2023 EMI POWERFACTORY CASE

NORTH and SOUTH ISLANDS

Transpower New Zealand Limited

December 2023

Keeping the energy flowing

TRANSPOWER

Transpower New Zealand Limited The National Grid

CONTENTS

1 Overview

The System Operator releases,the latest PowerFactory case files for the Electricity Market Information (EMI) website for November 2023.

This year's North Island update has seen a few updates affecting both steady state load flow and dynamic (rms) simulations.

Power Flow simulations: The study cases provided converge easily. Peak load cases should have voltages above 0.95 p.u and less than 1.05 p.u for 66kV and above. Light load cases may have nodes with voltages slightly above 1.05 p.u.

Dynamic simulations (rms): The study cases were tested for initialisation and balanced RMS solves with 3 phase fault conditions on various 220kV busbars, typically cleared in 120ms. The faults were studied separately and found to be stable. Generator and load trip events were done separately and confirm that machine governor controls (where modelled) respond accordingly.

Eigenvalue analysis: The case is created with controller models that will linearise (where possible). Small signal analysis can therefore be carried out on the case. Such studies are subject to the internal limitations of PowerFactory regarding in built components of the software that will not linearise – this is detailed in the Technical Reference documents provided within the help menu of the application.

Harmonic Analysis: The case as provided is not suitable for harmonic analysis due to the use of lumped parameter line models. The case library includes a script to modify the line data modelling from lumped parameters to the distributed parameter modelling required for harmonic analysis. The resulting case is not verified for harmonic studies but can provide an initial frequency scan.

Protection Analysis: The EMI case is not suitable for detailed protection analysis and a case should be requested from Transpower's Protection team.

2 Software Version Issues

2.1 PowerFactory versions

It is advised to run the case files in PowerFactory 2021 SP7 as they were tested for both steady state and dynamic solutions in this version and found to be stable.

From PowerFactory 2022 onwards a new version of DSL has been introduced. A number of changes have occurred to the DSL model initialisation tests and checks within the software. One particular issue for our older SIPS models is that some connections within frames (i.e. connectors between slot inputs and outputs) which work in the 2021 software now throw up error messages that inhibit a solution. The 2023 SIPS case has been tested and modified (specifically the OHB, OHC and WTK frames) to work in PowerFactory 2023 but further testing was not done.

2.2 Known Issues

These are often quite technical issues but are noted here to assist users not familiar with the selected modelling.

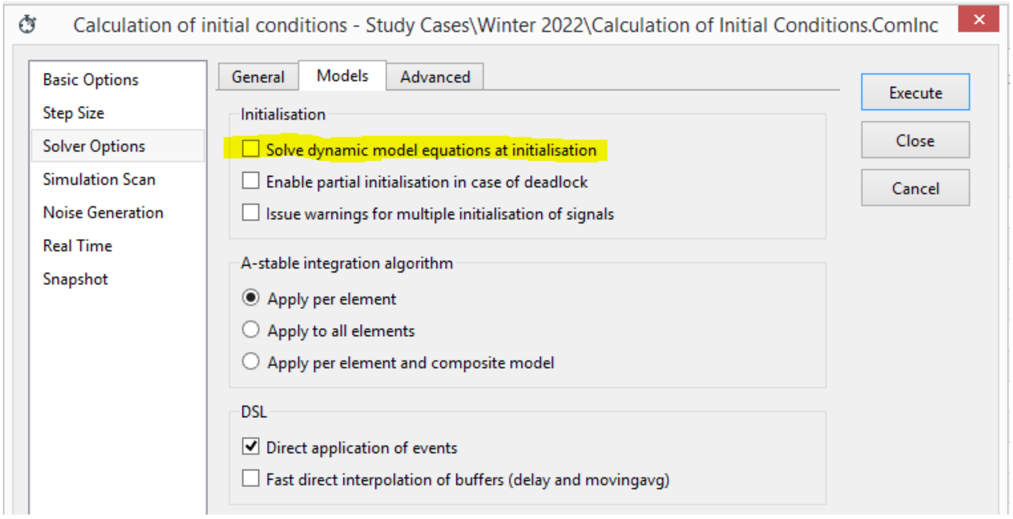
2.2.1 Dynamic Model Initialisations

Every effort is made to ensure that dynamic (i.e. RMS) models initialise in steady state with zero-value derivatives and remain stable when run with no disturbance.

However, some models may not be able to initialise with zero derivatives, this includes for example:

- Phase locked loop controls where voltage angle is used as a state variable, the derivative of this can only be 0 if the system initialises at a perfectly stable 50 Hz which is very unlikely given the mathematical differences between the power flow and rms models.
- Some Limiter models where a non-limited signal creates a non-zero input to an integrator deliberately to keep the limiter inactive

By default, the initialisation of dynamics does not have the PowerFactory option to 'solve dynamic model equations' selected:

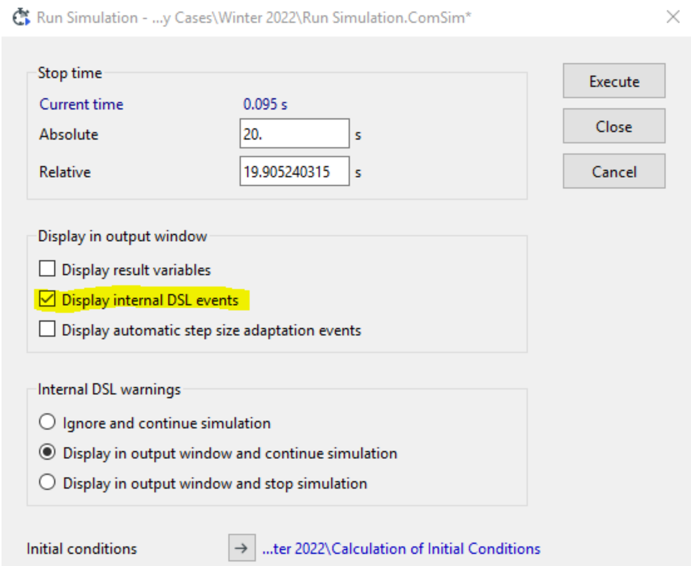


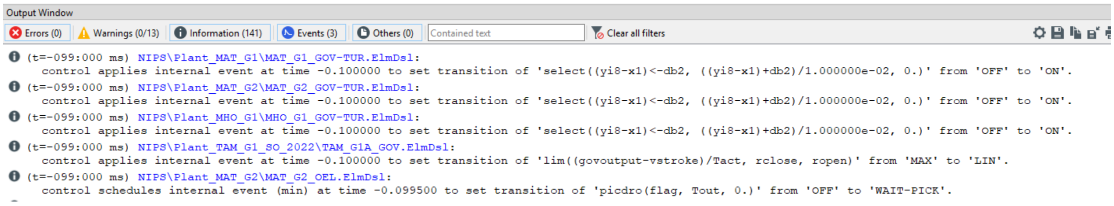
In version 2021 of PowerFactory some initialisation errors have been observed in previously acceptable models because the relevant initialising equations for the state variables (i.e. inc() statements) within the model are reliant on calculations that are either within the dynamic model equations or embedded in the DSL block diagram (such as signal additions, multipliers etc). In some cases even if this is a simple algebraic calculation it is not carried out if this option is not selected, resulting in an apparently incorrect initialisation and an error message.

Future releases may have the highlighted option enabled – but there are other changes required within the existing models to allow for this without creating many warning messages during the initialisation. From version 2022 there is new functionality allowing inc() statements to also initialise state variable derivatives, which may be a better solution.

2.2.2 Internal DSL Events

Because the ‘solve dynamic model equations’ option is not selected as described above, several models have internal DSL events at the beginning of the simulation. These will appear in the output window if the option to “Display internal DSL events” is selected:





In future releases models might be modified to remove these events, or the ‘solve dynamic model equations’ option in the installation might be enabled which removes most of these events.

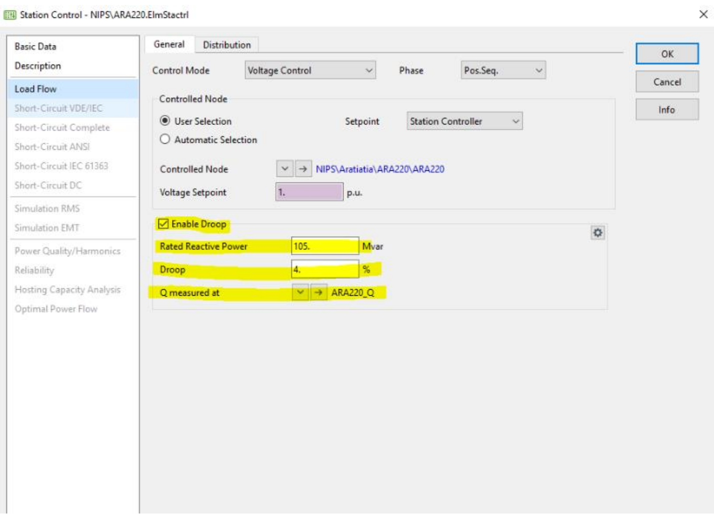
3 Major Updates in NIPS 2023 case

3.1 Changes affecting Steady state/Short circuit calculations

1. The 2023 expected load forecasts have been uploaded. These provide external users the ability to move through years or seasonal load conditions the same way Transpower would. Selection of the load profile is by a trigger in the study case.

2. Study cases have been set up for Winter and Summer out to 2026. This allows users to set up their own studies more easily and provides an example of how Transpower set up study cases.

3. Most Station Controllers (ElmStactrl) have been changed to add a droop setting. This makes it easier to redispatch generation and makes it less likely for generators to reach reactive power limits. The actual droop setting at the station is used where this is known, and where this is not known 4% is used because this is a reasonable estimate in most cases. If the in-service generation units in a case are changed then the droop setting of the relevant station controller needs to be updated to reflect the new MVA total. A script (Droop_MVA_Set) is provided in the library which runs through all station controllers and sets the Rated MVA to the sum of the rated MVA of all online generators participating in that station control. The reactive power is measured at a boundary which includes all generators in the station control. For more detailed information on droop settings, refer to PowerFactory’s Station Controller technical reference.



An additional script (Droop_MVA_report) is provided which will simply report what is set up in the case without modifying any values – this is useful for checking purposes

4. To enable users to easily set the voltage setpoint at each substation, all the relevant station controller voltage setpoints are linked to a scale and a trigger. The triggers are stored in the study case – this is a new approach (rather than say using Operational Scenarios). The triggers make it easier to configure an appropriate network voltage profile for a particular load scenario.

5. HAM STC added to base case.

6. ATI Series Reactor added to base case.

7. Bombay Major Capex Project – BOB-WRT section of BOB-WIR-OTA circuits dismantled and OTA-WIR section reconductored, BOB Interconnection added, BOB-HAM-2 removed.

8. CPK Substation has been modeled.

9. SVC and STC controllers set with correct droop.

3.2 Future Grid changes/ reinforcements (variations)

Where major project work on the grid is financially committed, these projects have been included as Variations which can be enabled to study future periods. The details of these are as follows:

3.2.1 Harapaki and Tauhara generation

New generation at Harapaki and Tauhara are added to the existing RDF-WRK-1 line.

Harapaki: 41 x 4.3MW wind turbines, 176MW, estimated fully operational September 2024. This variation has several expansion stages which enable more turbines to reflect that the wind farm will be commissioned over a long period. The timing is the current best estimate however is subject to change. A generic WECC dynamic model is provided.

Tauhara: Geothermal single 152MW generator, estimated operational Q3 2024. Dynamic models are copied from the Te Mihi generators.

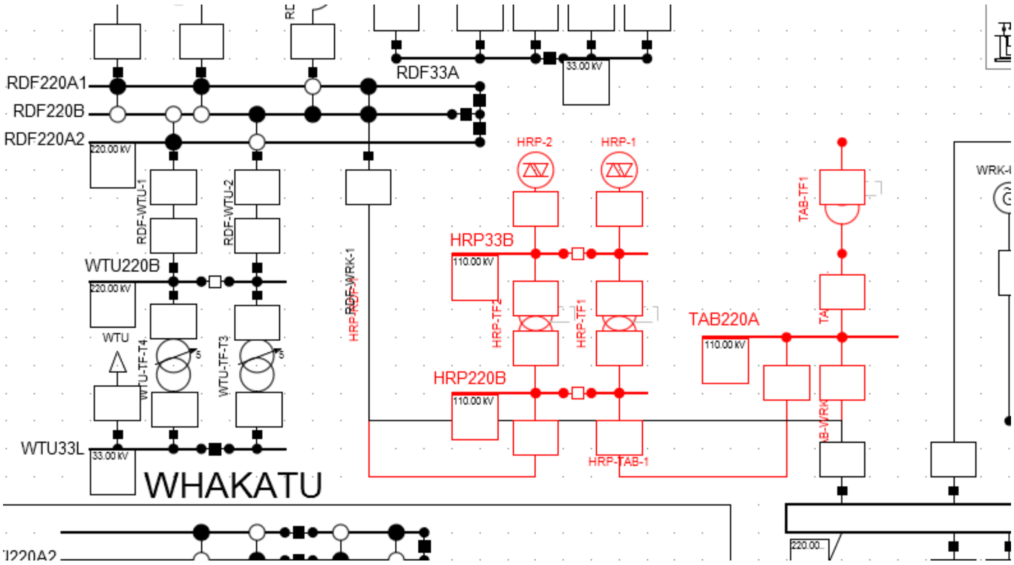
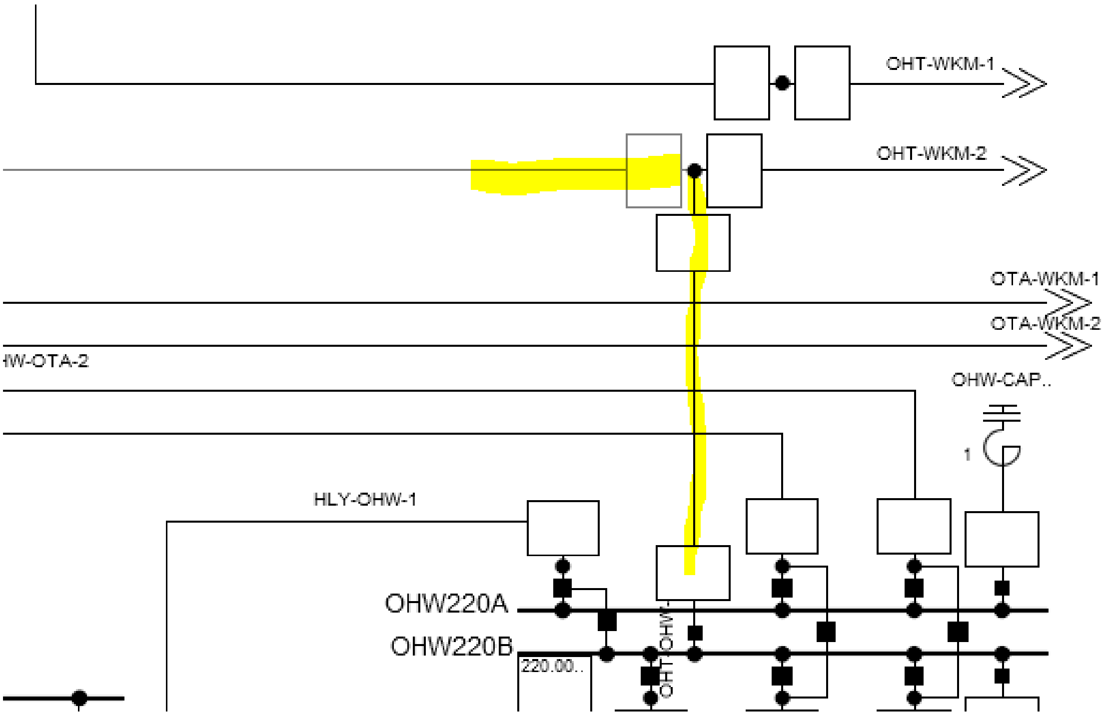


Figure 1: Harapaki and Tauhara generation variation

3.2.2 Brownhill – Pakuranga Bypass

This variation reflects Transpower's major project to inspect and replace joints on the BHL-PAK cables and the temporary bypass which connects one circuit from WKM to OHW. More information on this project can be found on the Transpower Website: [Brownhill Pakuranga Cable Remediation](). The provided variation has an expansion stage for each phase of the project, with the timing of each expansion stage reflecting the project plan as of November 2023.



BHL-PAK Bypass Variation

3.2.3 Hautapu GXP

A new 220/33kV GXP is commissioned, tee-ed from the OTA-WKM circuits. Operational January 2025

3.2.4 Solar Farms

Several solar farms were added:

- Te Herenga o Te Ra Solar Farm (HTR), 8x4.3MVA inverters, connecting at Waiotahe November 2024
- Helios Solar, 115MVA, connecting at Edgcumbe June 2025
- Kaitaia Solar Farm (KTS), 6x4.3MVA inverters, embedded in the TOP Energy network at Kaitaia, commissioning November 2023
- Rangitaiki Solar Farm (RGT), 6x4.3MVA inverters, embedded at EDG, commissioning March 2024

All solar farms are modelled as static generators, set to use a constant impedance model for RMS simulations. None of these stations have fully commissioned or completed testing so detailed dynamic models are not yet available. In future releases these models may be added. For embedded solar farms, an equivalent impedance to the relevant GXP is modelled where this information is available.

3.2.5 Te Huka G3

The planned Te Huka G3 geothermal unit has been added. Modelled as a single 51MW unit, connecting at the TAB GXP in July 2024. Detailed modelling information is not yet available, so the machine model and plant model were copied from PPI G1, which is a similar size geothermal unit. The PSS model from PPI was not copied because PSS settings are site specific.

3.2.6 Transformer Replacements

A third 250MVA Interconnecting Transformer is added at RDF in January 2024 (RDF-TF-T5). Kawerau T13 is replaced with a new 250MVA transformer in March 2025.

3.2.7 Otahuhu STATCOM

A new 165 MVA STATCOM is added at the OTA 220kV bus in May 2026. No dynamic models are currently available, so the STACOM is modelled as a constant impedance static generator.

3.3 Changes affecting Dynamic simulations

1. Version Control information has been added in the description field of all common models. This information is primarily intended for System Operator internal use however it does provide users with an indication of the date models were added.

2. Several models have been updated. These have been identified in the description field of the relevant common models. Updated models include: ARA, MTI, PRI, WAA, WPA.

3. Windfarm grids are included for TWN, TWS, TWC, TRH, WWD, TAP – by default these are not activated and windfarms are modelled in base case simulations as static generators

4. Unencrypted models are included in these windfarm grids for TWN, TWS and TWC, an encrypted model for TAP is included

5. Library\Templates have been included for :

    - TAP wind farm (using an encrypted model with site specific parameters)
    - WPP wind farm (using a generic IEC 4B model with site specific parameters)
    - HRP wind farm (using a generic WECC 4B control with conservative control performance parameters – this is not based on site specific parameters which are not available yet)
    - TWC wind farm (using CIGRE based DFIG generation)
    - These specific generators have been modelled within the appropriate substation or expansion stage. The templates simply make it easy to assign a copy of one of these models to a different location.

6. It should be noted that dynamic models are not included for the windfarms at TRH, MCK, WWD, TUK and TUR. Where these windfarms will be a significant factor in study results a model should be used, please consult with the SO if required.

7. Dynamic models specific to the new Tauhara generation are not available yet. A copy of the Te Mihi Geothermal control system has been modelled at Tauhara B to provide a credible dynamic behaviour of the plant when it is included in studies.

8. Generic dynamic models for voltage controllers have been added at sites JRD, MKE where a specific controller model is not yet available. Some voltage control action is required for credible transient study results when these generators are in service; however study results for rms studies in the Taranaki region should confirm the basic generic model has performed acceptably.

9. The base case is suitable for small signal stability studies. However, the windfarm dynamic models have not been verified for small signal analysis.

4 Dynamic Models Used in NIPS 2023 case

The tables below show the current models used in the NIPS case file:

Note that Voltage Droop is determined by Xc > 0, not by the presence of the droop slot.

Limiters may be internal to exciter/AVR models or may be separate models. Similarly Turbine modelling may be included within a Governor model or as a separate model.

If generic models are being used this is identified in the site name

CONTACT						
Generators	V Droop	Exciter/AVR	PSS	Limiters	Governor	Turbine
OKI	Yes	Yes	No	No	Yes	No
PPI	No	Yes	Yes	OEL/UEL	Yes	No
SFD	No	Yes	Yes	OEL/UEL	Yes	Yes
SPL	No	Yes	Yes	No	Yes	Yes
TAA	No	Yes	No	OEL/UEL	No	No
TAA G3 (as PPI)			No			
TAB (as THI)						
THI	No	Yes	Yes	OEL/UEL/V Hz	Yes	No
TRC	No	Yes	No	No	Yes	No
WHI	Yes	Yes	No	OEL/UEL	Yes	No
WRK (G1,7,8)	Yes	Yes	No	No	Yes	No
WRK (rest)	No	Yes	No	No	No	No
EASTLAND						
Generators	V Droop	Exciter/AVR	PSS	Limiters	Governor	Turbine
TAM	No	Yes	No	OEL/UEL	Yes	No
GENESIS						
Generators	V Droop	Exciter/AVR	PSS	Limiters	Governor	Turbine
HLY (Rankine)	No	Yes	No	No	Yes	Yes
HLY U5	No	Yes	Yes	OEL/UEL	Yes	Yes
HLY U6	Yes	Yes	No	No	Yes	No
KTW_generic	No	Yes	No	No	Yes	Yes

PRI	No	Yes	Yes	PQ	Yes	Yes
RPO	No	Yes	No	OEL/UEL	Yes	Yes
TKU	No	Yes	No	OEL/UEL	Yes	Yes
TUI_generic	No	Yes	No	No	Yes	Yes
KING COUNTRY						
Generators	V Droop	Exciter/AVR	PSS	Limiters	Governor	Turbine
MHO	No	Yes	No	OEL/UEL	Yes	Yes
MANAWA						
Generators	V Droop	Exciter/AVR	PSS	Limiters	Governor	Turbine
LMD_generic	No	Yes	No	No	No	No
MAT	No	Yes	No	OEL/UEL	Yes	Yes
MPA_generic	No	Yes	No	No	No	No
PTA_generic	No	Yes	No	No	No	No
RHI_generic	No	Yes	No	No	No	No
WHE_generic	No	Yes	No	No	No	No
MERCURY						
Generators	V Droop	Exciter/AVR	PSS	Limiters	Governor	Turbine
ARA	Yes	Yes	Yes	OEL/UEL/SCL	Yes	Yes
ARI	No	Yes	Yes	OEL/UEL	Yes	Yes
ATI	No	Yes	No	No	Yes	Yes
KAG	No	Yes	No	OEL/UEL	No	No
KPO	No	Yes	No	No	Yes	Yes
MOK (G2, 11,12,21,22)	Yes	Yes	No	OEL/UEL	Yes	No
MOK_generic (G1,10)	No	Yes	No	No	No	No
MOK_generic (G3,30,31,32, 41)	No	Yes	No	No	Yes	No
MTI G1-G5	Yes	Yes	No	OEL/UEL/SCL	Yes	Yes
MTI G6-G10	No	Yes	No	No	Yes	Yes

NAP	No	Yes	No	OEL/UEL	Yes	No
NTM	Yes	Yes	No	OEL/UEL	No	No
OHK	No	Yes	No	No	Yes	Yes
RKA_generic (G1-4)	No	Yes	No	No	No	No
RKA (G21)	Yes	Yes	No	OEL/UEL	Yes	No
WKM	Yes	Yes	No	No	Yes	Yes
WPA	Yes	Yes	No	OEL/UEL/SCL	Yes	Yes
PIONEER						
ANI	No	Yes	No	No	Yes	Yes
TODD						
Generators	V Droop	Exciter/AVR	PSS	Limiters	Governor	Turbine
EDG_generic	No	Yes	No	No	No	No
JRD_generic	No	Yes	No	No	No	No
KPI	Yes	Yes	No	No	Yes	No
MKE_generic	No	Yes	No	No	No	No
WAA	Yes	Yes	No	No	Yes	Yes
TOP						
Generators	V Droop	Exciter/AVR	PSS	Limiters	Governor	Turbine
NGA_generic	No	Yes	No	No	No	No
OTHERS						
Generators	V Droop	Exciter/AVR	PSS	Limiters	Governor	Turbine
GLN_generic	No	Yes	No	No	No	No
KIN	No	Yes	No	No	No	No

5 Major updates in SIPS 2023 case

5.1 Changes affecting Steady State/Short Circuit simulations

1. As with NIPS, the 2023 Load forecasts have been left in the case. These provide external users the ability to move through years or seasonal load conditions the same way Transpower would. Selection of the load profile is by a trigger in the study case.

2. As with NIPS, study cases have been provided out to 2026.

3. As with NIPS, most Station Controllers (ElmStactrl) have been changed to add a droop setting.

4. As with NIPS, the voltage setpoint at each substation with the new control option is linked to a scale and a trigger. The triggers are stored in the study case and create a network voltage profile for that study case.

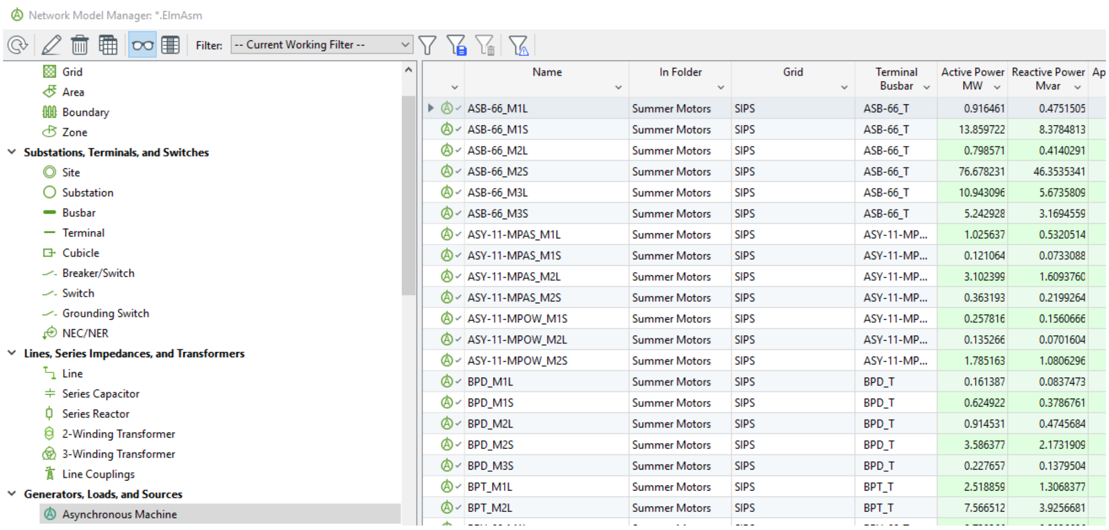
5. Norwood GXP added to base case.

6. New Gore supply transformers added to base case.

7. Kaiwera Downs Stage 1 added to base case.

8. Manapouri rated power factor changed to 0.9482 to reflect new MCO of 128MW, and governor model updated to operate correctly up to 135MW.

9. Motor Load – details of motor load have been added to the SIPS case in two variations, one with Summer motor load and one with Winter motor load. The variations replace the existing load at each affected GXP by adding induction machines and appropriately reduced normal loads to reflect data from the motor load survey conducted in 2023. Note that the motors are not added to the single line diagrams. The motors and extra loads can be seen in the Network Model Manager:



Name	In Folder	Grid	Terminal Busbar	Active Power MW	Reactive Power Mvar
ASB-66_M1L	Summer Motors	SIPS	ASB-66_T	0.916461	0.4751505
ASB-66_M1S	Summer Motors	SIPS	ASB-66_T	13.859722	8.3784813
ASB-66_M2L	Summer Motors	SIPS	ASB-66_T	0.798571	0.4140291
ASB-66_M2S	Summer Motors	SIPS	ASB-66_T	76.678231	46.3535341
ASB-66_M3L	Summer Motors	SIPS	ASB-66_T	10.943096	5.6735809
ASB-66_M3S	Summer Motors	SIPS	ASB-66_T	5.242928	3.1694559
ASY-11-MPAS_M1L	Summer Motors	SIPS	ASY-11-MP...	1.025637	0.5320514
ASY-11-MPAS_M1S	Summer Motors	SIPS	ASY-11-MP...	0.121064	0.0733088
ASY-11-MPAS_M2L	Summer Motors	SIPS	ASY-11-MP...	3.102399	1.6093760
ASY-11-MPAS_M2S	Summer Motors	SIPS	ASY-11-MP...	0.363193	0.2199264
ASY-11-MPOW_M1S	Summer Motors	SIPS	ASY-11-MP...	0.257816	0.1560666
ASY-11-MPOW_M2L	Summer Motors	SIPS	ASY-11-MP...	0.135266	0.0701604
ASY-11-MPOW_M2S	Summer Motors	SIPS	ASY-11-MP...	1.785163	1.0806296
BPD_M1L	Summer Motors	SIPS	BPD_T	0.161387	0.0837473
BPD_M1S	Summer Motors	SIPS	BPD_T	0.624922	0.3786761
BPD_M2L	Summer Motors	SIPS	BPD_T	0.914531	0.4745684
BPD_M2S	Summer Motors	SIPS	BPD_T	3.586377	2.1731909
BPD_M3S	Summer Motors	SIPS	BPD_T	0.227657	0.1379504
BPT_M1L	Summer Motors	SIPS	BPT_T	2.518859	1.3068377
BPT_M2L	Summer Motors	SIPS	BPT_T	7.566512	3.9256681

The Motor Load variations are enabled in the cases for Summer 2023 and Winter 2024 and these converge with no errors and bus voltages within limits. Note that the magnitude of the motor load does not have the load season or load year triggers applied – the motor load data provided are only for the peak island load for summer 2023 or winter 2024.

For subsequent years, these motor load variations could be enabled but the magnitudes might be slightly low. To solve with bus voltages within limits Automatic Tap Changing will probably need to be enabled – this is because the supply transformers for the motors are modelled as having a continuous tap changer so that the terminal voltage will be 1 p.u. on initialization.

5.2 Future Grid changes/ reinforcements

5.2.1 Frankton Supply Transformer Replacement

Frankton T2 and T4 are replaced with new 120MVA transformers in May 2025

5.2.2 Kaiwera Downs Windfarm Stage 2

Kaiwera Downs Stage 2 is included as a variation, commissioning December 2025. Dynamic Models are not currently available, so the wind farm is modelled as a single constant impedance static generator.

5.2.3 Timaru T8 Replacement

Timaru T8a and T8b are replaced with a single 250MVA unit in May 2024.

5.3 Changes affecting Dynamic simulations

1. As for NIPS, version control information has been added to common models. This information is primarily intended for System Operator internal use however it does provide users with an indication of the date models were added

2. The Motor Loads added (as detailed above in the steady state changes) will have a significant effect on dynamic simulations. This is particularly relevant for the voltage recovery on the Grid after fault clearances and is most noticeable close to the Islington area loads.

3. Several models have been updated, including COB, OHA, ROX, TKB, WPI. Updated models can be identified by the version control data in the description field.

4. The Manapouri Governor and Turbine models were modified to allow each unit to initialize and operate correctly up to 135MW

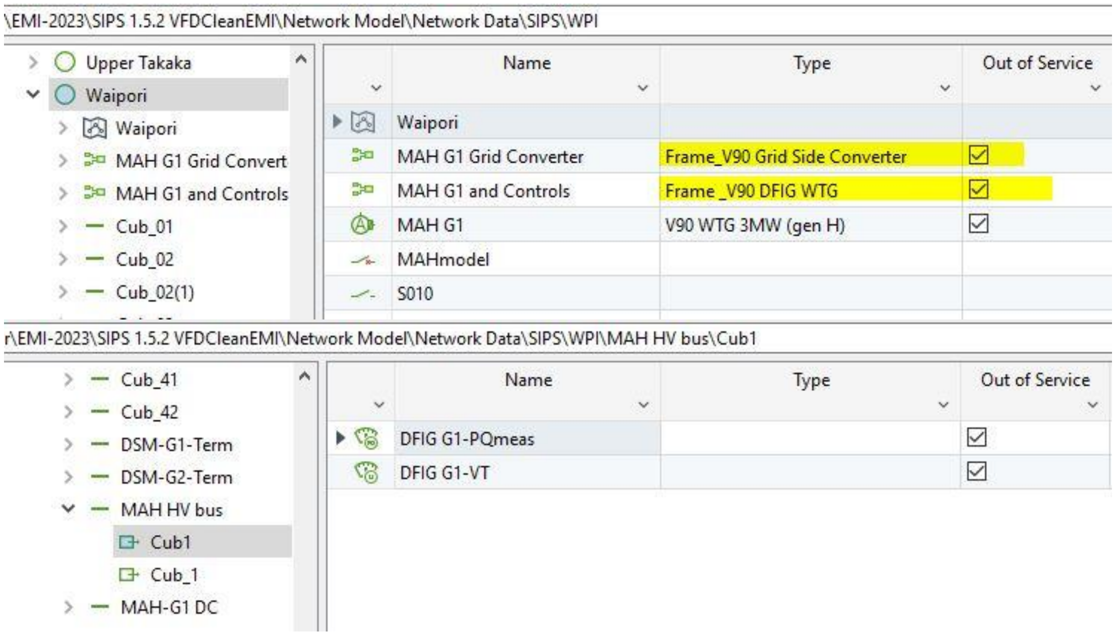
5. Models have been added for

   - White Hill (WHL) wind farm at North Makarewa (using CIGRE based DFIG generation).

   - Mahinerangi (MAH) wind farm at Waipori (using CIGRE based DFIG generation)

   - Note that these models use standard parameters as site specific parameters are not currently available.

   - These specific generators have been modelled within the appropriate substation and are out of service by default. Studies can use these models by simply bringing all the associated equipment into service in place of the static generator model. A further step of enabling the model Frames and the Measurement devices in the HV cubicle is also required (these are specifically disabled to avoid warning messages when these models are not in use)



- A template for the DFIG model used is provided in the Library\Template folder. The use of a template makes it easy to assign a copy of this model to a different location.

6. It should be noted that dynamic models are not included for the new windfarm at KWD. Where this windfarm will be a significant factor in study results a model should be used, please consult with the SO if required.

6 Dynamic Models used in SIPS 2023 case

CONTACT						
Generators	V Droop	Exciter/AVR	PSS	Limiters	Governor	Turbine
CYD	No	Yes	No	OEL/UEL	Yes	Yes
ROX	No	Yes	No	No	Yes	Yes
GENESIS						
Generators	V Droop	Exciter/AVR	PSS	Limiters	Governor	Turbine
TKA	No	Yes	Yes	OEL/PQ	Yes	Yes
TKB	No	Yes	Yes	OEL/PQ	Yes	Yes
MANAWA						
Generators	V Droop	Exciter/AVR	PSS	Limiters	Governor	Turbine
ALD	No	Yes	No	No	No	No
ARG	No	Yes	No	No	No	No
COB	No	Yes	No	No	Yes	Yes
COL	No	Yes	No	No	Yes	Yes
HBK	No	Yes	No	No	No	No
KUM	No	Yes	No	No	No	No
WAU	No	Yes	No	No	No	No
WPI	No	Yes	No	No	No	No
MERIDIAN						
Generators	V Droop	Exciter/AVR	PSS	Limiters	Governor	Turbine
AVI	Yes	Yes	No	No	Yes	Yes
BEN	No	Yes	Not in service	UEL/OEL	Yes	Yes
MAN	No	Yes	Yes	UEL/OEL/ SCL/PQ	Yes	Yes
OHA	No	Yes	No	No	Yes	Yes
OHB	Yes	Yes	No	UEL/OEL	Yes	Yes
OHC	Yes	Yes	No	UEL/OEL	Yes	Yes

WTK	Yes	Yes	No	UEL/OEL	Yes	Yes
OTHERS						
Generators	V Droop	Exciter/AVR	PSS	Limiters	Governor	Turbine
AMS	No	Yes	No	No	No	No
KWT	No	Yes	No	No	No	No
OPU	No	Yes	No	No	Yes	Yes

7 User Guide

This section provides a brief user guide for the provided study cases.

7.1 Triggers

This section provides a brief overview of the triggers in the EMI case and how they should be used. More detailed explanations of triggers and characteristics can be found in Chapter 18 of the PowerFactory User Manual.

7.1.1 Load Forecast Triggers

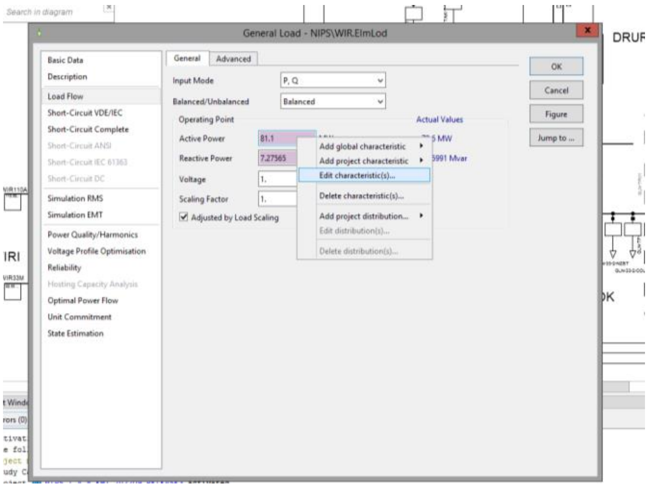
Two triggers are provided to change the load forecast – LoadSeason (which selects the forecast to use) and LoadYear (which selects the year to use). Most loads in the case have two Matrix characteristics (ElmChaMat), one for P and one for Q, which contains the load values for each forecast and year. A few loads which are not seasonal, i.e. generator auxiliary load or traction loads, do not have characteristics. Note that peak forecasts are provided by Grid Zone, but due to a limitation in the forecasting, the trough forecasts use the Transmission Planning Report (TPR) Regions. There is not a significant difference between the Grid Zones and TPR regions and it is acceptable to use the region forecasts in place of the Grid Zones for connection studies. Forecasts are available for the following Scenarios:

Name	**Description**
At_zone_peak_*season*_EXP	The peak load for each Grid Zone in that season, based on expected (50% probability of exceedance) forecast. Note that the trigger applies to all Grid Zone simultaneously, so the total Island load is higher than the expected peak. This can cause convergence issues in later years. Forecasts are provided for summer, winter, and shoulder seasons.
At_regional_trough_*season*_day_EXP	The load for daytime trough for that TPR region. This will generally be higher than the nighttime trough. This forecast is useful when considering peak solar output.
At_regional_trough_*season*_night_EXP	The load for nighttime trough for that region.
At_island_peak_*season*_EXP	The peak load for the whole island in that season, based on expected (50% probability of exceedance) forecast.

	Forecasts are provided for summer, winter, and shoulder seasons.
At_island_trough_*season*_day_EXP	The load for daytime trough for the whole island. This will generally be higher than the nighttime trough. This forecast is useful when considering peak solar output
At_island_trough_*season*_night_EXP	The load for nighttime trough for the whole island.

The provided study cases have the triggers set up to suit each case. When running studies, users should be careful to choose the correct triggers. The choice of island or regional load depends on the nature of the studies being conducted. By default, the provided study cases use island peak, however users should follow the relevant guidelines and use engineering judgement. Note that these triggers are not time sensitive – that is changing the study time will not change the load. The load can only be changed using the triggers.

If the user wants to set the value of a specific load / loads, the triggers can be disabled by opening the relevant load/s, going to the “load flow” page, right clicking in the Active Power box and selecting “Edit Characteristic”, and then unchecking the active box:



Alternatively, a script (DeleteLoadTrigger.ComDPL) is provided which disables all of the active load triggers.

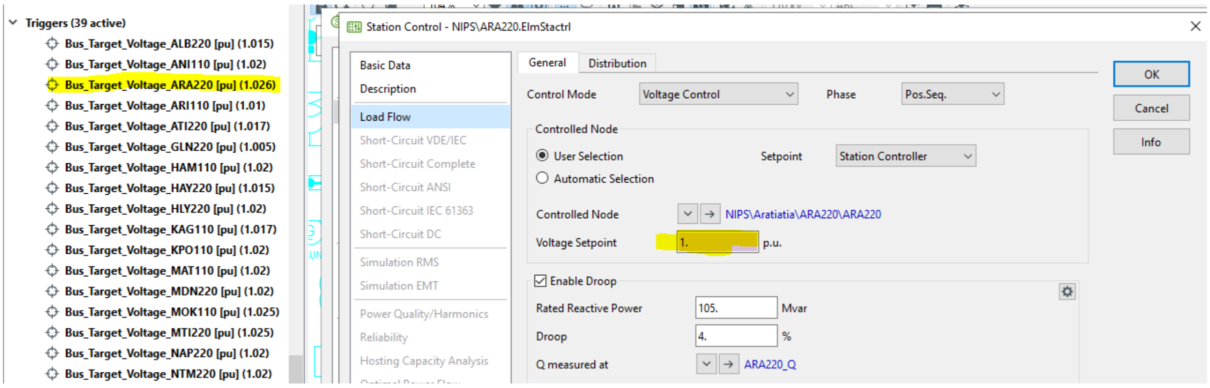
Note that in the provided cases, generation is set in the relevant variation in the “Generation Scenarios” folder. Only small, embedded generators are linked to the load triggers. Therefore, if the user changes the load triggers, they will likely need to redispatch generation to match their specific case.

7.1.2 Wind and Solar Contribution

Two triggers are provided which scale the wind and solar generation by the specified percentage. The trigger applies to the scaling factor, not the active power setpoint. In the base case, the generator output is set to the unit’s MCO, then the trigger applies to the scaling factor, so if the Wind contribution trigger is set to 0.5, each windfarm will output 50% of it’s rated MCO. By default, the wind trigger is set to 0.3 in all cases, and the solar trigger is set to 0.5 in summer peak, 0.1 in winter peak, and 0 in the nighttime trough cases. The System Operator believes these are reasonable values, however users should set these triggers to the appropriate value for their specific study, i.e. if studying peak solar output it might be more appropriate to set the solar trigger to 1.0. Note that the SIPS case does not have a solar farm trigger because there are no solar farms in the South Island.

7.1.3 Bus Target Voltage Triggers

Several triggers are provided which set the voltage target at major 220 and 110kV buses. These triggers are linked to the voltage setpoint of the relevant station controller. The trigger scales the voltage setpoint by the value of the trigger. All station controller setpoints are set to 1 so that the value of the voltage setpoint is the value of the trigger:



Note that the final voltage of the controlled bus may not be the value of the trigger because of the droop setting of the station controller – refer to the Station Controller Technical Reference for more details regarding droop (available through the PowerFactory help menu).

7.2 Provided Cases

The EMI case is provided with study cases set up for peak winter and summer load from 2023 to 2026, and a Summer Trough 2023 case. The provided cases have all triggers set to appropriate values and generation set based on historical data. Users can use these cases as is or modify them to suit their specific study.

7.3 Slack Buses

The NIPS case has three variations for selecting a slack bus – one for the HVDC, one for HLY5, and one for “future slack.” Future slack adds 1000 MW static generators at BPE, WKM, and WRK (for a total of 3000 MW) to use as slack buses. These do not represent specific generation but rather locations where the Grid Owner assess that significant new generation is likely to connect in the future. The SIPS only has an HVDC slack – there is sufficient generation in the South Island that a future slack is deemed unnecessary.

By default, the provided cases use the HVDC slack. With either the HVDC or HLY5 slack, when using the Island Peak forecast all cases will converge and the slack will be within its operational limits. When using the Region peak forecast, all cases will converge however the slack might be slightly outside of its operational limits. The choice of slack bus depends on the specifics of the study – region of interest, purpose of the study, etc. Users should follow relevant guidelines and use engineering judgement.

For System Operator connection studies as described in GL-EA-953, we recommend not using the “Future Slack” variation. This variation is intended for longer term planning studies, to represent generation projects that are not sufficiently advanced to include individually. Within the timeframe of SO connection studies (approx. 3-4 years from EMI case publication), the case generally should converge with the HVDC slack. If your case doesn’t converge, we recommend adding more thermal generation (i.e. an extra Rankine or Gas Peaker) and/or increasing wind contribution instead of using the future slack. Users should exercise engineering judgement.