QUARTERLY SYSTEM OPERATOR AND SYSTEM PERFORMANCE REPORT

FOR THE ELECTRICITY AUTHORITY

Transpower New Zealand Limited
April to June 2021

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 2020/21 (April to June 2021), 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 year to date, and actions taken in regard 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).

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Commentary

This section provides a high-level update for this quarter. The remainder of the report provides supporting detail in two sections:

- System Operator performance
- System performance.

Update (April to June 2021)

- Early in the quarter, we increased Security of Supply reporting as it looked as if there was a reasonable chance the 1% risk curve would be crossed. But with inflows and more gas becoming available by mid-May this was no longer the position, so the additional reporting was stood down. We also produced an outage watchlist and engaged with the Electricity Retailers' Association of New Zealand (ERANZ), the Electricity Networks Association (ENA), the Security and Reliability Council (SRC), and the Electricity Authority (Authority) regarding process and accountabilities for an official conservation campaign and rolling outages.
- The Code change consultation for Extended Reserves (AUFLS) provision in the North Island took place in April and we have worked with Major Electricity Users' Group (MEUG) members in response to questions they raised.
- We hosted our annual Asset Owner Engineering Forum on 29 June, attended by over 70 people including representatives from the Authority, generators, distributors, consultants, developers and universities. The theme was based on embracing new connections and aimed at informing participants of improvement initiatives we have or are delivering for enabling the participation of new technology. It was successfully rearranged into a virtual forum due to Wellington being at COVID-19 Alert Level 2.
- Real Time Pricing (RTP) phase 1 was successfully deployed on 13 May, three weeks ahead of schedule. The project continues to progress well and track to time and budget.
- As part of the System Operator Service Provider Agreement (SOSPA), we have delivered our System Operator 2021/22 planning documents to the Authority by the end of the financial year.
- We completed a business continuity exercise. The exercise was performed in a workshop environment and simulated a cyber-attack impacting key systems, including the loss of the Wholesale Information and Trading System (WITS), Supervisory Control and Data Acquisition (SCADA) and Inter-Control Centre Communications Protocol (ICCP).
- We completed the final business audits for this year and have identified the audits we will undertake as part of the 2021/22 Audit Plan.
- The Reserve Management Tool (RMT) audit & Scheduling Pricing & Dispatch (SPD) audit were completed in April and sent to the Authority. The auditors found nothing of concern.
- We received good scores and comments from our customers as part of the stakeholder participant survey.

- We prepared and published a PowerFactory (DIgSILENT) dataset of the New Zealand power system via the Electricity Authority's website ('the Electricity Market Information (EMI) dataset') which enables people to perform their own power system analysis using the same information as the System Operator.
- We published two longer Market Insight articles, one on forecasting intermittent generation in New Zealand and one on the importance of scale when it comes to Distributed Energy Resources (DER).
- We attended kick-off meetings for the commissioning of both Tauhara B (Contact Energy, 180 MW geothermal) and Harapaki (Meridian Energy, 176 MW wind farm) new generating stations.
- We published on our website an update to the procedure related to planned asset testing while connected to the power system (PR-EA-010).
- We are working with the Authority following their request for technical advisory support to aid their response to the "G2" recommendation in the Electricity Pricing Review.

Recent initiatives

- As part of our ongoing work to enable generation connections in New Zealand, we published our guideline outlining requirements for system studies that Asset Owners will need to complete
- We surveyed Electricity Distribution Businesses (EDBs) on their intentions around the use of controlled load (hot water and other ripple-controlled loads) once the Regional Coincident Peak Demand (RCPD) incentive was removed in order to determine if this would result in any changes in behaviour.
- We published our assessment of the System Operator's ability to maintain security after an HVDC bi-pole tripping event should Tiwai close.
- We undertook a high-level forecast of potential peak capacity issues for Hawkes Bay which indicated we may have seen peak shortages in several periods in April, May and June as peak demands increased and if we did not see increased inflows to Waikaremoana. Inflows have since improved and we are not anticipating issues in the short-term.

Recent/Current investigations

- An evaluation is underway on the System Security Forecast (SSF) to ensure it continues to deliver on its 'purpose' considering changes happening to the New Zealand power system.
- We detected South Island power system oscillations between Manapouri and Clyde of 1.7 Hz in early May. These were not at a level to cause concern, and were correlated with the operations of Manapouri G1 generating unit; Meridian has now resolved this issue.
- We completed our investigation and published a report to the Authority on proposed changes to the Code to better incorporate inverter connected resources.
- When one of the two fibre optic communications cables south of Christchurch was rendered inoperable by flooding on 31 May, we undertook studies to understand the impact should the second cable also be compromised. The system remained stable and secure operating via one cable.

System Operator performance

1 Customers and other relationships

Security of Supply Stakeholder Engagement

In April, as part of our 'dry winter' preparations in our role as System Operator, we published an outage watchlist which defines outages that might be detrimental to national storage. The outages may either constrain off thermal, geothermal or wind generation, constrain on hydro generation, or put large non-hydro generation on N-security. We worked with Transpower's Grid Delivery division to review any planned outages ahead of a formal request (at the 4% risk curve) to defer these.

We also engaged with the Electricity Retailers' Association of New Zealand (ERANZ), the Electricity Networks Association (ENA), the Security and Reliability Council (SRC), and the Electricity Authority (Authority) regarding process and accountabilities for an official conservation campaign and rolling outages.

Inflow events in May and more gas becoming available (see Section 13 for details), took us to a position where we were unlikely to cross the 1% curve in the near term (outside of exceptional circumstances). As a result, we discontinued daily reporting to the industry on 18 May. Should the storage position return to within seven days of the 1% risk curve, daily reporting will resume.

Meetings continue with Ministry of Business, Innovation and Employment (MBIE), the Electricity Authority (Authority), and the Gas Industry Company (GIC) but on a monthly basis.

Code change consultation – Extended Reserves

The Code change consultation for Extended Reserves (AUFLS) provision in the North Island took place in April. These code changes will reverse the old Extended Reserves concept out of the Code and reinstate an essentially common mandate for AUFLS. It also includes a requirement for providers to move from existing two block to proposed four block AUFLS scheme by June 2025.

Since then we have worked with the Authority and engaged with MEUG members in response to questions they raised as part of the consultation. The proposed Code change will bring an end to the exemptions MEUG members have for providing AUFLS. The meeting was to help clarify how they can engage with the System Operator to progress equivalence arrangements (instead of the existing exemptions) in order to meet their Code obligations. Concerns raised from MEUG were related to the likely impact to MEUG members' ability to sell interruptible load in the market, as AUFLS will take priority under the Code.

The Authority will publish all the responses and decision on their website in early August.

Electricity Authority

The Authority has requested technical advisory support to aid their response to the "G2" recommendation in the Electricity Pricing Review (ie to consider security and

resilience of power system in light of expected future changes). We are working with them to develop a scope that will deliver a multi-year work programme.

North Island Electricity Distributor Forum

We attended the quarterly forum of the North Island distribution companies hosted by Counties Power. We used this forum to continue our education programme regarding System Operator processes.

Major Energy Users' Group (MEUG)

Our Operations Planning group provided training to MEUG members on the use of the Planned Outage Coordination Process (POCP). With the support of the Electricity Authority, we have been encouraging large users to use the tool to enable them to get early warnings of major outages, and to help them meet their own compliance obligations. Oji, Pan Pac, Alinta, Norske Skog, Rio Tinto and NZ Steel attended, and we will continue to work with them to assist them in using the tool.

Support for new connections

As part of our ongoing work to enable generation connections in New Zealand, we published our guideline outlining requirements for system studies that Asset Owners will need to complete. These studies will enable Asset Owners to satisfy us that their new asset is able to meet relevant Code performance obligations. This will help to ensure timely commissioning and successful integration and operation of new assets into the New Zealand power system.

In mid-May a team from our Hamilton control centre visited Top Energy at Ngawha Geothermal to build relationships and share information related to the System Operator requirements and operational processes. Feedback was very positive, and this service will be incorporated as part of connecting new participants from now on.

Asset Owner Engineering Forum

We hosted our annual Asset Owner Engineering Forum on 29 June, attended by over 70 people including representatives from the Authority, generators, distributors, consultants, developers and universities. This year's theme was around embracing new connections and aimed at informing participants of improvement initiatives we have or are delivering for enabling the participation of new technology. The forum offers the opportunity for the System Operator and asset owners to interact, encouraging collaboration at a technical level, and the chance to discuss any challenges in meeting the required Asset Owner Performance Obligations. Originally planned as a face to face forum, this was successfully rearranged into a virtual forum due to Wellington being at COVID-19 Alert Level 2.

Annual System Operator participant survey

We sent out our participant survey in April and have received some good feedback as well as helpful suggestions to improve our processes. The survey closed in mid-June and the 53 responses have been provided to the Authority as a SOSPA deliverable for this financial year.

SOSPA planning for 2021/22

We have delivered our System Operator 2021/22 planning documents to the Authority. These are annual obligations under the SOSPA contract and involve significant work across multiple resources to collate and prepare. The documents include:

- Planning documents such as the System Operator strategic plan, business plan and various capital planning documents for the next four years.
- Work agreements with the Authority for how we will engage and educate industry; and how we will support the Authority with its statutory objective and undertake our System Operator annual audits.
- Performance Metrics and Incentives commitment which sets the measures by which the System Operator service is assessed.

GM Stakeholder Meetings

Dr Jay has met with Genesis, Meridian, Methanex, MBIE, the GIC, Ministerial advisors, ERANZ, and the ENA. He has corresponded with PJM, National Grid, AEMO, Mondo, and CIGRE Australia.

Association of Power Exchanges (APEx) and the Electricity Engineers' Association (EEA)

Dr Jay attended an APEx board meeting on the 12 May. Topics discussed included lessons from the Texas weather related outages, and market development in Pakistan. The EEA conference was deferred until August due to the Wellington Alert Level 2 COVID-19 lockdown. Transpower has a range of presenters, including topics on outage planning, system restoration, and future people requirements.

2 Risk & Assurance

COVID-19 response

We continue to remain vigilant regarding COVID-19. The additional control room desks set up last year remain available if we need to instigate our COVID-19 shift protocols.

The Wellington region entered Alert Level 2 in late-June. Our COVID-19 process is that all control rooms (no matter where they are) respond to the highest level in the country, so both our control rooms were under Level 2 conditions during that period. They have now stepped back down a level to Alert Level 1 like the rest of the country.

Business Continuity Planning

During May, we undertook a business continuity exercise. This provided an opportunity for us to check the content of plans and continue to train our people. The exercise took place in a workshop environment and simulated a cyber-attack impacting key systems, including the loss of the Wholesale Information and Trading System (WITS), Supervisory Control and Data Acquisition (SCADA) and Inter-Control Centre Communications Protocol (ICCP). Overall, the exercise went well, with some good lessons being identified to feed back into our plans as part of lifting our preparedness.

Business process audits and 2021/22 Audit Plan

The final three business process audits were completed this quarter and submitted to the Authority by the end of the financial year. The Regional Contingency Planning audit was deemed effective with three low risk findings identified for management to

consider. The Event Investigation audit identified two medium risk findings and one low risk finding relating to prioritising events, improving staff awareness and timely closure of events. The Managing Grid Offers audit identified three low risk findings relating to the System Operator gatekeeper function communicating requirements to the Grid Owner.

The 2021/22 Audit Plan was also provided to the Authority by the end of June, the planned audits are:

33. Under Frequency Event Process
34. Managing Conditional Offers
35. RMT Operational Change Procedure
36. RMT / SPD Annual Audit
37. Outage Block Mapping
38. Commissioning Risk Policy

SOSPA audits

The Reserve Management Tool (RMT) audit and Scheduling Pricing & Dispatch (SPD) audit were completed in April and sent to the Electricity Authority. The auditors found nothing of concern.

EDB load control survey

The System Operator surveyed Electricity Distribution Businesses (EDBs) on their intentions around the use of controlled load (hot water and other ripple-controlled loads) once the Regional Coincident Peak Demand (RCPD) incentive was removed. This was to determine if any changes in behaviour (for example ceasing load control activities once the incentive expired) may lead to increased peak loads and associated security issues. The majority of EDBs have responded with the information requested and the System Operator is analysing this information to determine potential impacts and if any modelling scenarios need to be developed for the various security products the System Operator provides (i.e. security of supply and New Zealand Generation Balance (NZGB)).

Operational impact assessment, Tiwai (TWI) closure – managing an HVDC bipole

We published our assessment of the System Operator's ability to maintain security after an HVDC bi-pole tripping event should Tiwai (TWI) close. We found that under extreme South Island light load conditions post TWI, north HVDC transfer needs to be limited to maintain security. However, as load increases so does our ability to manage larger HVDC bi-pole trippings, due to more generation being online. Looking at historic 2018 HVDC transfer and South Island load data, the need to constrain the HVDC would be minimal. Overall, we are confident that using our existing operational measures we can continue to manage frequency and voltage within limits. However, there are opportunities to improve our Over Frequency Arming scheme and tools to lift HVDC north transfer limits during periods of extreme light load in the South Island.

This is part of the stream of work detailed in Section 8 of this report.

3 Compliance

April

We reported two System Operator breaches in April.

The first related to the System Operator incorrectly modelling the electricity risk curve calculation from March 2020 to March 2021. Under the Security of Supply Forecasting and Information Policy (SOSFIP), the System Operator must include in its risk curve calculations a floor equal to (among other things) the amount of contingent hydro storage that represent higher levels of risk of future shortage. In modelling the 4% alert level risk curve the System Operator did not include amount of contingent storage associated with the higher alert level (10%). There was no market or operational impact associated with the breach.

The second related to the Mangahao 33kV substation outage. The market model still had part of the bus that was disconnected as part of the outage. Because of this, the market solver set the price to $0 and discarded the metered load from its calculations. The market impact is difficult to determine however purchasers should have paid $770k more for electricity during the affected trading periods.

May

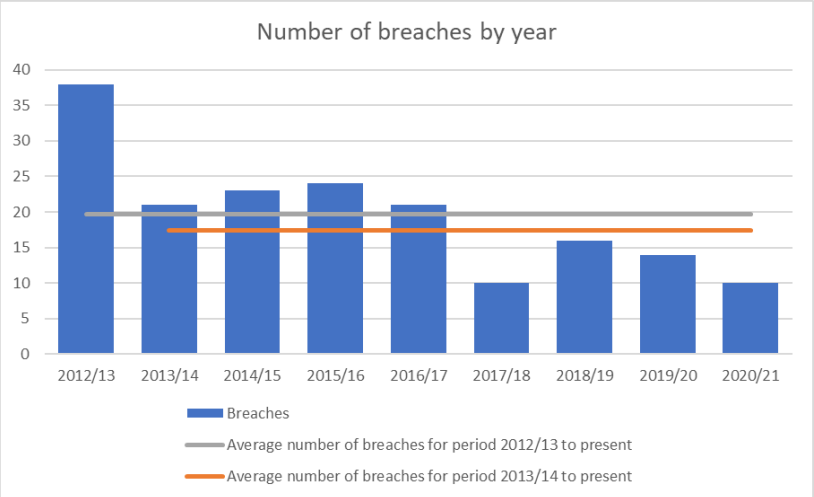
We did not report any System Operator breaches in May.

On 2 May 2021, Genesis Energy's Huntly station unit 5 generator (Huntly Unit 5) tripped. The disconnection of generation from Huntly Unit 5 removed 271 MW of injection into the power system resulting in an under-frequency event. On 6 June 2021 we submitted our Causation Report, which includes information from both Genesis and the Grid Owner on the circumstances around the event. The report recommended that Genesis be found as the causer of the under-frequency event.

June

We did not report any System Operator breaches in June.

We have seven outstanding breaches with the Authority compliance team.



Appendix A shows instances where the System Operator has applied discretion under 13.70 of the Code.

4 Impartiality of Transpower roles

The entries in the table below are the open issues in the conflict of interest register (Register). These issues are being actively managed in accordance with our policy for managing conflicts of interest.

April

No items were opened in the Register during April.

May

No items were opened in the Register during May.

June

No items were opened in the Register during June.

There are five open items in the Register that are being actively managed.

System Operator Open Conflict of Interest Issues		
ID	Title	Managed by
29	**Preparing the Net Benefit test – System Operator involvement:** The System Operator is reviewing how it can provide information for use by the grid owner undertaking a Net Benefit Test.	Operations Planning Manager
31	**Discussions concerning Demand Response:** A System Operator employee is part of a Transpower working group investigating the possible future use of the Transpower demand response platform. The System Operator role is to provide the System Operator perspective on any demand response proposals. Impartiality mitigations have been implemented to ensure the grid owner is not treated more favourably than any other participant with respect to demand response.	SO Market and Business Manager
39	**New SO Compliance & Impartiality Manager:** This relates to potential perception; the person filling this role also works for Transpower's legal team on a part-time basis. Workstreams will be allocated accordingly.	GM Operations
40	**General System Operator/Grid Owner dual roles:** This is a general item that will remain permanently open to cover all employees with a dual System Operator/Grid Owner role. The item documents the actions necessary to ensure impartiality in these circumstances; these items will be monitored to ensure their continue effectiveness.	SO Compliance & Impartiality Manager
41	**General relationship situation:** This is a general item that will remain permanently open to cover all potential conflicts of interest arising under a relationship situation. This item documents the actions necessary to prevent an actual conflict arising and will be monitored by the SO Compliance & Impartiality Manager to ensure their continued effectiveness.	SO Compliance & Impartiality Manager

4.1 Independence recommendations update

Transpower's Risk & Assurance has engaged Deloitte to conduct an audit of the breach process managed by the System Operator to ensure impartiality in the end-to-end breach process (Grid Owner vs other participants). An audit of the breach process covers the System Operator inherent independence threat around monitoring the Grid Owner's compliance with the Code. The System Operator worked with Deloitte to scope the audit and develop terms of reference and Deloitte commenced the audit in June. The System Operator expects the audit to be completed in July/August, with a draft report to the circulated to the System Operator following completion.

5 Project updates

5.1 Market design and service 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.

Real Time Pricing (RTP)
The project continues to progress well and track to time and budget. Phase 1 was successfully deployed on 13 May, three weeks ahead of schedule. This release has no direct market impact and introduces only minor change to the System Operator function but is a significant preparatory milestone for the wider RTP project.

Phase 2 development continues to make good progress and initial functional testing is underway in some areas. Early phase 2 deployment planning is underway and will continue as development and testing proceeds. Phase 2 business procedure reviews and updates continue and training development started in June. Requirements validation for phases 3 and 4 continues to make good progress.

There are a number of projects affecting similar systems and business functions active over the next few months. Inter-project dependencies have been extensively reviewed and a draft plan has been formulated to mitigate these risks from placing the RTP project delivery date in jeopardy.

The project team presented at the Authority's June Industry Engagement session which was well received and generated a number of good quality questions. The next engagement session will be led by NZX who will be talking about changes to the WITS trading platform.

Situational Intelligence (SI)
SI data lake – This project was partially commissioned in June 2021. Current project focus is on production implementation of the base platform with next steps being real-time visualisation

SI roadmap project - The business has completed the planning, and a draft five-year roadmap including the updated benefits has been submitted for review. The first year is focused on enabling the business requirements for RTP. Finalising the SI Roadmap and delivery of first year RTP business requirements is planned for July 2021.

Extended Reserves (Automatic Under Frequency Load Shedding - AUFLS)
The AUFLS Data Portal project has progressed well with production release in June. As part of testing for completion, the team conducted external User Acceptance Testing with one distributor in early June.

In parallel, the System Operator has been working with the Authority confirming a Technical Advisory Services (TAS) Statement of Work (SoW) on the effort to roll out the data portal to North Island Distributors and to conduct a Transpower industry consultation on the AUFLS Technical Requirements (ATR) document. This TAS was approved mid-June, and the roll-out is expected to commence 1 July.

5.2 Other projects and initiatives

Continuous Business Improvement Initiatives

Initiative	Activity Completed	Improvement Implementation
Modelling Improvement Working Group	Established a modelling working group in September 2020 resulting in a collaborative forum that: • has representation from all modelling groups within Transpower • discusses common issues and makes action plans to address them • evaluates and prioritises resolving issues in a consistent and structured way • engages with projects on modelling related queries and future change implications to core modelling activity	The group meets fortnightly and actively working through implementing improvements. Recent successes include: • Implementation of a SCADA Operational Support Environment (OSE) to provide a dedicated environment for core modelling activity that integrates with power system applications. • improved Excel templates for Outage Blocks from Real Time System modelling. • Established knowledge management base for sharing modelling knowledge across teams. • Solution established to improve consistency of data between SCADA and PI. Working towards implementing in November 2021.
System Security Forecast (SSF) Report Evaluation	An evaluation is underway on the System Security Forecast report that the Electricity Industry Participation Code stipulates the System Operator must publish every two years and update every 6 months. The purpose of this evaluation is to: • Reduce the time spent by the Power System engineers to complete the reporting by improving the reporting study analysis and creation process. • Ensure that the SSF delivers on its 'purpose' considering changes happening to the NZ Power System. i.e. the SSF that was fit for purpose over the last 10 years may not be suitable for the next 10 years given the ever-changing environment we are operating in.	Evaluation underway analysing the following due to be completed in July: • Current state process currently taken to complete the SSF report. • Customers of the SSF report – validate who consumes the information, which parts of it and what actions are taken/informed by the content. Options analysis and solution enhancements will commence in August with an evaluation report and recommended improvements targeted to be produced in October 2021.

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 Q4
TAS SOW 95 – Battery Energy Storage Systems Offering Reserve	Complete	223.50
TAS SOW 96 – Reliability standards for inverters	Complete	29.00
TAS SOW 97 – RTP engagement session support	In progress	81.50
TAS SOW 98 – AUFLS Data Portal Deployment to NI Distributors	In progress	5.00
Total hours		**339.00**

7 Outage planning and coordination

Outage Planning – near real time

While we continued to see high volumes of work requiring outages over this period, numbers are dropping as we enter the winter season. Careful management and proactive actions ahead of potential weather-related issues kept unplanned outages low with no customer impacting incidents.

New Zealand Generation Balance (NZGB) reporting

Generation balances have improved over the quarter. The July NZGB report forecast no N-1-G generation shortfalls for the next six months. Applying low gas, no wind assumptions, minor N-1-G shortfalls are forecast for July and mid-August.

The Grid Owner published its Annual Outage Plan for 2021-22 on 3 May 2021. NZGB now reflects this published plan.

Outage Planning events or items of note

System Operator engineers worked with the lines project/maintenance teams to enable a complex Bombay-Otahuhu 2 outage. The outage was for urgent conductor repairs needed at a non-preferred time of the year. With some good collaboration, an understanding of the importance and some flexibility with how we manage the outage, we managed to secure it.

8 Power systems investigations and reporting

Operational impact of Tiwai exit

Following Rio Tinto's announcement in January of its plan to delay the closure of Tiwai until 2024, the Operations Tiwai exit working group reviewed its work programme to decide what activities to pause and which to continue. Our engineering studies will continue, and include:

- South Island transient (rotor angle) stability analysis, including challenges managing a bi-pole tripping
- South Island Over-Frequency performance analysis
- Small signal stability analysis across the North and South Islands.

The first of these reports, "Managing an HVDC bipole tripping" was published on the Transpower website in June (details of which are included in Section 2 of this report: Risk & Assurance). Draft reports outlining the remaining challenges and their potential likelihood of occurrence have been prepared and are now going through internal review and will be shared with the industry.

The page on the website has been developed to keep industry informed of the findings from our operational studies into the impact of Tiwai's exit on our ability to operate the power system.

Hawkes Bay regional capacity issues

We undertook a high-level forecast of potential peak capacity issues for Hawkes Bay. This indicated we may have seen peak shortages in several periods in April, May and June as peak demands increase, if we did not see increased inflows to Waikaremoana (we do have existing real time processes to mitigate security concerns). We shared our analysis and communicated our processes with regional stakeholders at an online briefing on Wednesday 7 April. Inflows have since improved and we are not anticipating issues in the short-term.

South Island power system oscillations

South Island power system oscillations between Manapouri and Clyde of 1.7 Hz were detected in early May. While these were not at a level to cause concern, Meridian and Contact were asked to provide information of any plant changes, but none were identified. Subsequently we have correlated the oscillations with the operations of Manapouri G1 generating unit. Meridian replaced a Power System Stabiliser (PSS) control card on Manapouri G1 which resolved the issue.

Reliability standards for inverters

We completed our investigation and published a report to the Authority on proposed changes to the Code to better incorporate inverter connected resources. This included a summary of the technical differences to be considered between synchronous and inverter generation, Code clauses to review in Part 8 and 13, and a two-plus year roadmap of investigation required to support the review.

New Electricity Market Information Dataset Released

Annually we prepare and publish a PowerFactory (DIgSILENT) dataset of the New Zealand power system via the Electricity Authority's website. This dataset is referred to as the Electricity Market Information (EMI) dataset and enables people to perform their own power system analysis using the same information as the System Operator. This dataset is particularly useful for anyone considering connecting new generation in New Zealand, as it can be used to perform connection studies.

This year's EMI Dataset, released in May, contains updates affecting both steady-state and dynamic load-flow simulations and can also perform fault studies on the core grid. Users are advised to run the case files in PowerFactory 2019 SP4. This will ensure stable performance that reflects the expected system response and behaviour to simulated tripping events and fault conditions.

9 Performance metrics and monitoring

The following dashboard shows System Operator performance against the performance metrics for the financial year to date as required by SOSPA 12.3 (a).

Only those metrics with a weighting are used in the calculation of the System Operator score and incentive payment.

		Annual Target	Actual to date	Points
Smart about money				
Perception of added value by participants		80%	79%	
Customers are informed and satisfied				
Annual participant survey result		82%	84%	5
Annual participant survey result response rate - First tier stakeholders		80%	100%	
On-time special event preliminary reports		90% ≤ 10 business days	0 to date	5
Future thinking and insights	Future thinking report	≥ 1	1	5
	Longer Market Insight reports	≥ 4	4	5
	Bite-sized Market Insights	≥ 45	48	
Quality of written reports		100% of standard	100%	
Role impartiality		80%	93%	5
Code compliance maintained and SOSPA obligations met				
Market breaches remain below threshold		≤ 3 @ ≥ $40k	3	10
Breaches creating a security risk - below threshold/within acceptable range		≤2	0	10
On-time SOSPA deliverables		100% (50)	100%	10
Successful project delivery				
Improved project delivery	Service Maintenance projects	≥ 60% on time	15%	
		≥ 60% on budget	62%	
	Market Design and Service Enhancement projects	≥ 60% on time	0%	
		≥ 60% on budget	100%	
Accurate capital planning		≥ 50%	58%	10
Commitment to optimal real time operation				
Sustained infeasibility resolution		80% ≤ 10am or equiv	94%	5
High spring washer resolution		80% ≤ 10am or equiv	100%	
Dispatch Accuracy	Energy (Optimal dispatch)	Reported on via dashboard		
	Reserve Management Objective	Reported on via dashboard		
Fit-for-purpose tools				
Capability functional fit assessment score		75.00%	68.80%	
Technical quality assessment score		65.00%	68.10%	
Sustained SCADA availability		99.90%	99.99%	10
Maintained timeliness of schedule publication		99.00%	99.99%	10

9.1 Dispatch accuracy dashboard

As part of the Strategic Objective Work Plan for 2019/20, we developed a Dispatch Accuracy dashboard for energy dispatch. This is a means of monitoring overall industry performance and is contained in Appendix B, along with an explanation of the methodology we used to create the dashboard.

The purpose of this year is to evaluate how well each of these measures illustrate industry dispatch performance. We have used this year as an opportunity to evolve the dashboard measures, the standards and metric calculation so that it provides the greatest insight. This evaluation has been performed in consultation with the Electricity Authority.

Based on our experience of this year, we believe that the dashboard has provided valuable insights into dispatch performance as a whole and it should continue to form part of the Quarterly report.

We will continue to evolve the measures in the dashboard and potentially the metric, if we consider it continues to provide additional value, and look to develop aspects of the optimal dispatch tool such as considering the impact of load bids.

Via the dashboard, we have collected a snapshot of these aspects of performance since January 2019 which provides valuable trend data. The dashboard will also provide a good mechanism to see how changes to the power system, such as the introduction of more wind generation, affects performance.

We do not believe there is merit in formalising a metric with a defined target level of performance since the variations we have investigated have been due to other participant action and not system operator performance.

Instead, our proposal for 2021/22 is:

We investigate and report to the Electricity Authority on all instances of variations in the dashboard above a defined threshold.

We will work with the Authority to define the thresholds for the measures.

April to June 2021

- *Discretion applied under 13.70 to meet dispatch objective (June)*

  There were 15 occurrences during the month, which is much higher that the norm, but is not an indication of a system problem or a common theme

  - Two of these were a normal switching requirement at a particular location due to the lack of circuit breakers
  - Five were tripping of grid assets resulting in the disconnection of generation. Discretion is used to manage dispatch until the market model is updated
  - Five were due to prevent overloading in a steady state during a planned outage putting load and generation on N security (one of these was created but not sent out in real time)
  - Three were required to bring on more energy during high winter peak load

- *Frequency excursions (May and June)*
  There were two occurrences in May and three in June
  - Both the May occurrences were due to Huntly tripping on 2 May
  - Two of the June excursions were when a Tiwai line tripped
  - One related to a tripping of Kawerau geothermal generation.

- *FK outside of band limit (May)*
  - We have been experiencing issues with the data for this measure. These outliers may therefore be an issue with data and not system performance. The updated figures and explanation will be included in next quarter's report.

- *Constrained on energy – frequency keeping (April and May)*
  - These are a reflection of the high frequency keeping costs this quarter. As noted in Section 13, we have not seen prices this high since October 2014.

Optimal dispatch

The dispatch load and wind offer accuracy measures are broadly consistent with the previous quarter. The optimal dispatch accuracy measure shows an increase in this quarter relative to the previous quarter. During this quarter there was an increased cost of dispatching resources due to the reduced hydro inflows and increased prices of offered resources (as observed through the increased spot prices during this period). This increased the cost of forecast errors on dispatch however this increased cost was lower than the increase in the average dispatch costs. This implied a net reduction in the proportion of the forecast error costs relative to the average dispatch costs which results in an improvement in the optimal dispatch accuracy measure.

10 Cost-of-services reporting

We provided the Authority with a final report on the cost-of-services for financial year 4 (2019/20) on 22 December 2020.

11 Actions taken

The following table contains a full list of actions taken during Q3 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**:	• Shared a Future Thinking report: Operational impact assessment, Tiwai closure – managing an HVDC bipole • Assisted the Electricity Authority with evolving market design, providing technical advisory support to aid their response to the "G2" recommendation in the Electricity Pricing Review • Continued to provide proactive communications and insights by publishing two Market Matters articles, one on forecasting intermittent generation in NZ and one on the importance of scale when it comes to DER • We are getting ready to consult on the review of the Procurement Plan to include future proofing – this will take place during August • Implemented changes from our refreshed SO Service Stakeholder Education and Engagement plan, such as producing infographics to describe the roles undertaken by the System Operator and the where the System Operator fits within the industry, produced social media articles on work we have been doing, and started to refresh our website • Updated our Asset Testing process (as part of streamlining the connection of new assets and technologies to the power system), and communicated the revision of practices, codes and guidelines.

(ii) To comply with the **statutory objective work plan**:	By 1 April, delivered proposals as part of SOWP 2020/21 to:
	• incorporate feedback on innovation, communication and responsiveness
	• evaluate the dispatch accuracy metrics for energy and reserves which described how during 2021/22 we will:
	  • provide a targeted piece of work to respond to the feedback from the industry chief executive interviews
	  • continue to produce the energy and reserve dashboards and work with the Authority to report on the outlying variations.

(iii) In response to participant responses to any **participant survey**:	**Feedback from the 2019-20 survey** • "*I support the Test Plan Review and would like to see improvement in this space*". This update was published on our website and shared at the June Asset Owner Engineering Forum
(iv) To comply with any **remedial plan** agreed by the parties under SOSPA 14.1	N/A – No remedial plan in place.

System performance

12 Security of supply

The declining trend in hydro lake levels paused as consistent small-scale inflows pushed storage sideways through much of April. However, prior to this, as per our policy, in instances where we think there is a reasonable chance of crossing the 1% risk curve, we activated specific actions including daily reporting, developing an outage watchlist and investigating potential grid reconfigurations.

As a result of material South Island inflows ahead of cold change on 11-12 May, and with further moderate inflows expected in catchment areas in mid-May, this took us to a position where we were unlikely to cross the 1% curve in the near term (outside of exceptional circumstances). As a result, we discontinued daily reporting to the industry on 18 May. Should the storage position return to within seven days of the 1% risk curve, daily reporting will resume.

The improving situation was helped from March to May by market response to the tight situation through improved coal supply chain, more efficient use of gas with a Nova/Contact tolling arrangement, small changes to the gas supply assumptions and an improved diesel supply chain to Whirinaki. In May, thermal generation improved with Huntly 5 returning to service. In addition, Genesis secured additional gas for this winter from Methanex and Ballance Agri-Nutrients. This meant the amount of gas available to electricity generators aligned with our thermal assumptions within the risk curves. In early June changes in gas demand at Huntly power station and Methanex's production site were evident as a result of the Methanex/Genesis deal coming into effect. This appears to have contributed (among other things) to a reduction in coal-powered thermal generation.

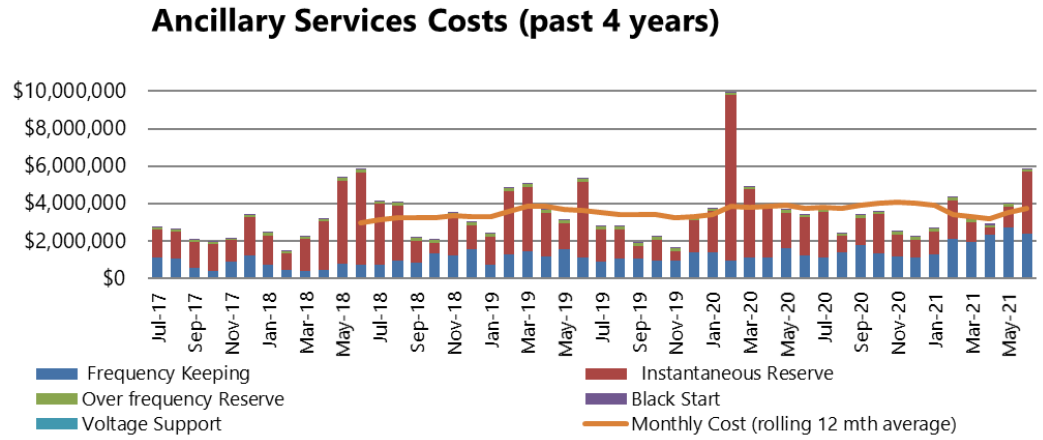
The national hydro storage position improved steadily throughout June and for the first time since late January, hydro storage conditions in the South Island returned to above the 10th percentile of historic storage positions. Although this is good news, storage levels are still lower than average for the time of year and we are still vulnerable to another low inflow sequence, asset failures, or any other combination of events. We continue to monitor the situation closely.

By the beginning of July, New Zealand hydro storage is 87% of average for the time of year. North Island storage is 47% of historical average (a significant improvement in North Island supply, as over this quarter North Island storage was as low as 21% of historical average). These increases were driven by above average winter inflows.

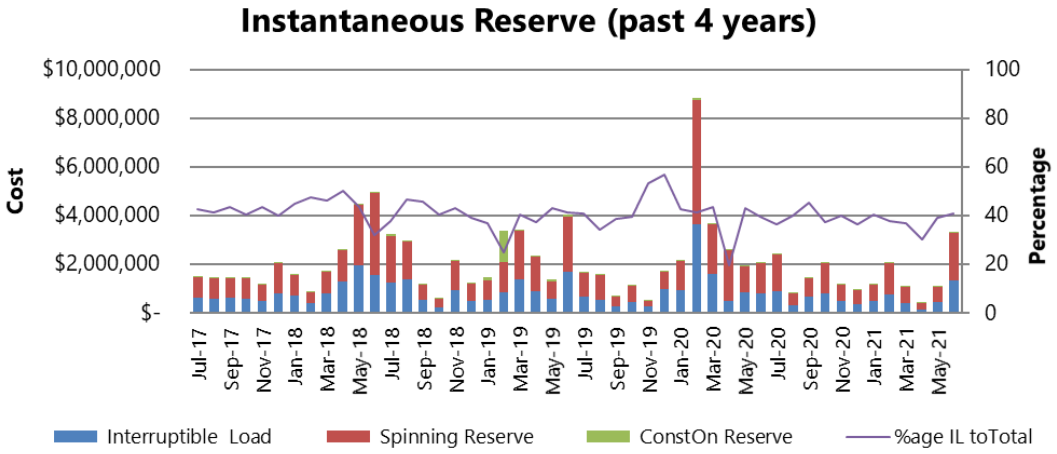
With this improved hydro storage position, Transpower Incident Management Teams were stood down in late May and our focus has turned towards seeking feedback, identifying lessons learned and developing action points to improve our dry year response for future years. We have generally received positive feedback on our response this year, as well as directly from Meridian, MEUG, and MBIE. Areas for improvement include:

- Simplifying modelling
- Ensuring risk curves reflect the market
- Assumptions more clearly published.

13 Ancillary services



This quarter's ancillary service costs were $12.9 million, which is a 24 per cent increase compared to Q3's costs of $10.4 million. The significant increase in ancillary services costs this quarter were primarily driven by frequency keeping cost being considerably above average as well as instantaneous reserve costs in June reaching $3.3 million. June saw the highest ancillary services costs since March 2020.

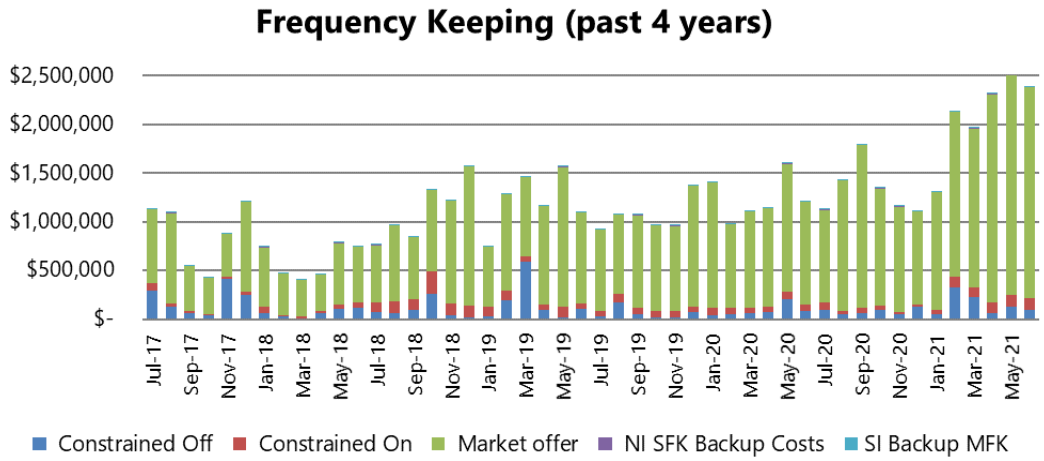


This quarter, the instantaneous reserve costs were $4.8 million, which is a 12 per cent increase to the previous quarter ($4.3 million). Interruptible load costs increased by $253k (15 per cent increase), spinning reserves increased by $230k (9 per cent increase) and constrained on costs increased by $13k (45 per cent increase).

In April, instantaneous reserve costs were $400k which is the lowest they have been since May 2016. This was due to the quantity of reserves procures being relatively low (particularly in the North Island). Additionally, the average price for reserves was very low, especially for fast instantaneous reserves.

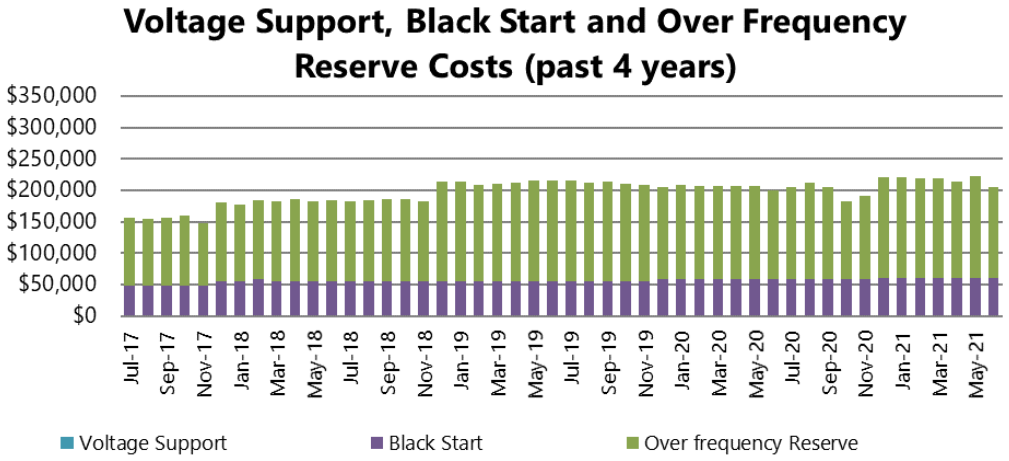
In May and subsequently in June the costs for instantaneous reserves approximately tripled on the previous month. In June, the costs for instantaneous reserves reached $3.3 million which is the highest seen since March 2020. This was due to the average

price for both fast and sustained instantaneous reserves being very high as well as a sharp increase in the quantity of North Island reserves required.



This quarter the frequency keeping costs were $7.4 million, which is a 38 per cent increase compared to Q3's costs of $5.4 million. This quarter saw the highest quarterly frequency keeping costs since Q2 of 2014. Each of the three months frequency keeping costs were $6.3 million or higher. We have not seen prices like this since October 2014.

In Q3 the frequency keeping costs were evenly split between the North and South Islands, $2.69 million each. However, in Q4 the costs were significantly skewed with $5.5 million in the North Island and only $1.9 million in the South.

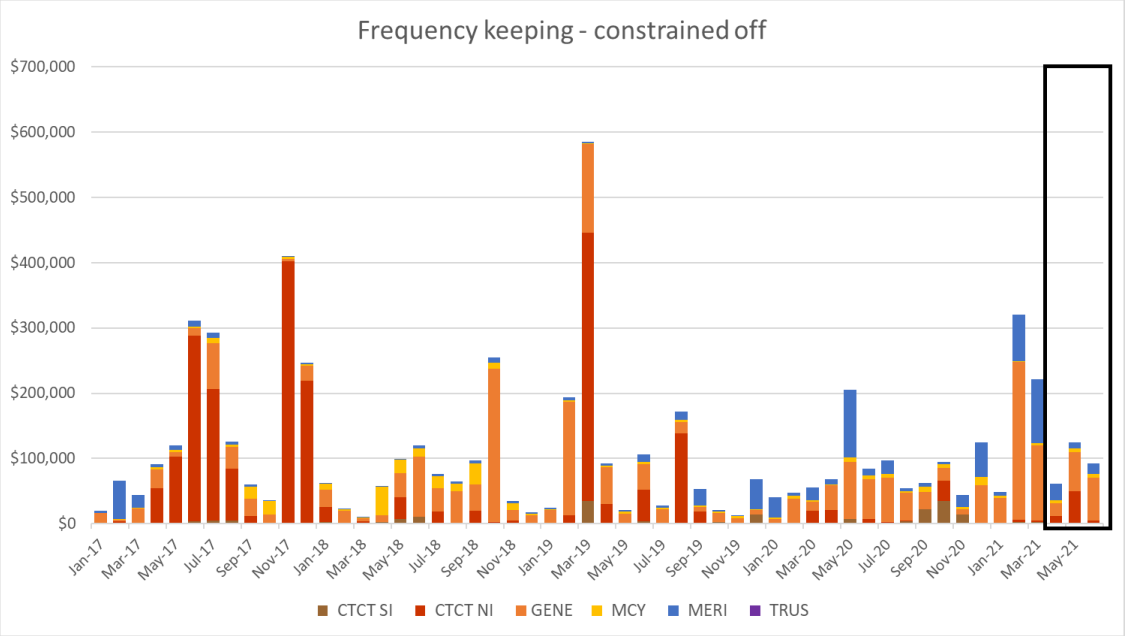


This quarter, there was no variance to the black start costs and only a slight decline in over frequency reserve costs due to equipment outages causing reductions in availability fees. There are no voltage support costs as we do not currently procure this service.

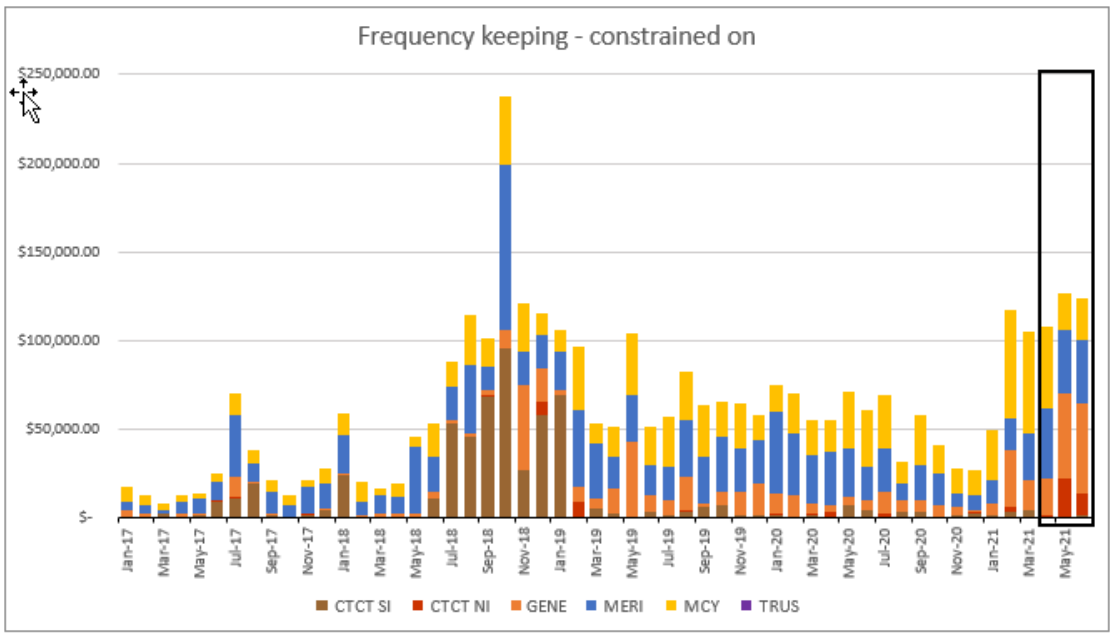
13.1 Constrained on/off costs

Note: Where there is a high payment, as opposed to in increasing/decreasing trend, it will often relate to payments over a small number of trading periods.

Frequency Keeping

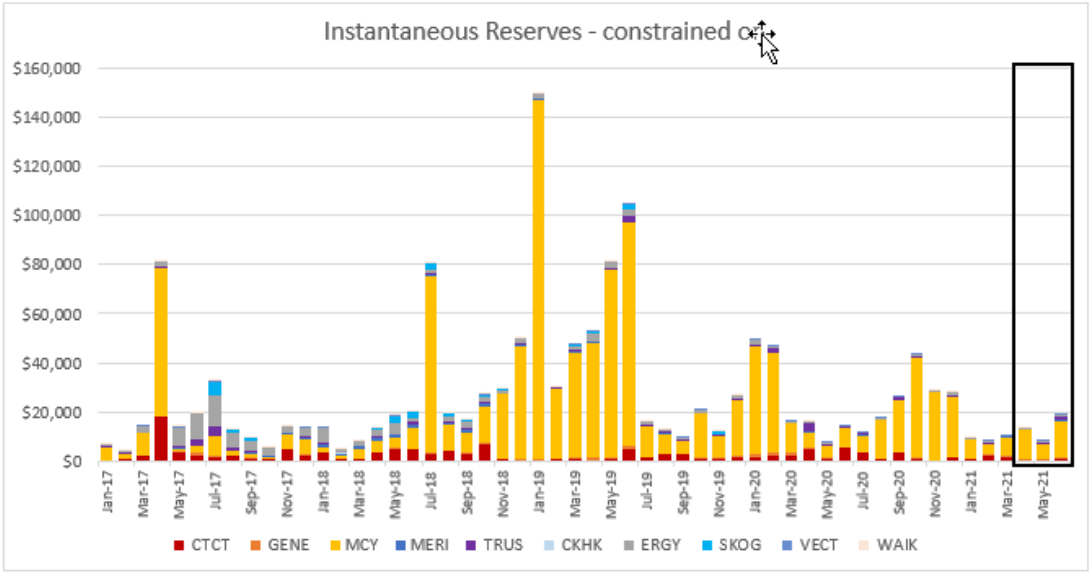


For 2020/21 Q4, the frequency keeping constrained off costs decreased by 53 per cent on the previous quarter to $279k. This Q4 total constrained off costs approximately match the costs in Q2. The difference between these quarters was that in Q2 the costs we relatively evenly split between the North and South Island. Whereas, in Q4 the constrained off costs in the North Island were $54k higher than in the South Island.



For 2020/21 Q4, the frequency keeping constrained on costs continued at the same levels as February and March 2021, although the costs were distributed differently amongst the generators due to who was frequency keeping in the months. Because the constrained on costs in January were significantly lower than the subsequent five months, the $358k of Q4 cost was 31 per cent higher than the previous quarter.

Instantaneous Reserves



For 2020/21 Q4, the instantaneous reserves constrained on costs were 45 per cent higher than the previous quarter reaching $40k. However, this is still relatively low compared to historical quarters.

14 Commissioning and Testing

Generation testing and commissioning

We attended kick-off meetings for the commissioning of both Tauhara B (Contact Energy, 180 MW geothermal) and Harapaki (Meridian Energy, 176 MW wind farm) new generating stations. We continue to receive enquiries regarding potential solar farms.

We have also seen an uplift in asset testing associated with remedying faults or as part of Asset Owners meeting their Code requirements.

Todd Corporation has commissioned the country's largest grid-connected solar farm (2.1 MW) in Kapuni, South Taranaki.

Asset testing procedure update

We published on our website an update to the procedure PR-EA-010 Planned asset testing while connected to the power system. Details of the update were shared at the June Asset Owner Engineering Forum. Asset Owners need to be familiar with this procedure to ensure the success, and avoid delays to, any planned commissioning or testing. Guidelines on testing and modelling requirements can also be found under the Asset Testing section of the Transpower website.

15 Operational and system events

April

Hawkes Bay regional capacity issues

We held a briefing with regional stakeholders in Hawkes Bay to present high level analysis of potential capacity issues in the region. We also communicated our operational management approach. Following this briefing we continued to liaise particularly with Genesis on its generation capability from Waikaremoana and Unison and Eastland Electricity to establish options for load management in their area. We also reassessed generation outages, distribution load shifting and transmission outages in the area and provided options and advice to assist asset owners to secure their outages. This included providing advice to Transpower's Grid Delivery division and Ventia on approaches to the commissioning of Fernhill and Woodville protection. Water levels rose in May to levels that alleviated this risk

May

South Island flooding impacts communication links

One of the two fibre optic communications cables south of Christchurch was rendered inoperable by the flooding on 31 May. Studies were undertaken by the System Operator to understand the impact should the second cable also be compromised, and we worked closely with the Incident Management Team to identify and share critical risks.

The system remained stable and secure operating via one cable

June

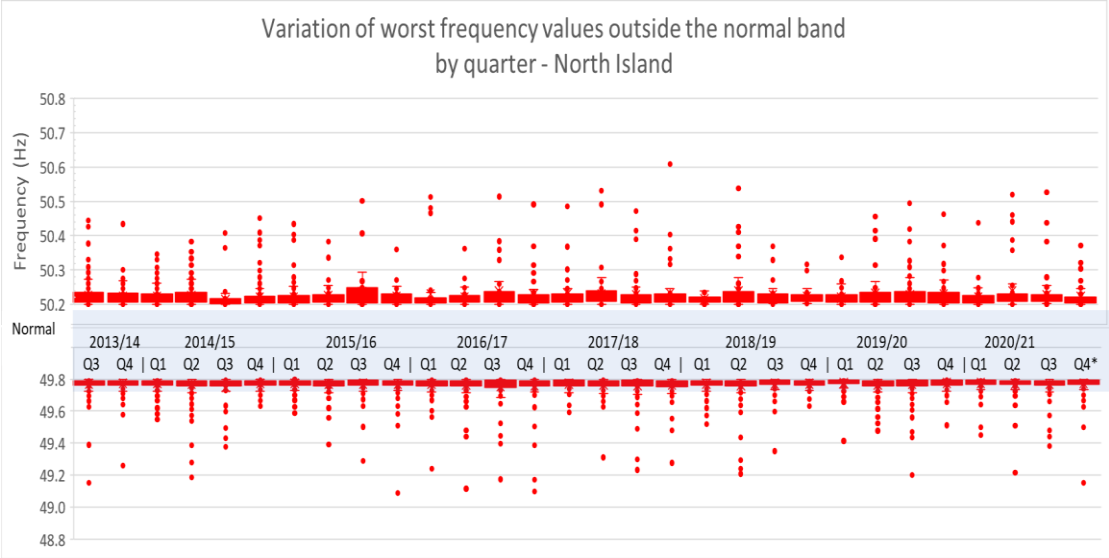
No significant operational events to report.

16 Frequency fluctuations

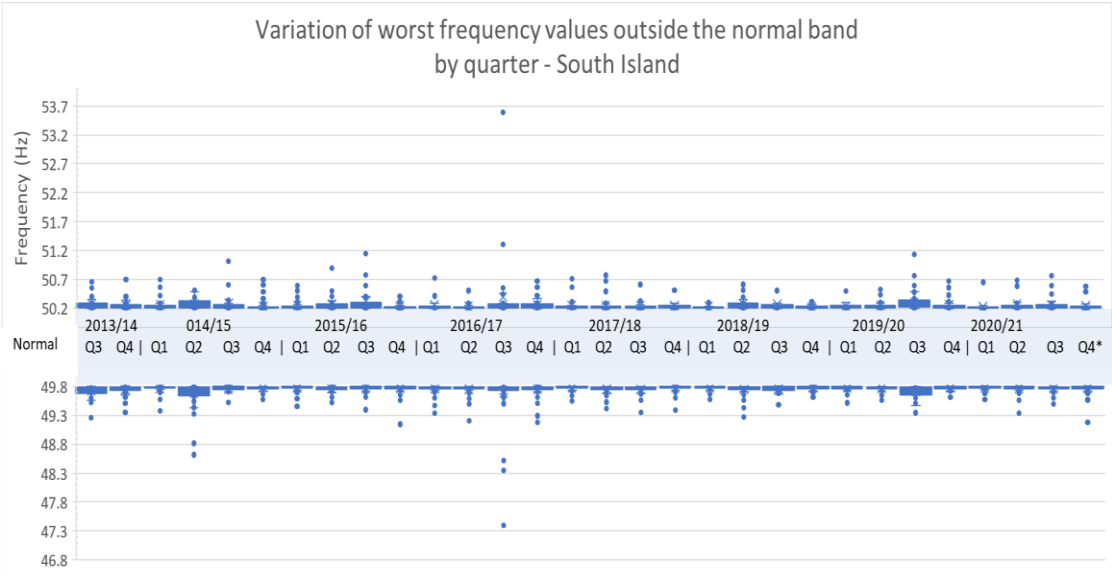
16.1 Maintain frequency in normal band (Frequency value)

The following charts show the distribution of the worst frequency excursion outside the normal band (49.8 to 50.2 Hz) by quarter since July 2014, including the reporting period.

North Island



South Island

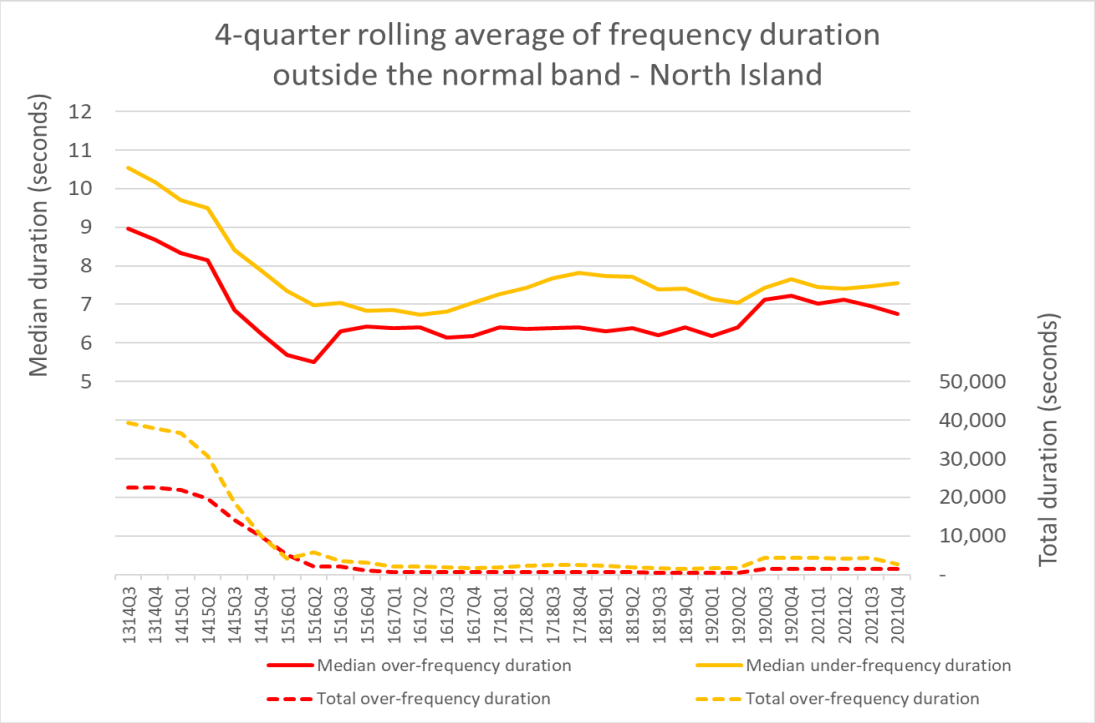


Note: These box and whisker charts show the distribution of data. The “box” represents the distribution of the middle 50% of the data, the “whiskers” indicate variability, and outliers are shown as single data points.

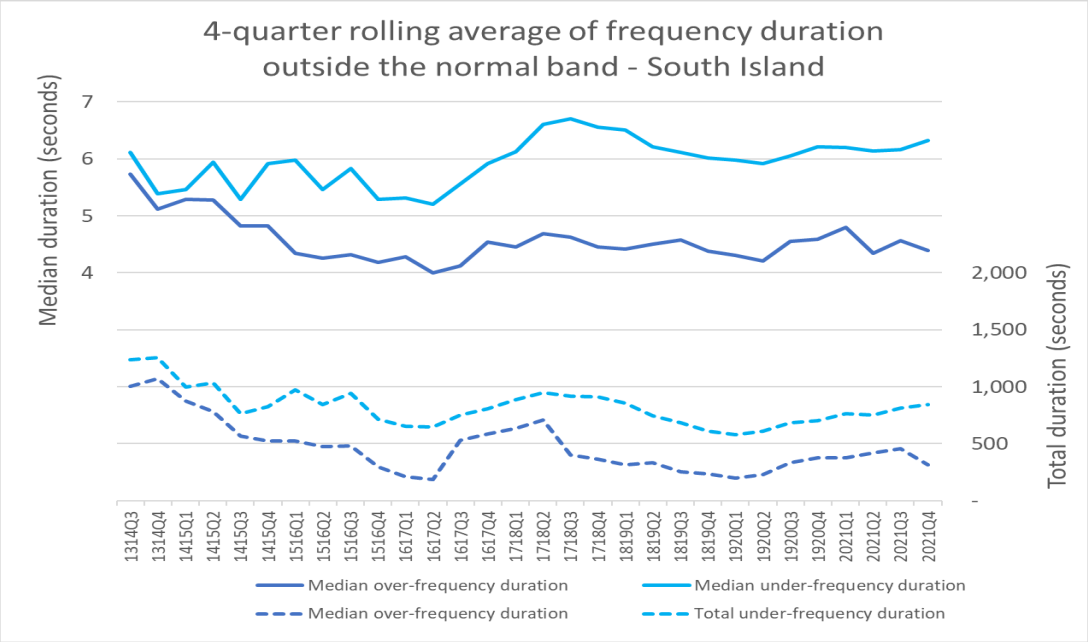
16.2 Recover quickly from a fluctuation (Time)

The following charts show the median and total duration of all the momentary fluctuations above and below the normal band for each island. The information is shown as a 4-quarter rolling average to illustrate trends in the data.

North Island



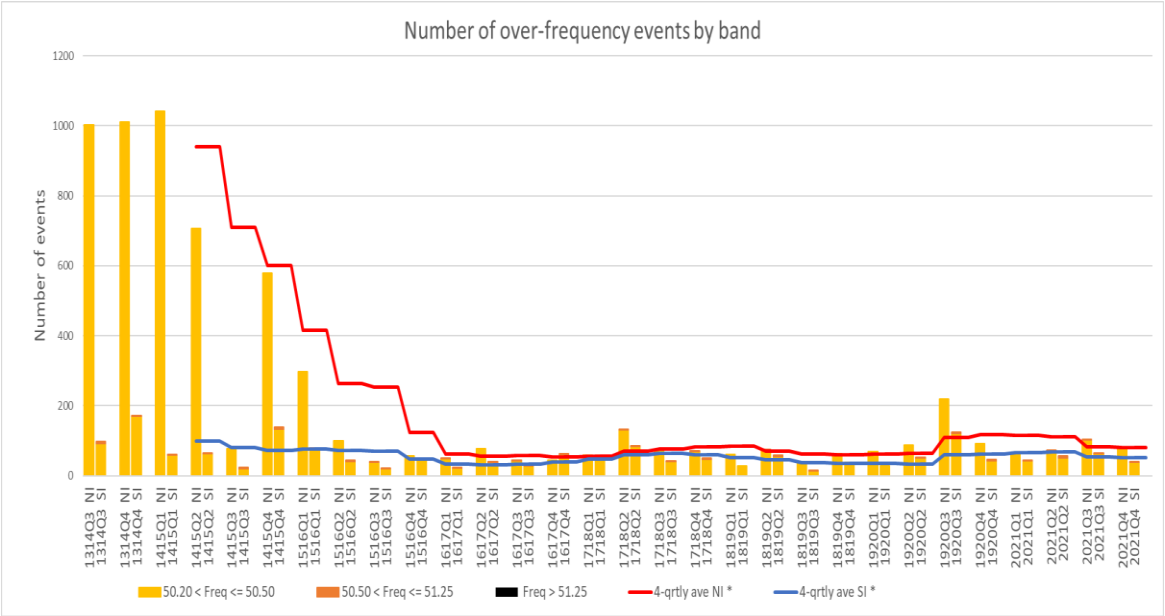
South Island



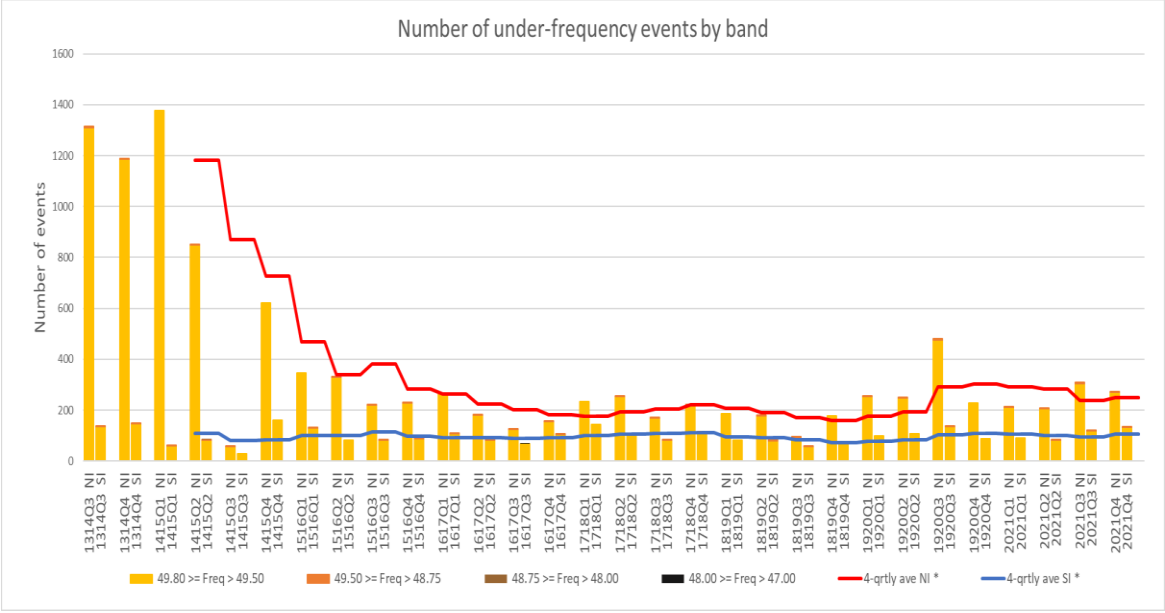
16.3 Manage frequency and limit rate of occurrences during momentary fluctuations (Number)

The following charts show the number of momentary fluctuations outside the frequency normal band, grouped by frequency band, for each quarter since 2014. The information is shown by island, including a 4-quarter rolling average to show the prevailing trend.

Over-frequency events



Under-frequency events



16.4 Manage time error and eliminate time error once per day

There were no time error violations in the reporting period.

17 Voltage management

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

18 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-20	Aug-20	Sep-20	Oct-20	Nov-20	Dec-20	Jan-21	Feb-21	Mar-21	Apr-21	May-21	Jun-21
Demand Allocation Notice	-	-	-	-	-	-	-	-	-	-	-	-
Grid Emergency Notice	-	-	-	1	-	2	-	1	1	-	-	1
Warning Notice	-	-	-	-	-	-	-	1	-	-	-	-
Customer Advice Notice	11	15	9	6	12	10	8	4	4	8	14	14

19 Grid emergencies

The following table shows grid emergencies declared by Transpower as System Operator from April to June 2021.

Date	Time	Summary Details	Island
16/06/21	16:05	A grid emergency was declared to assist with load restoration to Gisborne and Wairoa following a fault on the 110 kV bus at Tuai Substation.	N

Appendix A: Discretion

April

Event Date & Time	Event Description
	None

May

Event Date & Time	Event Description
10-May-2021 13:17	MAN2201 MAN0 Discretion Max: 578. MAN discretioned down from 678 MW to 578 MW to allow room for MAN to restore the partially offloaded TWI L2. Last Dispatched MW: 678

June

Event Date & Time	Event Description
1/06/2021 06:57	ARG1101 BRR0 Discretion Max : 0 PSO for BLN_KIK_1 to allow for switching of ARG_KIK_1 Last Dispatched MW: 11.5
3/06/2021 15:58	ARG1101 BRR0 Discretion Max : 0 For switching Last Dispatched MW: 8
7/06/2021 07:20	HWA1101 PTA1 Discretion Max : 0 HAWERA 110 KV bus fault Last Dispatched MW: 3
15/06/2021 18:19	COL0661 COL0 Discretion Max : 27 COL_HOR2 overloading in steady state. TRP trader advised of discretion. Last Dispatched MW: 28
15/06/2021 18:31	COL0661 COL0 Discretion Max : 27 COL_HOR2 overloading in steady state. Last Dispatched MW: 28
16/06/2021 07:34	COL0661 COL0 Discretion Max : 27 COL_HOR_2 overloading in steady state. Last Dispatched MW: 28
16/06/2021 07:46	**NOT SENT.** COL0661 COL0 Discretion Max : 26 COL_HOR_2 overloading in steady state. Last Dispatched MW: 27
16/06/2021 07:48	COL0661 COL0 Discretion Max : 27 COL_HOR_2 overloading in steady state. Last Dispatched MW: 27
16/06/2021 15:57	TUI1101 KTW0 Discretion Max : 0 TUI Bus Fault Last Dispatched MW: 8.78
16/06/2021 15:57	TUI1101 TUI0 Discretion Max : 0 TUI Bus Fault Last Dispatched MW: 23.72
16/06/2021 15:57	TUI1101 PRI0 Discretion Max : 0 TUI Bus Fault Last Dispatched MW: 22.5
18/06/2021 08:12	BWK1101 WPI0 Discretion Max : 0 Added discretion due to circuit tripping (BWK CB172 did not Auto-reclose) BWK1101 WPI0 generation tripped. Last Dispatched MW: 54
29/06/2021 17:45	WHI2201 WHI0 Discretion Min : 10 Required for energy dispatch. Minimum running range 10 MW Last Dispatched MW: 8.04
29/06/2021 18:00	WHI2201 WHI0 Discretion Min : 10 Required for energy dispatch. Minimum running range 10 MW Last Dispatched MW: 30.52
29/06/2021 18:17	WHI2201 WHI0 Discretion Min : 10 Required for energy dispatch. Minimum running range is 10 MW Last Dispatched MW: 10

Appendix B: Dispatch Accuracy Dashboard

Same quarter in 2019/20 ← → This quarter 2020/21

			2020 April	May	June	July	August	September	October	November	December	2021 January	February	March	April	May	June
Operator discretion applied	Total number of instances (5-minute dispatches) where operator interventions depart from the dispatch schedule to ensure the dispatch objective is met.	100% binding	498	586	718	791	416	599	540	515	493	481	557	360	350	347	652
	Instances where the system operator has applied discretion under 13.70 of the Code to meet dispatch objective		-	1	3	3	-	4	10	3	-	-	3	3	-	1	15
Frequency keeper (MW)	Average absolute deviation (MW) from frequency keeper dispatch point. A movement of frequency keeping units away from their setpoint suggests greater variability in the system, but can also indicate the need for additional dispatches	NI	6.80	6.87	6.97	7.01	7.06	7.11	7.06	6.89	7.11	6.88	6.64	6.88	6.73	7.14	6.89
		SI	6.64	6.41	6.80	6.51	6.53	6.83	6.62	6.74	6.50	6.35	6.48	6.45	6.59	6.65	6.58
Time error (s)	Average absolute daily time error (s) indicates imbalance between generation and load, a reflection of imperfect dispatch	NI	0.2843	0.2277	0.2768	0.2368	0.2018	0.2064	0.1815	0.2092	0.1777	0.1953	0.2447	0.2019	0.2003	0.2113	0.2148
		SI	0.1923	0.2323	0.2845	0.2507	0.1979	0.1973	0.1818	0.1947	0.1872	0.2266	0.2506	0.2051	0.1898	0.2213	0.2072
Frequency excursions	Number of frequency excursions (>0.5Hz from 50Hz)		1	1	1	1	1	-	6	3	-	5	3	2	-	2	3
FK within 1% of band limit	% of time frequency keepers spend near to or exceeding their regulation limits indicates the need to redispatch.	NI	1.8%	2.4%	3.2%	3.1%	3.7%	3.5%	2.8%	2.66%	2.87%	2.39%	2.88%	2.15%	2.94%	3.59%	2.76%
		SI	2.7%	3.5%	4.3%	4.0%	4.6%	4.8%	3.9%	3.85%	4.16%	3.43%	3.78%	3.13%	3.87%	5.75%	2.78%
FK outside of band limit	% of time frequency keepers spend outside their regulation limits	NI	0.05%	0.00%	0.04%	0.11%	0.02%	0.02%	0.01%	0.15%	0.01%	0.01%	0.05%	0.02%	0.02%	0.09%	0.01%
		SI	0.00%	0.00%	0.01%	0.00%	0.01%	0.00%	0.00%	0.18%	0.00%	0.00%	0.03%	0.00%	0.00%	0.14%	0.00%
HVDC modulation beyond 30MW band	% of minutes where the maximum HVDC modulation exceeds 30MW away from its dispatch setpoint. This indicates greater variability in the system, but can also indicate the need for		6.92%	13.90%	9.62%	14.65%	9.83%	9.72%	8.19%	8.50%	7.42%	9.00%	10.29%	11.97%	10.19%	10.60%	13.79%
Constrained on energy- Total	Total Monthly Generation	MWh	2,931,637	3,629,018	3,710,599	4,006,808	3,861,813	3,671,507	3,642,908	3,396,766	3,429,779	3,349,472	3,155,453	3,338,962	3,364,562	3,722,811	3,726,894
	Total constrained on - All sources	MWh	32,088	26,519	24,247	23,649	26,426	24,579	24,672	23,347	18,499	24,386	13,538	10,561	24,629	23,878	23,017
		% of all generation	1.09%	0.73%	0.65%	0.59%	0.68%	0.67%	0.68%	0.69%	0.54%	0.73%	0.43%	0.32%	0.73%	0.64%	0.62%
Constrained on energy ($) - Frequency keeping	Total constrained on $ due to frequency keeping (within band is attributable to SO)	$ Constrained On Energy	303,542	491,296	488,575	712,042	379,543	503,196	399,820	292,501	455,009	325,530	426,305	407,568	574,408	849,250	529,563
		$ Grid Constrained On Energy	55,553	71,518	61,301	69,715	31,973	57,712	40,822	28,503	27,411	49,807	43,198	35,972	108,176	126,538	123,621
Optimal Dispatch (%)	Compares the average impact of a perfect foresight case against dispatch solutions. Indicates impact of wind offer, load forecast and PSD accuracy.	%	87.29%	90.77%	92.78%	93.190%	94.380%	94.340%	94.270%	93.980%	92.800%	93.310%	93.450%	93.440%	94.790%	95.500%	95.310%
Dispatch load accuracy error (%)	Average absolute difference between forecast generation (load plus losses, including PSD) and actual generation relative to the average actual generation	%	99.52%	99.52%	99.56%	99.590%	99.620%	99.620%	99.620%	99.600%	99.610%	99.570%	99.570%	99.580%	99.610%	99.590%	99.550%
Wind offer accuracy (%)	Average absolute difference between persistence wind offer (based on 5mins prior) and the actual wind output relative to the average wind output	%	97.53%	97.28%	97.41%	97.300%	97.400%	97.780%	97.750%	97.370%	97.530%	97.610%	97.310%	96.900%	97.340%	97.600%	97.250%
	Metric calculation rows	FK outside band	3	3	3	3	3	3	3	1	3	3	3	3	3	2	3
		Constrained on energy - Total	1	3	3	3	3	3	3	3	3	3	3	3	3	3	3
		Optimal Dispatch (%)	1	2	3	3	3	3	3	3	3	3	3	3	3	3	3
Dispatch accuracy %	**Metric out of 3 (3 is best possible result)**		1.7	2.7	3.0	3.0	3.0	3.0	3.0	2.3	3.0	3.0	3.0	3.0	3.0	2.7	3.0

Scale for measures:

Variation of up to 0.25 std devs from standard | ... up to 1 std dev from standard | ... up to 2 std devs from standard | ... over 2 std devs from standard

Scale for metric: 1 2 3

NOTE 1: Commentary on the current quarter's data is included in section 9.1 of this report

NOTE 2: Summary data for "FK outside of band limit" is not shown for the South Island in March 2020. The data collected for this month has missing values for a number of dates which meant the measure could not be calculated.

Understanding the dashboard

The purpose of this dashboard is to identify trends and outliers for measures that represent overall industry performance in energy dispatch. The System Operator actions are only one of the influences in this performance. Three of the measures in which the System Operator has some influence in the performance are converted into a metric. During 2020/21 we will monitor how well this metric represents performance, with the purpose of baselining a target and metric as part of the 2021/22 performance metrics.

Measures selected

We have selected measures that cover the following key areas of dispatch performance:

- When operator discretion is required
- Variations in frequency
- When generators are required to be constrained on/off to meet the dispatch objective
- Variation in output and inputs to the Optimum dispatch tool, which compares what happened in real time to what would have happened if there had been perfect foresight

Colour scale

The dashboard uses coloured shading to make it easy to highlight interesting cells or ranges of cells and emphasise unusual values. In this case we have used a colour scale from green (good performance) through to orange (outliers). Each of the cells sits on a colour gradient within this scale.

The colour scales used in the dashboard reflect performance against a standard. A standard that represents good performance has been applied to each of the measures. Variance from this standard identifies outliers which we comment on in section 9.1 of the report. The current standard is the average of the data since January 2019.

[1]

Metric

The measures that contribute towards the metric are:

- FK outside of band limit [2]
- Constrained on energy- Total
- Optimal Dispatch (%)

There are three stages to calculating the metric

1. **Determine a standard**
   This is based on what represents good performance
2. **Rate the comparison on a scale of 1 to 3**
   The monthly performance is compared to the standard against a predefined scale. There are two scales used in this calculation - FK outside of the band limit and Constrained on energy - Total; and Optimal Dispatch (%). These are shown in the tables below: [3]

Score	Outcome	Measure is:
3	Good performance	Up to 0.25 std devs above the standard
2	OK performance	Between 0.25 and 1 std dev above the standard
1	Weak performance	Over 1 std devs above the standard

Score	Outcome	Optimal dispatch is:
3	Good performance	Up to 0.25 std devs below the standard
2	OK performance	Between 0.25 and 1 std dev below the standard
1	Weak performance	Over 1 std devs below the standard

3. **Calculate an overall metric score**
   The overall metric is the average of the three individual scores.

Example:

			Month	Standard
FK outside of band limit	% of time frequency keepers spend outside their regulation limits	NI	0.20%	0.08%
		SI	0.02%	0.01%
Constrained on energy- Total	Total constrained on - All sources	MWh	23,649	28,417
		% of all generation	0.59%	0.80%
Optimal Dispatch (%)	Compares the average impact of a perfect foresight case against dispatch solutions. Indicates impact of wind offer, load forecast and PSD accuracy.	%	93.2%	92.37%
	Metric calculation rows	FK outside band	2	
		Constrained on	3	
		Optimal Dispatch	3	
Dispatch accuracy %	Metric out of 3 (3 is best possible result)		2.7	

FK outside of band limit = (0.2+ 0.02)/2 = 1.1 -> 2 (as a result of the distribution for this measure)
Constrained on energy- Total = 0.59 -> 3 (as a result of the distribution for this measure)
Optimal Dispatch (%) = 93.20% -> 3 (as a result of the distribution for this measure)
Overall metric = (2+3+3)/3 = **2.7**

[1] Since last quarterly report we have changed the way in which we measure variation, to make it in terms of standard deviations (instead of percentage variations) for both the conditional formula shading and the metric calculation
[2] Last quarterly report used the measure FK within 5% of band limit, we have updated this as variation outside of band limit was felt to be more meaningful
[3] The score was changed during the year from a five point (1-5) to a three point (1-3) scale.