ERCOT PMU Conference
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Smart-Substation™
How does my substation change in the world of the Smart Grid?

Movement from a Static As-Designed to a Proactive Intelligent Substation Infrastructure

**From:**
- Local Manual Inspection & Evaluation
- Periodic Maintenance
- Centralized Control, large footprint Protection System, Manual Switching, & Trouble Response
- General Knowledge of Environmental Conditions and Operating Status
- Physical Security

**To:**
- Self Monitoring, Remote Diagnosis & Reporting
- Prioritized Condition-Based Predictive Maintenance
- Compact Distributed Protection & Control with Automatic Response and Predictive Avoidance
- Time-Correlated Environment, Operational & Non-Operational Status
- Intelligent Automatic Monitoring & Detection and Cyber Security
Smart-Substation™
What cutting-edge technology can Siemens provide

Non-operational
- Voltage Regulator Monitoring
- Fault Records
- Intrusion Monitoring
- Harmonics and Power Quality Monitoring
- Transformer Health Monitoring
- Circuit Breaker Health Monitoring
- Environment Monitoring
- Security Monitoring

Operational
- Communication
- Monitoring, Protection and Control
- Load Shedding Load Transfer
- Load Tap Changer Control
- Fault Characterization, Location Response
- Power Factor and Cap Bank Control
- Reclosers, Switches & other Field Devices
- Data Encryption
- Phase Measurement Unit
- Station Control
- Local Visualization

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Potential SMARTGrid Distribution Level Integration

Enterprise Systems
- CIS & MDM
- Eng. Analysis
- GIS

Distribution Management Systems
- AMI
- Distributed Resource Mgmt.
- Dispatch Operation M Analysis
- Dist. SCADA

Bulk Power Mgt. Sys.
- Trans. SCADA
- TMS

Corporate IP WAN

Customer Automation

IP WFAN
- Feeder IEDs

Distribution Automation - IEC 61850 Messages
Automated Metering Communication - ANSI C12.22 Messages
Transmission SCADA
Enterprise
Security/Authentication

AMI FAN Gateway

ADA Controller
- Dist IED
- Dist RTU

Substation

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How to push CIM model to substation

- CIM data model from GIS to DMS
- Communication between DMS and substation over different mediums and protocols
- Depending on the model in the substation, multiple solutions for the “brain” in the substation are possible
Linking CIM and IEC 61850

CIM: IEC 61970

- UML, Inheritance, Associative, Flexible

IEC 61850

- Tables, Aggregation, Hierarchical, Standardized

- XML, tool for both models

- Rules for mapping

East-West

Transmission substation

Breaker 8

MMXU1

PhV

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Substation SCADA
A component-based modular system architecture

Substation SCADA – component overview

Field & substation devices

ADA Controller & local WEB UI

Substation SCADA

IEC 61850
DNP

SCADA
IMM
VVC

UI
Base
PF

others
ICCP
TMDS

IEC 61850

DNP
DNP
others
SEL (IED)
GE (IED)
Others (IEDs)

TM 1703 emic Small RTU

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Substation SCADA
Modern easy-to-use Windows user interface

- All applications at one glance
- Local and remote viewing
- Intuitive and self-learned ergonomics’ concept
- Ease to visualize and analyze the information
- Fast and secure operation
- Workflow-oriented Workspace and Navigation capabilities
- Clear distinguished presentation between Real-time and Study operations
Advanced Applications in Substation SCADA

... optimizes the efficiency

- Fault Location
- Fault Indicators / Short Circuit
- Fault Isolation & Service Restoration
- Power Flow Calculation
- VVC
Substation SCADA
Web based architecture - user interface

Web based and mobile operation

Secure information access …
… at any time and any place

- From mobile workplaces, e.g. from car
- From multi-screen consoles in the control center
- From remote standby shift location and at home
- From standard PC in the office
- Alarming via wireless devices, e.g. mobile phone and SMS
Features and functions of Substation SCADA

- Substation SCADA as the D-SCADA Controller
- Interfaces to existing devices (DNP, Modbus, ..)
- Downloadable logical CIM model
- Fully IEC 61850 compliant
- Integrated Web UI
- Fault location, isolation & restoration based on logical model
- Advanced intelligent calculations based on CIM model

IEDs
IEC61850, DNP, ..
Possible solution
D-SCADA Controller

Siemens Voltage Reg.

Cooper Line Recloser

S&C Capacitor Controller

DNP

IEC61850

DNP / IEC61850

Substation SCADA

Transmission RTU

IEC61850 IEDs
(OC, UV, OV, UF, OF, ...)

SEL protective relays

S&C PulseCloser

tbd
Smart-Substation™
What is the value of Siemens Smart-Substation™?

- Automation and decentralized logic improves power factor and helps to reduce outage times
- Substation design becomes standardized and repeatable
- Minimal engineering for commissioning reduces cost
- Integration of expert applications is the step towards Smart Grid
- Expert applications reduce information overload at the control center
- Better utilization of equipment reduces substation visits and improves fleet management
- Field proven system with extreme scalability high reliability
- Siemens expertise helps to manage the complexity of substation design
- Security helps to operate the substation with more reliability
SIGUARD System for Phasor Data Processing
Real Time Visualization and Disturbance Recording

Siemens Energy, Inc.
SIGUARD Phasor Data Processing System
System Architecture

- Install on single PC or multiple PCs
- Supports multiple User Interfaces (UI)
- Works with all PMUs strictly conforming to IEEE C37.118 Standard
SIMEAS R - PMU

Hardware

19-inch System
6 slots
up to
32 analog and
64 binary inputs

½ - 19-inch System
3 slots
8 analog and
16 binary inputs
PDC Concepts

SIGUARD is a software-based
- Phasor Data Concentrator
- Data Archive
- User Interface

- Users
  - System operators
  - Power system analysts

- Modes of Operation
  - Online: Real-time operation
  - Offline: Post event analysis
SIGUARD Phasor Data Processing System

Application Areas

- Voltage stability
- Frequency stability
- Power oscillations
- Loadability

- Inter-Area Oscillations
- Loss of Synchronization
- Heavy Load
- Line Trip
- Reactive power shortage
- Transmission corridor congestion
- Voltage collapse
- Cascading outages
- Frequency deviation
- Local Oscillations
- Loss of Generation

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SIGUARD Phasor Data Processing System

Conclusion

Primary Application Areas
- Voltage stability
- Frequency stability
- Power oscillations
- Loadability

Customer Benefits
- Operational support for preventing blackouts
- Close information gap between protection & SCADA measurements
- Greater loading of transmission lines while maintaining stability
- Fast analysis of power swings; quickly generate disturbance reports

Phasor measurement technology leads to future Smart Grid app’s
- System integrity protection schemes (SIPS)
- Power oscillation damping devices (FACTS, fast valving)
- Real time state estimator
Discussion