

Wide Area Power System Monitoring and Control

International Case Studies

Dr. Patrick McNabb

ISGT 2012, Berlin



CONFIDENTIAL

Copyright © 2012 Psymetrix Limited 1

Intro

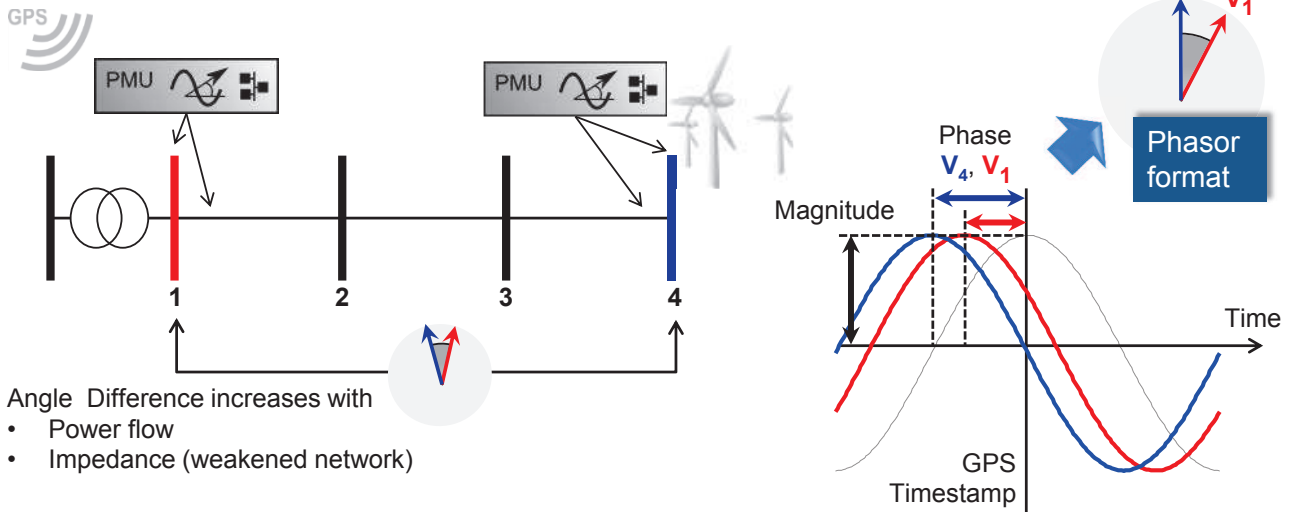


- ◆ WAMS/WADS Technology – Smart Transmission?
- ◆ Areas of WAMS Application
 - ◆ Oscillatory Stability Monitoring (OSM)
 - ◆ Avoiding Separation
 - ◆ Disturbance Monitoring
- ◆ Case Studies
 - ◆ Iceland
 - ◆ South America
 - ◆ Australia
 - ◆ WECC – Scalability of WAMS

CONFIDENTIAL

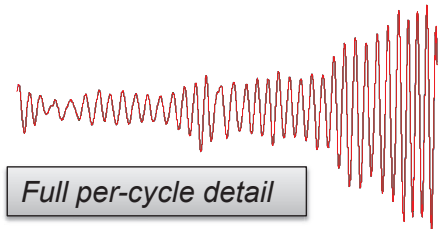
Copyright © 2012 Psymetrix Limited 2

Synchrophasor Measurement



Synchrophasors: Key Features

- ◆ Synchronised V, I measurements
- ◆ 50/60Hz data captures dynamics
- ◆ 3-phase measurements
- ◆ Real-time streaming



CONFIDENTIAL

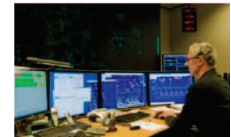
Copyright © 2012 Psymetrix Limited

3

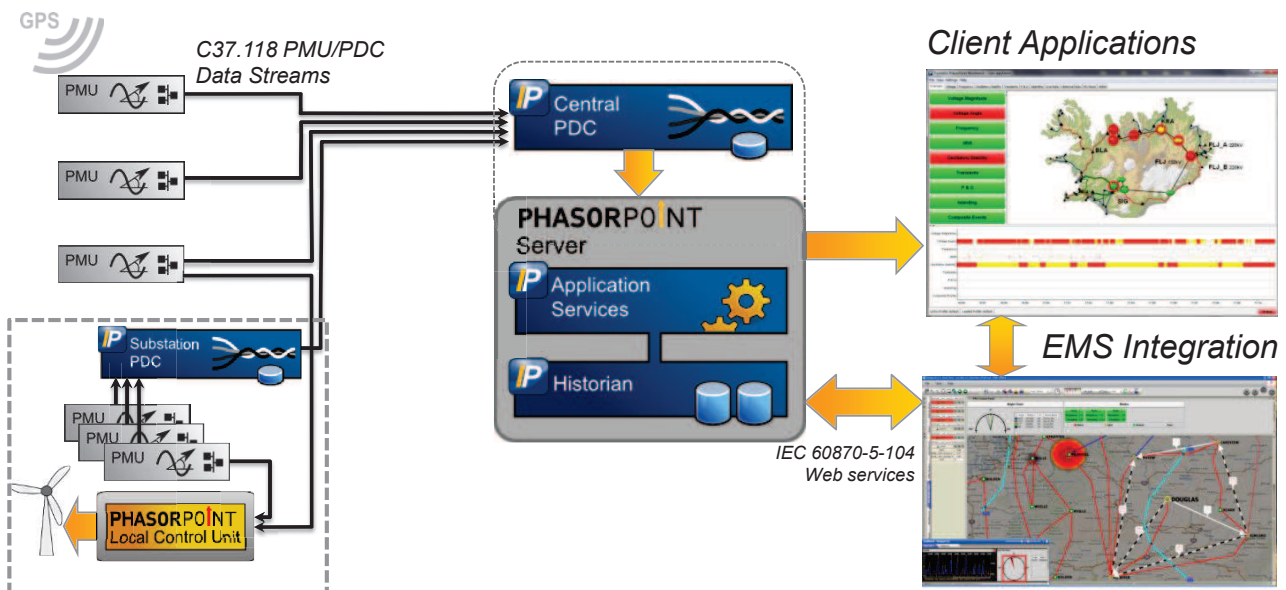
Why Synchrophasors?



Improve security
Increase transfer
System analysis
Manage renewables



Wide Area Monitoring, Protection and Control Solutions



CONFIDENTIAL

Copyright © 2012 Psymetrix Limited

4

PhasorPoint Summary



Real-Time Control Room

Oscillation
Management

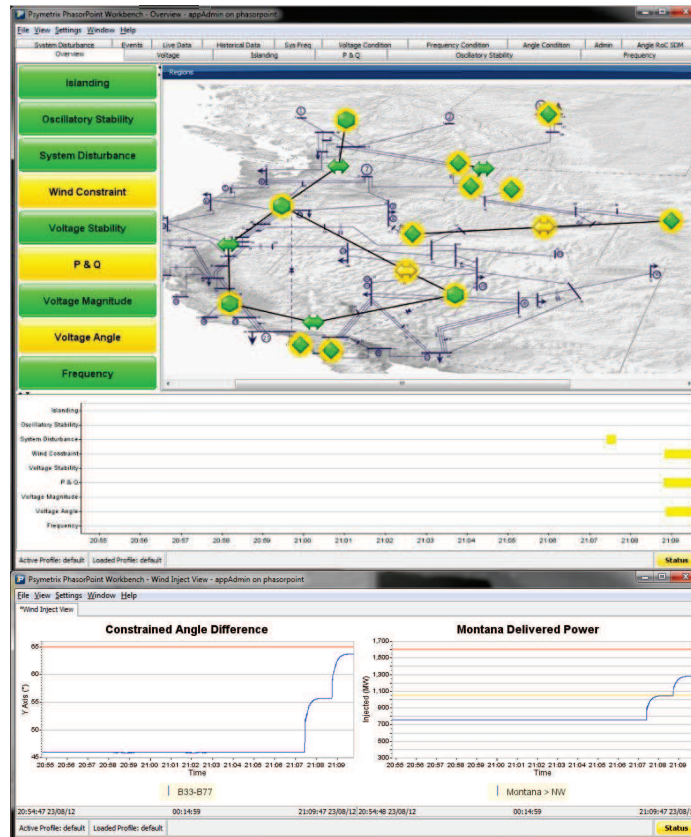
Separation
Management

Disturbance
Monitoring

Angle
Constraints

Situational
Awareness

**Proven
Scalable
Flexible**



Historic

Analysis & Design

Post-event
analysis

Control
Design&Test

Stability Risk
Assessment

Renewable
Connection

Operator
Support

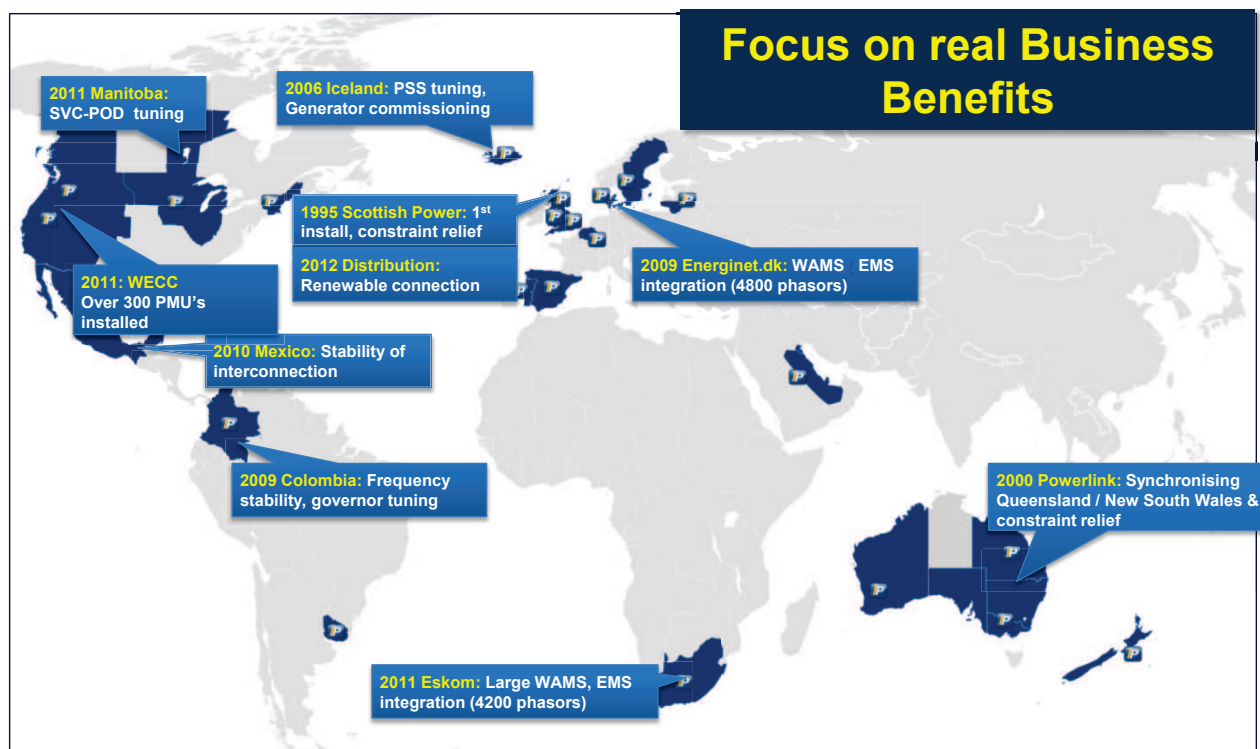
**Efficient
Manageable
Open**

CONFIDENTIAL

Copyright © 2012 Psymetrix Limited

5

Global Activities



CONFIDENTIAL

Copyright © 2012 Psymetrix Limited

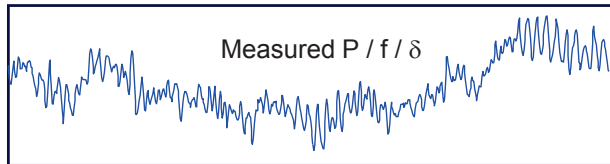
6

Oscillatory Stability

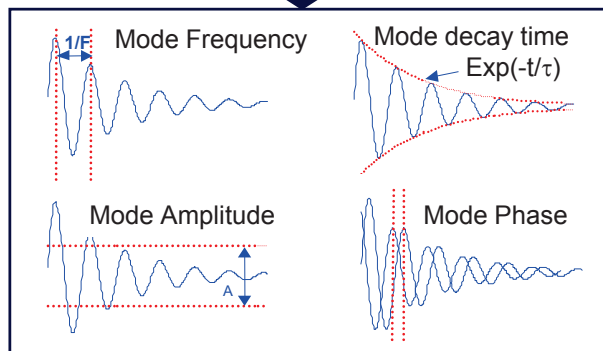


- ◆ For recurring oscillation issues
 - ◆ Select measurements where mode observable
 - ◆ Analysis to extract stability information (PDX)

PROBLEM IDENTIFICATION
Measurement & Analytics



Simultaneous multi-oscillation detection and characterisation direct from measurements



Fast Modal Analysis: **Alarms**

Trend Modal Analysis: **Analysis**

Alerts/Alarms show the operator when and where to take action

CONFIDENTIAL

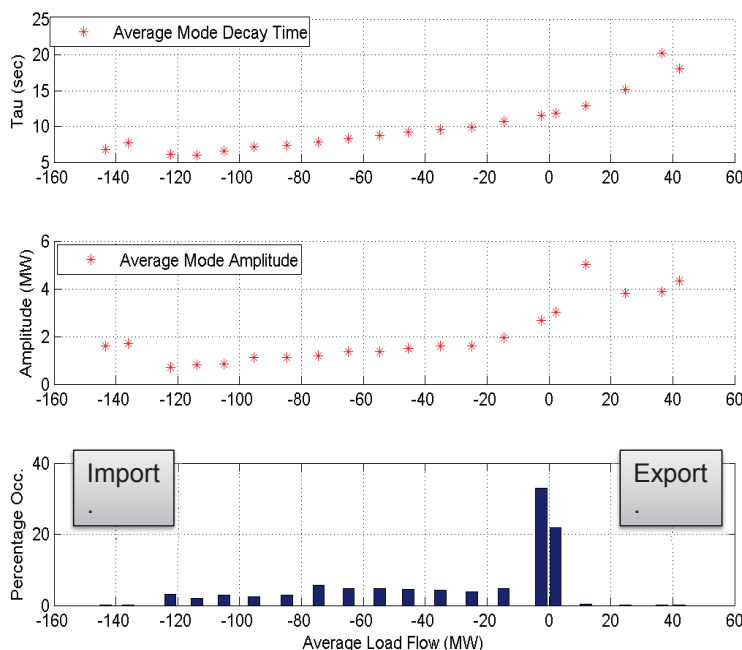
Copyright © 2012 Psymetrix Limited

7

Ecuador, 0.42Hz Oscillation



- ◆ Damping vs. Loadflow Relationship?
 - ◆ Dispatch rules for use in Control Room



OPERATIONAL GUIDANCE
Procedure to accompany alarm

Reducing export improves damping

Rule: Staged export decrease till damping improves

Further work to define most effective specific actions

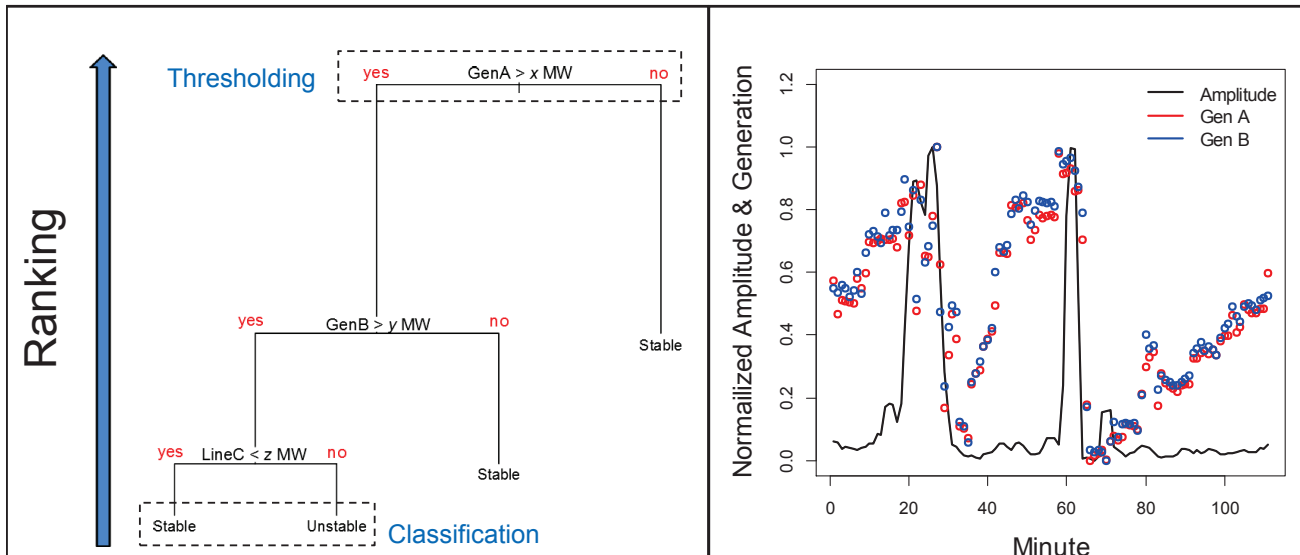
CONFIDENTIAL

Copyright © 2012 Psymetrix Limited

8

Oscillation Source Location

- Relationships damping vs loadflow
- What combination of conditions lead to poor damping?
- Classification Trees for hierarchical structure and ranking



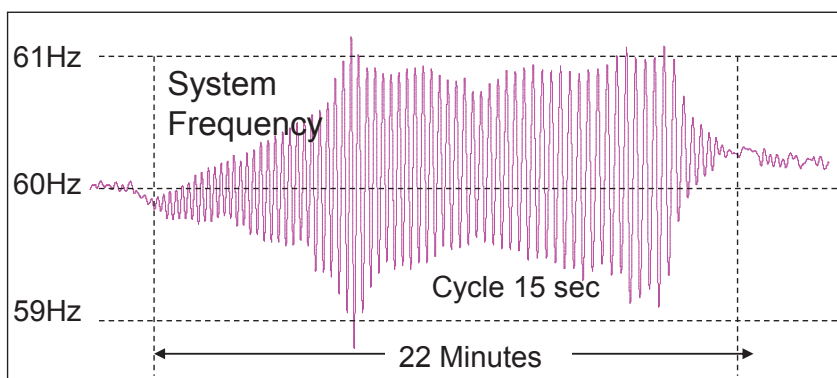
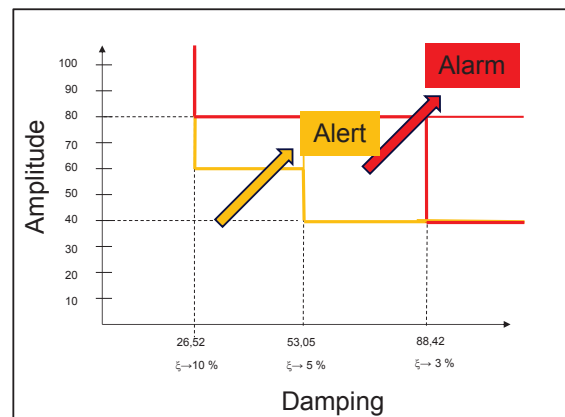
CONFIDENTIAL

Copyright © 2012 Psymetrix Limited

9

XM, Colombia

- Identifying & resolving frequency instability
- Governor testing & tuning
- Control room warning/response
- Operational rules in alarm state
- Planned
 - Generator Modelling & Test tools
 - Wide Area Defence Scheme



CONFIDENTIAL

Copyright © 2012 Psymetrix Limited

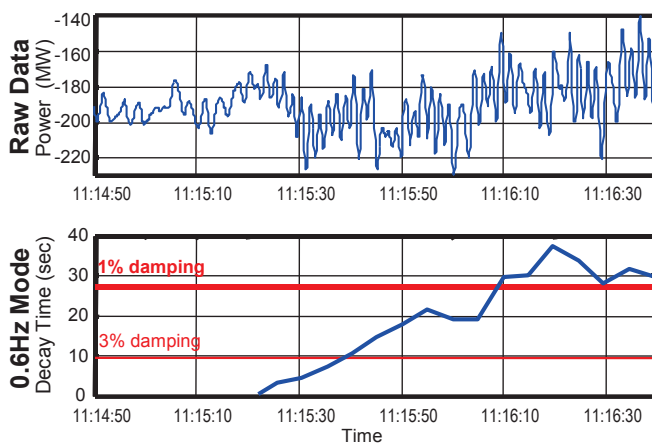
10

AEMO & Powelink, Australia

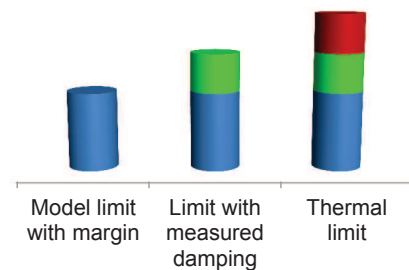
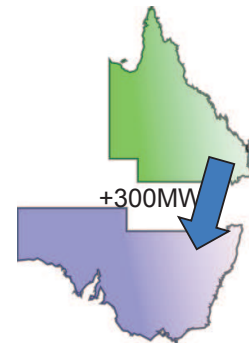


- ◆ Control-room monitoring & alarming
- ◆ Oscillation constraint relief
- ◆ Avoiding system separation
- ◆ Commissioning
(e.g. QNI & other interconnectors)

Separation avoided, 10 April 2004



Queensland – NSW Interconnector



CONFIDENTIAL

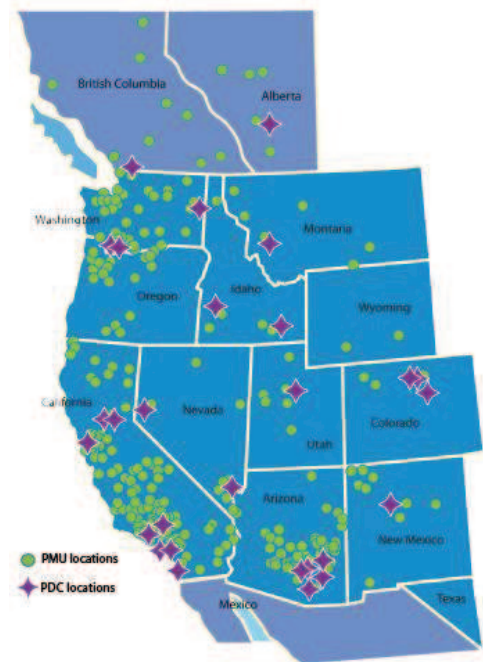
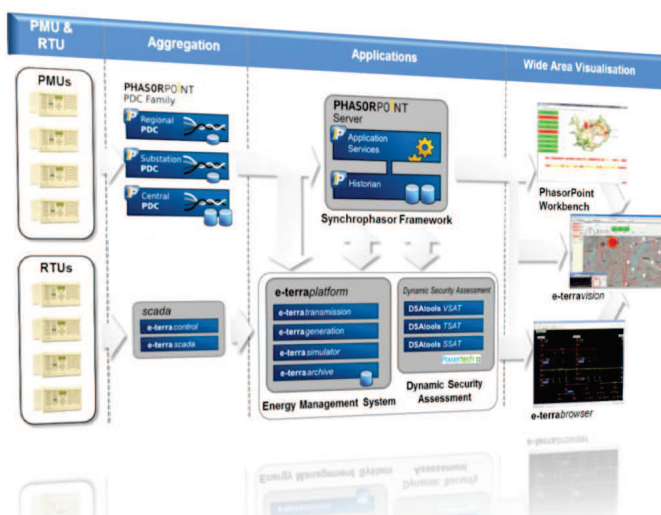
Copyright © 2012 Psymetrix Limited

11

WECC, US / Canada / Mexico



- ◆ Integrated WAMS, EMS, DSA
- ◆ 340 PMUs, 50 PDCs
18 utilities, 3 countries
- ◆ Issues
Oscillations, Disturbances, Islanding, Voltage Stability, Connecting Renewables



http://www.wecc.biz/awareness/Lists/SiteNews/Attachments/12/WISP_FactSheet.pdf

CONFIDENTIAL

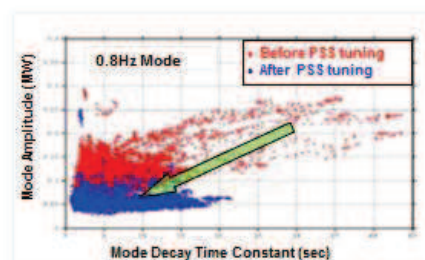
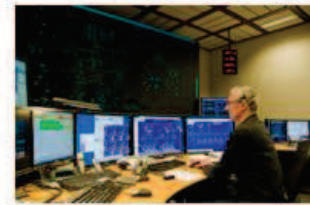
Copyright © 2012 Psymetrix Limited

12

Landsnet, Iceland



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



CONFIDENTIAL

Copyright © 2012 Psymetrix Limited

13

Islanding Video



PHASORPOINT CASE STUDY

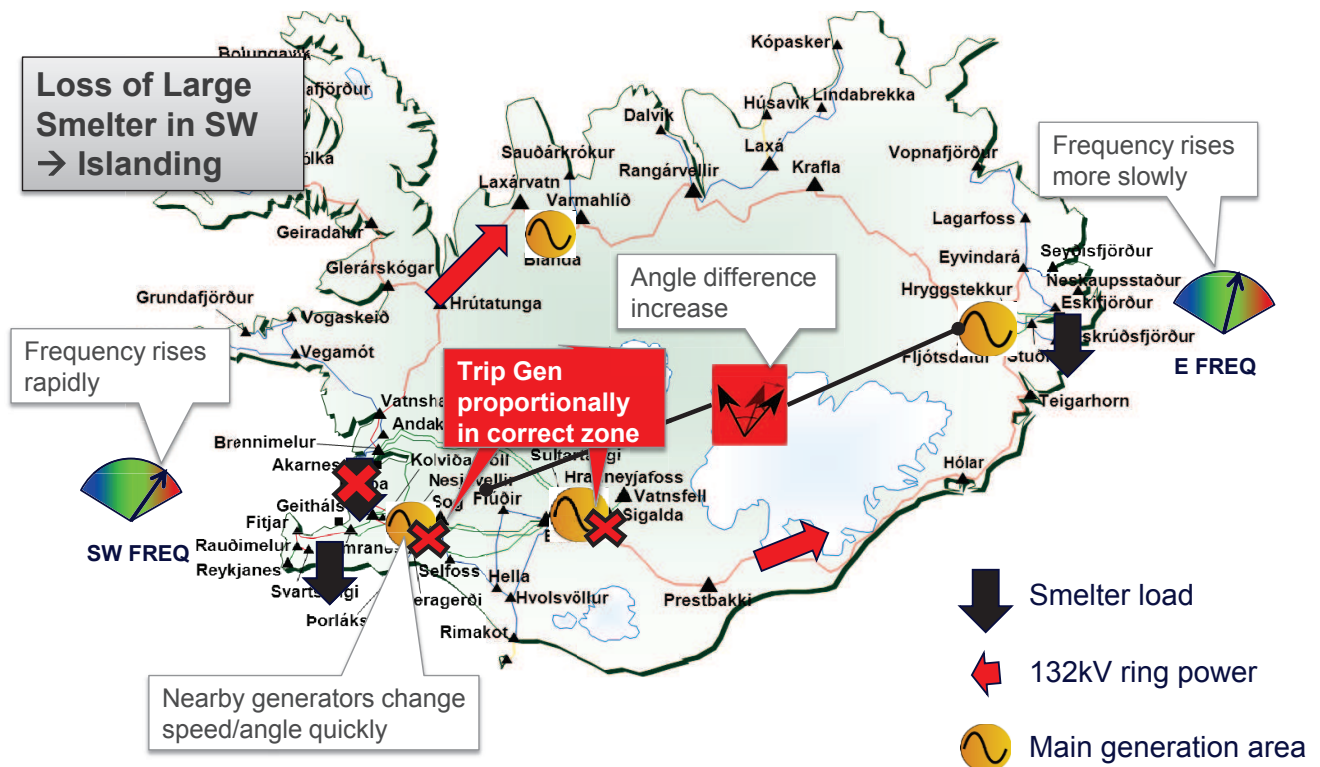
System Separations in Iceland

CONFIDENTIAL

Copyright © 2012 Psymetrix Limited

14

Wide Area Defence



CONFIDENTIAL

Copyright © 2012 Psymetrix Limited

15

Summary



- Psymetrix & Alstom Grid combines world leading WAMS & EMS solutions
- Joint vision and roadmap for deployment of synchrophasor technology
- Unified operational system view
- Improved awareness of system behaviour
- Improving system reliability
- Constraint relief opportunities

solutions for secure and sustainable grids

CONFIDENTIAL

Copyright © 2012 Psymetrix Limited

16