Protection & Automation Strategies for Distribution Automation in a Smart Grid
12th International Workshop On Electric Power Control Centers
Bedford Springs, Pennsylvania, USA
June 2-5, 2013
Introduction

- Grid
- Distribution System
- Centralized Substation Protection and Automation
- Balancing Authority to DMS
Understanding the Grid

Source: NERC Document - Understanding the Grid DEC12
How the Grid is Changing

http://www.seia.org/research-resources/solar-industry-data


A Proposed Natural Gas Combined Cycle Power Plant in New York
Source: New York Power Authority

http://www.naturalgas.org/overview/uses_electrical.asp
Electricity to 334 million people
Electricity demand of 830 GW
211,000 miles/340,000 Km. of high-voltage transmission line (230kV or higher)

http://www.opuc.texas.gov/images/NERC_Interconnections_Map.jpg
Over 100 Balancing Authorities. Overseeing the Balancing Authorities are operators called Reliability Coordinators.

Relationship between Reliability Coordinators and Balancing Authorities is similar to that between air traffic controllers and pilots.

Note: The highlighted area between SPP and SERC denotes overlapping Regional area boundaries. For example, some load serving entities participate in one Region and their associated transmission owner/operators in another.

As of July 25, 2012
Submit changes to balancing@nerc.com

Load Serving Entities (LSE): 53
Membership: 800+
Generating capacity: ~186 GW
Peak demand: ~164 GW
Generating Sources: ~1350
Solar: Over 1 GW
Transmission lines (mi): ~60k
GWh of annual energy: ~832
Annual billings: ~$29B
States served: 13+DC
Square miles: ~214,000
Population: ~60 M

EMS:
Analogs: ~50,000 (2Sec-10Sec)
Buses: ~14,000 (69-765 kV)
(~7000 neighboring buses)
PMU: 129/81 Substations

http://www.pjm.com/

http://www.ferc.gov/market-oversight/mkt-electric/pjm.asp
IED Interfaces

- Instrument Transformer
- PC/Tablet
- Switchgear
- Sensor
- Circuit Breaker
- Station Computer/Concentrator/Station Automation System
Present Distribution System

Control Center

Substation

Bay

Process Units

IEC61970/61968, IEC61580, IEC101, IEC104, DNP, Modbus, etc.

Limited FLISR
VVO/CVR
Limited IT-OT
Convergence

Limited FLISR
VVO/CVR
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Convergence

IEC61970/61968,
IEC61580, IEC101,
IEC104, DNP,
Modbus, etc.

IEC61850-9-2
GOOSE

LAN/WAN

LAN/WAN

LAN/WAN/Serial

Hardwired

Non Microprocessor
Relay

Hardwired

Station Automation System

DMS

Comm. Network

Comm. Network

IEC61970/61968,
IEC61580, IEC101,
IEC104, DNP,
Modbus, etc.

IEC 61850-9-2

Instrument Transformer/Sensor/Breaker

MU 1…

MU 2…

MU x…

PU 1…

PU n…

PU x…

RTU

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30 May 2013 | Slide 11
Future Distribution System

Control Center

Substation

IEC61970/61968, IEC61580, IEC101, IEC104, DNP, Modbus, etc.
IEEE 1588, IRIG B

Bay

Process Units

IED 1
IED n

GOOSE

Hardwired

PU 1...
PU n...
PU x...

IEC 61850-9-2

Instrument Transformer/Sensor/Breaker

RTU

Non Microprocessor Relay

FLISR VVO/CVR SE
Asset Mgmt (IT-OT)

IEC 61850-9-2

GOOSE
Balancing Authority (BA) to DMS

BA Control Center

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Utility EMS

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Utility 1 DMS

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BA EMS

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Com. Network

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Utility 1 EMS

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Com. Network

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Utility n EMS

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Com. Network

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DMS 1

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DMS 2

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DMS n

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IEC61970/ IEC61968, IEC61580

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SE Contingency Analysis AGC VVO

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SE Contingency Analysis AGC VVO Asset Mgmt (IT-OT)

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GPS

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GPS

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GPS

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GPS

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GPS

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FLISR VVO/CVR SE Asset Mgmt (IT-OT)
Summary

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For Additional Information or Discussion

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