Discussion Topics

- Foundation projects
- Project Overview
- Distribution Management System
- Communication Solution
- Substation Enhancements
- Distribution Automation Selection
- Installation Examples
- Accomplishments to date
- Next Steps
PPL Electric Utilities Overview

PPL ELECTRIC UTILITIES SERVICE TERRITORY

- T&D company that serves 1.4 million electric customers
- Maintain 48,000 miles of power lines
- Employs about 2,200 people
- 10,000 square miles
- ~ 7,400 MW Peak
- 36.3 million KWH delivered
Laying the Smart Grid foundation

- 2002 - 2004: AMI Deployment
- 2005 - 2007: OMS Deployment
- 2010 - 2012: Smart Grid - Phase 1

- GIS Deployment 2003 - 2005
- Local Automation Trial 2006 - 2007
The Vision for Phase One

- Transform energy distribution in Harrisburg, PA
  - Energy Efficiency
  - Reliability
  - Operations
  - Planning improvements

- Collaborate with our business partners to showcase Smart Grid capabilities

- Showcase the results and benefits of the project to our customers, stockholders and regulatory authorities
Why Phase One is Important

- Reduction in Customer Minutes Interrupted per year (CMI)
  - Automatic sectionalizing & rapid fault locating

- Voltage optimization
  - Conservation factor of 0.5 for each 1% drop in voltage (inductive vs. resistive load)

- Many societal benefits including:
  - Increased economic activity
  - GHG Emission reductions: 104,473 tons of CO₂

- Future functionality enablement:
  - Asset / Maintenance optimization
  - Integration and control of Distributed Energy Resources: PHEVs, Distributed Generation, Load Management
Phase One – Project Scope

• System-wide DMS functionality:
  – Develop a system-wide Distribution Management System

• Upgrades in Harrisburg operating region:
  – 10 substations, 50 circuits, 511 capacitors and sectionalizing devices.
  – Approximately 63,000 customers
  – New secure WiMax canopy over 150 square miles of Harrisburg Region

• Develop an end-to-end cyber-security framework

• Integrate with OMS, TMS and AMI infrastructure
Phase One

Project Cost: $38.1M
DOE - ARRA - SGIG Contribution: $19M
**Distribution Management System (DMS): Features**

- System Wide Deployment
- Real-time sensing & control
  - Power Flow Model
- Redefine how the system and System Operators interact
- Reliability improvements through quicker restoration
  - Distribution Automation
  - Switching optimization & recommendation
- Energy (circuit) optimization
  - Volt /VAR control
- Foundation for the future
  - integration of distributed resources and its interaction with load
  - advanced grid design & customer participation capabilities
DMS Functionality

Loadflow Analysis

- Will be run periodically (~15 min) or triggered by an outage
- Use all available SCADA data from substations or distribution devices
- Updated nightly from GIS system
- Operators will make real-time changes which will be overridden when GIS data posts

Centralized Volt/Var Control

- DMS system will do automatic Volt/Var control using SCADA controlled pole mounted distribution capacitor banks
- Based on periodic loadflow analysis to determine areas where voltage or power factor can be optimized
- Actual meter voltages will be used to help find discrepancies in loadflow model
Interaction with AMI system

- Power Line Carrier for all residential and small commercial meters
- Cellular for large commercial and industrial meters
- Hourly meter data on residential and commercial customers
- 15 minute meter data on Industrial customers
- Blink Counts Available
- Data is collected every 8 hours for hourly reads and daily for billing reads
WiMax Radio Installations
Substation Enhancements

- Upgrade 50 substation circuit breaker relays with microprocessor based units
- Implement remote fault target and magnitude collection from relays
- Upgrade 10 substation SCADA RTUs which communication with the TMS system for substation and breaker control
- Add additional substation RTUs to collect all the data from the 511 distribution devices
- Install fiber-optic cable for DMS backhaul
- Install Ethernet hook-up in substation control house for employee computers
Distribution Automation Requirements

All 3 phase sectionalizing equipment will provide:

- Per phase voltage and current
- Per phase MW and MVAR
- Per phase fault indication (A ph to Grd, etc)
- Fault Current (amps)

All 3 phase capacitor banks will provide:

- Voltage
- $\Delta V$ for last switching event (Voltage Rise)
- Indication of blown fuse or stuck oil/vacuum switch

This data will be scanned every 10 seconds from the SCADA RTU
Distribution Considerations

- Install sectionalizing every 250 to 350 customers on the 3 phase backbone
- Visible break required between the motor and the operating handle on airbreak switches
- Consistency with existing distribution hardware
- Limited availability of bucket trucks during storms
- Use reclosers for line end protection and use airbreaks if additional sectionalizing is required
- Minimize the use of battery powered equipment
- Automatic battery tests must occur regularly
- Radio equipment and RTUs can be programmed from the ground
Accomplishments to Date

- About 200 units were installed between October 2010 and January 2011
- 3 substations converted
- Preliminary DMS system is installed and allows basic SCADA control of DA devices
- Starting to debug DMS system based on real data and information received during DA device operations
- Huge data correction effort is underway in our GIS system
Next Steps

- 300 more DA locations to engineer and install
- One year until DMS is in production
- Develop business practices and system to leverage data
- Look at reviewing maintenance practices and schedules
- Start engineering next area to deploy smart grid
Questions?

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