TRANSPOWER

Operations Division

UG-OC-841 NZGB - Application and Calculation User Guide

This Userguide is part of the Outages and Constraints (OC) process within Transpower and forms part of the System Operator function. The document can be found in the Operational Documentation Library

Document Status:	**Issued**
Published Date:	**4/06/2026**

Version	Date	Change
1.0	06/10/2022	First draft version.
2.0	03/11/2022	Initial Issue
4.0	14/06/2024	Updated for new load & supply assumptions.
6.0	13/11/2024	Correction to some of the generation capacity values in the appendices.
7.0	8/4/2025	Removed Firm - No Wind from scenarios (not used). Added info added around the wind percentile and approximate percentage of output.
8.0	08/08/2025	Update to WRK capacity number and addition of LAU and KWD. Include BESS into NZGB. RHO and RUK added.
9.0		Instructions for accessing NZGB updated.

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Ref	Related Artefact	Description	Location
1.			
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IMPORTANT

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Contents

1 Introduction

1.1. Document Purpose and Scope

This is the user guide for Asset Owners (AOs) using the NZGB application which is part of the Operations Customer Portal. This user guide document describes the features of NZGB, instructions on how to use the application and a definition of the generation balance calculation including the underlying assumptions.

1.2. Operations Customer Portal Overview

The Operations Customer Portal provides centralised access to the following System Operator applications:

- Planned Outage Co-ordination Process (POCP)
- Automated Under Frequency Load Shedding (AUFLS)
- Asset Capability Statement (ACS)
- New Zealand Generation Balance (NZGB)
- System Operator Register (Dispensations and Equivalence)

The URL to access the Operations Customer Portal is https://customerportal.transpower.co.nz/

1.3. NZGB overview

The New Zealand Generation Balance (NZGB) is an outage assessment tool utilised by Transpower's Operations Planning Group. The NZGB application takes scheduled equipment outages from the Planning and Outage Co-ordination (POCP) website and forecasts whether there will be enough generation capacity to securely meet demand (i.e. to also meet frequency keeping and reserve requirements). This can be used to:

- Communicate to industry participants any potential North Island generation balance shortfalls over the next 200 days.
- Provide industry participants with a means of assessing the potential impact of their planned outages on the North Island generation balance.
- Enable industry participants to select optimum outage periods with least impact to the North Island generation balance.

2 Using NZGB

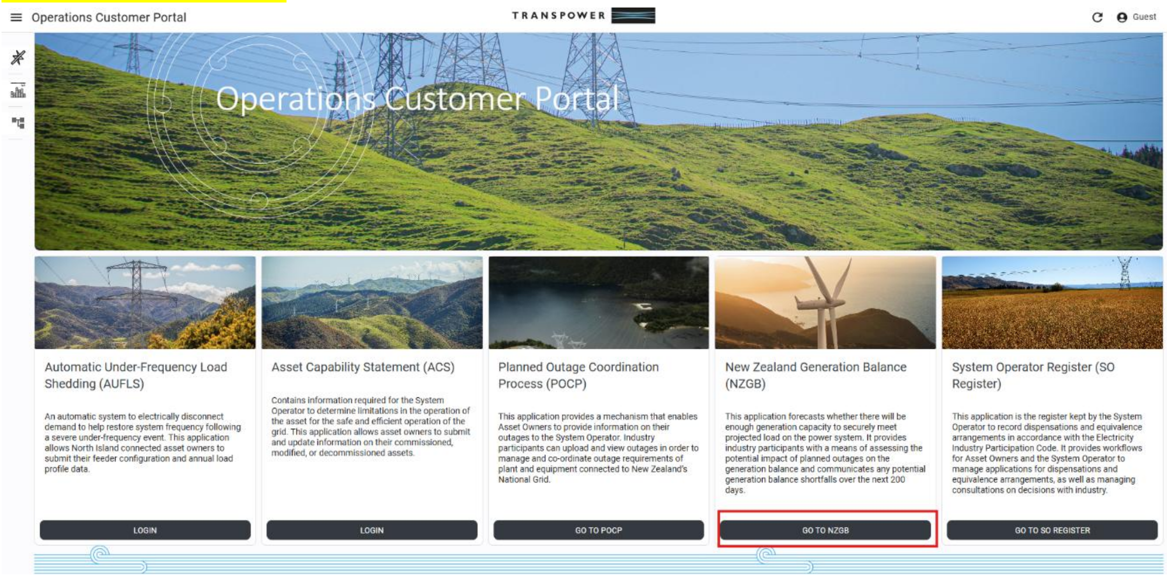
All accounts registered under any customer portal application will have access to NZGB. However, NZGB is open to users without authentication or registration for non-Asset Owner users through the NZGB application User types

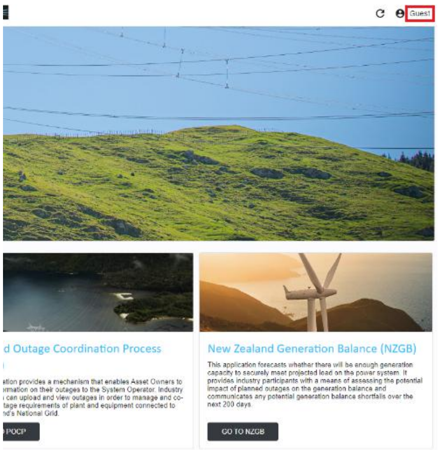
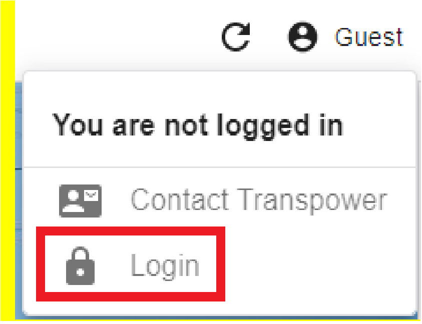
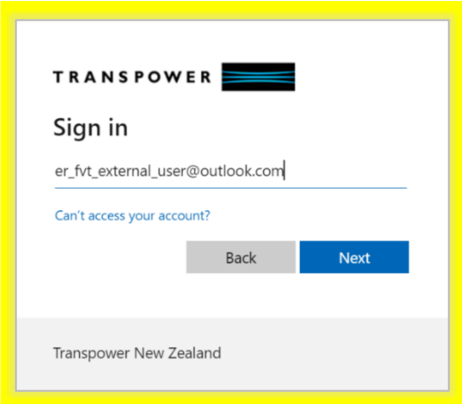
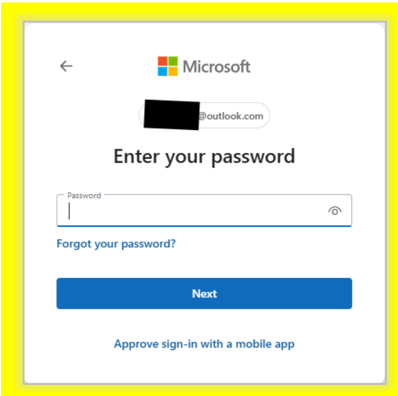
Users have the following accesses:

User	Description
Guest (Un-authenticated user)	▪ View N-1-G balance ▪ View documents, including monthly reports and any assessments ▪ Adjust timeframes to view generation balances ▪ View N-1 balance ▪ View generation, load, and HVDC transfer limits used in calculation ▪ View outage Gantt chart ▪ Select generation balance for a given day to get further details on calculation values used, outages considered, and available generation by station ▪ Get email notifications when new documents (e.g. monthly report or assessment) are uploaded to the NZGB website ▪ View comments made by NZGB admins
Authenticated User	Can access the same features as Guest.

2.1 Accessing NZGB

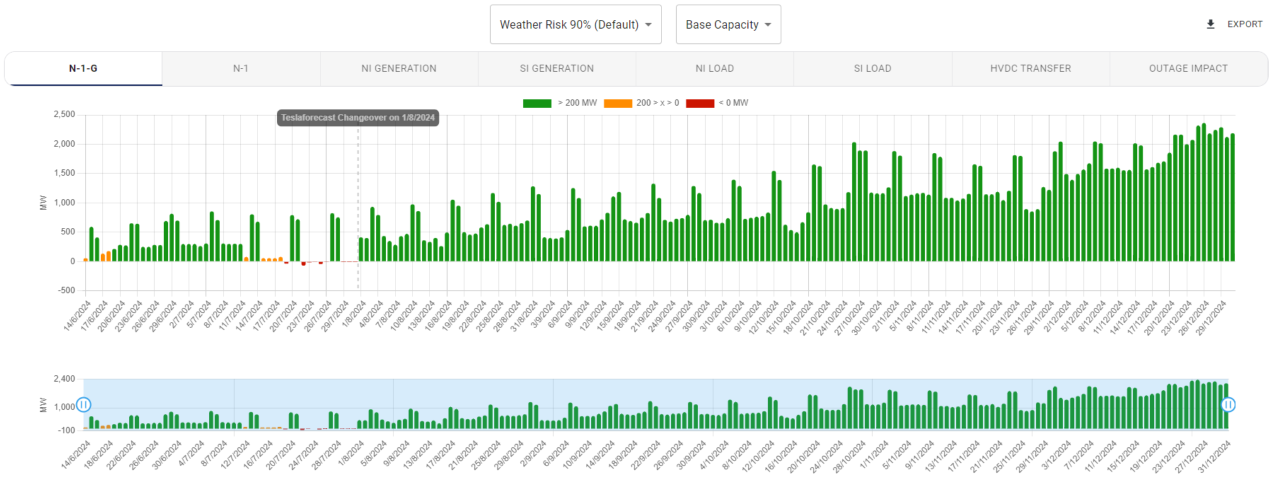
NZGB can be accessed without authentication (Guest) or with authentication (by an user who has a login to any other Operations Customer Portal application).

Step	Description
1.	Enter the following URL in a web browser – https://customerportal.transpower.co.nz/. You will be taken to the 'Operations Customer Portal' home page. Click on GO TO NZGB. You will be able to access NZGB as a Guest. 

Step	Description	
2.		If you have a login for one or more other Operations Customer Portal applications, you can authenticate yourself. This will allow you to use those other applications also without further authentication. Click on the '**Guest**'
		Click on the 'Login' button.
3.		Enter your email address and press the '**Next**' button.
4.		You will be taken to an '**Enter password**' pop-up screen – enter your password and press the '**Sign in**' button.
5.	You will be logged into the Operations Customer Portal and can access the NZGB application as normal.	

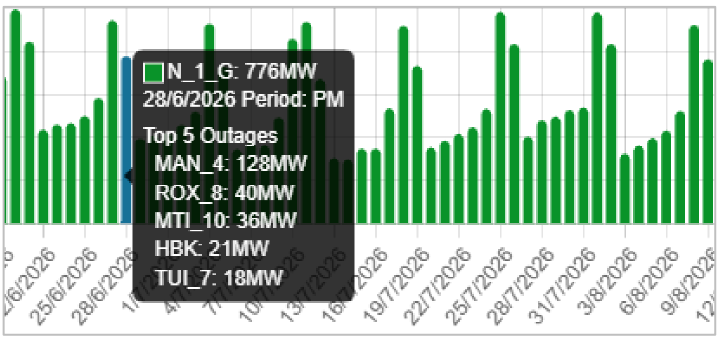
3 NZGB Dashboard

The 'NZGB Dashboard' is the landing page. It has several tabs to switch between different graphs. The user can move between graphs with the timeframe in the window fixed. To restore the configuration to default settlings, i.e. slider bar, zoom, etc, the user can refresh the page or press 'F5' button on their keyboard.

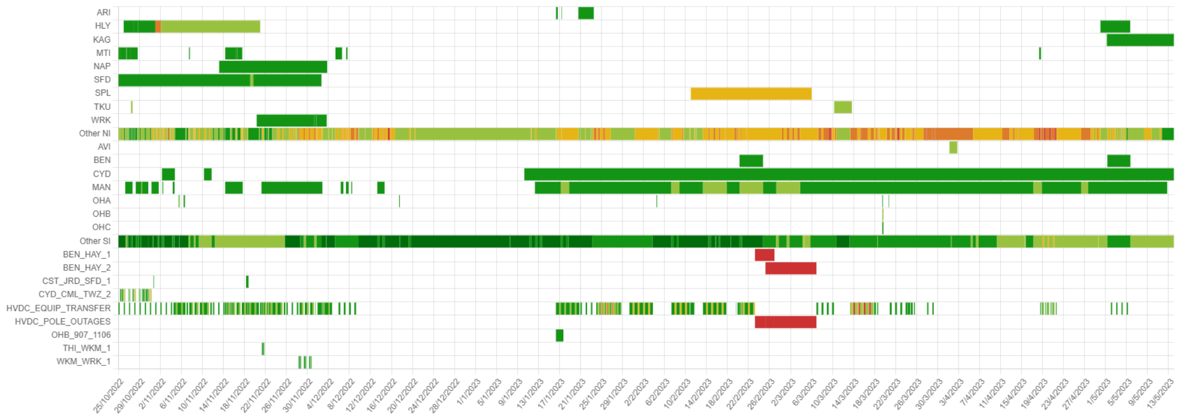


- **N-1-G:** Shows the available generation capacity to securely supply demand after the occurrence of the worst-case contingent event, with reserves considered to cover the next worst event.
- **N-1:** Shows the available generation capacity to securely supply demand with reserves considered to cover the next worst event.
- **NI/SI Generation:** The available generation after all outages are considered
- **NI/SI Load:** The worst-case load assumptions used in the calculation
- **HVDC Transfer:** The HVDC limit after all HVDC equipment outages are considered. The limits are based on Transpower's Bipole Operating Policy
- **Outage Gantt:** A high level overview of the outage impacts based on stations or transmission assets

For each segment of the graph, more information about each day can be seen by hovering over each bar. For example, N-1-G will show the date and worst-case value in MW, along with which period it was selected from (whether an AM or PM), and the colour of the bar will represent different MW values based on the margin thresholds (Red < 0MW, 0MW< Orange < 200MW, 200MW < Green):



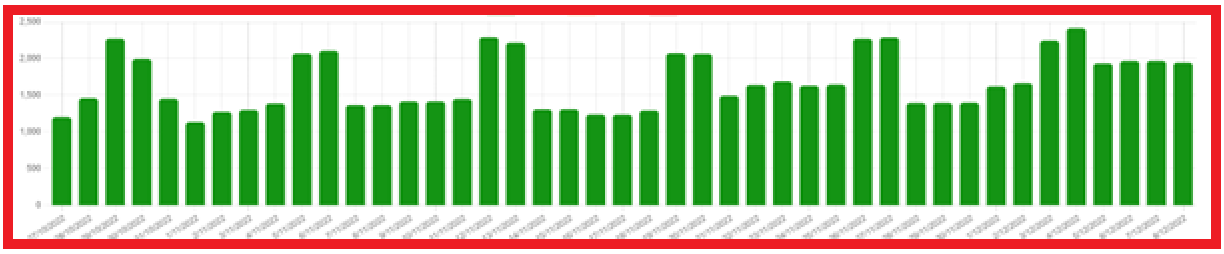
The Gantt chart is an exception to the other graphs as the time resolution shows up to 1 minute as opposed to 1 day (all other graphs). The Gantt chart values displayed are based on calculated values output by the NZGB model.

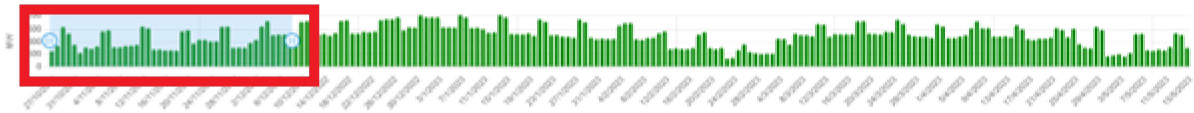


Note: 'other_si' , ' other_ni', and 'HVDC_EQUIP_TRANSFER' are aggregated values. The segments used for these are further categorised as 0- 99MW, 100-199MW, etc

The slider bar on the bottom of the page can be adjusted to focus on a particular range of time in interest.

Adjusting the slider bar will change what is displayed on the graphs:

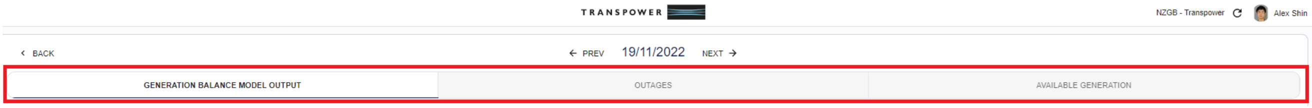




4 Navigating the New Zealand Generation Balance

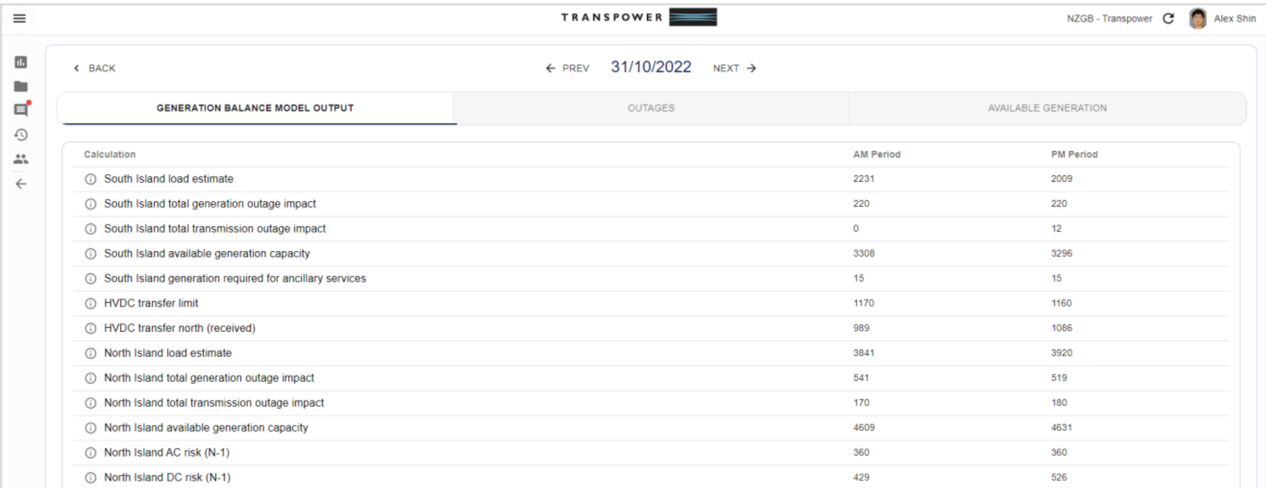
4.1 Daily Detail Page

Once a segment on the dashboard graph is clicked, the user will be directed to a daily detail page where a break-down of Generation Balance Model Output, Outages, and Available Generation will be displayed under their corresponding tab.

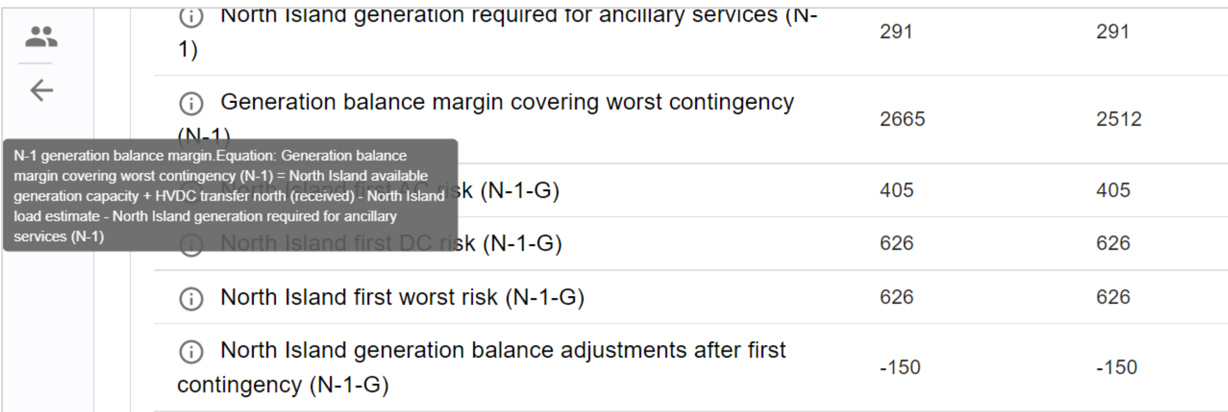


4.1.1 Generation Balance Model Output

This contains the output produced by the NZGB model and can be used by the user to interpret the inputs and the intermediary steps taken during the calculation. Hovering over the help symbol on the right of the output name will display more information about the item and some will include equations that the value is derived from.



Calculation	AM Period	PM Period
South Island load estimate	2231	2009
South Island total generation outage impact	220	220
South Island total transmission outage impact	0	12
South Island available generation capacity	3308	3296
South Island generation required for ancillary services	15	15
HVDC transfer limit	1170	1160
HVDC transfer north (received)	989	1086
North Island load estimate	3841	3920
North Island total generation outage impact	541	519
North Island total transmission outage impact	170	180
North Island available generation capacity	4609	4631
North Island AC risk (N-1)	360	360
North Island DC risk (N-1)	429	526



North Island generation required for ancillary services (N-1)	291	291
Generation balance margin covering worst contingency (N-1)	2665	2512
North Island first AC risk (N-1-G)	405	405
North Island first DC risk (N-1-G)	626	626
North Island first worst risk (N-1-G)	626	626
North Island generation balance adjustments after first contingency (N-1-G)	-150	-150

Day Calculation Display Item	Description
South Island load estimate	Forecast South Island load and losses.
South Island total generation outage impact	Impact of South Island generation outages on the total available generation capacity.
South Island total transmission outage impact	Impact of South Island transmission outages on risk and available generation capacity.
South Island available generation capacity	South Island available generation capacity when transmission and generation outages are taken into account.
South Island generation required for ancillary services	South Island generation capacity required for reserve and frequency keeping.
HVDC transfer limit	The power transfer limit / capacity of the HVDC link (sent from Benmore).
HVDC transfer north (received)	The maximum power transferred north (received at Haywards) over the HVDC link. This value considers the excess generation in the South Island, the HVDC transfer capacity and losses inherent in the HVDC link.
North Island load estimate	Forecast North Island load and losses.
North Island total generation outage impact	Impact of North Island generation outages on the total available generation capacity.
North Island total transmission outage impact	Impact of North Island transmission outages on risk and available generation capacity.
North Island available generation capacity	North Island available generation capacity when transmission and generation outages are taken into account.
North Island AC risk (N-1)	Highest AC risk (generating unit) in the North Island.
North Island DC risk (N-1)	Highest DC risk (HVDC component) to be covered by reserves in the North Island.
North Island worst risk (N-1)	The highest of the AC and DC risks above.
North Island generation required for ancillary services (N-1)	North Island generation capacity required to provide reserves for the risk above and frequency keeping (i.e., risk and frequency keeping less interruptible load).
Generation balance margin covering worst contingency (N-1)	N-1 generation balance margin.

Day Calculation Display Item	Description
North Island first AC risk (N-1-G)	Highest AC risk in the North Island before any contingencies are applied for the N-1-G generation balance calculation. This value will be identical to “North Island AC risk (N-1)”.
North Island first DC risk (N-1-G)	Highest DC risk in the North Island before any contingencies are applied for the N-1-G generation balance calculation. For the loss of the first pole, this risk value uses the continuous rating risk subtractor of 500 MW. Therefore, this value could be different from the “North Island DC risk (N-1)”
North Island first worst risk (N-1-G)	The highest of the first AC and DC risk above, which could be different to “North Island worst risk (N-1)”.
North Island generation balance adjustments after first contingency (N-1-G)	This is the adjustment that would need to be done to the N-1 generation balance margin due to the difference between “North Island first worst risk (N-1-G)” and “North Island worst risk (N-1)”. Any difference is due to the different HVDC risk subtractors used for the N-1 and N-1-G generation balance calculations.
North Island second AC risk (N-1-G)	Highest AC risk in the North Island after the first worst case contingency has already occurred for the N-1-G generation balance calculation.
North Island second DC risk (N-1-G)	Highest DC risk in the North Island after the first worst case contingency has already occurred for the N-1-G generation balance calculation.
North Island second worst risk (N-1-G)	The highest of the second AC and DC risks above.
North Island generation required for ancillary services to cover second risk (N-1-G)	This is the quantity of generation that is required to cover reserves and frequency keeping for the next contingency.
Generation balance margin covering the next worst contingency (N-1-G)	N-1-G generation balance margin.
Selected minimum time	The precise time instance at which results are being displayed and when the lowest generation balance occurred.

4.1.2 Outages

In this section the user will be able to see the effects of various outages on the NZGB model. There will be a table containing a list of all the outages considered for a particular day and the POCP links on the left-hand column. Each outage will display its planning status, start time, end time, and amount of MW they reduce the generation balance by for the AM and PM peaks.

	POCP Outage ID	Generator/Circuit	Planning Status	Start Time	End Time	MW Loss	MW Reduced AM	PM
›		HVDC				-	14	-
	109762	MAN_6	Confirmed	13/11/2023 14:00	10/03/2025 16:30	128	128	128
	109819	MAN_4	Confirmed	16/02/2024 18:00	18/09/2025 16:30	128	128	128
	35665	SFD_22	Confirmed	28/08/2023 09:43	02/09/2024 00:01	100	100	100
	MKE_062_240624	MKE_062	Confirmed	24/06/2024 09:46	29/08/2024 17:00	50	50	50
	109265	WWD	Confirmed	30/05/2023 09:30	15/09/2025 17:00	44	44	44
	35770	ROX_5	Tentative	05/08/2024 07:00	06/09/2024 17:30	40	40	40
	35152	ROX_1	Confirmed	06/05/2024 08:00	30/10/2024 23:59	40	40	40

The HVDC outage can be clicked, which will expand it to show the risk from filter outages (HVDC_FILTERS_RISK), the reduction in transfer limit due to equipment or circuit outages (HVDC_EQUIP_TRANSFER), and the loss from a pole or bipole outage (HVDC_POLE_OUTAGE). Each of these segments can also be expanded to view the individual components that contribute to the reduction. The HVDC number used in the NZGB calculation is the worst case of these three segments.

	POCP Outage ID	Generator/Circuit	Planning Status	Start Time	End Time	MW Loss	MW Reduced AM	PM
	1117570	JRD_SFD_1	confirmed	31/10/2022 07:30	18/11/2022 18:30	-	-	-
	1112532	CST_JRD_SFD_1	confirmed	31/10/2022 07:30	31/10/2022 18:30	-	50	100
	1113659	CYD_CML_TWZ_2	confirmed	25/10/2022 07:30	31/10/2022 17:00	-	0	12
⌄		HVDC				-	90	90
^	HVDC_FILTERS_RISK					-	90	90
	POCP Outage ID	Generator/Circuit	Planning Status	Start Time	End Time	MW Loss	MW Reduced AM	PM
	1113999	BEN_F_4	confirmed	31/10/2022 07:30	04/11/2022 18:30	-	-	-
	1114015	HAY_F_6	confirmed	31/10/2022 07:00	04/11/2022 18:00	-	-	-
⌄	HVDC_EQUIP_TRANSFER					-	30	40
	HVDC_POLE_OUTAGES					-	-	-

4.1.3 Available Generation

This screen shows the available generation at each generating site based on AM and PM timeframes. This considers generation and transmission outages, transmission constraints (they will be flagged 'Yes' in the Constrained column), Wind assumptions for Wind generators and Solar assumptions. Rows are highlighted in red for the stations that have outages or are constrained, reducing their output below their maximum.

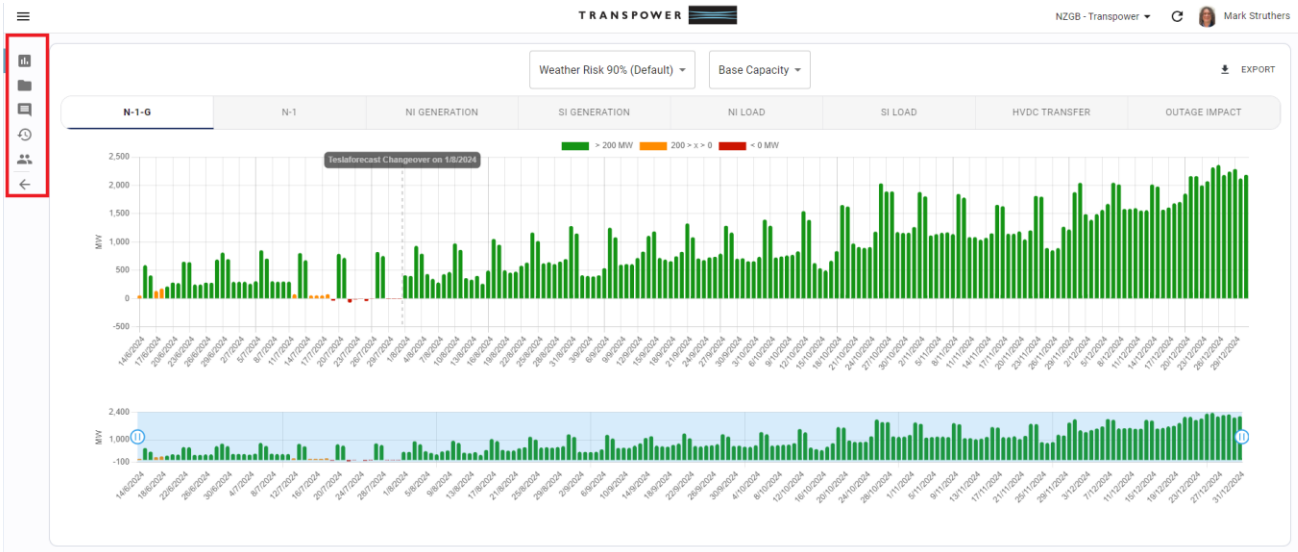
AGES AVAILABLE GENERATION

South Island Generators

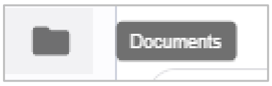
Station	Form of Energy	Max Output (MW)	Constrained	AM Output (MW)	PM Output (MW)
AVI	Hydro	220	-	220	220
BBR	Hydro	11	-	11	11
BEN	Hydro	540	-	540	540
COB	Hydro	32	-	32	32
COL	Hydro	45	-	45	45
CYD	Hydro	432	-	432	432
HBK	Hydro	27	-	27	27
KUM	Hydro	7	-	7	7
MAH	Wind	36	-	7	7
MAN	Hydro	896	-	640	640
OHA	Hydro	248	-	248	248
OHB	Hydro	212	-	212	212
OHC	Hydro	212	-	212	212
PRU	Hydro	12	-	12	12
ROX	Hydro	320	-	240	240
TKA	Hydro	25	-	25	25
TKB	Hydro	146	-	146	146
WHL	Wind	56	-	11	11
WPI	Hydro	84	-	70	70
WTK	Hydro	90	-	90	90
Total		**3651**		**3227**	**3227**
Wind		**92**		**18**	**18**

5 NZGB Menu

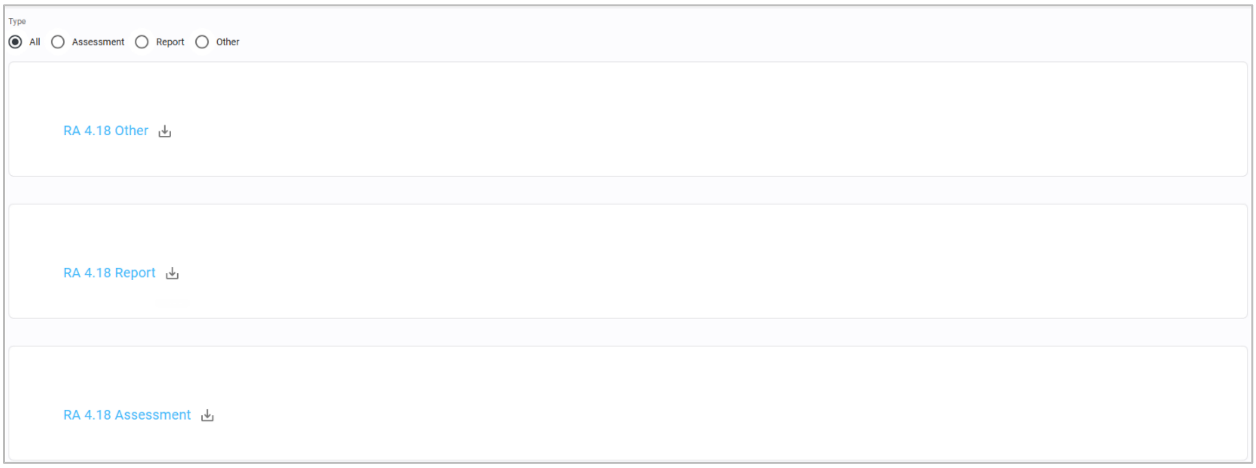
The NZGB Menu contains links to the various parts of the NZGB application – the generation balance outputs, the documents, and the comments made by the NZGB administrators.



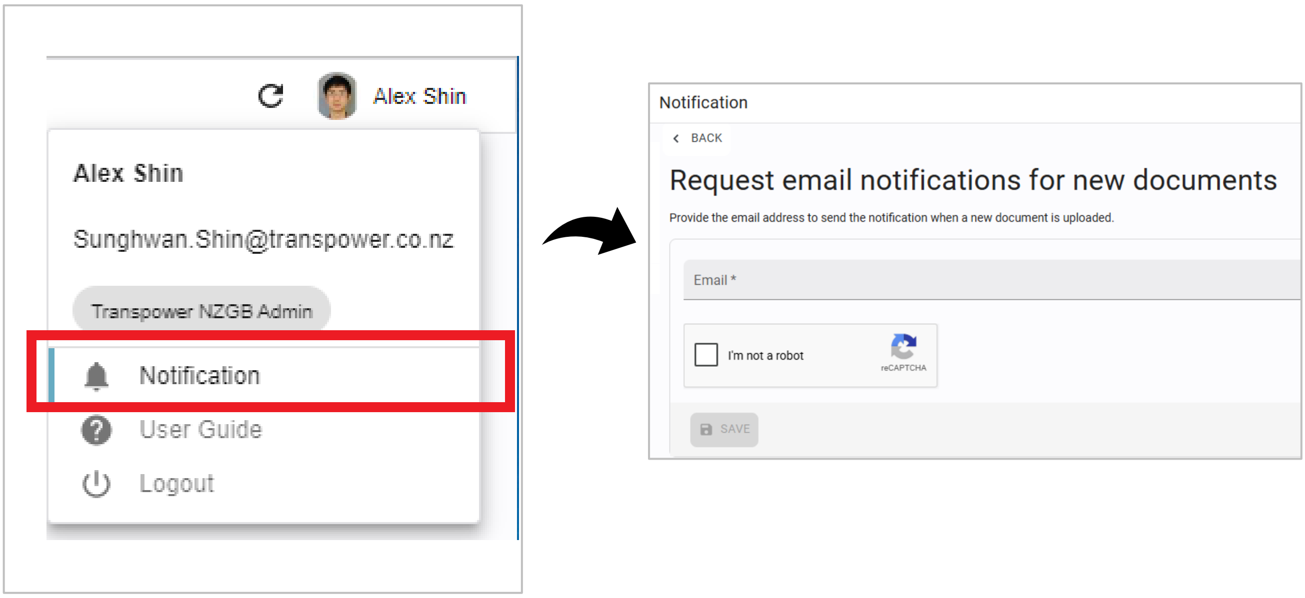
5.1 Documents



The documents page is where the monthly NZGB report is stored, as well as any assessments and supporting documentation. These can be filtered with the radio buttons shown below.



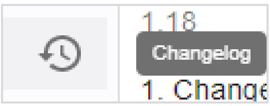
Users can subscribe to notifications that can alert them of any updates to the NZGB documents:



5.2 Comments

The comments page is where the NZGB administrators place information regarding any changes or industry information that may impact NZGB and its calculation

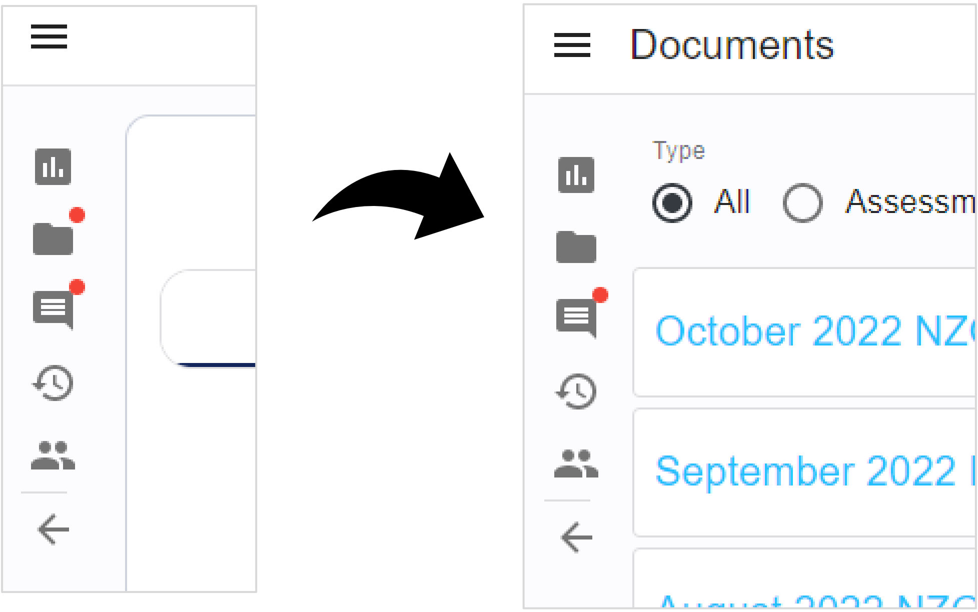
5.3 Change Log



The change log page contains a list of changes done to the NZGB calculation model. This will give an indication of the type of changes along with which area of the calculation it may impact.

5.4 New Update

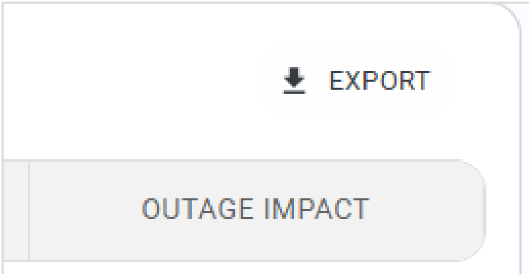
There will be a red dot on top of menu icons, which will indicate a new update has been made in that section. Once a menu section has been opened, the notification will clear:



6 Export

It is possible to export the results of the generation balance calculation as a Microsoft Excel workbook. This is achieved by clicking on the "Export" link on the Navigation Panel.

The items that are displayed on the Day Calculation Page form the columns in the exported file and results for each morning and evening period for each day form the rows. A shortened name is used as the label for each column and the mapping between these labels and the full descriptions provided on the Day Calculation Page is provided in the table below.



Export Label	Day Calculation Page Item
si_load	South Island load estimate
si_gen_outages	South Island total generation outage impact
si_trans_outages	South Island total transmission outage impact
si_generation	South Island available generation capacity
si_ancillary_req	South Island generation required for ancillary services
hvdc_transfer_limit	HVDC transfer limit
hvdc_available	HVDC transfer north (received)
ni_load	North Island load estimate
ni_gen_outages	North Island total generation outage impact
ni_trans_outages	North Island total transmission outage impact
ni_generation	North Island available generation capacity
n1_ni_ac_risk	North Island AC risk (N-1)
n1_dc_risk	North Island DC risk (N-1)
n1_ni_risk	North Island worst risk (N-1)
n1_ni_ancillary_req	North Island generation required for ancillary services (N-1)
n1_contingency	Generation balance margin covering worst contingency (N-1)
n1g_ni_ac_risk_1st	North Island first AC risk (N-1-G)
n1g_dc_risk_1st	North Island first DC risk (N-1-G)

Export Label	Day Calculation Page Item
n1g_ni_risk_1st	North Island first worst risk (N-1-G)
n1g_ni_adjustments_1st	North Island generation balance adjustments after first contingency (N-1-G)
n1g_ni_ac_risk_2nd	North Island second AC risk (N-1-G)
n1g_dc_risk_2nd	North Island second DC risk (N-1-G)
n1g_ni_risk_2nd	North Island second worst risk (N-1-G)
n1g_ni_ancillary_req	North Island generation required for ancillary services to cover second risk (N-1-G)
generation_balance	Generation balance margin covering the next worst contingency (N-1-G)

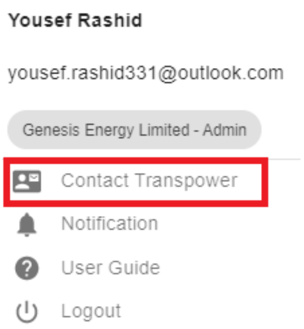
For further information on the meaning of Day Calculation Page items within this list, please refer to Section 5.1.

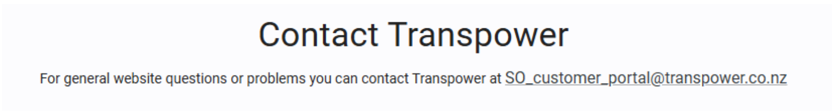
7 User Support

If you are unable to log into the Operations Customer Portal or have any queries, please contact the System Operator at the following e-mail address SO_customer_portal@transpower.co.nz Note that this e-mail will be staffed during business hours (Monday to Friday, 8am – 5pm).

This e-mail can also be accessed from the user menu.

Clicking on the e-mail address in the pop up will invoke your e-mail client so you can send an e-mail.





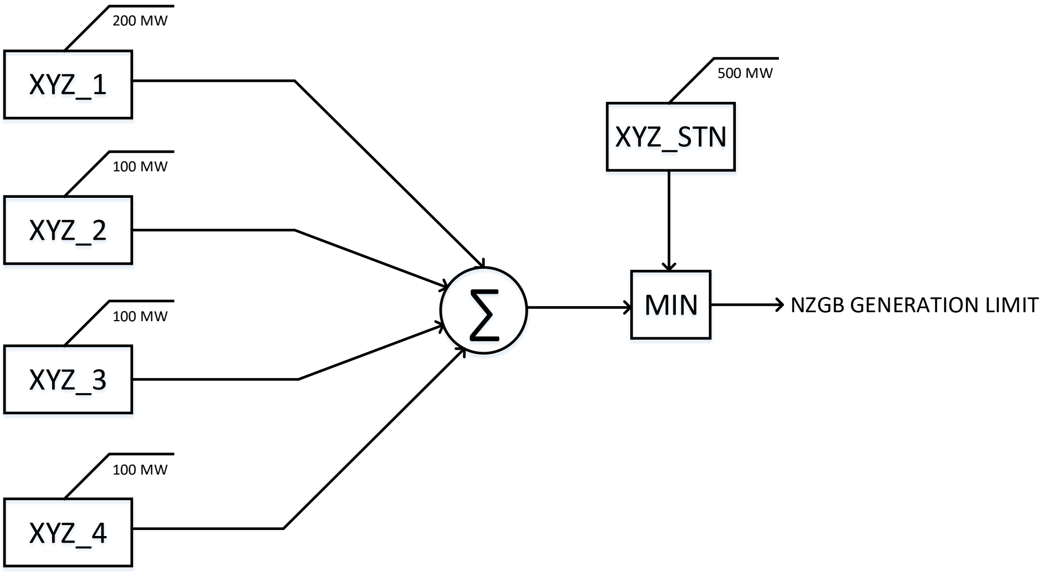
8 POCP outage input guidelines for NZGB processing

Generation outages in NZGB are sourced from POCP. This section discusses best practice naming conventions for POCP outage entries to support processing by NZGB.

We now have three outage naming conventions which NZGB will recognise when processing POCP entries the following is best practice for inputting data to allow consistency of data and correct processing of NZGB:

1. **Single unit outages**: This is to represent a full outage or capacity reduction of a single unit at a station. Input by '<station code>_<unit number>' (e.g. "XYZ_1").
2. **Station limit**: This is to represent a limitation on the station limit independent from individual unit capability e.g. flow rates. Input by '<station code>_STN" (e.g. XYZ_STN).
3. **Rolling unit outages**: This works like a single unit outage but is used when it is not straight forward to attribute the outage to one single unit in a short time period (<3 days). Input by '<station code>_RLN' (e.g. XYZ_RLN).

The diagram below shows the interaction between station and unit limits on an example "XYZ" hydro station, comprised of four units with installed capacity of 200 MW, 100 MW, 100 MW, and 100 MW respectively. The default station limit is 500 MW (the sum of the four individual units).



The following scenarios are to demonstrate how POCP "Outage Block" and "MW Loss" entries should be used to reflect certain outage conditions:

Scenario	Outage Block	MW Loss
Complete shutdown of unit 1	XYZ_1	200 MW
All units can individually generate at max, but the combined station output limited to 450 MW due to river flow limitations	XYZ_STN	50 MW
Fixed outage of unit 3, and combined station output limited to 450 MW due to river flow limitations	XYZ_3	100 MW
	XYZ_STN	50 MW
A rolling outage of units 2, 3 and 4, with only one unit expected to be out at any given time	XYZ_RLN	100 MW
A rolling outage of units 1, 2 and 3, with only one unit expected to be out at any given time	XYZ_RLN	200 MW
Fixed outage of unit 3, and rolling unit outage of units 2 and 4	XYZ_3	100 MW
	XYZ_RLN	100 MW

9 The Generation Balance Calculation

The objective of the generation balance calculation is to forecast whether there will be enough generation capacity to securely meet demand (i.e. meet frequency keeping and reserve requirements) considering scheduled equipment outages, and common market behaviours. This calculation focuses on whether the instantaneous power balance can be met (i.e. MW) and hence differs from other security of supply assessments that are concerned with energy shortages (i.e. MWh).

The calculation within the NZGB application considers a scenario of peak demand in the North Island with HVDC power transfer north. A simplified model of the New Zealand power system is used for the generation balance calculation whereby the following aspects are estimated for each island:

- Demand and losses;
- Available generation;
- Generation required for ancillary services (reserves and frequency keeping); and
- HVDC transfer capacity.

The NZGB estimates the margin to a generation balance shortfall (or the severity of such a shortfall) by calculating the following metrics[1]:

Metric	Definition
N-1 Generation Balance Margin	The difference between the available generation capacity and the capacity required to securely supply demand before the occurrence of a contingent event (i.e. reserves need to be obtained to cover the worst case contingent event).
N-1-G Generation Balance Margin	The difference between the available generation capacity and the capacity required to securely supply demand after the occurrence of the two worst case contingent events, where the second event is a generator or HVDC pole.

The following sections detail the assumptions built into the NZGB application as well as the way in which the application sources information for processing.

9.1 Daily Time Windows

The generation balance calculation is concerned with the morning and evening peak demand time periods for each day. The time windows (inclusive) that are associated with these peak periods are split by season, and weekday/weekend as defined below:

Season	Day Type	AM /PM	Start/End	Time	Trading Period
Summer (Dec – Feb)	Weekday	AM	Start	6:00	TP13
			End	12:00	TP25
		PM	Start	14:00	TP29
			End	17:30	TP36
	Weekend	AM	Start	7:00	TP15
			End	9:30	TP20
		PM	Start	17:00	TP35
			End	19:30	TP40
Shoulder 1 (Mar – May)	Weekday	AM	Start	7:00	TP15
			End	9:00	TP19
		PM	Start	17:00	TP35
			End	19:00	TP39
	Weekend	AM	Start	7:30	TP16
			End	10:30	TP22
		PM	Start	16:30	TP34
			End	20:00	TP41
Shoulder 2 (Sep – Nov)	Weekday	AM	Start	6:00	TP13
			End	8:30	TP18
		PM	Start	17:00	TP35
			End	19:30	TP40
	Weekend	AM	Start	7:00	TP15
			End	9:30	TP20
		PM	Start	17:00	TP35
			End	20:00	TP41
Winter (Jun – Aug)	Weekday	AM	Start	7:00	TP15
			End	9:30	TP20
		PM	Start	17:00	TP35
			End	19:30	TP40
	Weekend	AM	Start	8:00	TP17
			End	10:00	TP21
		PM	Start	17:00	TP35
			End	19:30	TP40

These time windows limit the scheduled outages and historical data that is considered in the calculation. An outage that overlaps with an AM or PM peak time will be accounted for in the associated calculation of AM or PM balance.

9.2 Demand Forecast

The NZGB predicts future demand through weather-based risk models provided by Yes Energy (TESLA load forecast model). These weather risk models utilise 10 years of historical telemetered data and weather data in these calculations.

9.2.1 Non-conforming demand & losses forecast

The loads returned by the Yes Energy weather risk forecasts do not include losses, or predict non-conforming loads (ie, does not predict loads that do not conform to weather events). The island demand and losses are calculated from this data as detailed in the following table:

Estimated Values	Calculation from Source Data
North Island Demand Conforming Losses	North Island Power Supply
Total System Conforming Losses	New Zealand Generation
South Island Conforming Losses	Total System Demand and Losses – North Island Demand and Losses
Non-conforming loads (North Island & South Island)	Individual non-conforming station values

In some specific instances, individual GXP or Grid Zone demand data is also used by the NZGB application. The values for this data are calculated in the same fashion but using historical GXP or Grid Zone telemetered load data as the source. These are used for estimations on the non-conforming loads and to apply NZGB constraints or AC disconnects.

All historical data used for demand estimation is provided to the NZGB application in the form of half-hourly time series data. Each half-hour data point is the average of the sampled SCADA data over a trading period.

The NZGB can use either of two prediction methods to forecast demand. These are described in detail below.

9.2.2 Yes Energy Load forecast

The Yes Energy weather risk forecasting model uses load input data from Energy Market Services to produce a load forecast model with the previous 10 years of historical load and weather data.

The Yes Energy load forecast has been developed for conforming load, meaning there are a few additional components considered for the total load requirements of NZGB:

1. **Conforming load**

   Conforming load is pulled directly from the Yes Energy weather risk load forecast model. The load forecast model has a load growth component and a weather risk component.

   The load growth component provides the basis for year-by-year load growth expectations; the weather risk component provides a view of how the load can vary depending on the weather.

   These weather risk forecasts utilize a MonteCarlo simulation that transplants historical weather into a current Load Forecast model, resulting in a range of forecasts in percentile form. This process allows the user to see, with today's relationships between the explanatory variables and demand, what demand may be if the historical weather conditions were to present themselves again. For example, we can see how high demand could get if 15th August 2011's weather (when it snowed in Wellington), were to happen again in August 2024 under the 100th percentile weather risk model.

The percentiles of weather risk returned by the Yes Energy model (from most optimistic to pessimistic) include the 1st percentile, 10th, 20th, 50th, 80th, 90th, 99th and 100th percentile.

2. **Non-conforming load**

Non-conforming load is not part of the Yes Energy weather risk load forecast model so needs to be added to NZGB separately. Non-conforming load is calculated using 2 years of historic SCADA data for non-conforming GXPs. A fourier-analysis is used to predict future non-conforming load from this data.

3. **Losses**

Losses need to be added to the load values, as generation must supply both load and losses, and NZGB has no network model to determine losses explicitly.

Losses are calculated using historical peak generation and load data. Losses will vary depending on the network configuration and generation dispatch, with historical values approximately 3-5%.

9.2.3 Available Demand scenarios

The Yes Energy Weather risk forecast provides the following scenarios for NZGB,

Estimated Values
100th Percentile
99th Percentile
90th Percentile
80th Percentile

The 90th Percentile weather risk scenario, solving negative alongside the base generation assumption is used in the trigger for NZGB Assessments and CANs, when solving within 1 month of real-time and outside of any schedules.

9.3 Available Generation Capacity

NZGB estimates the available generation based on two factors:

- The maximum capacity that is pre-configured in the tool; and
- The impact of transmission or generation outages which are entered into POCP.

Generation in the NZGB application is modelled in terms of generating stations which can then be (optionally) composed of individual generating units. Only dispatchable generation is considered by the calculation and the underlying assumption is that all generation will be offered unless outages are notified via POCP.

The sections below describe the various components of the generation availability estimate in more detail.

9.3.1 Maximum Generation Capacity

A full list of the maximum capacities of generating stations and units that are configured within the NZGB application can be found in Appendix 5.1.

9.3.2 Generation Outages

Generation outages reduce the available capacity of individual generating units or generating stations. The NZGB application utilises the "MW Loss" field from POCP to determine the outage reduction amount.

The NZGB uses unit level outage entries to determine the generation capacity available from particular units and separately uses the station level entries to determine the generation capacity available from the entire station.

9.3.3 Transmission Outages

Certain transmission outages can constrain or disconnect generation thereby reducing the available generation capacity. The manner in which transmission outages influence available generation can be complex, hence transmission constraints are modelled on a case-by-case basis in the NZGB application.

The following table provides a list of transmission constraints that are applied as a result of transmission outages in the NZGB application. The export limit value is the maximum allowable generation export from an area of region under the outage condition and the constraint value represents an indicative generation reduction to meet the export limit:

Outage	Description	Indicative Export Limits and Constraint
CYD_CML_TWZ_1 CYD_CML_TWZ_2 CYD_CML_1 CYD_CML_2	Generation export from the Southland region (CYD, ROX, MAN, MAH and WPI) limited to avoid overloading the NSY-ROX-1 circuit post-contingency.	Export Limit: Summer: 740 MW Shoulder: 790 MW Winter: 810 MW Constraint: Summer: 70 MW Shoulder: 0 MW Winter: 0 MW
NSY_ROX_1	Generation export from the Southland region (CYD, ROX, MAN, MAH and WPI) limited to avoid overloading the CYD-CML-TWZ circuits post-contingency.	Export Limit: Summer: 690 MW Shoulder: 710 MW Winter: 720 MW Constraint: Summer: 150 MW Shoulder: 60 MW Winter: 50 MW
LIV_NSY_1	Generation export from the Southland region (CYD, ROX, MAN, MAH and WPI) limited to avoid overloading the CYD-CML-TWZ circuits post-contingency.	Export Limit: Summer: 710 MW Shoulder: 720 MW Winter: 730 MW Constraint: Summer: 130 MW Shoulder: 50 MW Winter: 40 MW
CML_TWZ_1	Generation export from the Southland region (CYD, ROX, MAN, MAH and WPI)	Export Limit:

Outage	Description	Indicative Export Limits and Constraint
CML_TWZ_2	limited to avoid overloading the NSY-ROX-1 circuit post-contingency.	Summer: 790 MW Shoulder: 840 MW Winter: 840 MW Constraint: Summer: 20 MW Shoulder: 0 MW Winter: 0 MW
MTI_WKM_1 MTI_WKM_2	Generation export from MTI and WPA limited to avoid overloading of remaining MTI-WKM circuit pre-contingency.	Export Limit: Summer: 202 MW Shoulder: 225 MW Winter: 247 MW Constraint: Summer: 200 MW Shoulder: 175 MW Winter: 160 MW
THI_WKM_1 WKM_WRK_1	Generation export from the Central North Island region (THI, PPI, ATI, OHK, WRK, TAA, RKA, OKI, NAP, NTM, ARA, ARI_STH, KIN, KMI, WHE, KAG, MAT, ANI, WHI, KTW, PRI and TUI) limited to avoid overloading the OHK-WRK-1, ATI-OHK-1 and ATI-WKM-1 circuits post-contingency.	Export Limit: Summer: 480 MW Shoulder: 530 MW Winter: 600 MW Constraint: Summer: 650 MW Shoulder: 500 MW Winter: 470 MW
THI_WRK_1	Generation export from the Central North Island region (ATI, OHK, WRK, TAA, RKA, OKI, NAP, NTM, ARA, ARI_STH, KIN, KMI, WHE, KAG, MAT, ANI, WHI, KTW, PRI and TUI) limited to avoid overloading of the OHK-WRK-1, ATI-OHK-1 and ATI-WKM-1 circuits post-contingency.	Export Limit: Summer: 410 MW Shoulder: 460 MW Winter: 470 MW Constraint: Summer: 460 MW Shoulder: 370 MW Winter: 290 MW

The following table provides a list of transmission outages that result in the complete disconnection of generation from the grid in the NZGB application:

Outage	Generation Disconnected
ARA_WRK_1	ARA
MTI_WPA_1	WPA

Outage	Generation Disconnected
PPI_ THI_1	PPI
OHB_806_1007	OHB_8 and OBH_9
OHB_907_1106	OHB_10 and OBH_11
OHC_1206_1407	OHC_12 and OHC_13
OHC_1307_1508	OHC_14 and OHC_15
SFD_CB_612	SPL
ARI_44_77_97	ARI_1, ARI_2, ARI_3 and ARI_4
MNI_MKE_SFD_1, MKE_CB_102	MKE
CST_JRD_SFD_1, JRD_CB_132	JRD
MTI_87_84_117, MTI_97_117_187, MTI_97_87_117_107	MTI_1, MTI_2, MTI_3, MTI_4, MTI_5
MTI_127_164_177, MTI_107_177_127, MTI_97_127_177	MTI_6, MTI_7, MTI_8, MTI_9, MTI_10
MTI_117_107_127	MTI
WRK_44_57_197	WRK_1, WRK_14, WRK_7, WRK_8, WRK_15, WRK_16
WRK_47_134_87	WRK_15, WRK_16, WRK_4, WRK_9, WRK_10, WRK_11, WRK_12, WRK_13
WRK_47_44_197	WRK_1, WRK_14, WRK_7, WRK_8
WRK_47_57	WRK_15, WRK_16
WRK_47_67	WRK_15, WRK_16, WRK_4, WRK_9, WRK_10, WRK_11
WRK_57_103_87	WRK_4, WRK_9, WRK_10, WRK_11, WRK_12, WRK_13
WRK_57_67	WRK_4, WRK_9, WRK_10, WRK_11
WRK_67_103_87, WRK_67_77	WRK_12, WRK_13
SFD_CB_522	SFD_21
SFD_CB_552	SFD_22
BPE_TWC_LTN_1	TWC, TRH
NAP_NTM_1	NTM_1, NTM_2, NTM_3, NTM_4

9.3.4 *Determining Generation Availability*

The total generation availability is determined by examining the impact of outages on reducing generation capacity. The effect of transmission and generation outages are considered separately, and generation availability is calculated as the minimum of the two. Outages which impact an entire generating station or individual units are also considered separately.

The transmission and generation outages that reduce generation capacity are only considered for a particular peak demand period (the morning or evening period for a particular day), if their start or end times fall within that time window. Additionally, the NZGB takes into consideration actual concurrencies of outages within a given time window. This means that the application does not double count the effect of a series of staggered outages which do not overlap.

9.3.5 *Supply Scenarios - Base*

The NZGB has two Supply scenarios which are used to determine where the risk of generation availability lies, between plausible best- & worst-case supply availability scenarios.

The Base scenario is a metric for the best-case generation availability and assumes that generation not on outage (as defined above in section 10.3) will be available to operate at it's peak Maximum Continuous Operating (MCO) value.

Exceptions to this are wind generation, solar and BESS (Battery Energy Storage Systems). Wind is assumed to be the 35th percentile lowest output (~20%) of its stated capacity toward the generation balance under the base supply scenario. Solar generation is also derated monthly, as defined by the following table,

Solar capacity for each month												
Month	**Jan**	**Feb**	**Mar**	**Apr**	**May**	**Jun**	**Jul**	**Aug**	**Sep**	**Oct**	**Nov**	**Dec**
AM Peak	30%	20%	15%	0%	0%	0%	0%	0%	0%	15%	25%	40%
PM Peak	30%	20%	10%	0%	0%	0%	0%	0%	0%	10%	20%	30%

For BESS there is currently not enough data available for the analysis and therefore it is prudent to make conservative assumptions in the short term until substantial data becomes available. For this reason, assume 50% of the battery rating is available for both peaks. This percentage factors in an estimate of DoD (Depth of Discharge) of the BESS and a risk factor of the battery not being fully charged. The other consideration is the duration of the peak that must be factored into the energy that is available. Below is an example of how the available capacity is calculated:

BESS Capacity = 100 MW

BESS Energy = 200 MW/h

Outage = 20 MW

NZGB Peak Duration = 4 hours

Availability = 0.5 (50%)

Available capacity = ((Energy * Availability) / (Peak duration * Capacity)) * (Capacity - Outage) =

((200* 0.5)/ (4 * 100)) * (100- 20) = 0.25 * 80 = **20 MW**

9.3.6 Supply Scenarios – Firm

The Firm scenario is a metric for the worst-case supply availability scenario. As with the base scenario, it assumes generation not on outage (as defined above in section 10.3) will be available to operate at its peak Maximum Capacity Operating (MCO) value.

Exceptions to this include generation assets which have not historically operated for at least 90% of historic AM & PM peaks. Those assets are removed, with the following assumptions made before outages in POCP are accounted for,

- TCC will not be available (-360MW)
- 1 HLY Rankine will not be available over winter months (-250MW)
- 2 HLY Rankines will not be available over summer months (-500MW)

The assumption for solar availability from the Base scenario and lowest 10th percentile wind generation output (~8%) is applied in the Firm scenario.

9.4 HVDC Transfer

For the purpose of calculating the generation balance, the NZGB application assumes that the full available capacity of the HVDC link will be utilized to transfer maximum power from the South Island to the North Island. The first aspect the NZGB uses to determine the HVDC transfer is the quantity of excess South Island generation, which is calculated using estimated values for South Island available generation capacity, demand and ancillary service requirements. The second aspect is the available HVDC transfer capacity which is estimated by utilising the formulae provided in Transpower's HVDC Bipole Operating Policy. This is achieved by estimating the Wellington load and taking into consideration the influence of outages of the following equipment:

- HVDC poles;
- Filter banks at Haywards and Benmore;
- Electrode circuits at Haywards;
- 220 kV circuits between Bunnythorpe and Haywards;
- 220 kV circuits north of Bunnythorpe;
- 220 kV / 110 kV interconnecting transformers at Haywards; and
- Dynamic reactive equipment at Haywards (synchronous condensers and STATCOM).

The NZGB application calculates the HVDC transfer to be the lower of the excess South Island generation and the HVDC transfer capacity. Lastly, losses inherent in the operation of the HVDC are also accounted for by subtracting a fixed loss value from the HVDC power sent to calculate the HVDC power received. The following table shows the assumed HVDC losses at various power transfer levels:

HVDC Sent [MW]	HVDC Loss [MW]
0 to 200	6
201 to 400	12
401 to 700	28
701 to 1000	52
1001 to 1200	74

9.5 Generation Ancillary Service Requirements

The NZGB calculation dynamically estimates the generation that will be required for ancillary services, particularly frequency keeping and under-frequency reserves, for secure operation of the power system. This is important as the generation required for this purpose is not available to supply demand.

9.5.1 Reserve Estimation Methodology

The quantity of under-frequency reserve that is required to cover the worst case contingent event changes as a function of actual generation output or HVDC transfer. In reality, Transpower's Scheduling, Pricing and Dispatch application may find an optimum solution such that the generation output of the risk setting unit or HVDC transfer is limited thereby limiting the quantity of under-frequency reserves that are required. The exact optimum solution depends entirely on the actual energy and reserve offers that have been provided.

In the context of the generation balance calculation however, generation capacity utilised for supplying demand or providing reserves is equivalent. This means that the outcome of limiting generation output or HVDC transfer to reduce the quantity of reserves required would be equivalent to maximising generation output or HVDC transfer to supply demand and increasing the required reserves. Therefore, to simplify the generation balance calculation, the NZGB implements the latter methodology: assuming that the output of risk setting plant or the HVDC is at maximum capacity (taking outages into account) and then determining the reserves needed to cover this risk.

9.5.2 South Island Reserve and Frequency Keeping Requirements

South Island reserve and frequency keeping requirements indirectly impact generation balance margins by potentially limiting power transfer into the North Island (by reducing the available South Island generation capacity). For this purpose, the NZGB:

1. Assumes that 15 MW is required for South Island frequency keeping;
2. Assumes that 220 MW of reverse reserve sharing is available from the North Island as part of the National Market for Instantaneous Reserves; and
3. Dynamically determines the AC risk within the South Island.

The available capacity of the following generating units is used for dynamically determining the AC risk in the South Island:

1. An outage of MAN_BS_220_A causing the risk being equal to the sum of the available capacity of MAN_4, MAN_5, MAN_6 and MAN_7;
2. An outage of MAN_BS_220_C causing the risk being equal to the sum of the available capacity of MAN_1, MAN_2, MAN_3 and MAN_4; and
3. An outage of OHA_TWZ_1 or OHA_TWZ_2 causing the risk being equal to the available capacity of OHA.

Due to reserve sharing across the HVDC link, the AC risk in the South Island only has an influence on the reserves required when the AC Risk exceeds 220 MW.

Where none of these units are available, a minimum South Island AC risk of 125 MW is assumed.

9.5.3 HVDC Risks

The NZGB calculation considers the loss of a single piece of HVDC plant in determining the HVDC risk, which depends on the HVDC transfer and the risk subtractor. The HVDC transfer is determined as described in Section 3.5 and the risk subtractor is determined by taking into consideration outages of HVDC poles and filter banks at Haywards and Benmore. The risk subtractor values used within the NZGB are taken from the HVDC Operating Policy.

In the absence of pole or filter bank outages, the NZGB will utilise the risk subtractor of 650 MW to determine the reserve required to cover the loss of the first HVDC pole. However, this value relies upon the short-time rating of the remaining HVDC pole and is not suitable for the N-1-G generation balance calculation where the

HVDC pole is the first worst case contingency. In this instance, a risk subtractor of 500 MW is used for the initial HVDC pole contingency, in accordance with the continuous rating of the remaining HVDC pole. Note that for such a situation, the second HVDC risk is assumed to be the remaining flow on the HVDC link as the loss of the second pole results in complete disconnection of the North and South Islands.

9.5.4 North Island Reserve and Frequency Keeping Requirements

The North Island reserve and frequency keeping requirements directly influence generation balance margins by reducing the available North Island generation capacity. For this purpose, the NZGB:

1. Assumes that 15 MW is required for North Island frequency keeping;
2. Assumes that 200 MW of North Island interruptible load is available, reducing the reserves that are required from generating plant;
3. Dynamically determines the AC risk within the North Island; and
4. Dynamically determines the North Island risk by taking the worst of the DC risk and the AC risk.
5. The available capacity of the following generating units is used for dynamically determining the AC risk in the North Island:
6. Huntly Units 1, 2, 4 and 5; and
7. Stratford / Taranaki Combined Cycle (SPL);
8. An outage of NAP_WRK_2 or OKI_WRK_1 causing the risk being equal to the sum of the available capacity of OKI, NTM and NAP;
9. An outage of NAP_OKI_2 causing the risk being equal to the sum of the available capacity of NTM and NAP;
10. An outage of MTI_WKM_1 or 2 causing the risk being equal to the sum of the available capacity of MTI and WPA;

Where none of these units are available, a minimum North Island AC risk of 220 MW is assumed.

9.5.5 Additional Generation scenarios

NZGB includes additional generation (supply side) scenarios to test risks that may be available with common generation availability patterns. These include the scenarios of;

- All generation (as described in section 10.5.1)
- Firm generation only (removal of thermal units that haven't run at least 80% of the time, over the past 3 years)

9.6 Generation Balance Calculation Summary

The previous sections described how the various inputs to the generation balance calculation are obtained. The generation balance margin is defined by the following formula:

```
Generation Balance Margin = Available Generation and HVDC Transfer – Generation Required for Ancillary Services – Demand and Losses
```

The following sections provide a brief summary of the way in which the above formula is utilised for the N-1 and N-1-G generation balance calculations and the meanings of calculation values displayed on the Day Calculation Page.

9.6.1 N-1 Generation Balance Calculation

The N-1 generation balance margin is calculated by directly using the estimated generation, HVDC transfer, demand and risk values for the intact system in the generation balance formula above.

9.6.2 N-1-G Generation Balance Calculation

In order to calculate the N-1-G generation balance margin, the NZGB first re-calculates the impact of the worst case first contingency. This is required because as was described in Section 3.6 the DC risk considered in the

N-1 generation balance calculation and the first DC risk in the N-1-G generation balance calculation may differ. The NZGB then simulates the impact of this contingency by reducing the available generation or HVDC transfer, depending on whether this contingency was the loss of a generating unit or HVDC equipment. Lastly, the second worst case contingency is determined based on the equipment that remains in service. Updated values of generation, HVDC transfer and risk are then used in the generation balance formula above to arrive at the N-1-G generation balance margin.

9.6.3 *Definition of Calculation Components*

The Day Calculation Page displays the values of the major components of the generation balance calculation. These items are described in greater detail in the table below.

Day Calculation Display Item	Description
South Island load estimate	Forecast South Island load and losses.
South Island total generation outage impact	Impact of South Island generation outages on the total available generation capacity.
South Island total transmission outage impact	Impact of South Island transmission outages on risk and available generation capacity.
South Island available generation capacity	South Island available generation capacity when transmission and generation outages are taken into account.
South Island generation required for ancillary services	South Island generation capacity required for reserve and frequency keeping.
HVDC transfer limit	The power transfer limit / capacity of the HVDC link (sent from Benmore).
HVDC transfer north (received)	The maximum power transferred north (received at Haywards) over the HVDC link. This value considers the excess generation in the South Island, the HVDC transfer capacity and losses inherent in the HVDC link.
North Island load estimate	Forecast North Island load and losses.
North Island total generation outage impact	Impact of North Island generation outages on the total available generation capacity.
North Island total transmission outage impact	Impact of North Island transmission outages on risk and available generation capacity.
North Island available generation capacity	North Island available generation capacity when transmission and generation outages are taken into account.
North Island AC risk (N-1)	Highest AC risk (generating unit) in the North Island.
North Island DC risk (N-1)	Highest DC risk (HVDC component) to be covered by reserves in the North Island.
North Island worst risk (N-1)	The highest of the AC and DC risks above.

Day Calculation Display Item	Description
North Island generation required for ancillary services (N-1)	North Island generation capacity required to provide reserves for the risk above and frequency keeping (i.e. risk and frequency keeping less interruptible load).
Generation balance margin covering worst contingency (N-1)	N-1 generation balance margin.
North Island first AC risk (N-1-G)	Highest AC risk in the North Island before any contingencies are applied for the N-1-G generation balance calculation. This value will be identical to "North Island AC risk (N-1)".
North Island first DC risk (N-1-G)	Highest DC risk in the North Island before any contingencies are applied for the N-1-G generation balance calculation. For the loss of the first pole, this risk value uses the continuous rating risk subtractor of 500 MW. Therefore, this value could be different from the "North Island DC risk (N-1)"
North Island first worst risk (N-1-G)	The highest of the first AC and DC risk above, which could be different to "North Island worst risk (N-1)".
North Island generation balance adjustments after first contingency (N-1-G)	This is the adjustment that would need to be done to the N-1 generation balance margin due to the difference between "North Island first worst risk (N-1-G)" and "North Island worst risk (N-1)". Any difference is due to the different HVDC risk subtractors used for the N-1 and N-1-G generation balance calculations.
North Island second AC risk (N-1-G)	Highest AC risk in the North Island after the first worst case contingency has already occurred for the N-1-G generation balance calculation.
North Island second DC risk (N-1-G)	Highest DC risk in the North Island after the first worst case contingency has already occurred for the N-1-G generation balance calculation.
North Island second worst risk (N-1-G)	The highest of the second AC and DC risks above.
North Island generation required for ancillary services to cover second risk (N-1-G)	This is the quantity of generation that is required to cover reserves and frequency keeping for the next contingency.
Generation balance margin covering the next worst contingency (N-1-G)	N-1-G generation balance margin.
Selected minimum time	The precise time instance at which results are being displayed and when the lowest generation balance occurred.

9.7 Application Aspects

9.7.1 Application Architecture

The NZGB application interfaces with multiple systems to calculate generation balance margins and display these to the user. The overall architecture of the NZGB application is outlined in the diagram below:

Outage information is obtained from POCP and generation and load data used for the demand forecast and transmission constraints is obtained from Transpower's SCADA.

9.7.2 Manual Overrides

The bulk of the generation balance calculation is automated within the NZGB application as described before. However, NZGB administrators may from time to time apply manual overrides when the automated process cannot produce correct results. If manual overrides have been applied, a description will be provided on the Dashboard Page under the comments section.

10 Appendix

10.1 NZGB Model Summary

The generating station and unit capacities which are configured into the NZGB model for North Island and South Island generators are tabulated in Table 1 and Table 2 respective.

Table 1 - North Island Generation Capacity

Station Name	Station Code	Station Capacity [MW]	Generating Units	Generating Unit Capacity [MW]
Aniwhenua	ANI	25	-	-
Aratiatia	ARA	78	ARA_1 ARA_2 ARA_3	26 26 26
Aripuni	ARI	192	ARI_1 ARI_2 ARI_3 ARI_4 ARI_5 ARI_6 ARI_7 ARI_8	22 22 22 22 26 26 26 26
Atiamuri	ATI	80	ATI_1 ATI_2 ATI_3 ATI_4	19 19 19 19
Glenbrook	GLN	74	-	-
Huntly	HLY	1047* *It is assumed that only 2 out of 3 Rankines will be offered so a station maximum of 955 MW is used in the calculation.	HLY_1 HLY_2 HLY_5 HLY_6 HLY_4	250 250 405 50 250
Harapaki	HRP	176.3	HRP_123 HRP_456	86 90.3
Junction Road	JRD	100	JRD_071 JRD_072	50 50
Kawerau	KAG	106	-	-
Kinleith	KIN	39	-	-
Kaimai	KMI	42	-	-
Kapuni	KPI	24	KPI_1 KPI_2	12 12
Karapiro	KPO	96	KPO_1 KPO_2 KPO_3	32 32 32

Station Name	Station Code	Station Capacity [MW]	Generating Units	Generating Unit Capacity [MW]
Kaitaia Solar Farm	KTS	23	KTS_1	23
Matahina	MAT	72	-	-
Mill Creek	MCK	60	-	-
Mangahao	MHO	38	-	-
McKee	MKE	100	MKE_061 MKE_062	50 50
Mokai	MOK	105	MOK_1 MOK_2 MOK_3 MOK_10 MOK_11 MOK_12 MOK_21 MOK_22 MOK_30 MOK_31 MOK_32 MOK_41	4 4 7 34 4 4 4 4 19 7 7 7
Maraetai	MTI	360	MTI_1 MTI_2 MTI_3 MTI_4 MTI_5 MTI_6 MTI_7 MTI_8 MTI_9 MTI_10	36 36 36 36 36 36 36 36 36 36
Nga Awa Purua	NAP	147	-	-
Ngawha A	NGA	30	-	-
Ngawha B	NGB	31	-	-
Nga Tamariki	NTM	82	NTM_1 NTM_2 NTM_3 NTM_4	20 20 20 20
Ohakuri	OHK	108	OHK_1 OHK_2 OHK_3 OHK_4	27 27 27 27
Ohaaki	OKI	56	-	-
Onepu	ONU	60	-	-

Station Name	Station Code	Station Capacity [MW]	Generating Units	Generating Unit Capacity [MW]
Pohipi	PPI	51	PPI_1	51
Patea	PTA	31	-	-
Rotohiko	RHO	33.2MW 35.3MW/h	-	-
Rotokawa	RKA	31	RKA_1 RKA_10 RKA_11 RKA_12 RKA_21	3 16 3 3 5
Rangipo	RPO	120	RPO5 RPO6	60 60
Ruakākā	RUK	100MW 200MW/h	-	-
Stratford (Peaking)	SFD	200	SFD_21 SFD_22	100 100
Stratford Power Limited (Taranaki Combined Cycle)	SPL	360	-	-
Te Huka Binary Plant	TAA	30	-	-
Te Apiti	TAP	90	-	-
Te Mihi	THI	166	THI_1 THI_2	83 83
Tokaanu	TKU	240	TKU1 TKU2 TKU3 TKU4	60 60 60 60
Te Rere Hau	TRH	48	-	-
Tuai – Waikaremoana (incl. Piripaua, Kaitawa)	TUI	132	TUI_1 TUI_2 TUI_3 TUI_4 TUI_5 TUI_6 TUI_7	19 19 20 22 22 18 18
Te Uku	TUK	63	-	-
Turitea	TUR	119		
Tararua Central	TWC	93	-	-
Tararua – Stage 1	TWF	68	-	-
Whareroa	WAA	64	-	-

Station Name	Station Code	Station Capacity [MW]	Generating Units	Generating Unit Capacity [MW]
Wheao / Flaxy	WHE	25	-	-
Whirinaki	WHI	157	WHI_1 WHI_2 WHI_3	52 52 52
Whakamaru	WKM	100	WKM_1 WKM_2 WKM_3 WKM_4	25 25 25 25
Waipapa	WPA	51	WPA_1 WPA_2 WPA_3	18 18 18
Waipipi	WPP	133	-	-
Wairakei	WRK	174	WRK_1 WRK_4 WRK_7 WRK_8 WRK_9 WRK_10 WRK_11 WRK_12 WRK_13 WRK_15 WRK_16	11 11 11 11 11 11 29 29 29 8 8
West Wind	WWD	140	WWD1 WWD2 WWD3 WWD4 WWD5 WWD6	23 23 23 25 25 23

Table 2 - South Island Generation Capacity

Station Name	Station Code	Station Capacity [MW]	Generating Units	Generating Unit Capacity [MW]
Aviemore	AVI	220	AVI1 AVI2 AVI3 AVI4	55 55 55 55
Brach River (Wairau / Argyle)	BBR	11	-	-
Benmore	BEN	540	BEN1 BEN2 BEN3 BEN4 BEN5 BEN6	90 90 90 90 90 90

Station Name	Station Code	Station Capacity [MW]	Generating Units	Generating Unit Capacity [MW]
Cobb	COB	32	-	-
Coleridge	COL	45	-	-
Clyde	CYD	432	CYD_1 CYD_2 CYD_3 CYD_4	108 108 108 108
Highbank	HBK	27	-	-
Kumara	KUM	7	-	-
Kaiwera Downs	KWD	41	KWD_1 KWD_2 KWD_3 KWD_4 KWD_5 KWD_6 KWD_7 KWD_8 KWD_9 KWD_10	4.3 4.3 4.3 4.3 4.3 4.3 4.3 4.3 4.3 4.3
Lauriston	LAU	47	LAU0	47
Mahinerangi	MAH	36	-	-
Manapouri	MAN	896	MAN_1 MAN_2 MAN_3 MAN_4 MAN_5 MAN_6 MAN_7	128 128 128 128 128 128 128
Ohau A	OHA	254	OHA4 OHA5 OHA6 OHA7	66 66 56 66
Ohau B	OHB	212	OHB8 OHB9 OHB10 OHB11	53 53 53 53
Ohau C	OHC	212	OHC12 OHC13 OHC14 OHC15	53 53 53 53
Paerau / Pateraroa	PRU	12	-	-
Roxburgh	ROX	320	ROX_1 ROX_2	40 40

Station Name	Station Code	Station Capacity [MW]	Generating Units	Generating Unit Capacity [MW]
			ROX_3 ROX_4 ROX_5 ROX_6 ROX_7 ROX_8	40 40 40 40 40 40
Tekapo A	TKA	30	TKA1	30
Tekapo B	TKB	160	TKB2 TKB3	80 80
White Hill	WHL	56	-	-
Waipori	WPI	84	-	-
Waitaki	WTK	90	WTK_1 WTK_2 WTK_3 WTK_4 WTK_5 WTK_6 WTK_7	15 15 15 15 15 15 15

11 Document Information

11.1 Copyright Information

11.2 Document Feedback

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SCAN ME

11.3 Revision History

Link to document review survey https://forms.office.com/r/sYbiNMKMwY

SharePoint Revision	Date	Change	Section
2.0	16/12/19	Added to Operation Procedures management	
3.0	17/03/21	Major update to reflect changes to calculations, modelling etc.	
4.0	3/11/2022	Major update to reflect the change migration to the Operations Customer Portal	
5.0	14/06/2024	• Removal of short term forecasting references • Updated UI snapshots for Demand/Supply scenarios • Updated user-sign up process • 10.2 Demand Forecast - Updated to include Yes Energy weather risk • 10.3 Supply scenarios – Base & Firm assumptions added 11.1 NZGB Model Summary - table updates	
6.0	13/11/2024	BAU Review: Correction to some of the generation capacity values in the appendices.	
7.0	8/4/2025	Removed line about Firm -No Wind. Added additional info on wind percentile for the scenario	
8.0	08/08/2025	BAU Review: Update to WRK capacity number and addition of LAU and KWD. Include BESS into NZGB. Added RHO and RUK	11.1 10.3.5
9.0	4/6/2026	**BAU Review:** Instructions for accessing NZGB updated. [YI]	2.1

11.4 Metadata

Document ID Information

Document ID number:	UG-OC-841
Document Title:	UG-OC-841 NZGB - Application and Calculation User Guide
Document Type:	Userguide
SharePoint Version:	V9
Document Status:	Issued
Severity of Consequences:	Moderate
Frequency of use	Monthly
Level of Risk:	Medium

DMS Structure

Macro-Process:	Outages and Constraints (OC)	
Process:		
Process Hierarchy:	*L1:* 02 Scheduling	*L2:* 03 Manage Outages and Constraints
	L3: 03-04 Plan Outages	*L4:* [Business Model L4]
Document Complexity Rating (days)	21 days	

Document Control

Business Group Owner:	Operations Planning Engineering		
Prepared by (Writer/Reviewer):	Alex Shin		
Peer Reviewer	[Peer Reviewer]		
Approved by (Owner 1):	Minura Vithanage		
Approved by (Owner 2):	Click or tap here to enter text.		
Approved by (Owner 3):	Click or tap here to enter text.		
Published Date: (only changed by Doc Administrator)	4/06/2026		
Update Type:	BAU Review		
Next Review Date:	4/06/2028		
Review Period:	2 Years		
Primary User Group(s):	Ops Planning		
Secondary User Group(s):	Click or tap here to enter text.		
Hardcopy Kept in:	[Control Room Folder/Section]		
To be published on TP Web site	true	Web Area:	Public SO