

System Security Forecast 2010

Part C Security Analysis

Nelson and Marlborough



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I M P O R T A N T

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1. LIMIT GROUP ANALYSIS

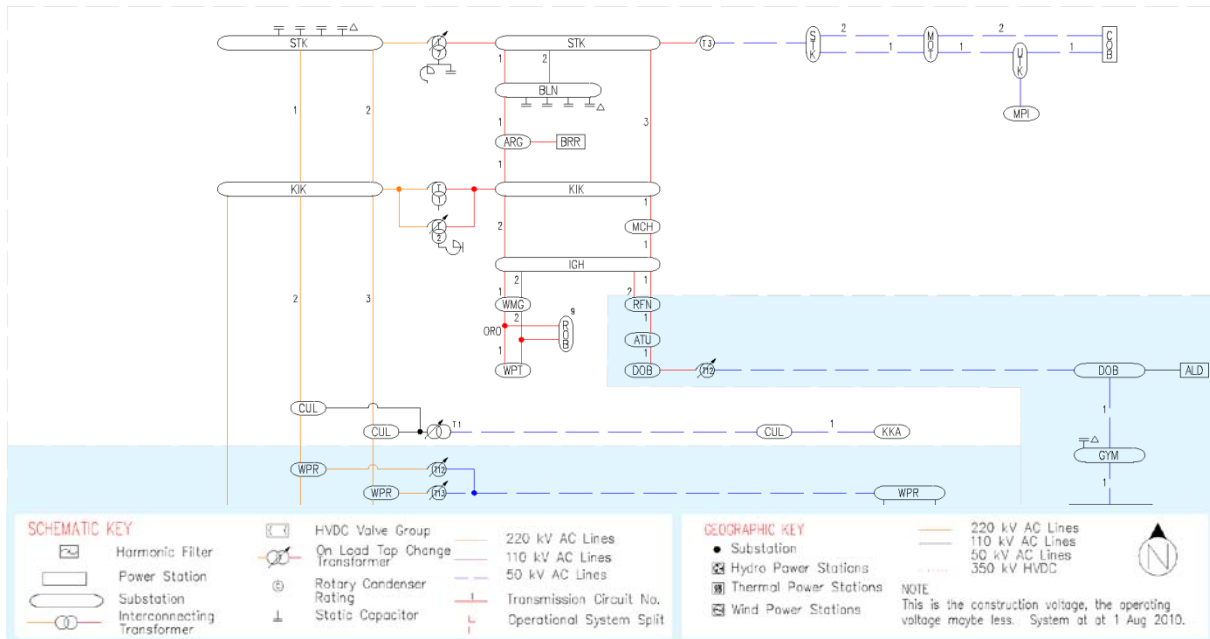
Power system issues within the Nelson and Marlborough region are described in this section.

1.1 NETWORK OVERVIEW

The Top of the South Island region is the area north and east of (and including) Murchison. It is supplied by 220 kV, 110 kV and 66 kV transmission circuits with interconnecting transformers located at Kikiwa and Stoke. Static capacitors are installed at the Stoke substation to improve the power system voltage and voltage stability performance. The three 220 kV circuits from the Islington substation supply most of the power for the region. There is generation in the region at Cobb, Argyle and Wairau (embedded behind Argyle).

The Nelson and Marlborough region is shown geographically and schematically below.





The capability of assets in the region is assumed to be that declared by asset owners as at 2 July 2010. The table below shows a list of committed projects in the region as notified by asset owners. These committed projects have been considered in the analysis.

Asset	Upgrade	Region	Commissioning Date
There are no grid upgrades during the period of study.			

Committed upgrades in the region

1.2 DEMAND AND GENERATION WITHIN THE LIMIT GROUP

The Nelson and Marlborough region has 43 MW of generation capacity. EC prudent load values indicate a 2011 winter peak load of 287 MW which is forecast to increase to 314 MW in 2013. Regional peak demand is greater than regional connected generation capacity.

For the purpose of these studies the minimum power factor has been assumed. A power factor scatter graph for the region is shown in Figure 1 & 2.

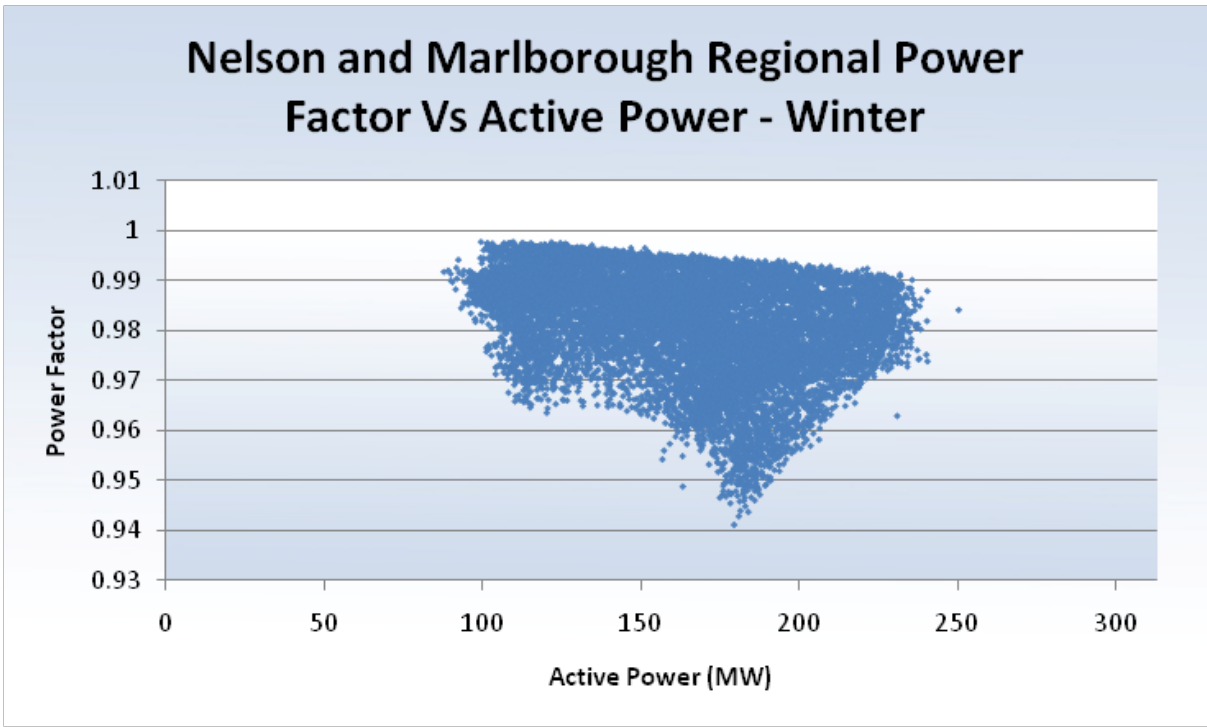


Figure 1: Nelson & Marlborough winter power factor

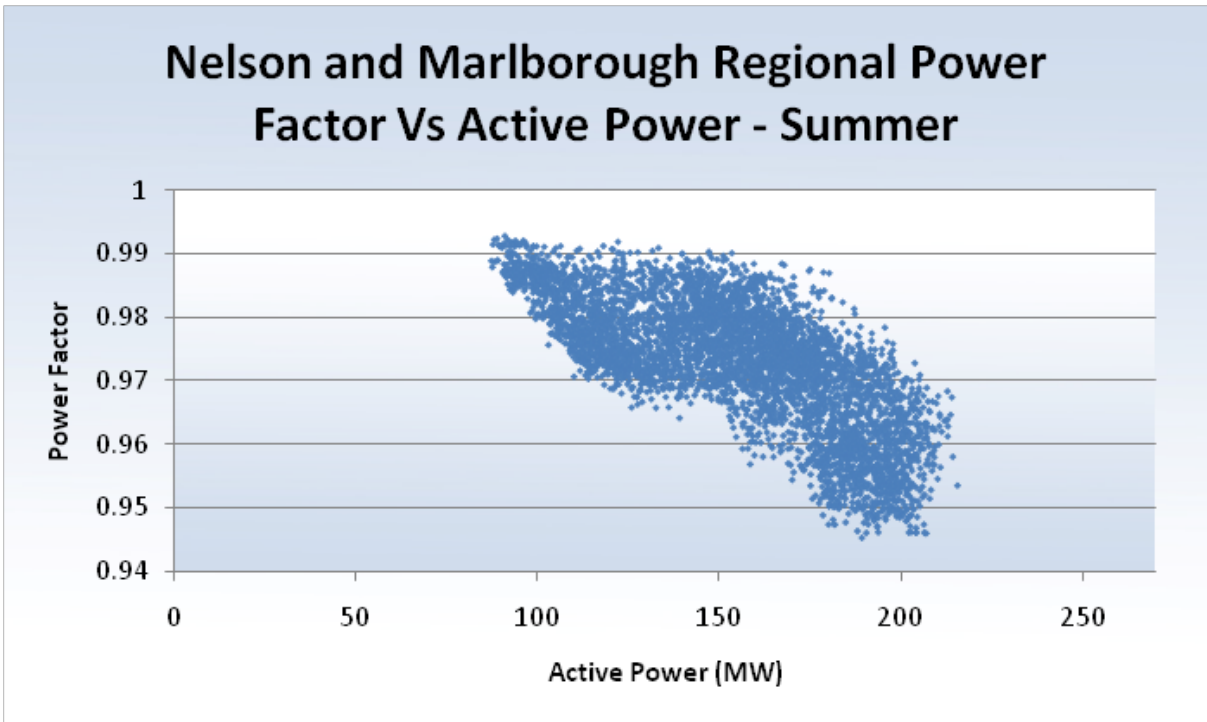


Figure 2: Nelson & Marlborough Summer power factor

For the purpose of these studies the minimum power factor has been assumed. For summer and winter peak the power factors are 0.95 and 0.94 respectively.

1.3 KEY ASSETS

1.3.1 CRITICAL CONTINGENCIES

Contingency	Power System Issue	Management Measures	Analysis
<i>Loss of an Islington-Kikiwa 220 kV circuit</i>	Voltage instability	Security constraints Load management	Load limit of 304 MW with max Cobb generation and 274 MW with no Cobb generation
<i>Loss of Cobb-Stoke 66 kV circuit</i>	Remaining circuit may exceed stated capability	Cobb runback scheme Load management	Load limit of 18/21 MW (summer/winter) applied to the combined Motueka and Motupipi loads

1.3.2 PLANNED OUTAGES

Outage	Contingency	Power System Issue	Management Measures	Risk Assessment
<i>Outage of the Stoke T7 220/110 kV transformer (including outage of the Stoke 11 kV capacitors)</i>	Loss of Kikiwa-Stoke-3 110 kV circuit	Low Voltage at Blenheim 110 kV bus	Security constraints, Load management	Load limited to 48 MW with 0 MW generation at Cobb
<i>Outage of the Kikiwa T2 220/110 kV transformer</i>	Loss of Kikiwa-Stoke-3 110 kV circuit	Kikiwa-T1 220/110 kV transformer exceeds stated capability	Security constraints, Load management, Short term ratings	Load limited to 60/63 MW (summer/winter)
<i>Outage of the Blenheim-Stoke-1 or 2 110 kV circuits</i>	Loss of the other circuit	Blenheim-Kikiwa-1 110 kV circuit may exceed stated capability or low voltages at kikiwa and Blenheim	Short term ratings	Blenheim load limited to 48/54 MW (summer/winter)
<i>Outage of the Inangahua-Kikiwa-1 or 2 110 kV circuit</i>	Loss of the other circuit	Grid voltages in the West Coast region fall below stated capability Loss of supply to Murchison, Robertson Rd and Westport	Grid reconfiguration, Security constraints, Short term ratings	
<i>Outage of the Stoke T3 110/66 kV transformer</i>	None	Cobb Generation and Tasman loads form an Islanded network	Local generation, Load management	
<i>Outage of the Cobb-Stoke-2 66 kV circuit</i>	Loss of Cobb-Upper Takaka-1 66 kV circuit	Loss of Cobb generation Stoke-Upper Takaka-1 66 kV circuit exceeds stated capability	Load management , Short term ratings, Local generation	Motupipi and Motueka load limited to 19/23 MW (summer/winter)
<i>Outage of the Cobb-Stoke-2 66 kV circuit</i>	Loss of Stoke-Upper Takaka-1 66 kV circuit	Disconnection of Cobb generation from the rest of the power system	Load management , Short term ratings, Local generation	Motupipi load limited to Cobb generation
<i>Outage of the Cobb-Upper Takaka-1 66 kV circuit</i>	Loss of Stoke-Upper Takaka-1 66 kV circuit	Cobb-Stoke-2 66 kV circuit exceeds stated capability limits	Load management , Short term ratings, Local generation	Cobb generation limited to 21/26 MW (summer/winter)

1.4 KEY POWER SYSTEM CAPABILITY LIMITS ON LIMIT GROUP

1.4.1 REGIONAL AND LOCAL POWER SYSTEM ISSUES

Power system capability limits that apply to both the region and local power system issues are shown in the following table. Detailed analysis for each issue can be found in the Appendix (section 2). You can navigate to the relevant issue by clicking on the section number in the right hand column of the following table.

Contingency	Limit Group	2011 summer/winter	2012 summer/winter	2013 summer/winter	Detailed Analysis Section
<i>Loss of an Islington-Kikiwa 220 kV circuit</i>	<i>Top of South Island load</i>	304 MW	304 MW	304 MW	
<i>Loss of an Islington-Kikiwa 220 kV circuit during low Cobb generation</i>	<i>Top of South Island load</i>	274 MW	274 MW	274 MW	
<i>Loss of an Cobb-Stoke 66 kV circuit</i>	<i>Motueka and Motupipi</i>	18/21 MW	18/21MW	18/21 MW	

Outage	Contingency	Limit Group	2011 summer/winter	2012 summer/winter	2013 summer/winter	Detailed Analysis Section
<i>Outage of an Islington-Kikiwa 220 kV</i>	Loss of any other ISL-KIK circuit	<i>Top of South Island</i>	251 MW	251 MW	251 MW	
<i>Outage of the Stoke T7 220/110 kV transformer (including outage of the Stoke 11 kV capacitors)</i>	Kikiwa-Stoke-3 110kV circuit	<i>Blenheim Motupipi Motueka</i>	Load limited to 48 MW with 0 MW generation at Cobb	Load limited to 48 MW with 0 MW generation at Cobb	Load limited to 48 MW with 0 MW generation at Cobb	2.4.1
<i>Outage of the Kikiwa T2 220/110 kV transformer</i>	Loss of Kikiwa-Stoke-3 110 kV circuit	<i>Blenheim Murchison Robertson St Westport Reefion Atarau Hokitika Greymouth Otira Dobson</i>	60/63 MW	60/63 MW	60/63 MW	2.4.2
<i>Outage of the Blenheim-Stoke-1 or 2 110 kV circuits</i>	Loss of the other circuit	<i>Blenheim</i>	48/54 MW	48/54 MW	48/54 MW	2.4.3
<i>Outage of the Cobb-Stoke-2 66 kV circuit</i>	Loss of Cobb-Upper Takaka-1 66 kV circuit	<i>Motupipi Motueka</i>	19/23 MW	19/23 MW	19/23 MW	2.4.6
<i>Outage of the Cobb-Upper Takaka-1 66 kV circuit</i>	Loss of Stoke-Upper Takaka-1 66 kV circuit	<i>Cobb Generation</i>	21/26 MW	21/26 MW	21/26 MW	2.4.6

Regional and local Power System Capability Limits



1.5 ASSUMPTIONS

The Special Protection Schemes also known as operational intertipping schemes in this region available to the system operator are listed in the table below.

Special Protection Scheme	Purpose	Armed	
<i>Stoke T7 outage Intertrip Scheme</i>	To avoid the other transformers at STK (STK T3) overload during the outage of T7	Enabled during the outage of T7	
<i>Cobb runback scheme</i>	To avoid the parallel circuit overload during the outage of Cobb-Stoke 66kv circuit	Enabled during the outage of Cobb-Stoke 66kV circuit	

Special Protection Scheme in the region



1.6 LOSS OF SUPPLY DURING OUTAGES



Grid Exit Point	Outage	Contingent Event
<i>Motupipi</i>	Loss of Motupipi-Upper Takaka 66kV circuit	None
<i>Loss of generation at Argyle</i>	Loss of Blenheim-Kikiwa 110kV circuit	None
<i>Kaikoura</i>	Loss of Culverden-Kaikoura 66 kV circuit	None
<i>Murchison</i>	Loss of Inangahua-Kikiwa 110kV circuit	None
Argyle	Outage of the Blenheim-Kikiwa-1 110 kV circuit	None
Robertson St and Westport	Outage of the Inangahua-Waimangaroa-Westport 110 kV circuit	Loss of the other Inangahua-Waimangaroa-Westport 110 kV circuit
Kaikoura	Outage of the Culverden 66/33 kV T1 transformer or the Culverden-Kaikoura-1 66 kV circuit	None
Motueka	Outage of the Stoke-Upper Takaka-1 66 kV circuit	Loss of Cobb-Stoke-2 circuit
Motupipi	Outage of the Cobb-Upper Takaka-1 66 kV circuit	loss of Stoke-Upper Takaka circuit

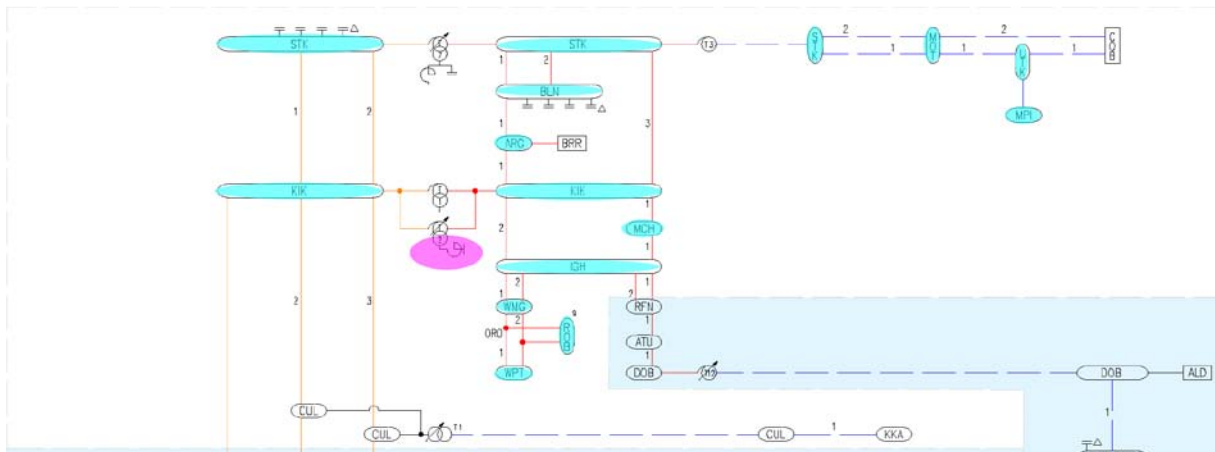


2. APPENDIX

2.1 REGIONAL ISSUES DURING NORMAL OPERATION

2.1.1 TOP OF THE SOUTH ISLAND REGION UNDER LIGHT LOAD CONDITIONS

Grid Exit Point	Power System Issue 	Causing Factor 	Indicative Limit	Operational Measures	Back to Limit Group
Top of the South Island (excluding Culverden and Kaikoura)	Grid voltages in the Top of the South Island may exceed advised capability	Top of the South Island under light load conditions Loss of KIK SVC during light load conditions	None	None	1.4.1



The Top of the South Island region can experience high grid voltages during times of light load. This is most noticeable during the morning trough load when there is limited irrigation demand during summer. The problem is compounded further if the Cobb units and the Islington synchronous condensers are unavailable. Studies have been conducted to determine the minimum load that the network can sustain for a defined set of system conditions.

2.1.1.1 Assumptions

The following assumptions are made:

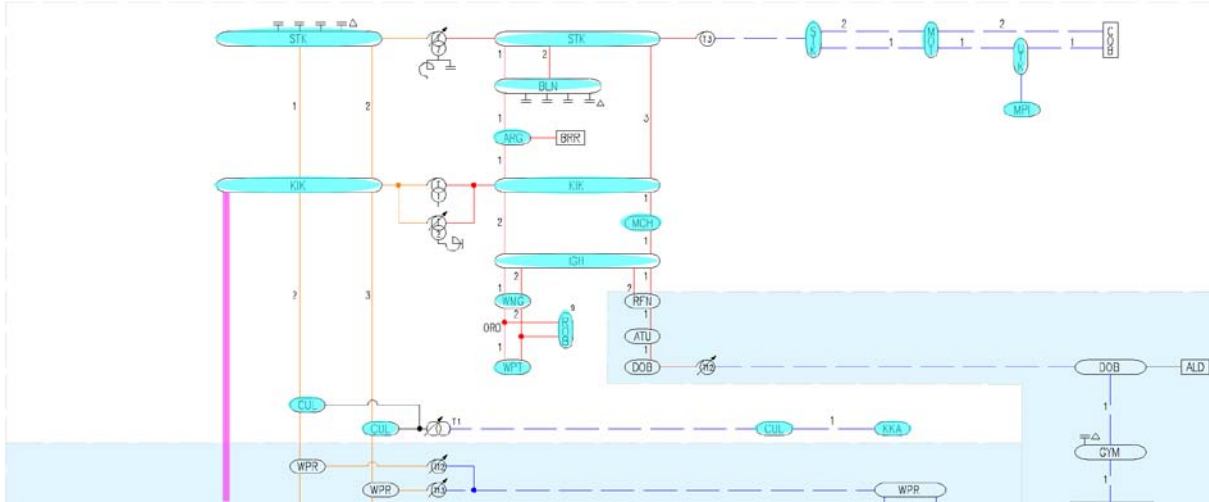
- A minimum South Island load of approximately 969 MW. This was determined from 2009 recorded SCADA output.
- The Cobb, Kumara and Argyle units are available but dispatching 0 MW
- The Stoke reactors are in service
- The Islington synchronous condensers are available
- The Tekapo A and B stations are all available along with few generation units from Ohau and Benmore are available to compensate for voltage levels north of Twizel
- The Bromley reactor is unavailable
- The additional Islington and new Kikiwa SVC is available.

2.1.1.2 Power System Analysis to avoid grid voltage rising above advised capability

With the addition of the Kikiwa SVC there are no longer any problems with the light loading in the Top of the South Island region.

2.1.2 LOSS OF AN ISLINGTON-KIKIWA 220 kV CIRCUIT

Grid Exit Point	Power System Issue	Causing Factor	Indicative Limit	Operational Measures	Back to Limit Group
Top of the South Island	Voltage instability	Loss of an Islington-Kikiwa 220 kV circuit	Load limit of 304 MW with max Cobb generation and 274 MW with no Cobb generation	Security constraints Load Management	1.4.1



The loss of an Islington-Kikiwa 220 kV circuit can cause voltage instability in the Top of the South Island. A power system capability limit on the amount of demand in the Top of the South Island region required to avoid voltage instability. Power system capability limits to avoid voltage instability are sensitive to the amount of generation, and shunt devices in service within the Top of the South Island region.

2.1.2.1 Assumptions

The analysis is based on the following assumptions.

Generation Capacity

The following assumptions are made on generation dispatch levels and plant availability to determine limits. These assumptions are based on the plant capability and historical generation patterns and are used as the base case dispatch scenario. For the 0 MW Cobb generation scenario, Cobb generation is assumed to be connected to the power system and to be providing reactive support. Argyle generation is assumed as 11 MW in all cases. The voltage stability limits are sensitive to the amount of local generation.

Plant	Assumed MW Output (station(s) total)
Argyle	11
Cobb	0-32
Total Generation	11-43

Availability of reactive plant

The following assumptions are made on grid reactive plant capability and availability. The dispatch levels shown are the maximum values of reactive support allowable on the network whilst ensuring voltage levels are within advised capability prior to the loss of plant.

Plant	Operation
Stoke 33 kV Capacitors (4x10 Mvar)	Dispatched by SO as required (4x10 Mvar dispatched)
Stroke T7 Transformer Capacitor at 11 kV (4x5 Mvar)	Dispatched by SO as required (3x5 Mvar dispatched)
Blenheim 110 kV Capacitors (4x5 Mvar)	Dispatched by SO as required (4x5 Mvar dispatched)

2.1.2.2 Power System Analysis due to Voltage Instability

Power system capability limits are required for the Top of the South Island load to avoid voltage instability following the loss of an Islington-Kikiwa 220 kV circuit. Two generation scenarios (Cobb generation is 0/32 MW) with load power factor of 0.94 have been studied. The following has been determined:

- Power system limits on the demand in the Top of the South Island region are 304 MW, at load power factor of 0.94 (with Cobb generation of 32 MW)
- Power system limits on the demand in the Top of the South Island region are 274MW, at load power factor of 0.94 (with Cobb generation of 0 MW).

2.1.2.3 Sensitivities

The power system capability limit to avoid voltage instability for the loss of a Kikiwa-Islington 220 kV circuit is affected by the amount of real power and reactive power provided by generating units and other plant in the Top of the South Island. The average load power factor is also an issue.

Network sensitivities are given in the table below. Note that these are indicative only and may vary based on system conditions.

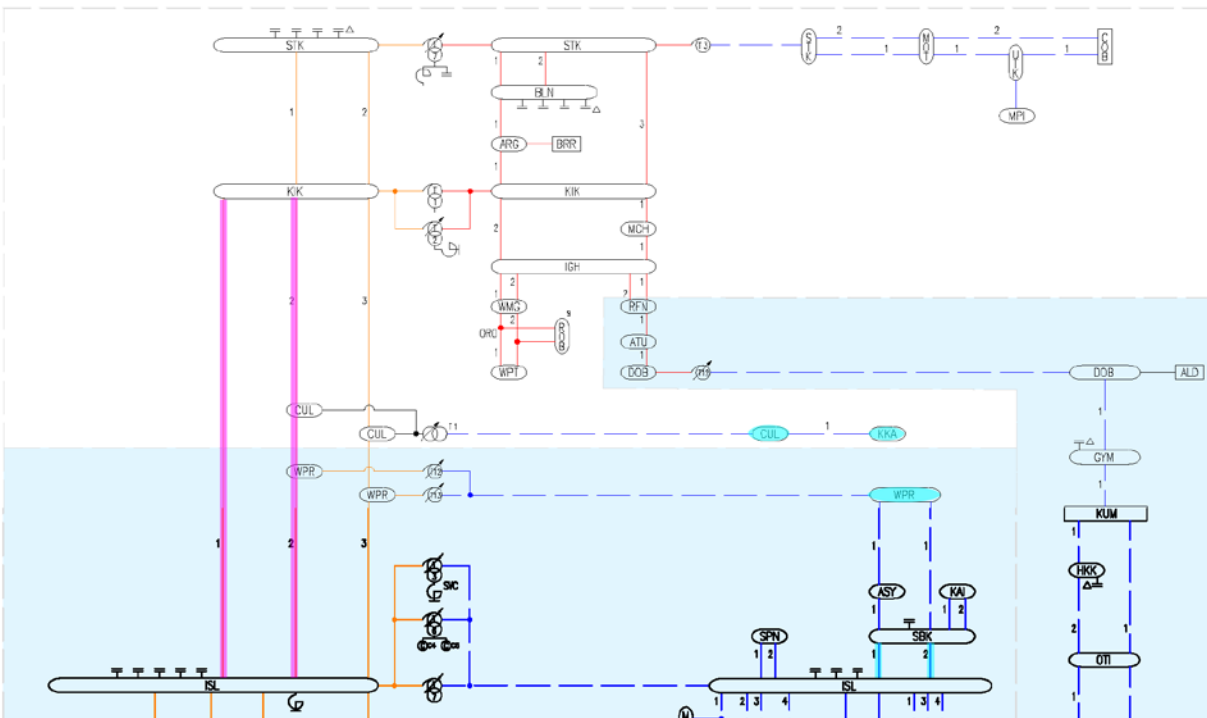
Plant	Sensitivity (for regional demand power factor 0.94)
Cobb G1-G4, G5&G6 (10 MW)	0.54
Stoke capacitors (10 Mvar)	0.47

Power system capability limits to avoid voltage instability for the loss of the Cobb generating unit will decrease by approximately 5.4 MW for a regional demand power factor of 0.94. The unavailability of a 10 Mvar capacitor will reduce the capability limit by approximately 4.7 MW.

2.2 REGIONAL ISSUES DURING OUTAGES

2.2.1 OUTAGE OF AN ISLINGTON-KIKIWA 220 kV CIRCUIT AND LOSS OF ANOTHER CIRCUIT

Grid Exit Point(s)	Power System Issue	Causing Factor	Indicative Limit	Operational Measures	Back to Limit Group
Top of the South Island	<p>Low voltage, voltage instability</p> <p>Risk of loss of supply to Culverden and Kaikoura</p> <p>Risk of loss of connection to Waipara and an increase in loading on Islington-Southbrook 66 kV circuits</p>	Outage of an Islington-Kikiwa 220 kV circuit and loss of another circuit	Load limit of 252 MW	<p>Security constraints</p> <p>Load management</p>	1.4.1



An outage of an Islington-Kikiwa 220 kV circuit and the loss of another Islington-Kikiwa 220 kV circuit may result in voltage instability in the Top of the South Island.

Under planned outage conditions, it is assumed that all generation in the Top of the South Island region would be in service.

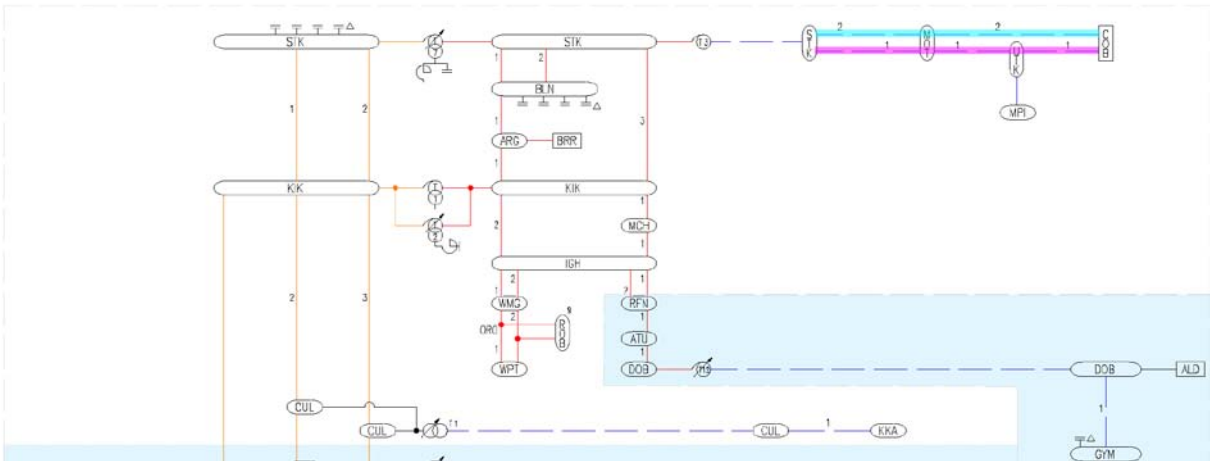
Indicative power system capability limits for the Top of the South Island region are approximately 252 MW assuming a regional power factor of 0.94 and maximum local generation output.

An outage of the Islington-Kikiwa-2 or 3 220 kV circuits and loss of the other circuit will cause a loss of supply to Culverden.

2.3 LOCAL ISSUES DURING NORMAL OPERATION

2.3.1 LOSS OF A COBB-STOKE 66 kV CIRCUIT

Grid Exit Point	Power System Issue	Causing Factor	Indicative Limit	Operational Measures	Back to Limit Group
Cobb Motupipi Motueka	Remaining Cobb-Stoke 66 kV circuit may exceed stated capability	Loss of a Cobb-Stoke 66 kV circuit	Load limit of 18/21 MW (summer/winter) applied to the combined Motueka and Motupipi loads	Security constraints, Short term ratings, Cobb generation "Runback" scheme	1.4.1



The Cobb station is connected to the grid via two 66 kV circuits between Cobb and Stoke. The loss of one Cobb-Stoke 66 kV circuit may cause the remaining circuit to exceed stated capability for both high and low generation scenarios.

Power system capability limits for low Cobb generation on the load at Motueka and Motupipi are required for the loss of the Cobb-Stoke-2 66 kV circuit to avoid the Stoke-Upper Takaka-1 66 kV circuit exceeding stated capability.

Power system capability limits on Cobb under high generation are required for the loss of the Cobb-Upper Takaka-1 66 kV circuit to avoid the section between Cobb and Motueka of the Cobb-Stoke-2 66 kV circuit exceeding stated capability.

Scenario	Limit on Cobb generation output	Combined Motupipi and Motueka load – Capability Limit
Cobb 0 MW	N/A	18/21 MW
Cobb 32 MW	26 MW	N/A

Under low (0 MW) generation, the combined Motueka and Motupipi load is limited to 18/21 MW for a load power factor 0.94.

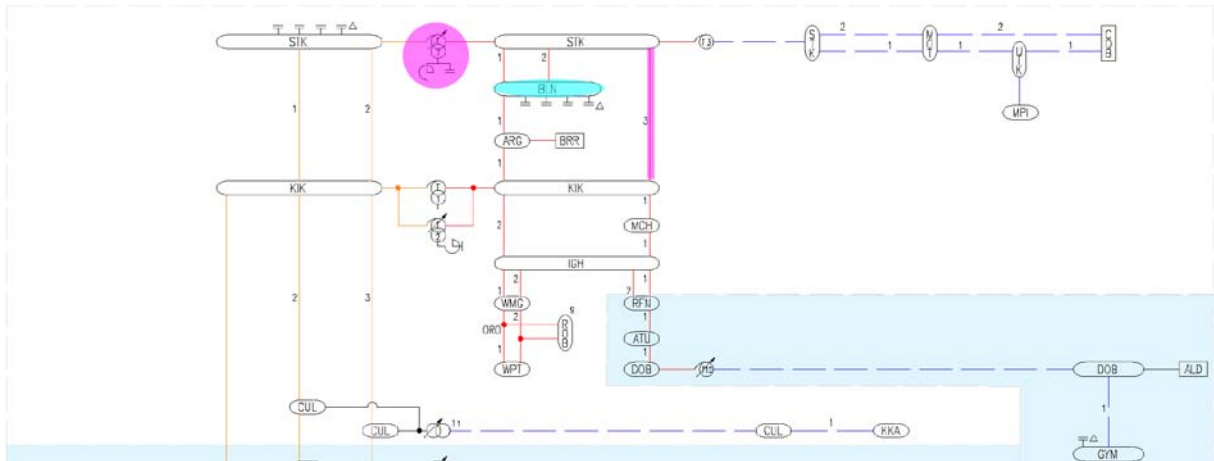
Operational measures to ensure the remaining circuit does not exceed stated capability are:

- apply security constraints for the low generation scenario,
- automatic "runback" scheme for Cobb generation under the high generation scenario.

2.4 LOCAL ISSUES DURING OUTAGES

2.4.1 OUTAGE OF THE STOKE T7 220/110 kV TRANSFORMER AND LOSS OF ANOTHER CIRCUIT

Grid Exit Point	Power System Issue	Causing Factor	Indicative Limit	Operational Measures	Back to Limit Group
Blenheim Motupipi Motueka	Under voltage limit at Blenheim	Outage of the Stoke T7 220/110 kV transformer (including outage of the Stoke 11 kV capacitors) and the loss of Kikiwa-Stoke-3 110 kV circuit	Load limited to 48 MW with 0 MW generation at Cobb	Security constraints, Load management	1.4.1



The outage of the Stoke T7 220/110 kV transformer causes an increase in loading on the Kikiwa-Stoke-3 110 kV circuit. The outage also removes the tertiary connected 11 kV Stoke capacitors.

The loss of the Kikiwa-Stoke-3 110 kV circuit is the critical contingency during an outage on the Stoke T7 220/110 kV transformer as it creates voltage collapse at Blenheim.

Power system capability limits on the combined Blenheim, Motupipi and Motueka loads are required during the outage to ensure voltage at Blenheim and Kikiwa-Stoke circuit 3 does not exceed stated capability. The analysis considers two different local generation scenarios with a regional power factor of 0.94.

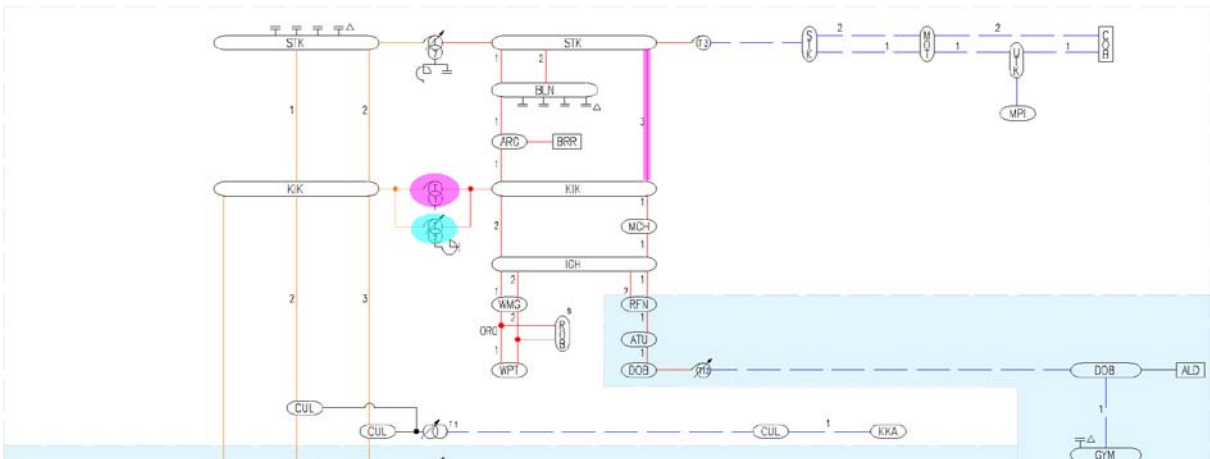
Generation scenario	Blenheim, Motupipi and Motueka loads
Cobb 0 MW	48 MW
Cobb 32 MW	81 MW

The critical contingency under voltage limits the total load to 48 MW, limited by Blenheim, Motupipi, and Motueka. This assumes 0 MW generation output at Cobb and a regional load power factor of 0.94.



2.4.2 OUTAGE OF THE KIKIWA T2 220/110 kV TRANSFORMER AND LOSS OF ANOTHER CIRCUIT

Grid Exit Point	Power System Issue	Causing Factor	Indicative Limit	Operational Measures	Back to Limit Group
Blenheim Murchison Robertson St Westport Reefton Atarau Hokitika Greymouth Otira Dobson	Kikiwa-T1 220/110 kV transformer exceeds stated capability	Outage of the Kikiwa T2 220/110 kV transformer and loss of Kikiwa-Stoke-3 110 kV circuit	Load limited to 60/63 MW (summer/winter)	Security constraints, Load management, Short term ratings	1.4.1



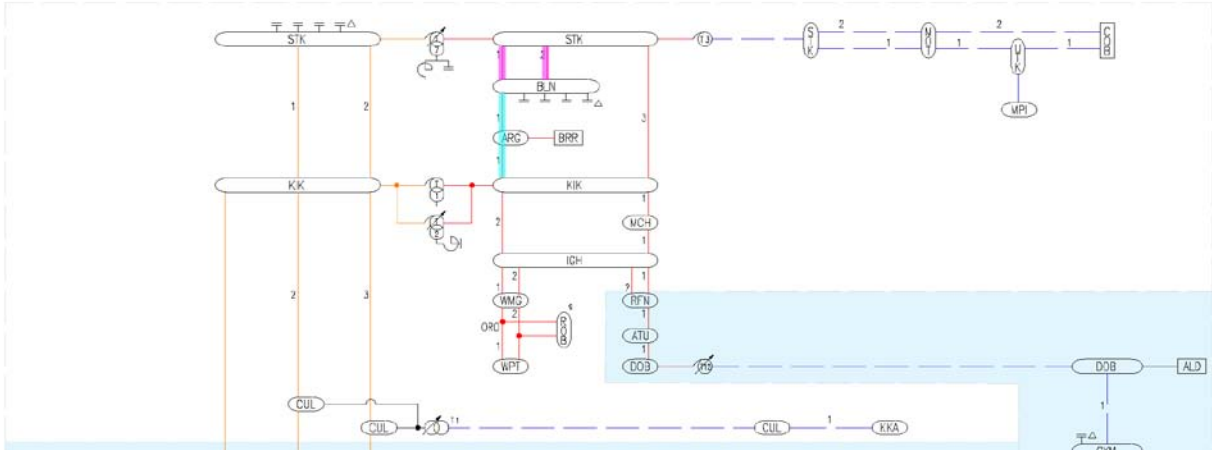
The outage of the Kikiwa T2 220/110 kV transformer leaves the Kikiwa T1 220/110 kV, transformer which has a lower 24 hour post contingency rating, in service. The worst contingency under this condition is the loss of Kikiwa-Stoke-3 110 kV circuit. The summer/winter limits for the power flow into the West Coast, power flow north of Kikiwa, and the loads at Murchison, Robertson Street, Westport, Reefton and Atarau is 60/63 MW. Argyle and Cobb generation are assumed to be not available in determining the limit for this outage.

Operational measures to manage the power system issue are:

- application of security constraints,
- load management,
- dispatching local generation.

2.4.3 OUTAGE OF THE BLENHEIM-STOKE-1 OR 2 110 kV CIRCUITS AND LOSS OF THE OTHER CIRCUIT

Grid Exit Point	Power System Issue	Causing Factor	Indicative Limit	Operational Measures	Back to Limit Group
Blenheim	Blenheim-Kikiwa-1 110 kV circuit may exceed stated capability or low voltages	Outage of the Blenheim-Stoke-1 or 2 110 kV circuits and loss of the other circuit	Blenheim load limited to 48/54 MW (summer/winter)	Short term ratings	1.4.1

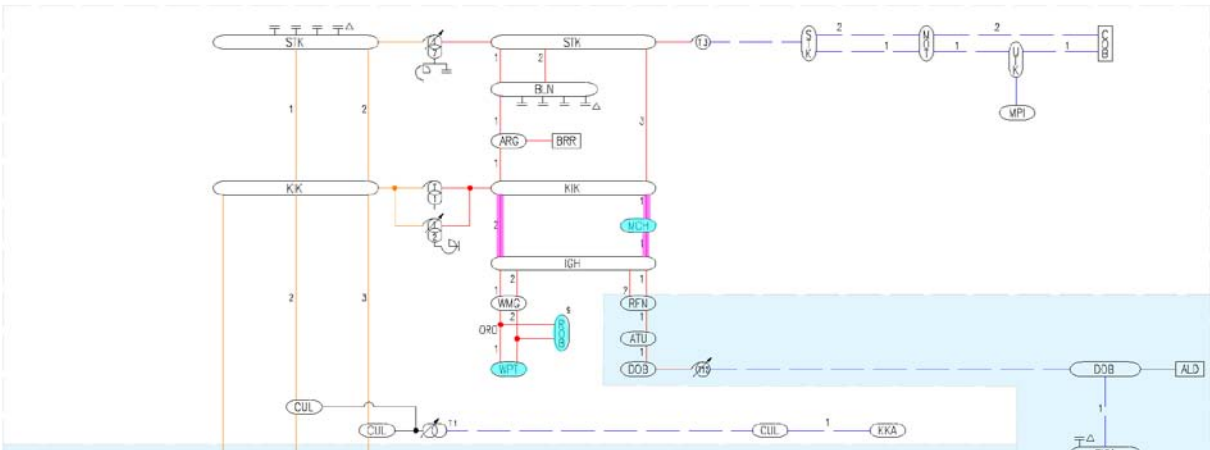


An outage of the Blenheim-Stoke-1 or 2 110 kV circuits and the loss of the other circuit may result in the Blenheim-Kikiwa-1 110 kV circuit exceeding stated capability or grid voltage falling below advised stated capability.

An indicative power system capability limit is 48/54 MW (summer/winter). This assumes a regional power factor of 0.94.

2.4.4 OUTAGE OF THE INANGAHUA-KIKIWA-1 OR 2 110 kV CIRCUITS AND LOSS OF THE REMAINING CIRCUIT

Grid Exit Point	Power System Issue	Causing Factor	Indicative Limit	Operational Measures	Back to Limit Group
Atarau, Reefton, Dobson, Robertson St, Westport, Murchison	Grid voltages in the West Coast region fall below stated capability Loss of supply to Murchison, Robertson Rd and Westport	Outage of the Inangahua-Kikiwa-1 or 2 110 kV circuit and loss of remaining circuit	N/A	Grid reconfiguration, Security constraints, Short term ratings	1.4.1



An outage of the Inangahua-Kikiwa-1 or 2 110 kV circuits and loss of the remaining Inangahua-Kikiwa 110 kV circuit can result in grid voltages in the West Coast region and at Reefton, Robertson St, Westport and Murchison to fall below the advised asset capability.

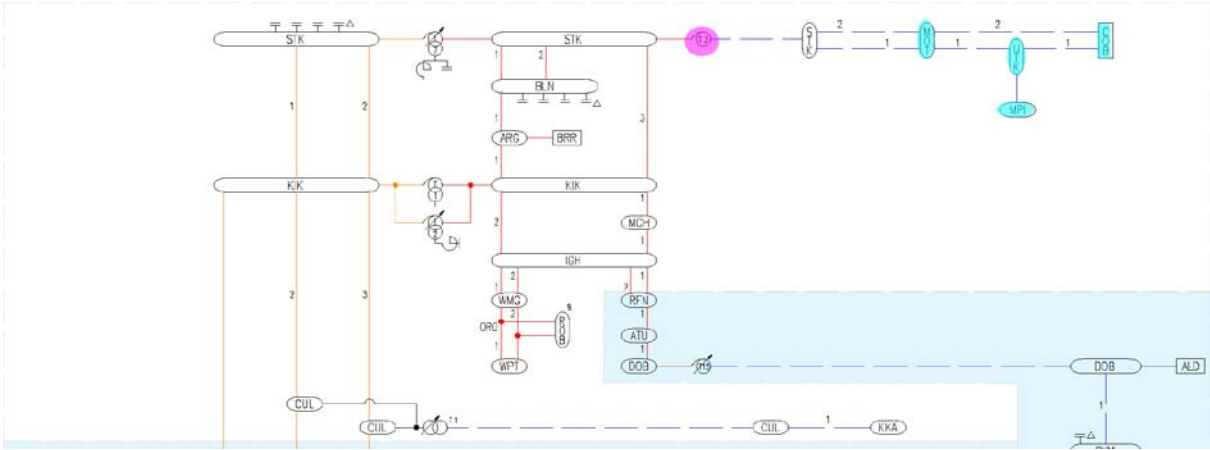
An operational measure to avoid this issue during the outage is to reconfigure the system by establishing a system split on the 66 kV circuit between Dobson and Greymouth.

Following such reconfiguration:

1. The loss of the remaining Inangahua-Kikiwa 110 kV circuit will result in the loss of supply to Atarau, Reefton, Dobson, Robertson St, Westport, and Murchison.
2. The application of security constraints and the use of short term ratings are required to manage the loading on the Coleridge to Otira 66 kV circuits for the loss of the other circuit.

2.4.5 OUTAGE OF THE STOKES T3 110/66 kV TRANSFORMER

Grid Exit Point	Power System Issue	Causing Factor	Indicative Limit	Operational Measures	Back to Limit Group
Cobb Motupipi Motueka	Cobb Generation and Tasman loads form an Islanded network	Outage of the Stokes T3 110/66 kV transformer	N/A	Local generation, Load management	1.4.1

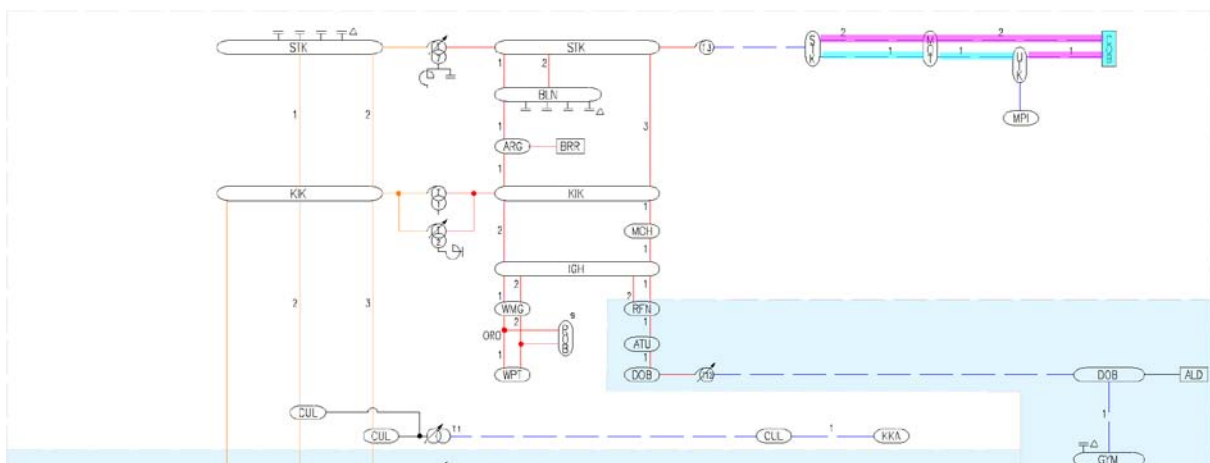


The outage of the Stokes T3 110/66 kV transformer results in the Islanding of the Cobb Power Station and Tasman 66 kV loads at Motueka and Motupipi.

Network Tasman Limited (the local distributor) and Trustpower (owner of Cobb Power Station) will need to work together to control the voltage and frequency on the islanded network.

2.4.6 OUTAGE OF THE COBB-STOKE-2 66 kV CIRCUIT, OR COBB-UPPER TAKAKA-1 66 kV CIRCUIT, OR STOKE-UPPER TAKAKA-1 66 kV CIRCUIT AND THE LOSS OF ANOTHER CIRCUIT

Grid Exit Point	Power System Issue	Causing Factor	Indicative Limit	Operational Measures	Back to Limit Group
Cobb Upper Takaka Motupipi Motueka	Loss of Cobb generation Stoke-Upper Takaka-1 66 kV circuit exceeds stated capability	Outage of the Cobb-Stoke-2 66 kV circuit and loss of Cobb-Upper Takaka 1 circuit	Motupipi and Motueka load limited to 19/23 MW (summer/winter)	Load management Short term ratings	1.4.1
	Disconnection of Cobb generation from the rest of the power system	Outage of the Cobb-Stoke-2 66 kV circuit and loss of Stoke-Upper Takaka-1 circuit	Motupipi load limited to Cobb generation	Local generation	
	Cobb-Stoke-2 66 kV circuit exceeds stated capability limits	Outage of the Cobb-Upper Takaka-1 66 kV circuit and loss of Stoke-Upper Takaka circuit	Cobb generation limited to 21/26 MW (summer/winter)		



The loss of the Cobb-Upper Takaka-1 66 kV circuit during an outage of Cobb-Stoke 66 kV circuit may cause the Stoke-Upper Takaka-1 66 kV circuit to exceed stated capability and also the loss of connection to Cobb power station. Power system capability limits on the Motueka and Motupipi loads are required during the outage to avoid Stoke-Upper Takaka-1 66 kV circuit exceeding stated capability. Indicative power system capability limits are 19/23 MW for advised summer/winter ratings. The same limit applies when there is an outage of Stoke-Upper Takaka-1 66 kV circuit.

The loss of the Stoke-Upper Takaka-1 66 kV circuit during an outage of the Cobb-Stoke 2 66 kV circuit creates an isolated system where Cobb generation supplies Motupipi load. For this reason, the load at Motupipi is limited to the connected generation at Cobb power station. The same limitations apply when there is an outage of Stoke-Upper Takaka-1 66 kV circuit.

During an outage of the Cobb-Upper Takaka-1 66 kV circuit, Cobb generation is limited to 21/26 MW (summer/winter) to avoid the Cobb-Stoke-2 66 kV circuit exceeding its stated capability. The same generation limit applies when there is an outage of the Cobb-Stoke-2 66 kV circuit.