EPRI GIS Interest Group

GIS Data Correction

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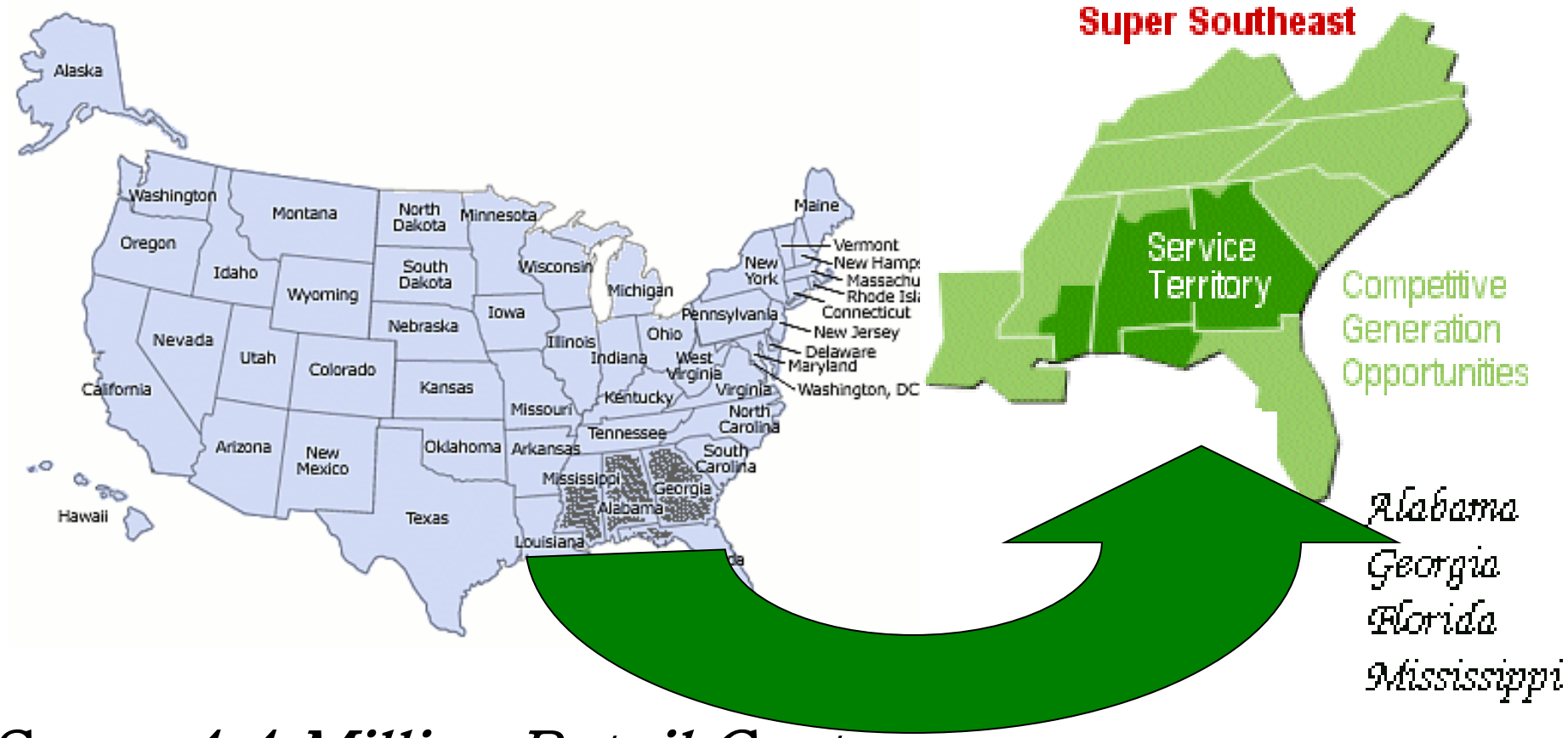
Data Management Center
GIS Operations

The Southern Company



Serve 4.4 Million Retail Customers
Generating Capacity : 42,000 MW
120,000 Square Miles

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Alabama Power Company

- Serves 1,431,334 Customers
- Vertically Integrated Utility
- Over 6,600 Employees
- 10,218 Miles Transmission
- 79,430 Miles Distribution
- 2200 Distribution Circuits

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A little GIS History

- In the beginning our GIS data was entered by digitizing paper maps
- From that point we posted Work Orders and made corrections as we got information from the field and from Osmose pole inspections
- We realized our data was inadequate but funding prevented more proactive efforts

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Why do you need good GIS Data?

- **Management Reports - Garbage in = Garbage out**
- **Accurate Storm Restoration Maps**
- **To get field engineers to adopt the technology you must provide them with an accurate product**
- **Data queries**
- **Add your reasons here!**

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Our New Motivation for Accurate GIS Data

IDMS – Integrated Distribution Management System – DMS, SCADA, OMS

A System with Industry Wide Implications and a System that is driven by the GIS Model

Smart Grid

Integrated Distribution Management System

IDMS

Department of Energy Smart Grid Investment Grant

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SMART ENERGY

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ROLTA

ALSTOM

EPRI ELECTRIC POWER RESEARCH INSTITUTE

IDMS – DOE / EPRI / Alstom

- Co-funded by US Department of Energy (DOE)
- DOE envisions IDMS as the next generation distribution operation platform to increase the nation's ability to provide reliable electric service.
- EPRI is participating in this project to promote standardized interface language between applications within distribution (CIM). IDMS will interface to CSS, ARMS, AMI, GIS, IVR, Work Mgt)
- Alstom – Software solution provider for IDMS

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A Little History of Operations

- OMS – 1988 In house application (DOES)
- SCADA – 1991
- GIS – 2000
- EMB – 2003 AutoCAD Electronic Map Board
- IDMS – 2012 - Integrated Distribution Management System
- IDMS OMS – 2013 – IDMS Outage Management System

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Prior to 2003

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Operator is the Integrator

- OMS – 1988
- SCADA – 1991
- GIS - 2000
- EMB – 2003
- IDMS – 2012
- IDMS OMS - 2013

After 2003

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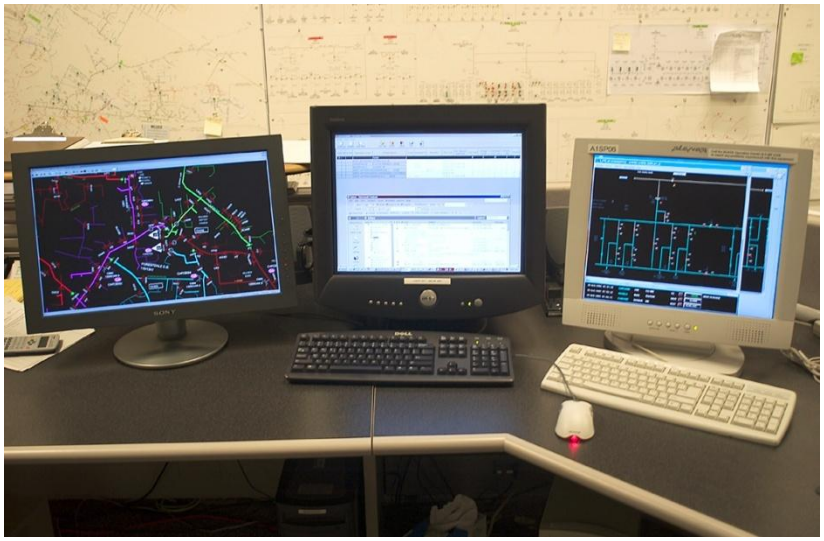
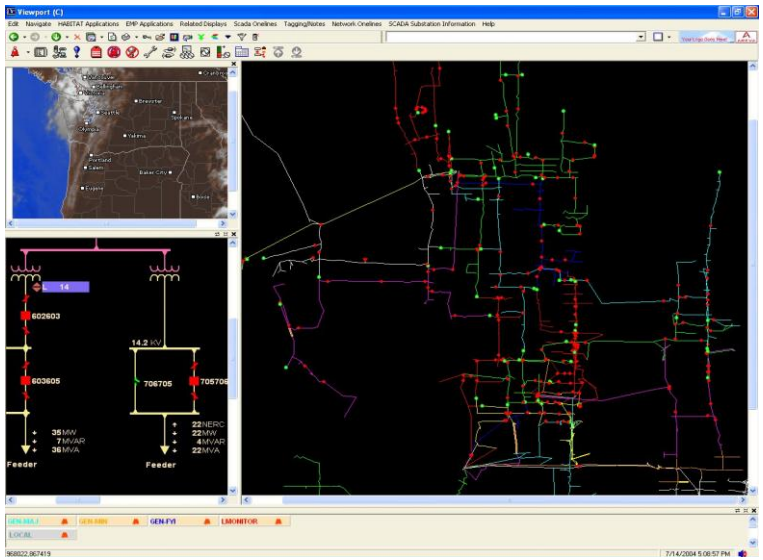
Progression to IDMS

Prior to IDMS



Three Separate Systems and Environments

IDMS



Integrated Environment

Advanced IDMS : Fault Location, Volt/Var Control, Demand Management, Operator training simulator, Power Flow / Short Circuit / Coordination Analysis, Contingency Analysis, Vehicle Location System, Dynamic de-rating of assets, Crew management and Switching management

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ADVANCED APPLICATIONS

- **AFISR:** (Automatic Fault Isolation and Service Restoration) An application that takes outage and fault indications and automatically performs the necessary switching by DSCADA (primary) and / or provides manual switching steps (secondary) to isolate the faulted section(s) of the electrical distribution feeder(s) and restore service to as many customers as practical. In some cases, the application will take the appropriate steps to free capacity on an adjacent feeder to allow additional service restoration (referred to as Tier 3 restoration). By utilizing the power flow analysis engine, this application would ensure that the actions taken do not cause the operation of electrical distribution assets outside of acceptable limits, protective devices are not erroneously operated, and customer service parameters are within regulatory requirement.

- **Fault Location:** Will utilize data from the digital relays presently being deployed in line reclosers and substation breakers. To provide additional input, the Fault Location application should utilize the data from a basic fault detection application (and possibly fault current magnitude) that executes in most of the pole mounted Remote Terminal Units (RTU's) at Alabama Power Company.

ADVANCED APPLICATIONS

- **Optimal Volt/Var/Loss Management**: The Optimal Voltage / Var / Loss Management application will utilize the analysis engine to predict a topology, voltage level, etc. to reduce the distribution losses by a quantifiable amount and, if enabled, direct DSCADA actions to the controlled devices to maintain the conditions.

  Industry accepted recoverable loss estimates range from .5% to 4.1% of the distribution kWh sold at a typical utility. This would equate to over $12,000,000 annually at Southern Company using the conservative loss recoverable factor of .5%.

- **Distribution Operator Training Simulator:** The trainee would utilize the same User Interface found in the Distribution Operations Center with familiar names of equipment and the scenarios should be based upon actual historical or anticipated operating problems. The DOTS will emulate the electric power distribution system to provide the data feedback to the trainee. DOTS would be deployed in parallel to the IDMS system to emulate the functionality of the system

ADVANCED APPLICATIONS

- **Power Flow / Short Circuit / Coordination Analysis:** Supports the switching management and AFISR application in providing feedback on the probable state of the electrical distribution system at the completion of each step based upon projected load and other switching approved for the same period of time. Will also determine if coordination of protection devices are within acceptable values prior to proposed switching steps.

  Real time information leads to improved asset utilization

- **Contingency Analysis**: Application that runs in the background, analyzing various single contingencies (single piece of equipment failure) based upon the present state, predicted operating conditions, considering switching that is scheduled, and loading based upon temperature forecasts to determine if the contingencies can be eliminated or that a loss of customer service for a substantial period of time will result. Assist in identifying and addressing the risk of the state of the distribution system.

ADVANCED APPLICATIONS

- **Outage Management:** Receives and analyzes trouble calls and makes predicted outages based upon algorithms, rule sets, and DSCADA. Displays predicted outages on the Electronic User Environment. Maintains historical outage information and calculates outage indices.

- **Vehicle Location System:** The ability to query the ARMS system and indicate on the Electronic User Environment the relative position of ARMS equipped vehicles. Would increase the efficiency and effectiveness of available personnel in restoring service. Would provide suggestions to trouble call assignments.

- **Dynamic Derating of Assets:** The dynamic modification of operating limits based upon Total Harmonic Distortion (THD) measurements. ANSI states that derating should begin with a 5% THD. Alabama Power Company's RTU has the ability to capture harmonic distortion.

ADVANCED APPLICATIONS

- **Crew Management Tool:** Utilizing labor resources effectively and efficiently during times of major outages

- **Switching Management:** Application that allows operations personnel to select electrical distribution facilities where switching is required for either clearance purposes or electrical topology changes e.g. move a normal open point and develop switching orders with business rules and power flow analysis applied step by step.

Data Correction for DMS

Field Audits -

- Using Distribution experienced retirees as contractors & engineers to ride/walk feeders collecting data from the sub breaker to the customer service wire. This process was done on paper maps with background imagery

- Maps come back in to DMC for posting to database and sent to Rolta for posting

Data Correction for DMS

Satellite Imagery

- Used satellite imagery to spatially correct data
- Imagery was printed on Field Audit maps

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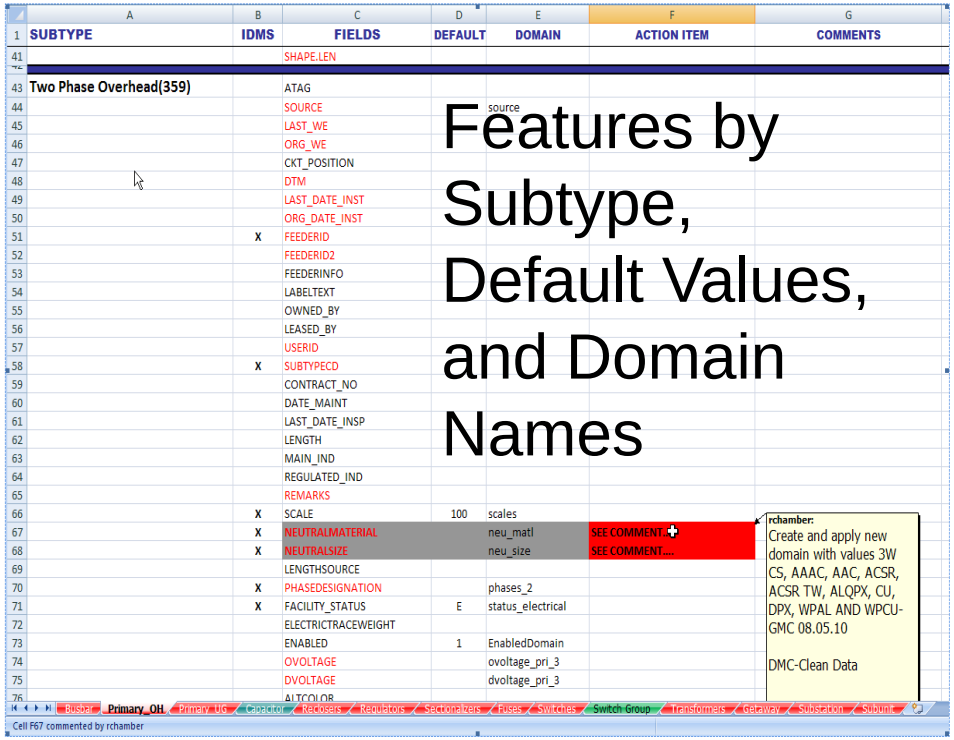
Data Correction for DMS

GIS Queries

- **Queries that look for data combinations i.e correct sizes and types of equipment and required attributes**
- **Eliminate impossible combinations therefore preventing input errors**



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Data Correction for DMS

Other Efforts

- Manual QA/QC
- Trained GIS editors on distribution material and construction standards
- Use GIS editors as storm evaluators with an experienced evaluator to improve their knowledge and experience

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Data Correction for DMS

- We completed the field verification and posting of over 2000 distribution feeders in the first quarter of 2012
- We then deployed the first phase (DMS) of IDMS
- Next came support for the OMS phase of IDMS

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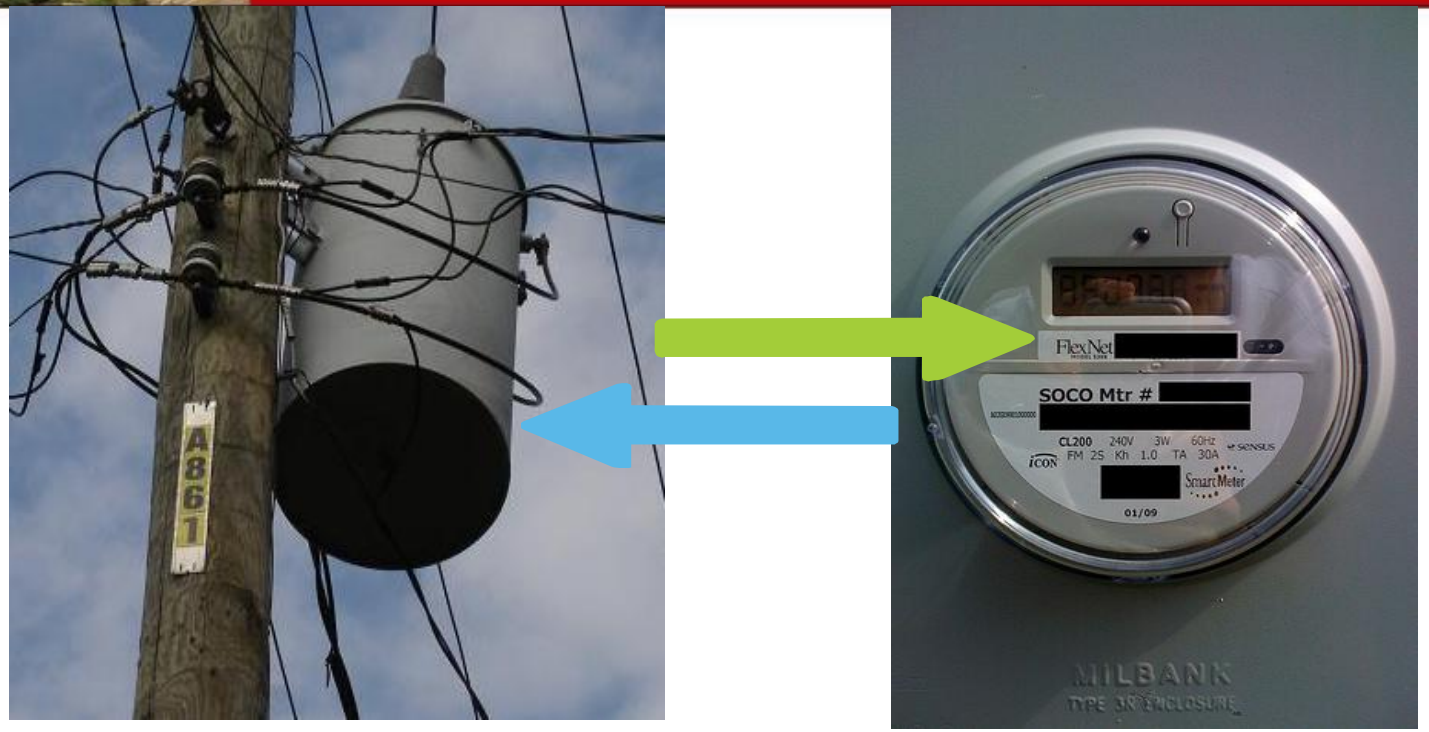
Data Acquisition and Correction for IDMS OMS

- Our current OMS (DOES or Distribution Outage Evaluation System) linked customer electrical address only to the feeder and switch
- IDMS - OMS needs customers linked to the serving transformer. With 1.4 million customers this was/is a big task

Customer Linking



Do this 1.4 Million times….How do you start? In Phases…

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Data Acquisition and Correction for IDMS OMS

Phase I

- Algorithm to attempt to programmatically link all 1.4 million customers.
  - Used spatial query of Customer Lat/Long to closest transformer then compared the feeder and switch to existing OMS/DOES data.
  - The results were categorized with a confidence level of 1 thru 5 with 5 being the highest confidence
  - An audit was done of a sample of the customer linking results. The audit showed an average error rate of 30%

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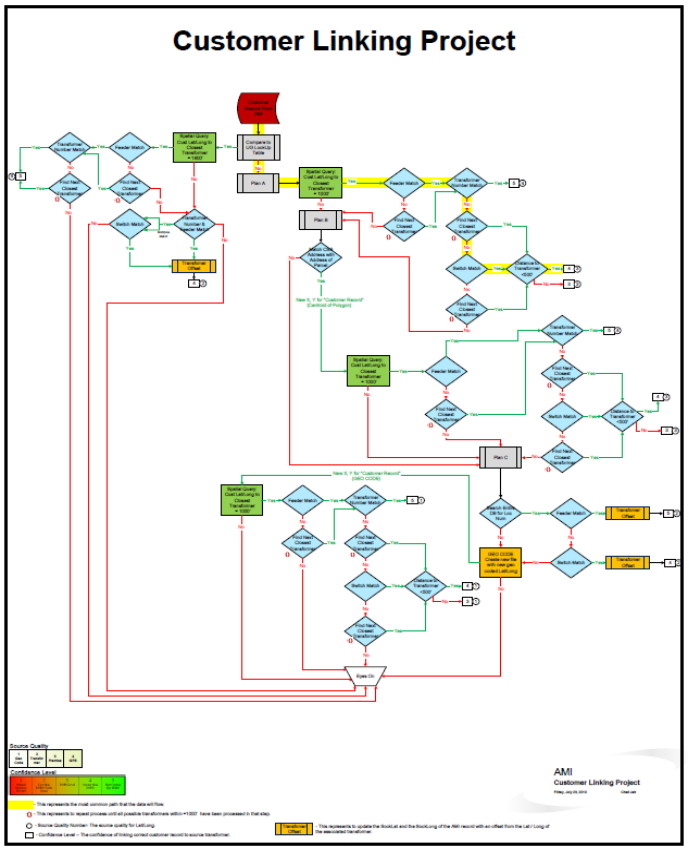
CUSTOMER LINKING PROJECT



We tried to link 1.4 million customers programmatically – Error rate of about 30%

A Confidence Level of 1 – 5 was assigned to each link – Level 5 being the highest confidence

Some accounts could not be linked programmatically
(Un-linked Customers – Level 1)

Those accounts with a confidence level of 1, 2 and 3 are being field verified by contracted retirees

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Data Acquisition and Correction for IDMS OMS

Phase II

- 30% error rate not acceptable

- After the retiree contractors finished the GIS data field verifications we transitioned them to field verify customers and link them to the correct transformer.

- These were links that we had low confidence of being accurate. This phase completed in the first quarter of 2013

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Data Acquisition and Correction for IDMS OMS

Phase III

- Still not satisfied

- To further increase accuracy we contracted with Rolta to do additional programmatic and manual linking and spatial adjustment of all customers based on imagery and parcel point data.

- This third and last phase should complete later this year and OMS should be deployed shortly after

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Long Story Short

- **In the beginning our GIS data was not very good**
- **We have recognized the value of accurate GIS data**
- **Even without DOE funding we were heading in the direction of improving our data and would have accomplished it over time.**
- **IDMS along with SGIG gave us both the requirement and the Co-funding we needed to quickly correct our GIS data and we believe we have achieved that goal….**

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Ongoing Challenges

- **Mobile/Electronic data collection and correction**
- **Getting the data we need from Work Orders… Communication with field engineers**
- **Post storm restoration data collection and correction**


QUESTIONS
April 27, 2001
Tornado Outbreak in
Alabama