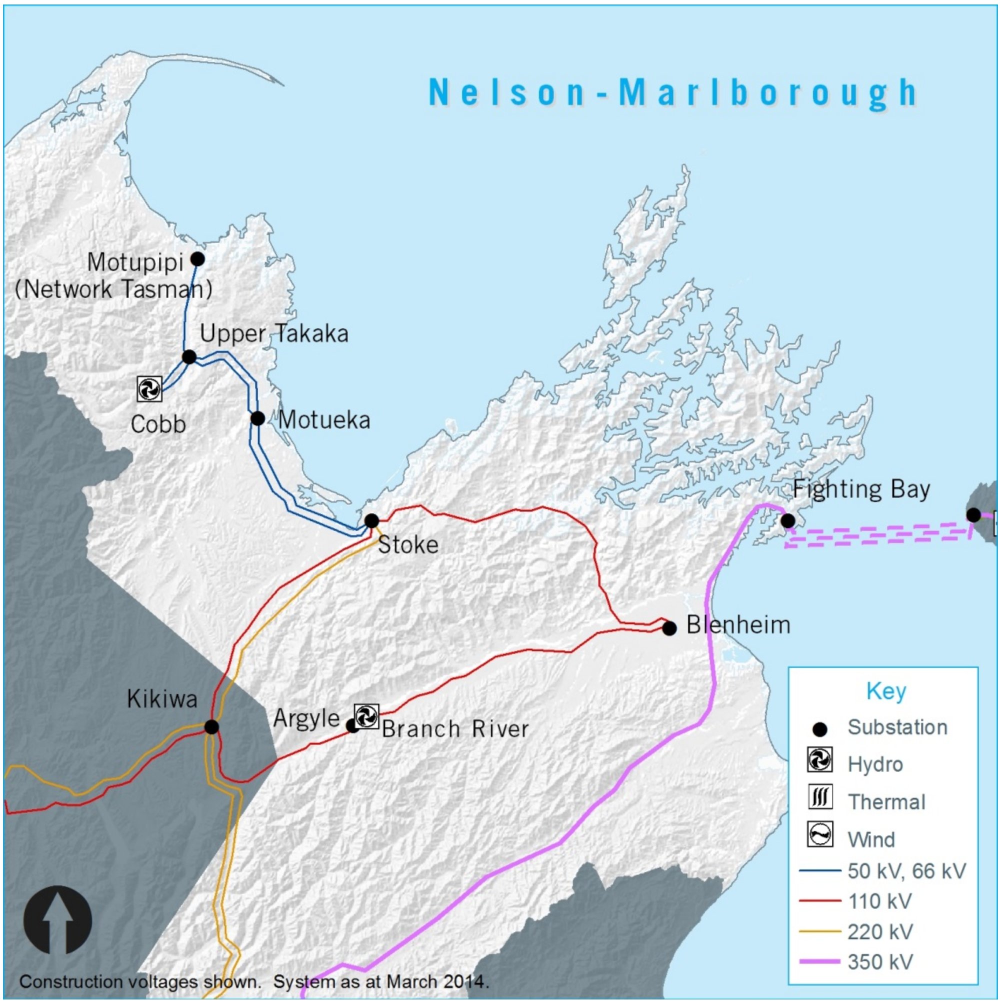
15 Nelson-Marlborough Regional Plan

15.1 Regional overview

This chapter details the Nelson-Marlborough regional transmission plan. We base this regional plan on an assessment of available data, and welcome feedback to improve its value to all stakeholders.

Figure 15-1: Nelson-Marlborough region



The Nelson-Marlborough region includes a mix of significant and growing provincial cities (Nelson, Richmond, and Blenheim) together with smaller rural localities (the Golden Bay area).

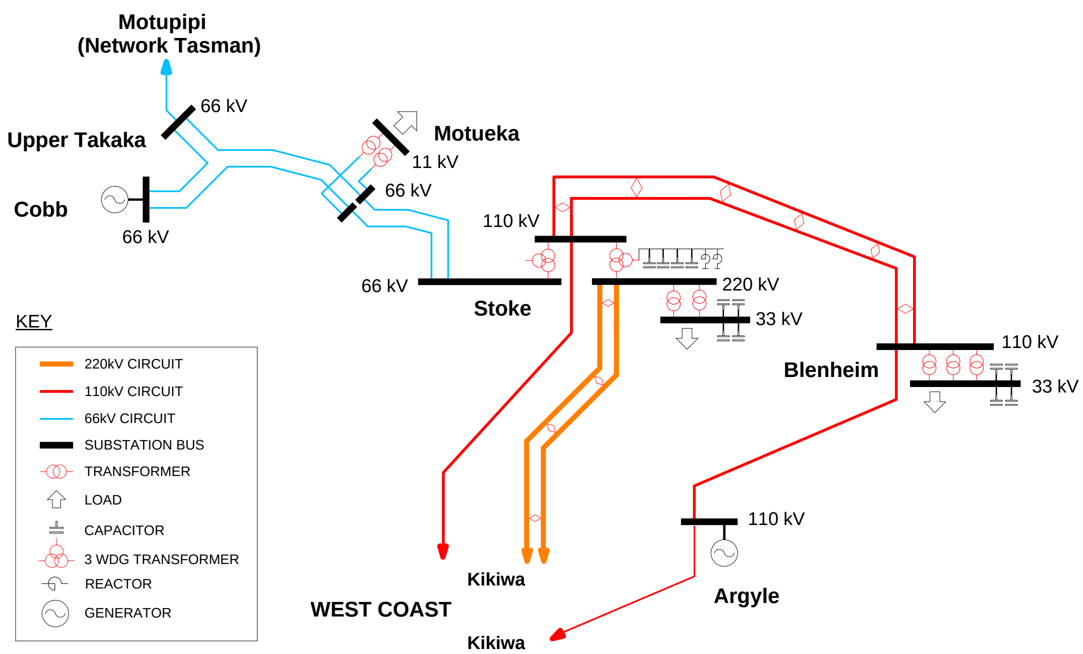
We have assessed the Nelson-Marlborough region's transmission needs over the next 15 years while considering longer-term development opportunities. Specifically, the transmission network needs to be flexible to respond to a range of future service and technology possibilities, taking into consideration:

- the existing transmission network
- forecast demand
- forecast generation
- equipment replacement based on condition assessment
- possible technological development.

15.2 Nelson-Marlborough transmission system

This section highlights the state of the Nelson-Marlborough regional transmission network. The existing transmission network is set out geographically in Figure 15-1 and schematically in Figure 15-2.

Figure 15-2: Nelson-Marlborough transmission schematic



15.2.1 Transmission into the region

The Nelson-Marlborough region is connected to the rest of the National Grid via 220 kV circuits from the Waitaki Valley with significant load off-take in the South Canterbury and Canterbury regions. Therefore, supply to the Nelson-Marlborough region is affected by transmission capacity from the Waitaki Valley.

The region is predominantly supplied by three 220 kV circuits between the Islington and Kikiwa substations, with some generation from the hydro generation stations connected at Cobb (which is strategic to the Golden Bay spur) and Argyle.

15.2.2 Transmission within the region

The transmission within the region comprises:

- 220 kV circuits from Kikiwa to Stoke

- parallel 110 kV circuits forming a ‘triangle’ between Kikiwa, Stoke, and Blenheim
- 220/110 kV and 110/66 kV interconnecting transformers at Stoke
- a 66 kV transmission spur supplying the Golden Bay area.

The reactive power support in this region is provided from the 60 Mvar capacitors at Stoke and 20.4 Mvar capacitors at Blenheim.

15.2.3 Longer-term development path

The two existing 220 kV Kikiwa–Stoke circuits have enough capacity to provide n-1 security within the region for the next 20-30 years.

As the Nelson-Marlborough region relies on generation several hundred kilometres away, there will be an on-going need for investment in reactive support (such as the STATCOM at Kikiwa and additional capacitors) to support the voltage.

The 110 kV Blenheim–Argyle–Kikiwa line may need upgrading if there is more than one significant new generator connected along the line, at Blenheim or embedded behind the Blenheim grid exit point.

Increased 220/110 kV interconnecting transformer capacity will be required beyond the forecast period at Kikiwa and/or Stoke. The capacity of the 110 kV Kikiwa–Stoke circuit may also need to be increased as this circuit is an important connection between the 220/110 kV transformers at Kikiwa and Stoke.

In the longer term, it may be economic to convert the section of 66 kV line from Stoke to Motueka to 110 kV. This conversion does not need to be investigated until approximately 2020, with possible implementation in approximately 2025.

15.3 Nelson-Marlborough demand

The after diversity maximum demand (ADMD) for the Nelson-Marlborough region is forecast to grow on average by 1.3% annually over the next 15 years, from 230 MW in 2014 to 280 MW by 2029. This is higher than the national average demand growth of 1.2% annually.

Figure 15-3 shows a comparison of the 2013 and 2014 APR forecast 15-year maximum demand (after diversity[115]) for the Nelson-Marlborough region. The forecasts are derived using historical data, and modified to account for customer information, where appropriate. The power factor at each grid exit point is also derived from historical data. See Chapter 4 for more information about demand forecasting.

[115] The after diversity maximum demand (ADMD) for the region will be less than the sum of the individual grid exit point peak demands, as it takes into account the fact that the peak demand does not occur simultaneously at all the grid exit points in the region.

Figure 15-3: Nelson-Marlborough region after diversity maximum demand forecast

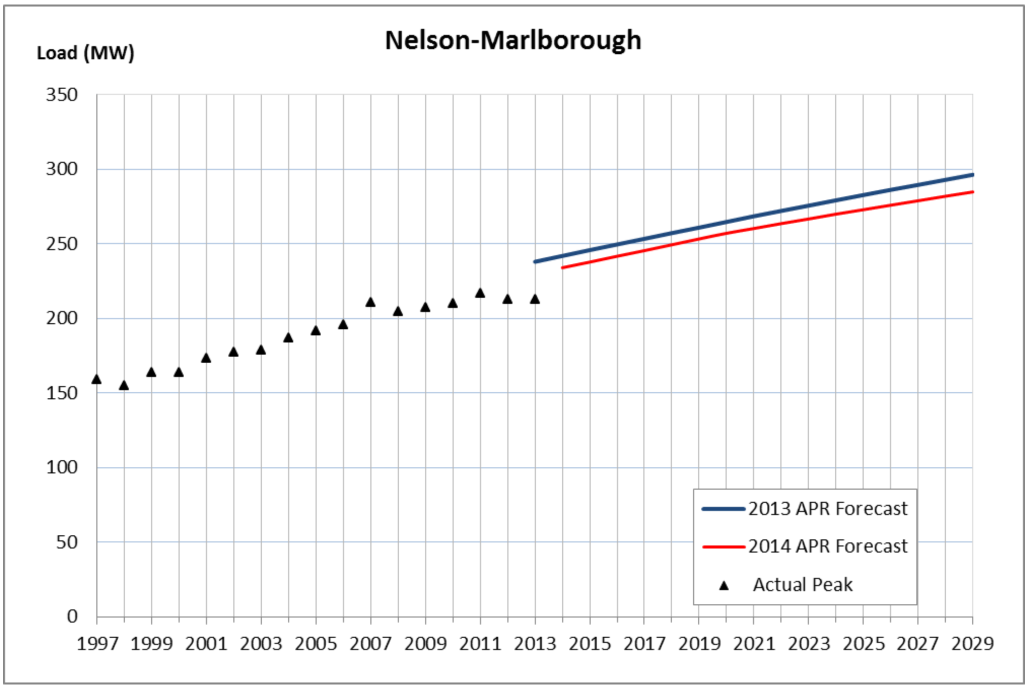


Table 15-1 lists the peak demand forecast (prudent growth) for each grid exit point for the forecast period.

Table 15-1: Forecast annual peak demand (MW) at Nelson-Marlborough grid exit points to 2029

Grid exit point	Power factor	Peak demand (MW)										
		Next 5 years						5-15 years out				
		2014	2015	2016	2017	2018	2019	2021	2023	2025	2027	2029
Blenheim	0.99	79	80	82	83	85	86	89	92	95	99	102
Motueka	0.98	21	21	21	22	22	22	23	24	24	25	26
Motupipi	0.96	7	8	8	8	8	8	8	8	8	8	8
Stoke	1.00	141	143	146	149	151	154	159	165	170	176	181

15.4 Nelson-Marlborough generation

The Nelson-Marlborough region's generation capacity is 57 MW, which is lower than local demand, requiring power to be imported through the National Grid.

Table 15-2 lists the generation forecast for each grid injection point for the forecast period. This includes all known generation stations, including those embedded within the relevant local lines company's network (Network Tasman or Marlborough Lines).[116]

[116] Only generators with capacity greater than 1 MW are listed. Generation capacity is rounded to the nearest megawatt.

Table 15-2: Forecast annual generation capacity (MW) at Nelson-Marlborough grid injection points to 2029 (including existing and committed generation)

Grid injection point (location if embedded)	Generation capacity (MW)										
	Next 5 years						5-15 years out				
	2014	2015	2016	2017	2018	2019	2021	2023	2025	2027	2029
Argyle – Branch River Scheme	11	11	11	11	11	11	11	11	11	11	11
Cobb	32	32	32	32	32	32	32	32	32	32	32
Blenheim (Lulworth Wind)	1	1	1	1	1	1	1	1	1	1	1
Blenheim (Marlborough Lines Diesel)	9	9	9	9	9	9	9	9	9	9	9
Blenheim (Waihopai)	3	3	3	3	3	3	3	3	3	3	3
Motupipi (Onekaka)	1	1	1	1	1	1	1	1	1	1	1

15.5 Nelson-Marlborough significant maintenance work

Our capital project and maintenance works are integrated to enable system issues to be resolved if possible when assets are replaced or refurbished. Table 15-3 lists the significant maintenance related work[117] proposed for the Nelson-Marlborough region for the next 15 years that may significantly impact related system issues or connected parties.

Table 15-3: Proposed significant maintenance work

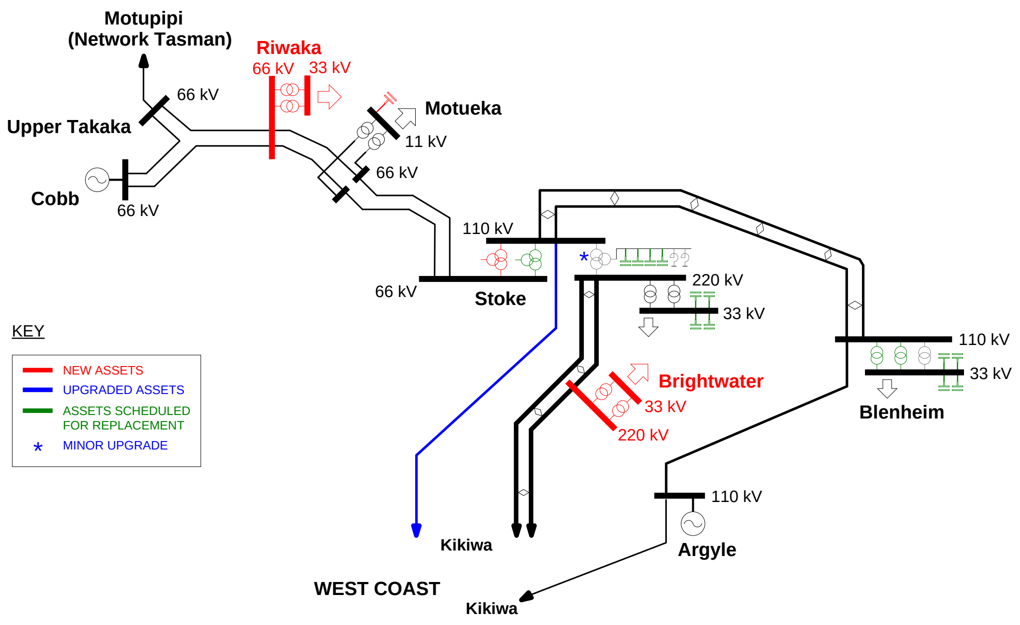
Description	Tentative year
Blenheim 33 kV capacitor banks replacement , and Blenheim supply transformers expected end-of-life	2019-2025 2023-2024
Stoke 11 kV capacitor bank replacement, Stoke 110/66 kV interconnecting transformer expected end-of-life, and Stoke 33 kV capacitor bank replacement	2015-2016 2020-2022 2029-2030

15.6 Future Nelson-Marlborough projects summary and transmission configuration

Figure 15-4 shows the possible configuration of Nelson-Marlborough transmission in 2029, with new assets, upgraded assets, and assets undergoing significant maintenance within the forecast period.

[117] This may include replacement of the asset due to its condition assessment.

Figure 15-4: Possible Nelson-Marlborough transmission configuration in 2029



15.7 Changes since the 2013 Annual Planning Report

Table 15-4 lists the specific issues that are either new or no longer relevant within the forecast period when compared to last year's report.

Table 15-4: Changes Since 2013

Issues	Change
No new issues or projects completed since 2013.	No change.

15.8 Nelson-Marlborough transmission capability

Table 15-5 summarises issues involving the Nelson-Marlborough region for the next 15 years. For more information about a particular issue, refer to the listed section number.

Table 15-5: Nelson-Marlborough region transmission issues

Section number	Issue
Regional	
15.8.1	Stoke 220/110 kV interconnecting transformer capacity
15.8.2	Stoke 110/66 kV interconnecting transformer capacity
Site by grid exit point	
15.8.3	Cobb–Motueka 66 kV transmission capacity
15.8.4	Kikiwa–Stoke 110 kV transmission capacity
15.8.5	Motueka supply transformer capacity
15.8.6	Motupipi single supply security
15.8.7	Stoke supply transformer capacity
Bus security	
15.9.1	Transmission bus security
15.9.2	Blenheim supply security and voltage

15.8.1 Stoke 220/110 kV interconnecting transformer capacity

Project description:	Resolve interconnecting transformer branch limits
Project status/type:	Possible, Base Capex
Indicative timing:	2023-2028
Indicative cost band:	A

Issue

A single 220/110 kV interconnecting transformer at Stoke provides a 110 kV interconnection to the Nelson-Marlborough region. This transformer has:

- a nominal installed capacity of 150 MVA, and
- n-1 capacity of 160/160[118,119] MVA (summer/winter).

The Stoke 220/110 kV transformer is effectively operating in parallel with the 150 MVA interconnecting transformer at Kikiwa. An outage of the Kikiwa transformer results in the Stoke transformer supplying the Nelson-Marlborough and West Coast regions.[120] This may cause the Stoke transformer to overload and cause low voltage issues within the West Coast region (see Chapter 16). The loading on the Stoke transformer depends on the generation in the Nelson-Marlborough and West Coast regions.

Solution

In the short term, these issues will be managed operationally via generation rescheduling and load management. Resolving station equipment constraints on the interconnecting transformer and managing the generation level in the Nelson–Marlborough and West Coast regions will resolve the issue for the forecast period.

In the longer term, a second 220/110 kV transformer may be required at Kikiwa.

15.8.2 Stoke 110/66 kV interconnecting transformer capacity

Project description:	Upgrade interconnecting transformer capacity
Project status/type:	Preferred, customer-specific
Indicative timing:	To be advised
Indicative cost band:	A

Issue

The Golden Bay loads at the Motueka and Motupipi grid exit points are supplied by:

- a single 110/66 kV, 23 MVA transformer at Stoke, and
- the Cobb generation station.

With no Cobb generation, the peak load at Golden Bay is forecast to exceed the Stoke transformer's continuous rating by approximately 4 MW in 2014, increasing to approximately 9 MW in 2029 (see Table 15-6).

[118] Stoke has only one 220/110 kV, 150 MVA interconnecting transformer. The n-1 capacity is the result of the transformer essentially operating in parallel with the Kikiwa–T2 (150 MVA).
[119] The transformer's capacity is limited by 110 kV disconnectors; with this limit resolved, the n-1 capacity will be 180/188 MVA (summer/winter).
[120] The normal operating arrangement is only Kikiwa–T2 (150 MVA) provides a 110 kV interconnection to the West Coast region, and Kikiwa–T1 (50 MVA) supplies the local 11 kV load.

Table 15-6: Stoke 110/66 kV transformer overload forecast

Circuit/grid exit point	Power factor	Transformer overload (MW)										
		Next 5 years						5-15 Years out				
		2014	2015	2016	2017	2018	2019	2021	2023	2025	2027	2029
Golden Bay	0.97	4	4	5	5	6	6	6	7	8	9	9

Solution

The short-term operational solution requires Cobb to generate at or above a minimum output to avoid overloading the Stoke transformer.

We are discussing with Network Tasman the option of installing a 40 MVA transformer in parallel with the existing interconnecting transformer. This (in conjunction with some generation from Cobb) will provide secure supply to the Golden Bay area for the forecast period and beyond. In addition, the existing transformer has an expected end-of-life within the next 5-10 years.

Installing a second Stoke 110/66 kV interconnecting transformer does not raise property issues as the existing substation has sufficient room to accommodate the new transformer.

Future investment will be customer driven.

15.8.3 Cobb–Motueka 66 kV transmission capacity

Project status/type :	This issue is for information only

Issue

The three circuits connecting Cobb, Motueka, and Upper Takaka include the:

- Cobb–Motueka–2 circuit rated at 21/26 MVA (summer/winter)
- Motueka–Upper Takaka–1 circuit rated at 21/25 MVA (summer/winter)
- Cobb–Upper Takaka–1 circuit rated at 29/35 MVA (summer/winter).

An outage of one of the Cobb–Motueka–2, Motueka–Upper Takaka–1 or Cobb–Upper Takaka–1 circuit will limit the Cobb generation station’s output.

Solution

The issue is managed operationally with an automatic generation runback scheme to constrain Cobb generation to match the remaining circuits’ capacity. This is considered adequate and future investment will be customer driven.

15.8.4 Kikiwa–Stoke 110 kV transmission capacity

Project description:	Thermal upgrade transmission capacity
Project status/type:	Possible, Base Capex
Indicative timing:	Beyond 2020
Indicative cost band:	A

Issue

There are two 110 kV circuits connecting the Nelson-Marlborough and West Coast regions:

- Kikiwa–Stoke–3 circuit rated at 56/68 MVA (summer/winter), and
- Kikiwa–Argyle–Blenheim–Stoke–1 circuit rated at 56/68 MVA (summer/winter).

An outage of a Stoke 220/110 kV interconnecting transformer results in Nelson–Marlborough region supply from the interconnection at Kikiwa, via the two 110 kV circuits. The Kikiwa–Stoke–3 circuit may overload when Nelson-Marlborough region load is high coupled with low local generation.

Solution

This issue can be managed operationally by constraining generation levels at Cobb and Argyle. A longer-term solution is to thermally upgrade the Kikiwa–Stoke 110 kV circuit.

15.8.5 Motueka supply transformer capacity

Project description:	New capacitors and grid exit point
Project status/type:	Preferred, customer specific
Indicative timing:	New capacitors: 2015 New grid exit point: 2017
Indicative cost band:	Install new capacitor: A New grid exit point: C

Issue

Two 66/11 kV transformers supply Motueka's load, providing:

- a total nominal installed capacity of 40 MVA, and
- n-1 capacity of 23/23 MVA[121] (summer/winter).

The peak load at Motueka is forecast to exceed the transformers' n-1 winter capacity by approximately 1 MW in 2015, increasing to approximately 5 MW in 2029 (see Table 15-7).

Table 15-7: Motueka supply transformer overload forecast

Circuit/grid exit point	Power factor	Transformer overload (MW)										
		Next 5 years						5-15 years out				
		2014	2015	2016	2017	2018	2019	2021	2023	2025	2027	2029
Motueka	0.98	0	1	1	1	2	2	3	3	4	4	5

Solution

We have discussed future supply options with Network Tasman. The preferred long-term development option involves:

- installing two 2.2 Mvar capacitors at Motueka, which will extend the transformer's real power capacity up to 2023, and
- establishing a new grid exit point near Riwaka, connecting to the 66 kV Stoke–Upper Takaka lines.

Installing new capacitor banks does not raise new property issues as the existing substation has sufficient room to accommodate the new equipment. Network Tasman has designated land for the new Riwaka grid exit point.

15.8.6 Motupipi single supply security

Project status/type:	This issue is for information only

Issue

Motupipi is supplied by a single 66 kV circuit from Upper Takaka, which means it has no n-1 security.

[121] The transformers' capacity is limited by the bus section limit of 23 MVA, and cable limit of 24 MVA; with these limits resolved, the n-1 capacity will be 24/25 MVA (summer/winter).

The forecast load growth at Motupipi will not exceed the present circuit rating for the forecast period and beyond.

Motupipi's point of connection is the 66 kV line termination, so the loading of the supply transformer rests with the customer.

Solution

The lack of n-1 security can be managed operationally. Future investment will be customer driven.

15.8.7 Stoke supply transformer capacity

Project description:	Upgrade protection New grid exit point
Project status/type:	Possible, customer-specific Possible, customer-specific
Indicative timing:	Upgrade protection : 2015 New grid exit point: 2020
Indicative cost band:	Upgrade protection: A New grid exit point: C

Issue

Two 220/33 kV transformers supply Stoke's load, providing:

- a total nominal installed capacity of 240 MVA, and
- n-1 capacity of 136/136 MVA[122] (summer/winter).

The peak load at Stoke is forecast to exceed the transformers' n-1 winter capacity by approximately 5 MW in 2014, increasing to approximately 46 MW in 2029 (see Table 15-8).

Table 15-8: Stoke supply transformer overload forecast

Circuits/grid exit point	Power factor	Transformer overload (MW)										
		Next 5 years						5-15 years out				
		2014	2015	2016	2017	2018	2019	2021	2023	2025	2027	2029
Stoke	1.00	5	8	11	13	16	19	24	30	35	40	46

Solution

Resolving the protection issue reduces the overloading. The transformer overloading issue can be further resolved by operational measures and, in the longer-term, by a new grid exit point at Brightwater connected to the 220 kV Kikiwa–Stoke circuits (see Section 15.10.1). Network Tasman has designated land for a new grid exit point.

15.9 Nelson-Marlborough bus security

This section presents issues arising from the outage of a single bus section rated at 50 kV and above for the next 15 years.

Bus outages disconnect more than one power system component (for example, other circuits, transformers, reactive support or generators). Therefore, bus outages may cause greater issues than a single circuit or transformer outage (although the risk of a bus fault is low, being less common than a circuit or transformer outage).

[122] The transformers' capacity is limited by protection equipment of 136 MVA; with this limit resolved, the n-1 capacity will be 143/143 MVA (summer/winter) constrained by low voltage switchgear.

15.9.1 Transmission bus security

Table 15-9 lists the bus outages that cause voltage issues or a total loss of supply. Generators are included only if a bus outage disconnects the whole generation station or causes a widespread system impact. Supply bus outages, typically 11 kV and 33 kV, are not listed.

Table 15-9: Transmission bus outages

Transmission bus outage	Loss of supply	Generation disconnection	Transmission issue	Further information
Argyle 110 kV		Argyle		
Blenheim 110 kV	Blenheim			15.9.2
		Argyle		See note 1
Cobb 66 kV		Cobb		
Stoke 66 kV	Golden Bay spur			See note 2
Stoke 110 kV	Blenheim			15.9.2
	Golden Bay spur			See note 2
Upper Takaka 66 kV	Motupipi			See note 3

1. There is no bus protection at Blenheim, so bus faults remove all connected circuits from service. This includes the Blenheim–Argyle–Kikiwa circuit, causing a loss of connection at Argyle.
2. The Golden Bay spur supplies load at Motueka and Motupipi and connects generation at Cobb. An outage of the Stoke 110 kV or 66 kV bus will disconnect the spur. This may or may not cause a loss of supply, depending on the balance of load and generation on the spur.
3. Motupipi is supplied on a single circuit from Upper Takaka. An outage on the Upper Takaka bus will disconnect the circuit, causing a total loss of supply at Motupipi.

The customers (Network Tasman, TrustPower, or Marlborough Lines) have not requested a higher security level. Unless otherwise noted, we do not propose to increase bus security and future investment is likely to be customer driven.

If increased bus security is required, the options typically include bus reconfiguration and/or additional bus circuit breakers.

15.9.2 Blenheim supply security and voltage quality

Project status/type:	This is for information only

Issue

There is a single 110 kV bus section at Blenheim, resulting in no n-1 security. Additionally, there are three 110 kV circuits (two circuits from Stoke and one from Argyle) supplying Blenheim's load. A fault on the:

- Blenheim 110 kV bus will result in a total loss of supply to the load, and
- Stoke 110 kV bus will cause a low voltage issue, which may lead to voltage collapse resulting in a loss of supply at Blenheim. The Blenheim load will be constrained to approximately 50 MW due to the voltage stability and the capacity of the 110 kV Blenheim–Argyle–Kikiwa circuit.

Solution

The faulted bus section at Blenheim and Stoke can be isolated via bus disconnectors, restoring supply to Blenheim. If n-1 connection security is eventually required, then a 110 kV bus coupler will need to be installed. Future investment will be customer driven.

15.10 Other regional items of interest

15.10.1 Brightwater grid exit point

Project description:	New grid exit point
Project status/type:	Possible, customer-specific
Indicative timing:	To be advised
Indicative cost band:	C

Brightwater is a proposed new 220/33 kV grid exit point connected to a Kikiwa–Stoke circuit. Load will be transferred from Stoke to Brightwater, so the load at Stoke remains within the capacity of the Stoke supply transformers (see Section 15.8.7). It will also provide diversity for the Stoke load.

The timing for the new Brightwater grid exit point will be determined by Network Tasman. Network Tasman has designated land for the new grid exit point.

15.10.2 Golden Bay voltage quality

Project description:	New capacitor at Motueka
Project status/type:	Preferred, customer-specific
Indicative timing:	2015
Indicative cost band:	A

Issue

Two 66 kV circuits connect Cobb generation to the transmission grid. Loss of the Cobb–Motueka–Stoke–2 circuit during a planned maintenance outage of the Cobb–Upper Takaka–1 circuit results in disconnection of Cobb generation from the grid and causes low voltage within the Golden Bay.

Solution

Possible development options include installing:

- capacitors at Motueka and/or Motupipi for voltage support, and reducing voltage step down post-contingency, or
- capacitor banks at Motueka, which will also help to extend the Motueka supply transformers' n-1 real power capacity for the forecast period and beyond (see Section 15.8.5).

15.11 Nelson-Marlborough generation proposals and opportunities

This section details relevant regional issues for generation proposals under investigation by developers and in the public domain, or other generation opportunities. The impact of committed generation projects on the grid backbone is dealt with separately in Chapter 6.

The maximum generation that can be connected depends on several factors and usually falls within a range. Generation developers should consult with us at an early stage of their investigations to discuss connection issues.

15.11.1 Maximum regional generation

The maximum generation estimates assume a light South Island load profile and high generation in the Nelson-Marlborough region (with Cobb generating 27 MW).

For generation connected at the Stoke 220 kV bus, the maximum generation that can be injected under n-1 is approximately 380 MW. The constraint is due to the 220 kV Kikiwa–Stoke circuit overloading when the other circuit is out of service.

Generation up to approximately 130 MW can be connected at the Blenheim 110 kV bus, or to the two 110 kV Blenheim–Stoke circuits. Higher levels of generation (approximately 160 MW of generation injection under n-1) require a thermal upgrade of the 110 kV Kikiwa–Stoke–3 circuit and a protection upgrade on the Blenheim–Stoke–1 circuit. Further increases require a thermal upgrade of the 110 kV Blenheim–Argyle–Kikiwa circuit.

15.11.2 Generation on the Blenheim–Argyle–Kikiwa circuit

Blenheim–Argyle–Kikiwa is a single 110 kV circuit rated at 56/68 MVA. The maximum generation that can be connected to this circuit depends on the location of the connection. With all circuits in service, approximately 50 MW can be connected, in addition to the existing generation injected at Argyle. Generation levels above this will need to be embedded within the Marlborough Lines network. Generation restrictions may also be needed for some outages. Alternatively, increasing the rating of the circuit is also technically possible.

15.11.3 Generation connection to the 66 kV network

The existing Cobb hydro generation station is already connected to the 66 kV transmission network, and its output must occasionally be constrained if a circuit is out of service or to prevent overloading of the Stoke 110/66 kV transformer.

Approximately 10 MW of additional generation can be connected if controls are installed to automatically reduce generation for some outages, and the Stoke 110/66 kV transformer capacity is increased. The 66 kV transmission lines have a variety of conductor types and ratings. Thermally upgrading or replacing the sections with the lowest capacities allows an additional 15 to 30 MW of generation before the remaining sections require upgrading.

