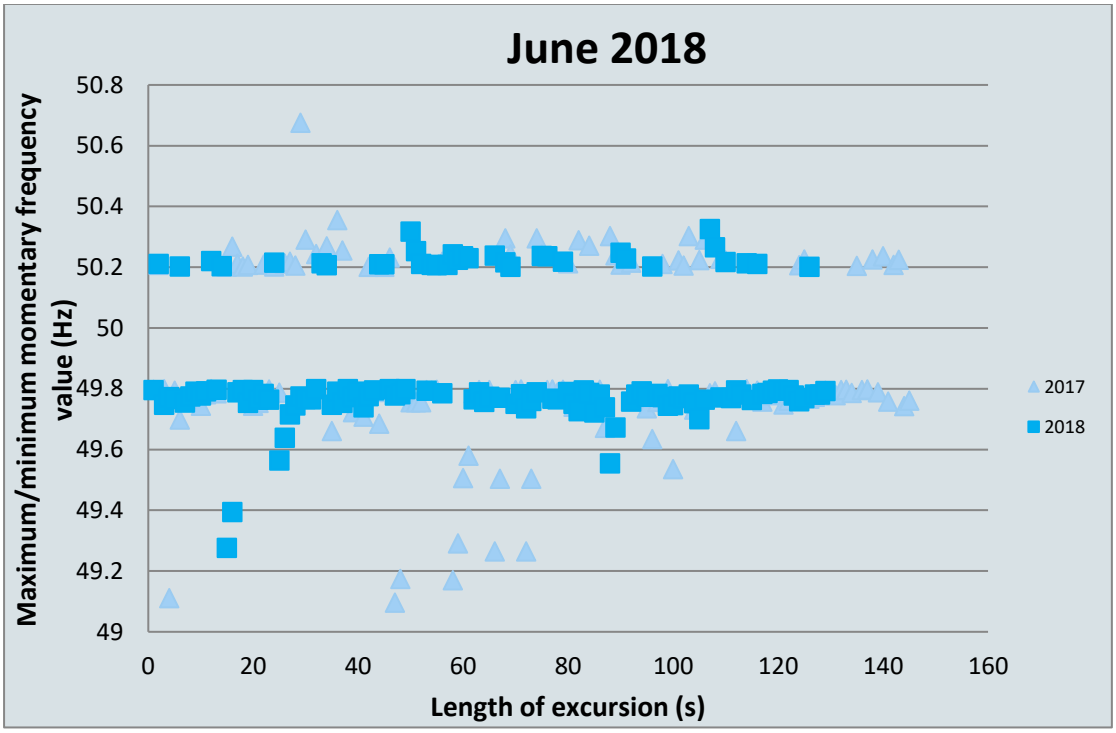
Transpower and the Authority are currently working together to update the presentation of this data to ensure more clarity around frequency performance and trends.

9.1 Maintain frequency in normal band and recover quickly from a fluctuation

The following charts show 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.







9.2 Maintain frequency and limit rate occurrences during momentary fluctuations

The tables below show the total number of momentary fluctuations outside the frequency normal band, recorded in each island, for each month over the last 12 months and the 12-month cumulative totals, grouped by frequency band.

North Island

Frequency Band	Jul-17	Aug-17	Sep-17	Oct-17	Nov-17	Dec-17	Jan-18	Feb-18	Mar-18	Apr-18	May-18	Jun-18	Annual rate
55.00 > Freq >= 53.75													
53.75 > Freq >= 52.00													
52.00 > Freq >= 51.25													
51.25 > Freq >= 50.50						1				1			**2**
50.50 > Freq >= 50.20	6	22	31	41	85	5	23	19	30	20	30	19	**331**
50.20 > Freq > 49.80													
49.80 >= Freq > 49.50	52	92	89	91	135	27	53	57	62	71	87	65	**881**
49.50 >= Freq > 48.75						1		2	1		1	1	**6**
48.75 >= Freq > 48.00													
48.00 >= Freq > 47.00													
47.00 >= Freq > 45.00													

South Island

Frequency Band	Jul-17	Aug-17	Sep-17	Oct-17	Nov-17	Dec-17	Jan-18	Feb-18	Mar-18	Apr-18	May-18	Jun-18	Annual rate
55.00 > Freq >= 53.75													
53.75 > Freq >= 52.00													
52.00 > Freq >= 51.25													
51.25 > Freq >= 50.50		2	1	1		1			2	1	3		**11**
50.50 > Freq >= 50.20	11	17	28	29	47	8	13	12	16	14	18	15	**228**
50.20 > Freq > 49.80													
49.80 >= Freq > 49.50	36	50	58	46	42	13	32	24	29	38	49	28	**445**
49.50 >= Freq > 48.75						1		2	1			1	**5**
48.75 >= Freq > 48.00													
48.00 >= Freq > 47.00													
47.00 >= Freq > 45.00													

9.3 Manage time error and eliminate time error once per day

There were no time error violations in the reporting period.

10 Voltage management

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

11 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	Jul-17	Aug-17	Sep-17	Oct-17	Nov-17	Dec-17	Jan-18	Feb-18	Mar-18	Apr-18	May-18	Jun-18
Demand Allocation Notice	-	-	-	-	-	-	-	-	-	-	-	-
Grid Emergency Notice	-	1	-	-	1	-	3	1	-	1	1	-
Warning Notice	-	-	2	-	-	1	-	-	-	-	-	1
Customer Advice Notice	2	6	6	1	8	1	3	6	4	10	12	4

12 Grid emergencies

The following table shows grid emergencies declared by the system operator from April to June.

Date	Time	Summary Details	Island
10-Apr-18	07:56	A grid emergency was declared at Hawera to assist with restoration of supply that was lost during a storm.	N
2-May-18	16:33	A grid emergency was declared at Rotorua to assist with restoration of supply following a fault.	N
Jun-18		None	

13 Security of supply

This quarter saw above-average inflows overall. The following table shows monthly inflows for both islands as a percentage of average for the time of year.

	April	May	June
North Island	143%	141%	111%
South Island	116%	103%	69%

National hydro storage decreased from 113% to 108% of average for the time of year (1 April and 30 June) but was sitting above 120% of average for much of that time, peaking at 132% at the end of May.

We sought feedback on the issue of thermal fuel limitations affecting security of supply risk. Based on the feedback, we propose to make no changes to the standard assumptions regarding thermal fuels but will monitor thermal fuel supply more closely, using a broader set of information (including more gas supply information where available).

We have also been working with Authority to prepare a joint consultation on the Security of Supply Forecasting and Information Policy, and associated Code clauses (including but not limited to the trigger for an Official Conservation Campaign).

14 Ancillary services

Review of the Ancillary Services Procurement Plan has commenced. The industry will be given an opportunity to comment on the plan. Result of the review is expected towards the end of the year.

There has been some interest from ancillary services participant on battery energy storage systems (BESS). It is expected the announcement from the Authority, that injection from a BESS meets the definition of a generating unit in Part 1 of the Code for the purposes of offering energy under Part 13 of the Code, will encourage increased battery developments in the market.

Refer Appendix B for Ancillary Services Graphs.

Appendix A: Discretion

April

Event Date & Time	Event Description
05-Apr-2018 11:42:41	MAN2201 MAN0 Tiwai Aluminium Smelter line 2 extended offload.
09-Apr-2018 11:56:33	MAN2201 MAN0 Restoration of extended potline
09-Apr-2018 12:02:05	MAN2201 MAN0 Restoration of extended potline.
10-Apr-2018 07:19:52	KPA1101 KPI1 OPK_KPI_SFD tripping
10-Apr-2018 07:50:38	HWA1101 PTA1 HAW bus islanded.
10-Apr-2018 07:50:54	HWA1101 PTA2 HAW bus islanded.
10-Apr-2018 07:51:12	HWA1101 PTA3 HAW bus islanded
10-Apr-2018 12:53:15	HLY2201 HLY2 HLY 2 tripping.
12-Apr-2018 07:38:33	WHI2201 WHI0 : Required for System Security
12-Apr-2018 07:46:00	WHI2201 WHI0 : Required for System Security
12-Apr-2018 18:06:39	WHI2201 WHI0 : End of Discretion
12-Apr-2018 18:08:01	WHI2201 WHI0 : End of Discretion
16-Apr-2018 15:30:28	MAN2201 MAN0 To provide capacity for reduction line restoration
19-Apr-2018 11:37:39	MAN2201 MAN0 Extended potline line 2
19-Apr-2018 15:43:33	HLY2201 HLY6 Huntly 6 tripped.

May

Event Date & Time	Event Description
10-May-2018 17:40:49	WHI2201 WHI0 : Required for system security.
28-May-2018 17:17:23	WHI2201 WHI0 : Required for system security.
28-May-2018 18:50:51	WHI2201 WHI0 : Low residual, required for FIR
28-May-2018 18:50:51	WHI2201 WHI0 : Low residual, required for SIR
28-May-2018 18:50:51	WHI2201 WHI0 : Low residual, required for energy shortfall
28-May-2018 19:25:41	WHI2201 WHI0 : Required for FIR
28-May-2018 19:25:41	WHI2201 WHI0 : Required for SIR
28-May-2018 19:53:58	WHI2201 WHI0 : Required for FIR
28-May-2018 19:53:58	WHI2201 WHI0 : Required for SIR
29-May-2018 17:18:10	WHI2201 WHI0 : Required for system security.
29-May-2018 17:20:09	WHI2201 WHI0 : Required for system security.
30-May-2018 17:35:24	WHI2201 WHI0 : Required for security of supply over the evening peak.
30-May-2018 17:50:08	WHI2201 WHI0 : Required for security of supply over the evening peak.
30-May-2018 20:18:48	WHI2201 WHI0 : Required for energy during load pick up.

June

Event Date & Time	Event Description
04-Jun-2018 19:43:51	SFD2201 SPL0 : SPL Gen tripped - IL tripped.
05-Jun-2018 07:25:29	ARG1101 BRR0 : Required off for system switching.
07-Jun-2018 12:07:39	MAN2201 MAN0 : TWI extended potline restoration, L2 188 MW.
08-Jun-2018 10:28:13	ARG1101 BRR0 : To accommodate ARG_KIK_1 restoration as part of planned work
11-Jun-2018 12:06:10	MAN2201 MAN0 : To model extended Potline return of 188MW
12-Jun-2018 17:36:36	WHI2201 WHI0 : Running MIN To cover MKE slow to sync for this TP.
14-Jun-2018 11:59:45	MAN2201 MAN0 : To model potline 2 return.
20-Jun-2018 11:47:03	KAW1101 KAG0 : Unit tripped
20-Jun-2018 17:22:50	WHI2201 WHI0 : Required for system security.
26-Jun-2018 17:29:57	WHI2201 WHI0 : Required for system security.
26-Jun-2018 17:55:09	WHI2201 WHI0 : Required for SIR
26-Jun-2018 17:55:56	WHI2201 WHI0 : Required for energy shortfall.
26-Jun-2018 17:55:56	WHI2201 WHI0 : Required for system security.
26-Jun-2018 18:15:49	WHI2201 WHI0 : Energy shortfall
26-Jun-2018 18:18:06	WHI2201 WHI0 : Energy shortfall
27-Jun-2018 09:40:03	WGN0331 : IL for FIR
27-Jun-2018 09:40:03	WGN0331 : IL for SIR
27-Jun-2018 10:23:04	MKE1101 MKE1 : Required for system security
27-Jun-2018 18:08:40	WHI2201 WHI0 : Required for security reasons to maintain reserves.
27-Jun-2018 19:22:51	WHI2201 WHI0 : Required for security reasons to maintain reserves.

Appendix B: Ancillary Services Graphs