Phasors in New Zealand

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NASPI

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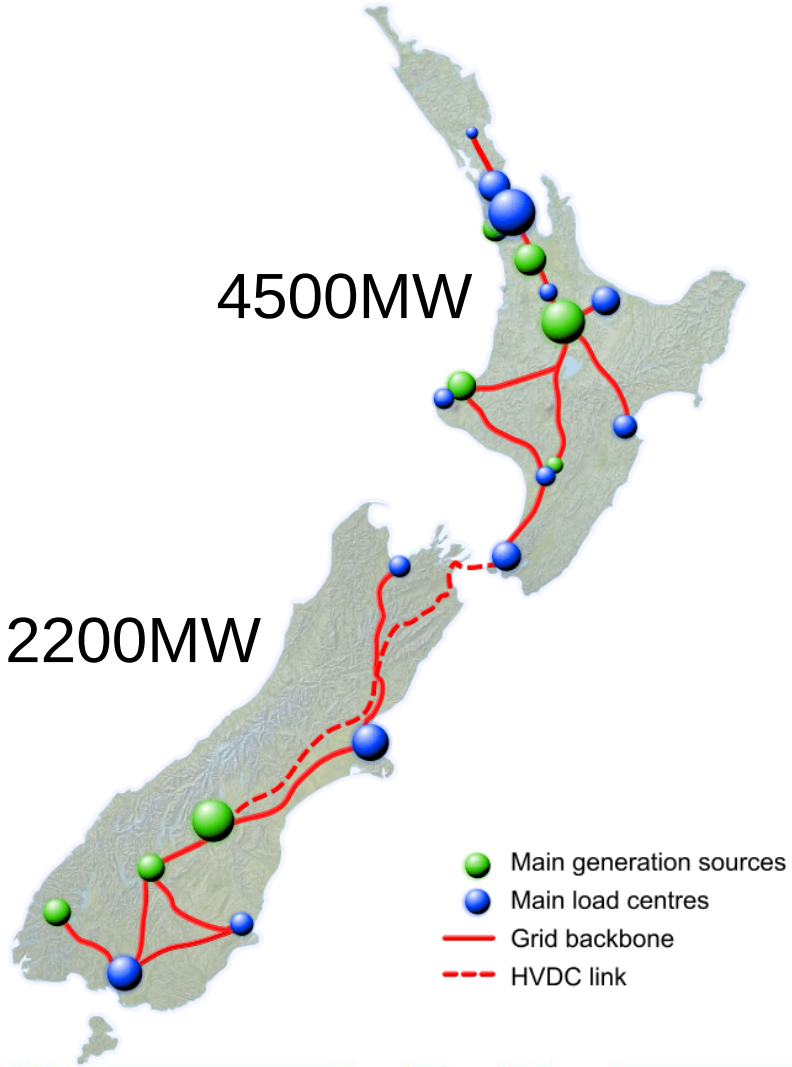
TRANSPOWER

New Zealand Grid



Two 50Hz asynchronous systems - North and South Island

Joined by HVDC (1200MW).

Long and skinny, high impedance, 220kV, 110kV, 66kV

South: Hydro, Wind
North: Hydro, Thermal, Wind

Why Phasors?

- Situational awareness
- Early warning on emerging stability issues
- Monitor equipment performance
- Validate power system models

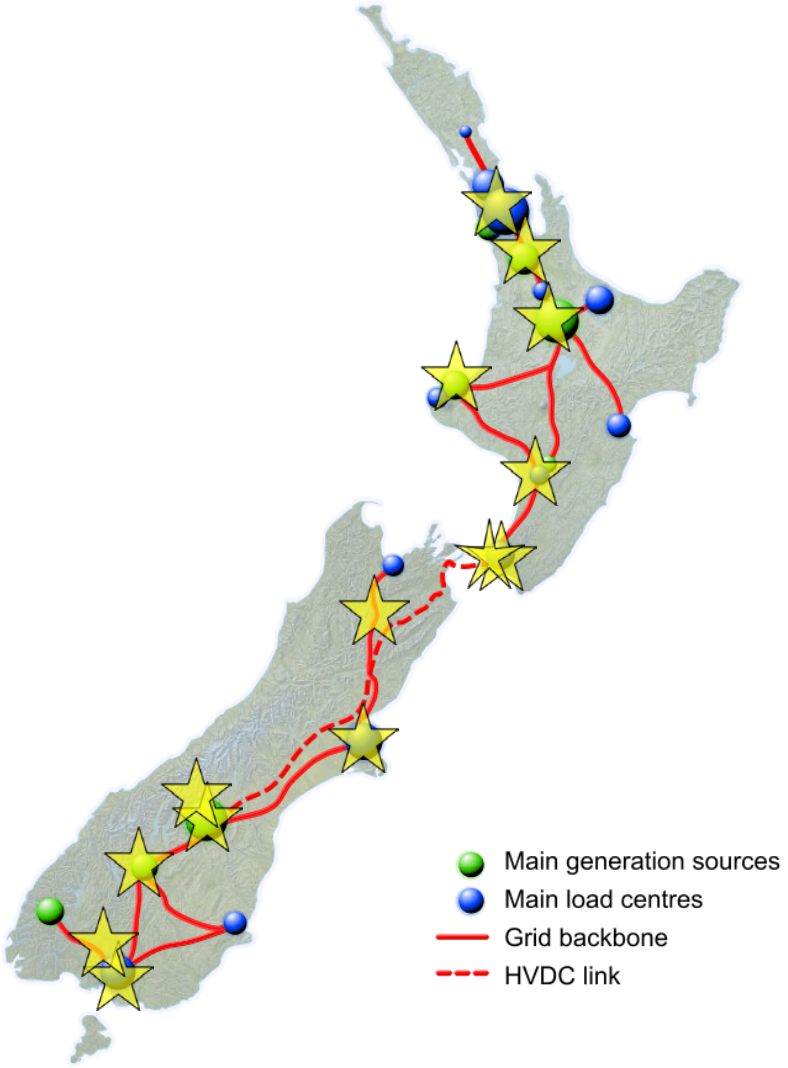
PMU Locations (14)

North Island

1. Otahuhu (Gen & Load)
2. Huntly (Gen)
3. Whakamaru (Gen)
4. Stratford (Gen)
5. Bunnythorpe
6. Haywards (HVDC terminal)
7. Westwind (Windfarm)

South Island

1. Kikiwa (STATCOM)
2. Islington (SVC & Load)
3. Twizel (Gen)
4. Benmore (HVDC terminal)
5. Roxburgh (Gen)
6. Tiwai (Smelter)
7. North Makarewa



Phasor measurements

- Synchronised recording of phasor data – time stamped by GPS clock
- Real Time measurement of 3 phase Voltage & Current – both magnitude and phase angle
- Sampled 50 times per second (50 Hz is nominal system frequency)
- Phasors are extracted from our protection relays

Data access

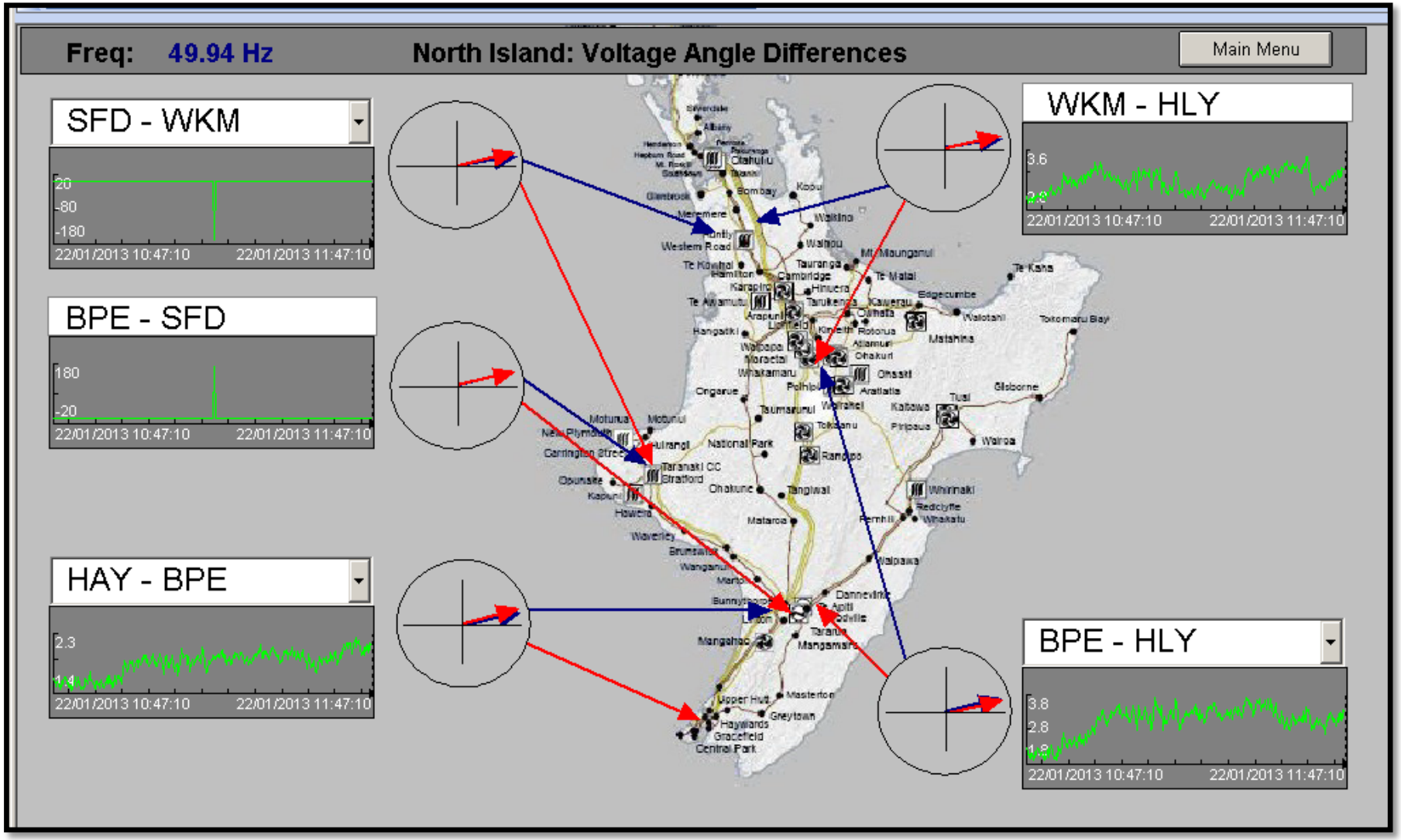
1. PI (OSIsoft) – Main data source
   SCADA, PMUs, protection logs, system logs, etc.

2. Psymetrix – Phasor-only data source
   Real-time monitoring and alarms
   Oscillation frequency, damping (stability)
   Locus plots
   Monthly system stability reports

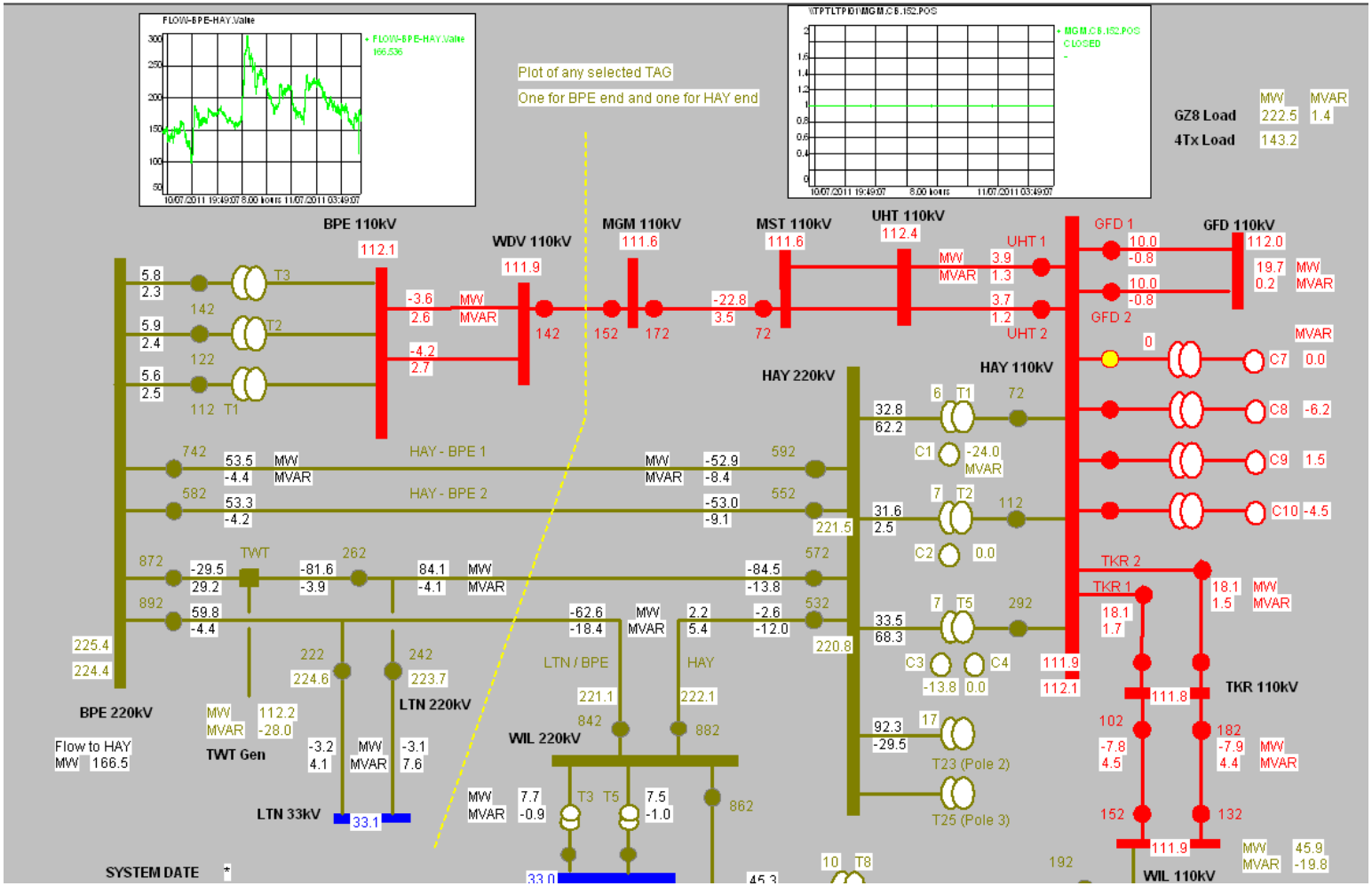
1. PI (OSIsoft) data access

- Main data source with SCADA, PMU, logs, etc.
  - Screens
  - EXCEL link
  - MATLAB link

1. PI (OSIsoft) data access



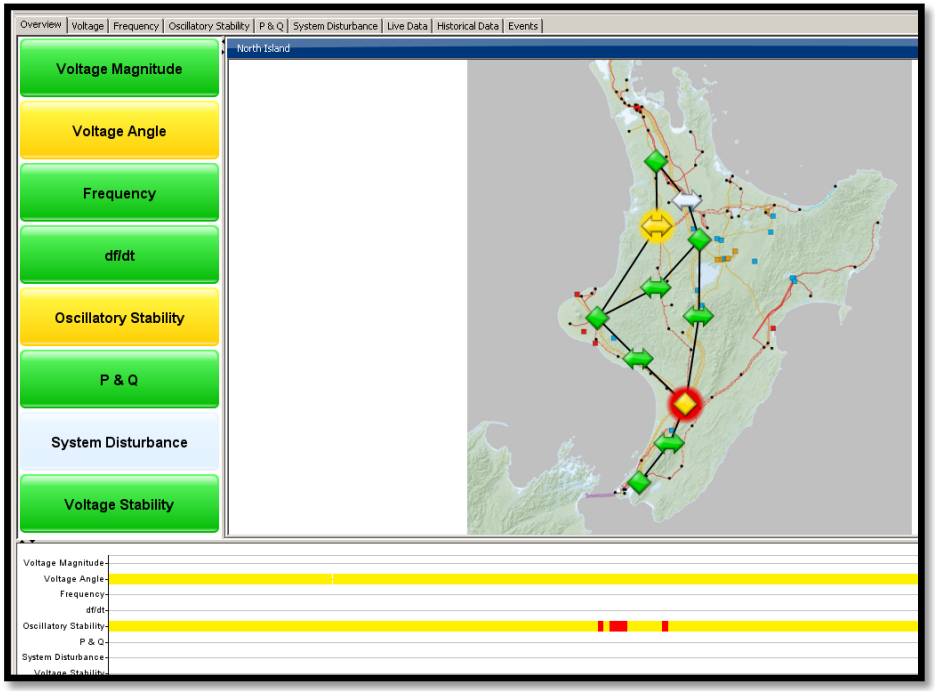
1. PI (OSIsoft) data access

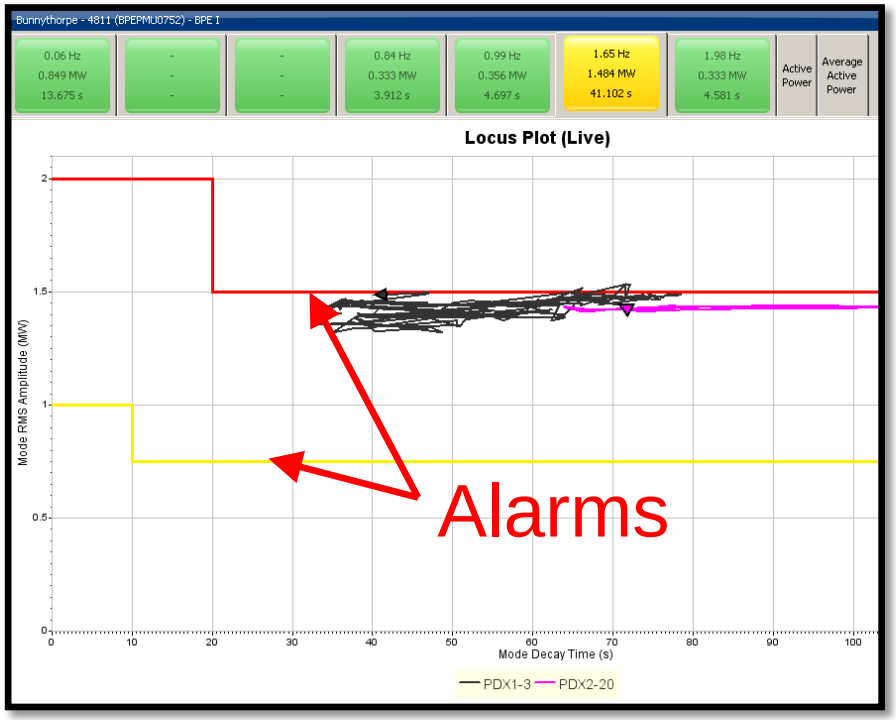


Custom screens are relatively easy to make

2. Psymetrix data access

- More specialized phasor applications.
  - Real time monitoring, eg alarms
  - Oscillations (freq and decay), locus plots

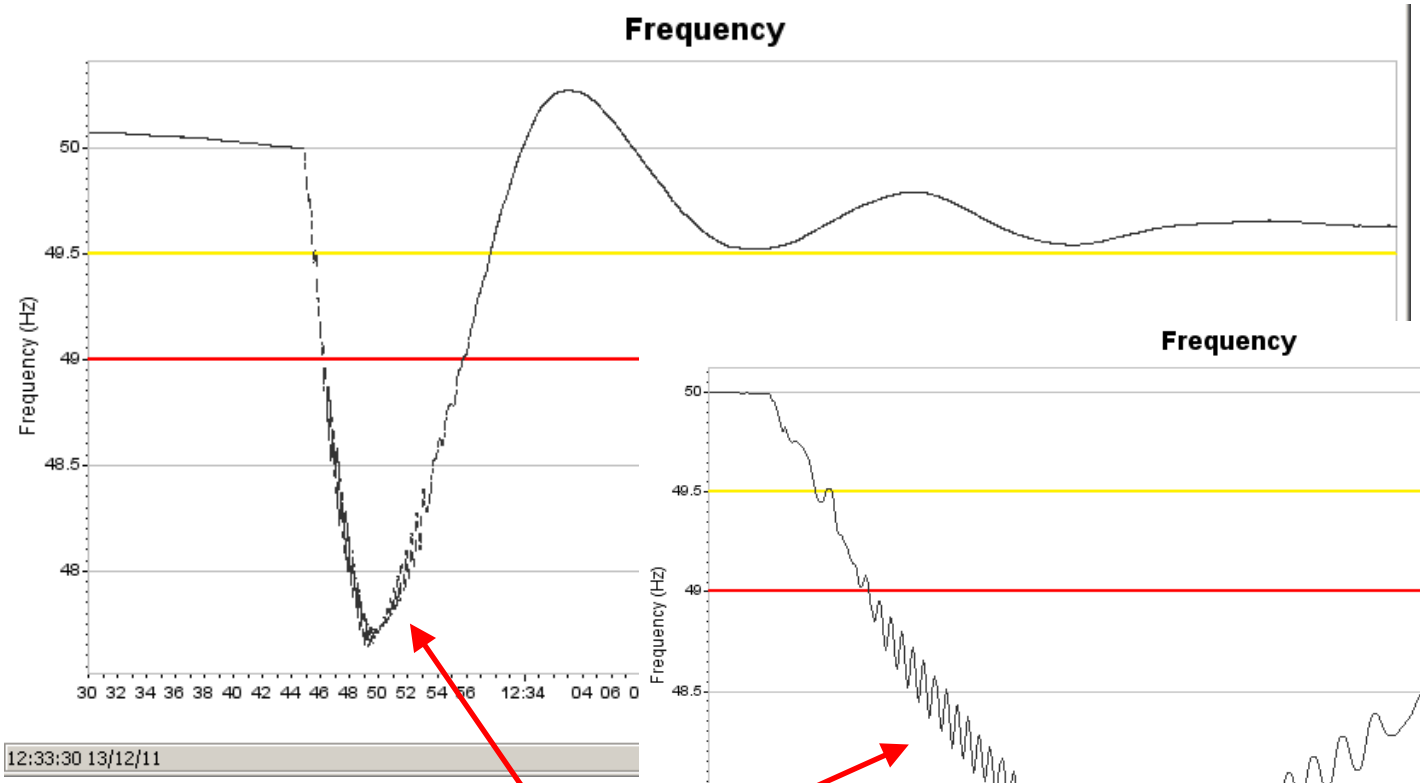


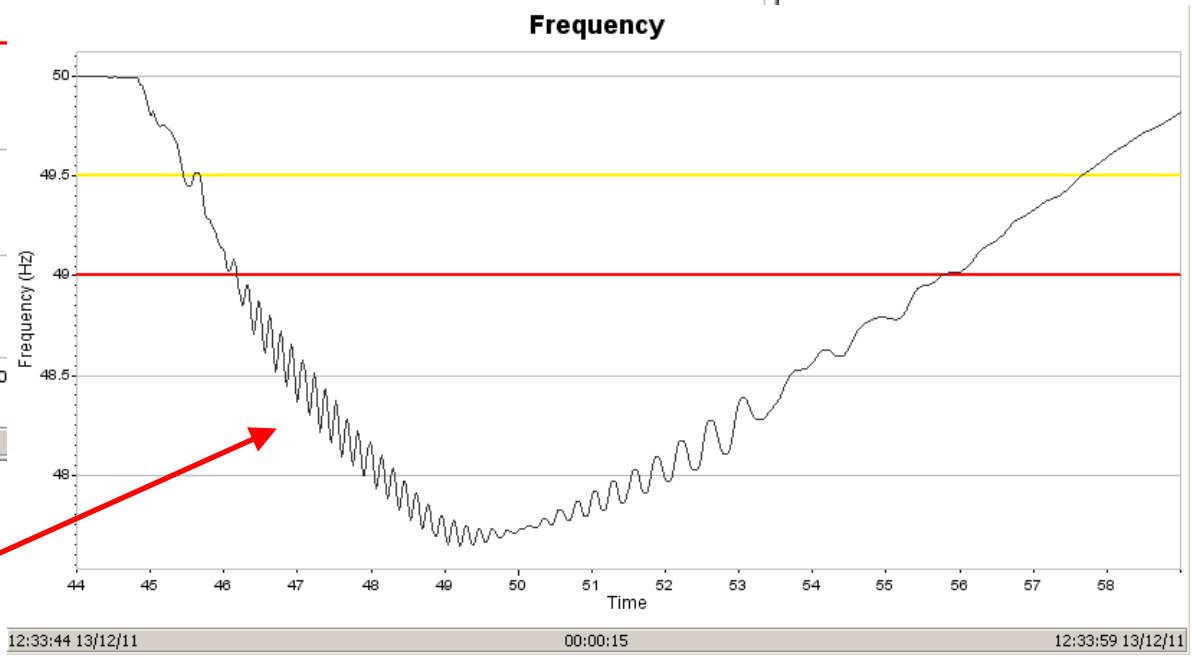


PMU Usage

- An investigation tool (not used in real time operations)
- Event analysis
- Power system model validation
- Monitoring oscillations (Psymetrix)

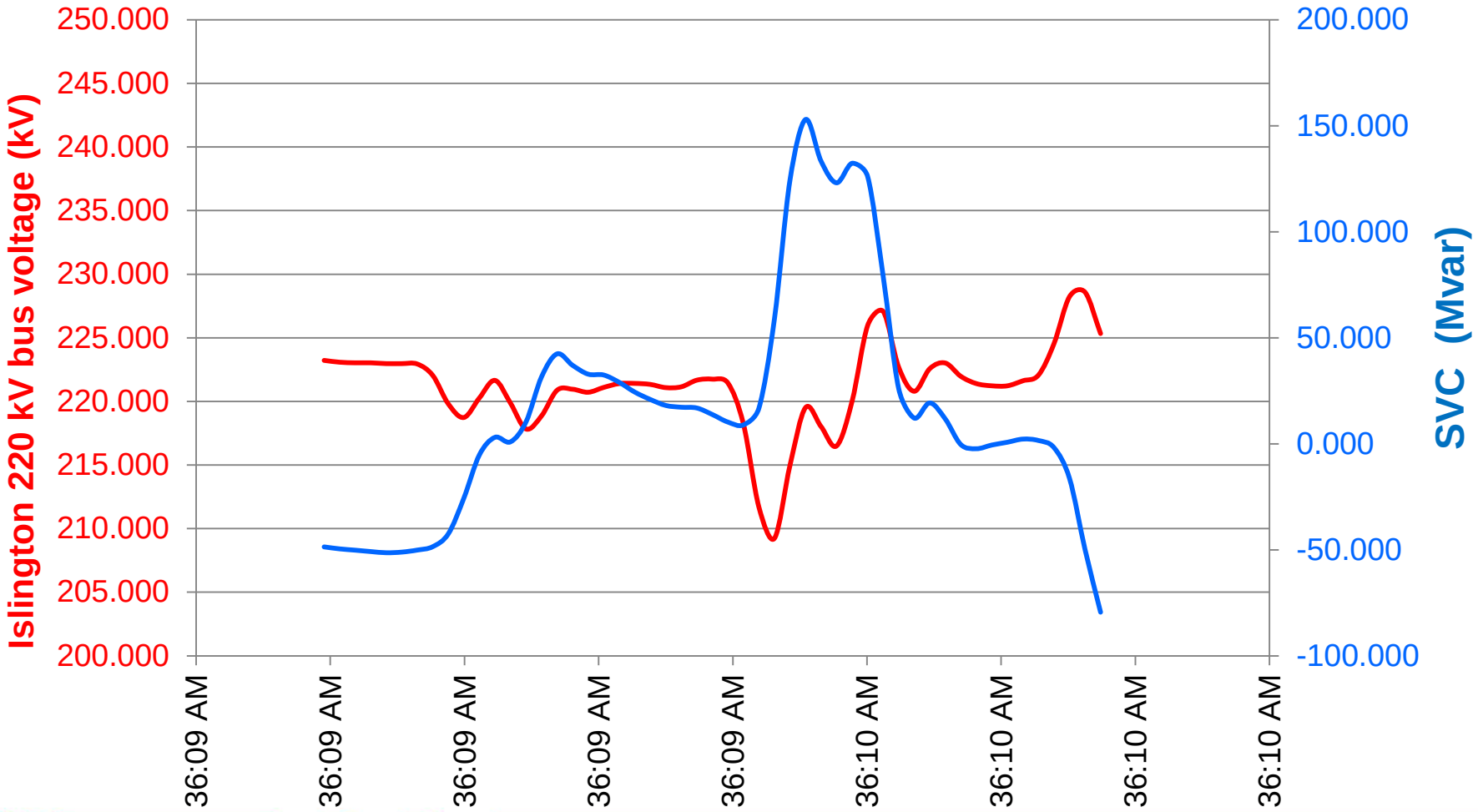
System Under-frequency event



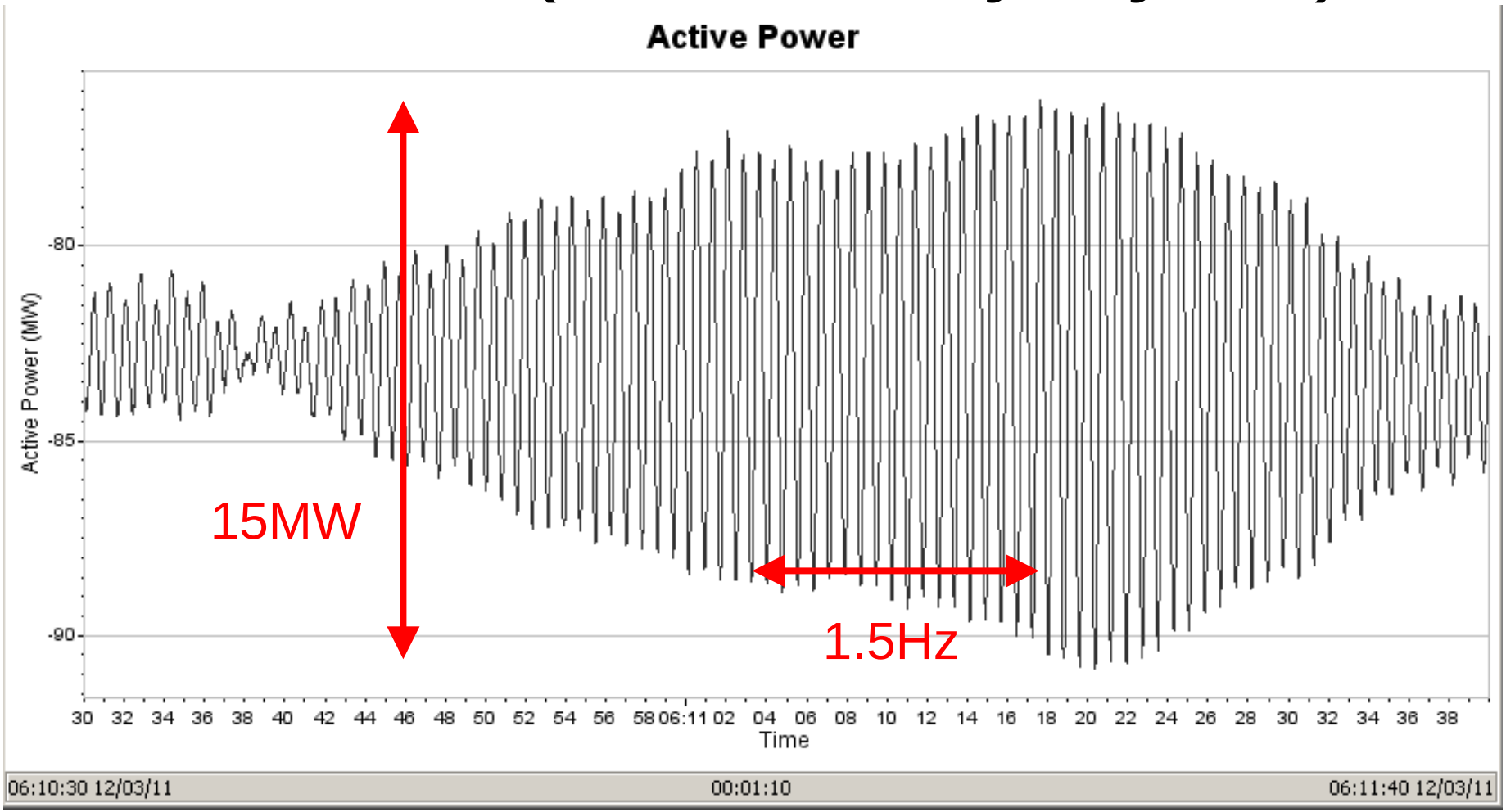


6.5Hz oscillation “Generator Pole slipping”

Monitoring SVC performance during grid faults



Undampped Oscillation in South Island (with mainly Hydro)



Phasors, to finish…

- 14 PMU sites give good grid coverage
- Plans to add 2 new sites at top of North Island
- Used for investigations:
  - Fault analysis, oscillation monitoring
  - Model validation
  - Equipment monitoring
- Storage / Data processing with PI & Psymetrix
- Developing more uses as time goes on, e.g. Anti-islanding detection