Northland tower collapse 20 June 2024

Report on the review conducted by the Electricity Authority Te Mana Hiko under section 18 of the Electricity Industry Act 2010

13 September 2024

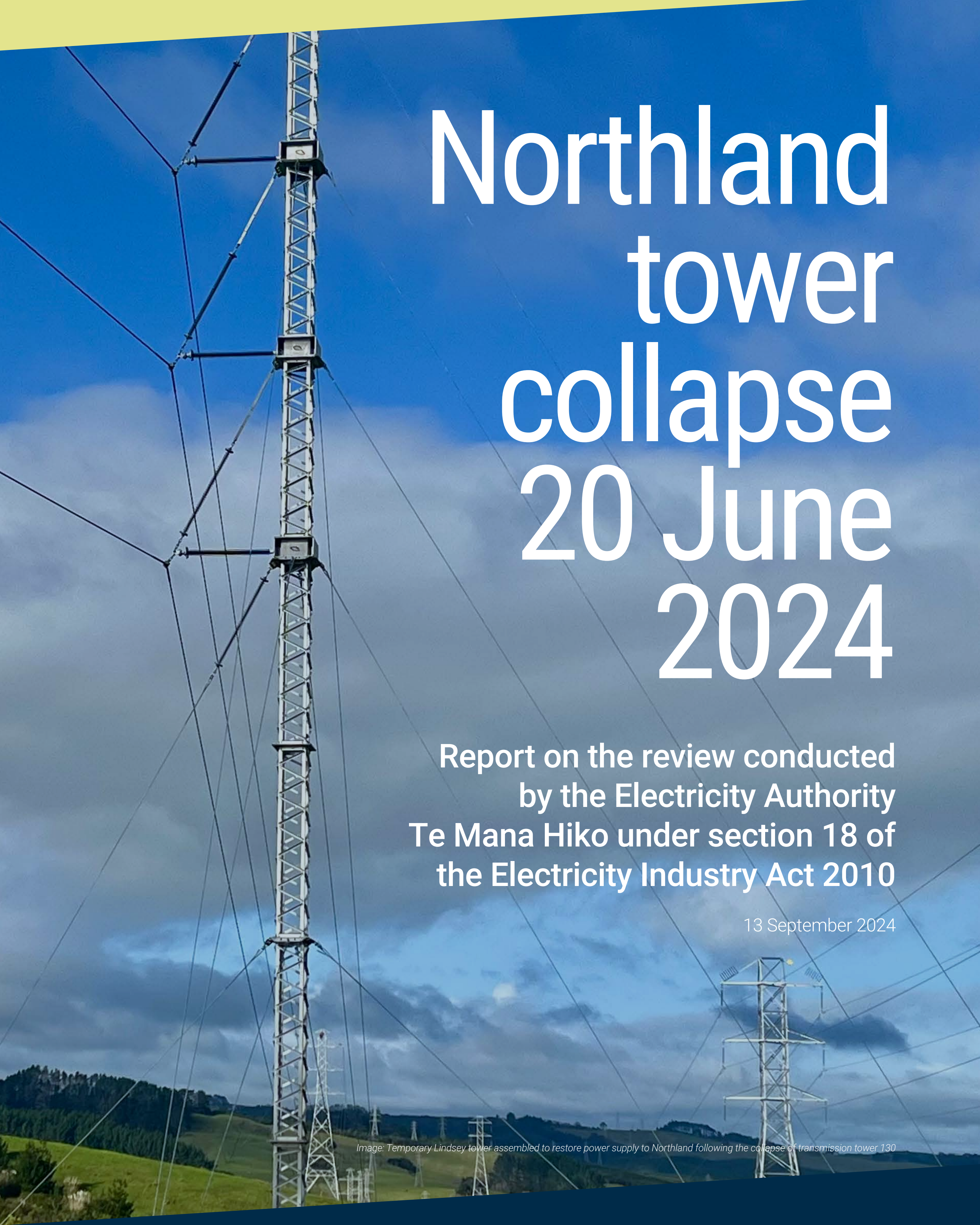

Image: Temporary Lindsey tower assembled to restore power supply to Northland following the collapse of transmission tower 130

ELECTRICITY AUTHORITY
TE MANA HIKO

Foreword

The collapse of a transmission tower near Glorit on 20 June 2024 left 88,000 customers in Northland without electricity, causing significant disruption to communities, businesses and households, and costing the region tens of millions of dollars. The transmission tower's collapse should never have occurred and could have been prevented, had better systems and processes been in place.

The impact on consumers in the Northland region has been front of mind when carrying out the review and drafting this report. We've heard how people and businesses were affected by the power outage. We've also heard how power was restored in an efficient and safe manner.

The aim of this review was to understand what went wrong, and to identify gaps in the system that allowed such an event to occur. Ultimately, we want to ensure that lessons are learnt, and actions taken to mitigate the risk of similar events happening in the future. This review has also underscored the critical role that local distributed generation played in restoring power to Northland, highlighting its importance in enhancing regional resilience not only in Northland but elsewhere in the motu.

The review looks across the roles and responsibilities of all relevant industry participants and this report contains a number of recommendations to improve processes, documentation, training and industry regulation. It also recognises the excellent co-operation among industry participants and other parties to ensure that power was restored as quickly as possible. Notably, several large businesses had their electricity use restricted, often at great cost to themselves, to prioritise power for residential consumers throughout Northland.

I thank all those who contributed to this review, sharing their time, insights, information and experiences. I would also like to thank Electricity Authority Te Mana Hiko (Authority) Board member Erik Westergaard for his input, and the core review team at the Authority for their valuable contribution to this work.

I hope that the recommendations in this report will translate into better outcomes for Northland, and for all electricity consumers in New Zealand, all of whom depend upon a safe secure electricity system to live, work and play. The reliable supply of electricity in every region is crucial. I hope, too, that this report helps foster industry cooperation in navigating the rapid changes the electricity system is undergoing, much of it driven by changes in technology. The move to more renewable generation, such as wind, solar PV and batteries, and a rise in distributed generation requires co-operation to plan for, and promote, regional resilience and the best means of achieving the reliable supply of electricity. Together you can make a lasting difference for all.

Sarah Sinclair
Independent Chair

Executive summary

At 11:03am on Thursday 20 June 2024 a transmission tower in Northland collapsed, cutting off supply to about 88,000 customers (the event). A tower collapsing during routine maintenance should not happen.

Although Transpower described the event as 'unprecedented and inconceivable', the underlying factors that contributed to the tower's collapse were entirely avoidable. Recommendations for better processes, documentation and training, along with the need for better oversight of these, is not unprecedented following the review of similar major events in the electricity industry and other sectors.

At the heart of this review is security of electricity supply – its criticality to consumers and businesses and what is needed to ensure that such events do not happen again. The review has emphasised, and has recommendations to reflect, the importance of robust processes and the responsibility for ensuring they are followed. The review is also an opportunity to focus on regional resilience at a system-wide level and the critical role regional resilience has for businesses and communities across New Zealand.

Key observations

- **Critical assets require active assurance of service provider work.** Transpower, as grid owner, is responsible for maintaining the national grid and ensuring that its assets (including towers, lines and substations) are resilient and robust. When assets are critical to the reliable supply of electricity, Transpower has a heightened responsibility to ensure that it exercises all the powers available to it to ensure that those assets are maintained safely and appropriately.

- **Transpower cannot just rely on service providers to ensure critical assets are maintained.** While Transpower maintains good contractual documentation with its service providers, this alone is insufficient to discharge its responsibilities as grid owner. This event demonstrated that too much reliance was placed on service providers ensuring their own compliance with the contractual obligations and identified gaps in Transpower's assurance processes. Robust assurance processes need to consistently give effect to the controls within contractual documentation. If Transpower had effective assurance processes in place, we would expect to have seen:

    - identification of deficiencies in Omexom's work procedures for baseplate refurbishment, and inconsistencies across the different work procedures used in different regions, and development of a 'best practice' for foundation maintenance work
    - Transpower's technical specifications (which service providers must ensure their work procedures comply with) adequately address key risks such as tower stability
    - Transpower's Grid Skills training programme for foundation work to cover key risks and a methodology for foundation maintenance work which maintains tower stability
    - a specific plan for Transpower's field audits of foundation maintenance work - if field audits are not tailored to the specific maintenance task, there is risk of critical errors going undetected
    - non-compliance by service providers identified by Transpower through its audit processes to be adequately reported up to Transpower's Board. A 'big picture' approach of service providers' compliance with legislative, procedural and compliance obligations is required in order to best assess risk.

  None of these assurance controls were evident in this case.

- **Transmission towers and poles are critical assets.** These often carry more than one circuit, in which case a tower failure would remove both circuits and could result in power cuts for consumers, as happened in Northland. A risk-based approach by Transpower should have identified the increased risk of towers carrying multiple circuits and resulted in a higher level of oversight for maintenance work, the associated documentation, and assurance processes.
- **Establishing and maintaining the right culture within Transpower is critical.** We would expect Transpower's culture to focus on proactive risk identification, assessment and management, promoting best practice and continuous improvement, and accountability at all levels. This includes fostering an environment where any concerns are promptly addressed, rigorous oversight is maintained, and lessons from past incidents are integrated into daily operations to prevent future failures. Transpower's overall culture around risk identification was not the focus of this review and we make no findings regarding Transpower's overall culture. However, the findings of this review raise real questions as to how identifiable risks were missed.
- **Transpower missed an opportunity to take action to address concerns relating to baseplate refurbishment raised by staff.** In 2021, a senior Transpower engineer identified a gap in the knowledge of the maintenance crews undertaking foundation work, including baseplate refurbishment work. That engineer recommended Grid Skills organise new training sessions with all new crew members to have a full course and refreshers every 12 months. This wasn't acted on. The failure to respond to, or action, the concerns raised does not align with the principles of proactive risk management and continuous improvement that we would expect to see within Transpower.
- **Insights to improve communications in significant events in future.** Communications by Transpower following the event were generally good but there is room for improvement. Distributed generators' and large business customers' feedback in relation to distributor communications was that it was excellent. This report recommends improved operational coordination and communication amongst relevant parties.
- **A system-wide approach is needed to prevent recurrence.** Issues with operational communications and training have been consistently identified as exacerbating factors in previous reviews of other significant events in the electricity industry, most notably the Authority's review into the 9 August 2021 power outage. To help foster a culture where lessons are learned from past incidents, our recommendations are not restricted solely to this event, or foundation maintenance work, and include mechanisms to ensure that Transpower generalises the lessons learnt, and is accountable for implementing changes to prevent recurrence.
- **Distributed generation plays a key role in regional resilience.** The existing distributed generation in Northland played a significant role in the restoration of power by enabling significantly more electricity to be supplied to consumers in Northland while the 220 kV circuits were out of service. We have conservatively estimated distributed generation to have saved Northland consumers around $26 million. Regional resilience can be further improved by additional new distributed generation in the pipeline, and investment to make the most of existing generation, which will move the Northland region closer to attaining a net electricity balance. If this generation can operate in electrical islands, temporarily isolated from the grid, it will mean that electricity supply can be maintained even if an event such as 20 June occurs, which cuts the region off from the national grid.

- **We make recommendations to promote islanded distributed generation.** Participants need to coordinate and cooperate to ensure that distributed generation can operate islanded, in order to promote regional resilience. The Authority must also ensure that the regulatory regime supports and promotes regional resilience and the ability of distributed generation to operate islanded. The Electricity Industry Participation Code 2010 (Code) can be improved to support innovation and new technologies. This report includes recommendations for action.
- **The review would have benefitted from greater access to information.** This review has highlighted to the Authority the importance of transparency and full access to all relevant information. While the Authority received and reviewed a significant amount of information provided by Transpower and Omexom, the review would have benefited from greater access to key documents. Specifically, legal privilege was claimed by Omexom for its draft Incident Cause Analysis Method (ICAM) report into the event, and by Transpower for interviews held with the Omexom maintenance crew, in their entirety. This has limited our ability to get a fuller understanding of the events on the day and the wider considerations which impacted this event.
- **The Authority will do more to promote regional resilience and accommodate changes to the power system.** Industry regulation needs to keep up with an evolving power system where changes are occurring at a rapid pace, largely driven by new technologies. The rise of distributed generation and a more decentralised system, where electricity can flow from power stations to homes, and from homes and businesses with solar panels and batteries back into the network, will require changes to the Code. Work is already underway to accommodate these changes and this review has identified other areas of the Code which should be reviewed.

The cause of the event

The transmission tower collapsed when nuts securing tower legs to the tower foundations were removed during planned maintenance work by Transpower's service provider in the Northland region, Omexom. This compromised the tower's stability, causing it to fall. The tower carried the two 220 kV circuits supplying electricity into Northland. The collapse of the tower tripped the one 220 kV circuit into Northland that was in service at the time, and disabled the other that was already released from service for maintenance elsewhere on the grid, causing the complete loss of supply to Northland. Fortunately, all the Omexom maintenance crew members on site were unharmed.

The most significant consequences of this event were borne by residential and business consumers in the Northland region. This emphasises the importance of ensuring appropriate standards are in place to maintain consumers' trust and confidence in the electricity system, particularly in a crisis. Therefore, while the technical cause of the event is evident, this review has also focused on the broader system and controls within which maintenance works take place. The review has identified shortcomings in training and supervision and the opportunity for review and improvement by Transpower of certain policies, procedures and technical specifications to ensure that Transpower's assurance and oversight of maintenance works conform to good industry practice standards.

Other factors contributed to the tower collapse

The maintenance crew working on the tower included two trades assistants who had not been adequately trained to remove nuts from foundation baseplates and were not properly supervised at the time the nuts were removed. These factors combined were an underlying cause of the collapse of the transmission tower. They led to a departure from Omexom's standard practice, which was to only remove nuts from one tower leg at a time.

Other factors also contributed to the tower's collapse, including gaps in Transpower's technical specifications for foundation maintenance work carried out by service providers, and in Omexom's own work procedures. These did not expressly address the risk of removing too many hold down nuts from the tower legs or specify a process for removing the nuts. Transpower's technical specifications only contain general requirements that foundation stability mustn't be compromised during any maintenance repair work, and that tower loads need to be determined so as not to compromise the stability of the tower. Omexom did not determine tower loads before undertaking work on the tower.

Transpower provides the industry training for tower foundation maintenance through its Grid Skills Foundations training course. This training also failed to adequately address risks and procedures, including for removing hold down nuts during tower maintenance.

Gaps in Transpower's assurance processes were also identified as factors, including the lack of any procedure for reviewing different service provider work procedures for the same work and identifying industry best practice.

At the time of the collapse, one of the two 220 kV circuits supplying Northland was already removed from service for maintenance elsewhere. This did not contribute to the loss of supply to Northland – the tower collapse would have tripped both 220 kV circuits regardless of how many circuits were in service. We have identified no deficiencies in maintenance planning procedures.

The impact of the Northland tower collapse on consumers was significant

Consumers are at the heart of this review – households, small businesses and large commercial businesses were all impacted as a result of the tower's collapse. We know that loss of power had a significant impact on Northland communities. The impact of this event cannot just be measured in minutes of outage, rather the broader impact of the interruption—ranging from inconvenience and disruption to daily life, to lost production, missed orders, heightened stress, and the overall toll on the Northland communities must be considered.

> "The Far North is definitely very restricted and cut off from a lot of things, so when something like this happens it does affect the businesses a lot. Because we're a small town we really need to try to make as much money as we can in the time we've got."
>
> *Levana Sietses, café owner, Kaitāia*[1]

Our intent is to understand the cause of, and response to, this event. From this, lessons can be learnt to ensure that consumers in Northland and throughout New Zealand receive a reliable supply of electricity.

Consumers need to have confidence that adequate processes are in place at every point in the electricity sector to ensure security of supply. Consumers also need to have confidence that regulatory and policy decisions that help shape the future of the electricity system will enable improved security of supply and resilience.

1 Radio New Zealand, 21 June 2024.

After the tower collapsed, restricted supply was restored to affected Northland grid exit points by 12.47pm, supplied by the 110 kV circuits and local generation. This allowed distributors to progressively reconnect consumers within their networks. Many large businesses were asked to restrict their electricity usage until sufficient transmission capacity to meet all load in the region was restored at 2.47pm on Sunday 23 June 2024.

The economic cost to Northland due to the loss of power supply was substantial. We estimate the cost at more than $37.5 million using the value of lost load (VoLL) set out in the Code. However, other estimates suggest losses as high as $60 million (Infometrics), and up to $80 million (Northland Chamber of Commerce). Without the benefit of distributed generation, the Authority estimates costs would have been at least $63.5 million.

That economic cost was borne by all consumers. Many businesses, from small local ice cream shops to major export earning industries, had to temporarily close or significantly reduce their operations while restoration was underway. For some companies, the impacts persisted beyond the time supply was restored.

> "Our entire stock of ice cream melted – $5,000 to $6,000 worth of stock. It's shocking but I've got used to it. It is what it is in Northland. We won't be open tomorrow. Some shops might be able to reopen when the power goes out, but that's not the same for food service."
>
> *Richard Holt, owner Cellini's ice cream and espresso*[2]

For many of these businesses, losses cannot easily be recovered, while others are left dealing with insurance claims to recoup lost income. Where consumers have suffered such significant disruption, considerable care must be taken in any communications after the event relating to compensation. These discussions affect people's livelihoods and wellbeing, and their importance cannot be underestimated.

Residential consumers would have also experienced disruption to their daily life. While restricted supply was restored relatively quickly, people may have had items damaged or spoiled, or may have been impacted by the closure of schools and workplaces.

> "People asked me whether they needed to get their own generators while other small providers like foodbanks were worried about their supplies in their freezers getting spoilt."
>
> *Kelly Stratford, Far North deputy mayor*[3]

2 Northern Advocate, 21 June 2024.

3 Northern Advocate, 21 June 2024.

The Minister requested this review under section 18 of the Act and the scope was agreed with the Authority

The Hon Simeon Brown, Minister for Energy, responded to the widespread impact of the power outage on families, businesses and communities, and the significant cost to the local economy, by asking the Authority to undertake a review and report back within 12 weeks. The request was made under section 18 of the Electricity Industry Act 2010 (Act). The Authority appointed Sarah Sinclair as the independent Chair of the review.

The scope of the review is to understand and explain the cause(s), the response, and lessons that can be learnt from the event. The terms of reference set out several questions for the Authority to consider as part of its review. They cover a broad range of issues including risk mitigation and assurance processes before the event, and actions taken to restore supply after the event.

The review also takes a broader view of the event, including whether any improvements should be made to New Zealand's electricity system resilience and whether there were appropriate communications between Transpower, distributors, retailers, businesses, and the public after the tower collapsed.

While this review has identified a number of areas where improvements can be made, it has also highlighted progress in some processes and identified examples of well-co-ordinated industry communication and co-operation. In particular, the response and recovery efforts by Transpower, distributors, distributed generators and the parties involved with the onsite recovery was well executed within a tight timeframe.

The Authority considered a range of information and engaged with industry participants and other parties

We would like to acknowledge the cooperation of industry participants, businesses and stakeholders that willingly aided the Authority's review.

The Authority's review draws from, and relies on, a large quantity of information provided during the investigation. Establishing the causes of the tower collapse, understanding the response to the event, and investigating the broader issues considered within this review required significant input from many parties.

The Authority has spoken to and obtained information from Transpower, Omexom, local distributors, distributed generators, retailers, other New Zealand regulatory agencies, large businesses in Northland, international regulators and transmission companies, Northland Chamber of Commerce and the Northland Economic Development Agency.

We have endeavoured to obtain the views of those at the centre of this review – the Northland community. We acknowledge, however, that in the time available to us, it was not possible to get the views of a broader sector of that community than those mentioned above. We do not believe this impacts on the findings in this report and hope that the recommendations will lead to improved outcomes for the Northland community and other regions throughout New Zealand.

Unfortunately, the Authority was not able to include information from Omexom's draft ICAM report into the incident. While Omexom has provided a copy of that report in draft to Transpower, Omexom has claimed legal privilege over it, and has declined to waive privilege to any part of that report for the purposes of this review. We cannot compel Omexom to provide information as it is not an industry participant.

When we provided extracts of this report in draft to Omexom for comment on the factual findings it observed that the Authority cannot require privileged information in any event. This is correct, but where the Authority has the power to require documents it can challenge privilege claims swiftly. We do not necessarily agree that legal privilege applies to the investigation report.

Local generation is key to regional resilience

Local 'distributed' generation played an essential role in the reconnection of power to Northland consumers. These resources boosted the limited grid capacity available from the 110 kV circuits until the first damaged 220 kV circuit was restored on Sunday 23 June. This local generation met 45% of the peak demand in the region.

What is distributed generation?

Traditionally, most of our electricity comes from large power stations, like hydro dams and gas or coal fired power stations, often in remote parts of the country. The power is injected into the national grid and sent through long power lines to towns and cities throughout the country. From there, local distribution companies send the power through their local networks to our homes and businesses.

Distributed generation, on the other hand, is electricity that is generated locally, where it is needed, and connected directly into a local distribution network. Distributed generation is valuable where the transmission grid or local distribution network has insufficient capacity to securely supply all the local load.

Distributed generation varies significantly in capacity but is typically smaller in scale than traditional grid-connected generation. It can include a range of generation technologies including hydro, solar PV, wind turbines, geothermal, backup diesel generators and battery energy storage systems (BESS).

Distributed generation resources in Northland include Ngāwhā Generation Limited's geothermal station near Kaikohe, Lodestone Energy's Kohirā solar farm at Kaitāia, Manawa and Top Energy's diesel generators, Vector's BESS, and some smaller distributed resources.

More generation is in the development pipeline for Northland, located throughout the region. Some projects are undergoing investigation for viability, some have attained consents, while others are committed and under construction. The Authority has work underway to improve visibility of generation investment and monitor long-term security of supply. We also have work underway to enable new generation investment.

However, more needs to be done to ensure that generation of all technologies contributes to regional resilience and give greater comfort to consumers of supply resilience and regional self-sufficiency when faced with unexpected disrupting events. In addition, the ability of future generation to operate within an isolated island will be increasingly important for ensuring supply resilience.

Some existing distributed generation in Northland is not currently capable of operating islanded. Ensuring the coordination of future distributed generation, and in particular the ability of this technology to operate islanded, will require a considerable amount of input and resources from a broad range of stakeholders.

What is 'islanded' generation?

Islanded generation refers to a situation where a power generator, like a backup diesel generator, operates isolated from the national grid. Normally, generators work together with the grid to supply electricity, but in an 'islanded' mode, the generator is cut off from the grid, either intentionally or due to a fault, and supplies power only to consumers in a local area. This can happen during a power outage. One or more generators, likely augmented with a battery energy storage system, essentially form an 'island,' maintaining electricity supply to a specific area without relying on the larger grid.

Transpower is engaging with local distributors Top Energy and Northpower and has agreed a terms of reference for a regional electricity development plan to support planning and investment decisions. This will consider the wider regional context, operation and maintenance considerations, as well as regional development goals. One of the key focus areas identified in the terms of reference is to "*[i]dentify and investigate the potential of introducing alternative ways of connecting new generation into the region, exploring the potential of making the region wholly or partly self-sufficient during outage events*."

The Authority commends the parties involved for the regional electricity development plan initiative and recommends that consideration by Transpower and local distributors be given to developing similar plans for other regions within New Zealand that are vulnerable to high impact low probability events. These initiatives should ensure the representation of a broad range of stakeholders. The views of all relevant industry participants and entities interested in the potential development of generation should be considered.

Improving industry regulation

The Authority is already working on changes to industry regulation in the Code to accommodate the rapid pace with which the power system is transforming. The Authority has identified several other areas of the Code and the Act which should be reviewed.

Ensuring the electricity system remains secure and resilient

The rise of distributed generation is changing New Zealand's power system. It is leading to a more decentralised system where electricity can flow in both directions on local networks under different generation and load conditions—from big power plants to homes and from homes and businesses with solar panels and batteries back into the network.

As part of its work programme the Authority is reviewing the common quality obligations in Part 8 of the Code. The object of this review is to remove barriers to new generation technologies while maintaining system security and resilience.

The Authority will specifically consider issues related to regional resiliency and the role of islanded distributed generation in this work.

A review of future system operation is also underway to adapt the operation of New Zealand's power system to the emerging role of consumers as active participants in the energy market.

Reviewing rules for distributor involvement in local generation

The Authority will also consider and consult on amendments to Part 6A of the Code.

Part 6A mandates corporate separation and adherence to arm's-length rules for all distributors involved in more than 50 megawatts (MW) of generation connected to its network. These rules are intended to promote competition and provide an 'even-playing field' for other parties investing in generation to be connected to the distributor's network. Part 6A was moved from the Act to the Code in 2022, so the Authority could be responsive to any emerging need for change.

The Authority has considered and granted exemptions to these rules, including for Top Energy and its subsidiary, Ngāwhā Generation Limited (NGL), who have an exemption from two of the arm's-length rules which permits the joint management of their distribution and generation businesses. The role of local generation at Ngāwhā Springs Power Station to the event recovery is highlighted above. We are also currently considering a similar exemption application from WEL Networks Limited.

While we believe that the exemption regime is working well, and does not prevent distributor investment in generation, this process can impose costs, and cause delay and uncertainty. Application of some arm's-length rules may also impose an undue compliance cost on distributors.

Given the importance of local generation to promoting regional resilience, we are looking at whether the rules in Part 6A continue to provide the appropriate settings for distributor involvement in generation connected to their network.

We will prioritise a review of Part 6A rules to ensure the Code better promotes reliability and efficiency alongside competition in the electricity industry for the long-term benefit of consumers. As part of this review, we will consider:

a. whether rules in Part 6A as they relate to distributor involvement in generation should be retained, given the existing obligations in Part 6 of the Code relating to the connection of distributed generation and in Part 4 of the Commerce Act 1986

b. if the rules should be retained in principle, whether some of the rules in Part 6A should be removed or better targeted to reduce unnecessary costs, and

c. if the rules are retained, in whole or in part, whether the current 50MW threshold is appropriate.

The Minister has separately announced that Cabinet has committed to ease restrictions on distributors owning generation (some ownership restrictions exist in the Act in addition to the rules in Part 6A of the Code). The Authority will work with the Government to ensure a joint approach addresses all issues.

Ensuring the Authority has the right tools to monitor the industry

This review has highlighted limitations on the Authority's information gathering powers under the Act. Section 46 of the Act provides the Authority with the power to require an industry participant to provide information and give other assistance to enable the Authority to carry out its monitoring, investigation and enforcement functions, including when undertaking section 18 reviews.

These powers are critical to the Authority's effective performance of its functions. In this review, given the time available to the Authority to complete it, and to ensure a prompt response, the Authority issued five section 46 notices to Transpower requiring the provision of information and assistance. We could not take the same approach in relation to Omexom, who is not an industry participant, even though it plays an important role as a significant field services provider engaged in grid maintenance work. Consequently, we had to use Transpower as an intermediary to obtain information from Omexom, rather than obtaining that information directly from Omexom. Other key information requested was not provided, including Omexom's draft ICAM report, which it claims is legally privileged.

The ICAM report is directly relevant to our review because it addresses the root causes and contributing factors to the event. While Omexom management met with us to answer our questions, this has been a material limitation on our review.

To be an effective regulator, the Authority must have adequate powers to perform its monitoring, compliance and enforcement functions effectively. We recommend MBIE review section 46 of the Act to ensure the Authority has the right set of tools to monitor the rapidly changing industry. This should include the power to require information from non-participants, and appropriate penalties to ensure effective compliance with the Authority's exercise of its information-gathering powers so the Authority can have confidence in the information provided.

Grid reliability standards remain appropriate

The Authority considers the grid reliability standards in Part 12 of the Code remain appropriate and has made no recommendations for changes to these standards. Whether Northland was on N security or N-1 security at the time the tower collapsed, would have made no difference to Northland consumers.[4] The region would have lost power regardless given both 220 kV circuits were carried on the same tower.

The grid investment framework aims to balance reliability and economic efficiency, aligning with the Authority's statutory objectives. Investing too little in the grid leads to frequent supply losses and high consumer costs, while excessive investment reduces outages but increases costs. The goal is to find a balance where the costs and benefits of investment best align.

In simple terms, the cost of providing an additional transmission line to remove the risk of a highly unusual event such as the 20 June tower collapse would be significant, and the risk of a similar event recurring is small.

In areas with high population and economic activity, higher security levels are generally justified due to the higher costs of outages and a larger customer base to share investment costs. For many regions, including Northland, achieving better than N-1 security through grid investment is not economically viable. For this reason, this report has given careful consideration to alternative means of ensuring reliable supply in regions on N-1 security.

4 N security means there is sufficient transmission capacity to meet the load, but there is no redundancy to survive the loss of a single transmission asset. On the other hand, N-1 security means there is sufficient redundancy to survive the loss of a single transmission asset without a loss of supply. These concepts are discussed in more detail in section 3 of this report.

The Authority considers regional resilience can be improved through the use of transmission alternatives like local generation and demand-side management. With numerous solar, wind and BESS projects under active development, the proposed review of the settings for distributors as providers of distributed generation, and with careful management and cooperation between stakeholders in the design and build of these resources, there is the potential to enhance regional resilience by integrating suitable resources into regional network plans.

Improving technical specifications and assurance processes for grid maintenance

We recommend improvements to grid maintenance arrangements to address the underlying causes and factors that contributed to the tower collapse. Omexom should review its training processes and supervision policies to ensure they are fit for purpose.

We also make a series of recommendations that take a system-wide approach and are designed to prevent similar incidents in future. This includes recommendations that Transpower consider how it can more effectively promote best practice by its service providers through its quality assurance processes, both in terms of how it assesses and measures contract performance and how it works with service providers to promote best practice work procedures.

We also recommend that Transpower consider conducting risk-based reviews of its technical specifications, training programmes and assurance processes, to ensure these are otherwise fit for purpose.

We acknowledge that work in this area has already begun. Transpower and its service providers are working together to develop a best practice approach for tower foundation work and ensure proper technical specifications and training are in place.

Transpower's public and operational communications

Maintaining consumers' trust and confidence in the electricity system during times of crisis is essential. Clear, accurate and timely communication with the public allows impacted consumers to plan ahead and manage their individual situations as well as possible. In addition, in a practical sense, effective communication can assist recovery efforts by lowering demand while load limits are in place.

Similarly, clear and appropriate operational communications, particularly in response to a grid emergency, are critical to the effective restoration of supply and to minimise the disruption and impact on consumers.

We found that Transpower's operational communications were broadly effective and supported the timely restoration of supply to Northland. However, there are improvements that can be made. A distributor commented that parallel communications paths provided ambiguity, particularly in the early stages of the event response.

A regional operating forum should be established early in a grid emergency response phase and meet as often as necessary to ensure authoritative operational communications and effective coordination of the operational response. It should involve operations managers from the system operator, the grid owner, and affected distribution and generation operators. This is effectively the forum that was established as the team of operators planned to re-liven the first 220 kV circuit on Sunday 23 June. Close coordination of Ngāwhā generation briefly shutting down, alongside grid switching and regional load management was critical.

The voice recordings from Transpower's control rooms on 20 June showed a marked improvement in formal operational communications since the events of 9 August 2021, when the largest electricity demand peak on record resulted in approximately 34,000 customers experiencing a power cut without warning. The Authority's review into 9 August had found that operational communications were ambiguous and at times unsatisfactory.

Distributed generators' and large business customers' feedback in relation to distributor communications was that it was excellent.

Overall, Transpower's public communications following the Northland event were of a generally acceptable standard with some examples of good practice and a couple of missed opportunities. Notably, responding to media enquiries was managed well. Social media engagement was, however, too light. Expectations of compensation for impacted business were left to run unchecked.

Communications with medically dependent consumers

Ensuring medically dependent consumers are well informed of events that may impact their electricity supply and are able to put in place appropriate arrangements is essential in a significant unplanned outage event like this.

Retailers demonstrated generally thorough and appropriate communications with medically dependent consumers during the Northland event. Retailers reported to us that they used text messages, phone calls, and media platforms to advise consumers and provide updates. No issues were found with retailers' communications with medically dependent consumers.

Assurance and implementation of recommendations

The Authority expects Transpower to provide the Authority with a plan of action to implement each of the relevant recommendations in this report. This should also include how Transpower will implement relevant recommendations made in the Transpower-commissioned investigation report and system operator report relating to the event. This action plan is expected within one month of the publication of this report.

We also expect Transpower to provide six-monthly progress reports to the Authority until the actions to implement the relevant recommendations are complete. The progress reports should also include actions taken by Transpower's service providers in response to the event and the relevant recommendations outlined in the various reports.

The Authority will actively monitor and report on progress.

List of recommendations

Recommendations relating to improving regional resilience (Sections 11 – 12)

R1. Transpower and regional distributors should engage with a wide range of stakeholders, including generation developers, mana whenua, regional community groups and regional business groups, to develop regional electricity development plans for all regions in New Zealand that are vulnerable to high impact electricity supply events and develop controls that enable greater resilience through coordination of multiple resources employing both old and new technologies.

R2. The system operator should lead the establishment of plans to stand up a regional (or wider if appropriate) operating forum to improve operational coordination and communication amongst relevant operations managers, including the system operator, grid owner, distribution and generation operators (including distributed generation operators) and any affected direct grid-connected industrial consumers.

R3. Transpower should review and improve contingency plans where possible to:

a. specifically provide for relaxing normal 'healthy grid' security levels during system emergency conditions, to maximise supply allocations to consumers, and

b. pre-determine and resolve, to the extent possible, any applicable safety concerns and protection settings where required, and

c. clarify delegated authorities to make decisions about relaxing normal security levels in grid emergency conditions.

R4. Transpower, Ngāwhā Generation Limited (NGL) and Top Energy should discuss, study and resolve the Ngāwhā phase shift concern that resulted in NGL shutting down its generating units before reconnection of Northland to the first restored 220 kV circuit.

Recommendations relating to industry regulation to improve regional resilience and support the Authority's functions (Section 13)

R5. The Authority should take into account the Northland event and the importance of promoting regional resilience in its ongoing review of the common quality provisions in Part 8 of the Code and of future system operation in New Zealand.

R6. The Authority should consider and consult on options to amend Part 6A of the Code, to ensure the Code better promotes reliability and efficiency alongside competition in the electricity industry for the long-term benefit of consumers. Consideration should be given to:

a. whether rules in Part 6A should be retained given arm's length requirements in Part 6 of the Code and Part 4 of the Commerce Act 1986;

b. whether some of the rules in Part 6A should be removed or better targeted to reduce application and compliance costs, or

c. if the rules are retained, in whole or in part, whether the current 50 MW threshold is appropriate.

R7. The Authority should review and, if necessary, update the current VoLL settings in the Code to ensure these remain fit for purpose.

R8. MBIE should review section 46 of the Act to ensure that the Authority has the necessary tools to effectively perform its functions, including the power to require information from non-participants, and to ensure effective compliance with the Authority's information gathering powers so that the Authority can have confidence in information provided.

Recommendations relating to improving processes for maintenance work for baseplate refurbishment (Section 14)

R9. Transpower should revise its technical specifications for baseplate refurbishment to include a process for removal of hold down nuts, and otherwise ensure they adequately identify all other risks and appropriate controls for baseplate refurbishment.

R10. To address the existing inconsistencies in service provider work procedures, Transpower should require its service providers to review and revise their work procedures for baseplate refurbishment to ensure they align with any revisions to Transpower's technical specifications made under R9.

R11. Transpower should undertake a wider review of its technical specifications for work performed on the grid, using a risk-based framework to determine high priority areas for review and, if necessary, revision, to ensure its technical specifications are fit for purpose.

R12. Grid Skills training for foundation work must be revised and updated to address the existing gaps in relation to the risks of, and process for, removal of hold down nuts from tower foundation baseplates, and ensure all other relevant risks and critical elements for baseplate refurbishment work are covered.

R13. Transpower should undertake a wider review of its Grid Skills training curriculum using a risk-based framework to determine high priority areas for review and, if necessary, revision, to ensure Grid Skills training addresses all critical risks, and procedures to mitigate such risks.

R14. Transpower should mandate Grid Skills foundation training be completed before a person carries out foundation maintenance work, including baseplate refurbishment, unsupervised, or supervises others in the performance of such work, and should require refresher training at regular intervals to ensure worker competency remains current.

R15. Transpower should undertake a wider review of its minimum training and competency requirements to determine whether any other training courses should be mandated, and refresher training required, in relation to any work it assesses as high priority or high risk, before a person can undertake such work unsupervised or supervise others in such work.

Recommendations relating to Omexom's training and supervision policies and procedures (Section 14)

R16. Omexom should review its training policies and procedures for new crew and site supervisors to ensure adequate training is provided before undertaking work on the grid.

R17. Omexom should review its site supervision policies and procedures to ensure adequate supervision of all workers not yet competent.

R18. Omexom should make the results of its reviews under R16 and R17 available to the Authority.

Recommendations relating to improving grid maintenance contracting arrangements and assurance processes (Section 15)

R19. Transpower should review its assurance processes in relation to service provider work procedures and consider how it can more effectively promote best practice consistently across service providers.

R20. Transpower should consider requiring its service providers to submit 'during' photographs at the completion of each job alongside 'before' and 'after' photographs, at least in relation to work that carries a high risk if Transpower's technical specifications are not followed during the work.

R21. Transpower should create a specific plan for field audits of tower foundation maintenance work and undertake a wider review of its plans for field audits of all maintenance work to determine high priority areas for review and create specific plans for field audits of maintenance work which has the potential to result in a high risk of harm.

R22. Transpower should review its requirements for competency certificates to ensure that competency certificates provide sufficient detail of a person's scope of competency so as to be an effective assurance control.

R23. Transpower should review its policies on escalation of service provider non-compliance events, and regular reporting on the results of its quality assurance processes in relation to each service provider, to ensure the Transpower Board and senior management can exercise effective governance and oversight.

R24. Transpower should review its KPIs in its service provider contracts and how they are measured to ensure they include a focus on compliance with Transpower's quality requirements when the work is carried out.

Recommendations relating to implementation of recommendations (Section 19)

R25. The Authority expects Transpower to provide the Authority with a plan of action to implement each of the relevant recommendations in this report and the relevant recommendations made in the Transpower-commissioned investigation report and system operator report relating to the event. This action plan is expected within one month of the publication of this report.

R26. The Authority expects Transpower to provide six-monthly progress reports to the Authority until the actions to implement the relevant recommendations in this report are complete. The progress reports should also include actions taken by Transpower's service providers in response to the event and the relevant recommendations outlined in the various reports.

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Figures

Tables

1. About this review

Event overview

1.1. Just after 11.03am on Thursday 20 June 2024 approximately 88,000 Northland customer connections experienced an unplanned power supply interruption when a 220 kV[5] transmission tower owned by Transpower fell to the ground near the rural community of Glorit (the event).

1.2. The transmission tower (tower 130 on the Henderson – Marsden A line) fell to the ground while Transpower's service provider Omexom[6] was carrying out maintenance work on the tower's foundation baseplates. During this maintenance work, an Omexom team member removed the hold down nuts from three of the tower's four legs (Legs A, B and C). The removal of nuts from Legs A and B, which were intended to resist tension forces, compromised the stability of the tower, ultimately causing the tower to collapse, and the 220 kV Huapai to Marsden circuit to Northland to trip.

1.3. The system operator declared a grid emergency at 11.17am. The system operator initiated power restoration using the parallel 110 kV circuits, with limited supply restored to Bream Bay, Maungatapere and Kaikohe substations by 12.47pm. The system operator advised distributors that while managed restoration of supply had occurred, load restrictions were likely to be required at peak times. As a result, several large businesses were asked to constrain their electricity use until full electricity supply was restored.

1.4. On Sunday 23 June at 2.16pm, one of the two 220 kV circuits supplying the Northland region was returned to service using a temporary tower structure to restore one 220 kV circuit. The circuit had been removed from service for planned maintenance when tower 130 collapsed. Returning this circuit to service enabled full restoration of capacity to Northland but left the region on N security.[7]

1.5. The grid emergency ended at 4.00pm on Sunday 23 June. On Wednesday 26 June at 6.18pm the second 220 kV circuit into Northland was restored using temporary pole structures. This restored full N-1 security to Northland.

1.6. The impact of the event on Northland consumers and the Northland region was significant. The Authority has estimated the financial loss alone to be more than $37.5 million, with other estimates suggesting losses as high as $80 million.

The Minister for Energy requested a review into the event

1.7. On Friday 21 June 2024 the Minister for Energy (Minister) wrote to the Authority requesting a review and report into the event under section 18 of the Electricity Industry Act 2010 (Act). The Minister's request, and the terms of reference for the review, are set out in Appendix A.

5 kV is the standard industry abbreviation for 1,000 volts.

6 Electrix Limited, trading as Omexom New Zealand.

7 N security means there is sufficient transmission capacity to meet the load, but there is no redundancy to survive the loss of a single transmission asset. On the other hand, N-1 security means there is sufficient redundancy to survive the loss of a single transmission asset without a loss of supply. These concepts are discussed in more detail in section 3 of this report.

1.8. Section 18 of the Act provides that the Authority must, on written request by the Minister, review and report on any matter relating to the electricity industry.

1.9. This report is the Authority's response to the Minister's request.

Scope of the review

1.10. The scope of the review is to understand and explain the cause(s) of the event, the response to the event and lessons that can be learnt from the event. The terms of reference set out questions for the Authority to consider when carrying out its review. These questions, and where they are addressed in this report, are set out in Table 1 below.

1.11. Our findings and recommendations are focused on the improvements that can be made to prevent recurrence of a similar event and ensure that consumers in Northland and throughout New Zealand receive a reliable electricity supply that is resilient to the impact of rare events.

Table 1. Questions addressed in this report

Question from the terms of reference	Chapter reference
1. What was the cause/s of the event?	**Sections 7 – 8** set out our findings on the immediate and underlying causes of the event
2. What were Transpower's planning, risk identification, risk assessment, risk mitigation and residual risk assessment processes for any transmission maintenance work related to the event? This should include consideration of: ◦ maintenance instructions, asset condition monitoring and assessment, and assurance procedures ◦ any relevant previous faults and failures of assets supplying the Northland region, and their disclosure ◦ the timing of the works being carried out given security of supply risks, including if other assets supplying Northland were out at the same time.	**Sections 4 – 5** set out the arrangements for planning grid maintenance, and the contracting arrangements and assurance processes for grid maintenance **Section 3** contains information on previous regional faults and failures **Sections 14 – 15** set out our analysis in response to this question
3. Do Transpower's assurance and management processes, for activities carried out by contractors, conform to good industry practice? Are any aspects of Transpower contracting arrangements likely to lead to adverse outcomes or unintended consequences?	**Section 15** sets our analysis of Transpower's assurance processes and contracting arrangements

Question from the terms of reference		Chapter reference
4.	What was the impact of local generation capacity on pre-maintenance planning and on recovery following the event?	**Section 3** contains information on the Northland grid and local generation **Section 9** sets out how local generation contributed to the response **Section 11** sets out our analysis of regional resilience in the Northland event, and in the wider New Zealand context
5.	What communications were there between Transpower, lines companies, other participants, and consumers regarding any planned transmission work related to the event and the increased risk of outage?	**Section 4** and **Section 6** contains information on Transpower's publication of planned outages **Section 14** sets out our analysis of grid maintenance planning specific to the Northland event
6.	After the tower fell, were there appropriate communications from and between Transpower, lines companies, retailers, businesses and the public?	**Section 9** sets out our findings on operational communications, public communications, distributor communications and retailer communications after the event **Section 16** sets out our analysis of these communications
7.	What actions were taken to restore supply and did these conform to good industry practice?	**Section 9** sets out our findings on the response and recovery **Section 12** sets out our analysis of the actions taken to restore supply
8.	What lessons can be learnt from the recovery from the event including the actions taken by the grid owner, system operator and other participants. For example, the use of strategic spares, communications, and load management? This includes the availability of temporary towers, spares and other critical assets, their location, and timeframes to deploy these.	**Section 12** sets out our analysis of the actions taken to restore supply **Section 16** sets out our analysis of communications to effect restoration of supply **Section 9** contains information on the use of temporary towers, their locations, and the time taken to deploy these
9.	How quickly does Transpower permanently rectify failures that do occur? How does this compare with comparable overseas jurisdictions?	**Section 12** includes information on Transpower's planned timing for the permanent replacement of tower 130 and a comparison with international jurisdictions of Transpower's temporary and permanent replacement

Question from the terms of reference		Chapter reference
10.	What lessons were learnt from similar events and were lessons learnt acted on in this event?	**Part 3** contains information on where we have identified improvements following recommendations after a previous event, most notably 9 August 2024 and improvements in operational communications
11.	How did retailers care for their medically dependent consumers during the event?	**Section 9** sets out our findings on retailer communications with medically dependent consumers **Section 16** sets out our analysis of these communications
12.	Does the Electricity Industry Participation Code 2010 (Code) provide appropriate provisions for such circumstances?	**Section 13** sets our findings and analysis in relation to improving industry regulation, identifying potential amendments to the Code and Act
13.	What are the grid reliability standards into Northland (under business as usual and under maintenance conditions), and how does this compare with other parts of New Zealand?	**Section 3** sets out the grid reliability standards
14.	Do the grid reliability standards in the Code need to be reviewed, particularly to address single points of failure?	**Section 17** sets out our analysis of the grid reliability standards
15.	More broadly does this event highlight improvements that should be made to electricity system resilience?	**Part 3** makes a number of recommendations in relation to electricity system resilience
16.	Are there any other lessons learned or recommended improvements?	**Part 3** contains additional lessons learnt and recommended improvements to be made

Our approach to this review

1.12. The Authority appointed Sarah Sinclair as independent chair of its review and established a cross-disciplinary project team to conduct the review.

1.13. As part of this review the Authority has met with representatives of parties involved in or affected by the event, and has gathered and examined a significant amount of information provided by these parties, including from:

(a) Transpower New Zealand Limited (Transpower) - as both the grid owner and system operator[8]

(b) Transpower's service provider in Northland, Electrix Limited, trading as Omexom New Zealand (Omexom)

(c) electricity retailers in Northland

(d) electricity distributors in Northland – Northpower Limited (Northpower), Top Energy Limited (Top Energy), and Vector Limited (Vector)

(e) Northland Chamber of Commerce

(f) Northland Economic Development Agency

(g) several large electricity consumers in the Northland region affected by the outage

(h) Utilities Disputes Limited, the industry's dispute resolution scheme

(i) international electricity regulators and transmission companies.

1.14. Several other reviews and investigations, completed and underway, touch on matters relevant to this review. We have engaged with other agencies to ensure we are building on and to the extent possible, not replicating, other work relevant to this review. Reports we have had regard to in this review include:

(a) the system operator's preliminary report into the event: *System operator preliminary report: Northland loss of supply* (Transpower, 5 July 2024)[9]

(b) Beca Limited's engineering investigation report (Beca Limited, 23 July 2024)[10]

(c) the Transpower-commissioned investigation report: *Transpower New Zealand Limited – Report of Investigation into 20 June 2024 Tower 130 Henderson to Marsden A Line Incident* (Daniel Twigg, 26 July 2024)[11] (referred to in this report as the 'Transpower Investigation Report')

8 Transpower has two parts to its business. As the grid owner, Transpower owns and operates the National Grid. As the system operator, Transpower is responsible for managing the real-time power system and operating the wholesale electricity market.

9 This report is published on the Authority's website as an appendix to Transpower's investigation report: Authority review into Northland outage | Our projects | Electricity Authority (ea.govt.nz).

10 This report is published on the Authority's website as an appendix to Transpower's investigation report: Authority review into Northland outage | Our projects | Electricity Authority (ea.govt.nz).

11 This report is published on the Authority's website: Authority review into Northland outage | Our projects | Electricity Authority (ea.govt.nz).

(d) the system operator-commissioned report into the operational performance of the system operator, grid owner and other relevant participants: *Northland loss of power supply, 20 June 2024* (Ray Hardy, 30 August 2024) (referred to in this report as 'the Hardy Report').[12]

1.15. While we have met with representatives of Omexom, we have not re-interviewed staff who worked on tower 130 on 20 June and who were interviewed as part of Transpower's investigation. Where appropriate we have instead referred to findings of the Transpower Investigation Report, alongside further information provided by Transpower and Omexom.

1.16. A draft of this report, or sections of it, was provided to Transpower and Omexom on 6 September 2024 for comment on the factual findings and to ensure the parties had an opportunity to correct any errors or provide additional context. The Authority received a response from Transpower and Omexom on 10 September 2024.

1.17. In cases where the Authority was satisfied that there were factual inaccuracies in the draft report, or where the Authority otherwise accepted the points that were raised, the report has been corrected or amended to reflect that.

Matters not addressed in this review

1.18. This review is not to determine any breach of the Code or other laws.

1.19. It is important to note that the Authority's findings in this report are specific to this review and in no way suggest that Transpower's actions (as either grid owner or system operator), or the actions of any other industry participant, may or may not amount to a breach of the Code. The Authority's compliance team will investigate any alleged Code breaches separately to this review.

1.20. The issue of compensation is also outside the scope of this review. While we recognise the importance of this issue to Northland consumers who have suffered significant losses because of the event, the Authority has no powers to order compensation.

1.21. Several other matters are outside the scope of the Authority's review as they are within the jurisdiction of other agencies. This includes any matters relating to quality standards under Part 4 of the Commerce Act 1986, which will be considered by the Commerce Commission, and matters relating to potential breaches of the Health and Safety at Work Act 2015, which may be considered by WorkSafe New Zealand.

12 This report is published on Transpower's website: system-operator | information-industry | system-events-and-assessments (transpower.co.nz).

Part 1: Context for the Northland event

2. Background
3. The Northland grid, grid reliability standards and security levels
4. Planning grid maintenance
5. Grid maintenance contracting arrangements and assurance processes

2. Background

2.1. Transpower is the state-owned enterprise that plans, builds, maintains, owns and operates New Zealand's high voltage electricity transmission network (the national grid, or grid).

2.2. Transpower is responsible for delivering electricity across the grid throughout New Zealand. The grid supplies electricity by connecting generating stations located around the country to grid exit points (GXPs) using high voltage transmission lines and substations. Some very large industrial consumers are also directly supplied from the grid.

2.3. The Northland region's electricity supply from the national grid relies on four long transmission circuits carried on two transmission lines running north from Auckland. The supply capacity available in Northland is augmented by distributed generation connected within the region.

What is circuit capacity?

Circuit capacity refers to the maximum amount of electrical power that a circuit (like a wire or a group of wires) can safely carry. An electrical circuit has a limit on how much electricity it can handle. If you try to push more power through the circuit than it can handle, it can overheat or cause damage, leading to potential failures.

2.4. Local distributors own and operate distribution networks that connect to transmission GXPs and supply electricity to consumers at progressively lower voltages. Distribution networks also provide connection points for local distributed generation. Northland has three distributors–Top Energy, Northpower, and Vector.

2.5. Transpower's Northland regional grid and the region's distribution networks together provide the supply capacity, security and reliability received by the region's consumers.

2.6. This report focuses on transmission grid-level capacity and security. The supply interruptions that commenced on 20 June 2024 at 11.03am were caused when a transmission tower collapsed, rather than a failure within one of the distribution networks. The collapse of tower 130 on the Henderson – Marsden A line triggered the region-wide supply interruption and the loss of connection to regional distributed generation.

2.7. This part of the report explains the other relevant context to the event. Northland's transmission grid, the applicable reliability standards and security levels, as well as the asset maintenance arrangements and assurance processes in place are all relevant to how the event occurred. They also inform the key findings and recommendations in parts two and three of this report.

3. The Northland grid, grid reliability standards and security levels

Northland transmission grid assets

Transmission lines and circuits are different things

A line is a row of support structures – usually poles or towers, many kilometres in length.

Lines carry one or two electrically independent circuits, each circuit having three conductors (the aluminium/steel ‘wires’, also called ‘phases’) operating at a defined nominal voltage measured between the phases. The difference between lines and circuits is important in this report.

Maps, line and circuit diagrams in this report show 110 kV grid assets in red and 220 kV assets in orange.

3.1. Figure 1 shows that the Northland region is a long peninsula, with electricity supplied by a 220 kV double-circuit line from Huapai (orange) and a 110 kV double-circuit line from Henderson (red). The circuits carried on these lines are normally operated in parallel. The two Northland line routes run in parallel for part of their length. The double-circuit 110 kV line dates from the 1930s and has a much lower circuit capacity than the two circuits on the 1960s-1970s era 220 kV line.

Figure 1. Northland transmission lines and distributor boundaries

Source: Transpower's 2023 transmission planning report – Chapter 7 (annotated)

Megawatts (MW) and megawatt-hours (MWh)

MW stands for 'megawatt', which is a unit of power.

MWh stands for 'megawatt-hour', which is a unit of electrical energy.

To clarify the difference:

- Power in MW is the rate at which electricity is produced, transmitted, stored, discharged or consumed
- Energy in MWh is the quantity of electrical energy produced, transmitted, stored, discharged or consumed over time.
- An appliance consuming 1 MW of power for an hour, uses 1 megawatt-hour (MWh) of electrical energy.

3.2. Table 2 shows the nominal winter circuit capacities for the four circuits that connect the Northland region to the Auckland region, via Huapai (two circuits operating at 220 kV) and Henderson (two circuits operating at 110 kV).

Table 2. Northland circuit winter capacities

Circuit	Nominal winter circuit capacity (MW)[13]
220 kV circuits	
Bream Bay - Huapai circuit 1 Simplex (ie. single) conductor	298
Huapai - Marsden circuit 1 Duplex (ie. double) conductor	595
110 kV circuits	
Henderson – Wellsford – Maungaturoto - Maungatapere circuit 1	68
Henderson – Wellsford – Maungaturoto - Maungatapere circuit 2	68

Source: 110 kV circuits from Transpower's 2023 transmission planning report, Chapter 7.
220 kV circuits from the SPD model.

13 We have used the unit megawatt (MW) throughout this report, including in places where 'MW at unity power factor' would be more strictly correct. This is to keep power system capacity concepts reasonably non-technical for accessibility by a wide readership.

3.3. The Northland grid is normally operated with two 220 kV and two 110 kV circuits in service and operating in parallel, connected with 220/110 kV interconnecting transformers at Henderson in the south and Marsden in the north.

3.4. As Table 2 shows, the 220 kV circuits have significantly greater capacity than the older 110 kV circuits.

N-1 and N security levels

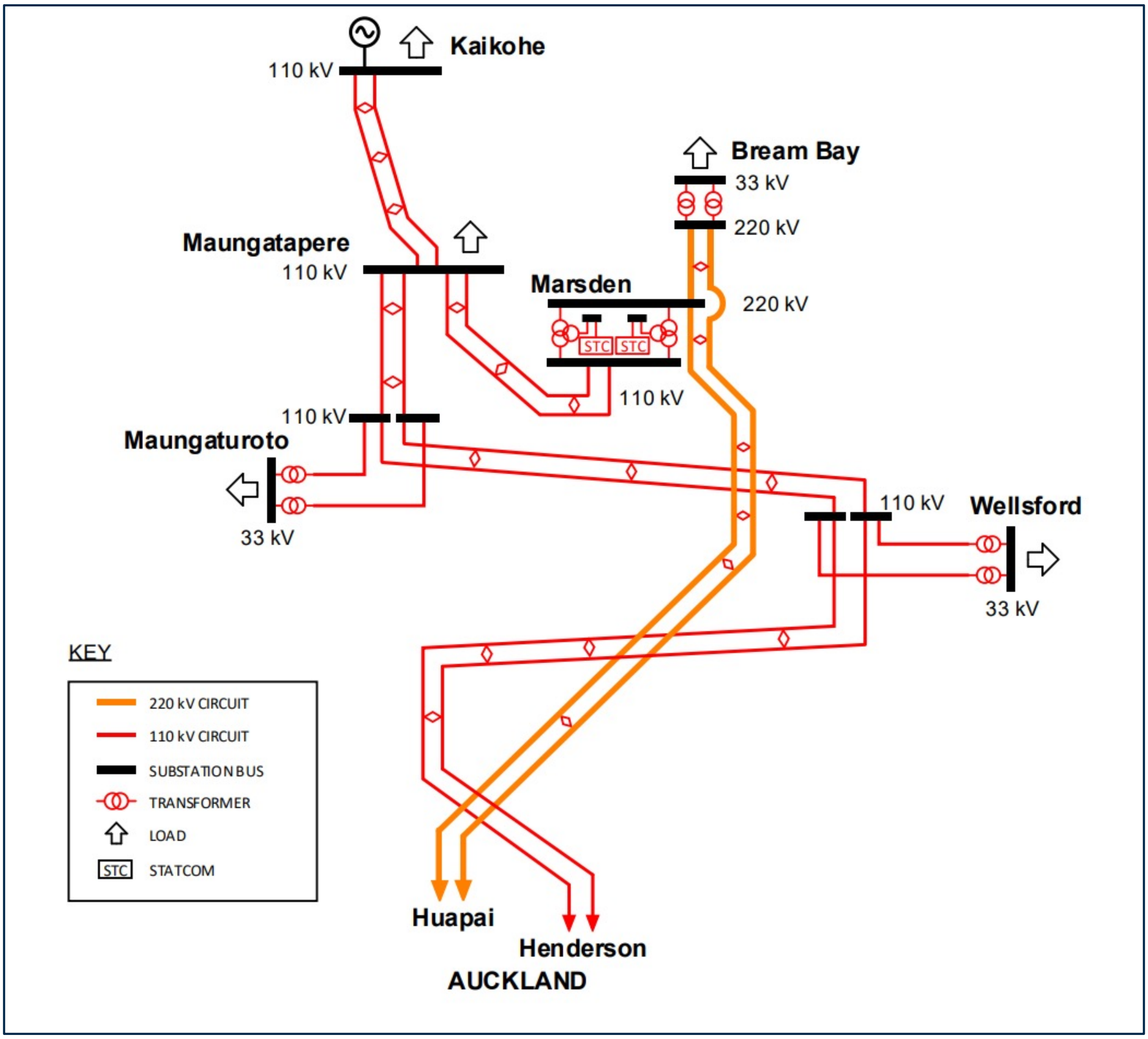
A power system can be described as N-1 secure when it is capable of maintaining normal operations in the event of a single contingency event, such as the unplanned loss of a transmission circuit or transformer.

However, if normal operations would be interrupted following a contingent event, such as a circuit fault, the security level is referred to as 'N'.

Contingent events can occur without warning from many possible causes including, for example, lightning striking circuits and circuit conductors striking a tower or the ground.

3.5. Figure 2 shows the two double circuit lines that supply Northland from Huapai (220 kV) and Henderson (110 kV). If either of the 220 kV circuits (either Bream Bay - Huapai circuit 1 or Huapai - Marsden circuit 1) are removed from service, or develop a permanent fault and trip, the normal N-1 security level for Northland reduces to N security until the circuit is returned to service.

Figure 2. The Northland grid normally provides N-1 security



Source: Transpower's 2023 transmission planning report – Chapter 7

3.6. This report does not discuss local distribution network configurations as these were not material matters for the event. We note, however, that the capacity and security levels provided by distribution network configurations are similarly critical for the capacity and security provided to consumers in Northland subregions.

The Northland 110 kV split

3.7. When either of the 220 kV circuits running north from Huapai is removed from service and the remaining 220 kV circuit should develop a fault and trip, Northland would be supplied only through the two parallel low-capacity 110 kV circuits that run north from Henderson.

3.8. In this situation, Northland aggregate consumer demand, net of local distributed generation, could exceed the capacity of the 110 kV circuits. If no precautions were taken, line protection relays would detect this condition as an overload and trip both 110 kV circuits to avoid asset damage.

3.9. The system operator routinely implements precautions to manage this risk by proactively opening both Henderson – Maungatapere circuit breakers at the Maungatapere end. This configuration effectively 'splits' the two 110 kV circuits into Northland away from the rest of the Northland grid.

3.10. In this configuration, Northland consumers supplied through the Bream Bay, Maungatapere and Kaikohe GXPs would still experience a supply interruption if one of the 220 kV circuits was out of service and the other one tripped. But the two 110 kV circuits from Henderson would not trip, retaining supply to consumers supplied through the Wellsford and Maungaturoto GXPs.

Distributed generation in Northland

Table 3. Northland distributed generation

Distributed generation	Type	Generation mode	Capacity (MW)	Grid connection
Ngāwhā A	Geothermal	Base load	25	Kaikohe 33 kV
Ngāwhā B			32	Kaikohe 110 kV
Kohirā (near Kaitāia)	Solar	Intermittent & variable	24	Kaikohe 110 kV
Wairua Falls (near Whangārei)	Hydro	Run of river	5	Maungatapere 33 kV
Manawa diesel generators	Diesel oil	Peaking & backup	4.5[14]	Bream Bay 33 kV
Top Energy diesel generators (several locations near Kaitāia)	Diesel oil	Backup	14[15]	Kaikohe 110 kV
Snells Beach	Battery energy storage system	Controllable charge and discharge	2.75	Wellsford 33 kV
Warkworth Sourth			2	
Taparoa			1.14	

Source: Transpower's 2023 transmission planning report – Table 7-2, and asset owner provided data

3.11. Northland currently has no generation that connects directly to Transpower's grid. The generation resources located in the region, referred to as distributed generation, connect to the three local distribution networks owned and operated by Top Energy, Northpower and Vector (Table 3 above).

14 The original installation was five 1.8 MW units, but this has been affected by unit failures and deratings. At the date of the event, the three serviceable units were together capable of 4.5 MW in total.

15 Approximately 14 MW is used as backup when Top Energy maintains its single circuit 110 kV Kaikohe - Kaitāia line and can also be used to help out in times of market stress such as on 20 to 23 June. There is another approximately 4 MW installed in more remote locations that are only used during faults or planned line work in the area.

3.12. Regional distributed generation provides local capacity for Northland that supplements the electricity imported through the grid from Auckland.

3.13. Table 4 reveals that the region's combined distributed generation capacity is much less than the capacity needed to always supply all of Northland's demand.

3.14. Additionally, Ngāwhā geothermal and Kohirā solar, with the highest generating capacities in the region, are unable to operate 'islanded'—that is, they cannot manage frequency and voltage to supply local demand if Top Energy's network is isolated from the grid to the south of Kaikohe.[16]

3.15. A connection to the grid is needed to balance Top Energy's consumer demand with the generally steady level of geothermal generation at Ngāwhā, and the intermittent[17] solar generation at Kohirā.

3.16. In contrast, Manawa and Top Energy's diesel generators can regulate frequency and voltage and operate islanded, supplying nearby demand up to their maximum capacity.

Consumer demand in Northland

3.17. Figure 1 showed the location of the five GXPs that supply Northland consumers from one of the three local distribution networks. The distribution networks connect to Transpower's grid at either 110 kV or 33 kV and in turn provide capacity to meet consumer demand, and connection to distributed generation, at progressively lower voltages.

3.18. Northland's aggregate electricity use reflects a diversified mix of residential, commercial and industrial consumers. The most significant recent change to industrial loads within the region was the shutdown of Refining NZ's Marsden Point oil refinery in April 2022 and its reconfiguration as a fuel import terminal, trading as Channel Infrastructure. Connected through Bream Bay GXP, this change reduced the demand from the refinery site by approximately 30 MW.

3.19. Table 4 shows the winter 2023 forecast peak demand and the actual pre-event demands on 20 June 2024.

16 Our electrical supply is 50 Hz alternating current. This means that the current and voltage are continually changing direction, completing 50 cycles every second. Frequency is related to the rotational speed of generators across the network. Generators need to be able to alter their output second by second to balance total supply and demand across the interconnected system. If they don't then all the generators will start to speed up or slow down, causing the frequency to deviate from the normal 50 Hz. Generators also control voltage, which is like the electrical pressure. Generators, transmission and distribution assets and consumer appliances are designed to operate within narrow frequency and voltage tolerances. If frequency or voltage deviates too far, generators may shut down to protect themselves and appliances may malfunction or be damaged.

17 Intermittent solar and wind generation can vary within seconds as clouds and wind gusts affect their output.

Table 4. Northland GXP demands

Grid exit point	Distributor	Forecast peak demands for winter 2023 (MW)	Actual GXP demands at 11.00am on 20 June 2024 (MW)
Kaikohe	Top Energy	80	58
Bream Bay	Northpower	26	16
Maungatapere	Northpower	126	89
Maungaturoto	Northpower	22	14
Wellsford	Vector	46	24
Northland coincident peak demand	**–**	**231**[18]	**201**

Sources: Forecasts from Transpower's 2023 transmission planning report – Table 7.1.
Actual demands from EMI data accessible on the Authority's website and the system operator's preliminary report.

The grid reliability standards as they apply to Northland

3.20. The grid reliability standards are set out in the Code[19] and are designed to ensure that the national grid operates safely and reliably, providing a secure supply of electricity to consumers.

3.21. The grid reliability standards require the 'core grid' to be designed to operate normally at N-1 security. Relevant to Northland, the core grid includes the 220 kV circuits north of Huapai but excludes the 110 kV Henderson – Wellsford – Maungaturoto – Maungatapere circuits 1 and 2.

3.22. The grid reliability standards only mandate the minimum required level of security that must apply. The grid in some regions, typically major population centres, may be built to a higher security level.

3.23. When a transmission circuit or other asset is out of service, a region normally on N-1 security will drop to N security. This is allowed under the grid reliability standards.

3.24. Table 5 shows how often regions have been on N security due to either planned or unplanned outages over the last two years, and how often these regions will be on N security in the 2024/2025 financial year based on planned outage data.

18 While the sum of the individual GXP peak demands is 300 MW, Northland's regional coincident peak demand is the sum of the individual GXP demand at the date and time of the regional peak.

19 See Subpart 3 of Part 12 and Schedule 12.2 of the Code.

3.25. The table is broken down into three sub-categories according to how many GXPs are affected by the outage:

(a) 3 or more GXPs affected

(b) 2 GXPs affected

(c) 1 GXP affected[20]

3.26. Table 5 also shows the total peak demand in MW across the GXPs affected to give an indication of how many consumers are affected.

3.27. Note that some GXPs appear in more than one of the sub-categories as different asset outages affect different groups of GXPs.

Table 5. Hours on N security due to outages, by region

(a) 3 or more GXPs affected

Region	GXPs affected	Peak Load (MW)	Hours on outage Previous 2 years	Hours on outage Upcoming 2024/2025 financial year
Northland	Bream Bay Kaikohe Maungatapere Maungatoroto	242	3858	2344
Hamilton	Hamilton Cambridge Te Awamutu Hinuera Waihou Waikino Kopu Piako	472	668	740
Coromandel	Waihou Waikino Kopu Piako	152	763	658

20 The lists of 'GXPs' in the original Transpower source data contained some locations embedded within distribution networks and some grid locations without load. These have been stripped out.

Region	GXPs affected	Peak Load (MW)	Hours on outage Previous 2 years	Hours on outage Upcoming 2024/2025 financial year
Hawkes Bay	Redclyffe Whakatu Tuai Fernhill Whirinaki	346	2240	410
National Park	Ongarue National Park Ohakune Mataroa	36	164	142
Oamaru	Oamaru Studholme Bells Pond	74	313	105
Upper Hutt/ Wairarapa	Upper Hutt Masterton Greytown	94	369	79

Source: Transpower data

(b) 2 GXPs affected

GXPs affected	Peak Load (MW)	Hours on outage Previous 2 years	Hours on outage Upcoming 2024/2025 financial year
Kawerau Aniwhenua	47	394	1844
Kaikohe Maungatapere	176	852	712
Dannevirke Waipawa	38	636	643
Wellsford Maungaturoto	52	857	548
Glenbrook Bombay	269	551	442

GXPs affected	Peak Load (MW)	Hours on outage Previous 2 years	Hours on outage Upcoming 2024/2025 financial year
Brydone Edendale	41	1452	372
Taumarunui Te Kowhai	132	546	237
Owhata Te Maitai	70	691	232
Hawera Waverly	42	918	229
Mt. Maunganui Tauranga	197	321	202
Waikino Kopu	82	766	167
Takanini Glenbrook	302	447	143
Oamaru Loss of supply to Black Point	57	211	116
Cromwell Frankton	113	615	94
Ohakune Mataroa	19	87	7
Greymouth Hokitika	36	0.62	0

Source: Transpower data

(c) 1 GXP affected

GXPs affected	Peak Load (MW)	Hours on outage Previous 2 years	Hours on outage Upcoming 2024/2025 financial year
Whakatu	88	3322	1133
Robertson Street	10	1585	1111
Kaikohe	76	83	973
Reefton	10	1145	888
Te Awamutu	36	1887	877
Bromley	168	705	803
South Dunedin	80	360	772
Southdown	24	1077	632
Frankton	70	1514	582
Norwood	24	135	548
Kaitimako	26	356	545
Silverdale	84	867	524
Paraparaumu	67	764	499
Mangahao	43	1015	496
Owhata	15	666	475
Glenbrook	185	1063	472
Opunake	13	1292	458
Cambridge	42	632	448
Opunake	13	447	420
Balclutha	31	1243	391
Tangiwai	47	964	380

GXPs affected	Peak Load (MW)	Hours on outage Previous 2 years	Hours on outage Upcoming 2024/2025 financial year
Bombay	84	802	324
Mangamaire	12	570	315
Temuka	57	747	297
Hokitika	21	956	288
Timaru	68	259	274
Greymouth	15	828	257
Takanini	117	962	227
Naseby	37	300	223
Kaiwharawhara	39	342	221
Greytown	14	503	214
Studholme	19	407	199
Melling	73	757	186
Ashley	15	281	177
Kaiapoi	30	104	168
Wiri	87	6098	164
Lichfield	10	519	155
Mataroa	9	316	117
Kopu	51	908	108
Halfway Bush	146	506	107
Te Matai	55	811	70
Marton	17	239	70
Pauatahanui	21	294	69

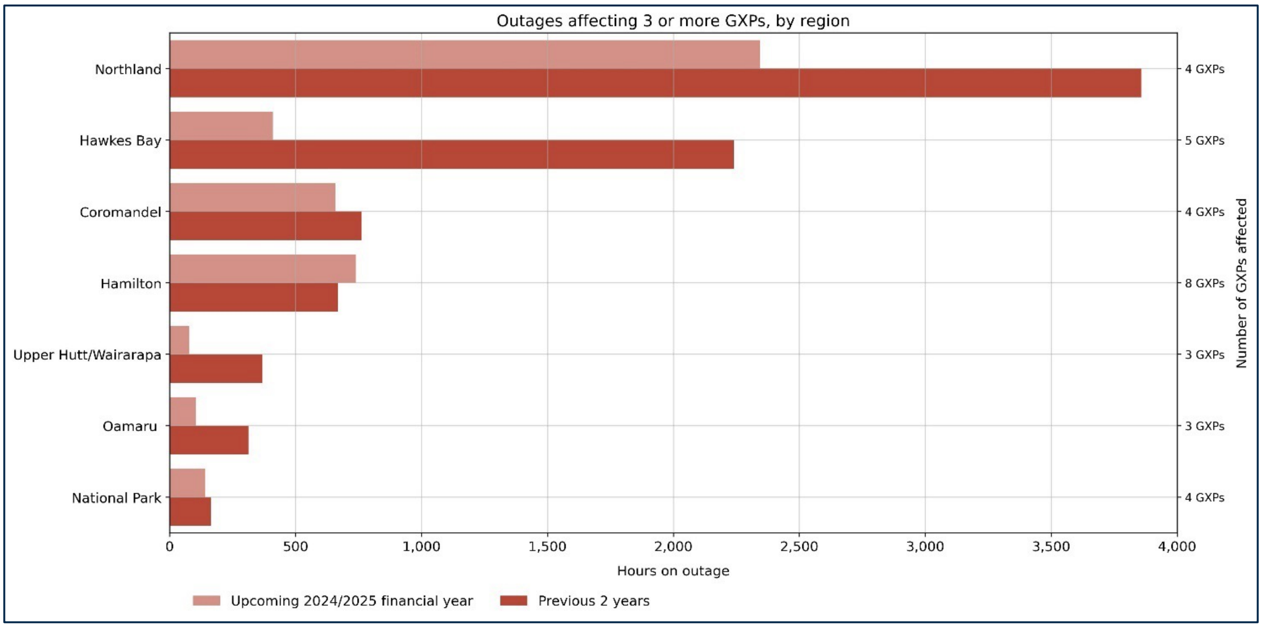
GXPs affected	Peak Load (MW)	Hours on outage Previous 2 years	Hours on outage Upcoming 2024/2025 financial year
Gracefield	63	740	55
Kimberley	16	215	20
Mt. Maunganui	67	106	11
Wilton	56	5097	
Rotorua	73	268	
Wairau Road 220 kV	70	252	
Tauranga	130	154	

Source: Transpower data

Why Northland has more and longer periods on reduced security

3.28. Table 5 shows that, amongst outages where 3 or more GXPs are affected, Northland stands out as being over-represented in the hours on N security. This is also illustrated in Figure 3 below.

Figure 3. Hours on N security due to outages, by region of 3 or more GXPs



Source: Transpower data

3.29. There are several reasons for this:

(a) the long transmission lines supplying Northland have reached an age where refurbishment is required to extend their lives, which often requires planned outages

(b) the lines pass through a narrow passage of land and are exposed to corrosive salt spray over much of their length, increasing maintenance requirements

(c) the lines are relatively exposed to tropical storms, such as Cyclone Gabrielle, which contributes to outages

(d) due to system configuration and more complex switching requirements, Transpower adopts more continuous outages for Northland rather than daily outages (while daily outages would reduce the total hours, they would require the switching sequence to be actioned every day of the outage, rather than just once at the beginning and end of the outage)

(e) 25% of Northland's hours on N security relate to the removal of the 220 kV Huapai-Marsden 1 circuit, as directed by the system operator, to manage high voltages at times of low demand.[21] This may be required when local generation voltage support capability is insufficient to manage the high voltage situation. This practice is mainly applied to 220 kV circuits, as they tend to be longer, higher capacity circuits, that boost voltage to a greater extent when lightly loaded.

Northland is not unique

3.30. While Northland has the most hours on N security for outages affecting three or more GXPs, it is by no means unique. Many other regions which are often on N security are provincial, but the Hamilton region stands out as including a significant city.

3.31. Table 5 shows many other regions drop to N security during outages—some with significant loads and for a substantial number of hours. For cases where two GXPs are affected, Cromwell/Frankton (113 MW), Mount Maunganui/Tauranga (197 MW), Takanini/Glenbrook (302 MW) are significant examples. For single GXPs, Bromley (in eastern Christchurch 168 MW), Halfway Bush (in Dunedin 146 MW) and Wilton (in Wellington 56 MW) are three examples of significant urban loads.

3.32. Northland is not alone in having only two 220 kV circuits. Hawkes Bay and Nelson are two regions also only supplied by two 220 kV circuits. However, these regions each have relatively large local hydro generation schemes – at Tuai in Hawkes Bay, and at Cobb and Argyle in the Nelson/Marlborough region. Unlike the geothermal and solar generation in Northland, these hydro schemes can operate islanded, thus increasing the resilience of their respective regions. The issue of islanded operation of distributed generation is discussed in more detail in part three of this report.

3.33. Transpower is engaging with Top Energy and Northpower to prepare a regional electricity development plan (RED plan) for Northland. This will also involve consultation with Northland strategic stakeholders including local government, business advisory groups, large businesses, mana whenua and other government agencies.

21 When lightly loaded, transmission lines behave like large capacitors, which can elevate the system voltage above the normal range. Removing a circuit from service increases the loading on the remaining circuit(s), thereby reducing the voltage rise. However, it also has the side-effect of reducing security to the affected region.

3.34. Northpower, Top Energy and Transpower have agreed a terms of reference for the RED plan to support planning and investment decisions considering the wider regional context, operation, and maintenance considerations, as well as regional development goals. The intention is to publish a regional development plan in December 2024 which identifies the preferred options for investment in Northland.

Previous regional outages

3.35. We have examined previous incidents involving transmission assets supplying the Northland region and identified one incident that bears some similarities to the event.

3.36. An outage was planned for the period 25 November to 6 December 2019 (~12 days continuous), when the Bream Bay-Huapai circuit 1 was to be removed from service for maintenance work on attachment points.

3.37. This planned outage reduced Bream Bay, Kaikohe and Maungatapere GXPs to N security, relying on the parallel Huapai-Marsden circuit 1 remaining in service throughout the planned outage.

3.38. A 110 kV system split was in effect, with Henderson – Maungatapere circuit breakers open at Maungatapere (as we explained earlier in this section). Auto-reclose on Huapai-Marsden circuit 1 was disabled to prevent possible damage to distributed generation in the region, notably the Ngāwhā geothermal station.

3.39. At 9.34am on 27 November 2019, Huapai-Marsden circuit 1 tripped, resulting in the loss of approximately 180 MW of load in the Northland region affecting at least 72,000 consumers, including the Marsden Point Refinery, which was still operating in 2019.

3.40. The system operator commenced restoration of Northland via the 110 kV circuits. An incident management team analysed protection information and decided to attempt to re-liven the faulted circuit before completion of a line patrol. The circuit reclosed successfully and restoration of the region's GXPs refocused on the high capacity 220 kV circuits.

3.41. Restoration was complete to Northland GXPs at 11:15am. Bream Bay-Huapai circuit 1 was also recalled to service, and Northland was restored to N-1 security at 11.31am.

3.42. The cause of the trip was determined to be bird excrement across an insulator on tower 234, causing a flashover and a temporary single phase to earth fault.

3.43. Transpower had previously installed bird deterrents in high-risk areas on the Northland lines. Following the 27 November 2019 event, Transpower identified additional higher risk areas due to land use changes and installed 59 additional bird perching deterrents on towers in the area.

3.44. Following the 2019 incident, we considered a report prepared by the system operator.[22] While the impact of the outage affecting the Northland region in 2019 was similar to the 2024 event, the early availability in 2019 of the self-repaired 220 kV circuit meant the outage duration and level of disruption was less severe than the 2024 tower event. The 2019 report estimated VoLL at $5.3 million.

22 Power System Event Reporting & Review - Event 3899 - Northland LOS SO Investigation Report v1.0 MAR 2020.

4. Planning grid maintenance

4.1. As grid owner, Transpower is responsible for developing and maintaining the high-voltage electricity network, which transports bulk electricity from where it is generated to cities, towns and some major industrial users throughout New Zealand.

4.2. Maintaining transmission lines in good condition requires the grid owner to develop and execute a proactive asset maintenance plan that includes:

(a) regular condition assessments across its asset fleets (including 40,000 poles and towers on around 11,800 km of transmission line), and

(b) maintenance (refurbishment and replacement) of assets that meet identified criteria.

4.3. Towers and poles are an essential part of Transpower's transmission assets. Often, transmission towers and poles carry more than one circuit, in which case a tower failure would remove both circuits and thus have a wider impact than a single circuit failure—as with the Northland event, a double circuit fault would interrupt supply into a region.

4.4. Transpower's overarching vision is for towers and poles to operate safely and reliably, at least lifecycle cost.[23] Its strategic approach is to maintain towers in perpetuity, unless an asset is identified as being no longer required.

4.5. Tower failures are relatively rare – between 1963 and 2019, Transpower recorded 53 tower failures, 12 of which were classified as foundation failures resulting from inadequate foundations or river encroachment and flooding.[24] The balance were caused by structural failure of tower members, most occurring under high winds. No previous tower failures have been attributed to human error during routine maintenance.

4.6. Transpower undertakes regular inspections of towers and determines the need for maintenance work through condition assessments. Transpower outsources condition assessments and maintenance work to several specialist service providers. The contracting arrangements in place are discussed in section 5.

Asset condition assessments

4.7. According to Transpower service specifications,[25] condition assessments are undertaken at intervals appropriate for the particular asset. Results of assessments are recorded in Transpower's asset management information system, identifying any urgent replacement and/or repair requirements.

4.8. Transpower's service specifications are detailed in what they require condition assessments to inspect and record. Specifications for condition assessments of tower structures alone exceed 20 pages and include assessing the condition of tower paint, tower steel members, foundations for each tower leg, and baseplates and anchor bolts.[26]

23 Transpower, *Transmission Line Towers and Poles Asset Class Strategy*, TP.FL.01.01, Issue 2.1, January 2019, at 3.1.

24 Transpower, *Transmission Line Towers and Poles Asset Class Strategy*, TP.FL.01.01, Issue 2.1, January 2019, at 2.2.3.

25 Transpower, *Transmission Lines Asset Maintenance Requirements Service Specification*, TP.SS 02.98, November 2023.

26 Transpower, *Transmission Lines Asset Maintenance Requirements Service Specification*, TP.SS 02.98, November 2023 at section 12.4.7.

4.9. Condition assessments produce a condition assessment score for various components on a scale from 100 (new) to 20 (replacement or decommissioning criteria) to 1 (where failure is likely under everyday conditions). For towers with concrete pile baseplates, refurbishment selection is based on the minimum condition assessment score of the four legs. The typical threshold for programming refurbishment is a score of 50, which is assigned before any significant corrosion or loss of section occurs.[27]

4.10. Once the condition assessments are complete, the Transpower asset planning team determines which sites to refurbish based on condition assessment scores and works with Transpower service delivery managers and the service provider to develop a work programme for each year. Refurbishment of tower baseplates falls within Transpower's predictive maintenance work programme, which is for work done on an asset before it deteriorates to an unsatisfactory condition.

4.11. The work is arranged into packages for which works orders are then issued to the relevant service provider.

Technical specifications for grid maintenance

4.12. Transpower sets the technical specifications for work on the national grid. Technical specifications are provided in different types of Transpower-controlled documents, with different levels of detail, including:

(a) service specifications, which specify minimum requirements for the specified work

(b) technical engineering drawings, which describe the outcomes Transpower requires to be achieved and can also include details of the process to be followed

(c) standard maintenance procedures (SMPs), which are approved procedures for certain maintenance work, primarily preventative maintenance activity.

4.13. Not all work a service provider is expected to carry out will be covered by a SMP. We understand these are typically reserved for the most high-volume work types.

4.14. Service providers are required to develop and maintain specific work procedures for the work they undertake on the national grid. Work procedures must ensure that the relevant technical specifications specified by Transpower are met.

Participants must coordinate their planned outages

4.15. The nature of transmission maintenance work can frequently require a transmission circuit or other grid asset to be de-energised and removed from service so the work can be carried out safely. On any day, multiple grid assets are likely to be removed from service for different reasons, including maintenance.

27 Transpower, *Foundations Asset Class Strategy*, TP.FL 01.02, Issue 3, Jan 2023.

4.16. The Code includes obligations on asset owners and the system operator to ensure the coordination of outages that affect common quality.[28] Obligations include:

(a) requiring asset owners to give notice of planned asset outages

(b) requiring the system operator to assess outage impacts

(c) requiring the system operator to determine the extent to which outages may impact the system operator's ability to plan to comply, and to comply, with its principal performance obligations under the Code.

4.17. The principal performance obligations relate to security of supply, real time operation of the power system, and coordination and communication with the electricity sector.[29]

4.18. Coordination aims to minimise impacts of planned asset maintenance on normal electricity supply operations. If the system operator considers that a planned outage would adversely affect its ability to plan to comply, and to comply, with the principal performance obligations, it may request the asset owner to keep those assets in service for the time being.

4.19. Asset owners must also endeavour to programme their planned outages at a time when there will be no disruption to the system operator's ability to plan to comply, and to comply, with the principal performance obligations. However, the final decision on planned outages rests with asset owners.

4.20. Transpower publishes the Planned Outage Coordination Process (POCP), which operates continuously in all time periods from the furthest future notified outage to near real time. This enables planned outage transparency and coordination across multiple asset owners that include the grid owner, generators, distributors, and large industrial consumers.

4.21. Transpower also has an outage planning policy that explains how, in its dual roles as system operator and owner of the national grid, it will meet its obligations around outage planning, coordination and assessment.[30]

Maintenance work that does not require an outage is not notified

4.22. Not all maintenance work requires an outage of normally in-service transmission assets. For example, work undertaken on a transmission structure (a tower or a pole) at ground level, working safely clear from live overhead conductors by adhering to minimum safe approach distances, does not require an outage.

4.23. Other than live line work, work that does not require an outage is not required to be notified to the system operator.

28 Technical Code D (Co-ordination of outages affecting common quality) of Schedule 8.3 of Part 8 of the Code. Common quality is the subject of Part 8 of the Code.

29 The system operator's principal performance obligations are set out in clauses 7.2A to 7.2D of Part 7 of the Code.

30 This policy is published on Transpower's website: Outage planning | Transpower.

5. Grid maintenance contracting arrangements and assurance processes

Transpower contracts out transmission maintenance

5.1. Transpower contracts out its transmission asset maintenance to four service providers: Omexom, Northpower, Downer, and Ventia.

5.2. Since 2022, Transpower has contracted service providers within six regional service areas (RSAs). It engages one service provider to be the exclusive provider in each RSA of certain 'in-scope services' for specified lines and stations.

5.3. Omexom is engaged as exclusive provider of certain services in RSA1 (Northland) and RSA6 (bottom half of the South Island), including tower foundations maintenance work in both RSAs.

5.4. The master grid services contract between Transpower and Electrix Limited (trading as Omexom) (master contract) establishes the overall framework of the relationship and terms that apply to all services provided under separate service contracts and work orders.

5.5. The service provider's key responsibilities under the master contract are discussed below. Other important aspects of the contractual arrangements, including procedures for raising and resolving significant breaches, and matters of risk, liability and insurance, are detailed in Appendix B.

Service provider key responsibilities

5.6. The service provider's key responsibilities under the master contract include:

(a) complying with all applicable performance requirements when carrying out its activities in connection with the master contract, which include Transpower's technical specifications for grid maintenance (such as service specifications and standard maintenance procedures or SMPs) referred to in the master contract or notified to the service provider from time to time

(b) a general responsibility to use all due skill and care, and comply with Good Industry Practice,[31] in the course of its activities in connection with the master contract

(c) maintaining a quality assurance system and using appropriate quality control techniques to ensure its activities are carried out in accordance with the master contract

(d) self-auditing compliance with the master contract under a self-audit programme which is submitted to, and accepted (or not rejected) by Transpower in advance

(e) using only suitably trained, experienced and certified personnel who meet Transpower's requirements relating to training and competency, and ensuring those personnel responsible for supervising the performance of any services onsite are suitably experienced and qualified to take full responsibility for the safety, work standards and conduct of the personnel under their supervision

31 The term 'Good Industry Practice' is defined in the master contract to mean 'in relation to any activity, the exercise of a degree of skill, diligence, prudence and foresight which would reasonably and ordinarily be expected from a skilled and experienced person engaged in New Zealand in the same type of activity, under the same or similar circumstances (provided that if the relevant activity involves electrical work, the term "Good Industry Practice" will be deemed to have the same meaning as "Good Electricity Industry Practice" in clause 1.1(1) of Part 1 of the Code).'

(f) using all reasonable endeavours to achieve the Key Performance Indicators (KPIs) and Administrative Performance Requirements specified in the master contract.

Responsibilities for setting technical specifications and procedures for grid maintenance

5.7. As explained in the previous section, Transpower sets the technical specifications for work on the national grid that service providers must comply with.

5.8. Under the master contract, Transpower is responsible for providing all information in its possession or control as reasonably required by the service provider to fulfil its obligations. The service provider is responsible for assessing what information it needs and requesting it within a reasonable time in advance of when it is needed.

5.9. The service provider is responsible for developing and maintaining their own work procedures for the work on the national grid. Work procedures must ensure that the relevant technical specifications specified by Transpower are met.

Responsibilities relating to competency and training personnel

5.10. The service provider is responsible under the master contract for determining competency and issuing competency certificates to its personnel in accordance with Transpower's requirements relating to training and competency.

5.11. Transpower prescribes the following general minimum requirements for work being undertaken on Transpower's behalf (outside substations):[32]

(a) site specific induction where required

(b) relevant work task competencies and competency certificate

(c) Prescribed Electrical Work registered or employer license as applicable

(d) supervision by competent person (which may be direct or indirect depending on individual's competencies and level of risk)

(e) work site safety plan and hazard briefing by competent person.

5.12. A competency certificate is a certificate endorsed by an employer defining functions an employee is competent to undertake. All employees working on Transpower assets must hold competency certificates and only carry out activities within the scope of the competency certificate held (unless under adequate supervision).

5.13. Service providers may have different processes for how competency is determined. However, competency certificates should only be issued following completion of training, and/or refresher training and when the worker has sufficient experience (under supervision) to demonstrate to the service provider that the competency certificate should be issued.

32 Transpower, *Minimum Training and Competency requirements for Transpower field work*, TP.SS 06.25, December 2022, at 2.2.

Transpower provides industry training

5.14. Grid Skills is Transpower's owned and operated private training establishment. It provides specialist training to people working on grid assets. Over 1800 people from 88 different organisations take part in Grid Skills training annually. The Transpower Investigation Report recorded that costs are met by attendees,[33] but Transpower has since confirmed that Grid Skills training is funded by Transpower.

5.15. Grid Skills provides more than 65 courses across substation and lines learning pathways.[34] Grid Skills training is delivered to meet the outcomes of Transpower assessment standards and where appropriate and available training is aligned to NZQA unit standards and qualifications. Grid Skills also approves trainers to provide Transpower specific training (under Transpower service specifications, this training must only be undertaken by Transpower approved trainers).[35]

5.16. Grid Skills training is, therefore, an essential element in ensuring a qualified and competent workforce that meets transmission industry needs. Grid Skills provides the training that enables service providers to meet their general obligation under the master contract to ensure workers are properly trained. Grid Skills is referred to throughout Transpower's service specifications relating to minimum training and competency, which service providers must comply with under the master contract. Grid Skills training is an important way for Transpower to be assured that workers have received appropriate, industry specific training.

5.17. The importance of Grid Skills training is reinforced by findings in the Transpower Investigation Report, which reported that a number of interviewees with long industry experience expressed the view that attending Grid Skills training courses is an essential element in the development of service providers' people to be competent to work on transmission equipment. We agree with the observation in the Transpower Investigation Report that, while service providers are required to assess employee competency, an element of competency is likely to include having undertaken training through Grid Skills, supplemented by on-the-job training.

Transpower's management and assurance processes for service provider work

5.18. Service provider work is managed through a tiered structure of responsibilities within Transpower that includes regional service managers (focused on contract performance and overall issues with the services of their service provider in the region), service performance managers (responsible for service provider contract performance in relation to lines and station work) and service delivery managers (responsible for delivery of the work, particularly focusing on defects work and work arising out of condition assessments performed by service providers).

33 Transpower Investigation Report at paragraph 4.30.

34 See About Grid Skills | Transpower.

35 Transpower, *Minimum Training and Competency requirements for Transpower field work*, TP.SS 06.25, December 2022, section 6.

5.19. In addition to day-to-day management of its service provider work, Transpower has an assurance process in place to ensure external provider service delivery aligns with Transpower requirements and is compliant with legislation.[36] Transpower's quality and compliance team is responsible for quality audits.

5.20. Transpower carries out several different audits as part of its assurance process including:

(a) field audits: Transpower identifies areas it wishes to audit based on the upcoming year's work plan and prioritises audits based on risk and learning from previous audits. A field audit generally involves a site visit and checks:

(i) work procedures are on site and relevant for the work being carried out

(ii) work practices comply with service specifications, approved work procedures and safety systems

(iii) adherence to procedures, process and guidelines

(iv) requirements of competency certification are met and align with requirement of work procedure or SMP

(b) management systems audit: Transpower audits the service providers' management systems every two years to verify service providers are able to deliver on their contractual obligations including competency and subcontract management

(c) other targeted audits: various other sub-system or process audits, for example audits of competency management tools.

5.21. Transpower's audit plan uses criteria depending on the maintenance work being carried out (for example lines, stations, vegetation etc). Transpower does not have a specific work plan for field audits of different work types, such as tower foundation maintenance work, rather, the same generic plan is used for all lines-related audits.

5.22. If a field audit identifies a non-compliance or opportunity for improvement, it reports this to the service provider. This is discussed onsite, with intervention applied in the case of personnel or plant safety issues, or if there is a risk of significant impacts. Transpower then raises any non-compliances and opportunities for improvement with the service provider after the audit is completed. Non-compliances are then tracked through to satisfactory closure.

5.23. Transpower also meets regularly with service providers to discuss safety and quality assurance. Those meetings include:

(a) monthly quality assurance meetings between Transpower's Quality and Compliance Team and the service provider to review and share findings from Transpower audit and self-audit plans and reporting

(b) quarterly relationship management meetings (and at an executive level, six monthly) to discuss overall performance

36 Transpower's minimum requirements and processes for assurance of service provider performance are set out in Transpower, *Auditing: Performance*, TP.SS 01.20, Issue 5, August 2021.

(c) quarterly forums where senior leadership from all service providers meet with Transpower to share significant incidents and lessons learned

(d) best practice forums which involve subject matter experts across the different service providers

(e) targeted meetings to discuss health and safety, including a Central Safety Leadership Team meeting every four months, and a Health and Safety Alignment Forum held quarterly.

5.24. Other aspects of the contracting arrangements also support Transpower's quality assurance, such as health and safety incident reporting and investigation requirements, the general responsibilities on service providers to maintain their own internal quality assurance and risk management systems, and competency and training provisions discussed above.

5.25. Transpower can also access all electronic records maintained by service providers in relation to contract work.[37] Service providers are required to provide 'before' and 'after' photographs of work in a photo library system called Recollect.

37 It is a requirement under the regional service contract (RSC1) that service providers use Transpower systems, or a system accessible by Transpower, to maintain electronic records relating to the lines, stations and services.

Part 2: Factual findings and causes

6. Events leading up to the tower collapse

How the baseplate refurbishment work was planned

6.1. A condition assessment of tower 130 was completed on 2 March 2021 by Northpower, the service provider for the Northland region at the time. The assessment identified two refurbishment tasks for tower 130:

(a) remove the soil covering of some of the legs of the baseplate

(b) refurbish the baseplates of each tower leg.

6.2. Transpower programmed the work as part of a wider package of refurbishment of in-region (RSA1) baseplate foundations works. Work orders were issued to Northpower on 16 September 2021 and then assigned (by new work orders) to Omexom, who replaced Northpower as Transpower's service provider in the Northland region in 2022.

6.3. The work was initially scheduled for completion in the financial year ended 30 June 2023 but was not completed. The work was rescheduled for completion in the 2024 financial year due to resourcing constraints resulting from a higher priority afforded Cyclone Gabrielle response and recovery work.

What baseplate refurbishment work involves

6.4. Baseplate refurbishment work can require a range of activities and methodologies, dependent on the condition of the baseplate. Refurbishment work for towers with concrete pile foundations like tower 130 will typically involve:

(a) removing the nuts and washers on top of the baseplate

(b) inspecting the bolts and baseplate holes for signs of corrosion

(c) preparing the steel surfaces by sand blasting all exposed surfaces, applying sealant to the bolt voids, refitting the washer and nuts and applying a protective coating to the refurbished metal surfaces.

6.5. Transpower sets technical specifications for this work. The work order in relation to tower 130 required baseplate refurbishment to the following technical specifications:

(a) Transpower Service Specification TP.SS.02.11

(b) Standard Drawing TE37252.

Work commenced on tower 130 on 19 June 2024

6.6. Omexom crews completed baseplate refurbishments on 24 other towers in RSA1 between September and December 2023, and four other towers in June 2024, before moving to tower 130.[38]

6.7. Work on tower 130 commenced on 19 June 2024. The work started but was stopped early on that day due to adverse weather conditions. The work on one tower leg, leg D, was in progress before the weather interruption. The hold down and lock nuts on leg D were replaced before the maintenance team vacated the site for the day.

The work did not require a planned outage

6.8. Tower foundation work, being at ground level, can be carried out while the overhead electrical circuits remain in service. This meant the work did not require an outage of transmission assets.

6.9. As a result, and as is usual practice for maintenance work of this type, there was no communication with the grid owner, local distributors or other participants about the work being undertaken, nor was there any requirement to do so.

Northland was operating on N security due to maintenance elsewhere

6.10. Other planned maintenance was in progress on 20 June that required the 220 kV Bream Bay – Huapai circuit 1 to be removed from service. The service status of Bream Bay - Huapai circuit 1 was unrelated to the foundation work on tower 130. It was for planned work at the following locations on the Northland grid:

(a) the 220 kV Henderson – Huapai circuit 1, for attachment point maintenance

(b) Marsden 220/110 kV interconnecting transformer T6

(c) Marsden STATCOM 6, which is connected to the tertiary winding of T6.

6.11. This outage had been entered into POCP on 25 January 2023 with a planning status of 'tentative' and updated to 'confirmed' on 12 May 2023.

6.12. While the planned outage of Bream Bay - Huapai circuit 1 reduced the region from N-1 to N security, it is not unusual for low-risk maintenance work, such as tower footing refurbishment, to be planned to run simultaneously with circuit outages.

6.13. In line with standard operating practice, a 110 kV system split was put in place by opening the circuit breakers at Maungatapere on the two 110 kV circuits from Henderson.

6.14. Table 6 summarises the operational status of the circuits supplying Northland at the time tower 130 collapsed on 20 June 2024. This shows the impact of the Bream Bay - Huapai circuit 1 planned outage and the 110 kV split.

38 This was the finding of the Transpower Investigation Report, at paragraph 6.4. It notes however that Transpower's records indicated 26 jobs had been completed by Omexom in FY23/24.

Table 6. Northland circuits service status on 20 June 2024

Circuit	Nominal winter circuit capacity (MW)	Service status at 11am on 20 June
	220 kV circuits	
Bream Bay-Huapai circuit 1	298	Removed from service for other maintenance work
Huapai-Marsden circuit 1	595	In service
	110 kV circuits	
Henderson-Wellsford-Maungaturoto-Maungatapere circuit 1	68	In service with a 'split' in place with the line circuit breaker open at Maungatapere
Henderson-Wellsford-Maungaturoto-Maungatapere circuit 2	68	In service with a 'split' in place with the line circuit breaker open at Maungatapere

Source: 110 kV circuits from Transpower's 2023 transmission planning report, Chapter 7.
220 kV circuits from Transpower's SPD model

7. Events of 20 June 2024

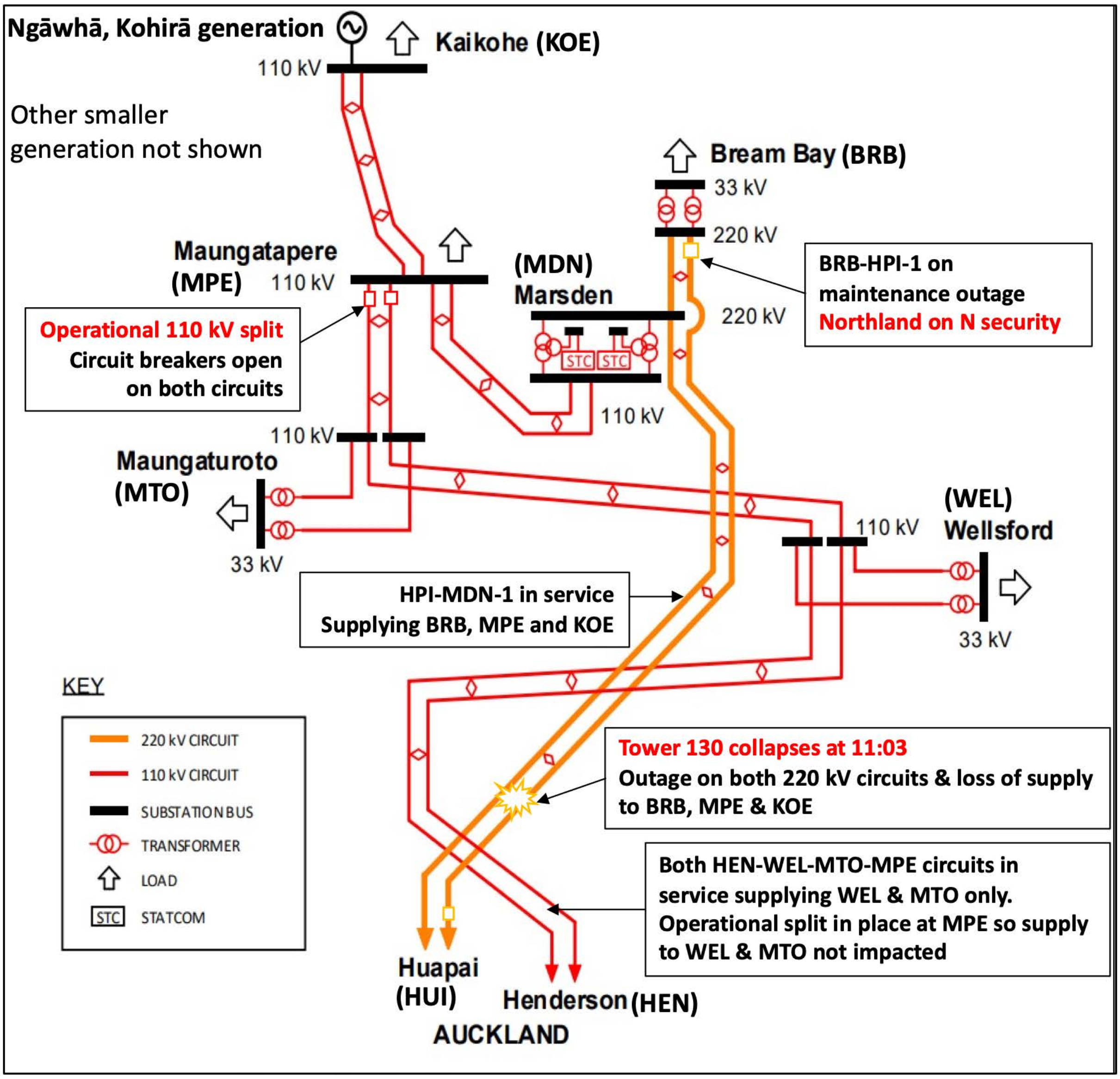
7.1. Just after 11.03am on Thursday 20 June 2024, approximately 88,000 Northland customers experienced an unplanned supply interruption. The initial loss of power totalled approximately 163 MW and affected supply to three Northland GXP substations:

(a) Kaikohe –Top Energy's sole supply point

(b) Maungatapere – supplying Northpower

(c) Bream Bay – supplying Northpower.

Figure 4. Northland schematic showing the key outage factors



Source: Transpower's 2023 transmission planning report – Chapter 7 (annotated)

7.2. Because of the way the grid was configured at the time, two Northland GXPs supplied from the Northland 110 kV network remained in service:

(a) Maungaturoto – supplying Northpower

(b) Wellsford – supplying Vector.

7.3. Figure 4 shows the grid configuration on 20 June and the key outage factors. This includes the planned outage of one of the two 220 KV circuits into Northland – Bream Bay – Huapai circuit 1 – and the consequent 110 kV system split in place on the two 110 kV circuits via Wellsford and Maungaturoto (discussed above).

Direct cause of the event was the collapse of a 220 kV transmission tower

7.4. The collapse of a 220 kV transmission tower on the Henderson – Marsden A line near the rural community of Glorit (HEN-MDN-A130 or tower 130), was the direct cause of the event (Figure 5).

Figure 5: Collapsed tower 130 near Glorit

Source: Transpower Investigation Report, Transpower, 26 July 2024

7.5. The collapse of tower 130 grounded the in-service circuit Huapai – Marsden circuit 1. Detecting a blue phase to earth fault, protection operations at Huapai and Marsden quickly and correctly tripped the circuit.[39]

7.6. The fact that one of the two 220 kV circuits (Bream Bay - Huapai circuit 1) was removed from service at the time of the tower collapse, and that Northland was on N security as a result, did not contribute to the cause of the event in any way. Should any tower on the Henderson – Marsden A line collapse at any time, regardless of asset outages and the prevailing security level, Northland would suffer a region-wide blackout.

What caused tower 130 to collapse?

7.7. The collapse of tower 130 was caused by the removal of first, the lock nuts and second, the hold down nuts from each bolt securing two of the tower's four legs (Legs A and B) to their foundations during planned maintenance work by Transpower's service provider, Omexom. The nuts were also removed from a third leg (Leg C), but it was the removal of nuts from Legs A and B, which were intended to resist tension forces, that compromised the stability of the tower, ultimately causing it to collapse.[40]

7.8. A maintenance crew of three people was working at the base of tower 130 at the time. The crew comprised a team leader and two trades assistants, who we refer to as the team leader, TA1 and TA2 respectively in this report, to protect the privacy of the individuals concerned and for consistency with the approach adopted in the Transpower Investigation Report.

7.9. The maintenance crew was working to refurbish the tower's four baseplates and their fixtures at the time of the tower collapse.

Nature of the work being carried out on tower 130

7.10. As with most towers on the Henderson – Marsden A line, tower 130's foundation is a concrete pile design with embedded hold-down bolts (eight bolts per baseplate for tower 130, other towers on the line may have less) concreted into the pile cap.

7.11. The base of each tower leg is welded to a steel baseplate through which holes are drilled to match the bolt locations. A washer, a hold-down nut and a lock nut fix the baseplate in place on top of the foundation pile.

7.12. The refurbishment work for tower 130 involved:

(a) digging out debris from one of the tower leg foundations

(b) sandblasting corrosion from the baseplate steel and the exterior of the hold down fixture

(c) removing the nuts and washer and sandblasting the revealed surfaces

(d) applying silicone sealant to the bolt voids, replacing the washer and re-tightening the nuts

(e) applying a steel protective treatment to all exposed sandblasted surfaces.

39 Transpower, *Protection and Automation Incident Analysis Report – HPI-MDN-1 Tripped on 2024/06/20 at 11:03*, 1 July 2024.

40 These were the findings of Beca Limited who provided specialist engineering advice to the Transpower Investigation. Beca's findings are summarised at paragraphs 6.33 and 6.34 of the Transpower Investigation Report.

7.13. Omexom does not, as a matter of course, obtain engineering assessments of each baseplate refurbishment job or series of jobs it is assigned by Transpower. The work order for this work did not specify that an engineering assessment was required, only that this work was to be to the relevant technical specifications. As we discuss in the following section, the service specification for baseplate refurbishment only identifies, in general terms, that foundation stability during maintenance work mustn't be compromised, and that tower loads need to be determined so as not to compromise the stability of the tower.[41] Omexom did not obtain an engineering assessment of tower 130.

7.14. A refurbished foundation is shown in Figure 6.

Figure 6: Refurbished tower foundation

Source: Transpower Investigation Report, Transpower, 26 July 2024

7.15. As noted above, work had commenced on tower 130 on 19 June 2024. All nuts were removed from the bolts on Leg D, and sandblasting was largely completed. The work was interrupted by inclement weather and finished early. The tower leg nuts were reattached before the crew departed. Leg D is the leg that remained bolted down at the time the tower collapsed the following day and ruptured.

Sequence of events on 20 June

7.16. The following is a sequence of events based on the findings of the Transpower Investigation Report, which was based on interviews with Omexom field staff involved in the event, and on further information provided by Omexom. We note that this sequence is largely based on interviews with the crew members following the event.

41 Transpower, *Maintenance and construction of steel towers and tower foundations*, TP.SS 02.11, Issue 3, December 2019, at paragraphs C4.1 – C4.2.

7.17. 20 June 2024 was the second day of work on tower 130. TA1 was assigned the tasks of clearing vegetation around the base of each leg, removing nuts and washers on the top of the baseplate, inspecting the bolts and baseplate holes for signs of corrosion, and, after sandblasting, applying sealant, tightening nuts and painting the steel. This was the first time TA1 had undertaken the task of baseplate nut removal by themselves without working directly with the team leader.

7.18. The team leader started by working with the crew to dig around Leg A. Once that was completed, the team leader started sandblasting. This required the team leader to wear PPE, including a helmet, and glass screen, which made it difficult to observe TA1 and TA2. TA2 was managing the sandblaster hopper and the line feeding sand to the equipment operated by the team leader as well as a line from an air compressor to the team leader's protective suit.

7.19. The sandblasting work started on tower Leg A, blasting the available surfaces, including the nuts then still attached to the Leg A bolts. During this time TA1 finished the digging work on Leg C to expose the baseplate.

7.20. When the sandblasting moved from Leg A to Leg C (diagonally opposite), TA1 removed the nuts (two nuts per foundation hold-down bolt) from Leg A (these were to be separately sandblasted). All 16 nuts were removed from Leg A.

7.21. When sandblasting on Leg C was finished, TA1 moved to Leg C (diagonally opposite Leg A) and removed all nuts from Leg C.

7.22. Sandblasting then moved on to Leg B and when that was finished TA1 removed all nuts from Leg B. We note Transpower's Investigation Report says there is some uncertainty as to whether all nuts above the baseplate were removed from Leg B. However, the Beca engineering investigation report found, having examined the condition of the bolts, that the baseplate lifted cleanly off the foundation indicating that all nuts had been removed.

7.23. We record that when we provided this sequence of events to Omexom for comment on the factual findings, Omexom suggested that there was some disagreement among crew members as to which trades assistant(s) removed nuts from Leg B. Omexom provided no evidence to support this suggestion, which is inconsistent with the findings in the Transpower Investigation Report, and nor was this raised when we met with Omexom in August to confirm, among other things, this sequence of events. For these reasons, we consider on balance that the better view is that it was TA1 who removed the nuts from Leg B. We note that we have not been given access to the notes from interviews with the crew members, or Omexom's draft ICAM report, which may have contained evidence to support this statement.

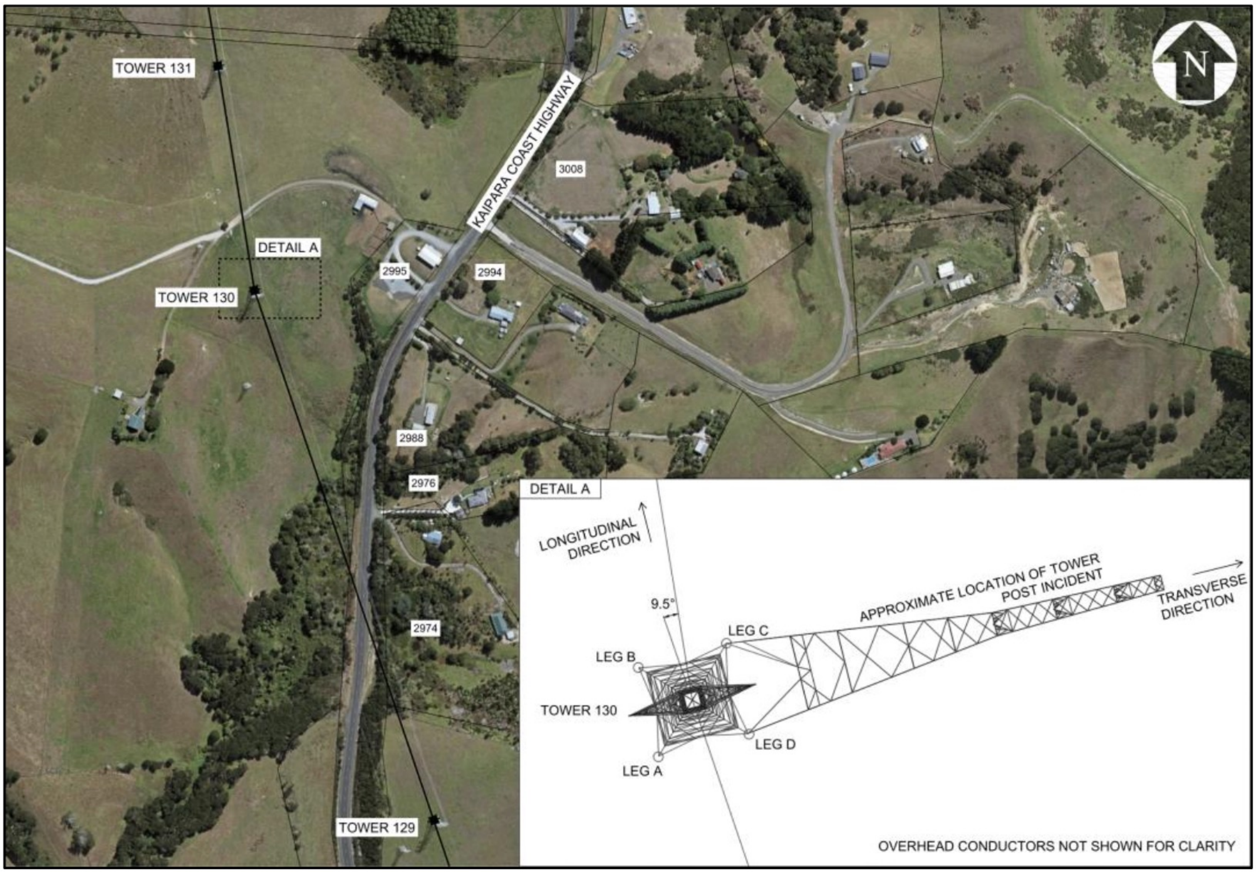
7.24. At this point, all nuts had been removed from Leg A, Leg C and Leg B (in that order). The team leader had moved to sandblast Leg D as it had not been completed to the required standard on the previous day.

7.25. The Beca engineering report's assessment is that the tower didn't fall immediately, presumably due to wind loading from the north-northeast at the time, counterbalancing the uneven loading due to different conductor weights and the line direction change angle.[42]

42 Transpower engaged Beca to provide expert engineering support to their investigation. Their assessment is contained in the Transpower Investigation Report starting at paragraph 6.30.

7.26. Shortly afterwards, possibly due to a drop in wind, the tower fell towards the east. When the tower started to fall, the team leader moved from their position at Leg D and ran away from the direction that the tower was falling. It is not clear precisely where TA1 and TA2 were in relation to the tower when it fell.[43] Fortunately, no one was physically injured when the tower fell.

Figure 7: Tower 130 location, leg references and longitudinal direction change



Source: Transpower Investigation Report, Transpower, 26 July 2024

7.27. Figure 7 shows that tower 130 is an angle suspension tower with conductors that form a 9.5-degree direction change between the two adjacent towers. This creates an obtuse angle in the line, carrying an 'interior angle' circuit (Huapai - Marsden circuit 1) on one side and an 'exterior angle' circuit (Bream Bay - Huapai circuit 1) on the other.

7.28. The tower also carried more conductor weight on one side, with duplex (ie. double) conductor carried on the 'interior angle' circuit but lighter simplex (ie. single) conductor on the 'exterior angle' circuit. Having a different number of conductors on each side of a double circuit line is rather unusual but not unique to the Henderson – Marsden A line.

7.29. The line geometry and unbalanced conductor loads meant the two tower legs beneath the interior angle (Legs C and D) were under compression, pushing against their foundations, while the two tower legs beneath the exterior angle (Legs A and B) were under tension, pulling away from their foundations.

7.30. The unbalanced forces on the two pairs of tower legs required hold down fixtures to be in place at all times, particularly on Legs A and B.

43 When we provided this sequence of events to Omexom for comment on the factual findings, Omexom noted that it is understood that one of the trades assistants was near Leg A taking photos of Leg A at the time. This information is not in the Transpower Investigation Report.

8. Underlying causes of the event

8.1. This review has sought to go beyond the direct cause of the event and determine whether there were any underlying causes or contributing factors in relation to the collapse of tower 130 and the loss of electricity supply to the Northland region.

8.2. The intent of this review, however, is not to apportion blame to individuals or entities. We note that Omexom is well regarded by Transpower and is considered to be a reliable and competent service provider, as is illustrated by their work on the response and recovery discussed in the following section.[44]

8.3. From the information and evidence reviewed for this report, we consider several factors contributed to the tower collapse:

(a) there was a lack of suitably qualified and trained workers undertaking the maintenance work on the baseplate foundation

(b) the supervision of the trades assistants undertaking the maintenance work on the baseplate foundation was inadequate

(c) Transpower's technical specifications and Omexom's work procedures for baseplate foundation maintenance did not identify risks of removing hold down nuts or provide a procedure for their removal

(d) Transpower's industry training (Grid Skills) on foundation maintenance did not address risks and procedures for removal of hold down nuts and in any event Grid Skills foundation training is not specifically mandated by Transpower

(e) Transpower's assurance processes do not include assessment of service provider work procedures to identify industry best practice. This has led to the development of different work procedures by service providers in different regions for the same work

(f) Transpower does not require service providers to submit 'during' photographs alongside 'before' and 'after' photographs at the completion of work at each site.

Maintenance crew working on tower 130 lacked adequate training

8.4. We have reviewed the training records for the three workers who were working on tower 130 on 20 June and the findings in the Transpower Investigation Report related to on-the-job training the workers received. All workers appeared to lack adequate training for their respective roles as they were performed on the day. The two trades assistants did not have the level of training that we would expect given the lack of direct supervision (discussed below). On the information provided as part of this review it also appears that the team leader, while having adequate training in baseplate refurbishment, lacked adequate training to effectively supervise the trades assistants' work.

44 See, for example, the comments from Transpower made on 23 June quoted in the Transpower Investigation Report at paragraph 7.30, and the observations made about the quality of work in comparison with other providers in the Transpower Investigation Report at paragraph 5.4.

Training received by TA1 and TA2

8.5. Neither TA1, who removed the nuts from the baseplates on tower 130, nor TA2 are recorded as having any formal training relevant to baseplate refurbishment specifically, or tower foundation work generally. Their relevant experience was therefore limited to on-the-job training.

8.6. TA1 had only worked on four baseplate refurbishments before tower 130, all in June 2024. TA1 could not recall what they were told to do in relation to nut removal on the day but described their approach to tower 130 'as just the usual process', and that it had been the sequence of work they had been shown on earlier jobs since they started baseplate refurbishment work earlier in the month.

8.7. TA2 had worked on significantly more baseplate refurbishments than TA1 (22 between October 2023 and June 2024). However, TA2 reported that while they had seen nuts being removed from tower legs at earlier jobs, it was never their task to do that. The Transpower Investigation Report records that on the day of the event TA2 saw TA1 taking the nuts off the first two tower legs (Legs A and C), but did not pay attention to what TA1 was doing after that and did not see the nuts from Leg B being removed, and it did not occur to TA2 that too many nuts might be being taken off.

8.8. We consider that the training TA1 and TA2 had received in relation to baseplate refurbishment was not adequate to enable them to carry out this work competently themselves, without adequate supervision. In this case, we consider adequate supervision would have required direct and continuous supervision, at least while tasks associated with a medium to high level of risk were undertaken, such as the removal of nuts from the foundation baseplates.

Training received by the team leader

8.9. The team leader did have documented training relevant to the work being undertaken at tower 130. They had been working on Transpower contract works for more than 10 years in two periods of employment with Omexom. They had completed relevant training for baseplate refurbishment, including Grid Skills courses relating to transmission lines and foundation work. This training was completed in 2014, but we note that there is no requirement for refresher foundations training.[45] The team leader also held a New Zealand Certificate in Electricity Supply (Transmission Line Maintenance) – a line mechanic qualification.

8.10. The team leader also received on-the-job training in baseplate refurbishment. They had worked on a total of 28 baseplate refurbishments between September 2023 and June 2024, before working on tower 130. The maintenance crew's supervisor directly supervised the first 18 baseplate refurbishments carried out by the team leader from September 2023 and remained part of the crew on site for five more jobs in December 2023.

8.11. The supervisor was interviewed as part of the Transpower Investigation and reported that they trained the team leader to remove all nuts above the baseplate from one leg at a time. The Transpower Investigation found that this was the service provider's standard practice for baseplate refurbishment in RSA1.[46] Omexom has accepted standard practice was not adhered to in relation to tower 130.[47]

45 Transpower's service specifications for minimum training and competency requirements specifies refresher training frequencies for certain competencies but this does not include foundations training. See: Transpower, *Minimum Training and Competency requirements for Transpower field work*, TP.SS 06.25, December 2022.

46 Transpower Investigation Report at paragraph 12.3.

47 Omexom New Zealand, *Omexom acknowledges Transpower commissioned investigation of transmission tower which affected Northland power supply*, 1 August 2024.

8.12. As this was 'on-the-job' training it was not recorded. The supervisor's recollection was, however, supported by another member of the lines team who stated that they were trained by the team leader and the supervisor to remove all nuts from one tower leg at a time. We note, however, that the team leader could not recall whether they had removed all nuts from more than one tower leg at a time on earlier occasions.

8.13. The team leader did not have any documented training or qualifications in site or worker supervision. Their relevant supervision experience was therefore limited to on-the-job training. Omexom's position is that the team leader received adequate in-person training and assistance prior to becoming a team leader, and was promoted only after they had been determined to be competent and suitable by their supervisor and Business Unit Contracts Manager. This followed observation of the Team Leader's abilities and attributes as a leader, including during the 22 occasions on which the team leader and supervisor worked together on baseplate refurbishments.

8.14. We acknowledge that the team leader is well regarded and was viewed by Omexom as a capable leader. We also accept that formal supervision training may not always be required if on-the-job training is demonstrably sufficient. Here, however, the findings set out above and directly below relating to the lack of appropriate supervision provided by the team leader suggests to us that they did not have sufficient training and experience to effectively supervise TA1 and TA2 and take full responsibility for the work being performed by them.

Maintenance crew working on tower 130 lacked appropriate supervision

8.15. The maintenance crew's supervisor was not on site when the work on tower 130 was undertaken, nor on any sites the team worked at during June 2024. Instead, the team leader's role was effectively to oversee the work of the trades assistants. We note that in Omexom's public statement on the event they refer to the team leader as the supervisor. Omexom has confirmed its view is that supervision of TA1 and TA2 was to be provided by the team leader, but this did not occur at the time the trades assistants were removing the nuts from the baseplates.

8.16. As explained in the sequence of events set out in section 7, the team leader was operating sandblasting equipment which impaired their ability to effectively oversee other activities on the site of tower 130, including the removal of the nuts on the tower leg's baseplates. Omexom accepts that sandblasting required the team leader's full attention.[48]

8.17. We agree with the findings of the Transpower Investigation Report that the work on the tower 130 site was not adequately supervised. We consider that this, combined with their lack of training, was a significant underlying cause of the event. Had the trades assistants been adequately supervised, or properly qualified to undertake the work without direct supervision, the tower collapse may have been avoided.

48 Omexom New Zealand, *Omexom acknowledges Transpower commissioned investigation of transmission tower which affected Northland power supply*, 1 August 2024.

Technical specifications and work procedures for baseplate refurbishment did not address removal of hold down nuts

Transpower's technical specifications

8.18. Transpower's technical specifications relevant to baseplate refurbishment include a drawing that specifies details for tower baseplate refurbishment, a 19-page service specification relating to maintenance and construction of steel towers and tower foundations, and a 220-page service specification relating to asset maintenance requirements for transmission lines, including steel towers and foundations.

8.19. None of these documents address the risks associated with the removal of hold down nuts. They do not specify how many nuts should be removed at a time from foundation baseplates, or in what order, and nor do they expressly prohibit the removal of nuts from multiple tower legs at a time.

8.20. We note that Transpower's service specifications for baseplate refurbishment do identify, in general terms, that foundation stability during maintenance work mustn't be compromised, and that tower loads need to be determined so as not to compromise the stability of the tower.[49] However, the work order for this work did not specify that an engineering assessment was required, and as we explain below, the Transpower Investigation Report identified differing views among Transpower and Omexom staff as to whether compliance with this service specification required an engineering assessment before undertaking baseplate refurbishment work.[50] In any event, it is evident that tower loads were not determined in this case.

Omexom work procedures

8.21. Transpower does not have a standard maintenance procedure for baseplate refurbishment. Instead, each service provider is responsible for developing their own work procedures which must comply with Transpower's drawings, service specifications and other applicable standards.

8.22. Omexom RSA1 (North Island) and Omexom RSA6 (South Island) developed separate procedures for baseplate refurbishments. The Omexom RSA1 work procedure for this work (used for tower 130) specifies that when preparing the baseplate, hold down nuts and washers must be removed, anchor bolt voids, bolt threads, nuts and washers sand blasted if corrosion is present, and sealant applied to bolt voids. However, like Transpower's documents, the work procedure does not specify the number of hold-down nuts and lock nuts to be removed at any one time, nor does it specify that nuts should only be removed from one leg at a time.

8.23. Omexom's work procedure prepared for a specific team leader in RSA6 is significantly different. It specifies a detailed sequence for removing baseplate nuts as follows:

> 1 man sets up blaster and gates on A leg, 1 man removes ½ the nuts from A leg
>
> 1 man blasts ½ the nuts on A leg, 1 man removes ½ the nuts on B leg
>
> 1 man blasts ½ the nuts on B leg, 1 man replaces nuts on A leg and removes the other nuts on A leg

49 Transpower, *Maintenance and construction of steel towers and tower foundations*, TP.SS 02.11, Issue 3, December 2019, at paragraphs C4.1 – C4.2.

50 Transpower Investigation Report at paragraph 4.41(b).

1 man blasts the remaining nuts on A leg, 1 man replaces nuts on B leg and removes the other nuts on B leg

1 man blasts the remaining nuts on B leg, 1 man moves the gates from A leg to C leg and removes ½ the nuts on C leg

1 man blasts ½ the nuts on C leg, 1 man moves the gates from B to D leg and removes ½ the nuts on D leg

1 man blasts ½ the nuts on D leg, 1 man replaces nuts on C leg and removes the other nuts on C leg

1 man blasts the remaining nuts on C leg, 1 man replaces nuts on D leg and removes the other nuts on D leg

…

Transpower training did not address risks and procedures for removal of hold down nuts

8.24. The Grid Skills training on foundation work did not cover critical areas relevant to the direct cause of the collapse of tower 130. Had this gap been addressed earlier, the event may have been prevented.

8.25. Grid Skills offers a foundations training course. This had previously been run as a three-day block course (which ran once in 2019 and twice in 2021). In 2023 this was replaced by three online e-learning modules and an on-the-job assessment.

8.26. The Grid Skills foundation course does not provide clear guidance on baseplate refurbishment and does not cover details such as:

(a) the number of nuts to be removed at one time

(b) the number of tower legs to be worked on at one time

(c) risks to tower stability and how work should be carried out to ensure structural stability is maintained at all times.

8.27. Other Grid Skills training courses are also relevant to tower foundations, such as the Grid Skills Tower Structure Maintenance Course. However, no training courses provided by Grid Skills directly address the above matters.

8.28. We agree with the conclusion of the Transpower Investigation Report that the content of the Grid Skills foundations course was and is inadequate for the purposes of baseplate refurbishment work.[51] Knowledge of foundation refurbishment and the proper methods for conducting this work on Transpower assets is essential for those involved. However, we do not agree with the Transpower Investigation Report's conclusion that these inadequacies were not causative and could not have contributed to the Northland event.

51 Transpower Investigation Report at paragraph 8.25.

8.29. If the risks to tower stability and the methodology that should be employed when removing nuts from foundation legs had been included in foundation training, the team leader working on tower 130 on 20 June would have had this training (they completed the foundation course in 2014). It is also more likely that service providers would have ensured this was included in their work procedures and highlighted the importance of these issues to the workers undertaking this work during on-the-job training.

Identified concerns relating to baseplate refurbishment had not been acted on

8.30. In 2021, a senior Transpower engineer identified a gap in the knowledge of the maintenance crews undertaking foundation work, including baseplate refurbishment work. That engineer asked another Transpower employee whether it would be possible for Grid Skills to organise and plan training sessions for foundation work. The recommendation was for all new crew members to have a full course, with refreshers every 12 months.

8.31. The senior engineer at Transpower followed up with a further email a few days later asking if there were any updates as '[w]e are eager to put together a training program prior to this year's baseplate refurbishment'. There was no response to this email and the training programme suggested was not implemented. When we queried Transpower's failure to action the concerns raised, Transpower said that there was little demand from service providers for the training, and Covid-19 related restrictions on in-person gatherings resulted in more training being transitioned to online training. This is not, in our view, an appropriate response to an identified lack of knowledge in lines mechanical crews that are carrying out maintenance work on critical assets such as transmission towers.

8.32. If this identified gap in knowledge had been acted on, and all new crew members were required to undertake the course, TA1 and TA2 may have received formal training (as opposed to on-the-job training) which may have covered critical elements such as tower stability and the number of nuts to be removed at any one time.

Transpower does not require completion of Grid Skills foundation training or refresher training

8.33. We've found above that the Grid Skills foundation training course was inadequate for the purposes of baseplate refurbishment work. However, even if it had properly addressed the risks and proper procedure for this type of work, Transpower does not require this particular training course to be undertaken before this type of work is carried out. Transpower has advised that it does require foundations training to be carried out before a person is deemed competent to carry out foundations work (whether provided by Grid Skills or otherwise). However, this is not apparent from the relevant service specifications, which simply records that the minimum requirements are 'relevant work task competencies and competency certificate'.[52]

8.34. In this case, the team leader had undertaken Grid Skills foundation training ten years ago. While Transpower's minimum training and competency requirements set a frequency for refresher training for certain competencies, this does not include a refresher requirement for foundation training. Had the Grid Skills foundation training adequately addressed baseplate refurbishment, and had refresher training been required before the team leader commenced the baseplate refurbishment work in September 2023, they would have had this training.

52 Transpower, *Minimum Training and Competency requirements for Transpower field work*, TP.SS 06.25, December 2022, section 2.2.

Transpower's assurance processes do not include work procedure assessments

8.35. Transpower does not approve, or routinely assess service provider work procedures. Rather, Transpower's view is that it is the service provider's responsibility to ensure its work procedures meet all applicable technical specifications. This means that service providers in different regions formulate different work procedures for the same work.

8.36. Work procedures are reviewed by Transpower auditors during field audits, but in a limited way. This includes establishing whether:

(a) work procedures are on site and relevant for the work being carried out

(b) work practices comply with service specifications, work procedures and safety systems.

8.37. Service provider work procedures are not assessed by Transpower at any point to determine whether they cover relevant risk areas or properly set out the correct methodology for the work to be undertaken. Transpower has told us that field audits are completed by experienced personnel who apply judgement in relation to the fit for purpose nature and potential risks arising out of work practices and procedures it observes. It points to an example where an auditor identified a work procedure needed to be adjusted to align with a new Transpower drawing.

8.38. It is unlikely that a review of Omexom's work procedure for baseplate refurbishment in RSA1 in isolation during a field audit would have identified any relevant issues with the work procedure itself. As noted above, it did not address the removal of nuts from the foundation baseplates, but neither did Transpower's technical specifications. It was not, therefore, inconsistent with any technical specifications.

8.39. However, had Transpower reviewed the different service provider work procedures for the same work together, or even if it had reviewed the different work procedures used by Omexom in different regions, it would have identified that there signficant differences in work procedures and no clear best practice approach.

8.40. In this case, the work procedure used by Omexom in RSA1 did not specify a procedure for removing the nuts from the baseplates, while the procedure prepared for a specific team leader in RSA6 contained a clear process that involved removing half the nuts from two legs at one time (see paragraph 8.23). Meanwhile a work procedure for baseplate refurbishment developed by another service provider, Ventia, specified that the hold down nuts are to be loosened 'one at a time'. We agree with the Transpower Investigation Report that this implies that one nut is to be checked, refurbished replaced and sealed before moving to the next. None of these work procedures were identified in field audits as being deficient in respect of the process for removing hold down nuts.

8.41. Reviewing the different work procedures for this type of work would have provided an opportunity to develop a best practice procedure for all service providers to follow as well as an opportunity to identify room for improvement in Transpower's own technical specifications.

Transpower's assurance processes do not include 'during' photographs

8.42. Transpower's assurance processes do not require 'during' photos to be provided to Transpower as a matter of course after the completion of each job. Only 'before' and 'after' photos are uploaded to Transpower's information system, Recollect. Other records of baseplate refurbishment work required by Transpower similarly focus on the outcome of the work rather than the work method and process followed during the work. Photographs are, however, taken during work by Omexom as part of its own quality assurance processes.

8.43. The Transpower Investigation Report concluded that photos taken by Omexom during baseplate refurbishment work completed in RSA1 and obtained by Transpower after the event show that a practice of removing all nuts from one tower leg at a time had been employed least since October 2023.[53] Close analysis of photos and their metadata from earlier in June 2024 also suggested that all or most of the nuts were removed from multiple legs at the same time.[54] This suggests that the practice of removing the nuts from more than one tower leg was not an isolated one-off event on 20 June.

8.44. While the 'during' photographs were taken in this case, a general requirement by Transpower that these be provided and a corresponding expectation that Transpower review such photographs would provide an opportunity for Transpower to identify any obvious hazards, risks or departures from good industry practice that are observable from such evidence.

53 Transpower Investigation Report at paragraph 5.13.

54 Transpower Investigation Report at paragraph 6.45.

9. Response and recovery

9.1. The maintenance crew working at tower 130 were uninjured by the event. They communicated the situation to Omexom management, who contacted Transpower's National Grid Operating Centre (NGOC) at 11.11am.

9.2. In line with standard protocol, Omexom management stood the maintenance crew down and, as Omexom (under a separate contract) is also the emergency response provider covering Northland, called an emergency response team to the site to assess the situation.

9.3. Responding to the event, the security coordinator at Transpower's National Coordination Centre (NCC) issued a verbal grid emergency notice (GEN) at 11.17am. This was followed up by a written notice at 2.41pm. The GEN was initially estimated to end at 6.00pm on Friday 21 June, but was revised several times, finally ending at 4.00pm on Sunday 23 June 2024.[55]

9.4. Declaring a grid emergency provides the system operator with powers to:

(a) stabilise and reconfigure the grid to balance available generation capacity with consumer demand

(b) coordinate the actions of all parties necessary to assess the situation, plan and implement a recovery plan to restore service progressively and safely, while minimising the impact of the emergency on consumers and asset owners

(c) take any reasonable action to alleviate the grid emergency.[56]

9.5. With the collapsed tower deemed unserviceable by onsite responders, quickly restoring either or both 220 kV circuits into the region was discounted as an initial option.

9.6. Figure 4 shows that the 110 kV double circuit line from Henderson to Maungatapere is the only alternative transmission line into the region. The system operator maintains a prepared step-by-step contingency plan designed for use if both 220 kV circuits become unavailable for service.[57] The contingency plan closely fitted the needs of the situation and was promptly put into action.

9.7. The contingency plan anticipates that the two 110 kV circuits have a limited capacity to supply the entire Northland region in all conditions. A balance must be maintained between:

(a) consumer demand across all in-region GXPs and

(b) capacity from regional distributed generation, which augments the capacity provided by the two 110 kV circuits.

55 In relation to system operator coordination (at NCC) and national grid operations (at NGOC), the main references for the response and recovery phase are (1) the *System operator preliminary report: Northland loss of supply, version 1.0, 5 July 2024 and (2) Northland loss of power supply, 20 June 2024 – Investigation into the operational performance of the System Operator, Grid Owner and other relevant participants*, Ray Hardy, 30/08/2024 (a report for Transpower available on Transpower's website).

56 Technical Code B (Emergencies) of Schedule 8.3 of the Code.

57 PR-CP-638/V3 Northland Region via 110 kV Contingency Plan issued 18 January 2024.

9.8. Table 3 identified distributed generation with significant capacity in the region. This includes the geothermal station at Ngāwhā, Kohirā (Lodestone's new solar farm) at Kaitāia, Top Energy's diesel generators near Kaitāia, Manawa's diesel generators at Marsden, and Vector's BESSs at Snells Beach and Warkworth South, along with some smaller distributed generation.

9.9. Following the restoration plan and coordinating the available capacity enabled NCC coordinators and NGOC controllers, along with local distribution and distributed generation operators, to progressively re-liven networks in the region via the 110 kV network from Henderson, with supply reaching:

(a) Maungatapere at 11.38am, 35 minutes after the tower collapsed, with Maungatapere demand limited by NCC to 20 MW

(b) Marsden 110 kV and 220 kV busses at 12.16pm, enabling the Marsden voltage control plant to restart

(c) Bream Bay at 12.28pm, limited to 10 MW

(d) Kaikohe at 12.47pm, limited to 10 MW and, subject to Top Energy operations, allowing Far North distributed generation at Ngāwhā and Kohirā to restart.

9.10. Local distributors Top Energy and Northpower managed the load limits allocated by NCC to progressively restore supply to their consumers and connection to local distributed generation throughout their respective distribution networks.

9.11. Vector had not lost supply at Wellsford, nor Northpower at Maungaturoto, because the 110 kV system split was in place, with open circuit breakers at Maungatapere, isolating Wellsford and Maungaturoto from the widespread loss of supply affecting Northland.

Initial recovery over the afternoon and evening of 20 June

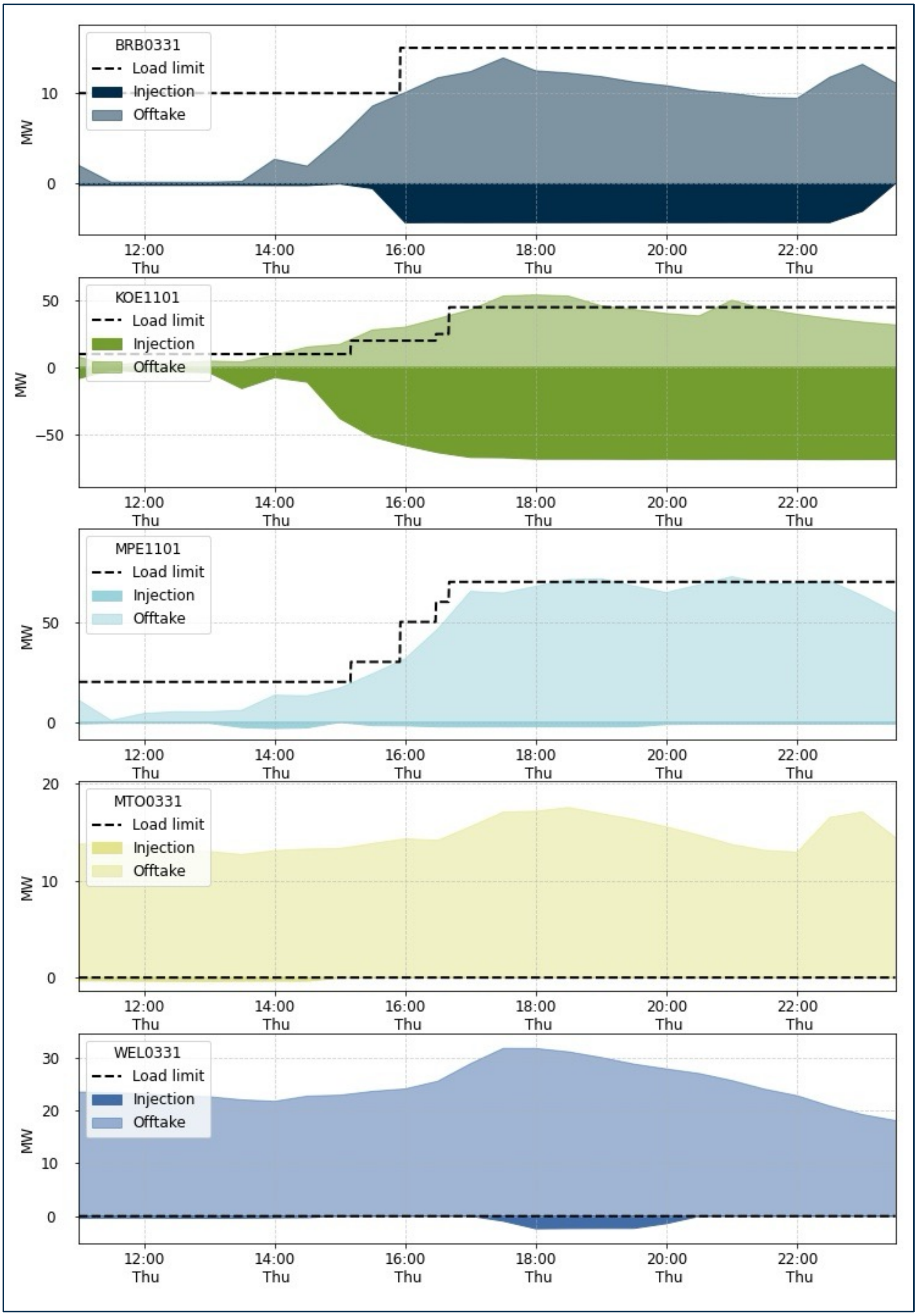
9.12. Figure 8 shows the load (offtake) and distributed generation (injection) at affected Northland GXPs along with the load limits allocated by the system operator to balance available supply with demand as the recovery progressed through the afternoon and into the evening peak. Note that the load limits apply to the net offtake at the GXP, ie, the offtake minus the injection.

9.13. Injection from distributed generators into each GXP is broken down by plant in Table 7, showing generation capacity in MW and as a percentage of peak GXP load.

9.14. Load limits remained in place until 2.21pm on 23 June, when the first 220 kV circuit was restored following the installation of an emergency tower. With a winter capacity of 298 MW, the restored 220 kV circuit relieved all constraints throughout Northland that had existed under the temporary 110 kV supply configuration.

9.15. Figure 8 shows that the distributors were able to adhere to their allocated load limits for the most part.

Figure 8. Load (offtake) and generation (Injection) at Northland GXPs with load limits where relevant



Source: Reconciled data, system operator log.
Note: A 0 MW load limit means "no limit set at the indicated time".

Table 7. Northland distributed generation by GXP

GXP	Substation name	Plant	Capacity	Generation capacity as percent of GXP load (MW)
KOE1101	Kaikohe	Ngāwhā geothermal	57	87%
		Kohirā solar	24	37%
		Top Energy diesels	14[58]	21%
MPE1101	Maungatapere	Wairua Falls hydro	5	5%
BRB0331	Bream Bay	Manawa diesels	4.5[59]	25%
WEL0331	Wellsford	Vector BESS	5.9	15%

Source: Transpower's 2023 transmission planning report – Table 7-2 and owner information

9.16. Top Energy had some difficulty measuring aggregate net load correctly at Kaikohe. Transpower was able to check Top Energy's net load on request, enabling Top Energy to keep within its net load allocation.

9.17. An unexpected issue arose in the afternoon: Ngāwhā's B station[60] tripped at 2.14pm, losing 17.5 MW of distributed generation capacity from the closely balanced network. The 110 kV circuits from Henderson immediately took up Ngāwhā's lost output, increasing to 120% of their N-1 circuit ratings. In response, NCC requested that Northpower hold its current load level at Bream Bay but limit Maungatapere offtake to 10 MW.

9.18. The N-1 violations highlighted by the loss of Ngāwhā B prompted a review of the decision to operate the two 110 kV circuits at N-1 security. In simple terms, N-1 security limits the aggregate load the two circuits are permitted to carry to the maximum capacity of one circuit. This avoids overloading the second circuit if one circuit should trip.

9.19. The alternative, operating the two parallel circuits at N security by loading them to their full capacity, would unlock another approximately 68 MW of capacity for supply to Northland consumers but increase the risk of a total loss of supply to the region should one of the two circuits trip. Line protection settings also need to be considered.

9.20. At 2.34pm, with both the system operator and the grid owner considering the option, Transpower grid owner and system operator managers made the decision to operate the 110 kV circuits north from Henderson at up to their N security ratings.

58 Approximately 14 MW are used as backup when Top Energy maintains its single 110 kV line feeding Kaitaia and can also be used to help out in times of market stress such as on 20 to 23 June. There are another 4 MW or so in more remote locations that are only used during faults or planned line work in the area.

59 The original installation was 5 x 1.8 MW units, but this has been affected by unit failures and deratings. At the date of the event, the 3 serviceable units were capable of 4.5 MW in total.

60 There are two parts to Ngāwhā geothermal, an A station and a B station.

9.21. The system operator log stated: "*Discussion and decision around running the remaining system at N. Executive directive that we do what we can to supply Northland with as much capacity as possible.*"

9.22. Initially, Transpower protection engineers advised that if one of the 110 kV circuits should trip the other would automatically trip on overload, protecting it from damage and removing any safety concern (but also blacking out the region again).[61]

9.23. Load limits at Northland GXPs were regularly updated through the afternoon. While Ngāwhā B restarted at 3.12pm and commenced ramping up, moving to operate the 110 kV circuits at N security provided a material block of capacity to assist with meeting as much of the evening peak demand as possible.

9.24. Northland went into the Thursday evening peak with load limits of:

(a) 70 MW at Maungatapere – as compared to the actual load of 102 MW the previous Thursday evening

(b) 15 MW at Bream Bay as compared to the actual load of 18 MW the previous Thursday evening

(c) 45 MW at Kaikohe as compared to the actual load of 66 MW the previous Thursday evening

(d) no specific limit at Maungaturoto – the actual load was 19 MW the previous Thursday evening

(d) no specific limit at Wellsford. NCC expected this would provide around 31 – 32 MW for Wellsford.

9.25. With the Thursday evening peak over, NCC considered, but later abandoned, an operational reconfiguration aimed at enhancing security.[62]

9.26. At 6.38pm on Thursday the following load limits were confirmed for the Friday evening peak:

(a) 75 MW at Maungatapere

(b) 15 MW at Bream Bay

(c) 45 MW at Kaikohe

(d) 15 MW at Maungaturoto

(e) no specific limit at Wellsford. At that time, the system operator's log noted that Vector had been asked to use best endeavours to hold Wellsford load as low as possible without shedding 'real load'.[63]

9.27. Subsequent days also saw significant actions being taken by the system operator, local distributors and distributed generators to maximise capacity and maintain security of supply into the region. These are set out below.

61 If overhead conductors overload, they heat up and expand, risking sagging too close to the ground and creating a safety risk.

62 The Hardy Report, page 16, provides more detail on the consideration given to 110 kV circuit loadings and off-load times, a 110 kV reconfiguration, and protection settings aimed at enhancing regional security.

63 In contrast with 'controllable load', which mostly applies to electric hot water cylinders and was utilised by all local distributors to reduce load, shedding 'real load' means switching consumers off at the distribution feeder level, which would blackout whole neighbourhoods and/or rural areas.

Timeline of key events from 21 through 26 June

9.28. The following timeline is from the system operator's logs.

The protection related analysis and updating of settings over 21-22 June was intended to enhance the security of the 110 kV circuits and avoid further disruption of Northland supply.

Date	Time	Description of events
21 June	10.35am	The GEN was extended to 11.59pm on 22 June.
	3.04pm	Transpower protection engineers advised that automatic tripping of the remaining 110 kV circuit was unlikely with the existing protection settings if one of the 110 kV circuits tripped. Pending new settings being applied, NCC gave delegated authority to NGOC to manually switch out the remaining circuit, to clear the overload, if one of the circuits should trip.
	5.55pm	The new temporary protection settings were applied to the 110 kV circuits (but inactivated), with testing to be carried out later that night when load was lower.
22 June	1.10am	The new protection settings on Henderson – Maungatapere circuit 1 were activated
	2.24am	The new protection settings on Henderson – Maungatapere circuit 2 were activated
	5.53am	NCC rescinded the delegated authority to NGOC regarding manual switching out of the 110 kV circuits.
	2.00pm	Ngāwhā discussed with Top Energy and NCC their wish to take Ngāwhā offline prior to the reconnection of the first 220 kV circuit. (This was to avoid the risk of damaging a generation unit due to the sudden associated phase shift that is felt as a 'bump on the system' by synchronous generation units.)
	7.12pm	The GEN was extended again to 11.59pm on 23 June.
23 June	12.00pm	Ngāwhā, Northland distributors, NGOC and NCC discussed and agreed on the plan for reconnecting the first 220 kV circuit (planned for 2.00pm) and coordinating the temporary shut down of Ngāwhā while 220 kV switching was carried out.
	2.16pm	The first 220 kV circuit into Northland (Bream Bay - Huapai circuit 1) was reconnected via the emergency tower, enabling all load restrictions to be lifted, but still at N security.
	4.00pm	The grid emergency was declared ended.
26 June	6.18pm	The second 220 kV circuit (Huapai - Marsden circuit 1) was reconnected, restoring Northland to N-1 security.

Grid owner's onsite and incident management teams' responses

9.29. The immediate priority for Transpower in its role as grid owner following the collapse of tower 130 was to ensure that no member of the Omexom maintenance crew had been harmed in the event. Once this was confirmed, the next objective was the reinstatement of supply to Northland.

9.30. A 220 kV circuit would alleviate the constrained supply situation through the 110 kV network and restore Northland capacity to allow supply to meet all local consumer demands at N security that existed just before tower 130 collapsed. The plan was to reinstate initially one, then both, 220 kV circuits as quickly and safely as possible following the collapse of tower 130.

9.31. Restoration of a 220 kV circuit following the collapse of tower 130 required the construction of a temporary structure under emergency conditions. This required a significant coordinated effort from many resources working in parallel.

9.32. To enable this coordinated response, the grid owner established an incident management team (GOIMT), and an executive incident management team (EIMT). The GOIMT provided guidance for the operational response to the incident and restoration, while the EIMT provided high level guidance and support for Transpower and engagement with stakeholders.

9.33. The EIMT and GOIMT met frequently, multiple times a day, to manage the response. The meetings covered a range of issues including:

(a) restoration options

(b) engagement of Omexom under the Emergency Structure Contract to carry out the response and recovery work

(c) engagement of Lumen, an engineering consultancy firm, to provide the design for the Lindsey tower (Lindsey towers are temporary structures that can be rapidly installed to provide circuit support for fallen circuits)

(d) assessments of ongoing grid asset work in other locations and whether that work could impact restoration efforts and may need to be halted

(e) transportation to site, detailed design and installation of the Lindsey tower

(f) discussions around running the 110 kV lines on N security, with engineering review sought and assessed

(g) regular progress updates.

9.34. The first circuit (Bream Bay - Huapai 1) was reinstated using a Lindsey tower at 2.16pm on Sunday 23 June. The Lindsey tower is the tall structure at the right in Figure 9.

9.35. The second 220 kV circuit (Huapai - Marsden 1) was reinstated using pole structures at 6.18pm on Wednesday 26 June. The three side-by-side poles are at the left in Figure 9.

9.36. Lindsey towers are packed in containers, ready for quick deployment to emergency sites. Transpower holds twelve Lindsey towers normally spread across four locations throughout the country. Of the six normally held in the North Island, three were available, as the other three were already in use due to damage caused by Cyclone Gabrielle.

9.37. Of the two North Island Lindsey towers remaining available after the tower 130 incident, one is currently located in Auckland, and one at Bunnythorpe, near Palmerston North.

9.38. This approach—storing the towers in containers and dispersing them geographically—was adopted following lessons learned from an earlier incident at Ruakura. For the Northland event, the Lindsey tower arrived on-site even before site access was fully established.

Figure 9.Temporary 220 kV circuit structures

Source: Transpower Investigation Report, Transpower, 26 July 2024

Impact on consumers and distributors

9.39. Figure 10 summarises the consumer impact on a timeline that shows key events in the top panel, the number of disconnected consumers in the middle panel, and compares the load that was able to be supplied during the event with the week prior in the bottom panel. The bottom panel enables us to estimate the quantity of electricity that wasn't consumed because of the outage. This estimate forms the basis for calculating the value of lost load.

9.40. The middle panel shows the number of disconnected consumers, starting at approximately 88,000 and dropping sharply as consumers were progressively reconnected throughout the afternoon and evening of 20 June. The middle panel also shows that a small number of consumers were able to be reconnected prior to 12.47pm when the 110 kV circuits were restored. This restoration was possible due to Manawa's diesel backup generation connected to Northpower's 33 kV Bream Bay network. Almost all consumers were able to be restored after evening load limits were set, although a small number of Top Energy consumers remained without power due to issues within Top Energy's network.

9.41. Immediately following the tower collapse, 163 MW of consumer supply was lost.[64] From Friday 21 June through to restoration of the first 220 kV circuit which enabled full load to be met without restriction, load was reduced by an average of 14 MW over the same period in the prior week or approximately 9%. This led to a reduction in energy consumed over the whole event of 1,877 MWh giving an estimated value of lost load of $37.5 million

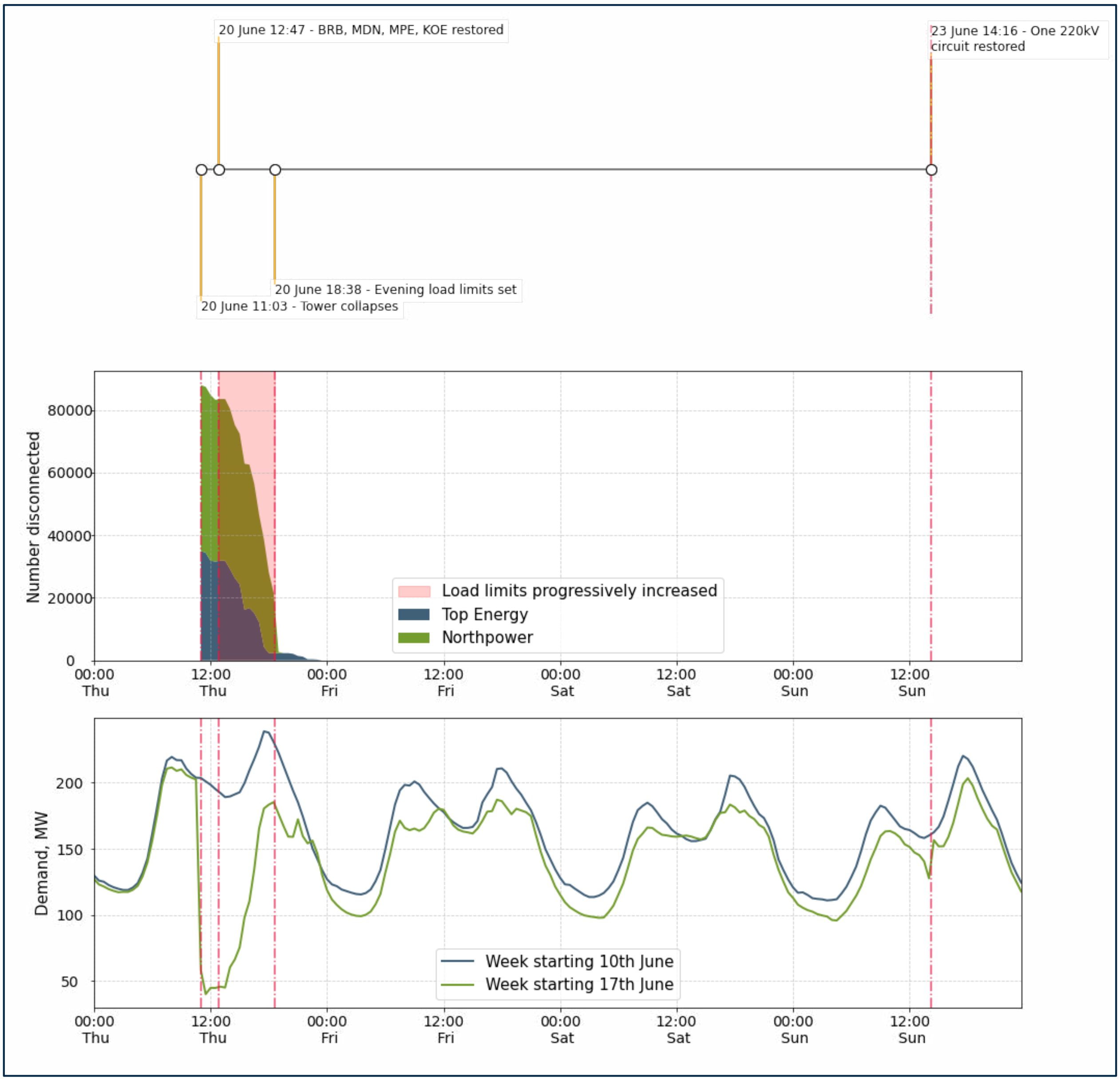
What is VoLL

VoLL stands for 'value of lost load' and is a way to put a dollar value on the electricity that people miss out on during a power outage, whether it's planned or unexpected. It measures how much it costs, in economic terms, when electricity doesn't reach homes or businesses. The value is shown as a dollar amount for each MWh (1,000 kWh) of electricity that isn't delivered during the outage. VoLL is currently specified in the Code as being $20,000/MWh, which is equivalent to $20/kWh. Note: in this report we also use the term VoLL to refer to the total economic cost of an outage in dollars.

9.42. The impact extended past the point when most consumers were reconnected. Several businesses that are large consumers of electricity were not able to recommence full operations until the first 220 kV circuit was reconnected at 2.16pm on Sunday 23 June 2024.

64 Based on reconciled data.

Figure 10. Event timeline, consumer disconnections and lost load



Source: Reconciled data, Top Energy and Northpower data, system operator log.

We spoke with Top Energy, Northpower and Vector to get their perspectives on the event.

Top Energy

9.43. Reconciled generation data indicates that Top Energy's diesel generators at Kaitāia were able to start at approximately 11.45am and supply some local load before the Kaikohe 110 kV bus was re-livened.

9.44. Once Top Energy realised the interruption was a Transpower grid issue, its operators set up its distribution network for restoration. This set up was based on a prepared plan.

9.45. After re-livening the Kaikohe 110 kV bus at 12.47pm, Top Energy was able to progressively restore its network. The diesel generators at Kaitāia were synchronised with the grid and helped keep Kaikohe under its load limit. Likewise, once Ngāwhā was restarted, its output further helped to keep Top Energy under its load limit at Kaikohe, and over time allowed the load limits to be relaxed. Northpower confirmed that Ngāwhā also enabled Northpower's allocated load limits to be increased, demonstrating Ngāwhā's regional importance. In simpler terms the distributed generation allowed for more people to be reconnected faster.

9.46. Top Energy reported that communications with Transpower were effective, and that they were able to reconnect customers up to their allocated load limits.

9.47. Figure 8 shows that Top Energy exceeded its load limit at Kaikohe at times. This was due to issues with its Supervisory Control and Data Acquisition (SCADA)[65] system that were identified and remedied.

9.48. The problem with Top Energy's SCADA system meant it was temporarily unable to monitor aggregate load at the Kaikohe 110 kV bus. While attempting to comply with load limits advised by NCC via NGOC, Top Energy became aware that Transpower's limit for the Top Energy load was different to the values Top Energy was calculating and using.

9.49. Once Top Energy became aware of this, its controllers worked with NGOC to regularly monitor the Kaikohe 110 kV net load according to Transpower's calculation, to comply with its allocated load limits.

9.50. In parallel with this measure, Top Energy contacted the system operator who advised the calculations behind the value that Transpower was monitoring, and Top Energy created a similar calculation within its SCADA system. Top Energy compared results with NGOC, then made the new internal calculated load total available to Top Energy controllers to use from early on Friday morning 21 June.

Northpower

9.51. Once Northpower realised that this was a Transpower grid issue, it began to prepare its distribution network for restoration. Northpower was able to use its prepared 'three-day' plan for restoration, which meant contacting the hospital and civil defence, and preparing for rolling outages should capacity prove to be scarce over the daily peak demand periods.

9.52. Northpower commented that while they received regular updates from Transpower, they first learned about the cause of the outage through social media (rather than Transpower).

9.53. Once generation from Ngāwhā stabilised, the grid was in a balanced state and restoration of supply and connections started. This can be seen in Figure 8 where load was progressively reconnected at the Maungatapere 110 kV bus. Northpower's ripple controllable load, in addition to Ngāwhā generation were key resources to maximise the amount of capacity available for all consumers.

65 SCADA systems are used by transmission and distribution operators to (a) provide network asset (eg circuit, transformer) status, voltage and current indications and (b) exercise remote control of switchgear, such as circuit breakers.

Vector

9.54. Vector takes supply from the 110 kV network at the Wellsford GXP. Vector has a battery energy storage system (BESS) at three locations connected to Wellsford through their network: Snells Beach (2.75 MW), Warkworth South (2 MW), and Taparoa (1.14 MW).

9.55. Vector staff noticed a 'dip on the lights' that coincided with a fault on the 11 kV network at Glorit at 11:03 am on 20 June. The cause was initially unknown but was subsequently confirmed by Vector's fault response crew as a transmission line that had fallen on Vector's 11 kV line. Because the 110 kV split was in place, the Wellsford GXP was unaffected and remained energised from Henderson. Vector customers continued to take supply and local distributed generation remained connected.

9.56. Vector was critical of Transpower's operational communications in the early stages. Vector called Transpower and was told that a tower had fallen across the state highway at Kumeu, which was the wrong location. Vector identified the location as Glorit, which was confirmed when Vector's crews arrived at the location of the 11 kV fault.

9.57. Vector also noted the parallel communications paths between Vector and Transpower that were giving different information. The first path was control room to control room and the second was a path from a Vector senior manager to Transpower's EIMT.

9.58. Transpower's view is that it is well understood that control room to control room communications take precedence, and that control room staff were in regular contact with one another and had all relevant information.

9.59. Vector has advised us that the parallel communication paths resulted in Vector receiving conflicting information. It was informed by Transpower that they may need to shed load on the evening of the failure and going forward. On the afternoon of the failure, Transpower informed Vector that they would be putting out a customer communication update about conserving power but not mentioning load shedding and asked Vector to in turn advise their affected customers. Vector asked Transpower why they were not including messaging on the potential for load shedding as it believed the transparency about possible outcomes was important for customers. After the feedback, Transpower added that messaging to their draft communication. Vector advised us that by late afternoon it had still not received any communications update to be able to advise customers of the potential for load shedding despite several follow up calls. Transpower's public media release was issued at 5.52pm; this was the first public communication from Transpower that Vector could reference for its communications to customers.

9.60. As evening peak approached, Vector had still not heard from Transpower as to whether they were in fact required to shed load. Vector management then rang Transpower management who said they thought Vector had been instructed to shed load. When Vector said they had not been asked but wanted to make sure they hadn't missed an important communication, Transpower management checked with the system operator and confirmed that Vector did not need to shed load.

9.61. The outcome was that Vector received conflicting information which caused confusion and had to clarify it with Transpower. They were advised that they may have to do some load shedding—and then prepared to do that—but were never asked to do any load shedding. Vector was not assigned GXP load limits for the Wellsford GXP.

Distributed generators

9.62. We spoke with Manawa Energy (Manawa), Ngāwhā Generation Limited (NGL), Lodestone Energy Limited (Lodestone) and Vector (as a distributed generator) to get their perspectives on the event.

Manawa Energy

9.63. Manawa Energy has three diesel generation units connected to Northpower's distribution network, which in turn connects to the grid at the Bream Bay 33 kV bus. The generation units have an aggregate capacity of 4.5 MW.

9.64. In the period before the Bream Bay bus was re-livened from the grid, the diesel units were started and used to reenergise a nearby Northpower zone substation that provided supply to a limited number of Northpower consumers. Once Bream Bay was livened from the grid, the diesels ran reliably, mostly during the daytime, until both 220 kV circuits were restored on 26 June.

Ngāwhā Generation Limited

9.65. The Ngāwhā A and B geothermal stations lost their network connection at 11.03am on 20 June causing all four generating units to shut down. By the time power was restored to the Kaikohe 110 kV bus at 12.47pm on 20 June, the geothermal units had been offline for long enough to cool down, and they required warming before restarting. NGL restarted the units one at a time from approximately 1.30pm.

9.66. As set out above, Ngāwhā and other generators in Top Energy's area supported load in Northpower's area by relieving congestion on the two low-capacity 110 kV circuits from Henderson to Maungatapere.

9.67. Ngāwhā decided to shut down prior to Transpower reconnecting the first 220 kV circuit to protect its plant from the sudden accompanying phase shift that is felt as a 'bump on the system'. Ngāwhā was able to shut down in 10 minutes, which is much faster than it would normally do. This was to minimise disruption to consumers.

9.68. With the first 220 kV circuit reconnected, Ngāwhā was able to restart.

9.69. NGL advised us that the initial trip, and the fast shut down to reconnect the first 220 kV circuit, caused about $200,000 of damage to Ngāwhā geothermal.

Lodestone Energy Limited

9.70. Lodestone's 24 MW (peak) Kohirā solar farm is located in the Far North, near Kaitāia. Kohirā is connected to Top Energy's Northern Pulp Line 33 kV zone substation (NPL) that connects back to Top Energy's Kaitāia substation. Kaitāia is connected to the grid at the Kaikohe via a single 110 kV circuit.

9.71. Kohirā's connection configuration is through a 33 kV circuit breaker at NPL, owned and operated by Top Energy, and a part cable, part overhead circuit to Lodestone's site. Lodestone has its own 33 kV circuit breaker (KTS CB202) in series with Top Energy's breaker at NPL.

9.72. Lodestone told us that Kohirā's anti-islanding protection tripped the solar farm offline at 11.03am, as designed.

9.73. Lodestone had issues with SCADA control of its 33 kV circuit breaker CB202 that required a technician callout. Additionally, cellular communications, used to coordinate onsite troubleshooting, proved to be unreliable under power outage conditions. Lodestone is investigating using satellite communications to improve voice communications with the site.

9.74. Lodestone reported *"good coordination and communications throughout the outage"* with both Top Energy and NGOC. Lodestone had multiple calls with NGOC regarding resolution of the SCADA issue. Lodestone called a technician to site to operate CB202 locally and troubleshoot the SCADA issue.

9.75. Lodestone learned of the direct cause of the Northland outage (the tower collapse) through media channels and from that information deduced the outage would take hours rather than minutes. As restarting Kohirā required a re-livened 33 kV network to connect to, estimated time to restore, even if it is just a best estimate that gets updated over time, is important to distributed generators—and other event responders.

9.76. Reconciled generation data showed that Kohirā resumed generation at around 8.00am the following day (21 June). Lodestone estimated its loss of generation opportunity across the afternoon of 20 June was in the 42 – 53 MWh range.

Vector

9.77. As the evening peak approached on 20 June, Vector proactively discharged (generated from) their BESS installations because they thought that was the 'right thing to do' to help Transpower manage the load north of Auckland to benefit customers in the Northpower and Top Energy supply areas. Vector's customers in the area did not have their supply interrupted because Wellsford GXP remained energised from Henderson after the tower collapsed. Vector's BESS output can be seen as an injection in the Wellsford chart in Figure 8. Vector also dispatched its battery at Taparoa, and offloaded capacity using 11 kV backstopping to assist with the recommissioning of the 220 kV circuit on 23 June.

9.78. Vector also commented that, while it wasn't required on 20 June, the BESS installation at Taparoa was designed for local community support and can operate in an islanded configuration, whereas the BESS installations at Snells Beach and Warkworth South were only designed to operate grid connected. The Taparoa BESS is therefore similar to Top Energy and Manawa's diesels, which powered small electrical islands supplying local Top Energy and Northpower load respectively.

9.79. Vector commented that commercial arrangements for distributed generators providing capacity under emergency conditions needs to be looked at. This issue is outside the scope of this review, but the Authority acknowledges Vector's concerns and will consider whether this is an issue that should be reviewed by the Authority in the future.

9.80. The Authority is currently reviewing the scarcity price settings in the Code and will consult with industry before the end of the year. The intent is that if there are any changes to the scarcity pricing settings, these would be made ahead of winter 2025.

Communications from Transpower

Operational communications

9.81. Hundreds of operational calls occurred between various parties throughout the event. We have reviewed the call logs from the NGOC and NCC control rooms and the following is a brief overview of the types of calls that occurred based on that review.

9.82. In all cases we reviewed, calls followed the protocol specified in clause 3(1) of Technical Code C (Operational communications) of Schedule 8.3 of the Code, which requires that *"every voice instruction must be repeated back by the person receiving the instruction and confirmed by the person giving the instruction before the instruction is actioned."*

Operational communications between NGOC and NCC security desk

9.83. Calls between NGOC and NCC addressed the initial tripping and loss of supply, explored restoration options, provided notification of the unserviceable status of the 220 kV tower, and discussed implementing PR-CP-638/V3, the contingency plan to restore Northland via the 110 kV line.

9.84. Following these calls, the execution of the contingency plan was led by the security coordinator at NCC. This involved instructing NGOC to carry out the step-by-step switching of transmission circuits and other assets specified in the plan, as well as advising Northpower and Top Energy of their individual GXP load limits. NGOC updated the security coordinator after each step was completed.

Operational communications between NGOC and distributors

9.85. As set out above, regular communication between NGOC and distributors was required as the restoration progressed to revise load limits at each GXP. There were also occasional calls directly between distributors and NCC.

Operational communications between NCC energy desk and other parties

9.86. Ngāwhā B control room called NCC at 11.07am on 20 June to report that all units had tripped and to claim a 'bona fide' physical reason for going off-line and reducing the MW specified in their offers. Ngāwhā A is not required to submit offers into the market so was not required to lodge a bona fide physical reason for an offer change with the system operator.[66]

9.87. Ngāwhā B called NCC to lodge another bona fide at 2.13pm as their OEC4 unit had tripped on startup due to a problem with a mechanical valve, which had been damaged in the initial 11.03am tripping. The immediate issue was eventually resolved, and the unit became available again at around 2.54pm. However, we understand the damaged valve needs to be replaced.

9.88. Several calls between NCC and distributed generators were made to assess any timing constraints for restarting generation, to ensure all distributed generation was disconnected prior to re-livening the grid, and to coordinate bringing generation back up once the grid was re-livened.

Other operational calls

9.89. There were additional operational calls from NCC to an internal technical specialist who was supporting NCC with the use of software modelling tools to calculate load limits.

66 Clause 13.97 of the Code sets out the basis for a generator to reduce their output under a Grid Emergency. A reduction requires a bona fide physical reason for any reduction. The tripping of transmission circuits connecting generation to the grid is considered a bona fide physical reason.

External public communications

9.90. Following the event Transpower communicated through a variety of channels to advise and update various stakeholders and consumers about a number of issues relating to the transmission tower collapse.

9.91. As soon as Transpower was informed of the event, it notified the offices of the Minister for Energy and the Minister for State-owned Enterprise. Following this, Transpower notified the Electricity Authority's GM Strategic Communications and Engagement at 11.30am and then the Chief Executive. Transpower notified WorkSafe shortly after. At 2.30pm on 20 June, Transpower arranged a teleconference with the Electricity Authority, Northpower, Top Energy and Vector.

9.92. Transpower also issued a number of press releases, with the first release at 11.54am on 20 June, and posted some updates on social media. Transpower also engaged with various media outlets to respond to queries in relation to the event.

9.93. A livestreamed press conference was held on 24 June with Transpower's Chief Executive, General Manager Grid Delivery, and Omexom's Managing Director.

9.94. Transpower also provided updates on its website and information relating to potential compensation avenues available to consumers. Potential compensation avenues were also raised in Transpower's press conference.

Retailer communications with consumers and medically dependent consumers

Medically dependent consumers

9.95. The Consumer Care Guidelines (Guidelines)[67] provide guidance for retailers' treatment of medically dependent consumers. This guidance includes:

(a) record keeping

(b) assessing applications for medically dependent consumers

(c) information for new customers including advising of the need for an emergency response plan

(d) planned outage coordination

(e) prohibition on disconnection for non-payment

(f) further guidance for distributors in an emergency.

9.96. As these Guidelines are not currently mandated, our approach has been to gather information from retailers regarding their responses to the tower collapse.

67 These guidelines are currently voluntary but from 1 January 2024 they will be incorporated into the Code and become mandatory obligations—this is discussed further in Part 3 of this report.

9.97. We contacted 11 retailers, each of which have more than 100 consumers in the Top Energy or Northpower regions and asked them for:

(a) the number of medically dependent consumers the retailer has in Northpower and Top Energy areas

(b) a description of any communications with these consumers that occurred during the power outages that resulted from the tower failure that includes:

(i) the channels used and how many were contacted through each channel

(ii) the messages that were used.

9.98. These retailers reported having a total of 936 medically dependent consumers in the Top Energy and Northpower areas. They contacted these customers through a mix of phone call and text messages. Phone calls were made to a total of 661 medically dependent consumers. Text messaging was also used to contact 562 medically dependent consumers, either in addition to or instead of phone calls. These communications started very soon after the tower collapsed. Most of the retailers had information on their websites.

9.99. In one case replies to “do not reply” texts were monitored just in case there was a reply requiring follow-up. Voice messages were left in cases where there was no answer. Most retailers told us that they included other vulnerable and pending/unconfirmed medically dependent consumers in their communications.

9.100. Unfortunately, there were instances of text messages going to out of date phone numbers. Retailers were in the process of updating these phone numbers.

9.101. In one case the retailer had recently (May 9) reminded its medically dependent consumers to make sure that their contingency plans were up to date. This was a result of a Transpower shortfall notice on that day.

9.102. To supplement the broad coverage by news and other media outlets, retailers communicated with consumers through social media and their websites. This alerted consumers to the unplanned outage and the area affected and directed consumers to Transpower’s webpage for updates.

9.103. Because the supply of electricity cannot be guaranteed, medically dependent consumers are encouraged to develop their own emergency response plan to respond to any electricity outage. Such a plan will be particular to the consumer and may range from ensuring that a stand-by battery is always fully charged, to relocating to a friend’s or family member’s premises which has electricity at that point in time, or even calling an ambulance to be taken to hospital.

Part 3: Analysis and lessons learned

10. Impact on consumers
11. Regional resilience
12. Action taken to restore supply
13. Improving industry regulation
14. Planning and undertaking baseplate refurbishment
15. Improving grid maintenance contracting arrangements and assurance processes
16. Communications
17. Grid reliability standards remain appropriate
18. Assurances: actions to prevent recurrence under consideration by Transpower and Omexom
19. Implementation of recommendations

10. Impact on consumers

10.1. Consumers are at the heart of this review. The most significant consequences of this event were borne by the consumers in the Northland region. Our intent is to understand the cause of, and response to, this event. From this, lessons can be learnt to ensure that consumers in Northland and throughout New Zealand receive a reliable supply of electricity.

10.2. Consumers need to have confidence that adequate processes are in place at every point in the electricity sector to ensure security of supply, from contractors working on assets in the field, through to distributors and Transpower, conveying electricity to consumers. Consumers also need to have confidence that regulatory and policy decisions that help shape the future of the electricity system will enable improved supply security and enhance resilience, particularly at a time when the electricity industry is transforming at an unprecedented scale and pace.

10.3. Approximately 88,000 connections, including households, and commercial and industrial premises, lost supply following the collapse of tower 130. Consumers were progressively reconnected over the afternoon and evening of Thursday, 20 June.

10.4. Even so, many large businesses were asked to restrict their electricity usage until 220 kV supply to the region was re-established on the afternoon of Sunday, 23 June. Many businesses suffered flow-on effects beyond the extent of the outage itself. The experiences and estimated costs of several large businesses are discussed in more detail below.

10.5. Most people who lost power would have experienced some disruption to their daily life. Even consumers who were restored with power relatively quickly may have had items damaged or spoiled or may have been impacted by the closure of schools and workplaces. In some cases, the full cost of the interruption was very significant and has potentially jeopardised employment in a region where unemployment consistently sits above the national average.[68] This is particularly relevant for businesses that represent large parts of small-town economies.

Estimating the overall cost to consumers

10.6. We estimated the overall cost to consumers using the Value of lost load (VoLL) specified in the Code—$20,000 per megawatt hour (MWh) of electricity not supplied.[69] In concept, VoLL is an estimate of how much an average consumer would pay to avoid a power outage.

10.7. While VoLL is given a specified value of $20,000, it is a blunt tool. In reality, the VoLL varies for each consumer (between residential, commercial, industrial consumers, and their scale). The VoLL may also increase with the duration of an outage, sometimes dramatically at an identified point in time, when for example manufacturing of non-durable products are involved. The spoilage of food past a certain time is an example of this. The $20,000 attributed to VoLL in the Code is therefore a very high-level aggregated estimate, and varies considerably depending on time of day, duration, and consumer type.

68 Quarterly Economic Monitor | Northland Region | Unemployment rate (infometrics.co.nz)

69 Schedule 12.2, clause 4(1) of the Code, also referred to as the value of expected unserved energy.

10.8. We estimated the lost load by taking the difference in offtake from the same period seven days earlier for each of the GXPs at Bream Bay (BRB0331), Kaikohe (KOE1101), Maungatapere (MPE1101), Maungaturoto (MTO0331), and Wellsford (WEL0331).

10.9. The total lost load was estimated as 1,877 MWh, which, when multiplied by VoLL at a rate of $20,000/MWh, gives a total VoLL of $37.5 million. This is our best estimate only as it is not possible to obtain verified data on losses in the time in which this review was carried out. This would have involved obtaining financial details from all consumers who suffered loss as a result of the event.

10.10. Infometrics has estimated the cost of the outage at $60 million by analysing the public estimates of the economic cost of the 1998 Auckland blackout, adjusted for inflation, economic differences between Auckland and Northland between 1998 and 2024 and other factors.[70] The impact on Northland under either estimate is significant.

Distributed generation significantly reduced the cost to consumers

10.11. As already noted, distributed generation in the Northland region enabled significantly more Northland load to be supplied during the event than would have been possible with the 110 kV circuits alone. Figure 11 breaks down the Northland load into three components:

(a) load supplied by the 110 kV circuits (yellow)

(b) load supplied by local distributed generation but within the circuit N security limit. This load could theoretically have been supplied by increasing the flow on the 110 kV circuits (green)

(c) load supplied by local distributed generation above the circuit N security limit (blue).

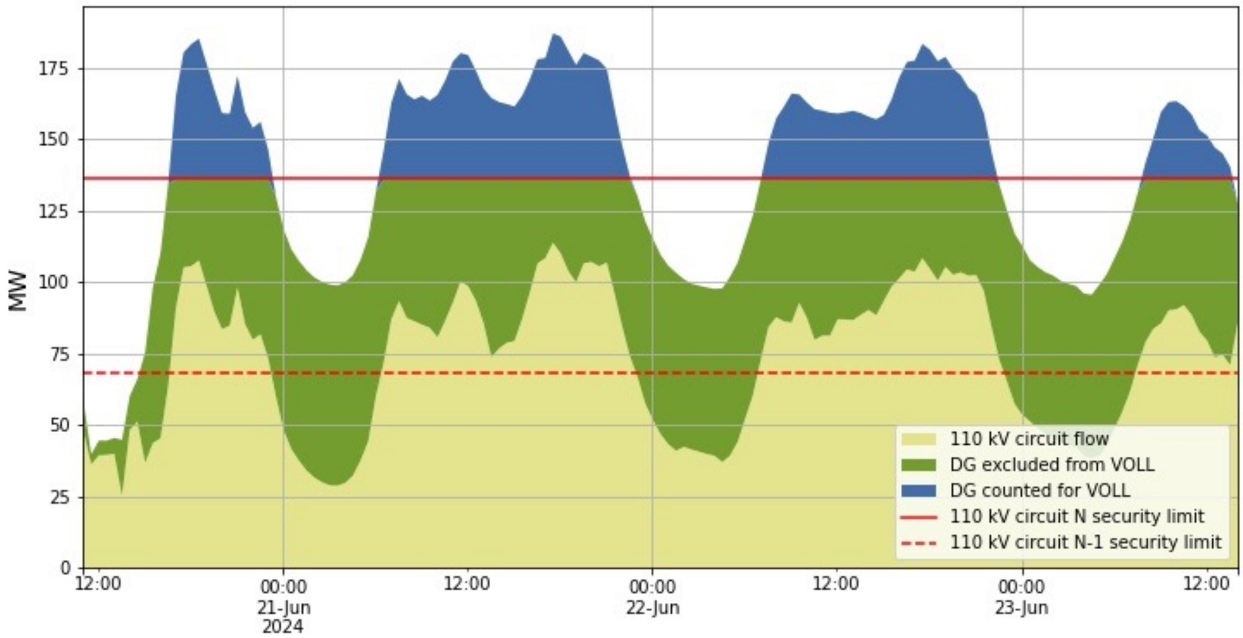
10.12. The N security limit of the 110 kV circuits is shown in solid red. The N-1 security limit is also shown for comparison in dashed red, illustrating the extra load that was able to be supplied as result of the decision to move to N security.

10.13. The area in blue provides a conservative estimate of the contribution of distributed generation in reducing the cost to consumers during the 75 hours of the grid emergency.[71] This adds up to 1300 MWh. Again applying a VoLL of $20,000/MWh we conservatively estimate this saved consumers around $26 million.

70 See: https://www.rnz.co.nz/news/national/520200/the-60-million-cost-of-the-northland-power

71 This conservative estimate assumes it would have been possible to keep the circuit flows hard up on the N security limit throughout the grid emergency, which is probably not realistic.

Figure 11. Distributed generation enabled more load to be supplied



Source: Reconciled data

The impact on Northland business was significant

10.14. Some Northland businesses who are large consumers of electricity were significantly affected by the event. Not only did they all lose power when the tower collapsed, they were also subsequently asked to restrict their electricity use as the power system was initially restored with limited capacity only.

10.15. We spoke to some of these businesses to understand the impact of the event on them and we summarise their perspectives below. Some businesses were able to easily quantify the financial impact on them, others were not. We appreciate that many other businesses and consumers were impacted by this event. Given the time constraints for producing this report, we were unable to fully capture the perspectives of a broader range of affected consumers and recognise that they may hold differing viewpoints to those represented below.

Channel Infrastructure (Channel)

10.16. Channel operates the fuel import terminal at Marsden Point. All the jet fuel used at Auckland International Airport flows through Channel's pipeline to Auckland.

10.17. Channel's normal maximum demand at Marsden Point is 3 MW with the pipeline pumps running. After losing power at 11.03am on Thursday 20 June when the tower collapsed, Channel was progressively reconnected with restricted supply of:

(a) 1 MW at 2.54pm on 20 June

(b) 1.6 MW at 9.47am on 21 June

(c) 1.9 MW at 11.03am on 21 June

(d) 2.6 MW at 2.53pm on 21 June.

10.18. All restrictions on supply were removed at 2.25pm on 23 June allowing the full load of 3 MW to be supplied.

10.19. Channel considered that communications about the event with their local distributor Northpower had been excellent. The only direct communication Channel received from Transpower was a letter two weeks after the event that thanked Channel for helping recover the power system, and suggested calling their insurance company, but contained no apology.

10.20. While the disruption of this event for Channel was low, given its ability to operate under restricted supply, the consequences of an extended outage had been demonstrated in 2017, when the pipeline was severed accidently and was out for 10 days. This caused significant disruption to flights in and out of Auckland, and to the wider economy.

10.21. Channel highlighted the vulnerability of Northland to power disruptions, and the risk of a 2017-scale event being repeated with the consequent New Zealand-wide impacts.

Golden Bay Cement (Golden Bay)

10.22. Golden Bay is based in Whangārei. After losing power at 11.03am on Thursday 20 June, limited supply was restored by 7.27pm that day but only for lighting and security. Over the next two days intermittent supply was available, which allowed for production to run for around two hours at a time. Supply was fully restored at 2.25pm on 23 June.

10.23. The interruption in supply resulted in significant cost in terms of both lost production and expenses. The kiln takes 30 hours to restart, so the three-and-a-half-day outage was effectively a five-day manufacturing outage, resulting in lost production of 10,000 tonnes of clinker and 12,500 tonnes of cement.

10.24. In addition, Golden Bay had to hire generators at a cost of $120,000 so that it could continue to load a ship to ensure market supply was maintained.

10.25. Golden Bay told us that throughout the event, the communications and planning from the Northpower team were excellent. Communications happened quickly after supply was interrupted, at a high level in both companies. Golden Bay reported that Northpower always made sure that they knew what was going on, and did their best to accommodate Golden Bay's requirements where they could.

10.26. During these discussions, when the extent of the outage became clear, Golden Bay agreed to stay offline so that residential connections could be restored as a priority.

10.27. Communications with Transpower consisted of an email and a letter thanking Golden Bay for its help and a statement that they expect Golden Bay will be in discussions with their insurer about the event and that their Insurers will reach out to Transpower's insurers in due course. As with Channel infrastructure, there was no apology from Transpower.

AFFCO Moerewa (AFFCO)

10.28. The impact on AFFCO was less than it could have been, because Thursday 20 June was planned as a non-killing day. There was no livestock in the yards ready to kill on the day of the event and all the product that was in the chillers had been there since the evening of 19 June. This meant that disruption was minimal. Had the event occurred on a killing day, the cost would have been in the hundreds of thousands of dollars.

10.29. AFFCO considered that communications with their local distributor, Top Energy, were "*awesome*". Because of their situation, AFFCO was able to agree to minimal load until 21 June, when it needed power for its chillers and freezers. AFCO supply was fully restored at 2.43pm on 23 June.

Juken New Zealand (Juken)

10.30. Juken has two wood processing mills in Northland, both of which were without power from 11.03am on Thursday 20 June until 2.49pm on Sunday 23 June. The power outage meant the boilers at both of Juken's mills cooled off and required a further 24 hours to heat up to get going again.

10.31. This was a significant outage for Juken. It estimates that it lost around $432,000 across both of its mills. Juken considered that communications with both Top Energy and Transpower were poor.

Culham Engineering (Culham)

10.32. Culham, based in Whangarei, has one of the largest fabrication facilities in New Zealand and employs over 450 people. Culham was without power from 11.03am on Thursday 20 June to 2.03pm on Friday 21 June. This was a substantial disruption for Culham, estimated to cost hundreds of thousands of dollars. Not only were their operations paused, but steel partly painted had to be sand blasted and repainted. Culham also lost their internal and external servers and communications with its lower North Island sites. This meant that work stopped at these sites too.

10.33. Culham considered that communications with Northpower were excellent, and that Northpower tried to help where they could.

Futurebuild LVL (Futurebuild)

10.34. Futurebuild operates a mill at Marsden Point. It was without any power from 11.03am to 5.44pm on Thursday 20 June, when limited power was restored for lighting and security only. At 4.00pm on Friday 21 June its supply restriction increased from 150 kW to 800 kW, which allowed Futurebuild to check its machinery to ensure it would restart safely. Power was fully restored at 2.25pm on Sunday 23 June.

10.35. Because of risks caused by the unscheduled shut down of machinery, a skeleton crew was needed at the mill overnight. Futurebuild estimates it lost around 20 hours of operations. The plant could not be restarted until Monday 24 June.

10.36. Futurebuild considered that communications with Northpower were extremely good. Northpower were able to keep Futurebuild informed about the situation which in turn allowed Futurebuild to plan a safe restart of its machinery and ensure that risks to plant and equipment were managed.

Transpower's response

10.37. Transpower was provided with a draft copy of this report for comment on factual findings. In relation to the views expressed by large businesses in this section, Transpower was concerned with the suggestion that communication from Transpower was poor. It said that the lines of communication are Transpower to distributors, and distributors to their connected customers and it would not be appropriate (and would cause confusion) if Transpower started communicating to distributors' customers as well. Transpower also stated that it had apologised to Golden Bay and Channel infrastructure in a recent in person meeting.

10.38. The Authority agrees that it is appropriate for distributors to maintain operational communications with their customers, as it is distributors who, during restoration, decide which customers to connect and when. It also minimises the risk of potential confusion arising from multiple communication pathways. However, the views of some of the large businesses indicate dissatisfaction with Transpower's communications generally and is not specific to operational communications. There may be room for improvement in terms of Transpower's public communications (through social media and other platforms), and response after any future events in terms of consumers who have been significantly impacted.

Remedial orders available under the Electricity Industry Act

10.39. This section provides general information on remedial orders available in the event of a Code breach. The information is not specific to the Northland event. The Authority's findings in this report are specific to this review and in no way suggest that Transpower's actions (as either grid owner or system operator) or the actions of any other participant may or may not amount to a breach of the Code. The Authority's compliance team will investigate any alleged Code breaches separately to this review.

10.40. The Authority does not have the power to order compensation. In the event of a supply interruption that has resulted from a Code breach, a formal complaint could be laid with the Rulings Panel in accordance with the requirements set out in the Electricity Industry (Enforcement) Regulations 2010 (Regulations) and the Authority's compliance processes. More information on Code breaches and the Authority's compliance processes can be found on our website.[72]

10.41. The Rulings Panel is an independent body that helps enforce the Code. It determines breaches, hears appeals against certain decisions and resolves disputes under the Code. If the Rulings Panel finds (following a formal complaint being laid) that any industry participant[73] has breached the Code, it may order remedial action. Section 54 of the Act sets out the remedial orders available to the Rulings Panel where there has been a breach of the Code by any participant. The Rulings Panel can, amongst other things, make compliance orders, order pecuniary penalties and order compensation. The Rulings Panel has previously awarded compensation to a business affected by an outage following a breach of the Code by the system operator.[74]

72 See: Code and compliance | Electricity Authority.

73 Section 7 of the Electricity Industry Act 2010 defines who an 'industry participant' is within the context of the electricity industry.

74 Rulings Panel (27 September 2013). See: www.electricityrulingspanel.govt.nz/documents/73/15845decision-27Sep13.pdf

10.42. There are several different limitations of liability set out in the Regulations for breaches of the Code. Transpower's liability in respect of a breach of certain subparts of Part 12 of the Code (relating to interconnection asset services and outage protocols) is limited to $2 million in respect of any one event or series of closely related events arising from the same cause or circumstance, or $6 million in respect of all events occurring in any financial year.[75] Transpower's liability as an asset owner is subject to the same limits in respect of any breach of any provision of Part 8 of the Code which relates to common quality.[76]

10.43. Transpower's liability as system operator in respect of any breach of the Code is limited to $200,000 in respect of any one event or series of closely related events arising from the same cause or circumstance, or $2 million in respect of all events occurring in any financial year.[77]

10.44. In a decision dated 2 May 2023,[78] the Rulings Panel considered a breach of the Code by Transpower as system operator and made a recommendation[79] to the Minister that the system operator's limit on liability be increased to reflect the increase in the maximum pecuniary penalty under section 54(1)(d) of the Act from $200,000 to $2 million. The increase in the maximum pecuniary penalty in the Act was made in 2022, following a review of the electricity industry compliance framework. That review also considered, but did propose, changes to the limits on liability of the system operator. The (then) Minister of Energy and Resources wrote to the Rulings Panel to clarify that there did not appear to be a case to further review the liability limits.

Utilities Disputes Limited's role in the 20 June event – jurisdictional issues prevent consideration of complaints without Transpower's consent

10.45. Utilities Disputes Limited (UDL) is a free and independent resolution service in New Zealand which helps resolve complaints about electricity services, gas, telecommunications, and water companies. UDL operates the approved Energy Complaints Scheme (Scheme) under the Electricity Industry Act 2010 and the Gas Act 1992. Complaints are considered according to the Scheme rules.[80]

10.46. UDL regularly considers outage complaints against lines companies and retailers. These complaints, following case law, consider electricity as a 'good'. Outage complaints are considered under Scheme rule 14(a). This rule allows UDL to consider complaints about a good or service provided by a Scheme member. However, Transpower has an exemption from this rule meaning UDL cannot formally accept complaints arising from the outage of 20 June 2024.[81]

75 Electricity Industry (Enforcement) Regulations, regulation 56.

76 Ibid, regulation 57.

77 Ibid, regulation 53.

78 Rulings Panel (2 May 2023). See: Electricity-Authority-v-Transpower-2023-Rulings-Panel-Decision-C-2022-002.pdf (electricityrulingspanel.govt.nz)

79 The Rulings Panel may, on determining a complaint, make a recommendation to the Minister to amend the Regulations pursuant to section 54(1) i(i) of the Act.

80 The Scheme rules (referred to, prior to July 2017 as the "Scheme document" and prior to April 2011 as the "Constitution") sets out the rules of the Scheme and can be found on UDL's website. See: ECS-rules-Utilities-Disputes-1-April-2019.pdf (udl.co.nz)

81 Scheme rules, Appendix 2, clause 2.

10.47. Transpower may, however, waive this exemption as it considers appropriate.[82] UDL has therefore approached Transpower and requested it consider how UDL may assist with processing outage complaints from 20 June 2024. UDL is awaiting confirmation from Transpower, however, in the meantime it has been assisting complainants by providing general information and putting complainants in contact with retailers' complaints teams. UDL has the necessary skills and expertise to assist consumers and Scheme members with disputes and is well placed to bridge the gap for consumers by providing an efficient means of resolving complaints relating to the outage.

10.48. Under the Consumer Guarantees Act 1993, there is a guarantee that the supply of electricity by a retailer to a consumer is of an acceptable quality.[83] The retailer is, therefore, usually the first contact point for the consumer. Resolving these complaints often requires the input of the lines company or asset owner who may be responsible for the outage. For consumers who do not fall under the Consumer Guarantees Act, such complaints are considered according to a number of factors including industry practice and standards, terms and conditions, and any legal requirements.

10.49. As of 23 August 2024, UDL had received nine complaints from consumers regarding the Northland outage. None of these complaints relate to medically dependent consumers. Two of the complaints raise customer service/communication issues. This reinforces our view set out in paragraphs 16.35 to 16.38 of this report that communications by retailers with medically dependent consumers were carried out well. We acknowledge, however, that to ensure this report was completed in a timely manner, and in the absence of any evidence of issues in relation to medically dependent consumers, we have not obtained details of the number or nature of consumer complaints that retailers have received.

82 Scheme rules, clause 14(c).

83 Consumer Guarantees Act 1993, section 7A.

11. Regional resilience

11.1. In the wake of Cyclone Gabrielle, the Northland event brings regional resilience into sharp focus once again. The event has demonstrated the need for a balance between:

(a) regional transmission capacity and redundancy

(b) in-region distributed generation and its capacity, variability and dispatchability

(c) the level and pattern of consumer demand and its flexibility as a demand management resource.

11.2. Northland consumers benefit from the investment in a material capacity of local distributed generation, including:

(a) Ngāwhā geothermal

(b) Top Energy and Manawa's diesel generating sets near Kaitāia and Bream Bay respectively

(c) Lodestone's recently commissioned Kohirā solar farm near Kaitāia, and

(d) Vector's BESSs in its Wellsford network.

11.3. In the event response and recovery phase, the existing operational distributed generation capacity across the technologies set out in Table 3 played an important role in boosting the limited grid capacity available through the 110 kV network. As noted in section 10, we estimate their generation saved consumers around $98 million in economic costs.

11.4. For the future, developers have announced several new projects of significant capacity, some are under construction, others are consented, and some are under active investigation for feasibility. Projects in Northland include:

(a) Meridian's Ruakākā project, the first stage of which will commission a 100 MW, 200 MWh BESS, to be connected at the Bream Bay grid connection point,[84] and

(b) NGL's additional geothermal stage at Ngāwhā, capacity to be determined but at this stage is likely to be approximately 32 MW.[85]

11.5. Several potentially grid-scale solar and wind installations have also been announced for the region. For example, Ruakākā stage 2 proposes a 120 MW solar farm on land adjacent to the stage 1 BESS.

11.6. Similarly, some 30 distributed generation projects totalling over 1,000 MW of capacity have been announced in many other regions throughout the country—mostly wind and solar.

84 Since the BESS can only store 200 MWh of energy, this means it can only sustain the full 100 MW output for two hours, or conversely a lower power output for a correspondingly longer time. Nevertheless, if it had existed on 20 June, it would have significantly boosted the system's ability to meet the peak regional load before the first 220 kV circuit was reconnected.

85 In our decision dated 15 December 2023 the Authority approved an application for an amendment to an existing exemption for Top Energy, Ngāwhā Generation Limited and senior management from the requirement in clause 6A.3 of the Code to comply with arm's length rules 3H and 3I for total generation up to 117 MW.

11.7. While not all announced projects survive the development pipeline, those that do will move Northland closer to attaining a positive net electricity balance.

11.8. The intermittent and variable real-time output of solar and wind generation will likely present a coordination challenge for transmission system and distribution network operators that will require careful management.

11.9. Conversely, resources designed to run in an islanded mode supplying nearby demand by design may present an opportunity to enhance network resilience for the benefit of consumers in regions like Northland.

11.10. In addition to islanded operation, adequately rated and controlled BESS technology is potentially a key enabler that could improve the network's resilience against contingencies like a 220 kV tower collapse. +/-100 MW of in-region BESS capacity capable of responding instantaneously could potentially enable the 110 kV circuits to operate without a split, strengthening supply security and enhancing regional resilience. Special protection schemes may also improve resilience by enabling low-capacity circuits to operate at higher loadings while managing the risk of a circuit tripping.

11.11. BESS in meaningful capacities, whether standalone or paired with other generation technologies such as solar and wind, can be designed with grid-forming inverters to improve regional resilience.[86] Co-operation is required between generators, the system operator, the grid owner, distributors and distribution operators to explore and implement options that provide grid-forming capacity.

11.12. While the duration of the disruption experienced during the event was relatively modest for many consumers, new technology capabilities applied to an event lasting several days may significantly benefit consumers. Cooperation will be required by multiple parties to explore opportunities.

11.13. In this regard, we note that Transpower, Northpower and Top Energy have recently agreed to cooperate on a Northland Regional Electricity Development Plan. This regional cooperation is to be applauded. A copy of the terms of reference has been provided to the Authority and are attached in Appendix C.

11.14. There was a broad range of stakeholders that responded to aid recovery of the regional power system following the 20 June tower collapse event. We expect that relevant interests are represented when drawing up terms of reference for a Northland Regional Electricity Development Plan. Suitably designed distributed generation and demand management, working with transmission and distribution providers, should play an important role in enhancing regional resilience.

11.15. A new transmission line build, providing more overhead circuits into regions like Northland, faces significant challenges, particularly related to obtaining line routes (easements) and the very high costs that would fall on consumers.

11.16. Chapter 7 of Transpower's 2023 transmission planning report[87] comprehensively addresses issues and opportunities for the region out to 2038. None of the options considered envisage new line build; costs could run to several hundred million dollars—and potentially more.

86 Grid-forming inverters generate their own 50 Hz alternating voltage. Inverters that are not grid-forming can only operate if another generator on the network is already generating a 50 Hz alternating voltage.

87 See: Transmission Planning Report 2023 (transpower.co.nz)

11.17. Other transmission upgrade options may enhance regional resilience. These include:

(a) existing circuit thermal upgrades and reconductoring

(b) installation of line circuit breakers e.g. at Maungaturoto

(c) special protection schemes that can allow the low capacity 110 kV circuits to operate at N security to unlock their full capacity under emergency conditions.

11.18. Beyond those enhancement options, distributed generation and demand participation must play a role in enhancing regional resilience.

R1. Transpower and regional distributors should engage with a wide range of stakeholders, including generation developers, mana whenua, regional community groups and regional business groups, to develop regional electricity development plans for all regions in New Zealand that are vulnerable to high impact electricity supply events and develop controls that enable greater resilience through coordination of multiple resources employing both old and new technologies.

12. Actions taken to restore supply

12.1. We have considered the planning, coordination and actions undertaken during the recovery and restoration stage of the event. These were described earlier in section 8. The question we address here is how well this phase was implemented and what improvements may be made.

12.2. At the outset, knowledge that a transmission tower had collapsed was evident to the maintenance crew (obviously), thankfully uninjured but very shaken, and any members of the public in the vicinity of Glorit at the time. The loud noise as the live 220 kV circuit hit the ground was reported by media to have been heard several hundred metres away from the tower site. From the outset, this was a publicly obvious, major event.

12.3. From the perspective of the grid, protection systems operated correctly and de-energised the in-service but grounded circuit.

12.4. In NCC and NGOC control rooms, SCADA indications alerted coordinators and controllers to the loss of the single in-service 220 kV circuit into Northland—but not the cause.

12.5. Onsite, the maintenance crew reported the event to their management, who promptly alerted NGOC at 11.11am, eight minutes after the tower collapsed. While seriously life threatening to the onsite crew, early identification of the exact state of the line meant operators weren't left considering the merits of trial reclosure attempts, and possibly line patrols, to identify the cause. A harder to find permanent fault would have delayed restoration commencement.

12.6. The nature of the event, particularly the unrecoverable state of the collapsed tower, quickly discounted 220 kV restoration options in the short term, leaving the 110 kV Henderson – Marsden circuits as the only viable option for initial restoration. The availability of PR-CP-638/V3, freshly reviewed in January 2024, provided NCC coordinators and NGOC operators a clear plan to restore limited supply to consumers and re-livened connections to distributed generation beyond Maungatapere.

12.7. That Wellsford and Maungaturoto retained supply due to the 110 kV split avoided the need for switching at those two 'tee-connected'[88] GXPs—they were already connected. This also expedited the restoration sequence as livening the Maungatapere bus required only switching at Maungatapere to clear the 110 kV bus and closing the two Henderson line circuit breakers.

12.8. With Maungatapere re-livened, and a modest load limit imposed on Northpower, progressive re-livening of Northland GXPs proceeded as described in section 8. Reconnecting regional distributed generation, particularly Ngāwhā, added to the maximum supply capacity available throughout the region.

12.9. The critical success factors underpinning the prompt restoration were:

(a) receiving early confirmation of the state of the 220 kV line

(b) early declaration of the grid emergency by the system operator

88 The 110 kV connections at Wellsford and Maungaturoto do not have 110 kV line circuit breakers.

(c) prompt decision making by NCC coordinators and NGOC operators to settle on a restoration plan based on contingency plan PR-CP-638/V3

(d) early establishment of the GOIMT and EIMT to keep an overview and ensure the control rooms were left to get on with their priorities

(e) efficient plan execution and inter-working between NCC and NGOC

(f) setting and regularly revising appropriate load limits by GXP and/or by distributor as the restoration progressed

(g) executing operational communications between control rooms in accordance with communications protocols, so instructions were unambiguous, and senders could be confident of receiver understanding

(h) making the decision to operate the 110 kV circuits between Henderson and Maungatapere at N security, unlocking a significant block of capacity (we'll come back to how that decision was made and how such decisions should be made in future).

Issues related to restoration

12.10. While this restoration was executed very well overall, there are always lessons that can be learned. The following items are of the nature of improvements to work on while Northland lessons are fresh.

12.11. Some of the items overlap with recommendations made in the Hardy Report. In general, we support the Hardy Report's seven recommendations but consider that some of these should be extrapolated to apply to any region in New Zealand. The Northland event has simply shed light on the lessons.

Issues related to communications with distributors and distributed generators

12.12. In section 9, we noted that Northpower and Lodestone told us they found out what had happened from media. Of course, their SCADA systems would have alerted to the loss of network power. Northpower deduced a grid-level problem and set about preparing its network for re-livening.

12.13. We consider NGOC's role in communicating directly with local distributors and distributed generation operators could have been better, at least in the early stages.

12.14. The Hardy Report noted, with respect to operations in the early stages: '*… a few instances where load limits were ambiguous partly because of the multiple communications channels being used*'.[89]

12.15. On the following day, the system operator set up an operating coordination forum that included key staff from the system operator, the grid owner, distributors and distributed generators. The Hardy Report noted that this '*… proved a success because it allowed parties to better understand actual operating conditions and to coordinate actions.*'[90]

89 Hardy Report, section 5.2.1.

90 Ibid.

12.16. We consider that, in appropriate circumstances related to regional (or wider) major event response (i.e. grid emergencies), rapidly deployed operating forums with the right operational people on the call are critically important to convey authoritative information, coordinate restoration responses and answer pressing questions. These should be established and led by the system operator, aimed at operations manager level, with details baked into contingency plans. Operations managers have direct access to frontline coordinators and operators, and should strive to support frontline staff so they can focus on their core roles.

12.17. The Hardy Report's second recommendation supports strengthening peer-to-peer relationships at the operations manager level. While we broadly support this recommendation, we note that relationship building amongst shift-based managers can be a challenge, especially when only rarely tested by an actual emergency and noting that managers come and go over time.

12.18. Of equal importance is to remember that these are rapidly changing times and the rapid rise of relatively large capacity distributed generation brings new technologies, new operators and new coordination challenges into an increasingly cluttered frame. The Authority's Future System Operations workstream seeks to explore industry-wide operational challenges and opportunities, relevant to the operational matters raised by the Northland event.

R2. The system operator should lead the establishment of plans to stand up a regional (or wider if appropriate) operating forum to improve operational coordination and communication amongst relevant operations managers, including the system operator, grid owner, distribution and generation operators (including distributed generation operators) and any affected direct grid-connected industrial consumers.

Relaxing N-1 security on circuits under grid emergency conditions

12.19. The fragility of the initial grid restoration under the operating conditions experienced through the afternoon of 20 June was demonstrated by the N-1 violations experienced following Ngāwhā B tripping at 2.14pm.

12.20. Seeking to maintain N-1 security on the two 110 kV circuits throughout this period had the effect of withholding valuable supply capacity from Northland consumers.

12.21. We support the logic of relaxing load limits on the two Henderson – Maungatapere circuits to N security while load limits were in place during the grid emergency. We appreciate the risk analysis that preceded that decision being made.

12.22. What we question is that it evidently took an "executive directive" to take this key step at 2.34pm, just after Ngāwhā B tripped, first mentioned in the log about 2 hours earlier as a decision already taken by the NCC Operations Manager and the Grid Delivery Executive General Manager at 12.28pm (i.e. 1 hour and 25 minutes into the event):

(a) at 12.28pm the log states: '*CC OM discussion with Grid Delivery EGM. Need to ascertain maximum load but approval given to run to N*'.

(b) at 2.30pm the log states: 'NCC OM posted this on the teams channel: NGA B has tripped so now we have N-1 violations. Grid Delivery EGM was happy to run as N but we'd want to be sure there's no safety concerns'.

(c) at 2.34pm, the log states: 'Discussion and decision around running the remaining system at N. Executive directive that we do what we can to supply Northland with as much capacity as possible.' (Emphasis added.)

12.23. We note that the Northland regional contingency plan PR-CP-638/V3 requires the security coordinator at NCC to study '... *the possibility of using splits and N security to maximise load restoration*.'[91] We take this to mean that the security coordinator already had authority, in fact was required, to study running the 110 kV circuits at N security.

12.24. We consider safety concerns, including protection adequacy, and delegated operating authorities are matters best addressed in contingency plans to the extent possible. This applies to all such operational contingency plans grid-wide and aligns with recommendations 3, 4 and 5 in the Hardy Report.

12.25. Once running at N security, relaxed load limits promptly came into effect and distributors allocated these to more consumers throughout their networks.

12.26. Technical Code B (Emergencies) of Schedule 8.3 of the Code provides the system operator with wide powers to act to alleviate a grid emergency, as recovery following the tower collapse clearly was. We do however appreciate that each grid emergency is unique and requires unique assessment, analysis and restoration decisions. The lesson here is about clarifying the decision-making process.

R3. Transpower should review and improve contingency plans where possible to:

a. specifically provide for relaxing normal 'healthy grid' security levels during system emergency conditions, to maximise supply allocations to consumers, and

b. pre-determine and resolve, to the extent possible, any applicable safety concerns and protection settings where required, and

c. clarify delegated authorities to make decisions about relaxing normal security levels in grid emergency conditions.

91 PR-CP-638/V3, section 2.4, Introduction.

Issues to investigate at Ngāwhā

12.27. While the loss of Ngāwhā B at 2.14pm on 20 June removed valuable capacity from the closely balanced network, we understand the cause was related to failure of a mechanical valve. The valve—to be replaced—is one of three that operate in parallel but only two are required to run the plant at 100% capacity.

12.28. The decision to shut down the Ngāwhā A and B stations before switching in the first 220 kV circuit in the early afternoon of 23 June was taken following consultation over the weekend between multiple parties.

12.29. Closing the first 220 kV circuit in parallel with the 110 kV circuits creates a phase shift that is felt at nearby generation stations as a 'bump on the system'. A sudden phase shift has the potential to damage rotating plant like Ngāwhā, so NGL required it to be shut down while the 220 kV switching occurred.

R4. Transpower, Ngāwhā Generation Limited (NGL) and Top Energy should discuss, study and resolve the Ngāwhā phase shift concern that resulted in NGL shutting down its generating units before reconnection of Northland to the first restored 220 kV circuit.

Regional contingency plans

12.30. Annual simulation exercises have been held regularly since the 9 August 2021 demand management event. Reports reviewing that event recommended annual pan-industry contingency exercises and these have been done in 2022, 2023 and 2024.[92]

12.31. The annual pan-industry exercises have reinforced the need for accurate situation analysis, clear contingency plans for recovery, formal communication channels and language, and the role of incident management teams. Several participants we have spoken with have credited the prompt recovery of the Northland grid to the annual exercises.

12.32. In carrying out this review, we have considered many aspects of power system maintenance and operation that are unique to the Northland region. These matters are different to the broader-focused scenarios tested under the existing pan-industry exercises and benefit from the system operator's separate, more regionally focused simulation exercises.

12.33. The system operator has developed a library of 17 contingency plans with a cover document that sets out contingency plan principles and procedures.[93] The contingency plans set out guidelines that anticipate specific contingent events and provide detailed recovery plans that include guidance and pre-prepared switching sequences. The regional exercises include exercising black start situations and new scenarios not included in the library to date.

92 The Authority's immediate assurance review into 9 August is available on our website: https://www.ea.govt.nz/documents/2033/Immediate-assurance-review-of-the-9-August-2021-demand-management-event.pdf. The investigation into 9 August ordered by then Energy and Resources Minister Megan Woods is available on MBIE's website: https://www.mbie.govt.nz/building-and-energy/energy-and-natural-resources/energy-consultations-and-reviews/nvestigation-electricity-supply-interruptions-9-august-2021/

93 PR-CP-024 Contingency Plans Principles and Procedures.

12.34. As we explained earlier, one of the contingency plans, PR-CP-638, was used to good effect to expedite recovery of the Northland grid through the 110 kV network on 20 June.

12.35. We appreciate the resource and expense involved in setting up and running simulation exercises but consider the benefits considerably outweigh the costs.

Transpower's planning for permanent replacement of tower 130

12.36. The Lindsey tower assembled onsite to reinstate the Bream Bay - Huapai circuit 1 on Sunday 23 June and the three pole structures to reinstate Huapai – Marsden circuit 1 are interim restoration solutions. The engineering design for both sets of structures takes account of all site specific loading conditions as if they were permanent structures. Provided they are maintained and inspected regularly, both the Lindsey tower and poles can be relied on to deliver secure service for long periods, potentially for years.

12.37. However, a permanent solution is still required, as the emergency structures may be required for use elsewhere. Transpower was initially considering two options for a permanent replacement of tower 130. Having considered costs and risks, and the best means of promoting reliable supply for the future, Transpower has determined what it considers to be the preferred option. Transpower is preparing to replace tower 130 with a modern equivalent structure that will fit the existing foundations and look substantially identical to the original tower. This will enable the Lindsey tower to be disassembled and repacked in its container and made available again in the event of another need.

12.38. The permanent structure that will replace tower 130 will need to be designed in an electronic format suitable for use in an automated manufacturing process. Transpower is working with a large international supplier to achieve this.

12.39. Based on forecast seasonal consumer demands in the region, Transpower's assessment is that the replacement work is best scheduled from mid-November onwards, as consumer demand reduces. The longer daylight hours will also assist construction. Additionally, Transpower plans to align this work with other outage-based work on the same circuits to minimise the number of outages and time that the region will be on N security.

Comparison of Transpower temporary and permanent replacement of tower 130 with Australia

12.40. It is challenging to make direct comparisons of Transpower's restoration efforts with those in comparable jurisdictions, given that each event is unique to its specific circumstances. We sought data on restoration time for similar events from other regulators and utility companies, however, we were advised by some jurisdictions that most restorations involved the installation of permanent structures at the outset, avoiding the need for temporary structures.

12.41. We have considered, however, transmission tower collapses in Australia, where temporary structures were used in the response, to provide a measure for evaluating Transpower's response.

12.42. On 13 February 2024 a significant weather event in Victoria, Australia caused six transmission towers near Geelong to collapse. Over 1 million consumers lost power; 400,000 were restored within a day, 30,000 consumers remained without power for three days, and 3,000 consumers were without power for more than a week.

12.43. The event tripped Moorabool and Sydenham transmission lines No.1 and 2. Temporary transmission towers were constructed with:

(a) line 1 restored by 25 February (12 days after event)

(b) line 2 restored by 6 March 2024 (22 days after the event).

12.44. The timeframe for permanent replacement of the transmission towers is unknown at this time.[94]

12.45. On 21 January 2020 seven transmission towers in Victoria either collapsed or were severely damaged from a major weather event resulting in two 500 kV lines tripping between Moorabool – Mortlake and Moorabool – Haunted Gully. Temporary transmission towers were constructed with:

(a) line 1 restored by 17 February 2020 (27 days after the event)

(b) line 2 restored by 3 March 2020 (42 days after the event).

12.46. Permanent replacement of the towers was planned to be completed by December 2020 (approximately 11 months).[95]

12.47. The Australian transmission tower collapses were due to severe weather events, which may have also hampered restoration efforts and the construction of temporary towers. Each of the Australian events also required the construction of multiple temporary towers.

12.48. Nevertheless, the swift and efficient construction of a temporary tower and re-livening of the first circuit by Transpower and Omexom within just three days of the event compares favourably to similar efforts in Australia. A permanent replacement for tower 130 is planned for mid-November onwards, five months after the event.

94 See: Review into the transmission and distribution businesses operational response to the 13 February 2024 Storms (energy.vic.gov.au)

95 See: final-report-vic-sa-separation-31-jan--2020.pdf (aemo.com.au)

13. Improving industry regulation

13.1. The Authority is responsible for overseeing and regulating the New Zealand electricity industry under the Electricity Industry Act 2010 (Act). One of the Authority's functions is to make and administer the Electricity Industry Participation Code 2010 (Code), which is the set of rules that govern the electricity industry.

13.2. We have sought to understand how best to improve regional security and resilience to major events by utilising the capabilities of the new technologies.

13.3. Such a future power system would be made up of materially greater quantities of distributed generation of all sizes and capabilities, and demand that possesses flexibility as to when and how it operates. Addressing the critical topics of common quality, and power system coordination and balancing, the Authority's Future Security and Resilience and Future System Operation work programmes are amongst the highest priority Authority initiatives.

Common quality requirements are under review

13.4. New Zealand's power system is changing. We need to ensure the common quality obligations[96] in Part 8 of the Code are fit for purpose now and in the future.

13.5. Traditionally, New Zealand's power system has been based on a centralised, synchronous generation system with transmission and distribution networks transporting electricity from generation sources to consumer connection points. The Code has been drafted with this system in mind.

13.6. With the increase in renewable generation resources, many of which are inverter-based resources such as wind, solar PV, and batteries, the system is becoming less centralised, with distributed energy resources connecting at points throughout the power system. Further to this, is the increasing opportunity for flexible load to more actively participate in the market, through load aggregators or their retailers.

13.7. These shifts present challenges to the operation of the power system. The Code as currently drafted does not always accommodate new technologies, and the new trading relationships that these give rise to.

13.8. In 2021, the Authority established the Future Security and Resilience (FSR) work programme. This is a multi-year programme of work created to ensure New Zealand's power system remains secure and resilient as we transition to a low-emissions energy system. The programme looks at the medium to long term challenges during the transition. It is based on the FSR roadmap, a 10-year plan published in 2022 that indicates ten activities that will need to be addressed during the transition to ensure the power system remains secure and resilient.

13.9. The two FSR projects currently in progress are a review of the common quality obligations in Part 8 of the Code and a review of future system operations in New Zealand.

96 Common quality' in Part 8 of the Code refers to the elements of the quality of power supply that cannot be technically or commercially isolated to an identifiable person or group of persons. Examples of these elements are voltage, frequency and power harmonics.

13.10. 'Common quality' in Part 8 of the Code refers to the elements of the quality of power supply that cannot be technically or commercially isolated to an identifiable person or group of persons. Examples of these elements are voltage, frequency and power harmonics.

13.11. The highest priority activity in the FSR work programme is a review of the common quality obligations in Part 8 of the Code. This part of the Code needs to be reviewed to ensure it enables maturing technologies, particularly inverter-based resources, in a manner that is consistent with the Authority's statutory objectives.

13.12. This review is the highest priority activity on the FSR work programme because of:

(a) the need to ensure the common quality requirements accommodate and facilitate the opportunities offered by evolving technologies, particularly inverter-based resources

(b) the increasing risk to security and resilience as more distributed generation is installed and bi-directional electricity flows become more prevalent

(c) the increasing risk of investments in evolving technologies bringing about outcomes that are not for the long-term benefit of consumers.

13.13. Amending Part 8 to enable evolving technologies will help remove barriers to inverter-based sources of generation, thereby improving the resilience of regional and grid electricity networks.

13.14. We published an issues consultation paper on Part 8 of the Code in April 2023 outlining seven broad issues related to the common quality requirements that the Authority had identified through stakeholder engagement. In June 2024, the Authority published a suite of papers to consider options for some of the issues. Work is progressing to address the remaining issues with further consultations expected later in 2024.

13.15. The second project currently in progress is the review of future system operation of the New Zealand power system. With the changes occurring across the power system outlined above, the traditional means of continuously balancing supply with demand is changing. Consumers are becoming 'prosumers', investing in solar and battery energy storage systems capable of exporting power back to the local network. The way the power system is operated needs to evolve to accommodate these changes. This will enable consumers to participate in, and potentially improve the security and resilience of, the power system.

13.16. The Authority published a discussion paper on future system operation in February 2024. Authority staff are considering the submissions and intend to publish an issues paper for consultation in 2025.

R5. The Authority should take into account the Northland event and the importance of promoting regional resilience in its ongoing review of the common quality provisions in Part 8 of the Code and of future system operation in New Zealand.

Rules relating to distributor investment in generation require review

13.17. The Authority has also identified the need to review and update the rules in Part 6A of the Code relating to distributor-owned generation that is connected to the distributor's local network.

Part 6A of the Code promotes competition in the electricity industry

13.18. Part 6A of the Code contains rules that require the corporate separation and arm's-length operation of distribution and generation of more than 50 MW that is connected to the distributor's network.[97] These rules have been in place in some form since the late 1990s.

13.19. The Part 6A rules are intended to promote competition in the electricity industry by restricting relationships between a distributor and a generator, where those relationships may not otherwise be at arm's-length. In doing so the rules seek to provide an 'even-playing' field for other parties investing in generation to be connected to the distributor's network.

13.20. The Authority can grant an exemption to any of these rules if it is satisfied that compliance with the rules is not necessary for the purpose of achieving the Authority's objectives, or if an exemption would better achieve the Authority's objectives than requiring compliance.[98]

13.21. The corporate separation and arm's-length rules were moved from the Act to Part 6A of the Code in September 2022, to allow for a more adaptive and responsive approach to the regulatory requirements in a rapidly evolving electricity system. The intent was to enable the Authority to amend any or all of the rules including the circumstances in which the rules apply.

Ngāwhā generation supported a large part of the restored load after the event

13.22. Top Energy and its subsidiary, Ngāwhā Generation Limited have an exemption from two of the arm's-length rules which permits the joint management of their distribution and generation businesses. The exemption applies in relation to the generation of up to 117 MW of geothermal generation at the Ngāwhā Springs Power Station.

13.23. In granting an amendment to this exemption last year, extending the permitted level of generation, the Authority was satisfied that NGL's generation at Ngāwhā Springs would provide benefits through a more competitive Over-the-Counter (OTC) forward market and, through this, downstream benefits in the retail market. The Authority also considered that granting the amendment would not be likely to discourage competing generation in the circumstances, and would result in resilience and reliability benefits, given both the baseload nature of geothermal generation and the ability of NGL to help reduce the impact of transmission faults. The application of the remaining arm's-length rules was a relevant factor in the decision to grant the application.

13.24. As set out above, the availability of distributed generation in Northland performed an important role in the event recovery. In future, access to distributed generation will be increasingly important to promote regional resilience.

97 Part 6A of the Code also includes rules relating to the separation of distribution from certain retailing. We have not considered those rules in this review.

98 Section 73 of the Act also imposes an ownership separation rule that prohibits a distributor, or any other person involved in a distributor, from being involved in more than 250 MW of generation that is directly connected to the national grid. Alongside the Authority's review of the Northland event the Minister has separately announced that Cabinet has committed to ease restrictions on distributors owning generation. The Authority will work with the Government to ensure a joint approach addresses all issues.

The Authority will review Part 6A to consider whether its promotes reliability and efficiency

13.25. The Authority can grant exemptions to the Part 6A rules. In addition to the exemption granted to Top Energy and NGL, the Authority is currently considering a similar application for an exemption from WEL Networks, in relation to the construction of two solar farms and a network battery.[99]

13.26. While we believe that the exemption regime is working well, and does not prevent distributor investment in generation, the application process can impose costs, delay and uncertainty. Application of some rules may also impose an unnecessary compliance cost on distributors.

13.27. Part 6A is about who owns generators connected to distribution networks. In our assessment, distributor generation ownership does not impact, or improves, the relevant markets, and can improve reliability and / or lower consumer costs.

13.28. To the extent that distributor generation ownership changes incentives (for example to foreclose or cross-subsidise), this could require a regulatory response. New entrant or existing generators should not be disadvantaged by distributor generation ownership.

13.29. Our view is that ownership has a limited impact on incentives. There are also limited opportunities to act on incentives, including because of parallel regulatory constraints, the ownership structures of some distributors and/or the small scale of generation proposed.

13.30. Given the above, it is timely to review the requirement to comply with the arm's length rules under Part 6A of the Code. We intend to review the extent to which the current arrangements achieve the right balance between enabling distribution generation and protecting competition. We are particularly interested in considering the role of the arm's-length rules in supporting competition, reliability and efficiency in light of other regulatory requirements that constrain distributors' opportunities to foreclose generation opportunities on their networks or gain a competitive advantage through cross-subsidising its generation business, including:

(a) Part 6 of the Code, which requires distributors to use, in respect of all distributed generators connected to its network, the same reasonable efforts in processing and considering applications for connection

(b) Part 4 of the Commerce Act 1986, which requires disclosure of transactions between related and unrelated parties and symmetrical treatment of connecting parties.

13.31. Alongside the Authority's review of the Northland event the Minister has separately announced that Cabinet has committed to ease restrictions on distributors owning generation (some ownership restrictions exist in the Act in addition to the rules in Part 6A of the Code). The Authority will work with the Government to ensure a joined-up approach addresses all issues.

99 See: Feedback sought on Part 6A exemption and dispensation application from WEL Networks Limited | Electricity Authority (ea.govt.nz)

R6. The Authority should consider and consult on options to amend Part 6A of the Code, to ensure the Code better promotes reliability and efficiency alongside competition in the electricity industry for the long-term benefit of consumers. Consideration should be given to:

a. whether the rules in Part 6A should be retained given arm's length requirements in Part 6 of the Code and Part 4 of the Commerce Act 1986;

b. whether some of the rules in Part 6A should be removed or better targeted to reduce application and compliance costs, or

c. if the rules are retained, in whole or in part, whether the current 50MW threshold is appropriate.

Calculating the value of lost load

13.32. Value of lost load (VoLL) is a measure of the economic value given to an amount of electricity that is prevented from being delivered to consumers (ie. is 'unserved') as a result of a planned or unplanned outage of one or more components of the electricity supply chain. VoLL is therefore the economic cost attributed to such an outage. In other words, VoLL is a way to put a dollar value on the electricity that people miss out on during a power outage. It is commonly expressed as a dollar amount for each MWh ($/MWh) of electricity (load) not delivered.

13.33. Currently, VoLL is specified in the Code as being $20,000/MWh, or such other value as the Authority may determine in special cases.[100] This $20,000/MWh figure is generic; it does not reflect, for example:

(a) specific classes of electricity consumer

(b) specific locations

(c) particular times of the day

(d) seasons of the year, or

(e) duration of power outage.

13.34. In spite of the generic nature of this single point estimate for VoLL in the Code, it is a key concept in scarcity pricing that helps enhance a competitive spot price and security of supply. It also is critical to the grid owner, generators and distributors in their investment decisions.

13.35. The Authority commissioned reviews of the VoLL in 2010 and 2012; however, these reviews did not result in a change to the $20,000/MWh value that has been in place since 2004. The Market Development Advisory Group, in its 2023 report, *Price discovery in a renewables-based electricity system*,[101] recommended that the Authority review the VoLL:

100 Clause 4 of Schedule 12.2 of the Code (Grid Reliability Standards) provides the value of expected unserved energy as $20,000 per MWh, or such other value as the Authority may determine. The Authority may determine different values of expected unserved energy under this clause for a different purpose and for different times. If the Authority determines a value of expected unserved energy under this clause, the Authority must publish its determination.

101 See: Market Development Advisory Group, "Price Discovery in a Renewables-Based Electricity System", 11 December 2023

The Code includes various parameters that ultimately have an important influence on security of supply. These include the default shortage values (also called 'value of lost load' or VoLL) that apply if forced load shedding is required, and the economically determined security of supply standard. If the parameters are set too low, the system will be less reliable than consumers want (and vice versa).

13.36. As noted in section 10, different organisations gave a range of estimates of the cost impact of this incident on consumers, which adds weight to the need to review the VoLL settings.

13.37. The Authority will review the current VoLL settings to understand whether any changes are necessary or desirable. We understand Transpower commissioned PWC to review the VoLL for a specific application in 2018. It may be possible to leverage this work.

R7. The Authority should review and, if necessary, update the current VoLL settings in the Code to ensure these remain fit for purpose.

Amendments to section 46 of the Act

13.38. The Authority recommends that the Ministry of Business, Innovation, and Employment (MBIE) consider whether an amendment to section 46 of the Act is required.

13.39. Section 46 provides the Authority the power to require an industry participant to provide information, attend interviews, or give any other reasonable and necessary assistance to enable the Authority to carry out its functions and exercise its powers.

13.40. The Authority may exercise its powers under section 46 only when performing its monitoring, investigation and enforcement functions, or when conducting a review at the request of the Minister under section 18.

13.41. The information gathering powers in section 46 are critical to the Authority's effective performance of its functions. This in turn supports a stable investment framework and regulatory environment. In this review, given the time available to the Authority to complete this review, and to ensure a prompt response, the Authority issued five section 46 notices to Transpower requiring the provision of information and assistance with this review. The Authority can require Transpower under section 46 to provide that information within a specified reasonable timeframe.

13.42. The limitations on the Authority's information gathering powers have, however, affected this review. The Authority does not have the power to require information or assistance from a non-participant, such as Omexom. Instead, we have had to rely on information requests to Transpower to obtain information it has received from Omexom. In addition, some information we requested has not been provided, specifically:

(a) notes from interviews with the workers onsite at tower 130 on 20 June conducted as part of Transpower's investigation (the interviews were carried out on the basis that the records would be kept confidential, and interviewees were advised of this—legal privilege was claimed over these notes)

(b) Omexom's draft ICAM means Incident Cause Analysis Method and report.

13.43. Omexom is contractually required to provide Transpower with an ICAM report following a significant event such as the collapse of tower 130.[102] ICAM is a process used to identify the root causes and contributing factors of an incident. We consider the ICAM report to be directly relevant to this review, the scope of which is to determine the cause(s), response, and lessons learnt.

13.44. A draft ICAM report was first provided to Transpower on 20 August 2024. However, Omexom claimed level privilege over the report and declined to waive that privilege. The Authority only received confirmation that the draft ICAM report was provided to Transpower on 26 August 2024. While we do not necessarily agree that legal privilege applies to the ICAM report, this did not allow the Authority sufficient time to consider the basis on which legal privilege was claimed and, if appropriate, challenge it, in time for the ICAM report to be of any value for this review.

13.45. It is noted however, that Omexom management were very accessible and met with us to answer our questions as part of this review.

13.46. The limitations on the Authority's information gathering powers have wider implications beyond the issues identified in this review. There are various entities that, while not industry participants, perform work related to the electricity sector, particularly service providers and contractors. We expect there will be further instances in future where the assistance or information non-participants have will be relevant to the Authority's monitoring, compliance and enforcement functions, or to future section 18 reviews.

13.47. The Authority considers it would be more efficient and effective for the Authority to have powers to require information and obtain assistance from non-participants. The Authority's powers under section 46 are already constrained by section 45 which only allows us to use section 46 for a particular purpose (monitoring functions, compliance functions or section 18 review).

13.48. There are other ways in which the Authority's information gathering powers are limited compared to other, comparable regulators. For example, while a failure to comply with section 46 can be treated as a breach of the Code, there is no complementary penalty for obstructing the Authority's exercise of its powers by attempting to deceive or knowingly mislead the Authority. Such provisions are common in other regulatory regimes.[103]

13.49. The Authority therefore recommends MBIE review section 46 of the Act to ensure that the Authority has the appropriate powers to perform its functions effectively.

R8. **MBIE should review section 46 of the Act to ensure that the Authority has the necessary tools to effectively perform its functions, including the power to require information from non-participants, and to ensure effective compliance with the Authority's information gathering powers so that the Authority can have confidence in information provided.**

102 In accordance with Transpower's service specification, *Reporting by Service Providers, Contractors and Consultants*, TP.SS 01.10, which is a performance requirement under the master contract between Transpower and Omexom, at 12.6.

103 See for example section 103(2) of the Commerce Act 1986, section 61 of the Financial Markets Authority Act 2011.

14. Planning and undertaking baseplate refurbishment work

Maintenance planning specific to the Northland event

14.1. There is nothing to indicate shortcomings in Transpower's maintenance planning procedures in relation to the Northland event.

14.2. The planned outage coordination process in the Code exists to enable outages to be coordinated to minimise impacts on normal electricity supply operations.

14.3. The fact that two different maintenance activities were taking place simultaneously on the Henderson – Marsden A line and while Northland was on N security, would not normally have been an issue.[104] This is because baseplate refurbishment work is considered low risk if good industry practice is followed.

14.4. In any event, the tower collapse would have caused both circuits to trip if they had both been in service at the time of the incident.

14.5. The 110 kV network split in place (due to Bream Bay – Huapai circuit 1 being out of service) had the additional benefit of retaining supply to Wellsford and Maungaturoto. This is because, had the split not been in place at the time of the event, the tower collapse could have caused the 110 kV circuits to overload and trip in an unpredictable manner.

Technical specifications and work procedures for baseplate refurbishment require revision

14.6. Transpower's documents for baseplate refurbishment did not address the risks associated with the removal of hold down nuts or specify a process for the removal of the nuts. The technical specifications are primarily outcome driven. They specify the outcome the service providers are to achieve, rather than the process to carry out the task.[105]

14.7. Transpower does require all work to be done to 'good industry practice' under the master contract. However, we do not consider that this requirement alone is adequate in terms of requirements for how this work should have been undertaken.

14.8. As grid owner, Transpower is responsible for ensuring critical assets are maintained safely and appropriately. Transpower also has a responsibility under the master contract to provide all information reasonably required by the service provider. While the service provider is responsible under the master contract for assessing and requesting the information it needs, the technical specifications Transpower requires its service providers to comply with should address critical elements of the work its service providers are undertaking, regardless.

104 N security is discussed in more detail in section 3 of this report.

105 A similar finding was made in the Transpower Investigation Report at paragraph 4.42.

14.9. We consider that Transpower's technical specifications for this type of work must, at least, address the specific risk to tower stability if too many nuts are removed at the same time, and suggest some controls to address this risk, such as only removing a prescribed number of nuts at a time, or only removing nuts from one leg at a time. It should also be clear exactly when engineering assessments should be obtained for baseplate refurbishment work (specifically addressing whether this depends on the type or condition of the tower, or the number of bolts removed).

14.10. Transpower should revise its technical specifications in conjunction with its service providers, who have developed different work procedures for this type of work. It is critical that an agreed best practice for this type of work is identified, agreed, and followed.

14.11. We also recommend Transpower undertake a wider review of its library of documents that set the technical specifications for work performed on the grid. A risk-based framework should be used to determine high priority areas where these requirements should be reviewed and revised where appropriate. The risk-based framework should consider the risk of harm from human error or departure from good industry practice when work is undertaken, both in terms of health and safety of workers and risk to the power system.

14.12. When reviewing technical specifications in high priority areas Transpower should consider whether it should develop its own SMP for this work, as opposed to requiring service providers to prepare their own work procedures. A SMP number was allocated several years ago for a maintenance procedure for baseplate foundation refurbishment, but this was not progressed. As noted above SMPs are typically provided for high volume work. We think they should also be considered for high risk or high priority work, such as work on critical assets like transmission towers.

R9. Transpower should revise its technical specifications for baseplate refurbishment to include a process for removal of hold down nuts, and otherwise ensure they adequately identify all other risks and appropriate controls for baseplate refurbishment.

R10. To address the existing inconsistencies in service provider work procedures, Transpower should require its service providers to review and revise their work procedures for baseplate refurbishment to ensure they align with any revisions to Transpower's technical specifications made under R9.

R11. Transpower should undertake a wider review of its technical specifications for work performed on the grid, using a risk-based framework to determine high priority areas for review and, if necessary, revision, to ensure its technical specifications are fit for purpose.

Grid Skills training

14.13. Transpower's Grid Skills training is an important element in ensuring worker competence. While training cannot foresee and address every possible risk and is not a substitute for the exercise of reasonable skill and care by workers on site, service providers should be able to rely on Grid Skills training to cover critical areas of work they are contracted by Transpower to undertake.

14.14. Grid Skills training on foundation work was inadequate for the purposes of baseplate refurbishment work. It did not cover critical areas relevant to the direct cause of the collapse of tower 130. We recommend that this training be revised and updated to ensure all relevant risks and critical elements for baseplate refurbishment are covered, including but not limited to, the removal of hold down nuts.

14.15. We also recommend Transpower undertake a wider review of its Grid Skills training curriculum using a risk-based framework to determine high priority areas where training programmes should be reviewed and revised where appropriate. The risk-based framework should consider the risk of harm from human error or a failure to follow good industry practice when work is carried out, both in terms of health and safety of workers and risk to the power system.

R12. Grid Skills training for foundation work must be revised and updated to address the existing gaps in relation to the risks of, and process for, removal of hold down nuts from tower foundation baseplates, and ensure all other relevant risks and critical elements for baseplate refurbishment work are covered.

R13. Transpower should undertake a wider review of its Grid Skills training curriculum using a risk-based framework to determine high priority areas for review and, if necessary, revision, to ensure Grid Skills training addresses all critical risks, and procedures to mitigate such risks.

Transpower training requirements

14.16. Service providers must comply with Transpower's service specifications for minimum training and competency requirements. These set out core training requirements for work being undertaken on Transpower assets, but these do not require the completion of Grid Skills foundation training before undertaking such work on the grid.

14.17. Transpower has advised that it does require foundations training to be carried out before a person can be deemed competent to carry out foundations work (whether provided by Grid Skills or otherwise). This is not, however, apparent from the relevant service specifications, which simply records that the minimum requirements are 'relevant work task competencies and competency certificate'.[106]

14.18. Given the high risk associated with foundation work if there is a failure to follow good industry practice, we consider Transpower should require Grid Skills foundation training to be completed before a person can be regarded as competent to carry out foundation maintenance work (including baseplate refurbishment) unsupervised, or before a person can supervise others in the performance of such work. Transpower should also require refresher foundation training at appropriate intervals, as it does for other types of competencies.

106 Transpower, *Minimum Training and Competency requirements for Transpower field work*, TP.SS 06.25, Issue 11, December 2022, section 2.2.

14.19. We also recommend that Transpower conduct a wider review of its training requirements to determine whether other specific Grid Skills training courses should be mandated before a person undertakes certain work on its assets. This review should adopt a risk-based approach to identify work that poses a high risk of harm (in terms of safety or security of supply) in the event of human error or a failure to comply with good industry practice.

14.20. As part of this review, Transpower should consider whether certain supervision training should be required before a service provider can assess a person as being competent to supervise others, and whether there should be a requirement for refresher training for specific Grid Skills training courses after a certain period of time, in relation to any other type of work.

R14. Transpower should mandate Grid Skills foundation training be completed before a person carries out foundation maintenance work, including baseplate refurbishment, unsupervised or supervises others in the performance of such work, and should require refresher training at regular intervals to ensure worker competency remains current.

R15. Transpower should undertake a wider review of its minimum training and competency requirements to determine whether any other training courses should be mandated, and refresher training required, in relation to any work it assesses as high priority or high risk, before a person can undertake such work unsupervised or supervise others in such work.

Service provider training and supervision arrangements

14.21. We have found that there was a lack of adequate training and supervision of the maintenance crew working on tower 130. These factors combined were an underlying cause of the collapse of the transmission tower. They led to a departure from Omexom's standard practice, which was to only remove nuts from one tower leg at a time.

14.22. Transpower's service specifications for minimum training and competency require service providers to ensure that workers receive appropriate training and that, until competency can be demonstrated, adequate supervision is in place. What constitutes 'adequate' supervision will depend on the work involved, and the degree of risk both in terms of health and safety risk and risk to security of supply. Transpower defines 4 levels of supervision depending on competency level and task risk, ranging from direct supervision to self-supervision.

14.23. We recommend that Omexom review its training policies and procedures for new crew and site supervisors against Transpower's service specifications, to ensure its workers are properly trained and their competency properly assessed for the work they are expected to undertake.

14.24. We also recommend that Omexom reviews its policies and procedures for assigning supervisor responsibilities on site. These should ensure that adequate supervision, particularly of trainee workers, is in place in each case, and that this meets Transpower's service specifications.

14.25. We recommend that Omexom makes the results of these reviews available to the Authority so that we can monitor progress against these recommendations.

R16. Omexom should review its training policies and procedures for new crew and site supervisors to ensure adequate training is provided before undertaking work on the grid.

R17. Omexom should review its site supervision policies and procedures to ensure adequate supervision of all workers not yet competent.

R18. Omexom should make the results of its reviews under R16 and R17 available to the Authority.

15. Improving grid maintenance contracting arrangements and assurance processes

15.1. This review has involved an examination of the contracting arrangements in place between Transpower and Omexom, and Transpower's assurance and management processes to ensure work carried out on the grid meets appropriate quality standards.

Transpower's contracting arrangements were generally comprehensive

15.2. The contractual framework in place between Transpower and its service providers is comprehensive, but we recommend improvements to how Transpower measures and monitors contract performance.

15.3. The master contract between Transpower and Omexom runs to over 200 pages and clearly defines the responsibilities of each party. It addresses those matters that would be expected in a contract of this type, such as liability, indemnification, insurance, breach remediation and dispute resolution. We also note that Transpower had procedures in place to seek legal assurance as to the adequacy of the contract before it was finalised.

15.4. It is significant that Transpower's contracting arrangements grant exclusive rights to perform specified maintenance work in a region to a sole service provider. Without the proper controls, this could create an unacceptable risk to the quality and timeliness of the services provided, as Transpower would be unable to simply choose to use another contractor for the specified work if the service provider's performance proved unacceptable, without first terminating the contract.

15.5. The checks and balances on service provider performance in the master contract have, however, clearly been developed with this risk in mind. In particular, under the contract arrangements:

(a) the service provider must comply with all performance requirements (including technical service specifications) specified by Transpower in the contract or from time to time, and Transpower can modify these performance requirements when it considers it necessary to do so (within reasonable bounds)

(b) the service provider has general responsibilities to use all due skill and care, comply with good industry practice, maintain quality assurance and risk management systems, and have policies in place to promote and implement continuous improvement

(c) the service provider must meet general competency requirements and ensure that:

(i) all workers are properly trained and competent for the tasks they undertake

(iI) all workers not yet competent are adequately supervised until they have completed appropriate training and have gained sufficient experience and knowledge to be deemed competent for the relevant tasks and associated risks, and

(iii) supervisors are suitably experienced and qualified to take full responsibility for the safety, work standards and conduct of the personnel under their supervision

(d) service providers must self-audit their compliance with the contract and performance standards and report results to Transpower under a self-audit programme acceptable to Transpower

(e) Transpower has the power to undertake compliance audits at its discretion, and the service provider must promptly take corrective action to rectify any performance failure identified in the audit

(f) the service provider must use all reasonable endeavours to achieve each KPI and administrative performance requirement, and is incentivised to achieve KPIs so through a performance bonus/service credit scheme.

(g) Transpower can suspend any particular work package and can appoint a third party to perform that work instead, if the service provider has committed a significant breach in respect of that work package, or there is a real risk of it doing so, or if one of the specified grounds for termination of the contracts by Transpower arises.[107]

How Transpower monitors and measures contract performance can be improved

15.6. While Transpower maintains good contractual documentation with its service providers, this alone is insufficient to discharge its responsibilities as grid owner. Imposing obligations on service providers to comply with quality requirements in service contracts is of little value in practice if compliance with them is not properly measured, monitored and action taken when breaches are identified.

15.7. It is incumbent on Transpower to use the tools it has to actively manage and oversee its service providers' performance. Not only is this good industry practice, but consumers (who bear the ultimate cost) should be able to expect such tools are meaningfully used.

15.8. It is also incumbent on Transpower as grid owner to establish and maintain a culture that focuses on proactive risk identification, assessment and management, promoting best practice and continuous improvement, and accountability at all levels. This includes fostering an environment where any concerns are promptly addressed, rigorous oversight is maintained and lessons from past-incidents are integrated into daily operations to prevent future failures. This report has not considered Transpower's culture as a standalone issue, but the Authority is concerned that, as we have outlined in section 8, Transpower missed an opportunity to take action to address concerns relating to baseplate refurbishment raised by staff in 2021. The failure to respond to, or action, the concerns raised does not align with the principles of proactive risk management and continuous improvement that we would expect to see within Transpower.

15.9. There were multiple contributing factors to the collapse of tower 130 that appear to have not met Transpower's requirements under the master contract, relating to training and supervision of workers, adherence to good industry practice, and failure to assess the tower loads as required under the relevant service specification. It also appears that the departure from standard practice may have occurred earlier in June. This raises a question of whether any of these issues should have been identified by Transpower's assurance processes it uses to monitor contract performance.

107 By operation of clause 33.1(a) of the master contract and clause 2.3 of the regional service contract. Transpower can also suspend services under the contracts and assign these to a third party if one of the specified grounds for termination of the contracts by Transpower arises.

15.10. We consider there is a need for improvements to Transpower's assurance processes and how it measures contract performance to improve Transpower's focus on the quality of work its service providers undertake, rather than just focusing on the outcome of the work. As this event illustrates, focusing primarily on outcome means that failures to adhere to quality requirements such as good industry practice and Transpower technical specifications can be missed.

Assurance processes in relation to service provider work procedures

15.11. As we found above, Transpower's assurance processes do not include any comprehensive assessment or approval of service provider work procedures.

15.12. We accept that it is appropriate that service providers should be responsible for developing their own work procedures. We also appreciate that it may not be practical for Transpower to review and approve all work procedures and associated policies developed by each of its service providers. We understand that service providers will likely have hundreds of work procedures they use for different work they perform.

15.13. However, we do consider that quality assurance processes in relation to work procedures need to improve. Transpower, as grid owner, is ultimately responsible for ensuring the quality of work undertaken on its assets. It is also in a unique position because it has access to the different work procedures used in different regions for substantially the same work, and it has the expertise to be able to critically assess different work procedures and identify best practice.

15.14. In this case, it is apparent that no best practice had emerged in relation to the process for removing nuts as part of baseplate refurbishment work. The work procedures we have reviewed all adopt different approaches. None of the different approaches were identified in field audits as being deficient in respect of the process for removing hold down nuts. The Transpower Investigation Report also highlights the difference in views on best practice that emerged among industry experts after the event. It cites different views within Transpower (ranging from no more than one nut should be removed at one time, to no more than half the nuts on a leg should be removed at one time).[108] It also cites differing views among Omexom and Transpower staff as to whether compliance with Transpower's technical requirements required an engineering assessment before undertaking baseplate refurbishment work.[109]

15.15. Had these service provider work procedures been reviewed together, a consistent, best practice could have been developed. Such a review would have also provided an opportunity to identify any room for improvement in Transpower's own technical specifications.

15.16. While we do not suggest Transpower should be responsible for approving all work procedures, we do recommend that Transpower review its assurance processes in relation to service provider work procedures and consider how it can more effectively identify and promote best practice across its service providers. A risk-based framework should be used to determine high priority areas where service provider work procedures should be reviewed. The risk-based framework should consider the risk of harm from human error when work is undertaken, both in terms of health and safety of workers and risk to the power system.

108 Transpower Investigation Report at paragraph 8.16.

109 Transpower Investigation Report at paragraph 4.41(b).

R19. Transpower should review its assurance processes in relation to service provider work procedures and consider how it can more effectively promote best practice consistently across service providers.

Requiring and reviewing evidence of work undertaken

15.17. It is important that Transpower's management and assurance processes provide adequate assurance that its technical specifications are being followed while the work is being undertaken. The end result or completed work should not be the only focus. Field audits do provide some assurance, as they observe work being undertaken onsite. But audits are necessarily limited in terms of frequency, and they cannot assess every element or activity undertaken on any given site.

15.18. The Transpower Investigation Report found that photographs taken by the service provider during jobs are not routinely provided at the end of each individual job. Only 'before' and 'after' photos are uploaded to Transpower's information system, Recollect, and able to be reviewed by Transpower at the end of each job. Photos taken during work can be provided on request at the end of the work programme.

15.19. We consider that it would be preferable for Transpower to require 'during' photos or other evidence such as whole of site videos to be uploaded at the same time as before and after photos. That would mean these photos or videos can be reviewed when Transpower is checking that the work in relation to each job has been completed. It would provide an opportunity for Transpower to identify any obvious hazards, risks or departures from good industry practice that are observable from such visual evidence alone.

R20. Transpower should consider requiring its service providers to submit 'during' photographs at the completion of each job alongside 'before' and 'after' photographs, at least in relation to work that carries a high risk if Transpower's technical specifications are not followed during the work.

Planning audits around specific work

15.20. Transpower currently lacks a specific audit plan for field audits of tower foundation maintenance work. If the plans for field audits are not tailored to the specific maintenance tasks, there is the potential for critical errors to go undetected, potentially leading to outcomes that put key assets at risk.

15.21. To maximise the effectiveness and value of these audits, Transpower should establish a specific work plan for field audits of tower foundation work and other critical maintenance activities where non-compliance with Transpower's technical specifications could result in a high risk of harm or impact to consumers.

R21. Transpower should create a specific plan for field audits of tower foundation maintenance work and undertake a wider review of its plans for field audits of all maintenance work to determine high priority areas for review and create specific plans for field audits of maintenance work which has the potential to result in a high risk of harm.

Competency certificates

15.22. Transpower requires all persons entering controlled or restricted areas, and/or carrying out activities on or near Transpower assets or other power system equipment, to have a current competency certificate for that activity.[110]

15.23. A competency certificate is a certificate endorsed by an employer that defines the functions an employee is competent to undertake.[111] Transpower requires that service providers ensure that workers only carry out activities for which they are competent and as specified in the competency certificate.[112] Transpower's service specifications also require that competency certificates shall only be issued:

(a) following satisfactory completion of training as endorsed by an approved trainer, or

(b) following satisfactory completion of refresher training,

(c) and when the worker has undergone sufficient experience in the discipline (under supervision) that demonstrates to the employer that the competency certificate should be issued.

15.24. We have reviewed the competency certificates for the three team members carrying out the maintenance work on Tower 130 on 20 June 2024. They are difficult to interpret:

(a) The competency certificates have space to list training under the headings 'Compliance', 'Competency', 'Qualification' and 'Skill'. None of the competency certificates list any competencies under the heading entitled 'Competency' – this section is blank on each. Omexom has noted that competencies can be recorded under the Compliance, Qualification and Skill headings. There are skills and compliances listed on the certificates for the team leader and TA2, and forklift compliances listed for TA1. All are signed by the business unit manager under the words 'I hereby certify that the person named above was properly trained and is currently competent'.

(b) The team leader's competency certificate records a designation of 'LSP Transmission Line Mechanic'. The competency certificates for TA1 and TA2 do not list any designations.

(c) The competency certificate for TA1 is dated 15 July 2024. It does not appear TA1 had a been issued with a competency certificate by 20 June, when the work was undertaken on Tower 130. Omexom has advised that this was because it was waiting for TA1's NZQA record. TA1 had started with Omexom in May 2024.

110 Under the grid services master contract.

111 TP.SS 06.25.

112 TP.SS 06.25.

15.25. Reviewing the competency certificates of workers on site is an important assurance control and is part of any field audit. Auditors conducting field audits are expected to check whether competency certificates are available on site, are current and relevant to the work being performed, whether the requirements of competency certification are met and align to the requirement of the relevant standard maintenance procedure or work procedure, and whether there is effective supervision of employees without the required competencies.

15.26. Competency certificates can also play a key role in service provider assurance and planning processes. Omexom have told us that competency certificates are used by their staff when scheduling work to determine who should do what work.

15.27. The difficulties with the competency certificates we have reviewed suggest that improvements could be made to the specifications for competency certificates so that they more clearly identify the scope of the certification – that is, what work the person is certified as competent to undertake. This could assist service provider work scheduling as well as ensuring that auditors can more effectively determine whether workers are certified as competent for the work they are carrying out.

R22. Transpower should review its requirements for competency certificates to ensure that competency certificates provide sufficient detail of a person's scope of competency so as to be an effective assurance control.

No clear reporting or escalation procedure for service provider non-compliance

15.28. Transpower's assurance process does not include a clear framework for escalating instances of service provider non-compliance with Transpower's quality requirements under the contracting arrangements, such as the requirement for good industry practice and compliance with Transpower's technical specifications, identified through oversight (including field audits). There is also no clear framework for regular reporting on non-compliance trends to Transpower's Board and senior management.

15.29. This contrasts with Transpower's detailed policy for health and safety incidents that includes a clear incident escalation framework under which high risk incidents are notified to the Chief Executive and Board. The Board also receives monthly health and safety reports that detail health and safety performance, incidents, action arising from any ICAM reports and their respective status.

15.30. Service provider non-compliance with quality requirements are not escalated in the same way. Instead, Transpower's Quality and Compliance team provide monthly audit programme reporting to management, which provides 'a measure of compliance to the audit process as well as identifying insights and trends' in service provider performance.[113] Escalation to the Transpower Board is only on an ad hoc basis, when warranted. There does not seem to be any formalised, regular reporting of trends in terms of the number, significance and type of non-compliance events identified and corrective actions taken.

113 TP.SS 01.20 page 5

15.31. While not the case in relation to the Northland event, sometimes the best indicator of the risk of significant non-compliance is a pattern of small non-compliance events. We consider it would be appropriate for the Board to have some visibility of overall performance by its service providers, at least on an annual basis. This would provide opportunities for Board governance and oversight, and for identifying trends that could be addressed through targeted action, such as refresher training or focused auditing.

R23. Transpower should review its policies on escalation of service provider non-compliance events, and regular reporting on the results of its quality assurance processes in relation to each service provider, to ensure the Transpower Board and senior management can exercise effective governance and oversight.

KPIs for service delivery should measure quality of work performed

15.32. The master contract includes financial incentives for service providers to achieve its KPIs, which include a KPI for safety and for service delivery. Performance against the safety KPI is assessed in part through critical control site audits. These audits provide assurance that the service provider has deployed the appropriate critical controls to meet their obligations relating to health and safety under the master agreement.

15.33. The service delivery KPI is intended to assess service provider performance 'to deliver the work plan to the required quality'. However, performance against the service delivery KPI measured by 2-year work schedule accuracy, 4-month work schedule delivery, and annual outage plan accuracy. These measure whether the work is completed within the agreed timeframes. Compliance with quality requirements under the contracting arrangements, such as the requirement for good industry practice and Transpower's technical specifications, is not measured as part of this KPI.

15.34. The way the service delivery KPI is measured could risk a lack a focus on the quality of the services performed and whether they meet the quality requirements under the master contract. We expect that Transpower will only assess work as complete if it considers the work was satisfactorily completed. However, as the event reveals, failure in the way in which the work is carried out – as opposed to the quality of the completed work – may not be apparent from this indicator alone.

15.35. We consider that there is room for improving how Transpower measures quality under the service delivery KPI. As we discussed above, Transpower has a comprehensive assurance process in place that includes regular field audits to assess compliance with Transpower requirements. Building in compliance audit results into the service delivery KPI could focus service providers not only on meeting service delivery targets but also on ensuring their work practices meet Transpower's quality requirements. This could help ensure good industry practice is not compromised or deprioritised to meet delivery timeframes (although we note that this was not an identified issue in this situation).

R24. Transpower should review its KPIs in its service provider contracts and how they are measured to ensure they include a focus on compliance with Transpower's quality requirements when the work is carried out.

16. Communications

16.1. There are two lanes for communication: operational and public.

Operational communications

16.2. The primary operational communication channels are between coordinators and operators staffing the control rooms of the system operator (NCC) and asset owners, and between those of the grid owner (NGOC) and other asset owners (distributors, generators and large direct connect consumers).

16.3. The minimum requirements for operational communications are set out in Technical Code C of Schedule 8.3 of Part 8 of the Code. These are designed to assist the system operator to plan to comply, and to comply, with the principal performance obligations and the dispatch objective.

16.4. The requirements include that:

(a) voice and electronic communications must be logged

(b) every voice instruction must be repeated back by the person receiving the instruction and confirmed by the person giving the instruction before the instruction is actioned (clause 3(1))

(c) parties must nominate and advise each other of the preferred points of contact and the alternative points of contact, alternative points of contact only to be used if the preferred points of contact are not available (clause 3(2))

(d) asset owners must nominate and advise the system operator of the person to receive instructions and formal notices (clause 3(2)).

Lessons learned from 9 August 2021 were key

16.5. We reviewed the recordings and transcripts of NCC's and NGOC's incoming and outgoing voice communications.

16.6. In all cases, calls followed the protocol specified in clause 3(1) of Technical Code C whereby instructions and information must be repeated back and confirmed to ensure they are correctly understood. This showed a significant improvement over the 9 August 2021 peak demand event and previous events, in which failure to follow correct communication protocols, including clause 3(1), was identified as a key weakness and contributing factor.[114] Correctly following communication protocols in the Northland event contributed to the smooth coordination of the restoration by the various parties involved.

16.7. Another recommendation from 9 August 2021 was 'Transpower should design and undertake pan-industry contingency exercises, monitored by the [Authority], sufficient to test processes, actions and communications, and to clarify responsibilities in a generation emergency.'[115]

114 9 August 2021 demand management event, Review under the Electricity Industry Act 2010, Phase 2, FINAL REPORT, 27 April 2022

115 Recommendation MBIE12 (and EA 1A), Appendix 1, 9 August 2021 demand management event, Review under the Electricity Industry Act 2010, Phase 2, FINAL REPORT, 27 April 2022

16.8. While the Northland event does not exactly fall into this category, the experience of working together gained through these exercises will undoubtedly have contributed to the smooth coordination of the restoration.

16.9. Overall, operational communications supported the timely restoration of supply to Northland, initially at reduced capacity and eventually at full capacity with normal N-1 security levels. This was expedited by having a pre-prepared contingency plan (PR-CP-638) for such a situation.

Opportunities for improvement

16.10. We are aware of one instance where a distributor (Vector) received conflicting information from Transpower through parallel channels, and as a result needed clarification about whether Transpower required them to manage load or not. The second (unofficial) channel was from a Vector senior manager to Transpower's EIMT.

16.11. This confusion may have been avoided if Transpower's official communications channels provided more regular updates with good clarity and certainty about what is likely to be required so that participants can prepare accordingly. This would have limited the need for Vector senior management to contact Transpower's EIMT. This is particularly important where a distributor has been advised of the potential for load shedding. If load shedding is required, distributors would need to take a number of steps to prepare for this including alerting additional staff in key roles, establishing IMTs, contacting retailers and any large customers the distributor maintains direct contact with, and providing appropriate social media updates.

Transpower's public communications

16.12. Maintaining consumers' trust and confidence in the electricity system during times of crisis is important to the on-going social licence under which participants in the system operate.

16.13. Clear, accurate and timely communication during a crisis allows impacted consumers to plan ahead and manage their individual situations as well as possible, and in a practical sense can assist managing demand.

16.14. These crisis situations need to be planned for, and for maximum effectiveness, rehearsed and methodically unpacked following both real and test events.

16.15. Overall Transpower's communications during the incident were of a generally acceptable standard with some examples of good practice and a couple of missed opportunities.

16.16. Pan industry exercises are essential to continue to test communications and consumer-facing responses. In section 12 of this report, we recommend that these be augmented with a regional contingent event. This will ensure a more targeted focus on communications in regional emergencies.

Appropriateness of the information

16.17. The information released was generally of a good standard and helpful to consumers, business and the media.

16.18. In addition, under the no surprises principle, the Minister's office was kept relatively well-informed of events as they unfolded in terms of both timing and level of detail given what was available.

16.19. One notable exception early in the event saw the Minister rely on information provided to inform media on Thursday afternoon that the timeline for restoring power was 'Friday evening at the earliest'.

16.20. While strictly correct, the situation was rapidly evolving and a plan was not fully-formed.

16.21. A few hours later Transpower notified the Minister's office that standing the tower back up was not an option and a significantly longer outage well into the weekend was likely given a new temporary tower was required. However, the media cycle had moved on, and this information was not passed on to consumers until the following day.

The timeliness of the information including the regularity of updates

16.22. When faced with a sudden onslaught of media requests in a crisis situation with limited initial information, Transpower's communications team did a good job overall responding to incoming media requests.

16.23. Despite a rapidly-changing environment, the communications team managed to field a lot of calls, arrange a number of interviews, brief and prepare senior staff, and produce information to go to out in press releases.

16.24. Northpower's communications were a textbook example of keeping customers in the loop. On the Thursday they posted 5 social media updates, including sharing Transpower statements, giving their customers confidence that the work was being prioritised, and power would be restored as fast as possible.

16.25. Eventually, across all platforms (social, mainstream and direct communications) once the repair plan was identified (Thursday late afternoon) the information communicated by Transpower began to be more specific and timeframes more accurate.

Any areas for improvement

16.26. The biggest communications error of the event was allowing the issue of compensation to run unchecked with businesses, setting up a series of expectations that were not able to be met. This created lasting ill-feeing in the Northland business community.

16.27. From very early in the event it should have been possible to foresee that impacted businesses would want to know if they could expect compensation for their costs due to the unplanned outage. It was also predictable that even the early media interviews would broach this question, and the implications of raising expectations around compensation payments could be significant.

16.28. Unfortunately, in the initial week or ten days following the event, Transpower gave some hope they would be recompensed.

16.29. On the morning of 24 June in an interview with Radio New Zealand, the Northland Chamber of Commerce cited Infometrics agreeing that the Chamber's assessment of the impact on businesses could be as high as $40-$60m. In the discussion about liability the Chamber suggested Transpower would be liable for the difference between Omexom's public liability insurance cover and the total cost.

16.30. Eleven days later, on 4 July, there was a meeting with Transpower and Northland business representatives where businesses left feeling the door was left open for compensation of some sort.[116]

16.31. The next morning on 5 July Transpower tried to dampen expectations and issued a statement specifically on compensation saying businesses would need to claim on their insurance. However, shutting it down two weeks after the initial event was to prove difficult.

16.32. It was clear this statement had little impact in managing expectations. As late as 8 July, Morning Report interviewed the Northland Chamber of Commerce's Darryn Fisher, who felt compensation discussions with Transpower were 'progressing well', discussing 'direct business compensation and how can we get to a reasonable number on that' and 'recognising on-going brand damage' to the region.

16.33. This issue is still not entirely resolved. It has clearly, and needlessly, damaged the relationship between Transpower and the Northland business community.

Retailers' communications with medically dependent consumers

16.34. Retailers' communications with medically dependent consumers appears to have been thorough and appropriate. Retailers reported contacting medically dependent consumers via text messages and telephone calls, and information on the outage was also provided through retailers' media platforms. Most retailers also advised us that they included vulnerable and pending/unconfirmed medically dependent consumers in their communications. In some cases, text messages were sent to out-of-date phone numbers and retailers advised that they were in the process of obtaining updated phone numbers for these consumers.

16.35. The Authority's Consumer Care Guidelines provide guidance for retailers' treatment of medically dependent consumers. Key elements of these guidelines are set out in Part Two of this report.

16.36. While the Authority has identified no issues in relation to retailers' communications with medically dependent consumers following the Northland event, the Authority's additional statutory objective is to protect the interests of domestic consumers and small business consumers in relation to the supply of electricity to those consumers. In line with that objective, the Authority has sought to enhance the protection of domestic and small business consumers, including by announcing the Authority's intention to mandate the Consumer Care Guidelines to become part of the Code, and by proposing amendments to the Code which will clarify retailers' obligations in relation to those consumers.

16.37. The Authority has recently published a consultation paper on a proposed amendment to mandate the Consumer Care Guidelines from 1 January 2025. The consultation also proposes operational improvements to provide retailers and distributors with clearer obligations on their consumer care responsibilities. These improvements are designed to make it easier for them to achieve the protections set out in the Consumer Care Guidelines by improving practicality and providing more operational flexibility.

116 Source Darren Fisher, RNZ 8 July.

17. Grid reliability standards remain appropriate

17.1. Consistent with the Authority's statutory objective, in essence the grid investment framework is designed to balance reliability and economic efficiency considerations.

17.2. If grid investment is too low, causing losses of supply to occur too frequently, the resulting economic costs to consumers will be very high. On the other hand, if the grid is "gold-plated", losses of supply will be infrequent, but consumers will have to bear the cost of the greater investment. Conceptually there is a sweet spot where the costs and benefits of an increment in grid investment balance.

17.3. Where population and economic activity are geographically concentrated, it will generally be economic to design the grid to a higher level of security, both because the costs of an outage are greater and because there is a larger customer base to spread the investment costs over.

17.4. For many regions, including Northland, it is unlikely to be economic for the grid design to exceed N-1 security.

17.5. Therefore, the Authority considers that the grid reliability standards remain appropriate. However, grid reliability can also be enhanced by "transmission alternatives" such as local generation and demand-side management.[117]

17.6. The same principle holds for development of distribution networks, which are experiencing increased numbers of connection requests for renewable generation. These seek to connect to local distribution networks, close to regional loads, whereas traditional grid-connected generation tends to be located in remote parts of the country. If such distributed generation is designed with suitable control systems, this presents an opportunity to enhance regional resilience. This was discussed in section 11.

17.7. New Zealand's GRS do not cover the risk that a transmission support structure (i.e. a tower or a pole) may collapse, tripping two circuits, because it is considered (and normally is) a very rare event not justifying pre-event management.

117 Code Part 1, Clause 1.1(1)

18. Assurances: actions to prevent recurrence under consideration by Transpower and Omexom

18.1. In discussions with Omexom and Transpower, and from information provided, it is evident that those parties have already implemented or are considering recommendations to improve processes and prevent recurrence of a similar event. Some of these actions are consistent with the recommendations the Authority has made in this report.

18.2. Omexom's view is that with any significant event, there are lessons and opportunities for improvement, and it is committed to making any necessary changes. Omexom has undertaken an organisational wide review to consider all aspects where there are opportunities for improvements. The actions that Omexom has undertaken or is considering include:

(a) further development of its work procedure for baseplate foundation maintenance to include a more prescriptive approach. A first draft is already underway

(b) working closely with Transpower to identify which specific work tasks require engineering assessments to ensure that they are carried out wherever appropriate

(c) working closely with Transpower to ensure that the Grid Skills foundation course provides the appropriate training and that all crew involved in baseplate foundation maintenance undertake that training

(d) undertaking a full competency review across all work activities carried out by Omexom on Transpower's network including how work is to be allocated to field crews

(e) reviewing the job handover/planning process to ensure competency, procedure, supervision and audit requirements are captured

(f) re-evaluating measures to ensure that critical risks are identified and effectively flow through to job planning

(g) reviewing supervision processes and prerequisites and reassessing what supervision is needed when a worker does not have the required level of competency for the work to be undertaken (this may occur, for example, where the worker is a trades assistant)

(h) reviewing their detailed quality assurance programme and documentation to ensure the correct competency, supervision and procedure checks are undertaken

(i) reviewing the content of tailgate meetings and morning briefings for maintenance work undertaken/to be undertaken to ensure they are sufficiently prescriptive and address all relevant matters

(j) reviewing risk awareness training

(k) implementing a three-stage culture/engagement programme that includes further site observations by managers, initiating a 'back-to-basics' campaign that encourages engagement between field crews and managers and implementing a programme across the company to enhance connectivity and engagement between all workers.

18.3. The Transpower Investigation Report contained a number of recommendations. Transpower also took action to mitigate potential risks before the completion of that report. The actions Transpower took shortly after the event, or which the Transpower Investigation Report recommends be taken, are as follows:

(a) all other work on tower structures was required to have confirmation of engineering checks completed before any work continued

(b) baseplate work was stopped across New Zealand on 21 June, and was to only be reinstated after a full internal review had been undertaken, and Transpower's investigation report, and the Authority's section 18 review had been completed

(c) Transpower should review and revise its drawings and specifications to ensure that in relation to baseplate refurbishment, they describe a methodology regarding nut removal and provide detailed recommendations as to when engineering advice should be obtained

(d) the Grid Skills Foundation training materials were to be reviewed and updated to specifically cover baseplate refurbishment work, to cover at least the following matters:

(i) the nature of the work

(i) engineering considerations relevant to such work, including tower types, foundation types, tower structural loadings, tower stability and restraint systems, and, if necessary, the engineering inputs which should be obtained before work is initiated

(i) how work should be carried out to ensure tower structural security is maintained at all times

(i) what risks or issues may arise around the time work is to commence or is underway

(e) ensure that availability of Grid Skills courses is actively and regularly made known to service providers

(f) require service providers to have all team leaders and supervisors assigned to work on baseplate refurbishments sites undertake the revised Grid Skills Foundation course as soon as practicable after the course becomes available

(g) encourage service providers to have all other people assigned to work on baseplate refurbishment work to take the course (after it becomes available) and require reassessment of competence before baseplate work is undertaken

(h) increase the scope of Transpower's service provider audits to verify (through sampling) that competency certificates accurately reflect the work a certificate holder actually undertakes on a site

(i) provide a refresher workshop for staff undertaking baseplate refurbishment work, with attendance required by at least one subject matter expert from each of Transpower's service providers

(j) require service providers to take a competency assessment

(k) require each service provider to produce for Transpower's review a new work method or procedure for baseplate refurbishment.

(l) review service provider quality assurance forms used by service providers to consider whether they should incorporate check points to record relevant work methods required to be followed on a job

(m) Transpower should initiate and complete its internal review which will cover Grid Skills training courses, the form of audits sheets for field auditors to use for tower foundation maintenance works, and how changes to its controlled documents will be incorporated into audit forms used by Transpower and health and safety personnel, as well as service providers' procedure and work method documents.

18.4. We endorse all the recommended actions undertaken or to be undertaken by both Transpower and Omexom, and consider those actions, in combination with the recommendations in this report, will deliver improvements in processes, identification and risk mitigation of maintenance work, and the resiliency of regions throughout New Zealand.

19. Implementation of recommendations

19.1. The Authority expects Transpower to provide the Authority with a plan of action to implement each of the relevant recommendations in this report. This should also include how Transpower will implement relevant recommendations made in the Transpower-commissioned investigation report and system operator report relating to the event. This action plan is expected within one month of the publication of this report.

19.2. We also expect Transpower to provide six-monthly progress reports to the Authority until the actions to implement the relevant recommendations are complete. The progress reports should also include actions taken by Transpower's service providers in response to the event and the relevant recommendations outlined in the various reports.

19.3. The Authority will actively monitor and report on progress.

R25. The Authority expects Transpower to provide the Authority with a plan of action to implement each of the relevant recommendations in this report and the relevant recommendations made in the Transpower-commissioned investigation report and system operator report relating to the event. This action plan is expected within one month of the publication of this report.

R26. The Authority expects Transpower to provide six-monthly progress reports to the Authority until the actions to implement the relevant recommendations in this report are complete. The progress reports should also include actions taken by Transpower's service providers in response to the event and the relevant recommendations outlined in the various reports.

Glossary

A glossary of commonly used terms in this report is set out below. For the sake of brevity, some of these terms are simplified versions of their legal meaning. References to legal definitions are included for completeness.

Act	Electricity Industry Act 2010
asset	Equipment or plant that is connected to or forms part of the grid or equipment or plant of an embedded generator (Code, clause 1.1).
Authority	the Electricity Authority Te Mana Hiko
BESS	battery energy storage system
circuit	A set of electrical conductors that carry electricity between two locations on the grid. Each circuit consists of three conductors or phases, functioning together as a unit. Circuits operate at a defined nominal voltage measured between the phases and can be strung on towers or poles.
Code	Electricity Industry Participation Code 2010
conductor	The aluminium/steel wire that carries electricity along a transmission circuit. Simplex and duplex refer to conductors of the same phase in a single or double configuration, respectively.
core grid	Those assets that comprise the main elements of the grid as determined by the Authority under Part 12 of the Code. The core grid typically includes assets operating at 220 kV and the more important ones operating at 110 kV and 66 kV.
distributed generation	Generating plant that is connected to a distribution network or to a consumer installation that is connected to a distribution network (Code, clause 1.1).
distributor	A business engaged in the distribution of electricity (Act, section 5). Distributors take electricity from the grid at GXPs, from where they reticulate it through their local networks to consumers.
EIMT	Transpower's executive incident management team
GOIMT	grid owner incident management team
grid	The system of transmission lines, substations and other works used to convey bulk electricity throughout New Zealand.

grid emergency	Includes a situation where, in the reasonable opinion of the system operator, urgent action is required in response one of the following events (Code, clause 1.1): a) the ability of the system operator to plan to comply, and to comply, with the principal performance obligations is at risk or is compromised b) public safety is at risk c) there is a risk of significant damage to assets d) independent action has been taken to restore the system operator's principal performance obligations e) an unsupplied demand situation.
grid owner	A person who owns or operates any part of the Grid (Code, clause 1.1). The vast majority of the grid is owned by Transpower, but small sections are owned by other parties. Transpower is the grid operator in respect of the entire grid.
grid reliability standards or GRS	The reliability requirements for the grid which are set out in Schedule 12.2 of the Code. The grid reliability standards require the core grid to be designed to meet an N-1 security standard.
GXP	Grid exit point, being a point of connection on the grid at which electricity predominantly flows out of the grid, either to a distributor or direct consumers (Code, clause 1.1).
ICAM	Incident Cause Analysis Method, a methodology that aims to distinguish an incident's visible symptoms from the underlying latent root causes.
industry participant or participant	A person, or a person belonging to a class of persons, identified in section 7 of the Act as being a participant in the electricity industry (Act, section 5).
kV	kilovolt, 1,000 volts, the unit of voltage
kW	kilowatt, 1,000 watts, a unit of electrical power (the rate at which electrical energy is generated or consumed)
kWh	kilowatt-hour, a unit of electrical energy, the amount of energy a 1 kW appliance would consume in one hour
line	Works used to convey electricity, usually a row of towers or poles that support one or two electrical circuits (Act, section 5).
MW	Megawatt, 1,000,000 watts, a unit of electrical power. Note: We have used the unit megawatt (MW) throughout this report, including in places where 'MW at unity power factor' would be more strictly correct. This is to keep power system capacity concepts reasonably non-technical for accessibility by a wide readership.
MWh	megawatt-hour, a unit of electrical energy

N security	The grid security level at which there is sufficient transmission capacity to meet the load, but there is no redundancy to survive the unplanned loss of a single transmission asset, such as a transmission circuit or transformer.
N-1 security	The grid security level at which there is sufficient redundancy to survive the loss of a single transmission asset, such as a transmission circuit or transformer, and still meet the load.
principal performance obligations	The principal performance obligations are those obligations on the system operator set out in clauses 7.2A to 7.2E of the Code. They mainly relate to security of supply and real time operation of the power system.
retailer	A business engaged in the sale of electricity to a consumer other than for the purpose of retail (Act, section 5).
SCADA	Supervisory Control and Data Acquisition System. Used by transmission and distribution operators to: a) provide network asset (eg circuit, transformer) status, voltage and current indications and b) exercise remote control of switchgear, such as circuit breakers.
service provider	A party who has entered an agreement with Transpower to provide grid maintenance services. Transpower has separate agreements with service providers in six regional service areas in New Zealand. Electrix Limited, trading as Omexom New Zealand, is Transpower's service provider in the Northland region.
system operator	The person who ensures the real-time co-ordination of the electricity system, which is Transpower, under section 8 of the Act (Act, section 5).
TA1 / TA2	The two trades assistants who were working at tower 130 on 20 June 2024 are referred to as TA1 and TA2 to protect their anonymity.
technical specifications	All technical specifications Transpower sets in relation to work on the grid, including specifications set in service specifications, technical drawings, standard maintenance procedures and other Transpower controlled documents.
tower 130	The 220 kV transmission tower on the Henderson – Marsden A line near Glorit that collapsed on 20 June 2024.
VoLL	Value of lost load. This is a way to put a dollar value on the electricity that people miss out on during a power outage, whether it's planned or unexpected. It measures how much it costs, in economic terms, when electricity doesn't reach homes or businesses. VoLL is currently specified in the Code as being $20,000/MWh. Note: in this report we also use the term VoLL to refer to the total economic costs of an outrage in dollars.

Appendix A Minister’s request and terms of reference for section 18 review

Hon Simeon Brown

Minister for Energy
Minister of Local Government
Minister of Transport
Minister for Auckland
Deputy Leader of the House

21 June 2024

Sarah Gillies

Sarah.Gillies@ea.govt.nz

Dear Sarah,

Request to undertake a section 18 review into the Northland transmission fault

As you are aware, on 20 June 2024 there was a significant transmission fault which resulted in Northland residents being without power. I am very concerned about the impact this had and would like to establish the facts of the matter.

I am writing to you to formally request that you undertake a section 18 review under the Electricity Industry Act 2010 into the Northland transmission fault.

Yours sincerely

Hon Simeon Brown
Minister for Energy

Private Bag 18041, Parliament Buildings, Wellington 6160, New Zealand | +64 4 817 6804 | s.brown@ministers.govt.nz

APPENDIX A

Hon Simeon Brown

Minister for Energy
Minister of Local Government
Minister of Transport
Minister for Auckland
Deputy Leader of the House

26 June 2024

Sarah Gillies

Sarah.Gillies@ea.govt.nz

Dear Sarah,

Terms of reference for Electricity Authority review of 20 June 2024 grid emergency under the Electricity Industry Act 2010

On 21 June 2024 I wrote to you requesting that you undertake a review, under section 18 the Electricity Industry Act 2010, into the 20 June event where a transmission tower fell resulting in significant loss of power in Northland.

The terms of reference of the review have now been established and are attached to this letter. The scope of the review is to understand and explain the cause(s) of the event, the response to the event and lessons that can be learnt from the event.

I request that you appoint an independent party to chair/head the review and that you consult with me on who that person is. I request that you provide a written report to me within 12 weeks of this request, in accordance with the scope and other matters set out in the attached terms of reference.

Yours sincerely

Hon Simeon Brown
Minister for Energy

Private Bag 18041, Parliament Buildings, Wellington 6160, New Zealand | +64 4 817 6804 | s.brown@ministers.govt.nz

Terms of reference for Electricity Authority review of 20 June 2024 grid emergency under the Electricity Industry Act 2010

Purpose of this document

Under section 18 of the Electricity Industry Act 2010 (the Act), the Minister for Energy (the Minister) has asked the Electricity Authority to review and report on the grid emergency event that occurred on 20 June 2024 which resulted in significant power outages in the Northland region.

This document describes the scope, conduct and output for this review.

Background

Around 11am on 20 June 2024, a 220kV transmission tower in a field near Glorit fell. Transpower has stated that this occurred when the nuts securing the tower to its base plate on three legs were removed causing the tower to lift off the base plate and fall.

Consequently, power was cut to Bream Bay, Kaikohe, Maungatapere, and Marsden. This represents most of Northpower and Top Energy's networks.

Power was mostly restored by the evening through the 110kV network, although consumers were asked to conserve power.

There was an economic impact as businesses were unable to trade. In addition, any unplanned outage puts medically dependent consumers at risk.

Transpower has appointed an external party to undertake a full investigation into the cause of the fallen tower.

Intent of this review

The Authority's statutory objectives are set out in the Electricity Industry Act 2010. The Authority's main objective has three main parts focused on: competition, reliability and operational efficiency. The reliability objective provides the starting point for this Inquiry, with efficient levels of reliability a key consideration.

Scope of the review

The scope of the review is to understand and explain the cause(s) of the event, the response to the event and lessons that can be learnt from the event.

The Authority will consider the following questions in carrying out its review and preparing its report:

1. What was the cause/s of the event?
2. What were Transpower's planning, risk identification, risk assessment, risk mitigation and residual risk assessment processes for any transmission maintenance work related to the event? This should include consideration of:
    - maintenance instructions, asset condition monitoring and assessment, and assurance procedures,

- any relevant previous faults and failures of assets supplying the Northland region, and their disclosure,
- the timing of the works being carried out given security of supply risks, including if other assets supplying Northland were out at the same time.

3. Do Transpower's assurance and management processes, for activities carried out by contractors, conform to good industry practice? Are any aspects of Transpower contracting arrangements likely to lead to adverse outcomes or unintended consequences?
4. What was the impact of local generation capacity on pre-maintenance planning and on recovery following the event?
5. What communications were there between Transpower, lines companies, other participants, and consumers regarding any planned transmission work related to the event and the increased risk of outage?
6. After the tower fell, were there appropriate communications from and between Transpower, lines companies, retailers, businesses and the public?
7. What actions were taken to restore supply and did these conform to good industry practice?
8. What lessons can be learnt from the recovery from the event including the actions taken by the grid owner, system operator and other participants. For example, the use of strategic spares, communications, and load management? This includes the availability of temporary towers, spares and other critical assets, their location, and timeframes to deploy these.
9. How quickly does Transpower permanently rectify failures that do occur? How does this compare with comparable overseas jurisdictions?
10. What lessons were learnt from similar events and were lessons learnt acted on in this event?
11. How did retailers care for their medically dependent consumers during the event?
12. Does the Electricity Industry Participation Code (the Code) provide appropriate provisions for such circumstances?
13. What are the grid reliability standards into Northland (under business as usual and under maintenance conditions), and how does this compare with other parts of New Zealand?
14. Do the grid reliability standards in the Code need to be reviewed, particularly to address single points of failure?
15. More broadly does this event highlight improvements that should be made to electricity system resilience?
16. Are there any other lessons learned or recommended improvements?

The Authority will also consider further questions that arise during the course of their review that are relevant to the scope of the review.

Section 18 states that if "the Authority considers that there are matters that fall outside the scope of the review but which it should nevertheless report on to the Minister, the Authority may include a report on those matters in the final report or in a separate report."

Consequently, this scope may expand to cover any other issues that emerge during the review that require investigation.

The Authority is expected to cooperate with any other reviews or investigations being undertaken into the event to extent as is reasonably practicable.

Conduct of the review

The Authority will appoint an independent party to chair/head the review.

The Authority will keep MBIE and the Minister up-to-date with the review as it progresses.

Output

The Authority will prepare a report for the Minister within 12 weeks from the date that the Minister requested the review.

A written report must incorporate all the details required to satisfy the intent and scope of the review.

As required by the Act, the Minister must make the report publicly available within 15 days of receiving the final report.

Appendix B Grid maintenance contracting arrangements and assurance and management processes

B.1. This appendix provides greater detail about the contracting arrangements in place between Transpower and its service providers relating to grid maintenance.

Contracting arrangements

B.2. Contracting arrangements between Transpower and its service providers comprise:

(a) a master grid services contract (master contract), which establishes the overall framework of the relationship and terms that apply to all services provided under separate service contracts and work package contracts

(b) service contracts, which establish the scope of services to be provided.

(c) work package contracts, which provide authorisation for the service provider to deliver certain works, usually specified in a work order.

Service provider to comply with performance requirements

B.3. One of the service provider's key responsibilities under the master contract is to comply with all applicable performance requirements when carrying out its activities in connection with the master contract specified by Transpower.

B.4. Performance requirements which include any service specifications,[118] standard maintenance procedures, standards or required policies or processes identified in the master contract or specified from time to time.

B.5. Transpower have developed a range of service specifications:

a. reporting requirements for service providers are set out in *TP.SS 01.01 – Reporting by Service Providers, Contractors and Consultants*

b. training and competency requirements for Transpower field work are set out in *TP.SS 06.25 Minimum Training and Competency requirements for Transpower field work*

c. the minimum health and safety requirements that service providers must meet when undertaking Transpower work is set out *TP.HSW 01.02 – Health and safety requirements for Transpower work*

d. technical specifications for work on the grid are contained in a range of Transpower controlled documents including service specifications, technical drawings and standard maintenance procedures. Documents relevant to baseplate refurbishment include:

i. TP.SS 02.98 Asset Maintenance Requirements

118 All documents labelled "TP.SS" or starting with "TP" are to corresponding Transpower Service Specifications.

ii. TP.SS 02.11 Maintenance and construction of steel towers and tower foundations

iii. Technical Drawing TE37252 Tower Baseplate Refurbishment Details

Reporting requirements

B.6. The service provider must comply with Transpower's service specifications for recording and reporting information relating to the provision of the services,[119] and must ensure its personnel attend regular and ad hoc meetings with Transpower as required.

B.7. Reporting requirements include updating Maximo for all work undertaken, once complete. Service providers also complete a monthly service provider report in the specified form that includes any asset performance/reliability issues, quality assurance non-conformance and remedial actions taken.

Audits

B.8. The service provider must have a self-audit programme to monitor its own levels of compliance, which it submits to Transpower in advance of each year. This must include quarterly reporting of the results of its self-audit of services provided under any service contract to Transpower's Service Contract Manager and Relationship Manager. Reports must identify any material instances of non-compliance and any corrective actions taken (or not). Transpower may reject a proposed programme but must not do so unreasonably.

B.9. In addition to self-audits, the master agreement provides for Transpower to conduct compliance audits to verify the extent to which the service provider is complying or has complied with the master agreement. A compliance audit may include a review of the conduct of any services at any site, or of any related records.

B.10. The scope and frequency of compliance audits is determined by Transpower at its absolute discretion. Transpower's service specifications specifies its processes for assurance of service provider performance.[120]

Relevant obligations under the regional service contract

B.11. More detailed requirements are set out in the regional service contract, including:

a. a requirement to maintain full and up to date records of the services in electronic form and using Maximo, Transpower's asset management system, including safety records, work procedures, drawings and relevant documentation and records required under the Performance Requirements

b. where necessary for a work package, the service provider must provide specialist engineering services as part of the work package.

119 Pursuant to clause 12.6 of the master contract. These service specifications are set out in Transpower, *Reporting By Service Providers, Contractors and Consultants*, TP.SS 01.01, Issue 23.1, November 2022.

120 Transpower, *Auditing: Performance*, TP.SS 01.20, Issue 5, August 2021.

Appendix C Northland Regional Electricity Development Plan

C.1. Transpower provided the following terms of reference for the Northland regional electricity development plan to the Authority on 23 August 2024.

Northpower TOP ENERGY Te Puna Hihiko TRANSPOWER Keeping the energy flowing

NORTHPOWER, TOP ENERGY, TRANSPOWER

Northland Regional Electricity Development Plan
TERMS OF REFERENCE

Role/Purpose: Empowering Te Tai Tokerau's Energy Future

This Terms of Reference (TOR) describes how Transpower, Northpower and Top Energy (the parties) propose to collaborate to align our strategic and operational priorities for the Northland region. We aim to ensure that all parties continue to deliver electricity transmission and distribution services while balancing price, resilience, security, and reliability of supply, now and in the future.

The parties intend to work together to produce a Northland Regional Electricity Development Plan (RDP) to support planning and investment decisions considering the wider regional context, operation, and maintenance considerations, as well as regional development goals. This work includes an agreed joint Engagement and Communication Strategy and related activities to support the development and publication of the RDP.

Regional Development Plan

The Northland RDP is a high-level outline of the essential electricity upgrades that are needed to support the region out to 2050 and beyond, including how the flexible use of electricity might influence the timing of the electricity system upgrades[1]. The RDP will not include distribution (township) level planning and will focus on the key higher voltage extensions from the transmission grid, whether they be Transpower, Top Energy or Northpower owned assets.

The purpose of the RDP is to communicate an integrated view of the electricity upgrades to a broad range of stakeholders and build confidence in the reliability and resilience in the electricity networks amongst stakeholders both now and into the future. The RDP will also demonstrate the investment decisions needed to ensure the planning, regulatory approval processes, asset procurement and project build for these upgrades are completed in a timely manner.

The RDP will use load growth forecasts driven by electrification of transport and industry, planned and potential development plans, population growth, new renewable generation investment and flexible demand analysis.

Background

The parties are focused on the long-term reliability and resilience of Northland's transmission and distribution networks.

As we prepare for growth and future electrification, decisions must be made that consider key drivers, such as:

[1] The RDP is intended to be a high-level outline. Therefore all planning information relied on to develop the RDP may also be high-level (detailed investigations may not have been conducted)

Northpower TOP ENERGY Te Puna Hihiko TRANSPOWER Keeping the energy flowing

- longer term recovery from extreme weather events and the tower failure event
- future impacts of climate change on assets
- existing constraints including the 110kV network capacity

Term

The Northland Regional Electricity Development Plan TOR will commence once signed by all parties and will expire with the written agreement of all parties.

Costs

Each party will bear its own costs for the work under this TOR. Technical work undertaken by any of the parties will be completed to concept assessment level only as required to identify the preferred options in the RDP. Any technical work beyond the concept assessment level will require an additional investigation funded separately.

Transpower will provide the resources required to coordinate and develop the RDP documents, Engagement & Communication Strategy documents including review by an external specialist resource familiar with Northland stakeholders before approval by the parties.

Roles and Responsibilities

Leadership Group

A Leadership Group comprised of Transpower, Northpower and Top Energy senior managers will oversee the Planning and Development Working Group. The Leadership Group will provide strategic oversight, set direction, and oversee risks. Additionally, the Group will define criteria for assessment and make key milestone decisions[2] on our broader approach in the context of Northland's development.

The Leadership Group will meet on an "as needs," with frequency to be assessed on an ongoing basis.

Planning and Development Working Group (PDWG)

The Planning and Development Working Group will be comprised of system planners, engineers, and customer and stakeholder engagement managers across both organisations. The PDWG will ensure a cohesive approach to our short, medium, and any long-term planning and development for the region. Short to medium-term challenges and constraints with each organisation's assets will be identified. The PDWG will:

- work through options
- assess feasibility, and
- identify risks and opportunities.

This information will be used to make recommendations to the Leadership Group. The PDWG will provide insights and consideration of any long-term planning decisions. Subject Matter Experts[3] (SMEs) will be required to provide input as the work progresses. This will also include development of an Engagement and Communication Strategy as well as the implementation of stakeholder engagement activity plans.

[2] Such as on strategy, opportunities, stakeholder engagement and messaging.
[3] For example, regulatory, environmental, property advisors, consenting specialists and communications.

The Planning and Development Working Group will meet fortnightly, with an aim to complete the exercise and identify preferred options for investment by 15 December 2024. A more detailed view of this timeline is located at the back of the document.

Development & Planning Overview

Outlined below are key focus areas that the parties will consider when formulating our high-level work programme:

EXPLORATION

- Agree high-level short- to medium-term planning assumptions, scenarios, and interfaces for joint planning.
- Agree scenario forecasts to GXP and zone substation level as required across the full planning continuum.
- Agree assessment criteria for the selection of options.

TECHNICAL ANALYSIS

- Identify investment triggers driven by condition (reliability), security, resilience, and criticality to maintain a reliable electricity supply into the region.
- Consider operational practices on the current network regarding outage co-ordination and how redundancy can be maintained while maintenance and repairs are undertaken.
- Identify and investigate the potential of introducing alternative ways of connecting new generation into the region, exploring the potential of making the region wholly or partly self-sufficient during outage events.
- Prioritise options using multi-criteria assessment, aligning investments where possible to achieve efficiencies.

PLAN DEVELOPMENT

- Develop an agreed high-level short- to medium-term joint plan, including reference to long-term requirements, for Transpower, Northpower and Top Energy.
- Engage with key stakeholders to gain insight into regional goals and aspirations and to ensure our plan development is relevant. Refine as appropriate.

ENGAGEMENT & COMMUNICATION

- Agree an Engagement & Communication Strategy and supporting implementation plan.
- Agree key messaging.
- Agree joint publication of the RDP.

Top Energy, Northpower and Transpower: Development Planning	
Regional Planning	**(Common view / addressing both long term issues and step changes)** • Integrated view of transmission and sub-transmission development to support the distribution network and wider regional transmission needs that impact on Northpower and Top Energy. This includes ownership, regulatory implications, long term resilience, growth, urban intensification, impact of electrification, role of non-network alternatives. • Stakeholder Engagement & Communications Strategy, including messaging and approach to key regional stakeholders and regulators.
GXPs	**(Substation specific projects and opportunities to coordinate)**

	• Enhancements required and timings – including resilience to major natural events. • Planned asset replacements (transformers, switch boards or significant works at Transpower's GXP sites).
Strategic Infrastructure Developments	**(Major infrastructure developments / plans across the region – awareness and implications)** • Transport plans. • Significant planned and potential development plans. • New generation including grid scale batteries. • New/additional industrial loads. • Increasing distributed generation within the distribution networks.
Strategic Customer Projects	**(Northpower/Top Energy/Transpower customer projects)** • Electrification. • New Demand. • New Generation. • Strategic projects of other connected parties (Ngāwhā Generation, Marsden point future development etc.).

Timeline[4]

	August	September	October	November	December	Future
Agree scope and terms						
Develop/ Agree forecasts						
Develop long list options						
Develop Shortlist options						
Engagement, communication, consultation						
Publish Regional Development Plan						
Fund/Design /Deliver projects[5]						

[4] Further detail on the workplan timeline will be developed after initial discussions between the three parties

[5] While this is not within scope defined in this ToR, we have noted these to illustrate the next tranche of work required to deliver the projects outlined in the Northland Regional Electricity Development Plan

Northpower TOP ENERGY Te Puna Hihiko TRANSPOWER Keeping the energy flowing

Agreement

Northpower:

Authorised Signature: ______________________

Name: Michael Gibbs

Title: Chief Operating Officer - Network

Date: 15/08/2024

Top Energy:

Authorised Signature:

Name: Claire Picking

Title: Top Energy GM Network

Date: 13/8/224

Transpower NZ:

Authorised Signature: Matt Webb

Name: ______________________

Title: ______________________

Date: ______________________

ENDS

Transpower New Zealand Ltd The National Grid

ELECTRICITY AUTHORITY
TE MANA HIKO