Distribution Grid Management

Presented by:
Joe LaCasse
Principle Control Center Leader
Xcel Energy

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Topics

- Traditional Distribution System
  - Physical Construct
  - Management of Electrical Grid

- Emerging Influences to the Distribution System
  - Distributed Energy Resources
  - Regulatory / Customer
  - Corporate

- Managing the Distribution System in the future - Grid Management
  - Intelligent Field Devices
  - Advanced Distribution Management System (ADMS)
    - IVVO
    - FLISR
  - Operational Resources
Traditional Distribution System – Physical Construct

- One-direction power flow
- Typically radial feeders
- Stand-by generation at customer site
Traditional Distribution System - Management

- SAIDI/CAIDI Reliability Targets
- Outages
  - SCADA for Feeder and Substation level events
  - Customer Call for tap level and below
- Large workforce to manually manage grid.
Emerging Influences to Distribution System – Distributed Energy Resources (DER)

- Solar
  - Rooftop
  - Solar farms
- Wind Generation
- Micro-Grids

Issues:
- Voltage Regulation
- Bi-Directional power flow
Emerging Influences to Distribution System – Regulatory / Customer / Corporate

- **Regulatory**
  - Accountable for MAIFI – Momentary Outages
  - Customer Credits
  - Environmental pressures

- **Customer**
  - Power Quality
  - Reliability

- **Corporate**
  - Safety
  - Revenue
Managing the Distribution System – Grid Management

Solution to electrical influences:

“Grid Management”

- Intelligent Field Devices
- Central Control of Grid functions
  - Advanced Distribution Management System (ADMS)
- Operational Resources managing the Grid
Examples of Intelligent Field Devices:

- Automated Field Switches
  - SCADA (Intelliteam) Switches
  - Intellirupter - recloser
- Remote Fault Indication / Power Flow Sensing devices
- Remote Control of:
  - Capacitor Banks
  - Field Regulators
  - LTC’s
- AMI (Advanced Metering Infrastructure) Meters at customer sites
Grid Management – Advanced Distribution Management System (ADMS)

- Distribution SCADA
- Distribution Network Impedance Model
- Distribution Network Topology processor
- Unbalanced Load Flow / Load Allocation
- State Estimation
**Grid Management – ADMS IVVO**

- **ADMS – Integrated Volt/Var Optimization (IVVO)**
  - Manage voltage/var flow on feeder/substation bus
  - Central control
    - Transformer LTC’s
    - Feeder Capacitors
    - Feeder Regulators
  - Operational Modes:
    - Demand Reduction
    - Voltage / VAR Optimization
Grid Management – ADMS FLISR

- ADMS – Fault Location Isolation and Service Restoration
  - Model Based (Impedance model built from GIS)
  - Fault data sent/polled automatically from RTU/Relay
  - Fault location identified by applying fault magnitudes to dynamic impedance model
  - Identify/control devices for isolating fault
  - Identify/control devices to restore service to customers
Communications

- Point to Point
- Mesh
- Fiber

Increased criticality of communication availability

- IVVO
- FLISR
Grid Management – Organizational Resources

- Grid Management Organization
  - Engineering/Technician resources
    - ADMS System availability
    - Field Device availability
    - Communications availability
  - Information Technology / Operations Technology Group
    - ADMS System accurate and available
    - Distribution Network Model Accuracy
  - Real-Time use of the ADMS functions for Operations decisions.
    - Control Center Personnel
    - Risk Assessment

- Training
Conclusion – Grid Management

- **ADMS - Distributed Energy Resources**
  - *Power-flow analysis displayed on system model on a tap, feeder, or substation level.*
  - *Distribution SCADA enables state estimation for improved power-flow accuracy.*
  - *Leverage weather, model, and DER characteristics to predict/understand system performance (bi-directional power flow and hidden load)*

- **Reliability – Regulatory and Customer Expectation**
  - *Automated Fault Locating*
  - *Automated FLISR – Central control and Field based*
  - *Improved momentary outage identification*
  - *Model based load flow analysis to identify system issues*

- **Corporate**
  - *Reduce Losses / Leverage voltage for capacity*
  - *Safety – Improved system awareness and decision-making*