



SMART TOOL DEVELOPMENT FOR POWER SYSTEM OPERATIONS

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POWER SYSTEMS ENGINEER

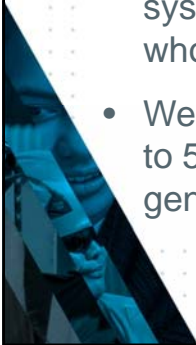


DATE: 17 AUGUST 2018

POWERING NEW ZEALAND TODAY + TOMORROW

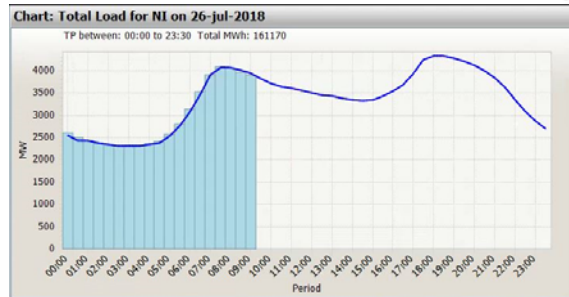
OUR ROLE

- Two parts of Transpower: Grid Owner and System Operator
- As the System Operator, we manage the real-time power system and operate the wholesale electricity market
- We manage the grid frequency to 50Hz by balancing generation and load

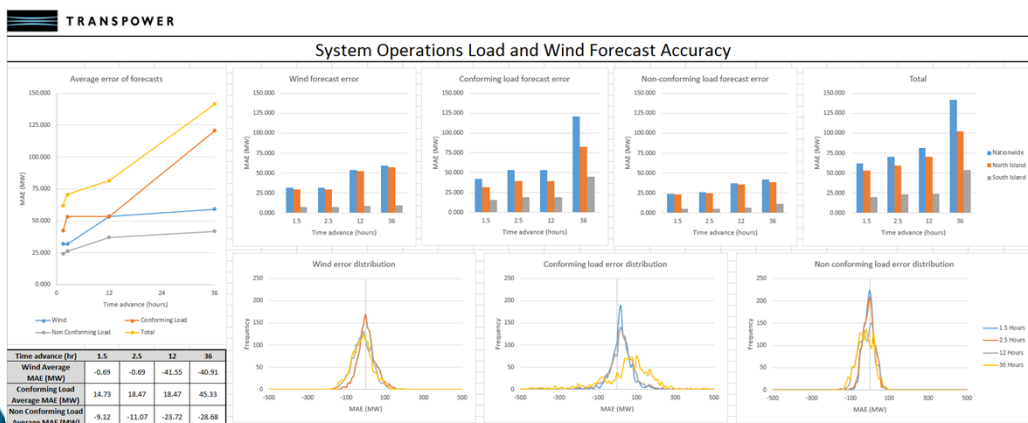


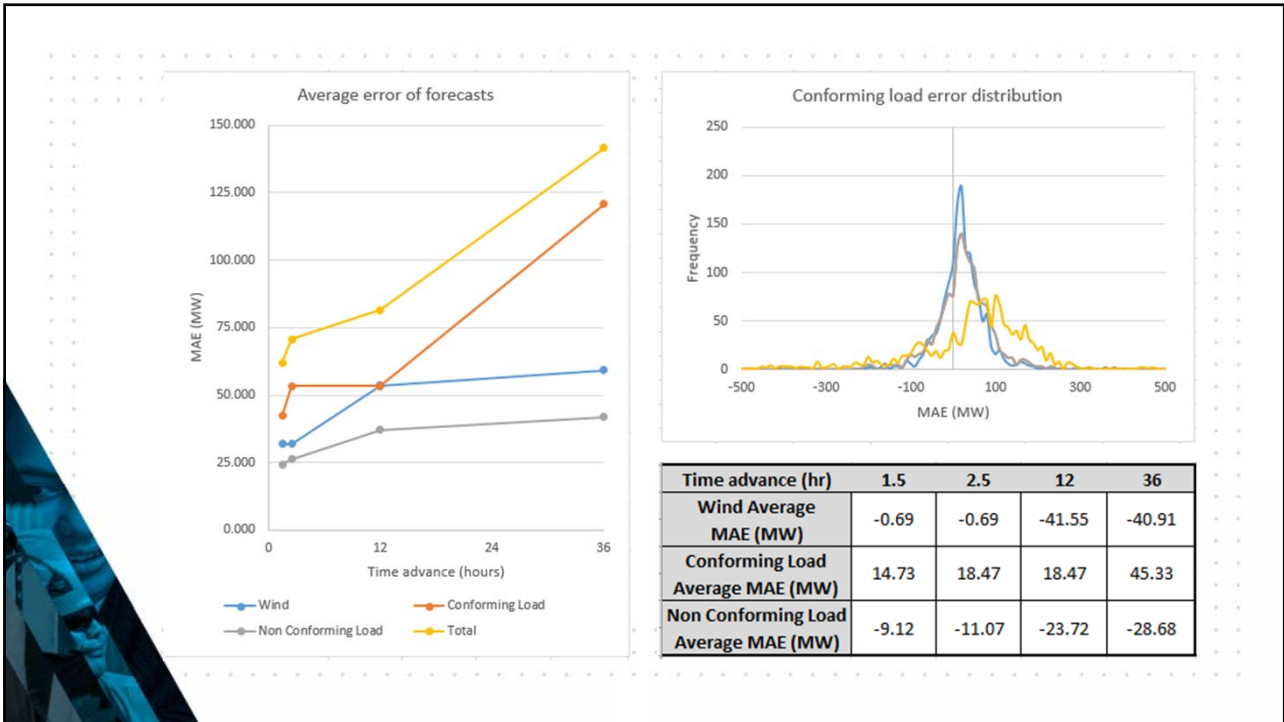
GENERATION DISPATCH (PROJECT 1)

- Dispatch to meet load with security and reliability
- Offers submitted for both MW and price
- Demand provided by load forecast
- Optimal solution found by SPD, schedules produced
- Calculation quantity increases towards real-time



LOAD AND WIND FORECAST ACCURACY TOOL





OPERATING THE TOOL

- Automated process in Oracle Business Intelligence runs queries to generate the forecast data
- Data is emailed to Market Services
- Excel macros copy across and process the data
- Interactive plots generated

Copy:
 - Load Forecast
 - Load Actuals
 - Wind Forecast

Run Histograms

Start plots at time:

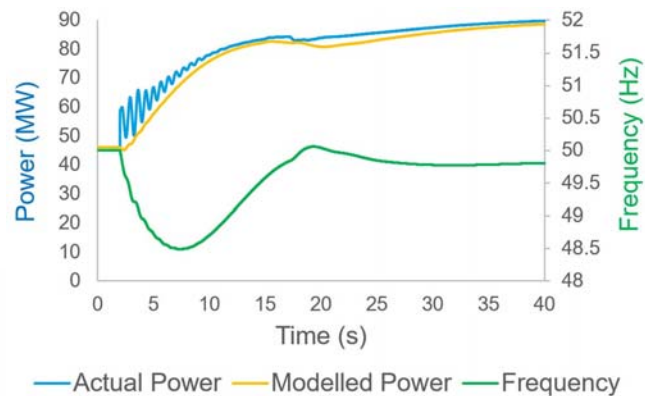
01-01-2018 00:00
 01-01-2018 00:30
 01-01-2018 01:00
 01-01-2018 01:30
 01-01-2018 02:00
 01-01-2018 02:30
 01-01-2018 03:00

End plots at time:

01-01-2018 22:00
 01-01-2018 22:30
 01-01-2018 23:00
 01-01-2018 23:30
 02-01-2018 00:00
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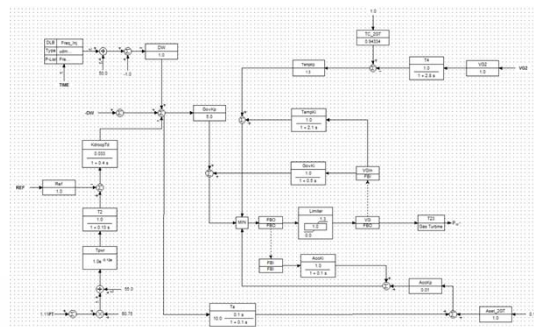
MANAGING POST-EVENT FREQUENCY IN NEW ZEALAND (PROJECT 2)

- Preventing cascade failure possible black out
- Fast and sustained reserve offered
- We need accurate models to ensure we procure reserves correctly



CHALLENGES IN GOVERNOR MODEL VALIDATION

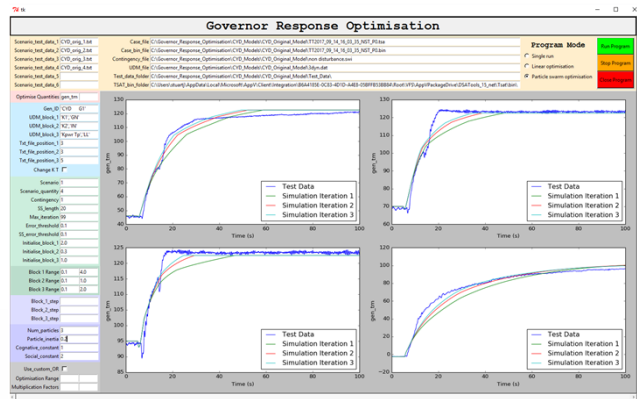
- Asset Owners submit DigSILENT Powerfactory models
- We validate models and rebuild in TSAT for real time use
- Repetitive and time intensive
- A simpler process needed, something more configurable than a “black box solver”



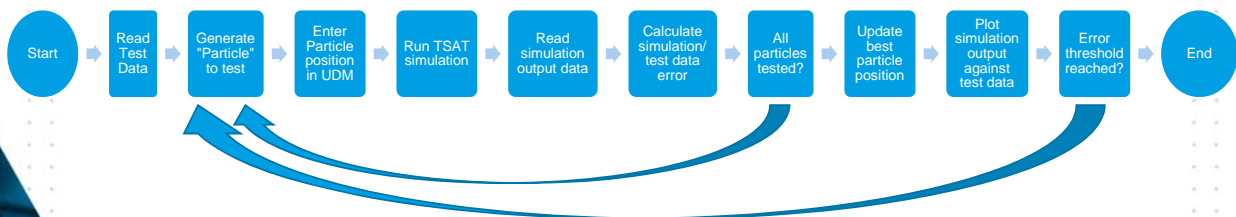
OUR SOLUTION TO THE PROBLEM

Steps:

1. Adjust model parameters
2. Simulate response to an underfrequency event in TSAT
3. Visual output, plot against test data
4. Tune the model



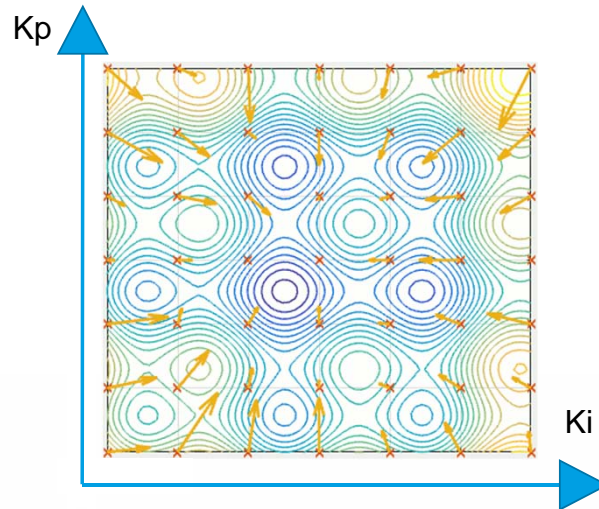
OPTIMISATION PROCESS



PARTICLE SWARM OPTIMISATION

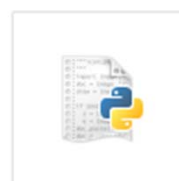
Update particles using:

1. Current velocity
2. Cognitive velocity
3. Social velocity

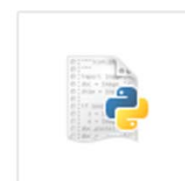


THE FEATURES

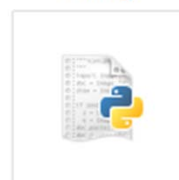
- User interface and engine coded in Python
- Multiple optimisation methods
- Optimises up to six scenarios simultaneously
- Can optimise any governor model variable



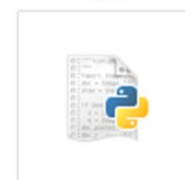
Config



Engine



Settings



User_interface

SCRIPT VS HUMAN

	Without Tool		With Tool	
	Time	Average error (MW)	Time	Average error (MW)
CYD	2 – 3 days of work	2.14770	1 hour of work + Up to 1 day running in the background.	1.97447
BEN		0.88649		0.35804
MTI		4.96685		0.65537
PTA		0.16755		0.16752
WHI		0.62427		0.60503



SUMMARY

- Load and Wind Forecast Accuracy Tool
 - Tracking forecast accuracy
 - Identifying ways to improve forecasting
- Governor Model Optimisation
 - Reducing the time needed to optimise a model
 - Increasing model accuracy

QUESTIONS?