



turning synchrophasor data into actionable information for secure, efficient and sustainable electricity networks

*Robert Folkes
robert.folkes@psymetrix.com*

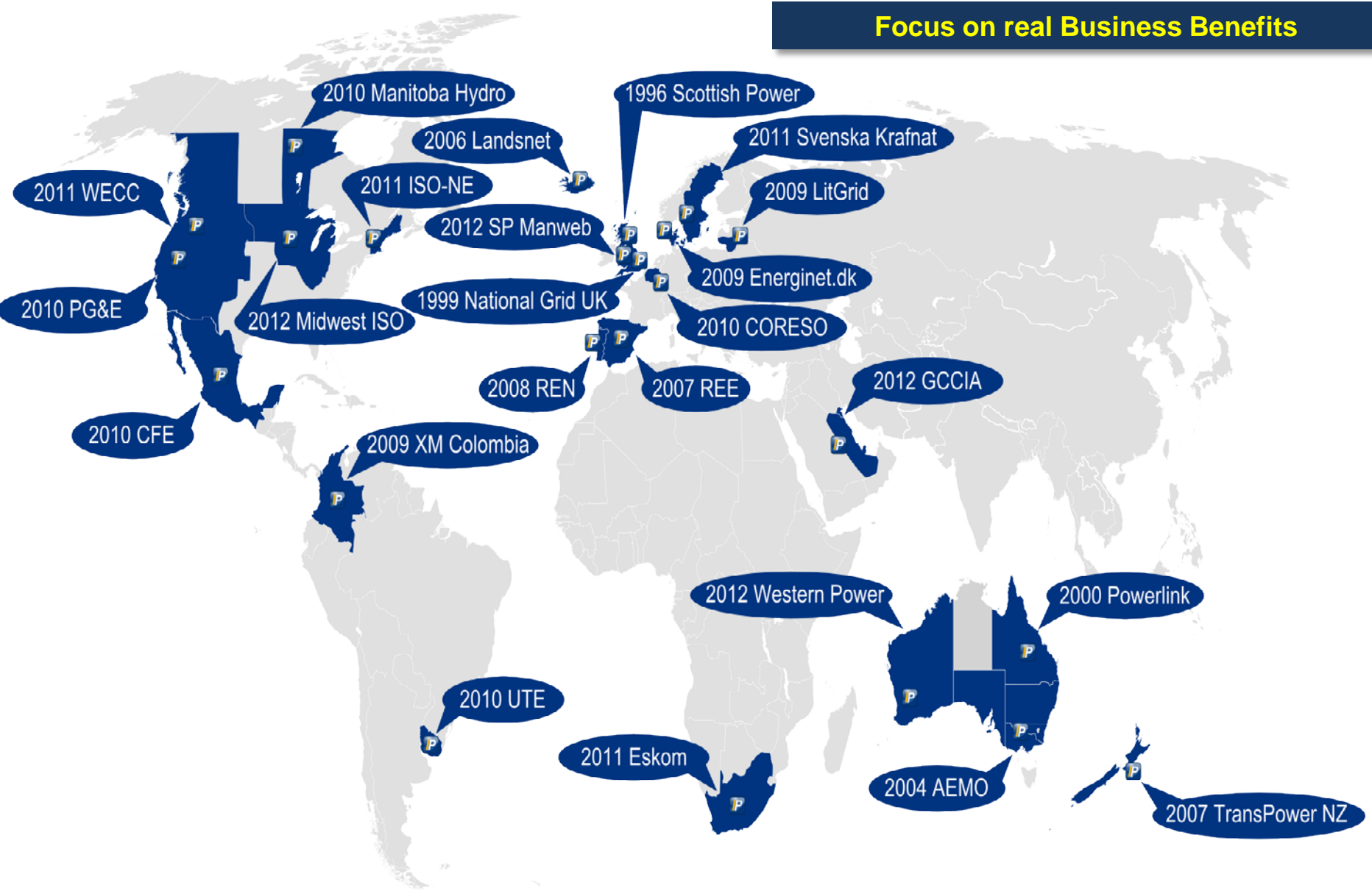
*Ryan Zuo
ryan.zuo@alstom.com*

Psymetrix is Alstom Grid's global **Centre of Excellence** for phasor-based applications including PDC and On-Line Stability Analysis

GRID



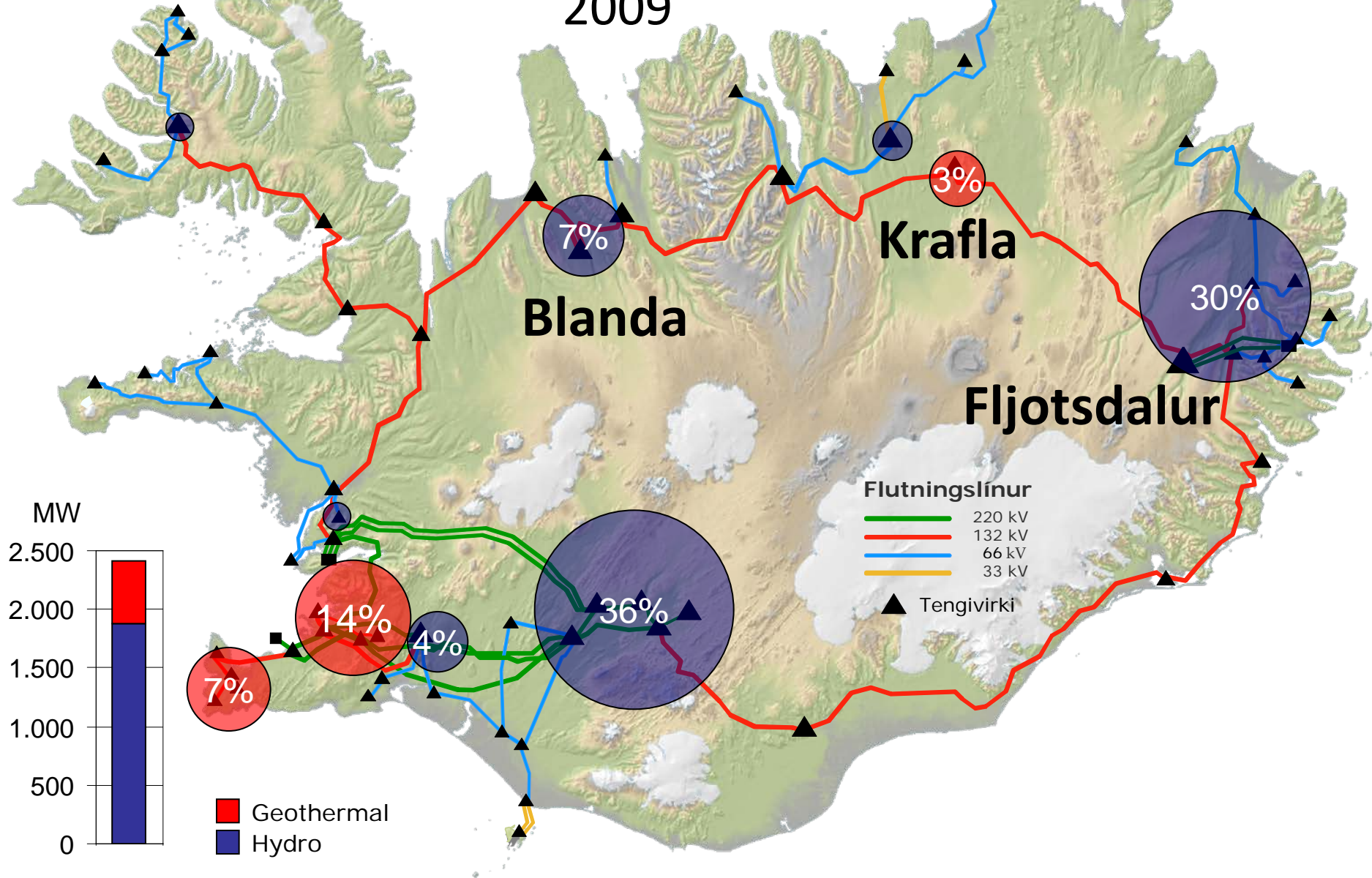
Focus on real Business Benefits





Generation Capacity

2009

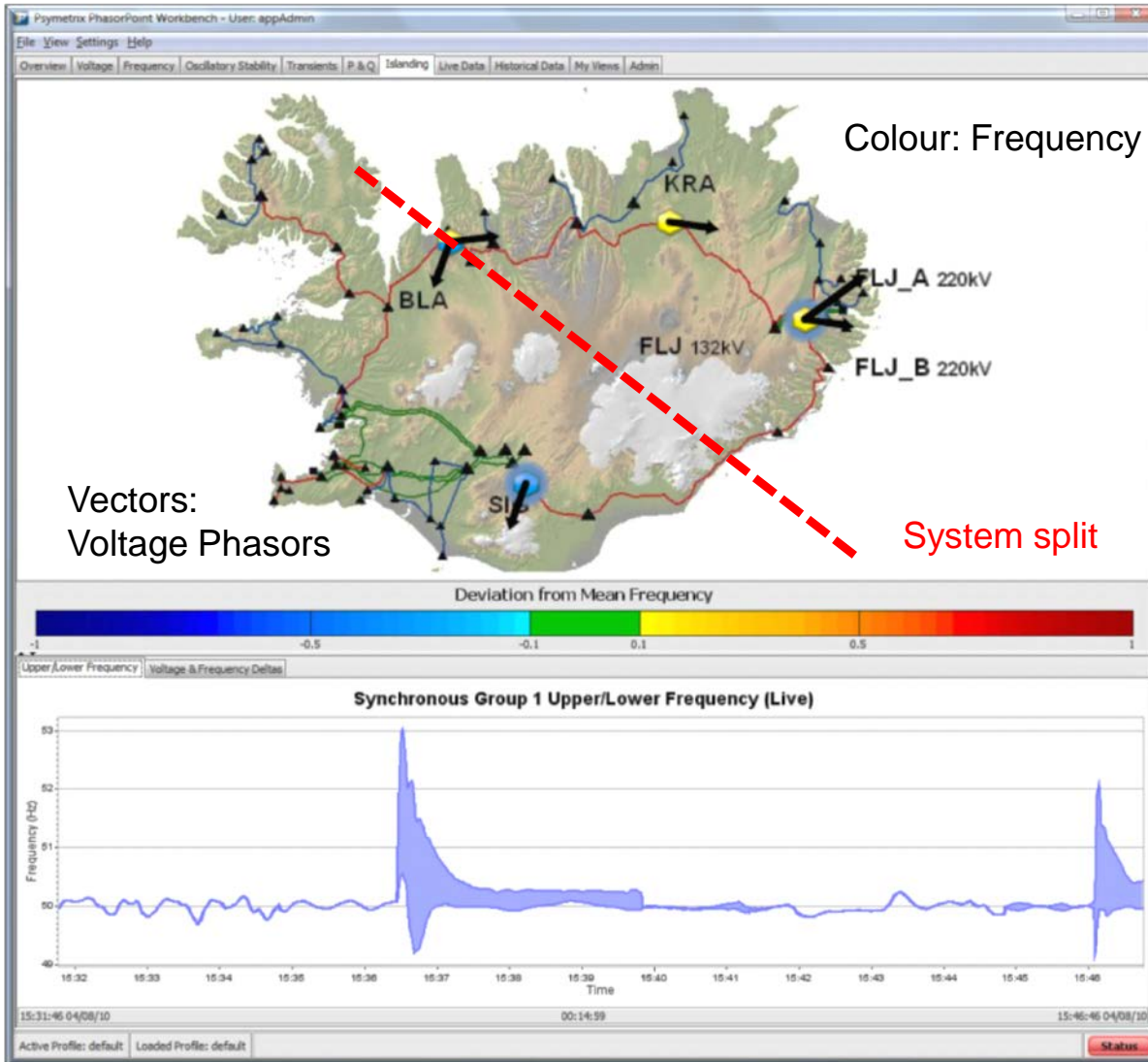


- ◆ Total load in Iceland 2100 MW
 - ◆ Aluminum smelters/potlines 1300 MW – **very large unit loads**

- ◆ Faults in the power system often cause potline trips.
 - ◆ Some thyristor controlled potlines must trip on line fault, to protect thyristors
 - ◆ Frequency deviation causes trip

- ◆ If a potline trips, large part of the load is lost
 - ◆ Geothermal plants may trip, several hours to reinstate
 - ◆ Transmission system may split into ≥ 2 islands \rightarrow weaker system, less able to stabilize
 - ◆ Recent 3- Φ fault caused several potline trips. 800MW lost ($\frac{1}{2}$ all load), frequency peaked at 54 Hz

- ◆ Defense Scheme Goals
 - ◆ Avoid system separation if possible
 - ◆ Otherwise, improve chances of island to recover
 - ◆ Only operate when required, avoid over-response



Identify islanding quickly

Alarm raised

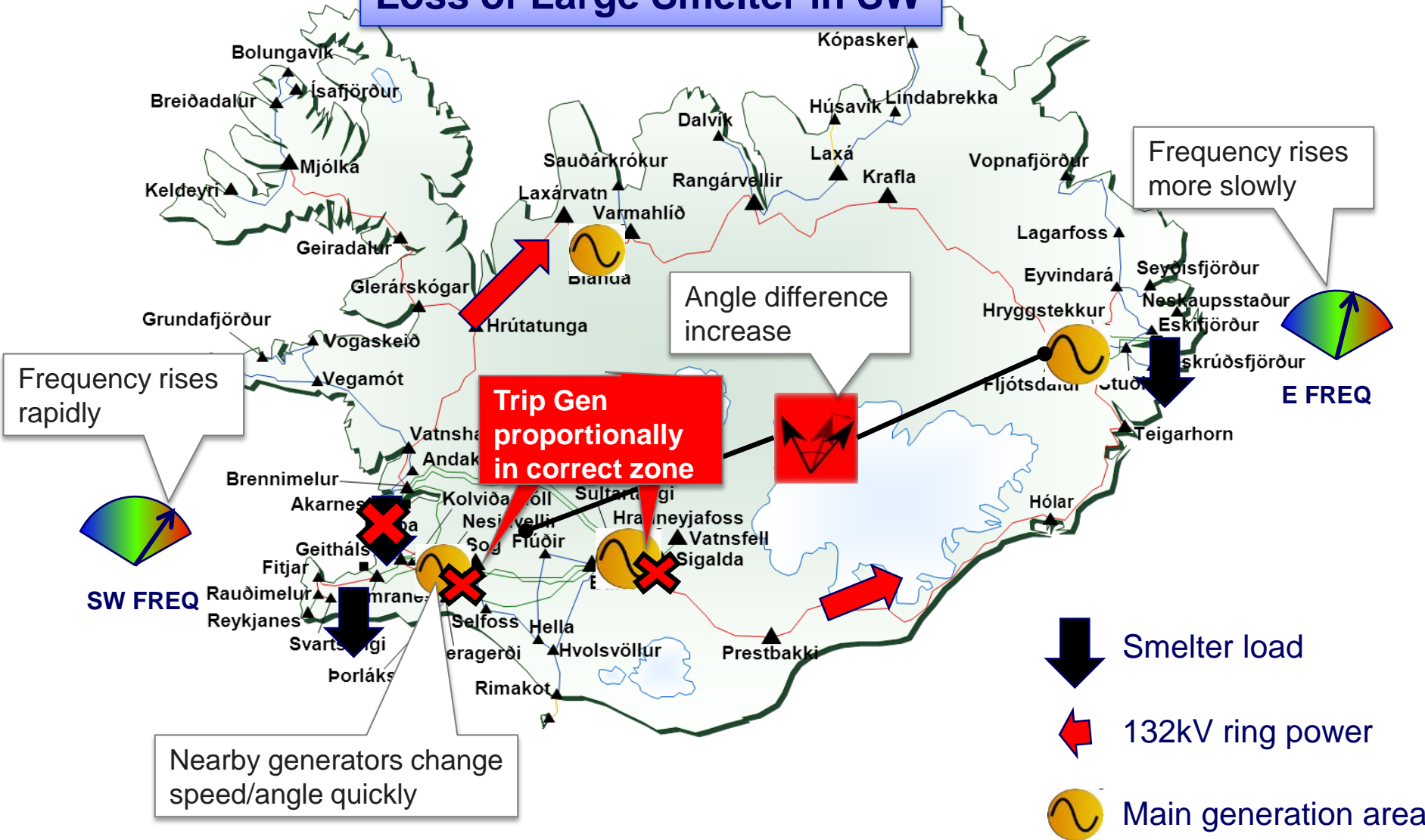
Islands clearly visualised

Keep customers connected

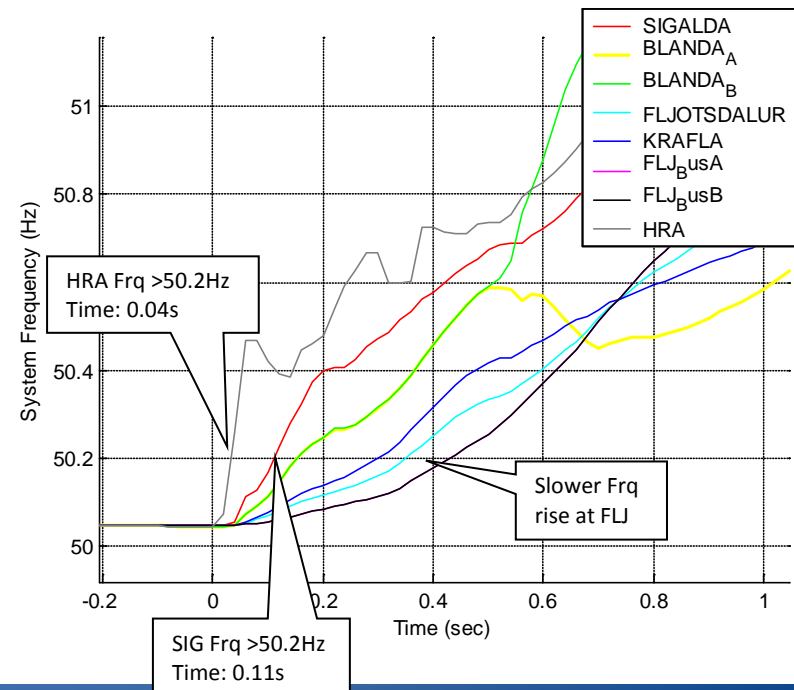
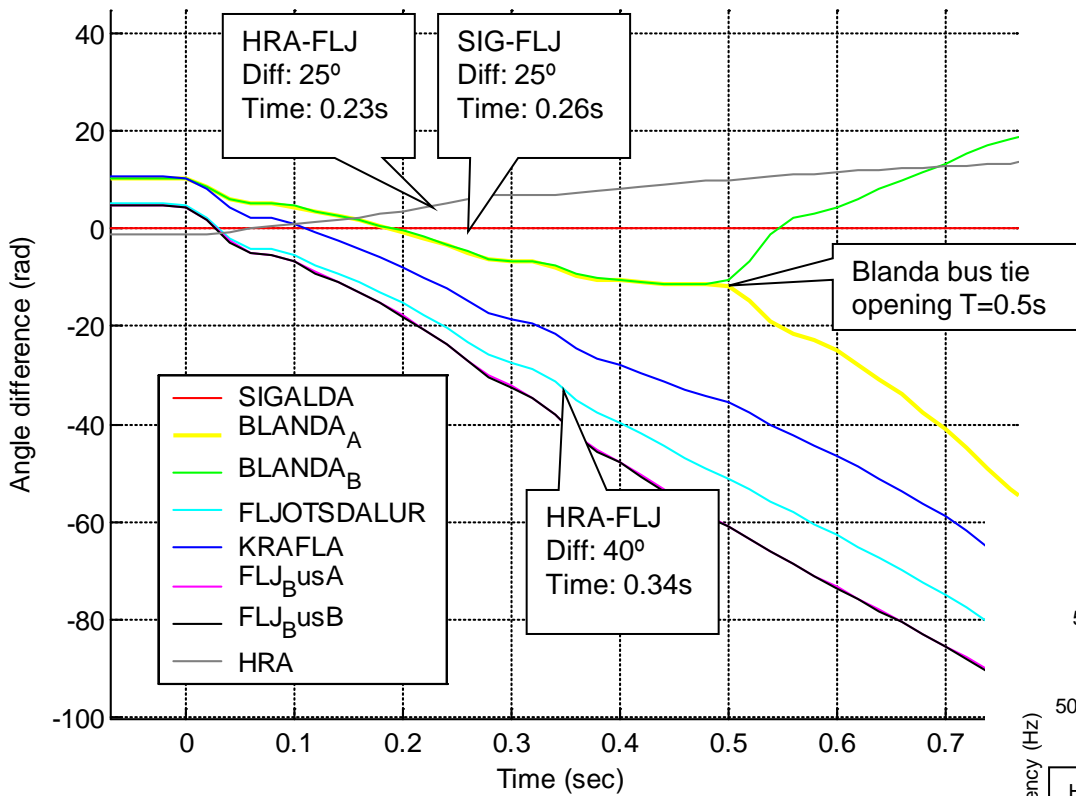
Reduce time to resynchronise

Improve system visibility in blackstart

Loss of Large Smelter in SW



Disturbance Record – 1 Sept 2010



Frequency Difference Δf

Δf

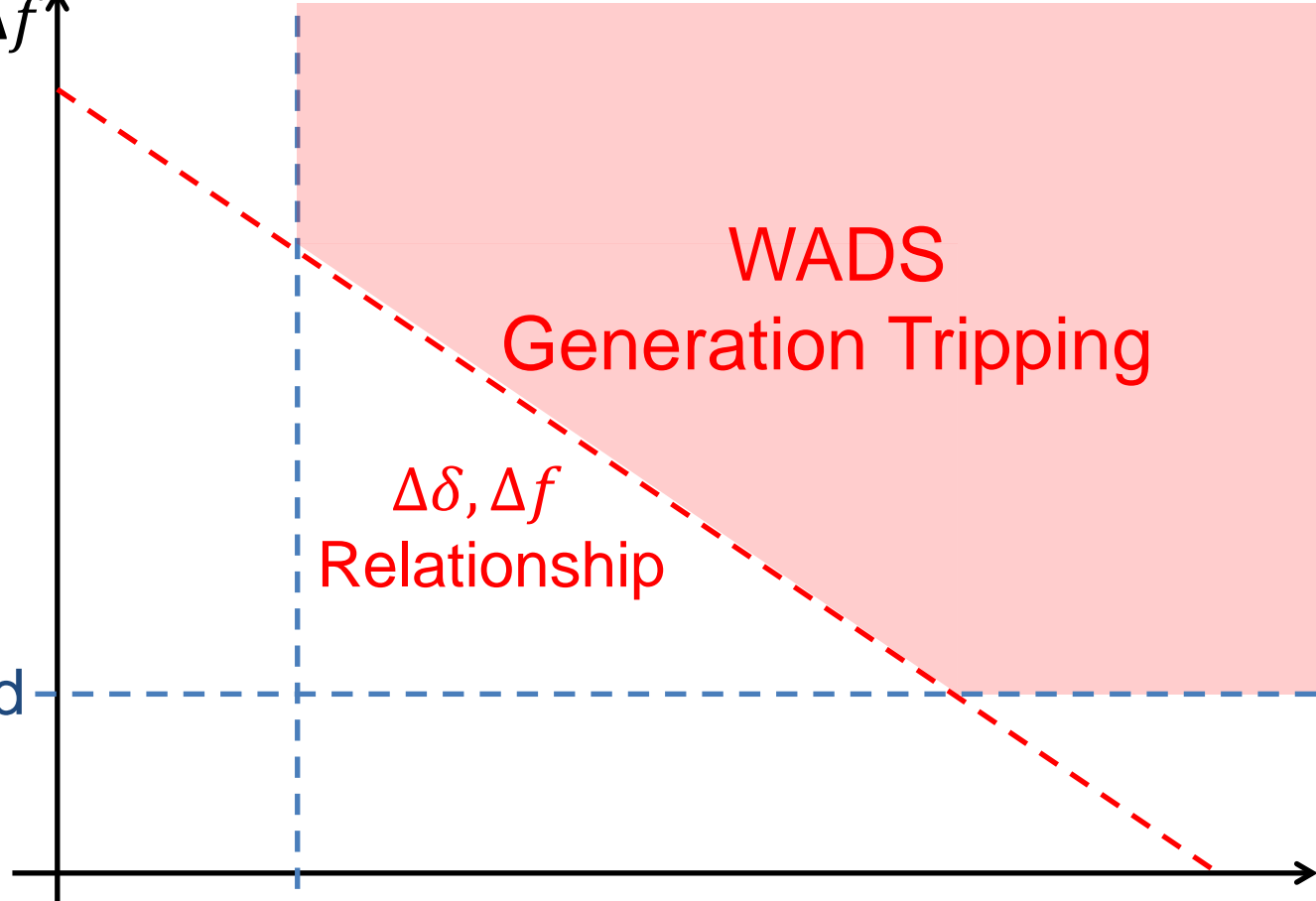
WADS
Generation Tripping
 $\Delta\delta, \Delta f$
Relationship

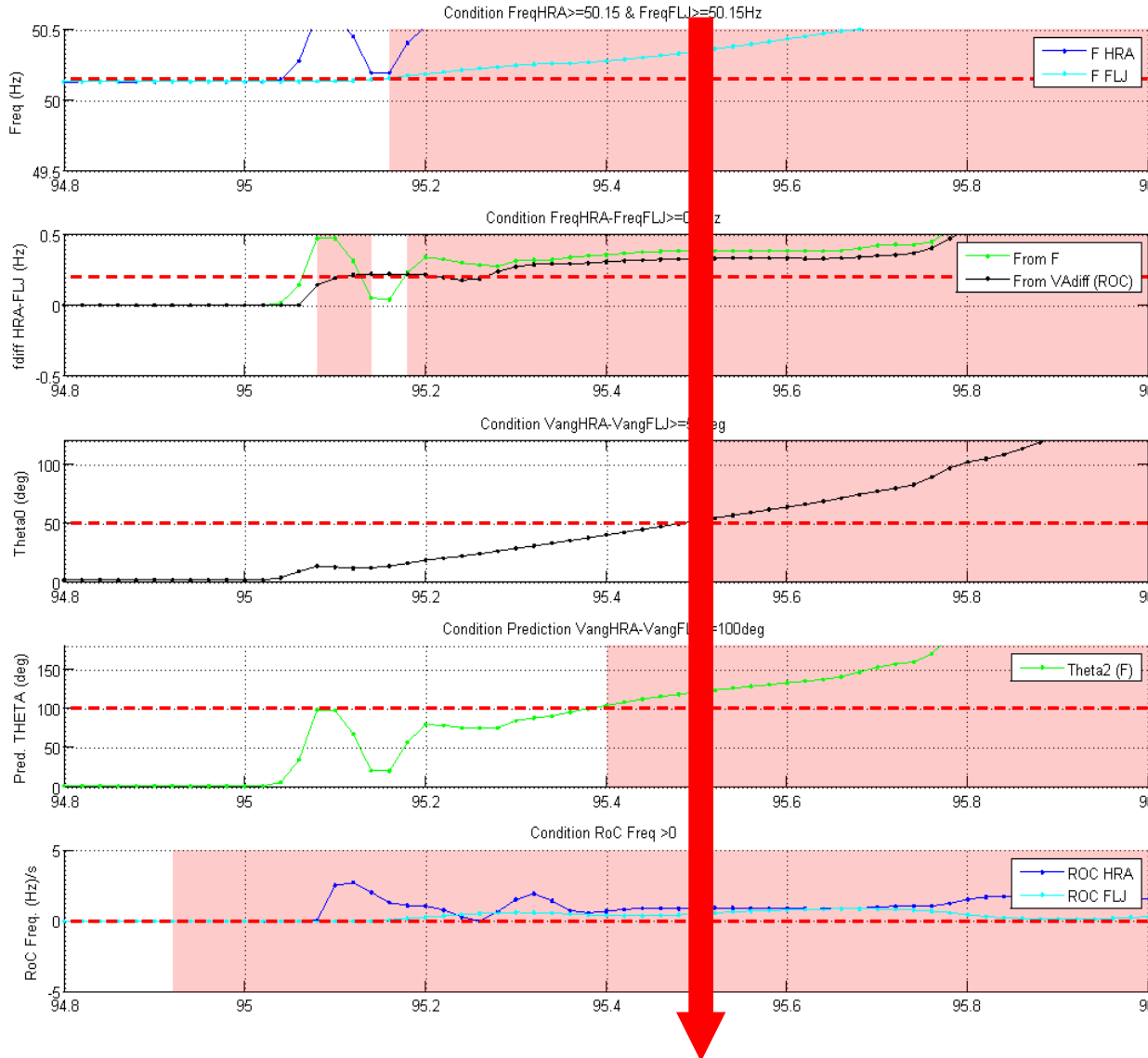
Δf Threshold

$\Delta\delta$

Threshold

Angle Difference $\Delta\delta$





Pink background = criterion met

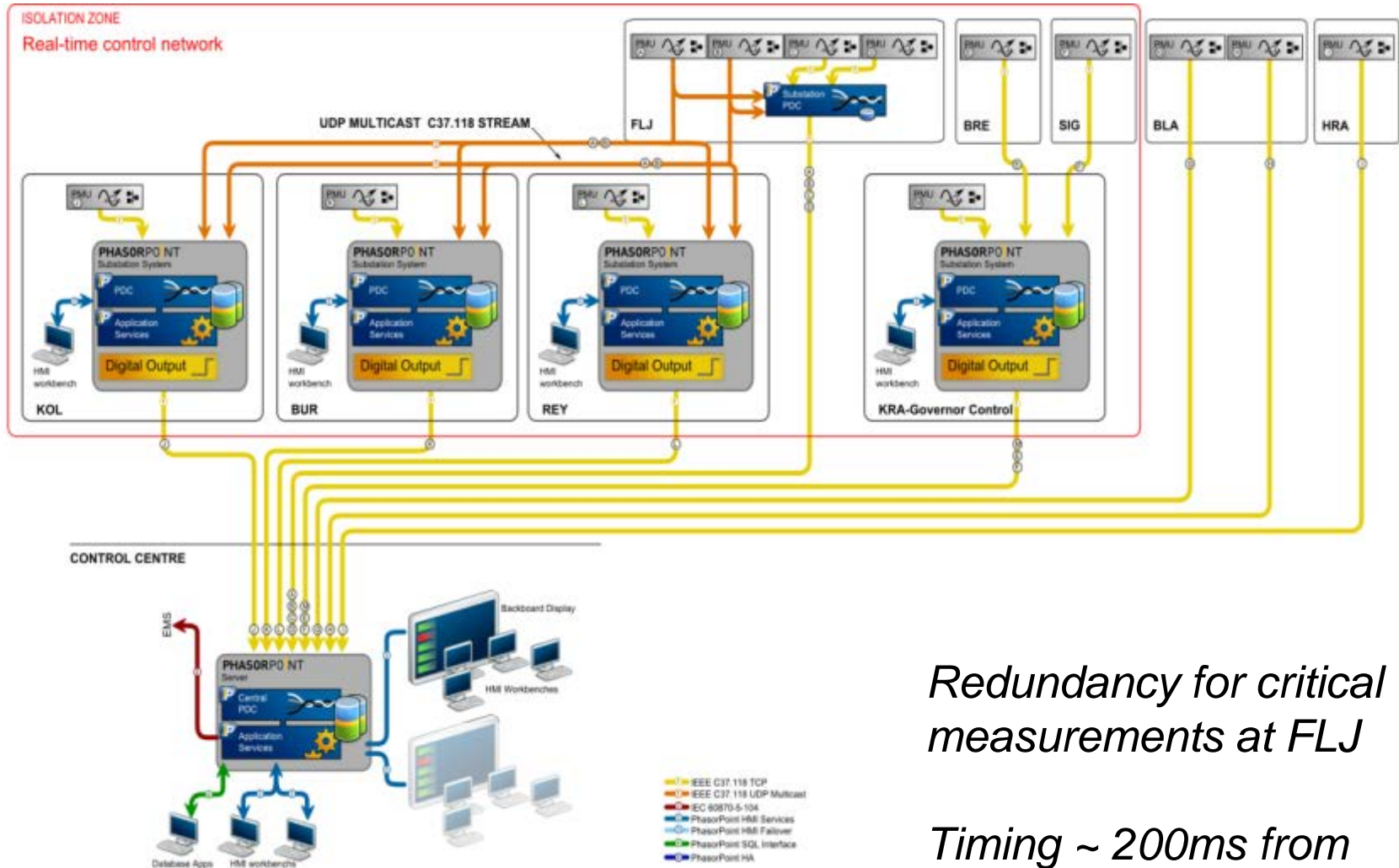
Measurements show:

- *Restraint when not required*
- *Triggering when required*
- *Confirm thresholds*

Simulations show:

- *Triggering conditions met for “family” of problems*
- *Threshold levels*
- *Effectiveness of actions*

All 5 Criteria met – tripping begins

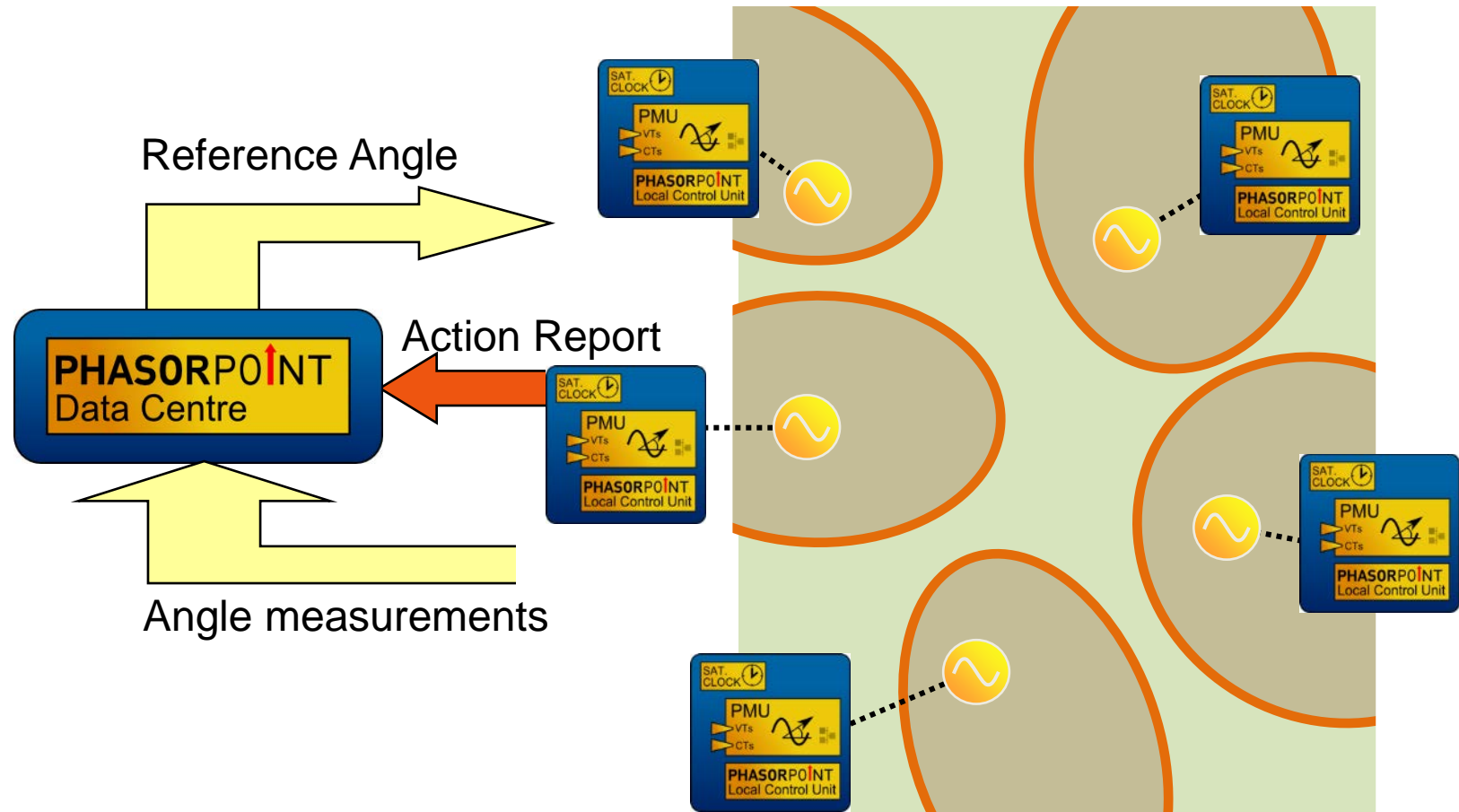


Redundancy for critical measurements at FLJ

Timing ~ 200ms from trigger conditions to trip

How can angle stability defence scheme be generalised for:

- Multiple areas (Iceland has 2 areas)
- Multiple fault types – Gen loss, load loss, line loss, short circuit



Are WADS the next generation of SIPS?

- ◆ Iceland is different because they push their system hard – but as other countries aim for 100% renewables, they are likely to face similar challenges
- ◆ Conventional SIPS are increasing in complexity - there may come a point where WADS are the only viable way forwards
- ◆ Projects like this are moving WAMS forwards from monitoring to control
 - - Psymetrix are presently working on two other control projects

- THANK YOU