New Phasor Data Applications in Europe

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EMEA & ANZ Activities

1997

’97 Continuous operational Wide Area Monitoring Anglo-Scottish Interconnection

’99 Adopted in English Control Room

’00 New line commissioning in Australia

’04 NEMMCO Operations Constraint Relief

’05 PMU based WAMS

’06 Australian Co-located systems

’07 Australian Blackout Avoided

’07 PSS tuning Success in Iceland

‘08 PhasorPoint Synchrophasor Applications Framework released

‘08 Substation PDC, Lithuania

’09 Denmark selects PhasorPoint

’09 Selected for large scale South African WAMS with Alstom

‘09 Governor issues improved in Colombia

’10 New expanded UK systems

’10 Sweden Combined EMS and WAMS with Alstom

’11 Wide Area Defense Project Iceland

2011

Focus on real Business Benefits

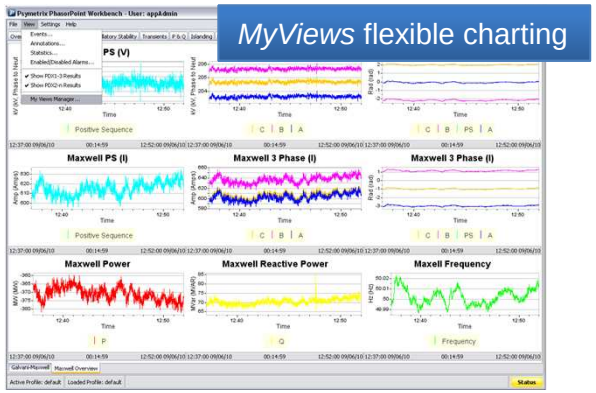
PhasorPoint System and Applications Framework

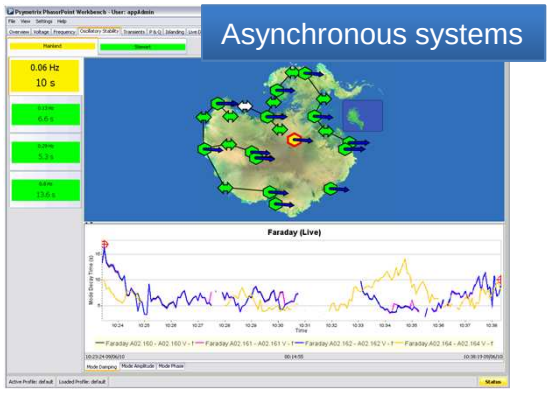
Basic Applications
Voltage, Phase Angle and Frequency
Active/Reactive Power and Symmetrical Components
Disturbances

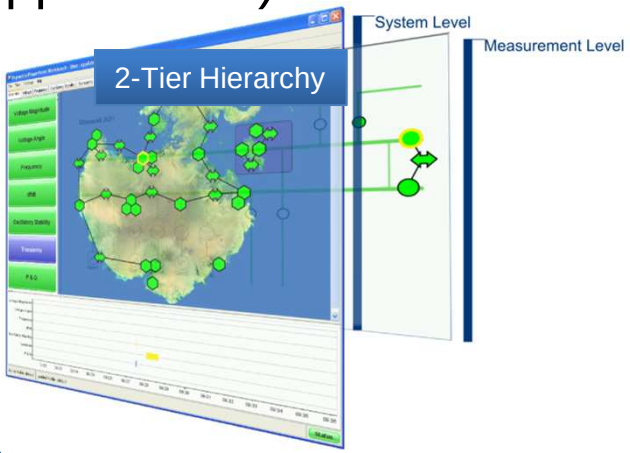
Advanced Applications
Islanding, Resynchronisation and Blackstart
Oscillatory Stability
Voltage Stability
Line Parameters and Thermal Rating
Generator Modelling and Test
Angle Constraint Active Management

Energinet.dk, Denmark

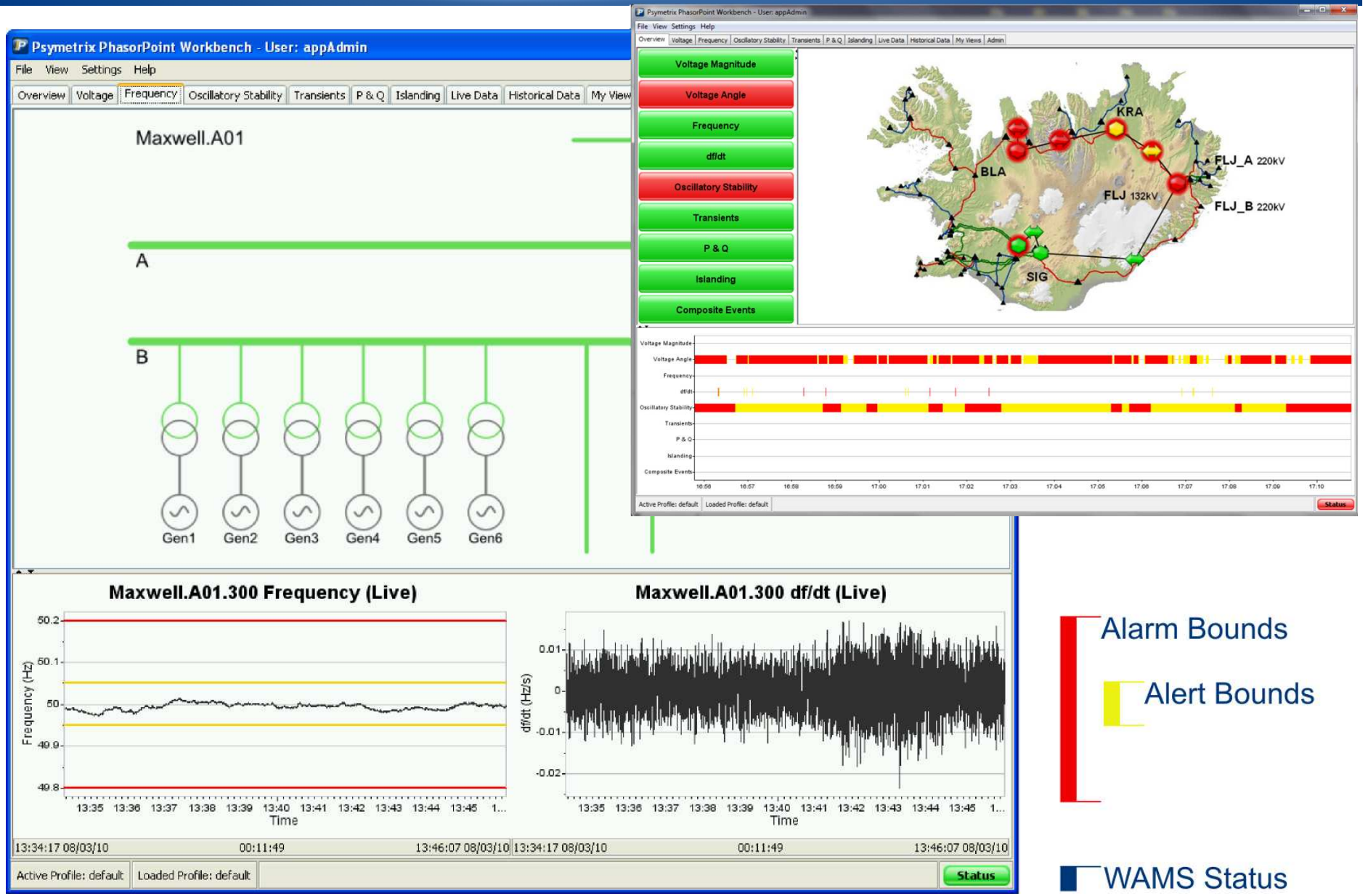
- Leading utility in sustainable supplies
  - High penetration wind power (20% energy now, 50% by 2025) + CHP
  - Predictability / controllability, frequency stability and voltage issues
  - Connection to N.Germany increasingly wind-dependent
  - Exposure to external disturbances – capability to run 60kV islands
- WAMS system characteristics
  - Large WAMS system (4800 phasors) Acceptance 2010
  - Local and European system visibility
  - Asynchronous systems – Scandinavia and Central Europe
  - Transmission and distribution PMUs
- Focus on reliability, size and visualisation (not applications)



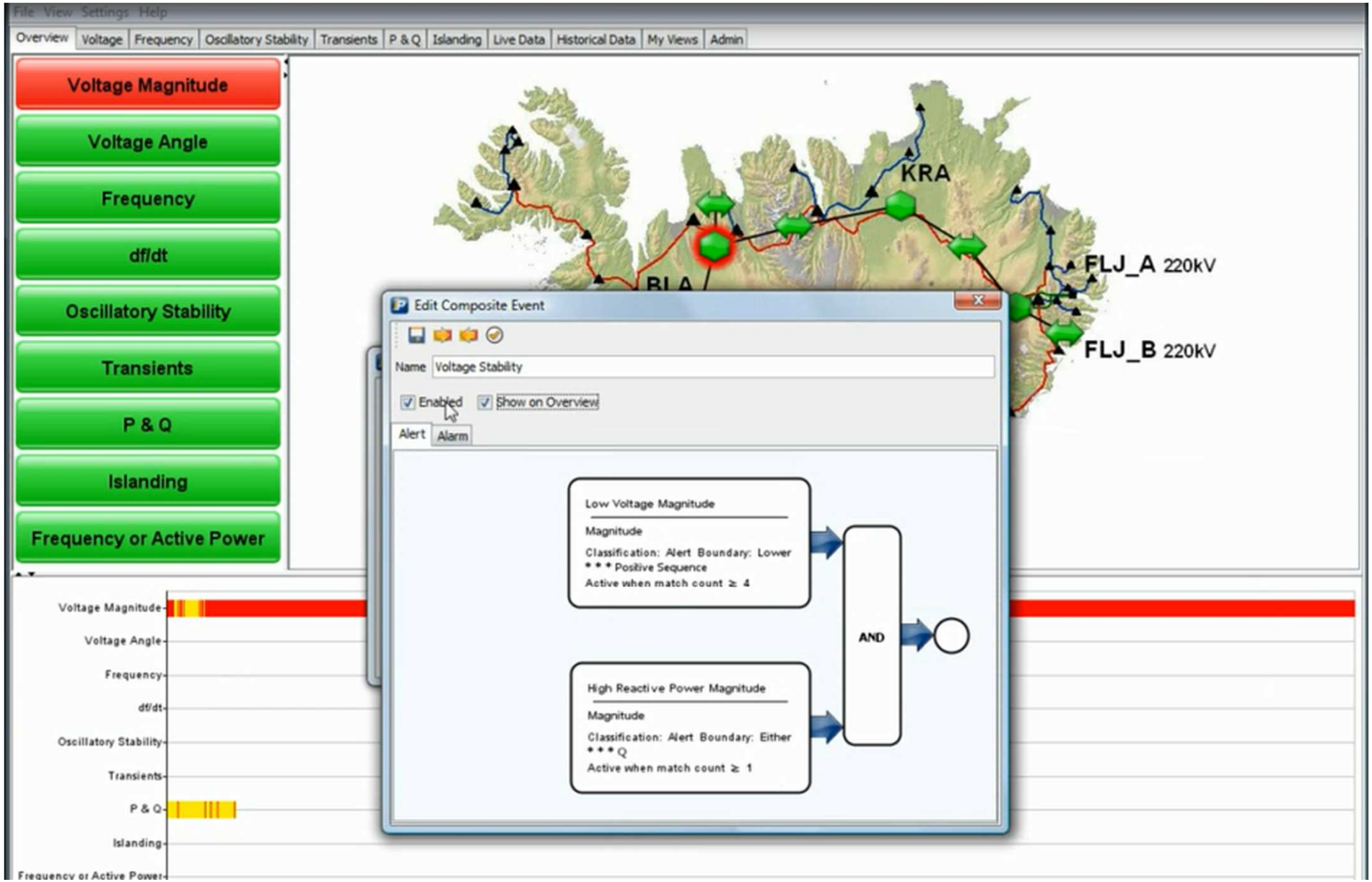




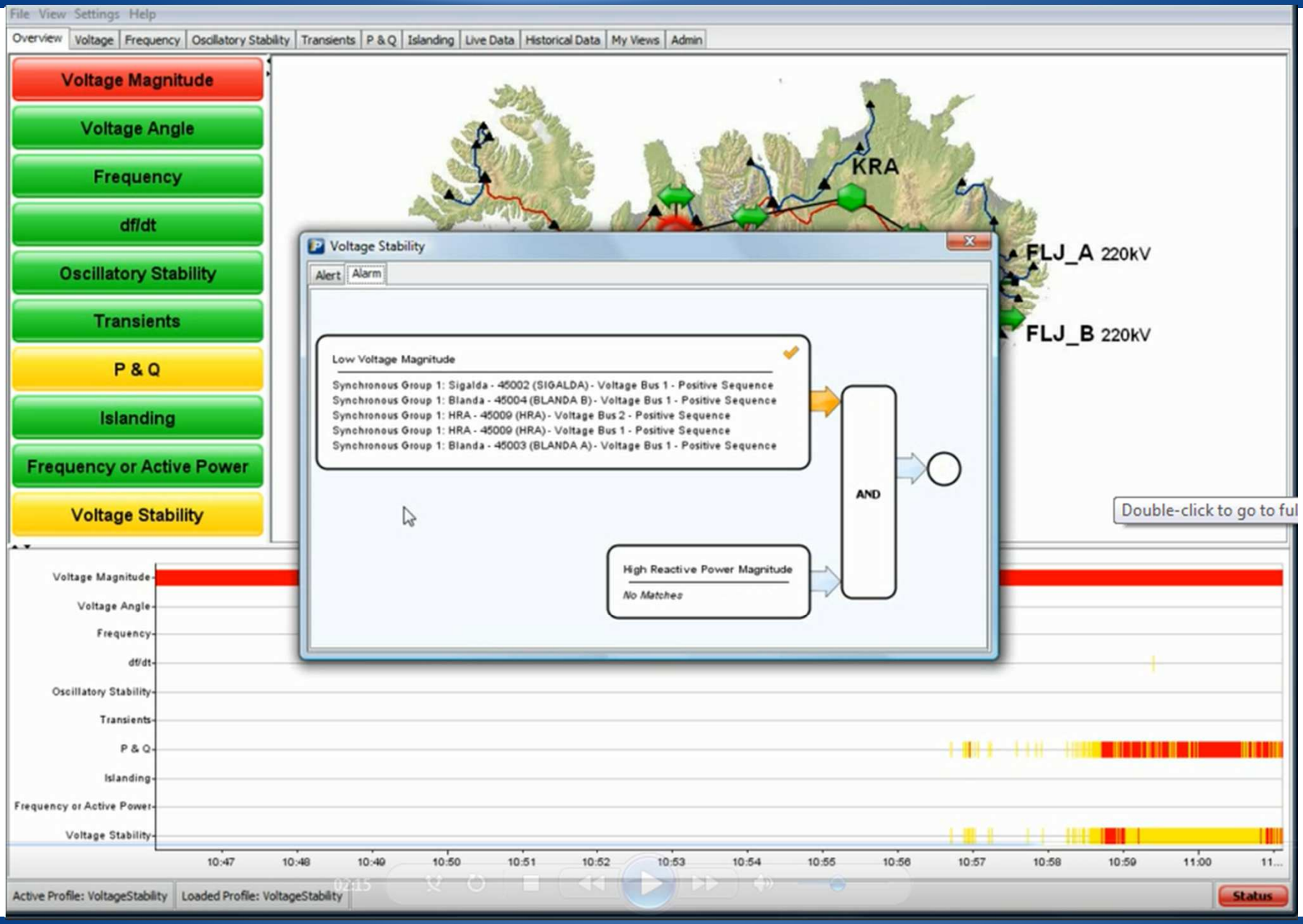
PhasorPoint User Interface – Drill Down



Defining Composite Events

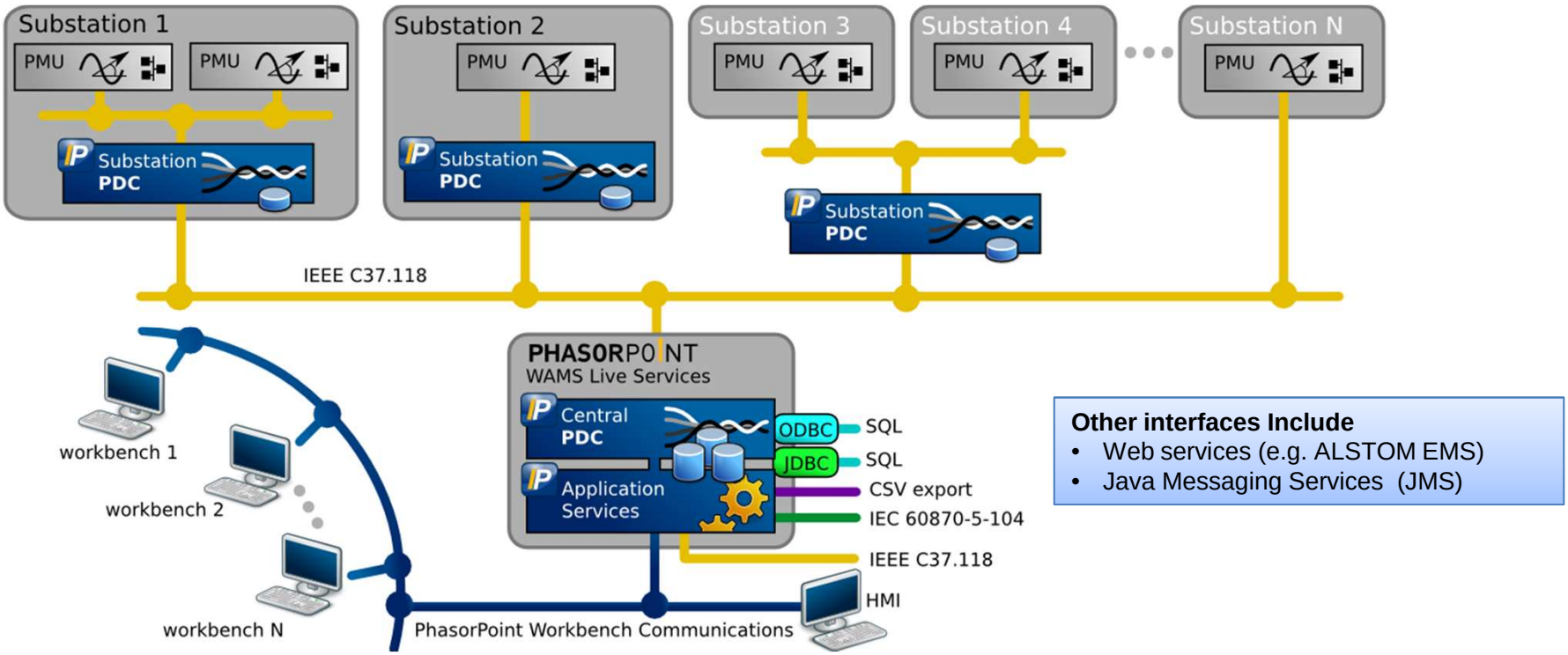


Customisable Dashboard – alarm state feedback



CORESO / ULB, Belgium/France

- PhasorPoint Open Interface
  - Access to historic data making use of WAMS configuration
  - Optimised for time-series data
  - Standard access for reporting & analysis, e.g. Excel, Matlab, R, NumPy, etc.



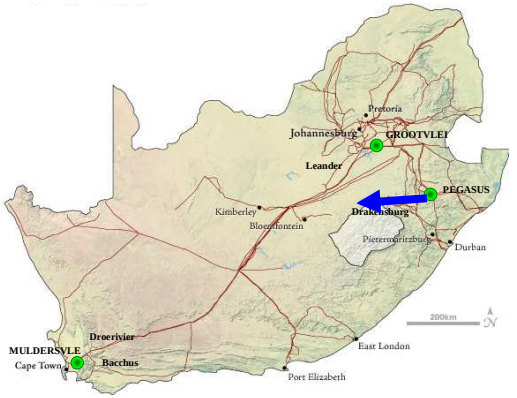
EXAMPLE QUERY:

```
SELECT * FROM pmu_1_10 WHERE ts >= '2010-07-21 00:00:00' AND ts < '2010-07-21 01:00:00'
```

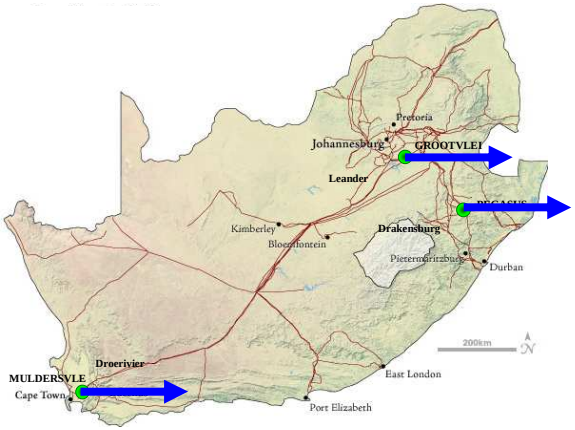
Eskom, South Africa

- Pilot project complete, next stage 99 PMU system
- Key features
  - Flexible user configurable displays (e.g. wallboard)
  - Flexible alarms (level, ROC, composite) & notification (via EMS)
  - Oscillatory stability
  - Disturbance capture & analysis
  - High availability
- Exploring new application areas e.g.
  - Constraining by angle
  - Bush fire alerts

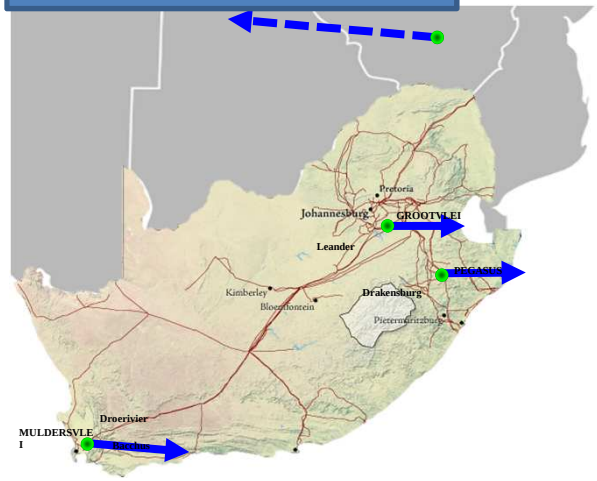
Local Modes (various)



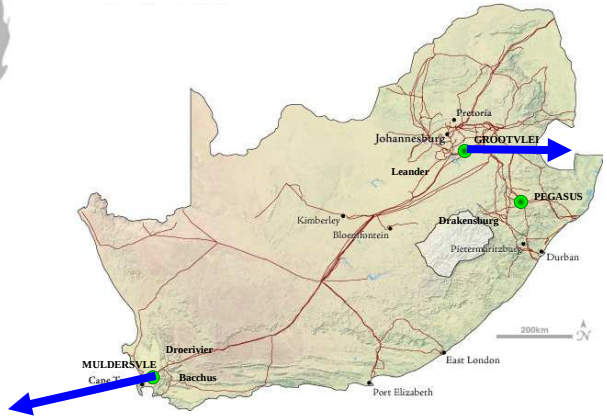
0.05Hz Common Mode



0.3Hz SAPP Mode

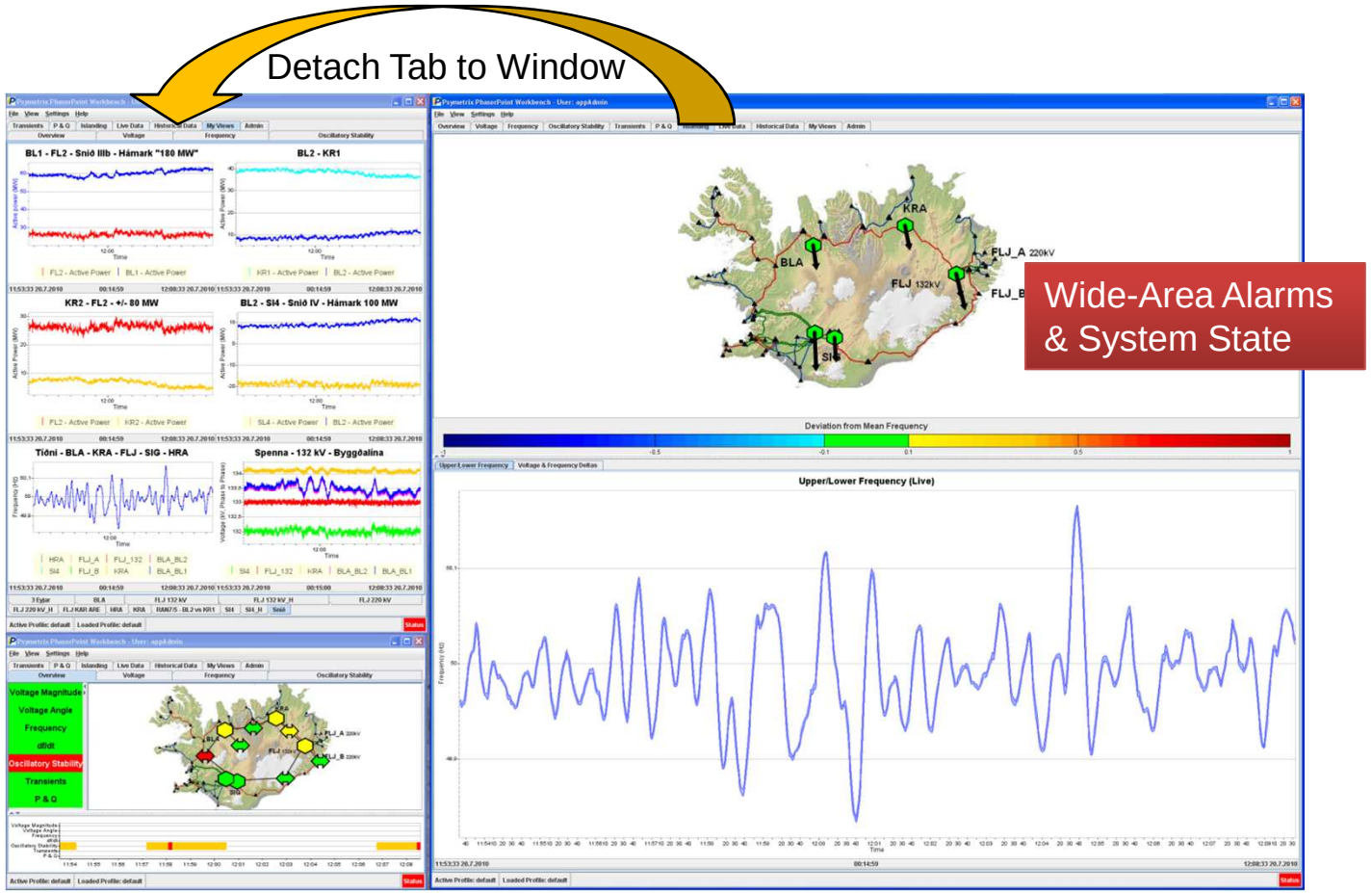


0.7Hz Interarea Mode

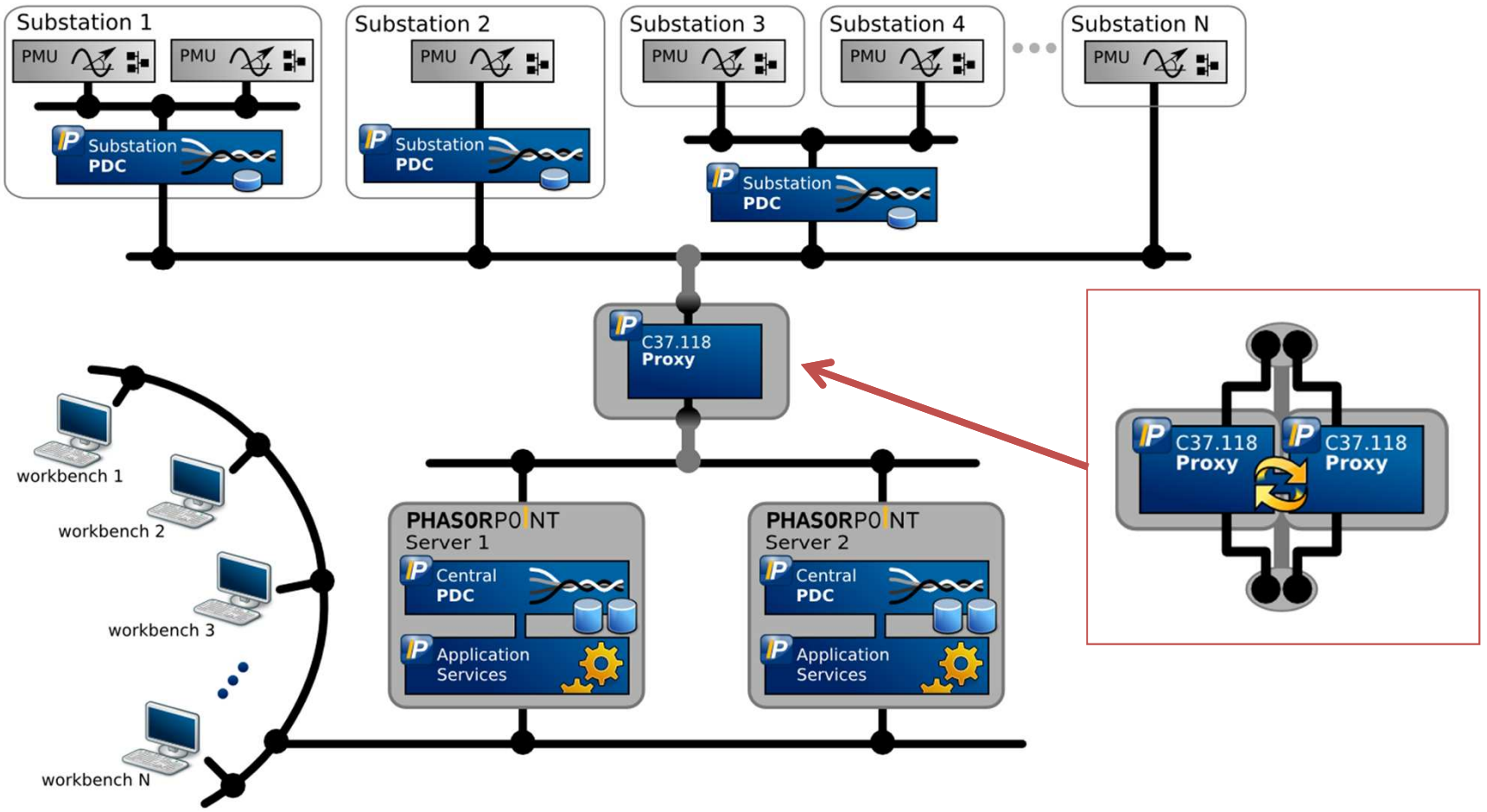


Display Enhancements

- Flexible screen layout
  - Separate floating windows
- Mapboard displays
  - Headline summary, admin designed, no mouse navigation

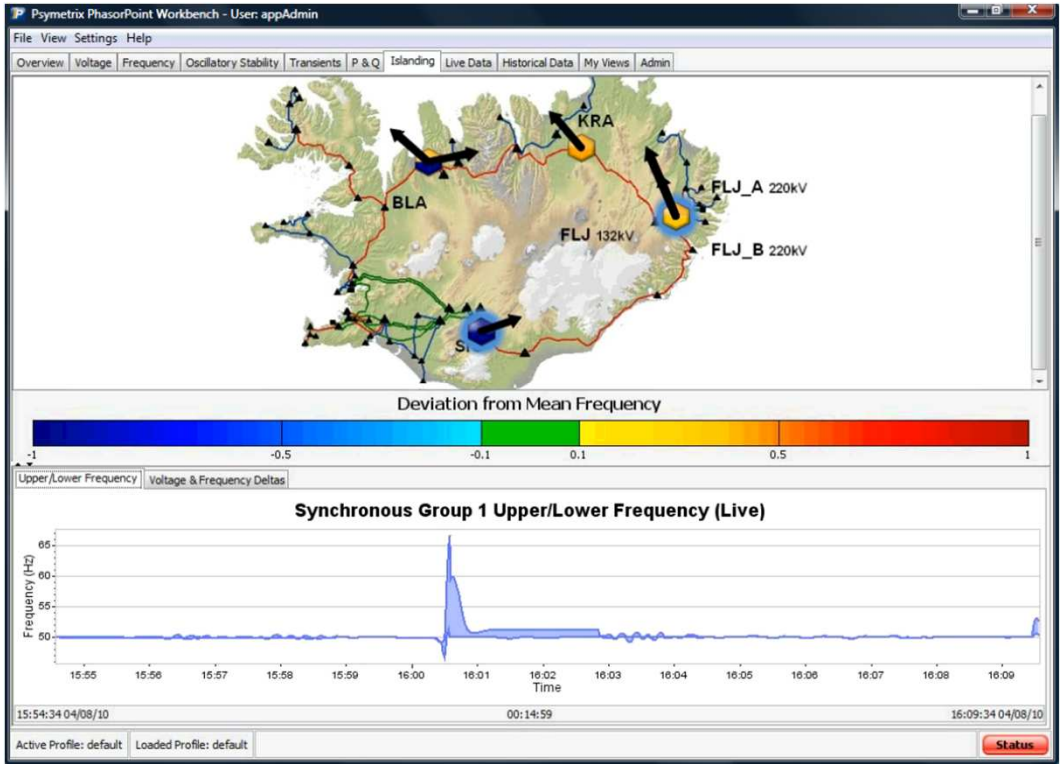


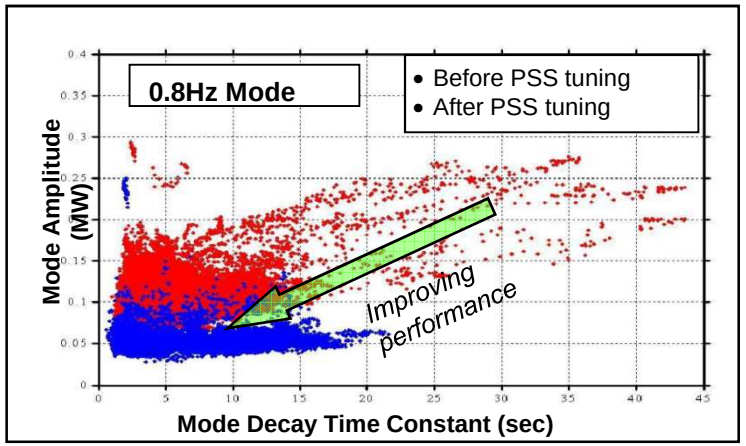
- High Availability & Redundancy (Active-Active configuration)

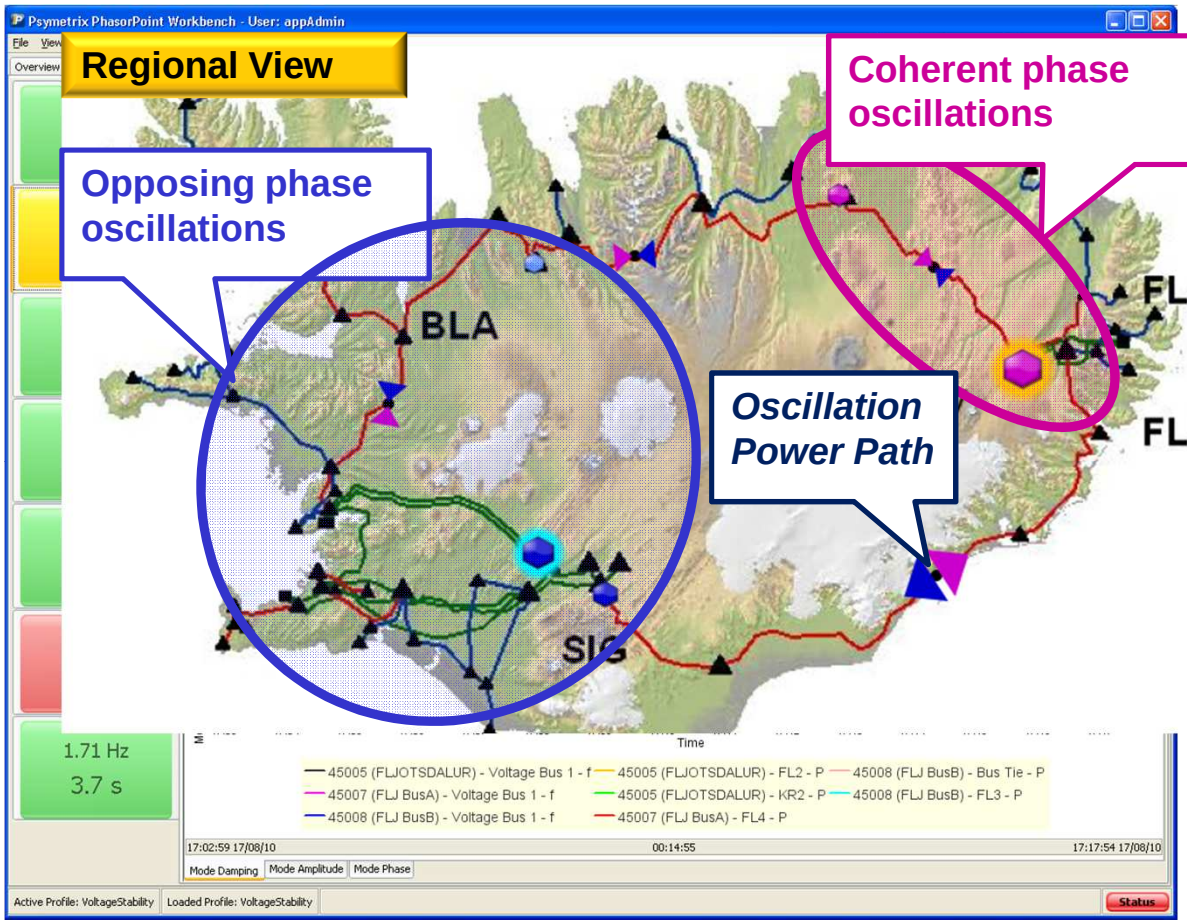


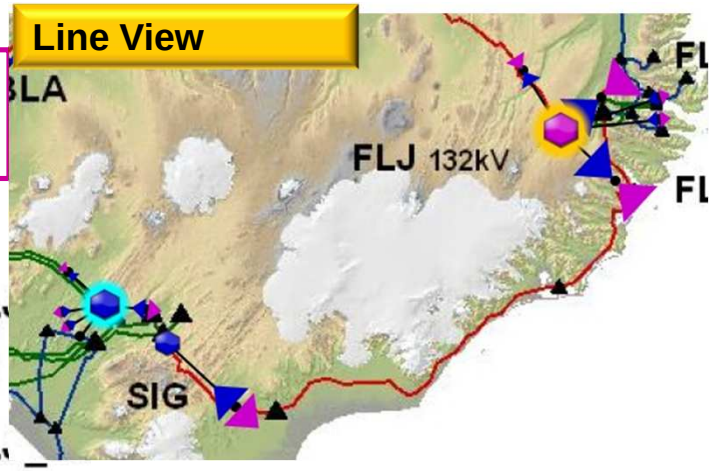
Landsnet, Iceland

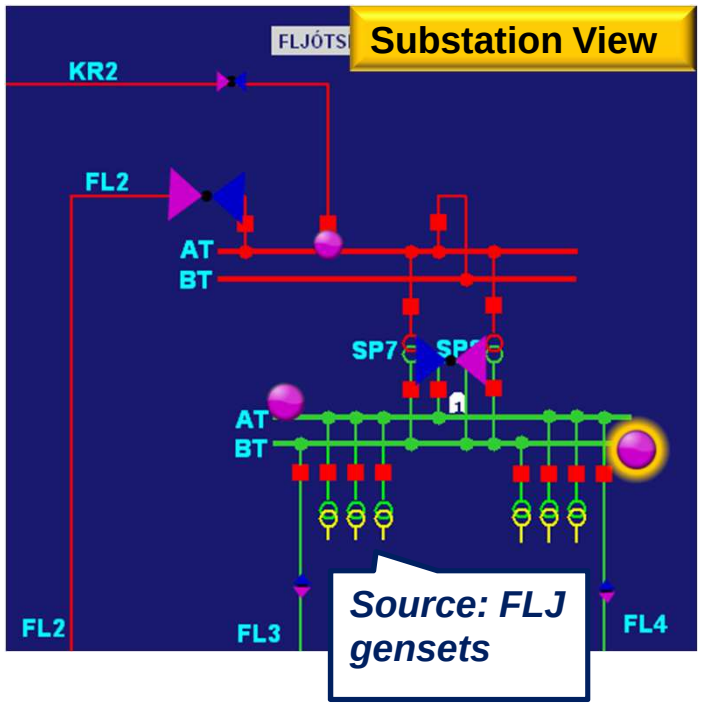
- Oscillations & PSS Tuning
- Governor stability
- Disturbance analysis
- Islanding & Resynchronisation
- In progress - Wide Area Defense



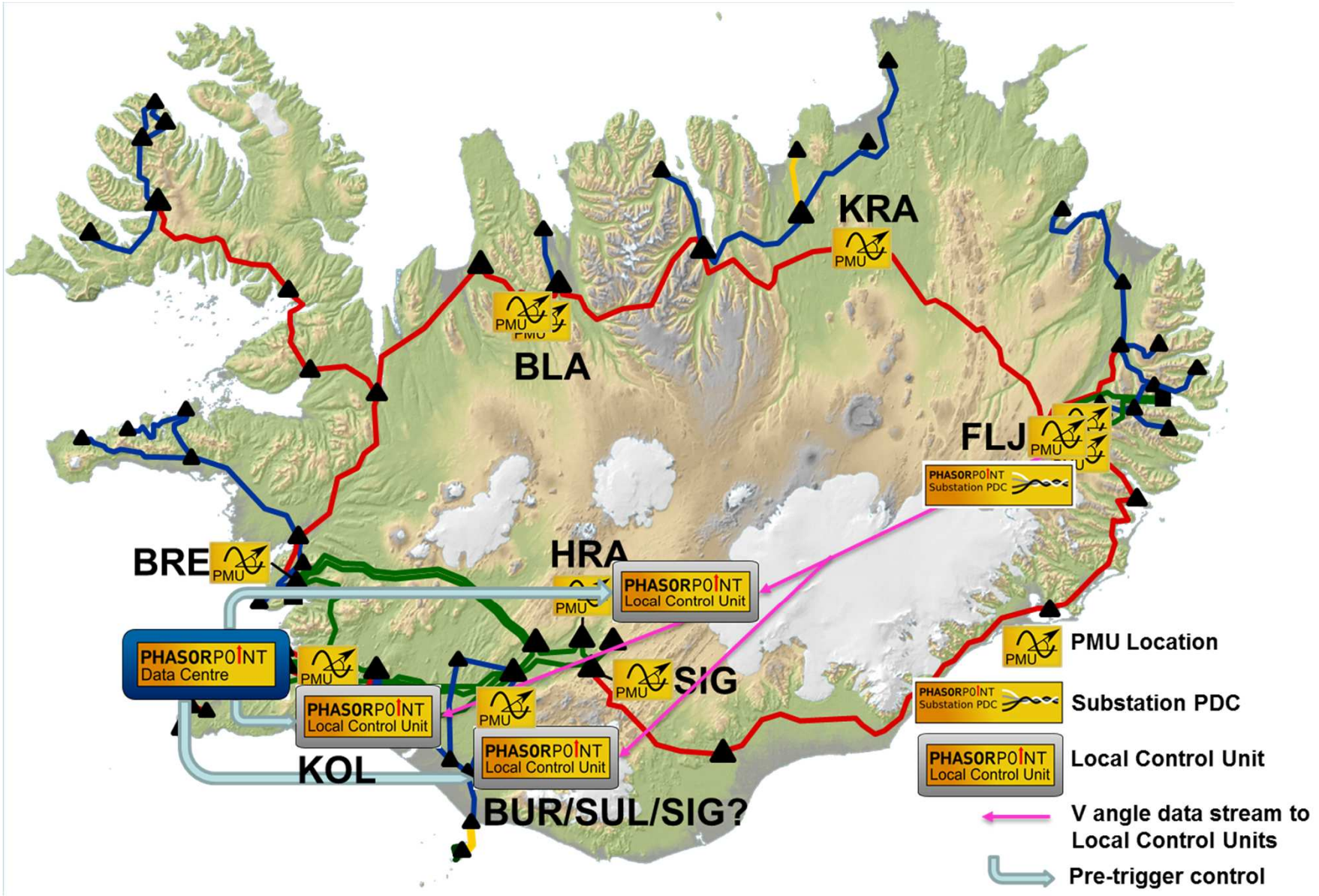








Automated Dispatch for Power Balancing

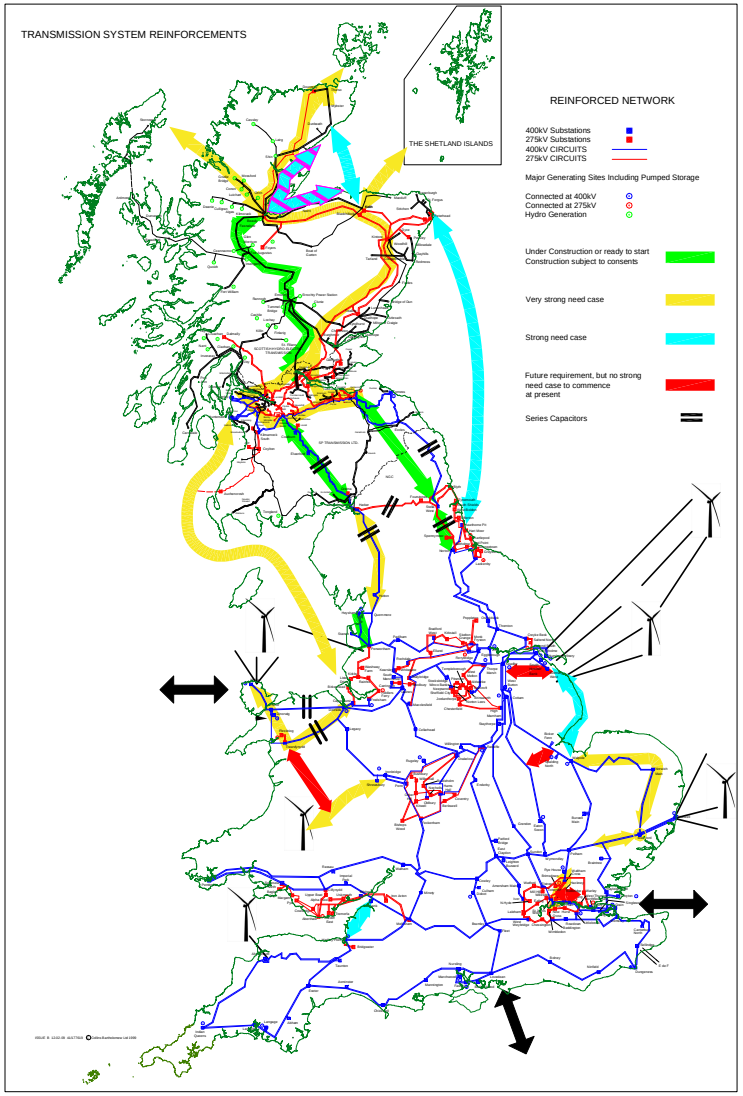


GB System

- Transition to high penetration renewables
  - Transmission
  - Distribution
- Issues
  - Frequency stability
  - Islanding
  - Oscillations
  - Modelling
  - Distributed control / Smart Grid
  - SSR
- Disturbance recorders as data source
  - 300 units in SP network
  - Testing

Omicron + synchroniser	Qualitrol IDM+LSU	PhasorPoint

Strategic Reinforcements



THANK YOU

QUESTIONS?

PROVEN SOLUTIONS FOR STABILITY, SECURITY & CONSTRAINT RELIEF

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