Application Integration Of Distribution Automation Technologies at Alabama Power Company

Working Group on Distribution Automation
2008 IEEE PES
January Joint Technical Committee Meeting
San Antonio, Texas
January 8, 2008

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APCo serves 1,403,203 Customers

Alabama Power owns or operates 81 electric generating units with 12,216 million kW Total Nameplate Capacity

- Coal ........................................... 68.23%
- Nuclear ...................................... 18.46%
- Gas and Oil ................................. 7.35%
- Hydro ........................................ 5.96%

Regulated by The Alabama Public Service Commission
Rate Stabilization
Install 28,000 new meters per year

Over 6,600 Employees

10,163 Miles Transmission

76,137 Miles Distribution

44,500 Square Mile Service Territory

Six Geographic Divisions
Outline of Presentation

- Before Distribution Automation
- Era of Distribution Automation
- Future of Distribution Automation
  - Integrated Distribution Management System
  - GIS field applications
  - Advanced Metering Infrastructure (AMI)
Facility Information ...

We have been designing and operating our facilities and storing information much the same way for a long time...
Before Distribution Automation

Prior to 1991
Distribution Switching Diagram
Before Distribution Automation

Prior to 1991

- Less than 5% of Distribution Substations were automated
- No devices on the Distribution Feeder were automated
- Distribution System was operated manually with wall-mounted switching diagrams from 55 locations
Era of Distribution Automation

1991 to 2007 (Today)

Innovations

- Electronic MapBoard (EMB)
  - Import of wall-mounted switching diagram into electronic format
  - Distribution line switching is maintained current showing actual switch state
  - System-wide view of Distribution electric system
Era of Distribution Automation

1991 to 2007 (Today)
Innovations

- Distribution Underground Switching (URD Plan)
  - URD maps in PDF format
  - Adobe Reader Tools with Commenting enabled
  - Deployed to operations centers is on Friday, December 7, 2007
Era of Distribution Automation

1991 to 2007 (Today)

- First Distribution feeder device for line monitoring was installed on May 29, 1991

- First Distribution substation was automated in June 1991 based on the new Distribution Automation technology to monitor power measurements and to remotely operate breaker control switches.
Outage Management System

- Utilized at APCo since early 1980’s
- Receives customer calls and SCADA events
- Predicts number of customers out and location of outages
- During major storm events: 200+ users of the system
- Automated customer reporting and automated customer callbacks
Era of Distribution Automation

1991 to 2007 (Today)
Innovations

Operator Desk in DOC
### Era of Distribution Automation

**1991 to 2007 (Today)**

Distribution Automation Deployment – 2,722 sites

- Distribution Substations (96.6 %) 645
- Distribution Line devices 648
- Distribution Switched Capacitor Sites 818
- Transmission Line Switch Sites 339
- Network Underground 190
- Standby Generator Sites 82
Era of Distribution Automation

1991 to 2007 (Today)

Innovations

- Site-specific automatic feeder reconfiguration
- Monitor harmonic content of feeders
- Automation technology facilitates operations efficiency improvements
  - Distribution system control reduced from 55 locations to 5 Distribution Control Centers
  - Distribution Control Centers roll-up to 2 centers at night after 10:00 PM
Era of Distribution Automation - Operations

- Deployed in 1997 - 2000
- 430 units at APCo / 1600 SoCo
- Dispatching & Tracking of Daily Work Activities (Orders, Trouble, and Reliability Work)
- Worked 1,324,717 Orders in 2006 previously handled with paper
- Replacement System in design. Deployment in 4th Qtr. 2007
The Future of Distribution Automation

**Future Operations Environment**

- Integrated Distribution Management System (IDMS)
  - Next generation operating system for Distribution Control Center
  - Connected model of Distribution System based on GIS database import
  - Seamless integration of operating applications
  - Single user interface environment
  - Advanced applications to enhance operational decisions
  - Distribution system-wide decisional analysis and operation
  - Distribution system efficiency improvement
The Future of Distribution Automation

1991 to 2007 (Today)
Application Integration by Operator

- Workstations facilitate application integration
  - Distribution SCADA
  - EMB
  - Outage Management
- Dedicated Distribution Automation workstation
- Operator performs integration of information
The Future of Distribution Automation

- Components included in the AREVA IDMS
- Existing or proposed systems

- Power Flow Analysis
- Coordination Analysis
- Fault Locating
- FISR
- Voltage/Var/Loss Optimization
- Harmonic Current De-rating of Assets
- Contingency Analysis
- Vehicle Locating System
- Training Simulator
The Future of Distribution Automation - Full Integration

Integrated User Environment
The Future of Distribution Automation - Full Integration

Integrated Distribution Management System (IDMS)

- Co-funded by US Department of Energy (DOE) and Electric Power Research Institute (EPRI)

- DOE envisions IDMS as the next generation distribution operation platform.

- Includes full integration of EMB, SCADA, and the development of the next generation OMS into one user interface.

- Two Phases of IDMS: Completion of Phase 2 in late 2009.
  - Phase 1: 18 months - deliverable is a demonstration of this integrated technology
  - Phase 2: 18 months. Implementation of IDMS at Alabama Power Company
The Future of Distribution Automation - Full Integration

**Advanced IDMS Applications**

- AFISR (Automatic Fault Isolation and Service Restoration)
- Fault Detection and Location
- Optimal Volt/Var Loss Management
- Distribution Operator Training Simulator
- Power Flow / Short Circuit / Coordination Analysis
- Contingency Analysis
- Advanced Outage Analysis / Prediction
- Vehicle Location System (ARMS)
- Dynamic Deration of Power Equipment (Harmonic loading)
Future Operations Environment

- Integrated Distribution Management System (IDMS)
  - Next generation operating system for Distribution Control Center
  - Connected model of Distribution System based on GIS database import
  - Near Real-Time incremental update of electronic switching diagram
Enterprise GIS

- With an enterprise GIS data set, updates are made in one place.

- Access to the most current data allows higher accuracy and more efficiency for data maintenance… and for the user.

- A consolidated data store is available for multiple uses.
CIM Utilization Experience

- Experience period – June 2006 to August 2006

- Semantic layer decouples application from data, but resulting XML file substantially increases model size

- Component attributes are removed from entity causing the schema to use relationships to provide adequate attribution
  - Attribution is abstracted to achieve flexible data format while causing model complexity
  - e.g. “Address” is not an attribute of equipment, but is in the Erp.Address space
The Future of Distribution Automation - GIS

CIM Utilization Experience

- Graphics placement was removed from CIM
  - GML is used to represent graphics placement
  - Use of GML resulted in considerable extensions to model
  - Use of GML did not provide adequate means to represent the same data element as different symbols at different scales
CIM Utilization Experience—APCo specific

- Metering was not complete in CIM data model
- Measurement points for line-post sensors did not exist
- Address information was very complex to represent using the Erp model
- Distribution pole-mounted recloser was not in CIM (Breaker is included but only in the context of a substation)
- Capacitor model was not complete requiring considerable number of extensions
- CT’s and PT’s were not represented resulting in extension additions
CIM Utilization Experience—APCo specific

- Alabama model contains approximately 500 attributes
  - Approximately 300 attributes of the Alabama attributes were found in the CIM definitions
  - Approximately 100 attributes required extensions which have been added to CIM
  - Another approximately 100 attributes were identified as Alabama custom attributes and will not be added to CIM
  - Consequently, approximately 400 of the 500 attributes in the Alabama model are in the CIM which includes the 100 attribute extension additions
CIM Utilization Experience—APCo specific

- Alabama chose to use a flatter XML file specifically to manage large GIS model files to achieve:
  - Faster translation from GIS XML to IDMS XML
  - Faster movement of smaller files across the network to support incremental updates of the operational model
CIM Utilization Experience—Observations

- Southern/Alabama supports the industry movement to a common model
- For 2 of the IDMS interfaces, the vendors do not offer a CIM compliant interface
- CIM is too complex and heavy for efficient movement of the GIS data model (based on the substation being the smallest increment)
- Southern/Alabama will continue to pursue opportunities to use CIM messages on the utility integrated bus to externalize IDMS data to the enterprise
The Future of Distribution Automation - GIS

Engineering Desktop
Mobile “desktop”

- All MS Office applications
- Local GIS data
- Drawing tools
- Customer/Meter information
- Engineering Calculation Tools
- Estimating (Future)
- GPS enabled

- ALL in the field!
The Future of Distribution Automation - GIS

- Damage Assessment
- Worst Case Scenarios
- Staging of Manpower and Material

Predictive Analysis with Weather Data
The Future of Distribution Automation

Application Integration

- Distribution Automation / Distribution SCADA
- GIS-based Electronic MapBoard
- AMI
The Future of Distribution Automation - Advanced Metering Infrastructure (AMI)

- Full Two-Way Network (By Definition)
  - Read Any Meter anytime
- All reading Types
  - KWh Readings
  - TOU Readings
  - Demand Readings (Including Resets)
  - Load Profile
- Voltage Information
- Active Power Outage, Power Restoration, and Tamper Detection
- Over Network End Device Reprogramming
- Over Network Downloadable Firmware
- Support Multiple Meter Vendors
The Future of Distribution Automation - Advanced Metering Infrastructure (AMI)

- Complete Roll-Out
  - ✓ 2007
    - Assemble AMI Team
    - RFP for technology and installation labor
    - Complete the Contracts
    - Install Network in Birmingham
  - ✓ 2008 (Birmingham)
  - ✓ 2009 (Eastern, Southern, Western)
  - ✓ 2010 (Southeast, Mobile)
Full Integration – A Summary

Application Integration thru IDMS

- Distribution Automation / Distribution SCADA
- Electronic MapBoard
- Outage Management System
- Switching Management
- Power Flow Analysis tool
- Crew Management (through ARMS)
- GIS
- AMI
Questions?
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