TRANSPOWER

APEX Summit
Preparation for Electromagnetic Transients (EMT) Studies for New Zealand

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Outline

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- Modelling the power system
- RMS and EMT modelling
- Transpower Generator Connection guidelines
- Case Study for Grid Zone 4 Network model

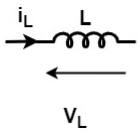
Why do we need modelling of Power System?

- Large network of assets spread in a large geographical area.
- Modelling assesses how the system operates under different conditions.
- Accurate mathematical modelling can lead to cost efficiency, better planning studies and less damage to the assets.

Main Types of Modelling :

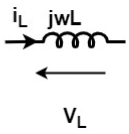
- Electromagnetic transient (EMT)
- Root mean square (RMS)

EMT Modelling



$$V_L = L\frac{di_L}{dt}$$

RMS Modelling



$$V_L = X_l I_l$$

- Differential equations in discrete time steps.
- Instantaneous values
- Solving transient power systems problem such as switching, lightning, inrush currents and over voltages.

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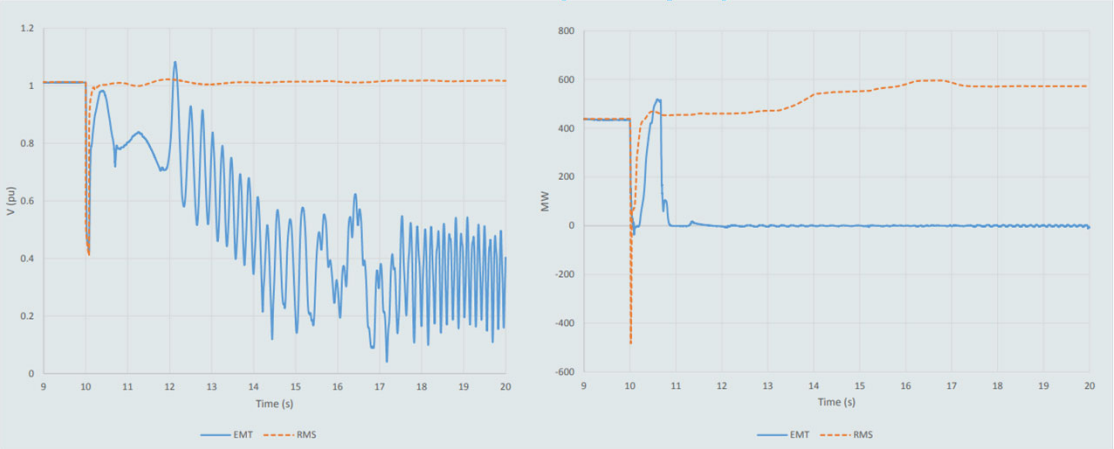
Comparison between EMT and RMS (example)



Voltage(pu) Vs Time of HVDC link

Active Power(MW) Vs Time of HVDC link

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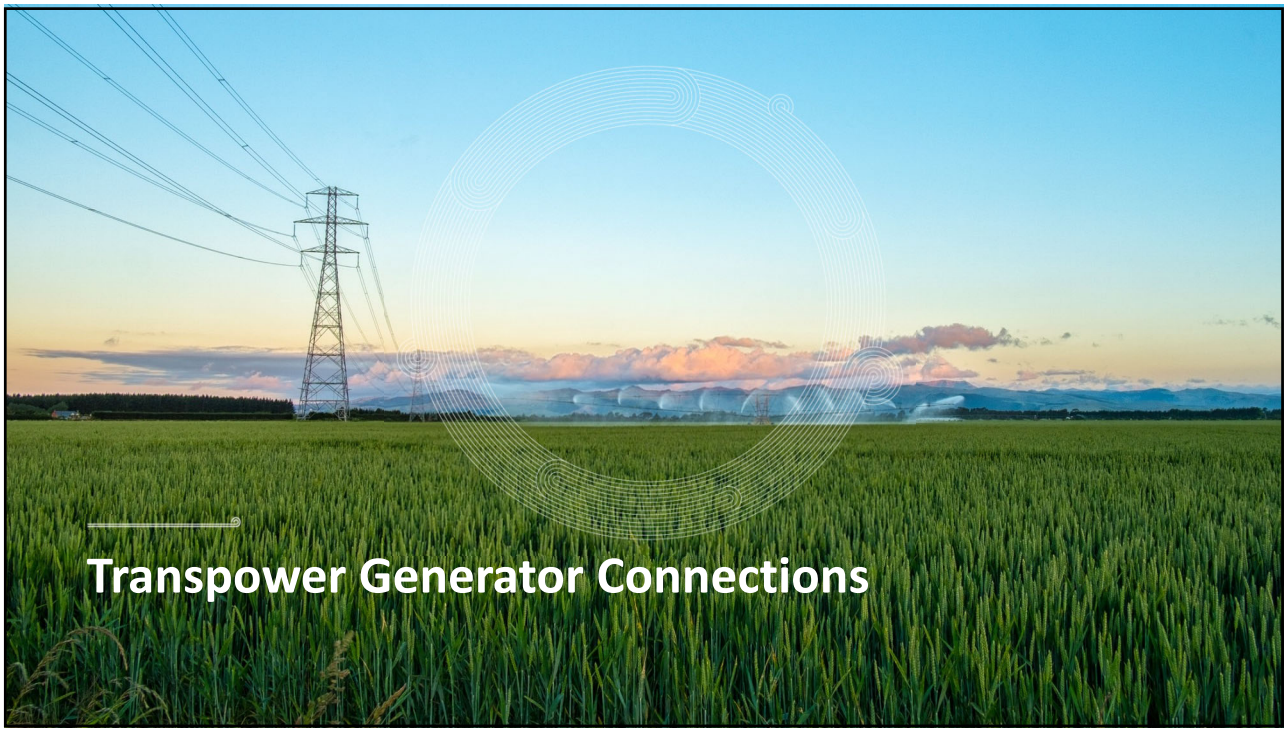
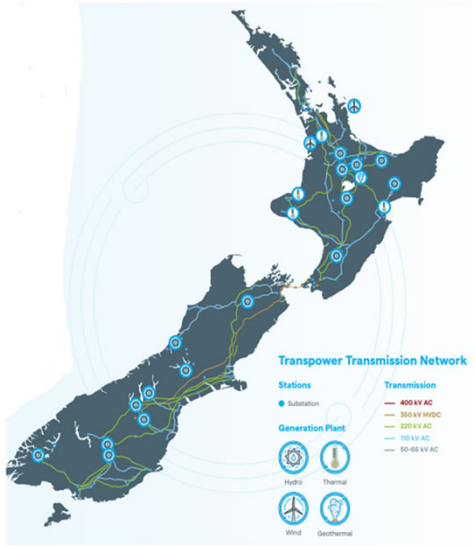
[1] AEMO: EMT models for high penetration of IBR in large scale power systems



Trend towards more inverters

- New Zealand energy market is transitioning toward more renewable based systems
- This transition relies heavily on the use of inverter-based resources (IBRs).



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Transpower Connection study requirement

- PSCAD EMT modelling to assess Fault Ride Through (FRT) for low Short Circuit Ratio (SCR) and weak grid connections.
- New Zealand power system is impractical to model in EMT due to complexity of the model.
- Divided into several grid zones (GZ) with the rest of the network modelled as equivalent models.

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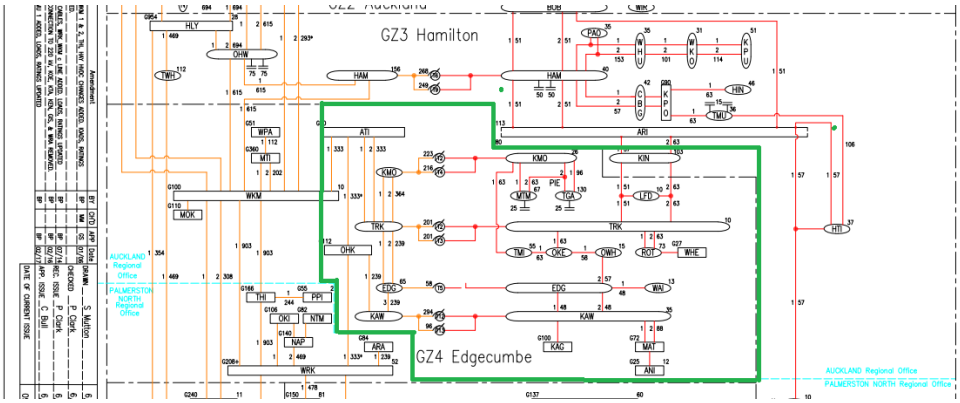
Case Study : Grid Zone 4

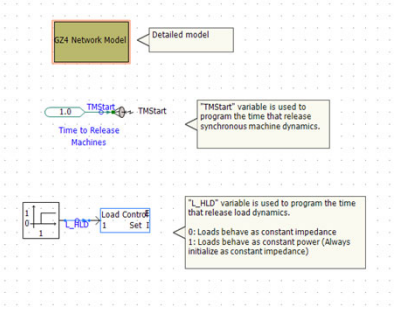
Case study : Grid Zone 4 (GZ4)

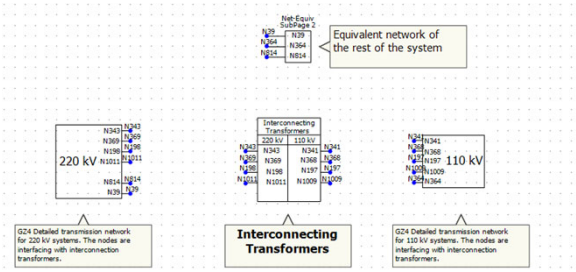
- Development of an EMT model of the Power System around Hawke's Bay and Edgecumbe area



Single line diagram of part of the North Island Power System.

Network Model





Overview of the network module.

-220kV and 110kV network with interconnecting transformers and equivalent network

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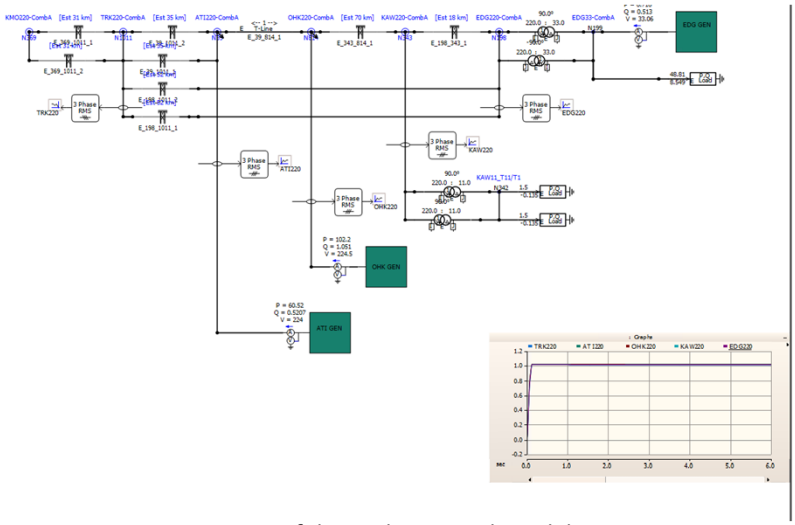
Network Model



Overview of the 220kV network module.

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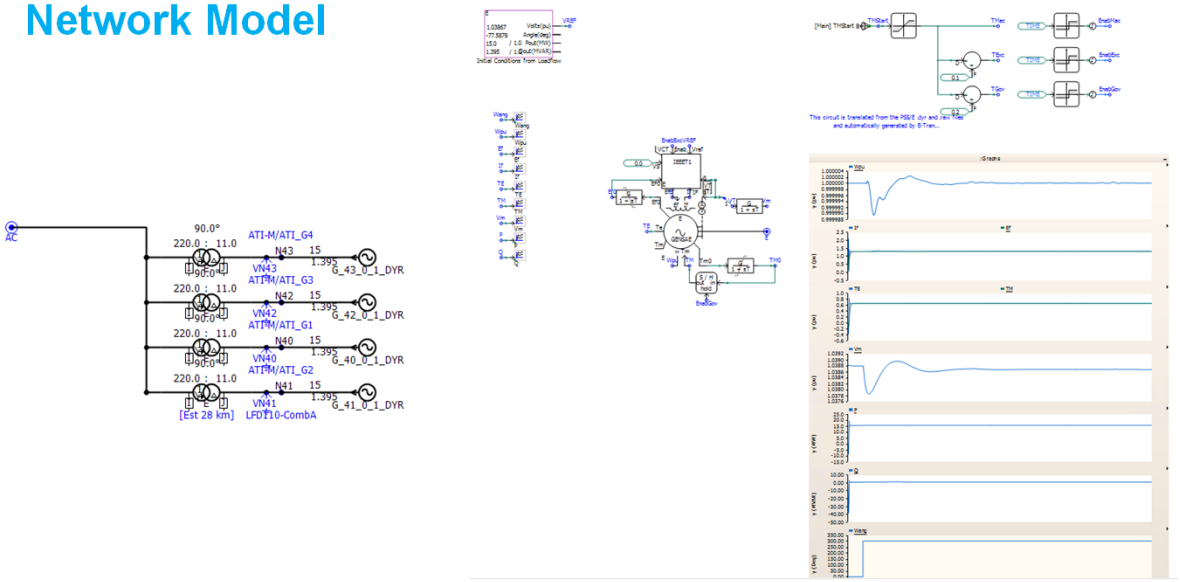
Network Model



Atiamuri (ATI220) Generators in Detail

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Conclusion

- Power Systems Modelling: EMT & RMS modelling
- Requirement to move towards EMT Modelling for the future IBR connections
- Case Study for Grid Zone 4 : Hawke's Bay and Edgecumbe area
- GZ4 generator EMT model in detail

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Thank you
Any Questions ?

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