

Overview of the Entergy Distribution System - Iraqi Ministry of Electricity Meeting April 19, 2010

System Infrastructure Summary

- Entergy's distribution lines are designed to meet the requirements of the National Electric Safety Code (NESC). The requirements of the NESC are minimum provisions that are considered necessary for the safety of employees and the public during installation, operation, and maintenance. Entergy's operates a grounded WYE (four wire) distribution system with primary voltages that range from 4.16 kV_{LL} – 34.5 kV_{LL}.
- 4,056 Distribution Circuits
 - 1,148 Arkansas
 - 713 Mississippi
 - 1,730 Louisiana (1,004 ELL, 211 ENOI, 515 EGL)
 - 465 Texas
- Distribution Circuit Line Miles and Square Miles
 - Arkansas: 34,388 OH Line miles, 3,221 UG Line miles; 23,097 sq miles
 - Mississippi: 15,735 OH Line miles, 2,278 UG Line miles; 17,162 sq miles
 - Louisiana: 28,634 OH Line miles, 3,586 UG Line miles; 29,530 sq miles
 - Texas: 11,091 OH Line miles, 1,780 UG Line miles; 14,613 sq miles

Planning Overview of the Entergy Distribution System -

Distribution Planning Summary

- Entergy's distribution Planning Guidelines were established to maintain the distribution system at a level that provides reliable service to the customers at a reasonable cost. Projects that are recommended to resolve system capacity and reliability issues must follow these guidelines and provide the long term least cost solution to resolve the identified problems.
- Distribution system capacity concerns can be divided into two major categories. The first category determines the adequacy of system components to meet normal load conditions. The second planning category determines the system's ability to continue serving these loads while operating with the loss of a major system component.
- The distribution planner performs analysis to ensure that the installed transformation, distribution lines and associated equipment have adequate capacity to serve the projected normal load demand.
- As an integral part of the planning process, the planning engineer must develop a plan to restore service, assuming a first contingency loss within a defined service area.

Overload and Voltage Guidelines

- **Power Transformer Loading**

- *Substation Class Power Transformers are considered 100% loaded when the Normal Weatherized Peak Load equals the Name Plan Rating found on the unit. However, during abnormal conditions, such as a contingency or loss of another unit, 110% of the Name Plan Rating becomes the overload threshold when considering switching for contingencies.*
- *Any unit where the normalized peak is forecasted to be at 100% of the name plate rating with in the next few years is to be identified and included in the Five Year Plan.*

- **Conductor Loading**

- *For distribution planning purposes, the conductor's 90 ° C rating is used to determine the maximum operating capacity. The 100 ° C rating should only be used for limited durations when operating under emergency conditions. The 100 ° C conductor rating should not be used as the planning criteria for project justification. – Dist. Planning Guideline.*
- *Other conditions such as sag, voltage drop, and conductor condition may cause the individual section of conductor to be de-rated.*
- *Likewise, URD, Secondary, and overhead conductors with insulation are subjected to numerous other de-rating conditions.*

- **Service Voltage**

- *Planning criteria notes the service voltage is to be +/- 5% of nominal (example 114v – 126v on a 120 volt scale) at all times. However, during abnormal conditions, an additional - 5% is allowed, if needed. Hence, 109v -126v on a 120 volt scale is acceptable during an abnormal event.*

Contingency Plans

- **Power Transformer Contingency**

- *Entergy's distribution system has developed into four types of planning areas: Independent Substation Service Areas (ISSA), Mutually Supportive Substation Groups (MSSG), Mobile Transformer Back-Up Substations (MTBS) and Replace or Repair Back-up Substations (RRBS).*
- *First Contingency Failure for each Substation Class Power Transformers is reviewed annually and posted by Planning to the Web for the DOC and others to share.*
- *As part of Entergy Risk Management, not all units are 100% backed up by existing equipment in place, in the field. However, there are a number of "mobile substations" available for most common voltage transformers.*
- *Once the Risk or amount of un-served load is too great for existing mobiles, Contingency Project to resolve the short fall is included in the 5 Year Plan.*

- **Feeder Contingency**

- *Back-up for loss of a Feeder is not generally considered in normal Distribution Planning. Occasionally, a large critical customer such as a Hospital will request a back up service. For those times, Planning will review the request and advise.*
- *Many feeders are radial and/or the adjacent feeder does not have the capacity to back-up at all times.*
- *Cost to benefit ratios typically prevents funding for line contingency projects.*

Planning Tools and Analysis

- **SynerGEE**

- *Entergy's distribution planning has been using software developed by SynerGEE. The software allows the planners to run load flow analysis, fault current calculations, breaker and downstream device coordination, along with other functions including lock rotor (motor start) analysis.*
- *Models are based upon actual real time data found in the AMFM GIS system. The bi-annual downloads (summer and winter peak) allow the planners to capture upgrades to the system along with newest loads.*

- **SQRT**

- *Entergy distribution planning has developed a database for storing Substation, Transformer, and Feeder Loads, along with the Capacity limits for each. With a hierarchy built-in, reports such as Capacity Margin, Future/projected loads, and historical loading can be generated at various levels.*
- *Historical growth rates used in SynerGEE and justification for large Capital projects are based upon the historical info stored in SQRT. Likewise normal weatherizing factors along with historical WF and GR are also found in SQRT.*

- **CPTrac**

- *Entergy distribution planning has developed a database for storing Projects. New Projects, completed projects, on going projects and those forecasted for the future are stored in one location.*
- *Other Groups such as Work Management and Design also use CPTrac for Tracking both Planning and Non-Planning work.*

Reliability Overview of the Entergy Distribution System -

Existing Reliability/Infrastructure Programs

- **Targeted Circuits/Devices**
 - *This program is to identify and address Circuits with questionable performance. The program is designed to address root cause problems through a focused inspection/mitigation, critical design review, and overall protective device coordination review.*
- **Tactics (Targeted Approach Center Towards Improving Customer Satisfaction)**
 - *This program is to identify and address line segments behind a protective device that meet the TACTICS performance thresholds for repeat outages.*
- **Feeder Backbone Inspections**
- **Pole Inspection, Reinforcement and Replacement**
 - *Projects to address the continuing program for maintaining our standing wood poles as part of the overall Reliability Improvement process.*
- **URD Cable Replacement**
- **Infrared Inspections**
- **Recloser, Regulator, ALT and Capacitor Inspection and Repairs**
- **Vegetation Skyline/Danger Tree removal**

Next Level Reliability/Infrastructure Initiatives

- Maintain Aggressive Vegetation Program
- Pursue Distribution Automation Functionality
 - Advanced Sectionalization and Optimal Coordination
 - Feeder Reconfiguration using Automated Load Transfer (ALT)
 - Fault Location to reduce scouting time and repeat outages
 - *Smart Fault indicators (mid-point switching)*
 - *Advanced Feeder Fault Location Tool (electronic data capture/calculated fault location)*
- Implement Continuous Process Improvement

Operations Overview of the Entergy Distribution System -

Distribution Operations Center Summary

- Entergy's Distribution Operations Centers (DOCs) monitor, operate, and control the distribution system. This operation includes switching, tagging, and clearances on the portions of the feeder which is controlled by the DOC. These functions also include the responsibility for dispatching power outages as well as any other reported issues regarding voltage, wire down, fires, and other troubles.
- The DOC's utilize SCADA to monitor, operate, and control all the distribution controlled equipment in substations. The DOC has control from the high side protection device of any power transformer that has a distribution voltage secondary and all devices downstream of that transformer high-side device. This includes the high-side protection device, the transformer, distribution bus main breakers, feeder breakers, and secondary bus.
- The Distribution Operations Centers Operate 24 hours a day, 365 days a year.
- The DOCs dispatch any issue (substation alarm, power outage, other trouble, etc.) the requires immediate response to appropriate field personnel.
- The DOC provides information (expected duration, response status, etc) regarding troubles that is used in communication with customers via various medias (phone, face-to-face, texting, website).

Outage & Other Trouble Management

- Outage and other trouble is managed through an Automated Mapping/Facilities Management (AM/FM) System. This is the facilities mapping system for our distribution system and it contains an Outage Management System application.
- This Outage Management System contains two trouble logs – Outages and Other Troubles. This is done for proper prioritization and management of all troubles.
- Outage Management Log
 - Cases are generated either by customers calling in to our Customer Service Center, automatically from a breaker opening in the SCADA system, or manually by an operator.
 - Contains algorithms that automatically predicts the over-current device that is open that is affecting the section out. This prediction is done based on the outage calls received by customers.
 - Cases are closed with the necessary information (cause, time restored, etc.) and these records are stored for later data analysis and needs.
- Other Trouble Log
 - Contains cases such as voltage issues, part lights, fire calls, emergency, and wire down.
 - Cases are closed with the necessary information (cause, time restored, etc.) and these records are stored for later data analysis and needs.

Emergency Restoration (DOC)

The DOC is responsible for many facets of Emergency Restoration during major events. These include the following:

- Prepare for forecasted storms by placing feeder breakers on 'non-automatic' before impact. Will close, via SCADA, feeder breakers after each trip until a permanent fault occurs.
- Control distribution system at a level based on area damage and response (always maintain control of feeder breakers). DOC may maintain control of entire distribution system or may relinquish some control to local offices.
- Delegate dispatching or control at levels appropriate for response to the event (substation, feeder, area line, etc.)
- Acquire and provide Operator support at the local level for issuing switching orders AM/FM Data Management.
- Monitor AM/FM system for data accuracy and any update issues.
- Update and monitor information in Network Overview Cases (Network, Feeder, and Case Specific) used in communication with the customer.
- Monitor Web Outage Reporting Tool and information contained therein
- Maintains 24 hour coverage for emergencies, etc.

Metering/Revenue Recovery Advancement In the Entergy Distribution System -

Metering Advancement Programs Under Review

- **Automated Metering Infrastructure (AMI) Pilots**

- *Entergy currently has two AMI pilots underway*
 - *Baton Rouge pilot includes 13,000 meters*
 - *New Orleans pilot includes 11,500 meters*
 - *The New Orleans pilot received partial funding via the federal stimulus package (50% funding for a \$10 million project)*
 - *Vendor used is Elster*
 - *Data from both pilots will be used to build the business case to justify future expansion*
 - *Preliminary estimate for system wide AMI conversion is over \$400 million*
- *Remote meter reading using Smartsync for large power accounts*

- **Established In-House Revenue Protection Group**

- *Hired 25 employees in 2007/2008 to focus on meter tampering, theft and improper functioning meters*
- *Lost revenue recovered with focused employees and improved processes*
 - **Non-Compliant Meters**
 - 2007 Billed = \$10.1M / Recovered = \$9.6M
 - 2008 Billed = \$11.2M / Recovered = \$10.9M
 - 2009 Billed = \$11.5M / Recovered = \$10.9M
 - **Electrical Theft**
 - 2007 Billed = \$2.7M / Recovered = \$2.2M
 - 2008 Billed = \$4.2M / Recovered = \$2.6M
 - 2009 Billed = \$5.4M / Recovered = \$2.6M
- *Data mining is critical to the detection process*

Meter Services Advancement Programs Underway

- **Implemented Service Suite Tool in late 2009**
 - *Implemented advanced mobile data and work management system across all of Entergy for short cycle work*
 - *Short cycle work orders need to be completed in 1-5 days*
 - *Vendor used was Ventyx*
 - *MDT units installed in 900 vehicles*
 - *Benefits from system include:*
 - *Centralized the order dispatch in each state*
 - » *Reduced from 300 people dispatching to 60*
 - *Fully automated order processing from customer request to completion*
 - *Application routes orders based on economic dispatch of resources*
 - *Street level routing with on-screen maps for users*
 - *GPS tracking of users*
 - *Utilization rates are at 80% or higher*
 - *Increased crew efficiencies by 30%*
 - *Reduced miles driven by 8%*
 - *Limited dispatch of outage tickets are being piloted this year*