Focus on real Business Benefits

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
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
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)
Defining Composite Events
Customisable Dashboard – alarm state feedback
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

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

Wide-Area Alarms & System State

Detach Tab to Window
High Availability & Redundancy (Active-Active configuration)
- Oscillations & PSS Tuning
- Governor stability
- Disturbance analysis
- Islanding & Resynchronisation
- In progress - Wide Area Defense
Opposing phase oscillations
Coherent phase oscillations
Oscillation Power Path

Source: FLJ gensets
Automated Dispatch for Power Balancing
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

<table>
<thead>
<tr>
<th>Omicron + synchroniser</th>
<th>Qualitrol IDM+LSU</th>
<th>PhasorPoint</th>
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</thead>
</table>

Strategic Reinforcements

GB System
THANK YOU

QUESTIONS?

PROVEN SOLUTIONS FOR STABILITY, SECURITY & CONSTRAINT RELIEF

Robert Folkes
robert.folkes@psymetrix.com
+44 131 510 0704
www.psymetrix.com