Appendix A: Grid Configuration

System Security Forecast 2024

Version: 1.01

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IMPORTANT

Contact Details

Address:	Transpower New Zealand Ltd Waikoukou 22 Boulcott Street PO Box 1021 Wellington New Zealand
Telephone:	+64 4 495 7000
Email:	system.operator@transpower.co.nz
Website:	www.transpower.co.nz

Contents

1 Introduction

The New Zealand power system consists of two separate networks, one in the North Island and one in the South Island, which are connected via an HVDC link. The backbone of the power system is a 220 kV network that spans the length of both islands. The bi-directional HVDC link is connected at Haywards in the North Island and Benmore in the South Island.

The base power system configuration and asset capability assumed in the 2024 System Security Forecast is based on the responses from the Security of Supply Annual Assessment survey. This survey was sent for industry to confirm their committed new generation or plans to decommission existing generation, all updates confirmed by 31 December 2025 have been included in this study. Committed new generation or grid scale battery storage has only been considered if the asset owner confirmed it has been consented and is proceeding. The base network is shown geographically and schematically in the Single Line Diagrams sections of this document.

2 Committed generation projects

Table 2-1 outlines generation projects which were notified to the System Operator as committed commissioning or decommissioning as of 31 December 2025[1].

Table 2-1 Committed generation projects

Generation Plant (Owner)	Region	Type	Operating Capacity (MW)	Grid Injection Point	Commissioning Date	Grid Zone
Ruakaka BESS (Meridian)	Northland	Battery	+/-100 MW, 200 MWh	Bream Bay	Commissioned	1
Pukenui (Aquila Clean Energy)	Northland	Solar	17.1MW	Kaikohe (embedded)	Commissioned	1
Twins Rivers (Ranui Generation Limited)	Northland	Solar	24MW	Kaitaia/Kaikohe (embedded)	2026	1
Ruawai (Northpower Limited)	Northland	Solar	14MW	Maungaturoto (embedded)	Commissioned	1
Te Papa Reireia (Maungaturoto Solar Farm Project LP)	Northland	Solar	17.6MW	Maungaturoto (embedded)	Nov 2025	1

[1] *Two solar farms were excluded due to uncertainty concerning the capacity of the Grid Injection Points, these will be updated in future as more clarity is provided. Any other generation not considered in this study will be considered in the next major update due in June 2026.*

Generation Plant (Owner)	Region	Type	Operating Capacity (MW)	Grid Injection Point	Commissioning Date	Grid Zone
Kaiwaikawe Wind Farm (Mercury)	Northland	Wind	70MW	Maungatapere (Embedded)	2026	1
Waerenga Solar Farm (Island Green Power Ltd)	Auckland	Solar	190	Awariki Road (new)	2027	2
Glenbrook BESS (Contact Energy)	Auckland	Battery	+/-100 MW, 200 MWh	Glenbrook	2026	2
Karapiro (Mercury)	Hamilton	Hydro	112 MW	Karapiro	Commissioned	3
Whitianga Solar farm (Lodestone)	Hamilton	Solar	23.75 MW	Kopu	2026	3
Rangiriri Solar Farm (Island Green Power Ltd)	Hamilton	Solar	146.7	Glen Murray Road (new)	2027	3
Tauhei Solar Farm (Harmony Energy)	Hamilton	Solar	150MW	Waihou	2026	3
Taiohi Solar Farm (NewPower Energy)	Hamilton	Solar	22.4 MW	Huntly (embedded)	Commissioned	3
Huntly BESS (Genesis)	Hamilton	Battery	+/-100 MW, 200 MWh	Huntly	2026	3
Te Herenga o Te Ra Solar Farm (Lodestone Energy Limited)	Edgecumbe	Solar	35	Waiotahe	Commissioned	4
Te Huka Geothermal (Contact Energy)	Edgecumbe	Geothermal	51	Tauhara	Commissioned	4
Edgecumbe Solar (Helios Energy Limited)	Edgecumbe	Solar	28.7	Edgecumbe	2026	4
TOPP2 (Eastland Generation)	Edgecumbe	Geothermal	55	Kawerau	Dec 2025	4

Generation Plant (Owner)	Region	Type	Operating Capacity (MW)	Grid Injection Point	Commissioning Date	Grid Zone
Te Ahi O Maui (Eastland Generation)	Edgecumbe	Geothermal	27.4	Kawerau	Commissioned	4
Ngatamariki (Mercury)	Edgecumbe	Geothermal	54	Nga Awa Purua	Dec 2025	4
Tuai (Genesis)	Hawkes Bay	Hydro	68	Tuai	Commissioned	5
Edgecumbe Solar Farm – EDS (Aquila Clean Energy)	Edgecumbe	Solar	27	Edgecumbe (embedded)	2026	4
Te Mihi G5 & G6 (Contact Energy)	Edgecumbe	Geothermal	102	Te Mihi	2027	4
Lauriston (Genesis)	Canterbury	Solar	47	Ashburton	Commissioned	11
Kaiwera Downs Stage 2 (Mercury)	Southland	Wind	152	Kaiwera2	2026	14

[2] *New Grid Injection Point- In and Out connection to North Makarewa and Three Mile Hill*

3 Committed grid upgrades

Table 3-1 outlines the grid upgrade projects which were notified to the System Operator as committed commissioning or decommissioning as of 31 December 2025.

Table 3-1 Committed grid upgrades

Asset	Changes	Commissioning Date	Grid Zone
Wairau Road second Transformer (T9)	Install WRD T9 220/110 kV, 250 MVA transformer	September-2026	1
Bombay GXP	Bombay-Hamilton-1 110 kV circuit disconnected.	Commissioned	2
Ōtāhuhu STATCOM	Install a 150 Mvar STATCOM at Ōtāhuhu 220 kV.	Commissioned	2
Glenbrook STATCOM (NZ Steel)	Installation of a 74 MVAr STATCOM on Glenbrook 33kV dirty bus to support voltage variations caused by the new arc furnace load.	December-2025	2
Hamilton–Whakamaru and Ohinewai–Whakamaru 220 kV circuits	Implement variable line ratings on the Hamilton–Whakamaru and Ohinewai–Whakamaru circuits.	March-2027	3
Hautapu GXP	New 220 kV GXP commissioned at Cambridge West, supplied from Ōtāhuhu–Whakamaru–1 and 2 circuits.	Commissioned	3
Huntly–Stratford 220 kV circuit	NZGP Stage 1 - Remove line protection static limit on the Huntly–Stratford circuit.	April-2026	3, 6
Kawerau 220/110 kV Interconnecting Transformer Replacement	Replace Kawerau–T13 with a 250 MVA transformer.	Commissioned	4
Lichfield–Tarukenga–1 110 kV Circuit	Reconductor 2 km section on the Lichfield–Tarukenga–1 circuit.	Commissioned	4
Tokaanu–Whakamaru 220 kV circuits	NZGP Stage 1 - thermal upgrade of the Tokaanu–Whakamaru 220 kV circuits with variable line ratings.	2026	4
Te Mihi–Wairakei, Te Mihi–Whakamaru and Wairakei–Whakamaru 220 kV circuits	NZGP Stage 1 - Thermally upgrade the Wairakei–Whakamaru C line. (Te Mihi–Wairakei, Te Mihi–Whakamaru and Wairakei–Whakamaru circuits)	2026	4
Edgecumbe–Kawerau 3 220 kV circuit	NZGP Stage 1 - Thermally upgrade the Edgecumbe–Kawerau 3 220 kV circuit.	August-2026	4
Tokaanu–Whakamaru 220 kV circuits	NZGP Stage 1 - Duplex the Tokaanu–Whakamaru 1 and 2 220 kV circuits.	June-2026, June-2027	4
Te Matai Transformer Replacement	Te Matai T1 capacity increased from 30 to 80MVA	December-2025	4

Asset	Changes	Commissioning Date	Grid Zone
Wairakei Supply Transformer	Wairakei T29 and T30 capacity increased from 50MVA to 60MVA	December-2025	4
Edgecumbe T5 Transformer Replacement	Replace EDG-T5 with old KAW-T13	December-2026	4
Edgecumbe-Kawerau 110kV split	Split the 110 kV: New N/O Kawerau CB172 & CB112 to Edgcumbe and close Edgecumbe CB292 to Edgecumbe T5.	Commissioned	4
Redclyffe Interconnecting Transformer	Install third Redclyffe Interconnecting Transformer (RDF T5).	Commissioned	5
Brunswick Supply Transformer	Brunswick new supply transformer	December-2027	6
Hawera Supply Transformers	Outdoor to indoor conversion project and protection upgrade project	Commissioned	6
Bunnythorpe–Ongarue 110 kV system	NZGP Stage 1 - Ongarue 110 kV split.	April-2026	7
Bunnythorpe–Tokaanu circuits	NZGP Stage 1 - Thermally upgrade the Bunnythorpe–Tokaanu circuits and implement variable line ratings.	April-2029	7
Marton Supply Transformers	Outdoor to indoor conversion project and protection upgrade project (removes the protection constraint)	July-2026	7
KAI-TF1 and TF2 branch limit	Upgrade the KAI-TF1 and TF2 11kV branch limit	Dec-2025	10
Timaru 220/110 kV interconnecting Transformer Replacement	Timaru T8A and T8B replaced 1 x 250 MVA 10% Z Unit.	Commissioned	11
Frankton Supply Transformer Upgrade	Frankton T4, T2A and T2B supply transformers upgraded to 2 x 120 MVA, 10% Z units.	Commissioned	13
CML-FKN 110 kV circuit upgrade	Thermal upgrade of CML-FKN 1 & 2 circuits to 100degC to increase Frankton transmission capacity	April-2026	13
INV 220/66 supply Transformer and 66 kV bus	New 66 kV bus and 220/66 kV supply transformer for Powernet at INV to support electrification in the area	Commissioned	14

4 HVDC capacity

High Voltage Direct Current (HVDC) Pole 2 has a nominal power rating of 500 MW limited by the rating of a single Cook Strait HVDC cable connected to Pole 2. HVDC Pole 3 is connected by two Cook Strait cables and has a nominal power rating of 700 MW. It is possible to operate the HVDC link as a balanced bipole or as an unbalanced bipole with 700/500 MW (on HVDC Pole 3/Pole 2).

The maximum HVDC transfer capacity is shown below in Table 4-1 at a power factor of 0.9. Note that the maximum HVDC capacity is dependent on the reserve cover available on the system at the time of dispatch, and to facilitate these transfer levels all circuits and reactive power plants between Haywards and Bunnythorpe must be in-service.

Table 4-1 HVDC capability

HVDC Transfer	MW (sent)	MW (received)
North transfer	1200	1132
South transfer	850	816

5 Demand forecast for both islands

Demand forecast used in this SSF uses the same method as the 2023 Transmission Planning Report (TPR) "expected" forecast[3] prepared by Transpower, in its role as the Grid Owner. However, it is aligned with the Grid Zones as studied in the SSF. The forecast represents an expected forecast with a 50% probability of exceedance (PoE). The demand and power factor forecasting involved both top down (national/regional) and bottom up (GXP) modelling of peak demand. More information about the demand forecast methodology can be found in Transpower's 2023 TPR, Section 3[4]. Power factors for each region were also taken from the demand forecast for the 2023 TPR.

Table 5-1 and

Table 5-2 show the expected regional peak and trough demand forecast used in individual regional analysis.

Table 5-1 Demand forecast - expected regional peak (MW)

Region	Summer			Winter		
	2024	2025	2026	2025	2026	2027
North Island						
Grid Zone 1	542	582	616	986	1029	1070
Grid Zone 2	1230	1252	1282	1533	1574	1626
Grid Zone 3	588	617	643	688	714	763
Grid Zone 4	387	428	443	587	607	628
Grid Zone 5	306	313	319	377	381	387
Grid Zone 6	208	216	220	239	243	249
Grid Zone 7	247	266	275	340	351	370
Grid Zone 8	472	489	505	731	744	757
South Island						
Grid Zone 9	225	235	240	264	269	274
Grid Zone 10	487	505	514	644	656	672
Grid Zone 11	419	428	446	318	334	341
Grid Zone 12	80	83	90	77	80	86
Grid Zone 13	201	211	220	226	236	240

[3] *The demand forecast was generated based on the TPR forecasting methodology (Te Mauri Hiko forecast) however aligns with peak Grid Zone contribution rather than peak TPR region contribution.*

[4] *Available online at www.transpower.co.nz (search Transmission Planning Report)*

Region	Summer 2024	2025	2026	Winter 2025	2026	2027
Grid Zone 14	947	953	961	1014	1020	1027

Table 5-2 Demand forecast - expected regional night trough (MW)

Region	Summer 2024	2025	2026	Winter 2025	2026	2027
North Island						
Grid Zone 1	212	229	268	254	263	291
Grid Zone 2	517	529	531	579	589	601
Grid Zone 3	246	267	275	261	270	278
Grid Zone 4	191	210	216	224	231	238
Grid Zone 5	111	114	115	113	114	115
Grid Zone 6	96	99	100	82	82	83
Grid Zone 7	67	76	79	79	82	87
Grid Zone 8	105	106	106	133	134	139
South Island						
Grid Zone 9	63	66	67	81	82	83
Grid Zone 10	232	232	246	209	211	217
Grid Zone 11	131	131	138	142	147	150
Grid Zone 12	27	28	29	22	22	23
Grid Zone 13	98	102	105	100	104	106
Grid Zone 14	663	668	669	636	639	642

Table 5-3 and

Table 5-4 show the expected island peak and trough demand forecast used in the 220 kV grid backbone analysis.

Table 5-3 Demand forecast - expected island peak (MW)

Region	Summer 2024	2025	2026	Winter 2025	2026	2027
North Island						
Grid Zone 1	528	570	602	945	990	1031
Grid Zone 2	1187	1210	1243	1495	1539	1591
Grid Zone 3	567	596	622	672	698	746
Grid Zone 4	381	423	439	573	592	613
Grid Zone 5	292	299	306	325	332	339
Grid Zone 6	189	197	202	224	229	235
Grid Zone 7	235	255	264	341	351	370
Grid Zone 8	447	465	480	697	710	723
South Island						
Grid Zone 9	213	223	228	245	249	253
Grid Zone 10	430	450	458	636	646	662
Grid Zone 11	347	356	374	291	307	313
Grid Zone 12	76	80	85	58	61	66

Region	Summer			Winter		
	2024	2025	2026	2025	2026	2027
Grid Zone 13	189	198	207	222	231	235
Grid Zone 14	927	934	941	1013	1020	1027

Table 5-4 Demand forecast - expected island night trough (MW)

Region	Summer			Winter		
	2024	2025	2026	2025	2026	2027
North Island						
Grid Zone 1	263	279	305	288	297	320
Grid Zone 2	520	533	535	599	610	622
Grid Zone 3	262	281	289	297	307	316
Grid Zone 4	221	243	250	255	264	271
Grid Zone 5	137	140	142	150	152	153
Grid Zone 6	119	122	124	112	113	114
Grid Zone 7	95	106	109	118	122	128
Grid Zone 8	127	129	129	160	161	165
South Island						
Grid Zone 9	84	89	90	90	91	93
Grid Zone 10	224	224	238	271	273	281
Grid Zone 11	144	143	152	152	158	158
Grid Zone 12	38	38	40	34	35	35
Grid Zone 13	90	94	97	95	99	99
Grid Zone 14	691	696	697	693	698	699

The SSF uses regional boundaries that are aligned to grid zones. These regional boundaries are sometimes different to those used in other publications resulting in differences in regional load forecasts between the SSF and other publications. For the N-1 Thermal and Voltage limit analysis, the expected regional peak demand forecast is used for individual grid zone analysis while the expected island peak demand forecast is used for 220 kV backbone analysis.

6 Load duration curves

The load duration curves show the percentage of time that the maximum load of each grid zone is above a specified MW value. The load duration curves as shown below were created using historical data from 1 May 2023 – 31 May 2024.

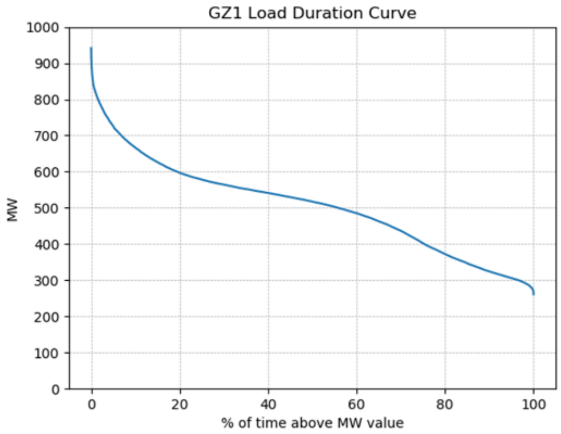


Figure 6-1 Grid Zone 1 load duration curve

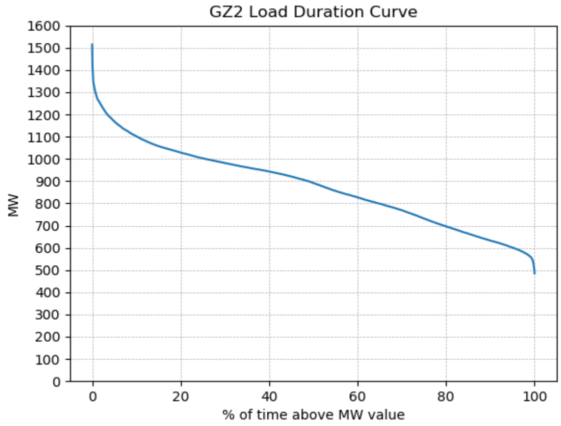


Figure 6-2 Grid Zone 2 load duration curve

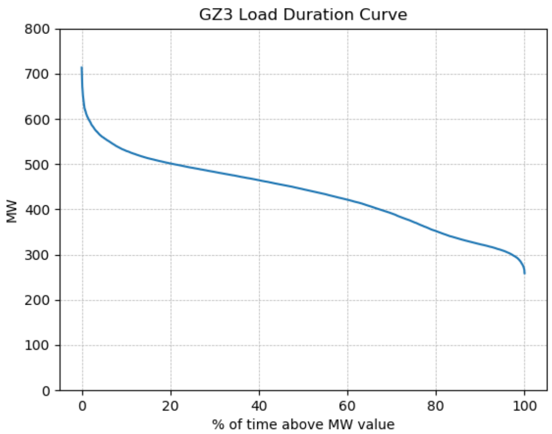


Figure 6-3 Grid Zone 3 load duration curve

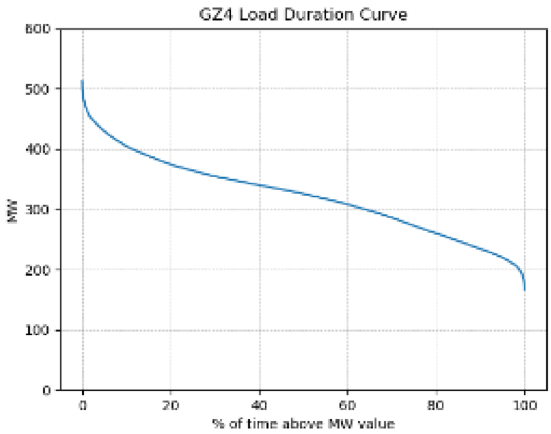


Figure 6-4 Grid Zone 4 load duration curve

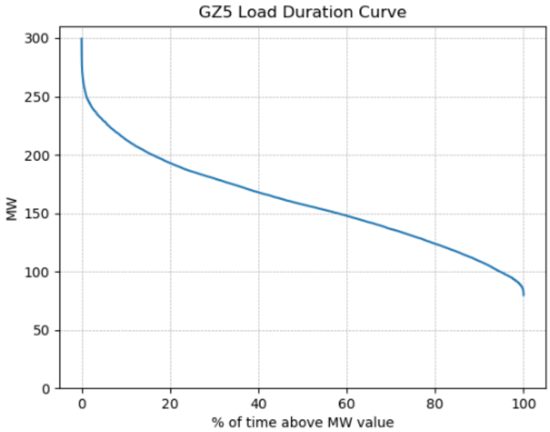


Figure 6-5 Grid Zone 5 load duration curve

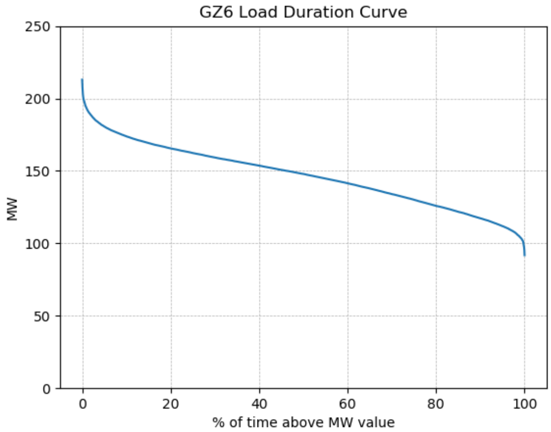


Figure 6-6 Grid Zone 6 load duration curve

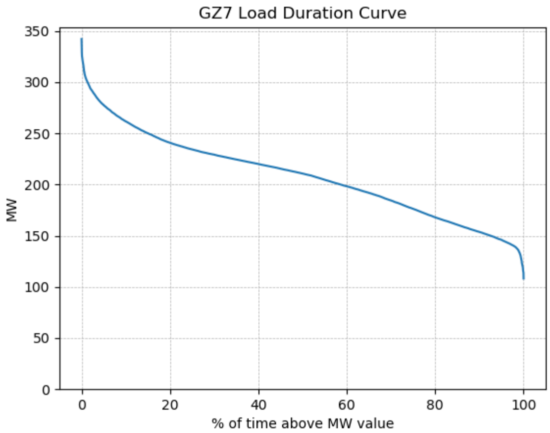


Figure 6-7 Grid Zone 7 load duration curve

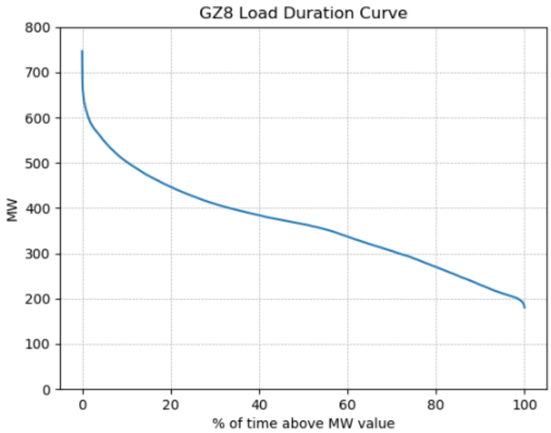


Figure 6-8 Grid Zone 8 load duration curve

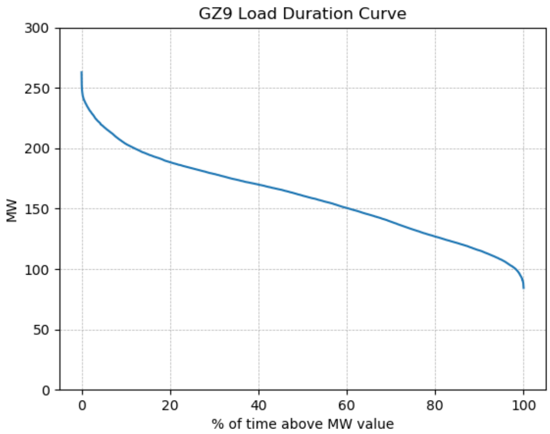


Figure 6-9 Grid Zone 9 load duration curve

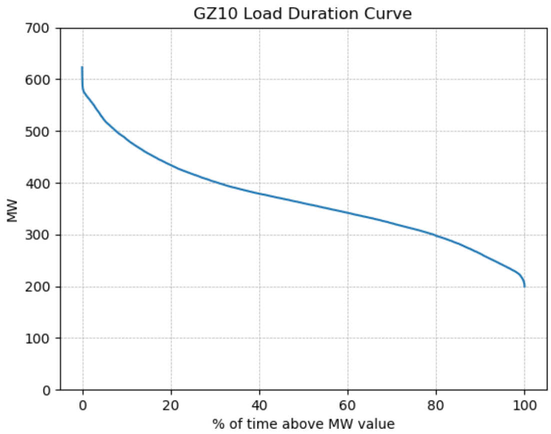


Figure 6-10 Grid Zone 10 load duration curve

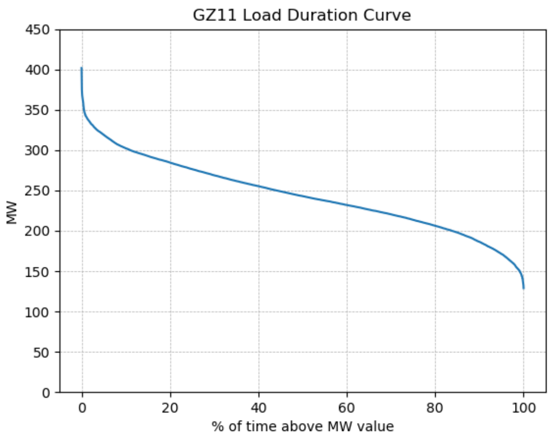


Figure 6-11 Grid Zone 11 load duration curve

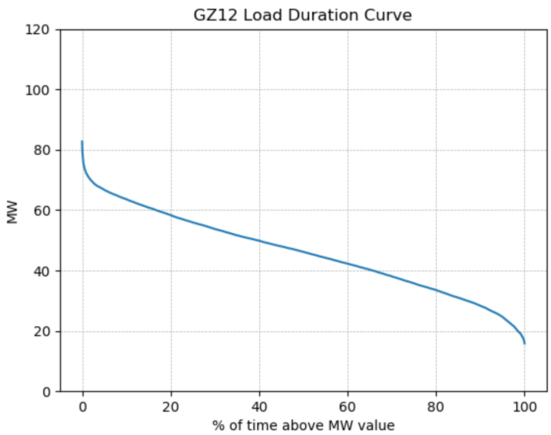


Figure 6-12 Grid Zone 12 load duration curve

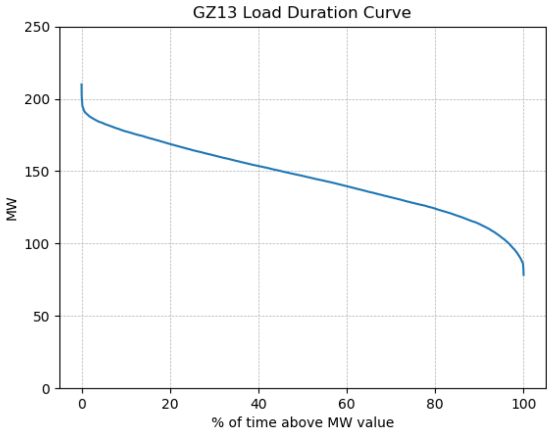


Figure 6-13 Grid Zone 13 load duration curve

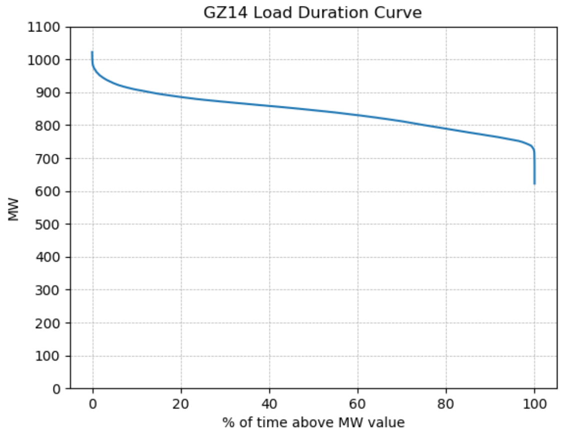


Figure 6-14 Grid Zone 14 load duration curve

7 Generation capacity in both islands

Hydro-power generation currently represents approximately 55% of the total installed generation capacity in New Zealand. The remainder is mainly thermal, wind, co-generation, and geothermal generation. The SSF studies assume that all committed or existing generating stations will operate at their stated capability until the end of the study period in 2027 or their planned decommissioning date, whichever is sooner. It is also assumed that there is sufficient fuel available for all existing generating stations and those committed to operate for the three-year period. The reactive power output available from the generators is assumed to be as per the generator Asset Capability Statements (ACS) supplied to the System Operator.

Table 7-1 lists the location, type, and generation capacity of generating stations assumed connected to the network in the SSF.

ACS information provided by asset owners to the System Operator is kept confidential in accordance with Part 8, Schedule 8.3, Technical Code A clause 3 (2) of the Code. Information concerning the capability of individual generating units has not been published in this SSF unless the information is already in the public domain.

Unless otherwise noted, non-dispatchable generators are considered static and not variable in this analysis. From a Market perspective both wind and solar are considered dispatchable generation.

Table 7-1 Location, type and capacity of generating stations.

Name	Type	Dispatchable	Capacity (MW)	Grid Zone
NORTH ISLAND				
Ngawha A	Geothermal	Yes	25.8	1
Ngawha B	Geothermal	Yes	35.4	1
Kaitaia Solar Farm	Solar	Yes	23.7	1
Pukenui Solar	Solar	No	17.16	1

Name	Type	Dispatchable	Capacity (MW)	Grid Zone
Ruakaka BESS (Meridian)	BESS	Yes	+/-100 MW, 200 MWh	1
Glenbrook	Cogeneration	Yes	95.7	2
Arapuni	Hydro	Yes	198	3
Huntly	Thermal	Yes	10475	3
Karapiro	Hydro	Yes	109	3
Kinleith	Cogeneration	Yes	39.6	3
Te Uku	Wind	Yes	67.6	3
Aniwhenua	Hydro	Yes	25	4
Aratiatia	Hydro	Yes	87.0	4
Ātiamuri	Hydro	Yes	80.0	4
Edgecumbe	Gas	No	9.80	4
Kaimai Scheme	Hydro	Yes	40.4	4
Kawerau (KAG)	Geothermal	Yes	106	4
Onepu (TA2, TA3, KA24, TOPP1)	Geothermal	Yes	61.9	4
Maraetai 1	Hydro	Yes	180	4
Maraetai 2	Hydro	Yes	180	4
Matahina	Hydro	Yes	80.0	4
Mōkai 1	Geothermal	Yes	80.0	4
Mōkai 2	Geothermal	Yes	46.0	4
Ngā Awa Pūrua	Geothermal	Yes	146.2	4
Ngatamariki	Geothermal	Yes	95.2	4
Ohaaki	Geothermal	Yes	94	4
Ohakuri	Hydro	Yes	117	4
Poihipi	Geothermal	Yes	55	4
Rotokawa	Geothermal	Yes	32.8	4
Rangitaiki Solar Farm	Solar	Yes	23.7	4
Tauhara	Geothermal	Yes	168	4
Te Herenga o Te Ra Solar Farm	Solar	No	22.8	4
Te Huka	Geothermal	Yes	51	4
Te Ahi O Maui	Geothermal	Yes	27.4	4
Te Mihi	Geothermal	Yes	183.72	4
Waipapa	Hydro	Yes	51.0	4
Wairakei	Geothermal	Yes	194.3	4
Whakamaru	Hydro	Yes	124	4
Wheao	Hydro	Yes	24.0	4
Edgecumbe Solar Farm	Solar	No	27	4
Te Mihi G5 & G6	Geothermal	Yes	102	4
Tuai (Wihi Station)	Hydro	Yes	64	5
Whirinaki	Thermal	Yes	156.3	5
Kaitawa	Hydro	Yes	36.0	5
Piripaua	Hydro	Yes	47.2	5
Harapaki	Wind	Yes	176	5
Carrington Street (Mangorei)	Hydro	No	4.95	6
Huirangi (Mangahewa)	Gas	No	9.00	6

[5] *This includes two Rankine units (U1 and U4), U5, and U6. A third Rankine (U2) is not considered in SSF studies, except for south flow and dry year analysis.*

Name	Type	Dispatchable	Capacity (MW)	Grid Zone
Huirangi (Motukawa)	Hydro	No	4.5	6
Kapuni	Gas/Cogen	Yes	23.5	6
McKee (McKee Power Plant)	Gas	Yes	94.0	6
Pātea	Hydro	Yes	32.9	6
Stratford (Stratford Peaker Plant)	Gas	Yes	220	6
Stratford (Taranaki Combined Cycle)	Gas	Yes	383	6
Whareroa	Cogen	Yes	60	6
Junction Road	Gas	Yes	98.0	6
Waipipi Wind Farm	Wind	Yes	133.3	6
Mangahao	Hydro	Yes	38.4	7
Rangipo	Hydro	Yes	130	7
Tararua Central	Wind	Yes	93.0	7
Te Rere Hau	Wind	Yes	48.5	7
Tararua North	Wind	Yes	34.3	7
Tararua South	Wind	Yes	33.7	7
Te Āpiti	Wind	Yes	90.0	7
Tokaanu	Hydro	Yes	240	7
Turitea North	Wind	Yes	119	7
Turitea South	Wind	Yes	102	7
Mill Creek	Wind	Yes	59.8	8
West Wind	Wind	Yes	142.6	8
SOUTH ISLAND				
Argyle	Hydro	Yes	3.8	9
Cobb	Hydro	Yes	36.0	9
Lake Rochfort (ROB)	Hydro	No	4.20	9
Matiri	Hydro	No	4.90	9
Highbank	Hydro	Yes	25.2	11
Lauriston (Genesis)	Solar	No	47	11
Opuha	Hydro	Yes	6.80	11
Tekapo A	Hydro	Yes	30.0	11
Arnold	Hydro	No	3.00	12
Amethyst	Hydro	No	7.20	12
Coleridge	Hydro	Yes	39.0	12
Kumara	Hydro	Yes	13	12
Dillmans	Hydro	No	3.50	12
Aviemore	Hydro	Yes	234	13
Benmore	Hydro	Yes	570	13
Ōhau A, B, C	Hydro	Yes	704	13
Pātearoa/Paerau	Hydro	Yes	12.43	13
Tekapo B	Hydro	Yes	160	13
Waitaki	Hydro	Yes	105	13
Clyde	Hydro	Yes	488	14
Kaiwera Downs Stage 1	Wind	Yes	43	14
Kaiwera Downs Stage 2	Wind	Yes	152	14
Mahinerangi	Wind	Yes	37.5	14
Manapouri	Hydro	Yes	875	14
Roxburgh	Hydro	Yes	352	14

Name	Type	Dispatchable	Capacity (MW)	Grid Zone
Waipori	Hydro	Yes	89.8	14
White Hill	Wind	Yes	66.4	14

8 Approved dispensations

The approved dispensations to the importing and exporting reactive power capability, are reflected in the network model. The full list can be found in SO Register in the Operations Customer Portal.

9 Reactive power sources in both islands

This section lists system capacitors, reactors, synchronous condensers, static var compensators (SVCs) and STATCOMs committed as of 15 April 2024.

The total reactive power available from the network capacitors excluding the HVDC filter capacitors is 2274 Mvar. The total reactive power available from the installed network SVCs and synchronous condensers is -900/1175 Mvar.

The Glenbrook STATCOM is a customer-owned reactive power device and not added to Table 9-5. The STATCOM at Glenbrook will be used to manage voltage on the Glenbrook 33 kV bus which will support plant operations.

Table 9-1 to Table 9-5 lists the location, amount, and switching information of different assets assumed connected to the network.

Table 9-1 List of shunt capacitors

Bus	No. x Size (Mvar)	Total (Mvar)	Automatically switched (RPC or AVR)
North Island			
Albany 110 kV (C1)	1 x 50	50.0	No.
Albany 220 kV (C2)	1 x 100	100	Yes.
Bombay 110 kV (C11)	1 x 50	50.0	No.
Hamilton 110 kV (C1, C2)	2 x 50	100	Yes.
Haywards 220 kV (F3, F4)	2 x 60 + 2 x 46	212	Yes.
Haywards 220 kV (F5, F6)	2 x 60 + 1 x 46	166	Yes.
Haywards 110 kV (F7, F8)	2 x 16	32.0	Yes.
Henderson 220 kV (C1)	1 x 75	75.0	No.
Hepburn Rd 110 kV (C11, C12, C13)	3 x 50	150	No.
Kaitaia 33 kV (C11, C21, C31)	3.2, 6.4, 12.8	22.4	No.
Mount Maunganui 110 kV (C1)	1 x 25	25.0	No.
Ohinewai 220 kV (C1, C2)	2 x 75	150	Yes.
Ongarue 33 kV (C1)	1 x 2.5	2.50	No.
Ōtāhuhu 110 kV (C11, C12)	2 x 50	100	No.
Ōtāhuhu 220 kV (C29, C30, C31)	3 x 100	300	No.
Penrose 220 kV (C1)	1 x 75	75.0	No.
Penrose 110 kV (C11, C12, C13)	3 x 50	150	No.
Tauranga 110 kV (C11)	1 x 25	25.0	No.

Bus	No. x Size (Mvar)	Total (Mvar)	Automatically switched (RPC or AVR)
Te Awamutu 110 kV (C1, C2)	2 x 15	30.0	No.
South Island			
Balclutha 33 kV (C1, C2)	2 x 4	8.00	No.
Benmore 220 kV (F3, F4, F5, F6, F7)	2 x 79.4, 2 x 79.8, 1 x 80	398	Yes.
Blenheim 33 kV (C1, C2, C3, C4)	4 x 5.10	20.4	Yes (33 kV +/- 2%)
Bromley 11 kV (C5A, C6A)	2 x 30	60.0	No.
Brydone 11 kV (C1, C2, C4, C5)	4 x 5.15	20.6	Yes (110 kV + 1% to +4%)
Greymouth 11 kV (C1, C2, C3)	4, 2 & 1	7.00	Yes (66 kV 0% to +2.5%)
Hokitika 11 kV (C7, C8, C9)	2, 4, 8	14.0	Yes (66 kV +/- 5%)
Islington 66 kV (C14, C15, C16)	3 x 36	108 (72)	Yes (66 kV + 2% to +4%)
Islington 220 kV (C21, C22, C25, C26)	2 x 57, 2 x 60	234	Yes
Islington 220 kV (C27)	1 x75	75.0	Yes
North Makarewa 220 kV (C1, C3)	2 x 50	100	Yes
Stoke 33 kV (C31, C32, C33, C34)	4 x 10	40.0	No.
Southbrook 66 kV (C11)	1 x 35	35.0	No.
Tiwai (HF1 & HF2)	2 x 26	52.0	No.
Tiwai (HF3)	1 x 45	45.0	No.
Tiwai (HF4)	1 x 30	30.0	No.
Tiwai (HF11, HF21)	2 x 10	20.0	No

Table 9-2 List of shunt reactors

Bus	No. x Size (Mvar)	Total (Mvar)	Automatically switched (RPC or AVR)
North Island			
Haywards 11 kV – R1	1 x 40	40	Yes
Haywards 11 kV – R5	1 x 40	40	Yes
Pakuranga 220 kV	2 x 100	200	No
Ōtāhuhu 220 kV	1 x 50	50	Yes
South Island			
Kikiwa 110 kV – R2	1 x 50	50	No
Islington 220 kV – R1712	1 x 80	80	No

Table 9-3 List of series reactors

Bus	No. x Size (Mvar)	Total (Mvar)	Automatically switched (RPC or AVR)
North Island			
Ātiamuri 220 kV -R112	1 x 31	31	No
Penrose 220 kV – R862	1 x 571	571	No

Table 9-4 List of synchronous condensers

Bus	No. x Size (Mvar)	Total (Mvar)	Automatically switched (RPC or AVR)
North Island			
Haywards 11 kV – C1 & C2	2x -30/+60	-60/+120	Yes
Haywards 11 kV – C3 & C4	2x -20/+35	-40/+70	Yes
Haywards 11 kV – C7, C8, C9 & C10	4x -40/+65	-160/+260	Yes

Table 9-5 List of Static Var Compensators (SVC) and STATCOMs

Bus	No. x Size (Mvar)	Total (Mvar)	Automatically switched (RPC or AVR)
North Island			
Albany 220 kV	1 x -100/+100	-100/+100	Yes
Haywards 220 kV	1 x -60/+60	-60/+60	Yes
Marsden 220 kV	2 x -35/+35	-70/+70	No
Penrose 220 kV	1 x -60/+60	-60/+60	No
Hamilton 110 kV	1 x -165/+165	-165/+165	No
Otahuhu 220kV	1 x -165/+165	-165/+165	Yes
South Island			
Islington 220 kV – SVC9	1 x -75/+150	-75/+150	Yes
Islington T3 LV – SVC3	1 x -50/+60	-50/+60	Yes
Kikiwa 220 kV – STATCOM	1 x -60/+60	-60/+60	No

10 Operational measures

Power system issues can be mitigated by the System Operator through a variety of operational measures. Some operational measures are put in place pre-event while others take effect after the event.

10.1 Credible events

The System Operator has determined that based on the consequences of a particular risk and the available mitigation options, the events classifications in Table 10-1 are used[6].

Table 10-1 Credible Events and applicable controls

Type of event	Credible events	Applicable controls
Contingent Event (CE) • An event where the impact, probability of occurrence, and estimated costs and benefits of mitigation are considered to justify implementing policies that	Loss of: • a single transmission circuit • an HVDC link Pole • single generating unit • reactive injection	Pre-Contingency Arrangements/Measures • Security constraints • Wider Voltage Agreements (WVA) • Load and Generation Agreements

[6] Policy Statement 2018

Type of event	Credible events	Applicable controls
are intended to be incorporated into the scheduling and dispatch processes pre-event.	• specified[7] 220 kV interconnecting transformers • both circuits of a double circuit line where the System Operator has determined a high level of likelihood of occurrence based on historical information • both circuits of a double circuit line where the System Operator has been advised of a temporary change to environmental or system conditions that give reason to believe there is a high likelihood of occurrence of the simultaneous loss of both circuits • the loss of reactive injections, both when provided as an ancillary service or when available from transmission assets • connection or disconnection of a large block or load	• Thermal Ratings • Transformer 24-hour seasonal ratings[8] • 15 minute off-load time • Use of asset emergency rating • Ancillary Services / Operating Reserves • Under-Frequency Reserve and Over-Frequency Reserve • Automatic Post Event Action / Special Protection Scheme • Automatic Under- Voltage Load Shedding (AUVLS) • Automatic inter-trips & overload protection • Grid Reconfiguration • Temporary splits • Permanent splits • Busbar section splits
Extended Contingent Event (ECE) • Events for which the impact, probability, cost and benefits are not considered to justify the controls required to totally avoid demand shedding or maintain the same quality limits defined for contingent events.	Loss of: • the HVDC link Bipole • All 220 kV interconnecting transformers • Otahuhu 110kV bus and Manapouri 220kV bus	The measures used to manage CEs • Automatic Under-Frequency Load Shedding (AUFLS)
Other • Events which are considered to be uncommon and for	Events which are considered uncommon or beyond reasonable	• All of the above measures may be employed post-contingently. No pre-

[7] 2024 Credible Event Review Scope
[8] *For a selection of transformers, 1-hour seasonal rating is utilised as a form of control.*

Type of event	Credible events	Applicable controls
which the impact, probability of occurrence and estimated cost and benefits do not justify implementing available controls, or for which no feasible controls exist or have been identified, other than unplanned demand shedding, AUFLS and other emergency procedures or restoration measures or events with no impact or where no pre or post-contingent management is required.	expectation of the System Operator • Select 220 kV or 110 kV bus bar • Select 66 kV bus bar connected to the core grid • The loss of both transmission circuits of a double circuit line. • The simultaneous loss of two or more of any of the generating unit, or, transmission circuit, or large load or load blocks; or reactive power sources • The close consecutive loss of two or more of any of the the generating unit, or, transmission circuit, or large load or load blocks; or reactive power sources	contingent controls are applied for other events

To avoid post-event issues following credible events, the System Operator applies security constraints in the Scheduling Pricing and Dispatch (SPD) model to maintain pre-event operation within stability limits and maintain operation within the stated short-term transmission capability as advised by the Grid Owner. The security constraints allow sufficient time after a credible event for the re-dispatch of generation or load shedding to maintain operation within advised transmission capability.

Other issues can be mitigated by the actions of asset owners. Load management can be used to reduce demand below the power system limit. The use of short-term transmission capabilities advised by the Grid Owner allow power system limits to be increased. Grid reconfiguration advised by the Grid Owner may change the power system limit. The operation of Special Protection Schemes (SPSs) [9] advised by the Grid Owner, inter-trip schemes and generation runback schemes, allow for generation or demand reduction pre or post event to ensure that assets are not overloaded post-event.

10.1.1 Pre-contingency arrangements

In the event that system security requirements are not met due to the unavailability of an asset or assets, the System Operator applies pre-contingency measures to manage the system security risk. Pre-contingency measures include security constraints, arrangements made with consumers to accept reduced security and/or reduced power quality, and load/generator agreements to maintain a specified level of loading or generation during the risk period.

[9] Special Protection Schemes

10.1.1.1 Security constraints

Studied circuit ratings are advised by the Grid Owner and include summer and winter values. They may be determined by the thermal limit of the conductors (conductor type and strain tension) or limitations on circuit components (for example protection, CT secondaries, circuit breakers, disconnectors) to carry current.

Security constraints may be applied to manage circuit loading to ensure:

- post-event circuit loading does not exceed short term ratings (with assumed15 minute off-load times) or the limits on circuit components whichever is lower.
- system stability is maintained following a contingent event.

Security constraints are represented within the scheduling and dispatch tools used by the System Operator. Security constraint equations within the scheduling application manage generation dispatch profile/scenario(s) to maintain power transfers within asset capabilities for the risk period.

10.1.1.2 Voltage agreements

If voltages are unable to be managed within the Code defined Asset Owner Performance Obligations (AOPO) range following a Contingent Event (CE) without declaring a GEN, the System Operator seeks a Wider Voltage Agreement (WVA) from the Grid Owner. Where a WVA is approved, the new voltage range only applies following a CE. Even where a WVA has been granted the AOPO range is to be observed during normal system operation, including during planned outages. The majority of WVAs are for the South Island 66 kV system, most of which allow voltage to fall to -10% as opposed to the normal range of ±5%.

The System Operator may also enter into a Local Quality Agreement (LQA) if requested by the grid owner. An LQA typically applies where the supply voltage is unregulated, i.e. the supply transformer is off-load tap change capable only, and is intended to achieve supply voltages within a range agreed with the connecting parties. Consequently, the grid voltage needs to be managed to a lesser range than the AOPO range. The Grid Owner's expectation is that the LQA is observed during normal system operation with no outages. Following CEs, best endeavors should be made to maintain the local voltage range using available reactive support, transmission assets, and/or generation.

10.1.1.3 Reduced security

Where loads are fed by a single radial feeder or single supply transformer the loss of that network component results in a loss of supply. In such cases the security of supply to this load is on N-security. Many customers fed by a single transmission circuit, radial feeder, or supply transformer accept N-security since the investment required to improve the security of supply may be uneconomic. Reduced security is an agreement between connected customer/s and the Grid Owner. It is possible that customer load may be placed on reduced security during outage or maintenance periods.

10.2 Thermal ratings

The thermal and voltage ratings of each transmission asset are based on the equipment specification, international standards and in some cases, age of the component and local meteorological conditions. Normal and contingency (or emergency) ratings are used to determine operating limits that allow system preparation for either the next contingency or for system restoration. These limits are updated on a regular basis.

10.2.1.1 15 minute off-load times

Overhead line conductors have a short-term overload capability derived from the thermal characteristic of the conductor. The short-term overload capability is determined by the maximum allowable sag of the conductor, which is caused by heating and subsequent expansion of the conductor due to increased current flow following tripping of a circuit. The time taken to reach the allowable sag limit depends on the current flow before and after the tripping.

In order to meet the requirements of the Code and manage circuit loadings within short-term ratings the System Operator ensures that there is sufficient time to take corrective action after an event, with sufficient available standby generation reserves or agreed load management to achieve the requirements. It is generally agreed that a sufficient time is 15 minutes. This time is consistent with being able to manage a single CE, also known as an N-1 event, and is based on international practice. It allows time for grid events to be managed by market mechanisms, such as generator re-dispatch where practicable, prior to taking other action. It also allows sufficient time to arrange manual demand curtailment to relieve the post-contingency overloading if generation re-dispatch does not exist. Special consideration is made for situations where it is not possible to meet 15 minute off-load times with all equipment in-service.

10.2.1.2 Post-contingency circuit ratings

Most power system components have a normal continuous rating and a set of post-contingency ratings that allow increased loading for defined periods of time. Transpower uses continuous and 24-hour post-contingency ratings for circuits and transformers when evaluating maximum transfer capabilities post-event.

10.2.2 Special protection schemes

Automatic post-event action is facilitated using special protection schemes (SPSs). Automatic SPSs are designed to prevent abnormal system conditions occurring, such as overload, or instability, following power system fault(s) and the associated fault clearance.

In addition to system re-configuration, schemes may control generation, load or other network components. The use of SPSs is common practice on the New Zealand power system and other international power systems. The design of sophisticated schemes allows greater utilisation of assets and in many cases offers an alternative to network reinforcement. The reliable operation of SPSs is essential to maintaining New Zealand's power system security. All Special Protection schemes configured in the transmission network will be available in Special Protection Schemes | Transpower.

10.2.2.1 Overload protection schemes

SPSs to open circuits that would otherwise overload are either referred to as overload protection schemes or inter-tripping schemes. There are situations where inter-tripping schemes are only enabled during outages or only operates following an overload condition if a prior tripping has occurred. SPSs that involve the action of busbar section circuit breakers to regulate power flows on the system are referred to as Auto Busbar Splitting Schemes (ABSS). An inter-trip that results in a system split is referred to as a System Split Inter-trip Scheme (SSIS).

Overload protection schemes are designed to trip circuits if overloads occur for longer than a specified time. A programmed time delay allows time for auto-reclose operations to occur while continuing to ensure circuits do not exceed short-term ratings should an auto-reclose be unsuccessful. The action of overload protection schemes that switch out overloaded circuits may result in loss of supply to Grid Exit Points (GXPs).

10.2.2.2 Generation run back

Generation may be automatically reduced post-event to a pre-arranged value to remove circuit overloads or generator instability. While installed to provide automatic action in a contingency, runback operation is not dependent on there being a contingency. A runback is initiated when the runback scheme is enabled, and circuit protection detects that loading on specified circuits exceeds a pre-determined limit.

If the circuit loading is not reduced within an inverse time-dependent period after a runback scheme operation has been initiated, the circuit is tripped.

Transpower has automatic runback schemes installed at Arapuni, Maraetai, and Te Āpiti. Runback schemes can allow operation to lower off-load times on monitored circuits rather than the standard 15 minute off-load time.

10.2.3 Grid reconfiguration

Under certain conditions, system reconfiguration may be implemented to prevent circuits overloading. Grid reconfigurations can only be applied if those reconfigurations have been offered by the Grid Owner. Grid reconfiguration may include:

- creating a temporary system split, which may put some parts of the grid on N-security closing or moving a permanent system split connecting transmission circuits to a different busbar to resolve issues resulting from a busbar section outage.

10.2.3.1 Temporary splits

Temporary splits may occur because of the action of an inter-trip system, such as an overload protection or auto-changeover scheme. Temporary splits may also be implemented for the duration of a planned outage to assist operation of the power system.

10.2.3.2 Permanent splits

The need to establish a permanent system split normally results from a determination that splitting the system at a given point enhances overall power flows across the remaining parallel paths.

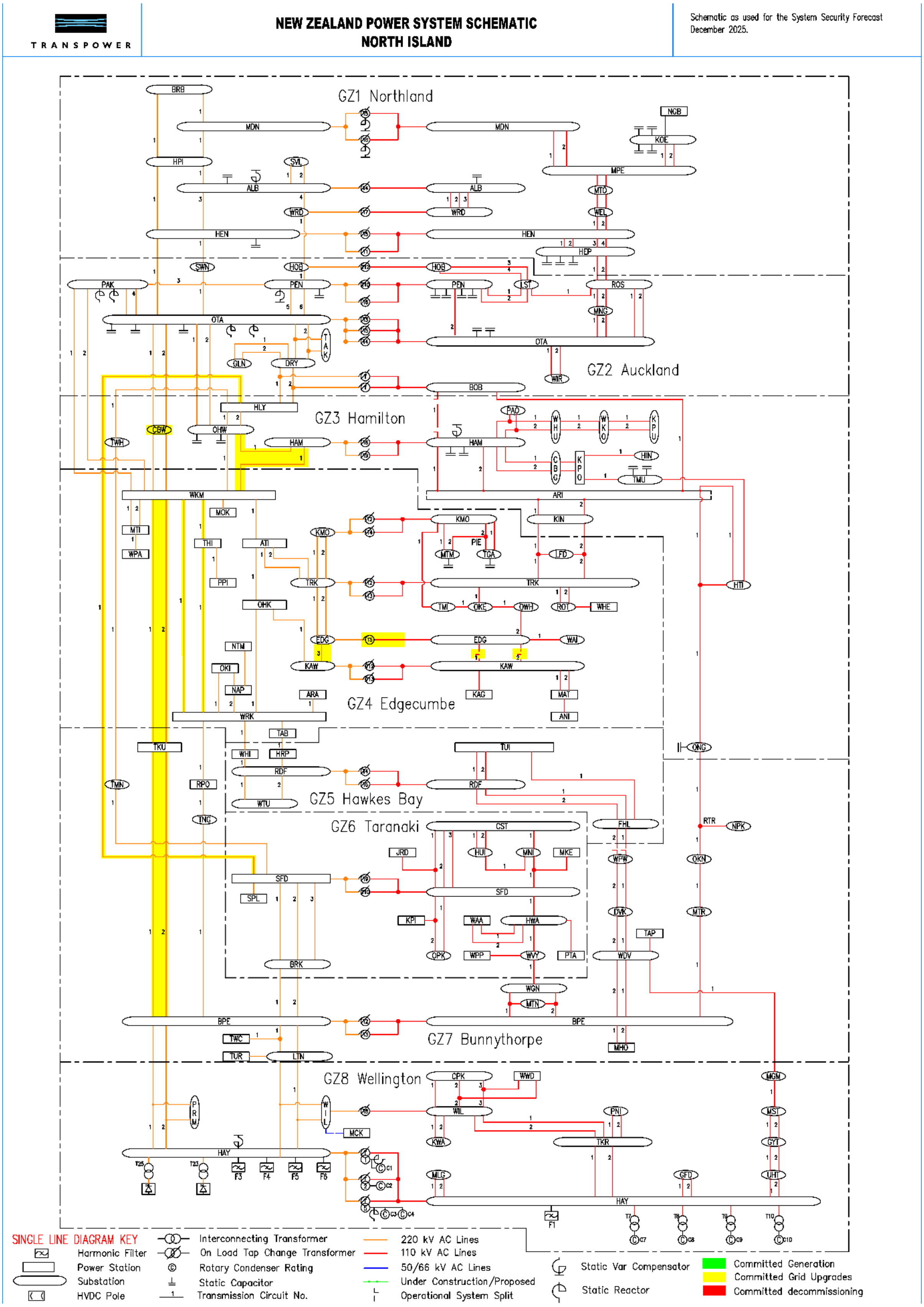
At present there are seven permanent splits on the New Zealand network:

- Fernhill-Waipawa 1 and 2 110 kV
- Edgecumbe Interconnecting Transformers T4 & T5
- Arapuni north and south busbars
- Ōtāhuhu-Penrose 2 110 kV
- Albany-Wairau Road 2 110 kV
- Studholme-Timaru 1 110 kV circuit open between 30th April and 1st October
- Glenavy–Studholme 1 110 kV circuit open between 01 October to 30 April

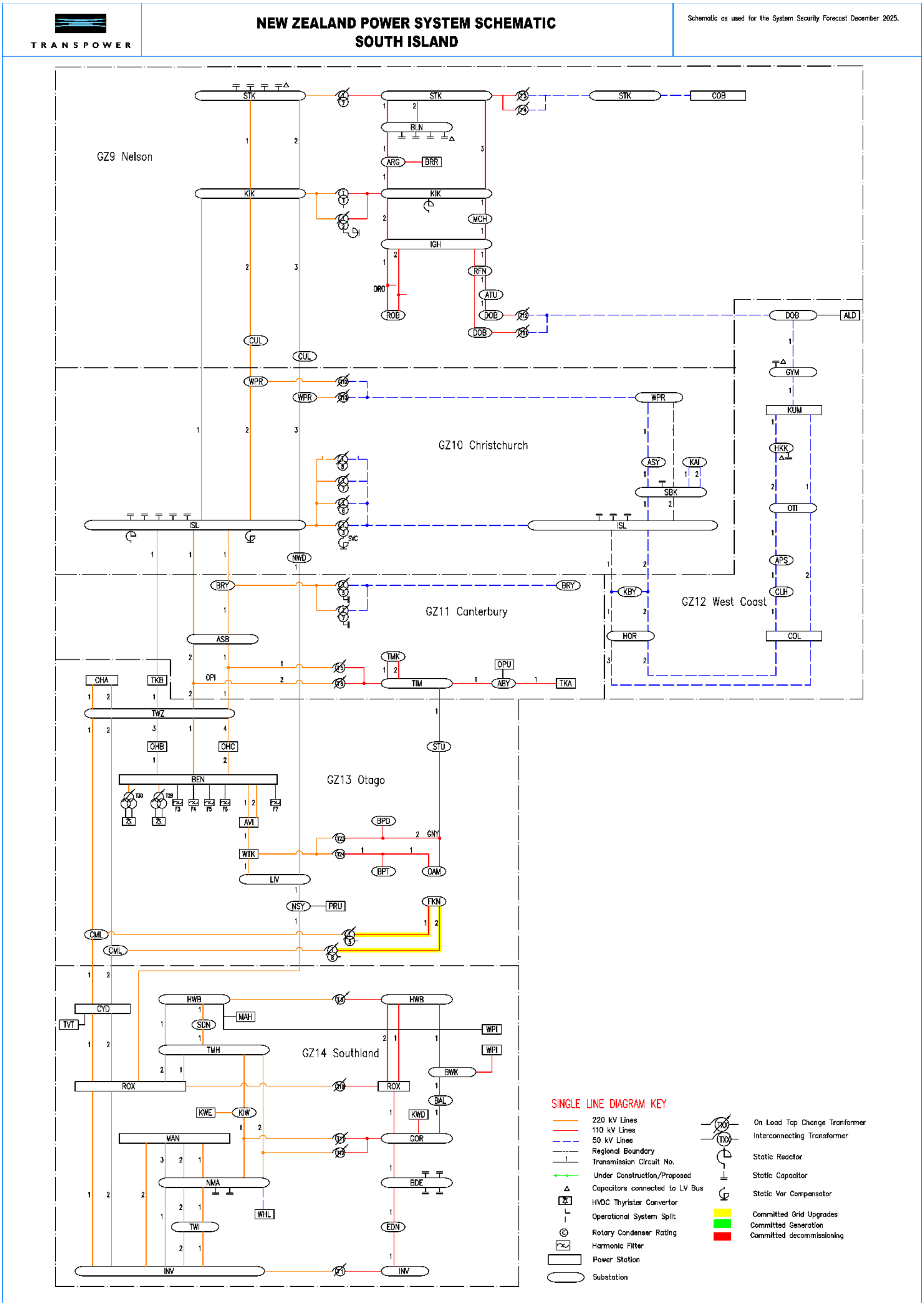
Conditions under which permanent splits may be temporarily reconfigured is determined through consultation between the system operator and the grid owner.

11 Single-line-diagrams

11.1 North Island

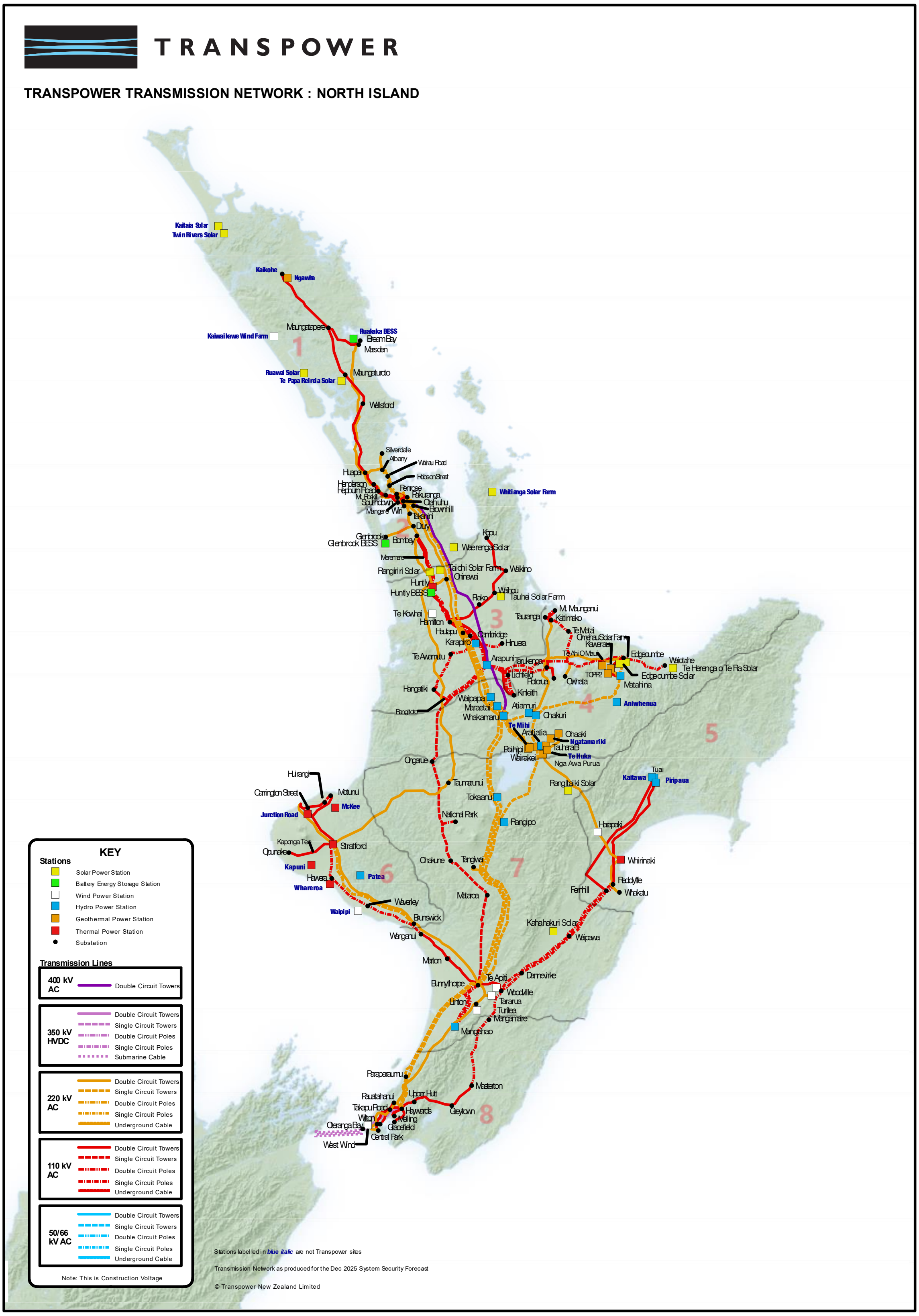


11.2 South Island

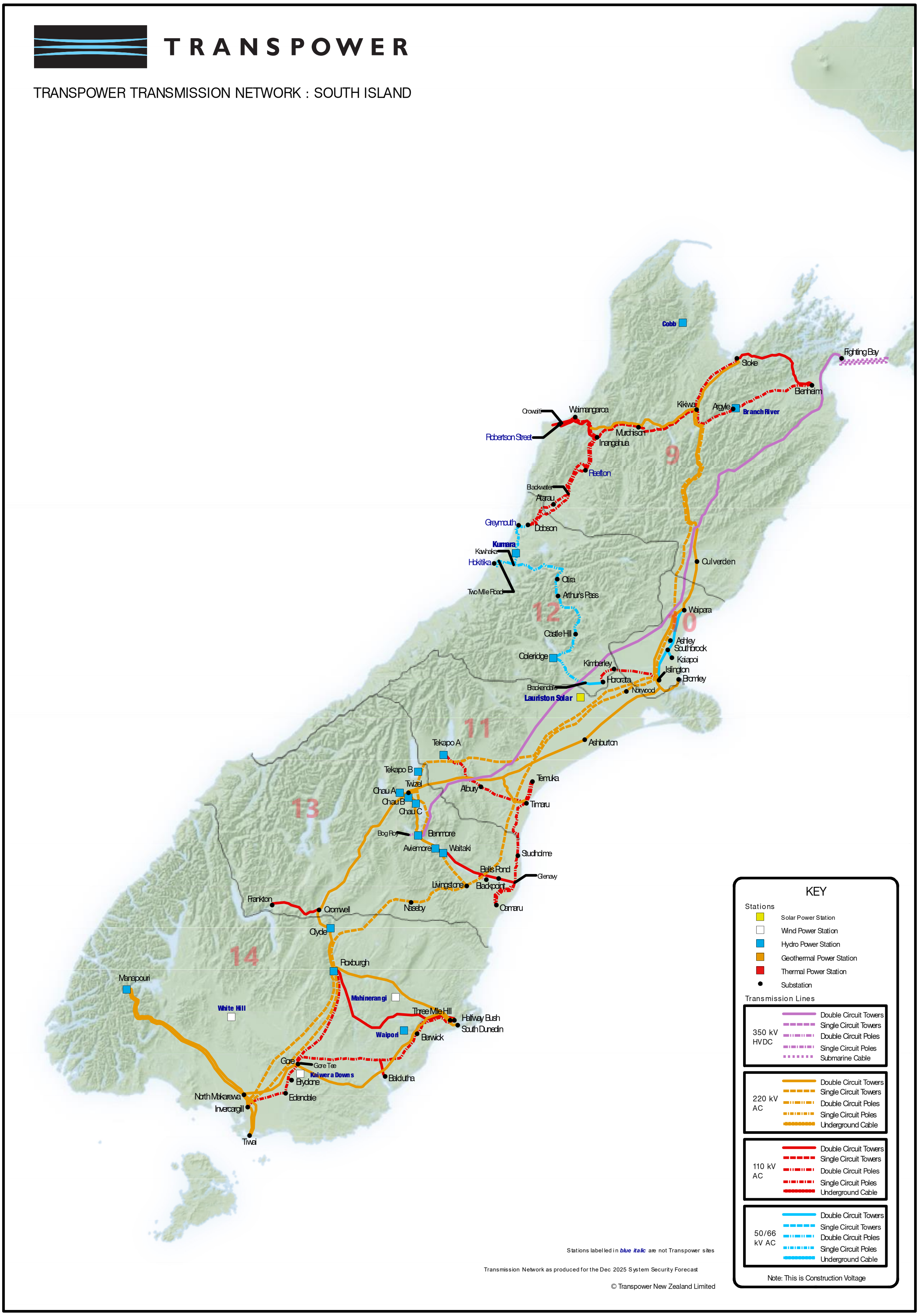


12 Maps

12.1 North Island



12.2 South Island



13 Terms & acronyms

13.1 Terms

Term/Acronyms	Description
Asset Capability Statement (ACS)	An Asset Capability Statement (ACS) is an enduring schedule of information parameters about assets connected to the power system. Asset Owners are obliged to complete a relevant ACS whenever commissioning/decommissioning or modifying their assets.
Automatic Under-Frequency Load Shedding (AUFLS)	An automated scheme that rapidly disconnects electrical load when frequency falls below a specified level, to prevent cascade failure. Grid owners and distributors are required to have AUFLS meeting the requirements set out in the Electricity Industry Participation Code.
Automatic Under-Voltage Load Shedding (AUVLS)	An automated scheme that disconnects electrical load when voltage falls below a specified level.
Asset Owner Performance Obligation (AOPO)	All assets connected to or forming part of the grid are required to be compliant with the asset owner performance obligations set out in the Electricity Industry Participation Code.
Committed Investment	An investment project yet to be commissioned that has been confirmed to be consented and progressing.
Contingency Plan	A plan that identifies power system conditions that constitute a risk and ensures that procedures are put in place for management of the risk pre- and post- event.
Contingent Event (CE)	The loss of certain assets connected to or forming part of the grid. Contingent Events are defined in the Electricity Industry Participation Code. Contingent events include the loss of any single transmission circuit or generating unit, but do not include the loss of an interconnecting transformer.
Demand	The term demand is used to refer to an aggregation of certain loads within a geographic region or whole island of New Zealand. Island demand is all the loads in one Island. Regional demand is the aggregate load in a defined region.
DC Load Flow	An approximation of the full AC load flow solution, which solves only for real power flow in a network.
Dynamic Stability	The ability of a power system to adapt to a significantly different new set of operating conditions.
Embedded Generation	Generation that is not directly connected to the grid.
Extended Contingent Event (ECE)	The sudden unplanned loss of the HVDC bipole, an interconnecting transformer, a busbar section, or other such event that the System Operator deems appropriate, is considered an extended contingent event.
Grid Reconfiguration	An operational measure in which the grid is reconfigured by the Grid Owner to avoid or mitigate the impact of a power system capability issue. This can include the removal of assets from service to increase the power transfer limit into a region at the expense of a reduction of security levels to certain parts of the power system.
Grid voltage falls below advised asset capability	A situation where grid voltage falls below the range that asset owners have advised that their assets are capable of operating in.
Grid Zones	The New Zealand power system is split into fourteen of these zones.
High Voltage Direct Current (HVDC)	In the New Zealand power system, HVDC is used in reference to the bipole HVDC link between Benmore in the South Island and Haywards in the North Island.
Load	Instantaneous rate of energy off-take from the grid. Load is used to refer to a single point where energy is taken from the grid (ie a single grid exit point).

Term/Acronyms	Description
Load Duration Curve (LDC)	A curve showing the duration, within a specified period of time, when the load equalled or exceeded a given value.
Local Quality Agreement (LQA)	A voltage range objective for a customer point-of-service. The voltage ranges that apply may cause the System Operator to operate the grid voltage within a lesser range than that set out in the Asset Owner Performance Obligations.
Load Management	The forced reduction of load in stages, either manually or automatically.
Planned Outage	A planned asset outage during which maintenance or repair activities may be carried out. Operational measures to enhance power system capability are often implemented during maintenance outages to offset reduced grid capacity during the outage.
Operational Measures	Measures of an operational nature that can be put in place to remove or reduce the impact of a power system capability limit. Examples include load management, grid reconfiguration, and Special Protection Schemes.
Peak Demand or Peak Load	The maximum value of demand or load over a certain period of time (usually a year).
Policy Statement	The Policy Statement sets out the policies and means that are considered appropriate for the System Operator to observe when complying with the Principal Performance Obligations. The Policy Statement is set out in in accordance with the Electricity Industry Participation Code.
Power Factor	The ratio of real power to apparent power at a given point in the power system.
Power System Capability Limit	A limit of the power system that if exceeded will result in assets operating beyond their declared capability or the power system will be operating in an unstable condition following the occurrence of a contingent event, or an extended contingent event, or a stability event with either uncontrolled or managed load reduction being required.
Power System Load Limit	A limit on load in a defined area to avoid not meeting quality targets and limits set out in the Policy Statement, during and following contingent events.
Power System Stability	The property of a power system that enables it to remain in a state of operating equilibrium under normal conditions and to regain an acceptable state of equilibrium following a disturbance. See also dynamic stability, transient stability, and voltage stability.
Power System Transfer Limit	A limit on transfer into a region or through a set of transmission circuits to avoid not meeting quality targets and limits set out in the Policy Statement, during and following contingent events.
Principal Performance Obligation	An obligation under the Electricity Industry Participation Code in relation to real-time delivery of common quality and dispatch.
Quality Targets and Limits	The targets for quality that the System Operator plans to meet during and following events. The quality targets and limits are set out in the Policy Statement and the Electricity Industry Participation Code.
Reactive Support	Energy that flows from devices such as synchronous condensers, capacitors, and Static Var Compensators (SVCs) into the power system to maintain transmission network voltage levels within prescribed limits.
Shoulder Rating	The stated capability rating applying to a transmission circuit during the defined period for which shoulder ratings apply.
Special Protection Scheme (SPS)	Protection grade schemes offered by an asset owner that will constrain generation or shed demand on the occurrence of certain events or conditions. Examples are generation runback schemes, Automatic Under-Voltage Load Shedding and demand intertrips.
STATCOM	A regulating device that can act as a source or sink of reactive AC power. Usually these are installed to support power factor, voltage regulation, and voltage stability.
Summer Rating	The stated capability rating applying to a transmission asset during the defined period for which summer ratings apply.

Term/Acronyms	Description
Transient (Angular) Stability	The ability of all the elements in a power system to remain in synchronism following an abrupt change in operating conditions (such as the occurrence of a fault on the power system).
Voltage Collapse	Voltage collapse occurs when the power system enters a state of voltage instability when a disturbance causes a progressive and uncontrollable drop in voltage.
Voltage Stability	The ability of a power system to maintain acceptable voltages at all buses in the power system under normal operating conditions and after being subjected to a disturbance. The power system enters a state of voltage instability when a disturbance causes a progressive and uncontrollable drop in voltage (also referred to as voltage collapse). The main factor causing voltage instability is the inability of the power system to meet the demand for reactive power.
Wider Voltage Agreement (WVA)	A post-contingency voltage range objective for a customer point-of-service. The voltage ranges that apply may cause the System Operator to operate the grid voltage to a greater range than that set out in the Asset Owner Performance Obligations.
Winter Rating	The stated capability rating applying to a transmission asset during the defined period for which winter ratings apply.

13.2 Acronyms

Acronym	Words
ACS	Asset Capability Statement
AUFLS	Automatic Under-Frequency Load Shedding
AUVLS	Automatic Under-Voltage Load Shedding
AVR	Automatic Voltage Regulator
CB	Circuit breaker
CCGT	Combined Cycle Gas Turbine
CE	Contingent Event
CT	Current Transformer
ECE	Extended Contingent Event
FKC	Frequency Keeping Control
HVDC	High Voltage Direct Current
LV	Low Voltage
N-1	A contingency under intact network conditions
pf	power factor
PoE	Probability of Exceedance
RPC	Reactive Power Control
SO	System Operator
SPD	Scheduling Pricing and Dispatch Model
SPS	Special Protection Scheme
SSF	System Security Forecast
SVC	Static Var Compensator
WUNI	Waikato Upper North Island
WVA	Wider Voltage Agreement

13.3 Site codes

Island	Region	Site	Code	Type
South	GZ11	Albury	ABY	Substation
South	GZ10	Addington	ADD	Substation
North	GZ01	Albany	ALB	Substation
South	GZ12	Arnold	ALD	Power Station (embedded)
South	GZ12	Amethyst	AMS	Substation
North	GZ04	Aniwhenua	ANI	Power Station
South	GZ12	Arthur's Pass	APS	Substation
North	GZ04	Aratiatia	ARA	Substation, Power Station
South	GZ09	Argyle	ARG	Substation, Power Station
North	GZ03	Arapuni	ARI	Substation, Power Station
South	GZ11	Ashburton	ASB	Substation, Power Station
South	GZ10	Ashley	ASY	Substation
North	GZ04	Ātiamuri	ATI	Substation, Power Station
South	GZ09	Atarau	ATU	Substation
South	GZ13	Aviemore	AVI	Substation, Power Station
North	GZ02	Awariki Road	ARD	Power Station
South	GZ14	Balclutha	BAL	Substation
South	GZ14	Brydone	BDE	Substation
South	GZ13	Benmore	BEN	Substation, Power Station
North	GZ02	Brownhill Road	BHL	Substation
South	GZ09	Blenheim	BLN	Substation
North	GZ02	Bombay	BOB	Substation
South	GZ13	Bells Pond	BPD	Substation
North	GZ07	Bunnythorpe	BPE	Substation
South	GZ13	Blackpoint	BPT	Substation
North	GZ01	Bream Bay	BRB	Substation, Battery Storage System (BESS)
North	GZ06	Brunswick	BRK	Substation
South	GZ09	Branch River	BRR	Power Station (embedded)
South	GZ11	Bromley	BRY	Substation
South	GZ14	Berwick	BWK	Substation
North	GZ03	Cambridge	CBG	Substation
South	GZ12	Castle Hill	CLH	Substation
South	GZ13	Cromwell	CML	Substation
South	GZ09	Cobb	COB	Substation, Power Station
South	GZ12	Coleridge	COL	Substation, Power Station
North	GZ08	Central Park	CPK	Substation
North	GZ06	Carrington Street	CST	Substation
South	GZ09	Culverden	CUL	Substation
South	GZ14	Clyde	CYD	Substation, Power Station
South	GZ12	Dobson	DOB	Substation
North	GZ02	Drury	DRY	Substation
North	GZ07	Dannevirke	DVK	Substation
North	GZ04	Edgecumbe	EDG	Substation, Power Station
South	GZ14	Edendale	EDN	Substation
North	GZ05	Fernhill	FHL	Substation
South	GZ13	Frankton (Queenstown)	FKN	Substation
North	GZ08	Gracefield	GFD	Substation
North	GZ05	Gisborne	GIS	Substation
North	GZ02	Glenbrook	GLN	Substation
South	GZ13	Glenavy	GNY	Transmission Line Deviation Point
North	GZ03	Glen Murray Road	GMR	Power Station
South	GZ14	Gore	GOR	Substation

Island	Region	Site	Code	Type
South	GZ12	Greymouth	GYM	Substation
North	GZ08	Greytown	GYT	Substation
North	GZ03	Hamilton	HAM	Substation
North	GZ08	Haywards	HAY	Substation
North	GZ01	Henderson	HEN	Substation
North	GZ01	Hepburn Road	HEP	Substation
North	GZ03	Hinuera	HIN	Substation
South	GZ12	Hokitika	HKK	Substation
North	GZ03	Huntly	HLY	Substation, Power Station
North	GZ07	Hinemaiaia	HMA	Power Station (embedded)
North	GZ02	Hobson Street	HOB	Substation
South	GZ12	Hororata	HOR	Substation
North	GZ01	Huapai	HPI	Substation, Transmission Line Deviation Point
North	GZ01	Hautapo	HTP	Substation
North	GZ03	Hangatiki	HTI	Substation
North	GZ5	Harapaki	HRP	Power Station
North	GZ06	Huirangi	HUI	Substation
North	GZ06	Hāwera	HWA	Substation
South	GZ14	Halfway Bush	HWB	Substation
South	GZ09	Inangahua	IGH	Substation
South	GZ14	Invercargill	INV	Substation
South	GZ10	Islington	ISL	Substation
North	GR06	Junction Road	JRD	Power Station
North	GZ04	Kawerau Geothermal	KAG	Power Station
South	GZ10	Kaiapoi	KAI	Substation
North	GZ04	Kawerau	KAW	Substation
North	GZ01	Kensington	KEN	Substation
South	GZ09	Kikiwa	KIK	Substation
North	GZ03	Kinleith	KIN	Substation
North	GZ04	Kaimai	KMI	Power Station (embedded)
North	GZ04	Kaitimako	KMO	Substation
North	GZ01	Kaikohe	KOE	Substation
North	GZ06	Kapuni	KPI	Power Station
North	GZ03	Karapiro	KPO	Substation, Power Station
North	GZ03	Kopu	KPU	Substation, Power Station
North	GZ01	Kaitaia	KTA	Substation
North	GZ05	Kaitawa	KTW	Power Station
South	GZ12	Kumara	KUM	Substation, Power Station
North	GZ07	Kuratau	KUR	Power Station (embedded)
North	GZ08	Kaiwharawhara	KWA	Substation
North	GZ04	Lichfield	LFD	Substation
South	GZ09	Logburn Road	LGN	Substation
South	GZ13	Livingstone	LIV	Substation
North	GZ02	Liverpool St	LST	Substation, Zone Substation
North	GZ07	Linton	LTN	Substation
South	GZ14	Mahinerangi Wind Farm	MAH	Power Station (embedded)
South	GZ14	Manapouri	MAN	Substation, Power Station
North	GZ04	Matahina	MAT	Substation, Power Station
South	GZ09	Murchison	MCH	Substation
North	GZ08	Mill Creek	MCK	Power Station
North	GZ01	Marsden	MDN	Substation
North	GZ08	Mangamaire	MGM	Substation
North	GZ07	Mangahao	MHO	Substation, Power Station
North	GZ06	McKee	MKE	Power Station

Island	Region	Site	Code	Type
North	GZ08	Melling	MLG	Substation
South	GZ10	Middleton	MLN	Substation
North	GZ02	Māngere	MNG	Substation
North	GZ06	Motunui	MNI	Substation
North	GZ04	Mōkai	MOK	Power Station
South	GZ09	Motueka	MOT	Substation
North	GZ01	Maungatapere	MPE	Substation
North	GZ08	Masterton	MST	Substation
North	GZ04	Maraetai	MTI	Substation, Power Station
North	GZ04	Mt. Maunganui	MTM	Substation
North	GZ07	Marton	MTN	Substation
North	GZ01	Maungaturoto	MTO	Substation
North	GZ07	Mataroa	MTR	Substation
North	GZ04	Ngā Awa Pūrua	NAP	Substation, Power Station
North	GZ01	Ngawha	NGA	Power Station (embedded)
North	GZ01	Ngawha B	NGB	Power Station
South	GZ14	North Makarewa	NMA	Substation, Power Station
South	GZ10	Norwood	NWD	Substation
North	GZ07	National Park	NPK	Substation
North	GZ06	New Plymouth	NPL	Substation
South	GZ13	Naseby	NSY	Substation
North	GZ04	Ngatamariki	NTM	Power Station
South	GZ13	Oamaru	OAM	Substation
South	GZ13	Ōhau A	OHA	Substation, Power Station
South	GZ13	Ōhau B	OHB	Substation, Power Station
South	GZ13	Ōhau C	OHC	Substation, Power Station
North	GZ04	Ohakuri	OHK	Substation, Power Station
North	GZ03	Ohinewai	OHW	Substation
North	GZ04	Okere	OKE	Substation
North	GZ04	Ohaaki	OKI	Substation, Power Station
North	GZ07	Ohakune	OKN	Substation
North	GZ07	Ongarue	ONG	Substation
North	GZ06	Ōpunake	OPK	Substation
South	GZ11	Opuha Hydro	OPU	Power Station (embedded)
North	GZ02	Ōtāhuhu	OTA	Substation
North	GZ08	Oteranga Bay	OTB	Substation
North	GZ02	Ōtāhuhu Combined Cycle Plant	OTC	Power Station
North	GZ02	Ōtāhuhu Gas Turbine Station	OTG	Substation, Power Station
South	GZ12	Otira	OTI	Substation
North	GZ04	Ōwhata	OWH	Substation
North	GZ02	Pakuranga	PAK	Substation
South	GZ14	Palmerston	PAL	Substation
North	GZ03	Piako Zone Substation	PAO	Substation
South	GZ10	Papanui	PAP	Substation
North	GZ02	Penrose	PEN	Substation
North	GZ04	Poike	PIE	Transmission Line Deviation Point
North	GZ08	Pāuatahanui	PNI	Substation
North	GZ04	Poihipi	PPI	Power Station
North	GZ05	Piripaua	PRI	Power Station
North	GZ08	Paraparaumu	PRM	Substation
South	GZ13	Paerau	PRU	Power Station (embedded)
North	GZ06	Pātea	PTA	Power Station
North	GZ05	Redclyffe	RDF	Substation
South	GZ09	Reefton	RFN	Substation

Island	Region	Site	Code	Type
North	GZ04	Ruahihi	RHI	Power Station (embedded)
North	GZ04	Rotokawa	RKA	Power Station (embedded)
South	GZ09	Robertson Street	ROB	Substation
North	GZ02	Mt. Roskill	ROS	Substation
North	GZ04	Rotorua	ROT	Substation
South	GZ14	Roxburgh	ROX	Substation, Power Station
North	GZ07	Rangipo	RPO	Substation, Power Station
North	GZ07	Raetihi	RTI	Power Station (embedded)
North	GZ04	Rangitoto Hills	RTO	Transmission Line Deviation Point
North	GZ07	Retaruke	RTR	Transmission Line Deviation Point
South	GZ10	Southbrook	SBK	Substation
South	GZ14	South Dunedin	SDN	Substation
North	GZ06	Stratford	SFD	Substation, Power Station
North	GZ06	Stratford Power Limited	SPL	Power Station
South	GZ10	Springston	SPN	Substation
South	GZ09	Stoke	STK	Substation
South	GZ13	Studholme	STU	Substation
North	GZ01	Silverdale	SVL	Substation
North	GZ01	Southdown	SWN	Substation
North	GZ04	Te Huka	TAA	Power Station
North	GZ04	Tauhara Power Station	TAB	Power Station
North	GZ04	Te Huka 3	TAC	Power Station
North	GZ02	Takanini	TAK	Substation
North	GZ04	Te Ahi O Maui	TAM	Power Station
North	GZ07	Te Āpiti Wind Farm	TAP	Power Station
North	GZ04	Tauranga	TGA	Substation
North	GZ04	Te Mihi	THI	Power Station
South	GZ11	Timaru	TIM	Substation
South	GZ11	Tekapo A	TKA	Substation, Power Station
South	GZ11	Tekapo B	TKB	Substation, Power Station
North	GZ04	Te Kaha	TKH	Substation
North	GZ08	Takapu Road	TKR	Substation
North	GZ07	Tokaanu	TKU	Substation, Power Station
South	GZ14	Three Mile Hill	TMH	Substation
North	GZ04	Te Matai	TMI	Substation
South	GZ11	Temuka	TMK	Substation
North	GZ07	Taumarunui	TMN	Substation
North	GZ03	Te Awamutu	TMU	Substation
North	GZ07	Tangiwai	TNG	Substation
North	GZ05	Tokomaru Bay	TOB	Substation
North	GZ07	Te Rere Hau	TRH	Power Station (embedded)
North	GZ04	Tarukenga	TRK	Substation
North	GZ05	Tuai	TUI	Substation, Power Station
North	GZ03	Te Uku Wind Farm	TUK	Power Station (embedded)
North	GZ07	Turitea Wind Farm	TUR	Power Station
South	GZ14	Teviot	TVT	Power Station (embedded)
North	GZ07	Tararua Wind Central	TWC	Substation, Power Station
North	GZ07	Tararua Wind Farm	TWF	Power Station (embedded)
North	GZ03	Te Kowhai	TWH	Substation
South	GZ14	Tiwai	TWI	Substation
North	GZ07	Tararua Wind Central Tee	TWT	Transmission Line Deviation Point
South	GZ13	Twizel	TWZ	Substation
North	GZ08	Upper Hutt	UHT	Substation
South	GZ09	Upper Takaka	UTK	Substation
North	GZ06	Whareroa	WAA	Substation, Power Station

Island	Region	Site	Code	Type
North	GZ04	Waiotahi	WAI	Substation, Power Station
North	GZ07	Woodville	WDV	Substation
North	GZ01	Wellsford	WEL	Substation
North	GZ07	Wanganui	WGN	Substation
North	GZ04	Wheao	WHE	Power Station (embedded)
North	GZ05	Whirinaki	WHI	Substation
South	GZ14	White Hill	WHL	Power Station
North	GZ04	Whakamaru North	WHN	Substation
North	GZ03	Waihou	WHU	Substation
North	GZ08	Wilton	WIL	Substation
North	GZ02	Wiri	WIR	Substation
North	GZ04	Whakamaru	WKM	Substation, Power Station
North	GZ03	Waikino	WKO	Substation
South	GZ09	Waimangaroa	WMG	Substation
North	GZ04	Waipapa	WPA	Substation, Power Station
North	GZ06	Waipipi Wind Farm	WPP	Power Station
South	GZ10	Waipara	WPR	Substation
South	GZ09	Westport	WPT	Substation
North	GZ07	Waipawa	WPW	Substation
North	GZ05	Wairoa	WRA	Substation
North	GZ01	Wairau Road	WRD	Substation
North	GZ04	Wairakei	WRK	Substation, Power Station
South	GZ13	Waitaki	WTK	Substation, Power Station
North	GZ05	Whakatu	WTU	Substation
North	GZ06	Waverley	WVY	Substation
North	GZ08	West Wind	WWD	Power Station