Application Integration Of Distribution Automation Technologies at Alabama Power Company

Working Group on Distribution Automation
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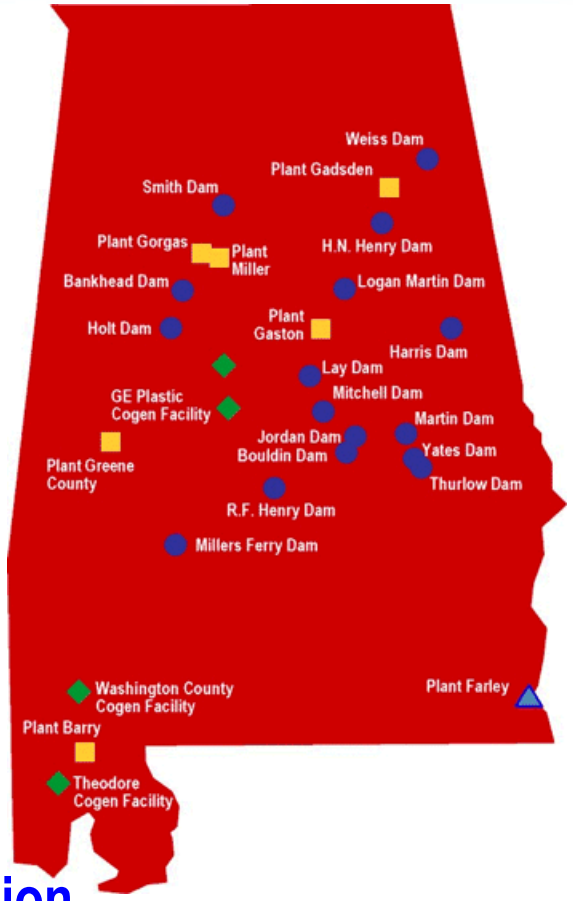
G. Larry Clark

Alabama Power Company

- 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

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Alabama Power Company

- 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

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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…

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Before Distribution Automation

Prior to 1991

Distribution Switching Diagram

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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

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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

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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.

Era of Distribution Automation

Outage Management System

DOES2000 - Company Summary

Company View Help

Divisions | Critical | View Notes | Refresh | Print | Close

Division	Restore Date/Time	# Feeders Out	Number of Calls	Estimated Cust. Out	Priority Calls	Wire	Service	Pole	Extreme	Est Critical Customers	Number of Outages
Totals		552	102081	634307	5613	4619	319	505	46	6158	6693
MOBILE		216	28567	197971	3393	2952	226	376	17	2274	899
WESTERN	08/31 23:45	149	25206	147707	918	690	40	60	14	1205	1798
BIRMINGHAM	08/31 08:00	145	39522	227530	1039	789	44	48	13	2076	2562
SOUTHERN	08/30 23:45	16	2517	20034	78	56	5	4	0	222	446
EASTERN	08/30 23:45	26	6225	40906	180	127	4	17	2	380	972
SOUTHEAST		0	44	159	5	5	0	0	0	1	16

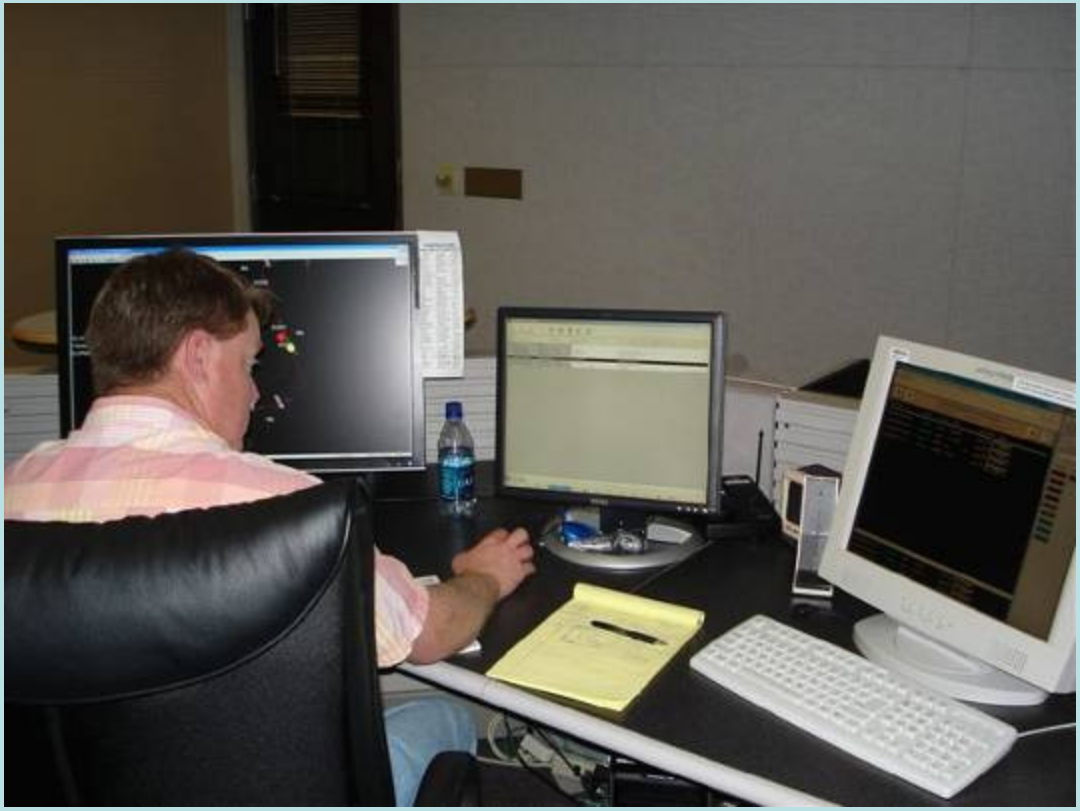
Ready NUM

- 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

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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

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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

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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

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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

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The Future of Distribution Automation

1991 to 2007 (Today)

Application Integration by Operator

- Workstations facilitate application integration
  - ✓ Distribution SCADA
  - ✓ EMB
  - ✓ Outage Management
  - ✓ Call Out
  - ✓ Work Management
- Dedicated Distribution Automation workstation
- Operator performs integration of information

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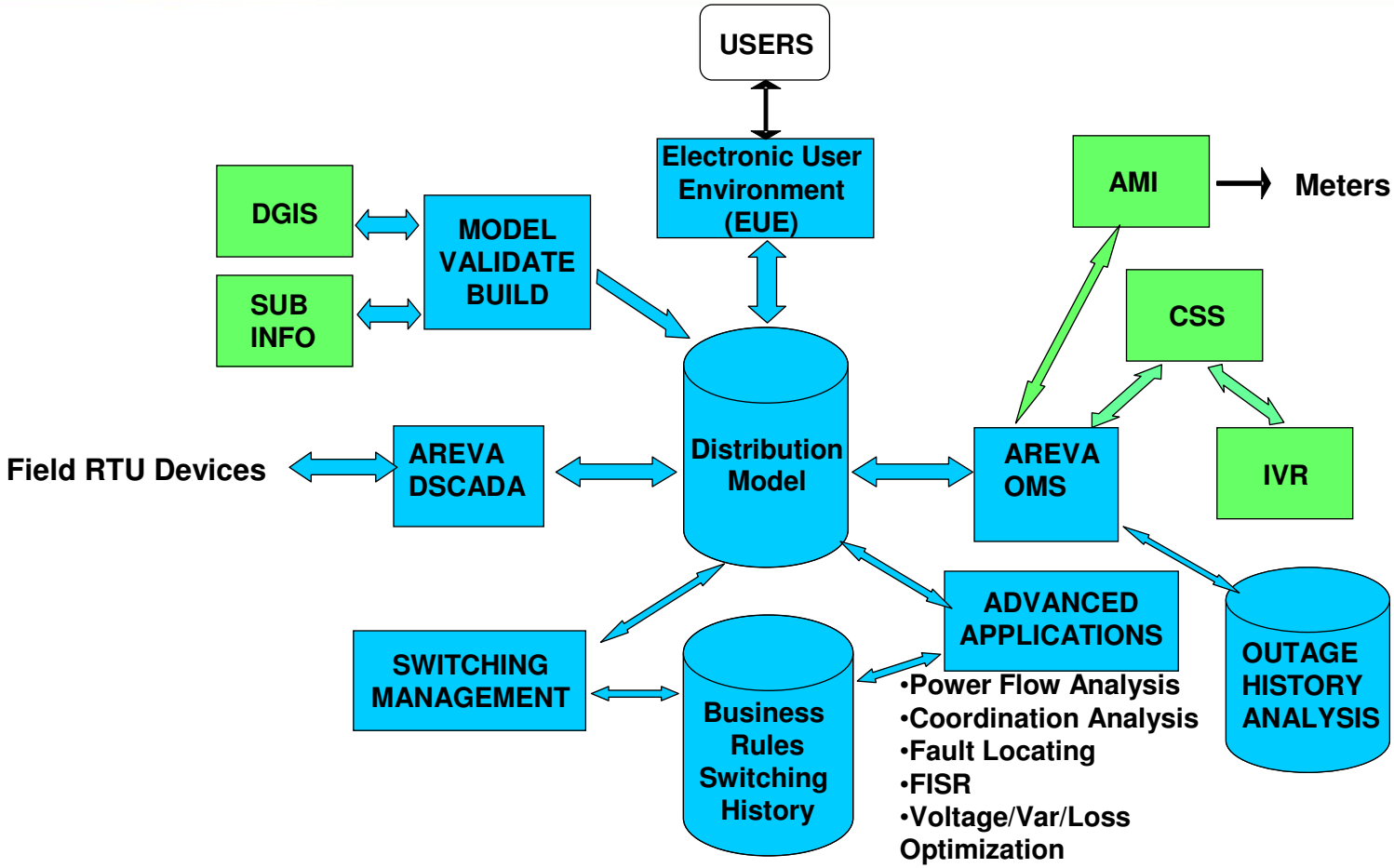
The Future of Distribution Automation



- 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

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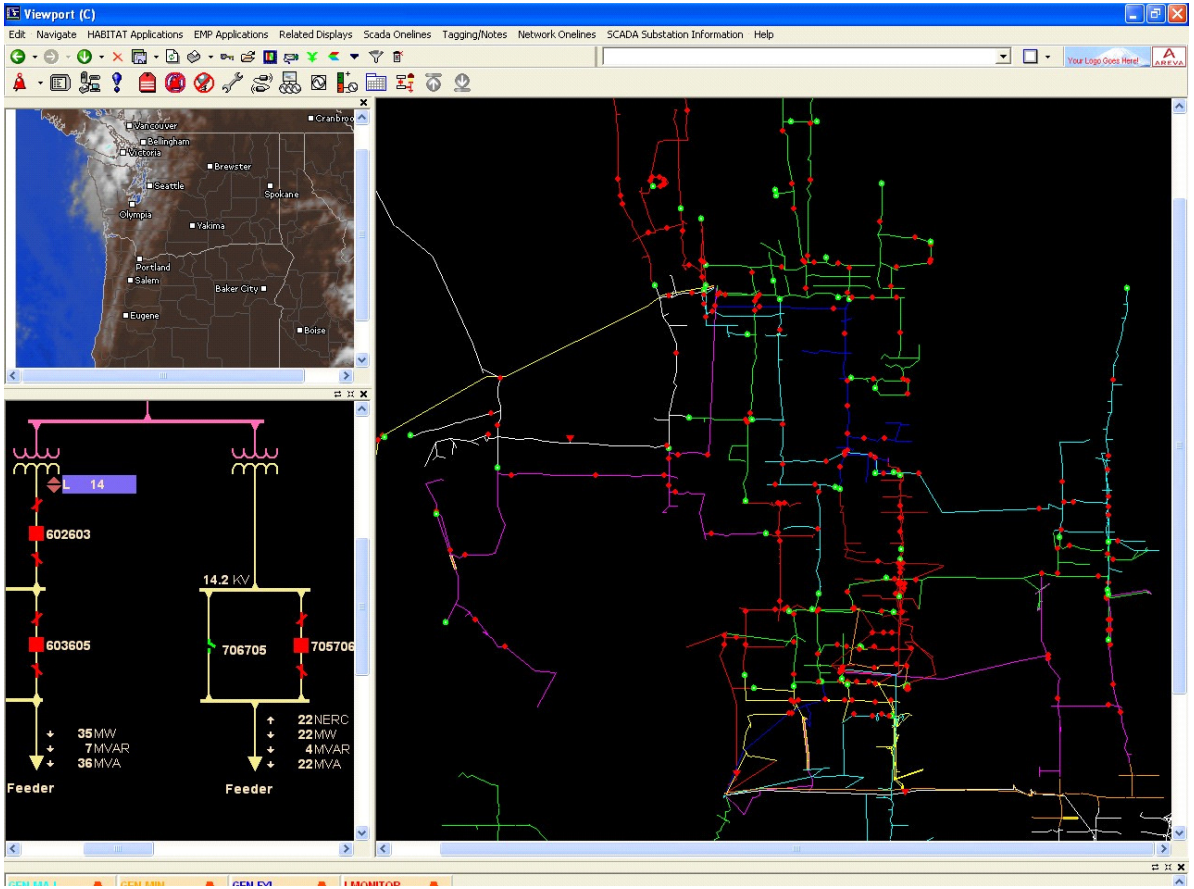
The Future of Distribution Automation - Full Integration

Integrated User Environment



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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

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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)

The Future of Distribution Automation - Full Integration

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

The Future of Distribution Automation - GIS

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

The Future of Distribution Automation - GIS

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

The Future of Distribution Automation - GIS

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

The Future of Distribution Automation - GIS

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

The Future of Distribution Automation - GIS

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

The Future of Distribution Automation - GIS

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

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The Future of Distribution Automation - GIS

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!

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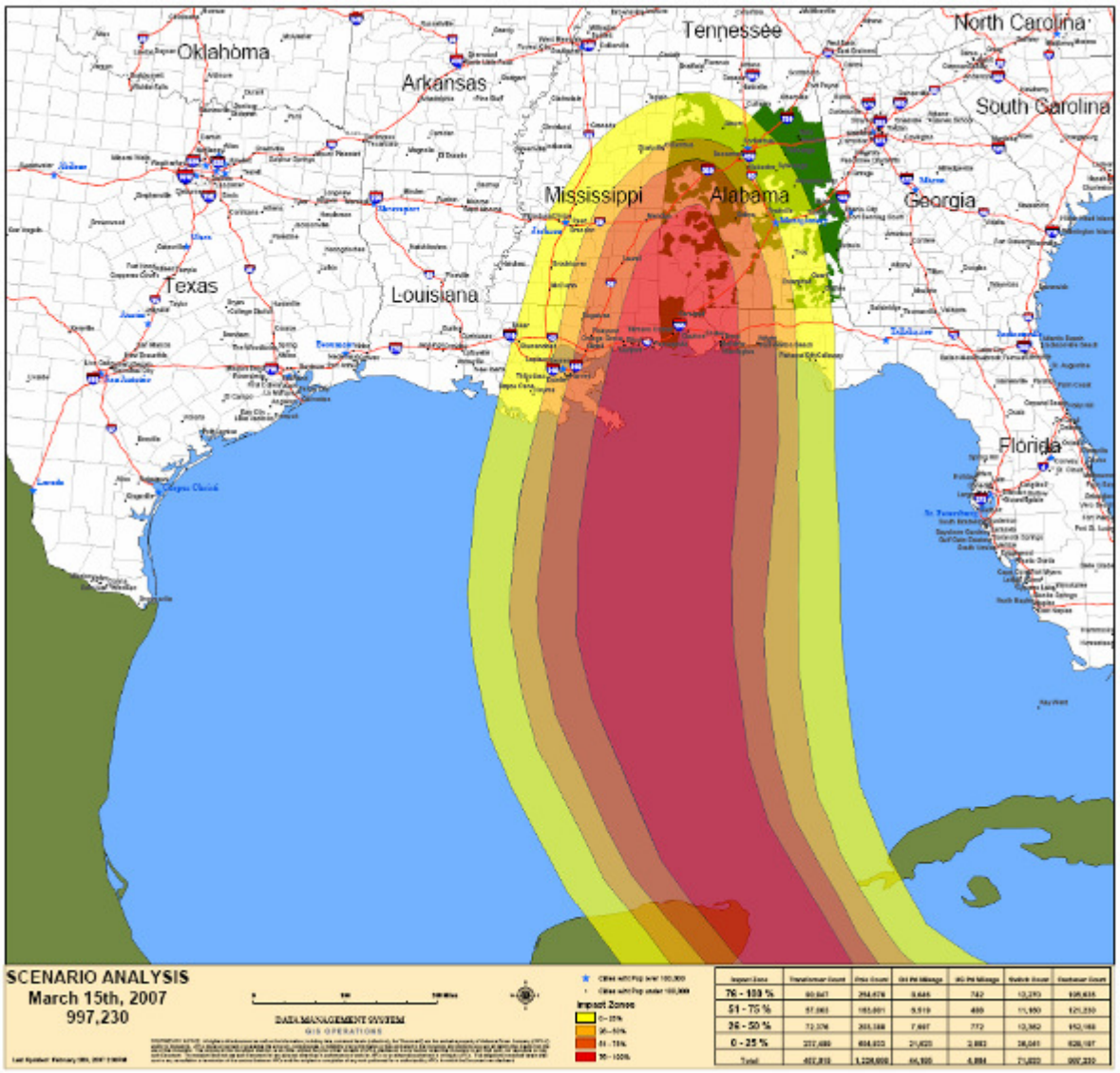
The Future of Distribution Automation - GIS



Predictive Analysis with Weather Data

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

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The Future of Distribution Automation

Application Integration

- Distribution Automation / Distribution SCADA
- GIS-based Electronic MapBoard
- AMI

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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

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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

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Questions?

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