Protection & Control in Smart Grids

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Operating the system closer to the limits …

Traditional power network design:
- Conventional generation
- Limited interconnection & exchange of energy
- Generation follows load

Today’s trends:
- Integration of decentralized energy resources
- Increasing size of interconnected systems
- Limitations in primary system extension
- Modern IT & communication offers new possibilities

Result:
The systems are operated closer to their physical limits
The response time is important …

0 … 100ms

Focus:
- Safety
- Avoid damage
- Limit currents & voltages

Realization: locally

100ms … 2min

Focus:
- Control stability
- Influence load
- Reconfiguration

Realization: mixed

2 … 5 min

Focus:
- Economic operation
- Coordination of work

Realization: centralized

Increasing importance
Your investment strategy has to incorporate different areas

The investment must be balanced properly!
Some examples
Systematic planning of network structure and protection concepts

Proper planning reduces investment and improves reliability!
Smart solutions require communication

Modern communication
- Transmits data for smart functions
- Helps the protection engineer to operate his system

The world wide accepted standard for communication in substations is IEC 61850

Meet the standard
IEC 61850

Main features are:
- Flexible and future-proof
- Engineering is part of the standard
- 100 MBit/s Ethernet performance
- No protocol converters
- Worldwide accepted Interoperability
- Ethernet allows different services on one bus

Challenges:
- Communication technologies have shorter life cycles
- Competence management

Smart solutions require flexible communication!

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PMU
Wide Area Monitoring with Synchrophasors

Measurement of vector quantities of voltages & currents with high accuracy in regard to amplitude, phase angle and time synchronization

IEEE C37.118

$V, I, f, \frac{df}{dt}$
Phasor measurement applications

Wide Area Disturbances:
- Inter-Area; Local Oscillations
- Voltage Collapse
- Frequency deviation
- Loss of synchronism

OSCOP P
- Offline monitoring
  - Offline evaluation
  - Redundant data

PDC
- Online monitoring
  - Online evaluation

Control centre use

Phasors

IEEE C37.118

SIPROTEC PMU (Prototype)

SIMEAS R PMU

TPR / CPR

Real-time respond

Online processing
- System protection
- Advanced out-of-step
Summary

- Our grid infrastructure is facing new challenges: we will operate the systems closer to the limits
- Balanced investment is required to achieve reliable and cost effective systems
- New technologies are used to build consistent, future proof solutions
Thank you for your attention!

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