SGTech17 – Automatic Controls Using WAMs

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Overview

1. The Icelandic Transmission System and Challenges in System Operation
2. WAMS in Landsnet’s Control Room
3. WACS and Smartgrid Projects
4. Migrate and Upcoming Projects
Peak load: 2250 MW
Total load: 17.7 GWh
100% Renewable Sources:
70% Hydro
30% Geothermal

Power intensive industry loads consume 80% of the total load

Introduction
Land Area 100,000 km²
Population 320,000

West Island
Hydro: 996 MW
Geo: 595 MW

East Island
Hydro: 846 MW
Geo: 60 MW

132 kV Ring connection
220 kV
Cut IV
WAMS
(Wide Area Measurement System)

- First PMU installed in 2006
- Today there are 34 PMUs in operation in 21 locations

PMU (Phasor Measurement Unit)
Phasorpoint Server
Landsnet’s Control Room
WACS Targets
(Wide-Area-Control-Schemes)

Islanding
Reduce occurrence by fast stability response
Minimise impact by improved island balance

Security of Supply
Reduce number and duration of outages
Reduce frequency excursions & trips

Extended use of network
Increase capacity of existing transmission
Offer new managed connections
WACS and Smartgrid Projects in Operation

East Load Shed
Triggered load shed

Microgrid
Island operation

Smelter Load Control
Down&Up fast action
Microgrid in the East

Auxiliary load ~20-30 MW

Potline X MW

20MW ≤ ΔP_{diff} ≤ 120MW

P > 130MW

20MW ≤ ΔP_{diff} ≤ 120MW

ARE

KR2

FL2

FLJ/KAR
Smartgrid – Microgrid in Vestfirðir
Dynamic Load Control of Smelters

Up regulation

- Step Up 1
- Step Up 2
- Ramp rate down

Down regulation

- Step Down 1
- Step Down 2
- Ramp rate up
Dynamic Load Control of Smelters
130 MW load loss in southwest

\[ \Delta P \approx \frac{d f_{\text{BRE}}}{d t} \cdot B R E \cdot d t \]

\[ \approx 800 - 900 \text{ ms} \]
Dynamic Load Control of Smelters

70 MW generation loss in southwest

1st load shedding limit at 49 Hz
Demonstrate Synchrophasor-Based System Response Control

• Demonstrate new system-responsive control
  – **Discrete control** fast triggered load step
e.g. East Iceland Load Shed, NAL, ISAL
  – **Fast ramp control** fast triggered gen/load ramp e.g. HRA
  – **Intelligent splitting** split choice for island balance e.g. SIG

• Proportionate to event, sensitive to location
• Implement with existing WAMS infrastructure, recommend for progression
• Repeatable process, can replicate for new service providers
East Load Shed
Triggered load shed

Adaptive Islanding
Choosing split-line

Generator fast ramp
Down&Up fast action

Smelter Load Control
Down&Up fast action

PhasorController (PhC)
- PLC
- WACS
- Advanced Function blocks
- IEC61850 – Goose
- ...
Distributed Wide Area Control Architecture

Control Units initiate response proportionate to event, self-limiting and sensitive to islanding state. TRIGGERED or RAMP responses of resource applied.

ZONES Centres of inertia represented by aggregate frequency & angle measurement. Zone Aggregate is SHARED with all Control Units.
Summary

• WAMS has become essential for Landsnet
  ➢ System monitoring
  ➢ Post-fault analysis
  ➢ Commissioning and testing of equipment

• WACS in operation have allowed for increased capacity of existing transmission system and have increased the security of supply

• Migrate – Develop distributed fast responding and robust control
  ➢ Discrete control
  ➢ Fast ramp control
  ➢ Intelligent splitting