Missouri Public Service Commission

Electric Roundtable Discussion Group

Record of Proceedings

Electric Utility
Storm Outage Planning and Restoration
& General Service Reliability

June 1, 2007
Governor Office Building
Jefferson City, Missouri

Missouri Public Service Commission

POST OFFICE BOX 360
JEFFERSON CITY MISSOURI 65102
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http://www.psc.mo.gov

MEMORANDUM

TO: Electric Roundtable Discussion Group

FROM: Warren Wood, Director of Utility Operations

SUBJECT: Record of Proceedings

DATE: June 12, 2007

Thank you for attending the Commission's Electric Roundtable session on **Electric Utility Storm Outage Planning and Restoration & General Service Reliability** held in Jefferson City, Missouri on June 1, 2007. As promised, please find attached a bound compilation of the materials presented.

Our desire is to make these meetings as informative, beneficial, and effective as possible. Any ideas or suggestions you may have to help us toward that end are always appreciated. Feel free to contact me at (573) 751-2978 or e-mail me at Warren.Wood@psc.mo.gov with any comments. We look forward to your attendance and active participation at future roundtable meetings.

Attachment

Table of Contents

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Electric Utility
Storm Outage Planning and Restoration &
General Service Reliability

June 1, 2007 - 9:30 to 4:00
Governor Office Bldg., 4th Floor Ballroom, 200 Madison Street, Jefferson City, MO

9:00 Registration Opens

9:30 Introductions & Opening Remarks
Warren Wood, Utility Operations Director, MoPSC Staff
Mark Hughes, Advisor to Chairman Jeff Davis, MoPSC

Storm Outage Planning and Restoration

10:00 Recent Major Storms in Missouri – How They Impacted the Electric System
Rob Land, Director of Risk Management & Training for the Association of Missouri Electric Cooperatives (AMEC)

10:25 What Customers Expect Prior to and Following Major Storms
Christina Baker, The Office of the Public Counsel (OPC) & Mike Dandino, OPC

10:50 The Major Elements of an Emergency Restoration Plan (ERP)
Dave Wakeman, Manager of Distribution Operations for Ameren

11:15 The Restoration Effort – What Worked & Future "Opportunities"
Martin Penning, Director of Operations for Empire &
Sam McGarrah, Director of Engineering and Line Services for Empire

11:40 Lunch on Your Own

1:00 Keeping All the Stakeholders in the Loop
Jim Charrier, Training & Exercise Manager for State Emergency Management Agency (SEMA)

1:25 Open Discussion/Question Period

1:45 Break

General Service Reliability

2:00 What is General Service Reliability & How is it Measured?
Mike Taylor, Energy Department Engineer for MoPSC Staff

2:25 Reclosers, Tap Fuses, and Sectionalizing Devices
Jerry Josken, Regional Power Systems Engineer for Cooper Power Systems

2:50 Vegetation Management Programs – Structures & Objectives
Jeff Wolf, Director of Resource Management for Kansas City Power & Light (KCP&L)

3:15 Infrastructure Inspection – Poles, Circuits & Devices
Jim McBee, Sr. Distribution Planning Engineer for Aquila

3:40 Open Discussion/Question Period

4:00 Adjourn

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Missouri Public Service Commission

Electric Utility Storm Outage Planning and Restoration & General Service Reliability

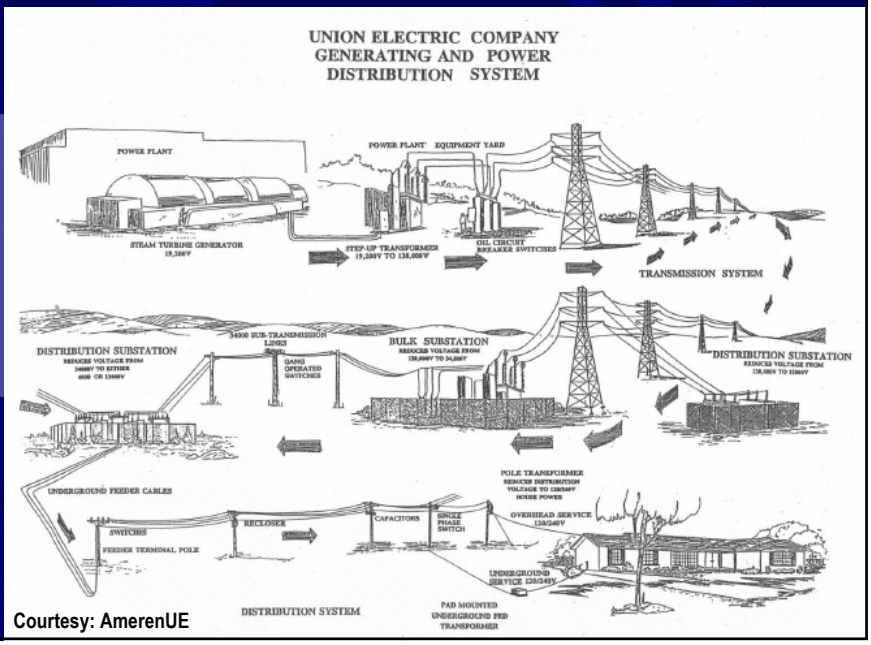
June 1, 2007

- Welcome to this Missouri Public Service Commission Roundtable on Electric Utility Storm Outage Planning and Restoration & General Service Reliability
- This promises to be a very interesting exchange of information and opinions.

- A compendium with all of today's presentations will be posted to our internet site within two weeks @ http://www.psc.mo.gov/publications.asp under the "electric" category.
- If you would like to be added to our roundtable distribution list, please make sure you sign the attendance sheet at the back of the room and give your e-mail address.

- If you would like to receive a certificate of attendance for today's roundtable, please provide me with a business card or your name and mailing address and clearly note that you wish to receive a certificate of attendance.
- If you wish to receive CLE credit please make sure to complete the CLE attendance sheet and evaluation form.

The major elements of the infrastructure that delivers electricity to customers :



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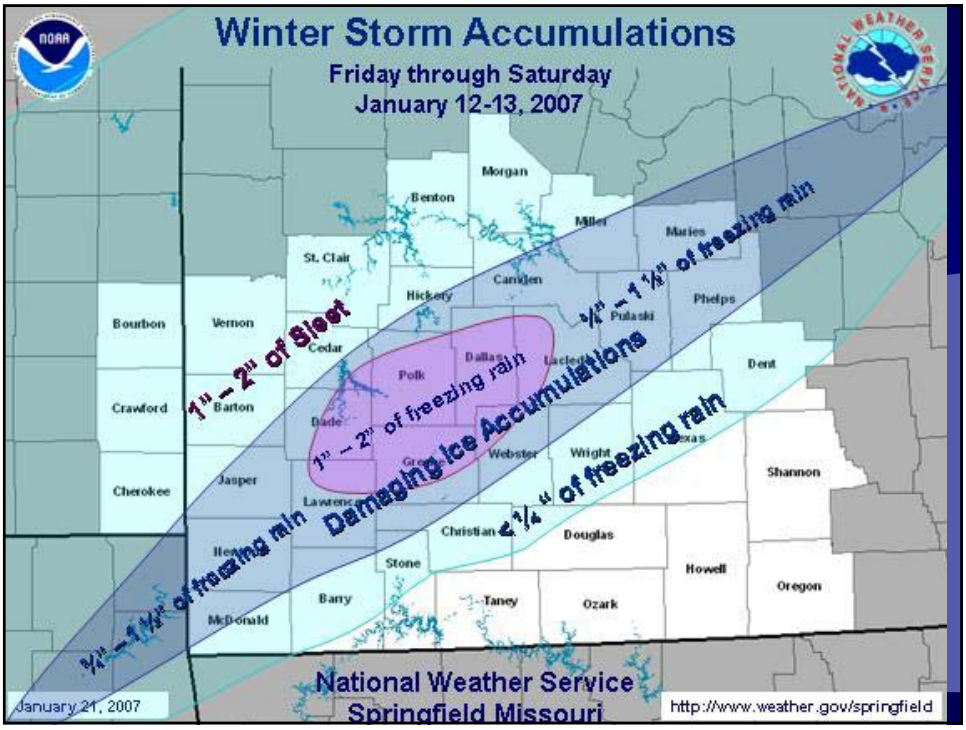
Courtesy: AmerenUE


Courtesy: AmerenUE
2006/07/20 07:08


Winter Storm Accumulations
Friday through Saturday
January 12-13, 2007
Damaging Ice Accumulations
1" – 2" of Sleet
1" – 2" of freezing rain
¼" – 1 ½" of freezing rain
¼" – 1 ½" of freezing rain
¼" – 1 ¼" of freezing rain
Morgan
Benton
Miller
Maries
St. Clair
Camden
Hickory
Phelps
Pulaski
Bourbon
Vernon
Cedar
Polk
Dallas
Laclede
Dent
Crawford
Barton
Dade
Webster
Wright
Shannon
Cherokee
Jasper
Lawrence
Christian
Douglas
Howell
Oregon
Stone
Barry
Taney
Ozark
McDonald
National Weather Service
Springfield Missouri
January 21, 2007
http://www.weather.gov/springfield

- Infrastructure in this region is designed for 70 mph sustained winds or about ½" of ice. This wind load design criteria assumes about a 1 in 50 year recurrence interval.
- Downburst and microburst can result in wind loads in excess of design criteria and cause a lot of damage to trees – on and off the easement.
- As ice accumulates its impact on infrastructure rapidly increases.
  - 1" of ice weighs ~ 4 times ½" of ice
  - 1 ½" of ice weighs ~ 9 times ½" of ice
  - 2" of ice weighs ~ 16 times ½" of ice
  - Trees are not designed to any particular ice load.

Electric Utility Storm Outage Planning and Restoration

9:30 Agenda & Introductions

Warren Wood, Utility Operations Director, MoPSC

9:45 Opening Remarks

Mark Hughes, Advisor to Chairman Jeff Davis, MoPSC

Electric Utility Storm Outage Planning and Restoration

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Rob Land, Director of Risk Management & Training for the Association of Missouri Electric Cooperatives (AMEC)

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Christina Baker & Mike Dandino, The Office of the Public Counsel (OPC)

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Martin Penning, Director of Operations & Sam McGarrah, Director of Engineering and Line Services for Empire

Electric Utility Storm Outage Planning and Restoration

11:40 Lunch – On Your Own

BE BACK BY ~ 12:50

Missouri Public Service Commission

Electric Utility Storm Outage Planning and Restoration & General Service Reliability

June 1, 2007

Electric Utility Storm Outage Planning and Restoration

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1:25 Open Discussion / Question Period

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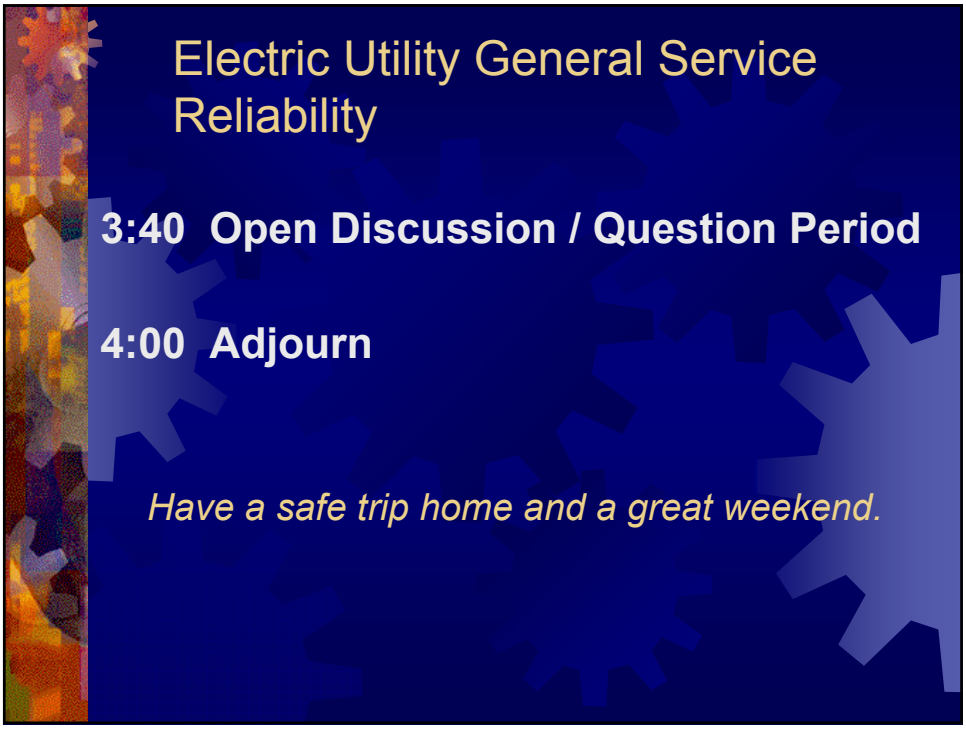
Electric Utility General Service Reliability
3:40 Open Discussion / Question Period
4:00 Adjourn
Have a safe trip home and a great weekend.

3.a

RECENT MAJOR STORMS IN MISSOURI

How They Impacted the Electric System

Rob Land, Director
Risk Management & Training Department
Association of Missouri Electric Cooperatives


01/15/2007


01/15/2007

National Electric Safety Code (NESC) requires that electric lines are designed to withstand up to ½" of ice – heavy standard

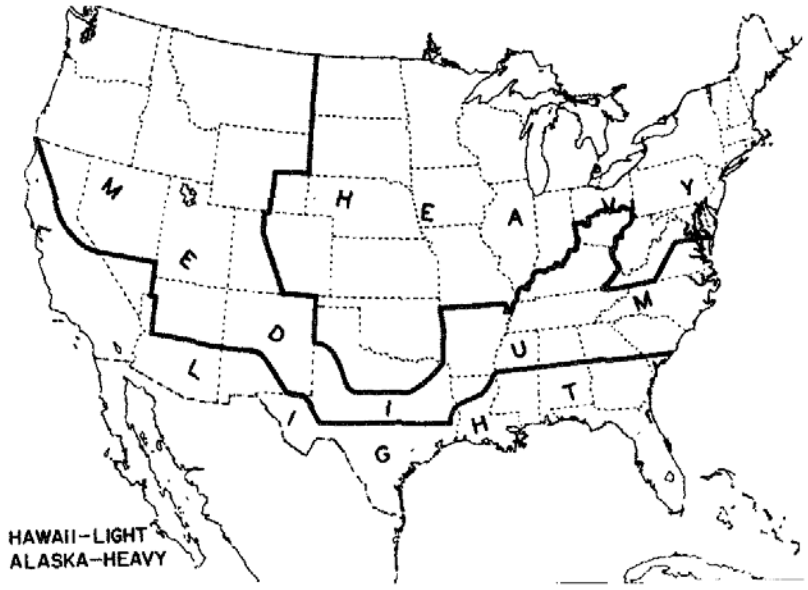

Figure 250-1—General loading map of United States with respect to loading of overhead lines

System Impacts

Stretched/damaged conductor

- One systems will be replacing 59 miles of three phase line.

Whiplash effect

System Impacts (Cont.)

Loss of meters

- System must be built back to pre-storm conditions, sometimes with less number of meters

System Impact (Cont.)

Damaged Equipment

- Transformers
- Breakers
- Regulators

System Impacts (Cont.)

Oil Spills

- Must be cleaned up

System Impact (Cont.)

Individual consumer services

- Thousands of individual services were replaced

System Impacts (Cont.)

Repairs after service is restored

- Leaning/temporary poles
- Additional ROW clearing
- Debris removal

Communications

Do you have a back-up communication system?


01/19/2007


01/19/2007

Shortages

Four separate ice storms in Central U.S.

Nov. 30 – Feb. 26

Shortages (Cont.)

States affected by 2007 ice storms

- Missouri – 2
- Illinois – 2
- Kansas
- Nebraska
- Iowa
- Oklahoma

Shortages (Cont.)

Materials

- Conductor
- Poles
- Crossarms
- Splices

Mutual Aid Assistance

Over 2660 total employees

- 1716 Mutual aid employees
  - Kansas
  - Iowa
  - Illinois
  - Kentucky
  - Tennessee
  - Mississippi
  - Arkansas

Specialized Equipment

- Track Vehicles
- Skidster

Questions?

3.b

What Customers Expect Prior to and Following Major Storms

Mike Dandino, Deputy Public Counsel

and

Christina Baker, PE, Assistant Public Counsel

Customer Satisfaction

- Satisfaction has lowered in past year
  - Ameren summer storms/ice storm public comments reflect expectations and indicate failure meeting them
  - American Customer Satisfaction Index

Primary Expectation of Customers

- Reliable-Safe-Reasonably Priced Electric

Reliability

Planning

- Design for known conditions in Missouri
  - Tornados/heavy winds
  - Ice storms
  - Earthquakes

Reliability

Planning

- Financial planning
  - Engage in efficiency monitoring

Reliability

Planning

- Long-range planning for upgrades
  - Value-based planning
- Embracing new technology

Reliability

Staffing

- Customer support centers
  - Responsive to customer's needs
  - Assistance for customer's locality
  - Timeliness of receiving support

Reliability

Staffing

- Customer information centers
  - Accurate restoration times
  - Restoration progress
  - Contact information

Reliability

Staffing

- Getting work done in the customer's area
  - Maintenance crews
  - Tree trimming crews
  - Emergency crews

Reliability

Maintenance

- Clear statement of who is responsible for what
  - What is customer's responsibility
- Schedule for maintenance determined
  - Schedule must be adhered to so catch-up not necessary

Reliability

Maintenance

- Repair based on worst performance
  - If it is broken…fix it
- Band-aid vs. replacement
  - Which one costs the ratepayer more?

Safety

Effect of loss of electrical service on safety

- Health issues
  - Availability of heat/AC
  - Medical support equipment
  - Traffic light outages
  - 911 Availability

Safety

Effect of loss of electrical service on safety

- Other Utility Services
  - Water supply
  - Wastewater processing
  - Telephone / Cell phone

Reasonably Priced

What customers are willing to pay

- Customers willing to pay more if perceive they are getting more
- Believe they should get what they pay for
- Customers becoming well informed about costs, wages and bonuses

Something to Remember

- Everything a utility does as it responds to an emergency has a public relations component to it...*

**Although There's No Such Thing As An Average Disaster, Common Themes And Practices Characterize 10 Utilities' Exceptional Responses*, Peter Jump, Electric Perspectives, Jul/Aug 1999

Bottom Line

Customers can forgive a lot if:

- Feel utility is working for them
- Feel like they are important
- Utilities realize they cannot be a utility without customers
- Problems occur due to something truly unexpected and beyond utility's control

3.c

Ameren Energy Delivery

Ameren Electric Emergency Restoration Plan

Dave Wakeman

Ameren Energy Delivery

Plan Content

- Overview
- Emergency Operations Center
- Individual Job Duties/Responsibilities
- Damage Assessment
- Restoration Update Conference Calls
- Extensive Damage Recovery
- Division Electric Emergency Restoration Plans
- Division Supply List
- Logistics
- Sending/Receiving Crews with Ameren System
- Handling Outside Crews
- Mutual Assistance to Other Utilities
- Technology
- Contingency Planning for Loss of Critical Systems and Facilities

Ameren Energy Delivery

Emergency Operations Center

- EOC Activation
- Storm Levels
- EOC/Division Responsibilities
- EOC Operations
- Resource Procurement/Release
- Restoration Update Conference Call
- Storm Critique

Ameren Energy Delivery

Individual Job Duties/Responsibilities

- EOC Personnel
- Distribution Dispatch Offices
- Division Storm Center
- Construction Field Jobs
- Service Crew Work
- Damage Assessment Roles
- Division Support

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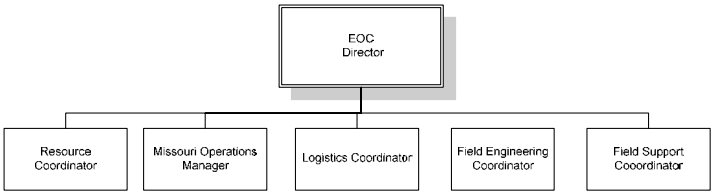
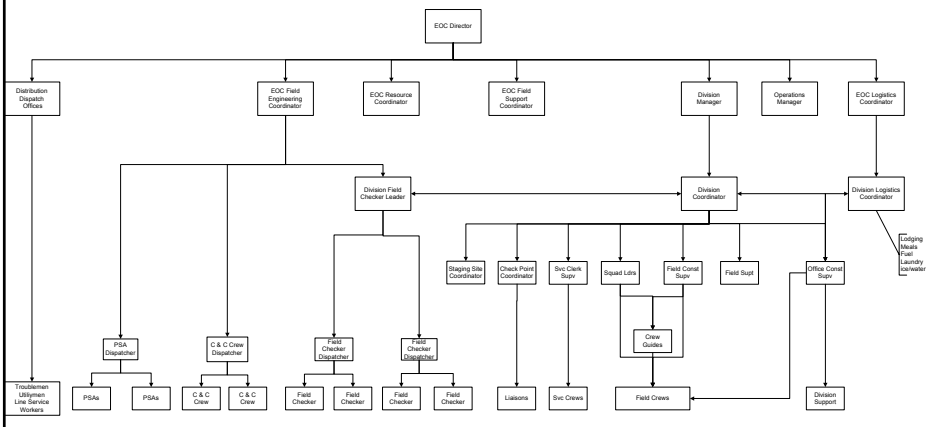


Ameren Energy Delivery



Ameren Energy Delivery

Damage Assessment

- Information Review
- Initial Field Damage Assessment (High Level)
- Detailed Damage Assessment
- Heavy Localized Damage Assessment

Springfield IL 3/11/06 taken from St. John's hospital window
(night of 3/11/06 - lots of damage to Springfield)

Ameren Energy Delivery

Restoration Update Conference Calls

- Call timing
- Call set up
- Call content
- Call documentation

Ameren Energy Delivery

Division Electric Emergency Restoration Plans

- Template SharePoint site
- Critical logistics information
- Annual Review is necessary

Ameren Energy Delivery

Division Supply List

- Items that may benefit a Division during a restoration
- Can be updated with new items
- Must have contingency plan for local offices

Ameren Energy Delivery

Logistics

- Major component of a successful plan/ restoration effort
- Must prepare for a variety of situations
- Power outages can affect your vendors
- Must build relationships/criteria before the need

Ameren Energy Delivery

Logistics

A Key to Success

Ameren Energy Delivery

Logistics - Lodging

- Lodging
  - Hotels
  - Dorms
  - Gyms/ Large Facilities
  - Tents
- Number of facilities can be large
- Contracts are a huge benefit

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Logistics – Meals

- Breakfast
- Lunch
  - Box Lunches
  - Snacks
  - Supplemental deliveries
- Dinner
  - Buffet
  - Restaurants

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Logistics - Miscellaneous

- Parking
- Busing
- Laundry
- Ice
- Water/Sports drinks
- Security
- ... (the thing you haven't thought of yet)

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Ameren Energy Delivery

Ameren Energy Delivery

Ameren Energy Delivery

Staging Sites

- Selected sites and Contracts upfront
- Sample layouts for sites
- Must staff sites
- Storm Trailers and Mobile Command Center

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Ameren Energy Delivery

Ameren Energy Delivery

Ameren Energy Delivery

Ameren Energy Delivery

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Handling Resources

- Sending Internal Resources
- Receiving Internal Resources
- Receiving Outside Resources
- Sending resources off property

Ameren Energy Delivery

Sending/Receiving Crews within Ameren System

- Sending Crews to Assist
  - Supervisors, Superintendents, Crew Dispatchers, Equipment
- Receiving Crews to Assist
  - Staging Sites, Material Trailers

Ameren Energy Delivery

Handling Outside Crews

- Checkpoints
- Checkpoint Coordinator
- Ameren Liaison
- Safety Coordinator
- Squad Leaders
- Crew Guides

Ameren Energy Delivery

Mutual Assistance to other Utilities

- Handled By Operations Managers
- Discussions with EOC
- Typically not supported by EOC

Ameren Energy Delivery

Technology

- Dispatch/EOC phones
- Cell phones
- Voice Radios
- Consoles/Truck/ Portables
- Mapping
- SCADA
- Weather tools
- Web pages

•Contingency planning for loss of critical systems and facilities

Ameren Energy Delivery

Resources on Demand

- System to track personnel and equipment
- Used to manage resources during storm restoration
- Information is kept to the individual level
- Web based for view throughout the company
- Tracks history and documents movements

Ameren Energy Delivery

Storm Plans

- Questions or comments

3.d

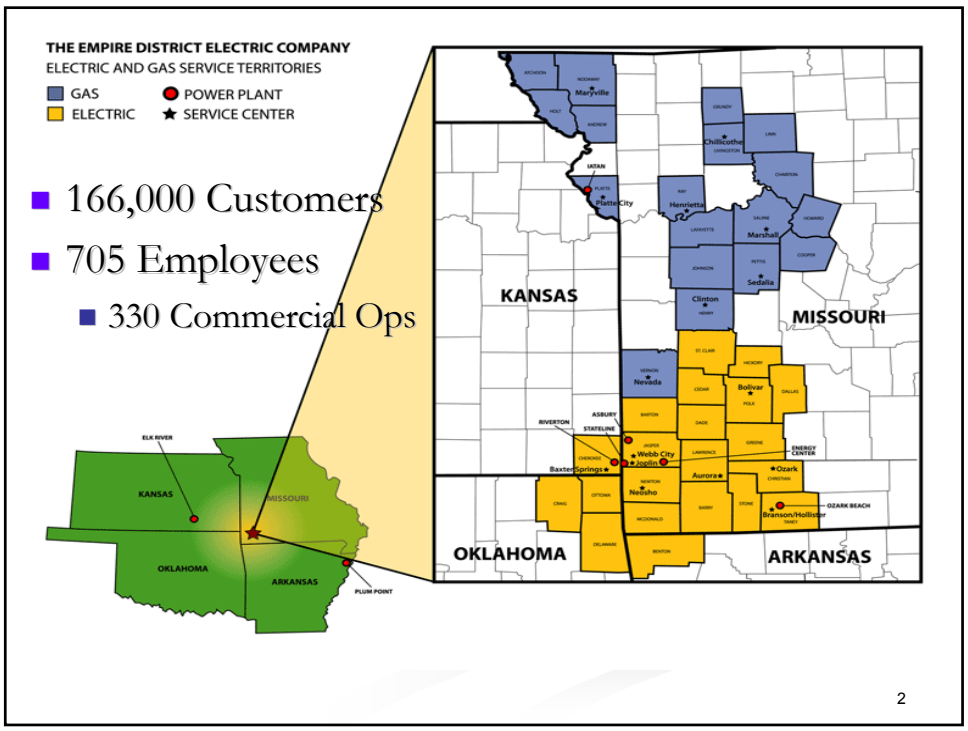
The Empire District Electric Company

Response to Ice Storm January 2007

Presented by

Martin Penning & Sam McGarrah

EMPIRE
SERVICES YOU COUNT ON

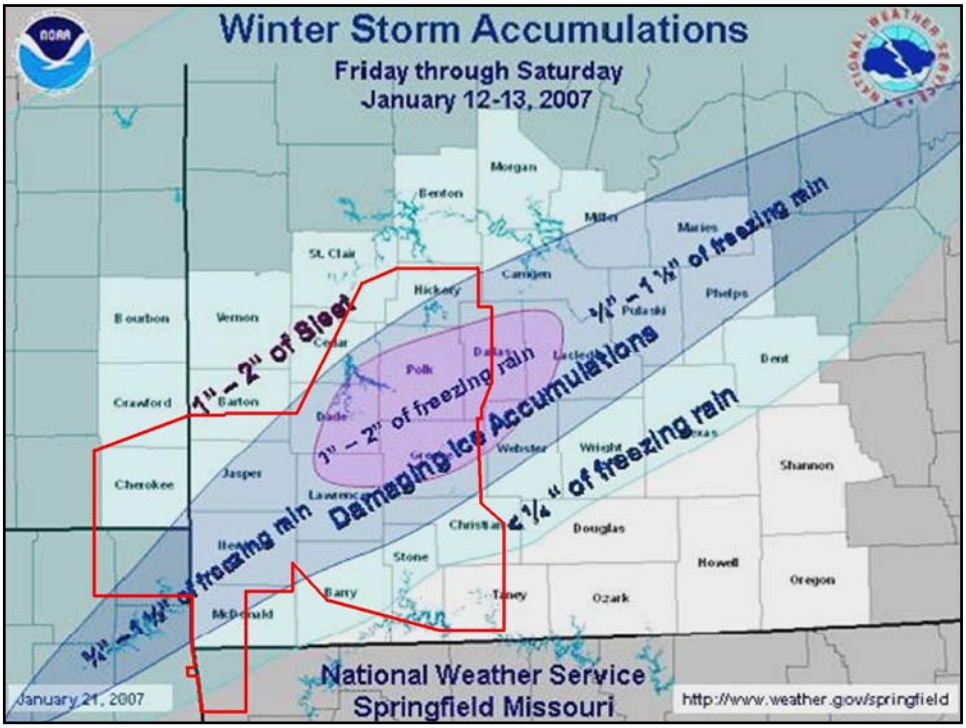


Overview of Storm Impact

- Storm was predicted about several days in advance.
- Three "waves" of storms:
  - Friday, January 12th
  - Saturday, January 13th (36,000 customers out)
  - Sunday, January 14th (85,000 customers out – 52% of total customers)

How Much Ice?

- Three to four times the amount we would consider a serious ice storm.
- The following pictures will give you an idea of the magnitude of the ice.


Winter Storm Accumulations
Friday through Saturday
January 12-13, 2007
Morgan
Benton
Miller
Maries
St. Clair
Camden
Hickory
Phelps
Bourbon
Vernon
Cedar
Polk
Dallas
Laclede
Dent
Crawford
Barton
Dade
Webster
Wright
Shannon
Cherokee
Jasper
Lawrence
Christian
Douglas
Stone
Howell
Oregon
Barry
Taney
Ozark
McDonald
1" – 2" of Sleet
1" – 2" of freezing rain
Damaging Ice Accumulations
¼" – 1 ¼" of freezing rain
¼" – 1 ¼" of freezing rain
¼" – 1 ¼" of freezing rain
National Weather Service
Springfield Missouri
January 21, 2007
http://www.weather.gov/springfield

Variation Across EDE System

West Side

- Ice accumulation of 3-4 inches on the roads.
  - Difficulty maneuvering vehicles
  - Difficulty walking and working on the ground
    (1 collarbone was broken while walking to hotel)

East Side

- More ice on wires and trees.
  - Increased galloping of conductors
  - Damage continued to accumulate long after the rain stopped.

How Much Damage?

1,040 Poles

1,100 Cross Arms

302 Transformers

118 Miles of Conductor

Cost - $29M

Restoration

What Worked?

- Planning
- Communication
- Coordination
- Flexibility
- Manpower
- Materials
- Tools

Planning/Communication

Early weather predictions allowed us to:

- Make early inquiries concerning outside line and tree contractors (tree trimmers were scheduled on Saturday)
- Alerted selected EDE Commercial Operations personnel
- Notified materials suppliers and ordered selected materials

Communications during the storm

- Regularly scheduled conference calls among EDE managers
- Frequent unscheduled calls between managers

Coordination

Transmission restoration was centrally coordinated. (Damage assessment, tree trimming and reconstruction.)

Number of additional personnel secured was coordinated with logistic capabilities and available material supply in mind.

Flexible Plan

- Large storms require an "adapt and overcome" mentality
- EDE personnel respond to the need as required (never "not in my job description")

Manpower

Adequate numbers of personnel:

- 400 EDE employees
- 1,565 Contractors
  - 860+ Linemen
  - 700+ Tree Trimmers
- Total of nearly 2,000 personnel

Regular hours

- Crews were placed on a regular schedule when we knew this was going to be a "long one"

Materials

Entered a supply chain alliance with Stuart Irby Company late '06

- Irby secured and began stocking a warehouse on EDE's system late fall
- Irby flew in support personnel to assist throughout the storm
- They were excellent and as a result we had very few material problems

Other suppliers also did an outstanding job

- Hubbell Power Systems in Centralia, Missouri made themselves available 24x7

Tools

Outage Management System

- Provided for an efficient means to troubleshoot and dispatch crews
- Saved days of restoration time

Mapping System

- Printed circuit maps in advance for 3 areas
- Very helpful to contractors

Logistics

Food

- Many restaurants opened their doors and worked through the night preparing food (hot food and brown bags)

Housing

- Joplin and Branson hotels/motels were extremely accommodating to our needs

Transportation

- Tour busses out of Branson were used to bus contractors to/from staging areas to Branson hotels

Laundry

- Area laundries assisted to clean soiled clothing

Fuel

- Tankers delivered fuel through the night to parked vehicles (in areas where fueling locations were scarce)

Restoration

Areas for Improvement

System Damage Assessment

- Transmission system damage assessment to be done sooner
- Pre-arrange to be done ASAP (weather dependent)

Communication

- General
  - Do a better job informing all customers, cities and emergency agencies concerning restoration status (was improved throughout the storm)
- A website is being developed
- Call Center
  - Considering a "home agent" approach to large events
  - Allows additional call center representatives to respond quickly even when roads are inaccessible (must have internet access)

Restoration
Areas for Improvement

Materials

- Make even better use of Stuart Irby Company (alliance was in its infancy)
- Eliminate duplication/confusion between EDE stores personnel (done)

Tools

- Outage Management System
  - Extreme call volumes caused our Interactive Voice Response (IVR) system to fail (settings have been changed)
  - Extreme situation overwhelmed our ability to "close out" outages in a timely manner (trained manpower and hardware)
  - Additional "reconnaissance" personnel to look for blown fuses, tripped reclosers and other problems would have allowed for manual tagging in the OMS
- Pre-Printed Circuit Maps
  - We needed more paper circuit maps for the contractors

Restoration
Areas for Improvement

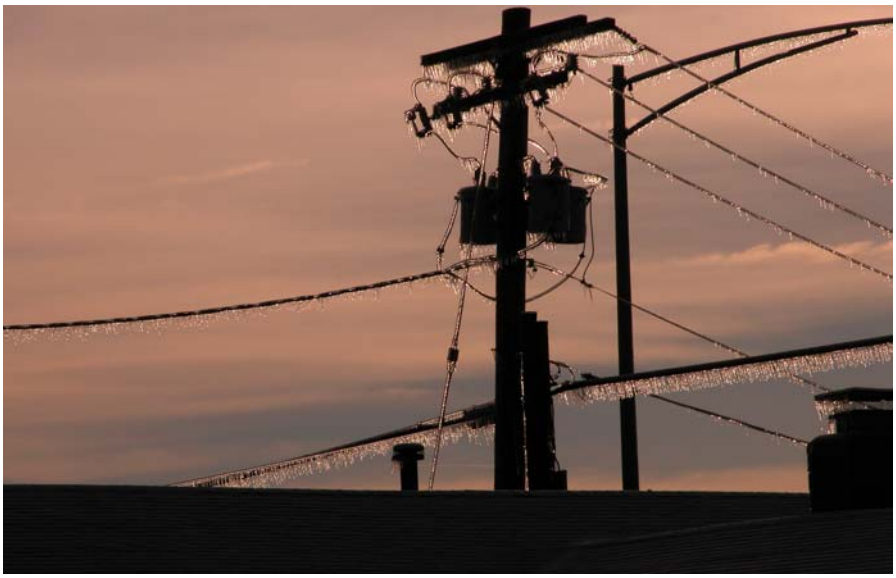
Logistics

- Very large numbers of contract employees made it difficult to keep up with them
- Make advance notification and contractual agreements with restaurants, hotels, laundries, etc
- Considering a contract with a professional logistics company
- Review adequacy of EDE backup generators
- Review backup power plans for communications facilities

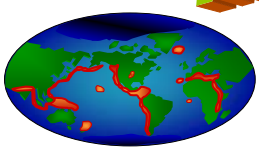
Questions??

3.e

"We Had a Little Ice Storm in Parts of Missouri Last Night"



Missouri Emergency Management Program



Ike Skelton Training Site

(Missouri State Emergency Management Agency)
(SEMA Operations Center - SEOC)

SEMA Mission Statement

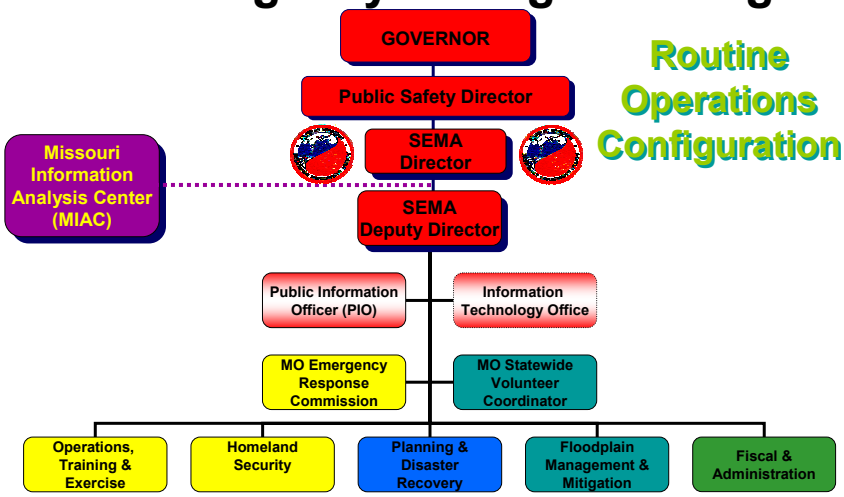
RSMo Chapter 44.020

- The State Emergency Management Agency is created for "assisting in [the] coordination of national, state and local activities related to…response, recovery, planning and mitigation."

- "This agency shall also serve as the statewide coordinator for…the National Flood Insurance Program."

Missouri

State Emergency Management Agency



SEMA Organization

Missouri

State Emergency Management Agency

Major State Emergency Program Participants

- Governor's Office
- Department of Transportation
- Department of Health & Senior Svcs
- Department of Natural Resources
- Department of Labor
- Department of Corrections
- Department of Agriculture
- Office of Administration
- Elementary & Secondary Education
- MONG
- Department of Public Safety
- Department of Mental Health
- Department of Economic Development
- Department of Revenue
- Department of Insurance
- Department of Conservation
- Department of Social Services
- Higher Education

SEMA Emergency Management Programs

- Emergency Management Performance Grant
- Homeland Security Grants
- Nuclear REP (Callaway & Cooper Nuclear Plants)
- Mitigation & Floodplain Management Programs
- Emergency Management Training & Exercises
- Response & Recovery Programs
- Statewide Volunteer Coordinator & Volunteer Programs
- Missouri Emergency Response Commission
- Seismic Safety Commission
- 911 Advisory Committee

Disaster Declarations

1993 – 2007

(as of May 10, 2007

Event	Federal	State Only
Flooding	6	3
Storms/Tornadoes	10	2
Ice Storm	3	1
Fire	1	1
Dam Failure	0	1
Hurricane Evacuees	1	0
SBA	5	0
TOTALS	26	8

Total costs for 26 declared disasters is **$900 M**

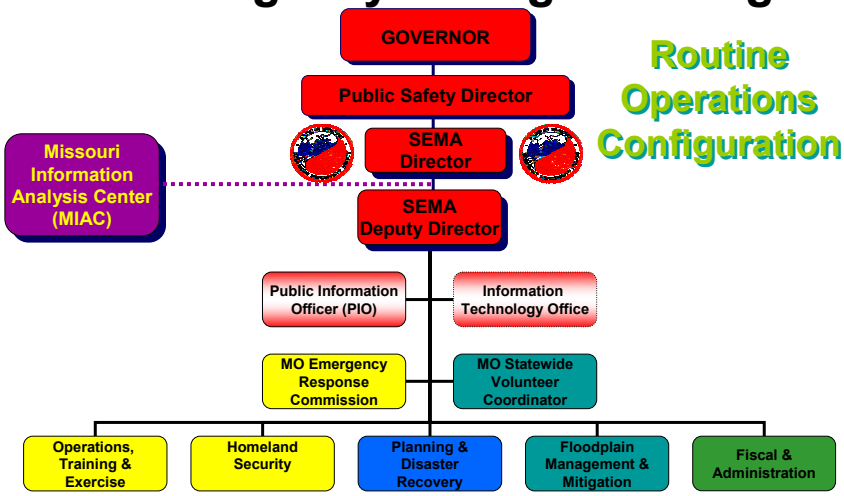
2006/07 DisasterEvents

Event	Date	Disaster
Storms/Tornadoes/Flooding	03/16/2006	DR-1631
Storms/Tornadoes/Flooding	04/05/2006	DR-1635
Storms/Tornadoes/Flooding	07/19/2006	DR-1667
Storms/Tornadoes/Flooding	09/22/2006	State Only
Winter Ice & Snow Storm	11/30/2006	DR-1673
Winter Ice & Snow Storm	01/12/2007	DR-1676

Missouri currently has 10 open disasters

Missouri

State Emergency Management Agency

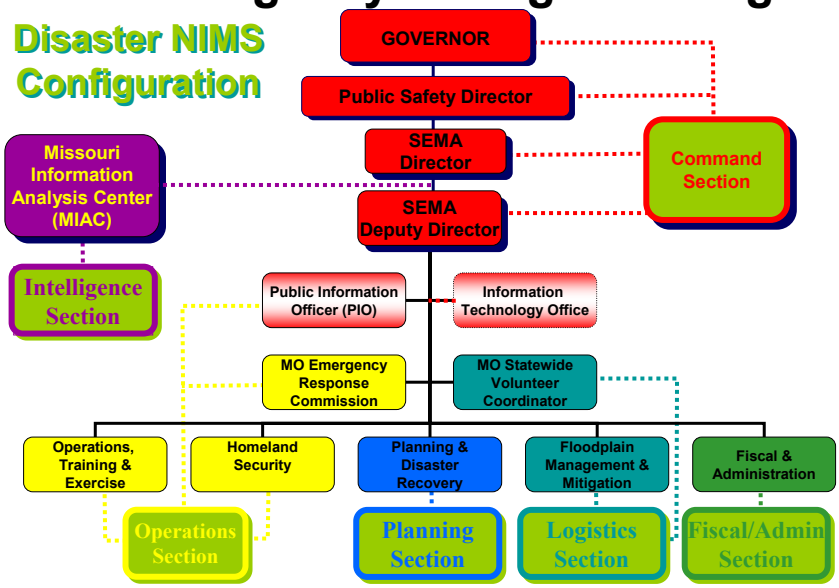


Routine Operations Configuration

Missouri

State Emergency Management Agency

Disaster NIMS Configuration

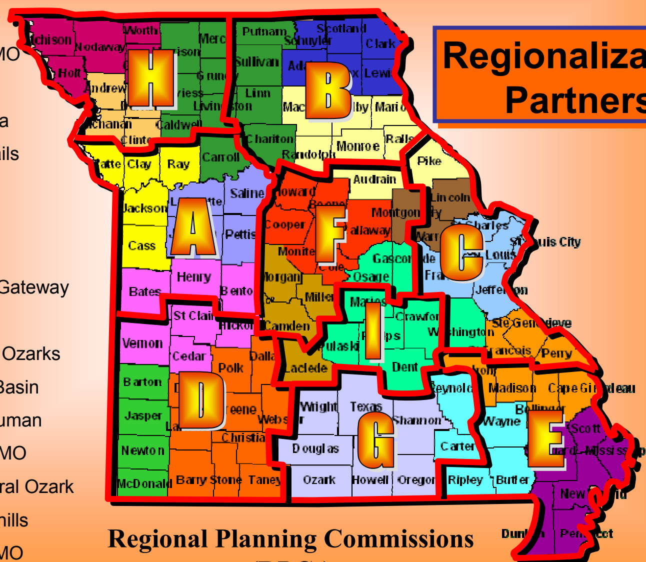


SEMA's 9 Area Coordinators

- Nine Regions - Statewide local interface
- Liaison, advise & train local officials
- Help develop local emergency plans
- Evaluate & advise local emergency response activities
- Provide situation reports & damage assessments to SEOC
- Help develop local HAZMAT plans & support HAZMAT activities
- Support & coordinate response & recovery actions

Missouri Association of Council of Governments (MACOG)

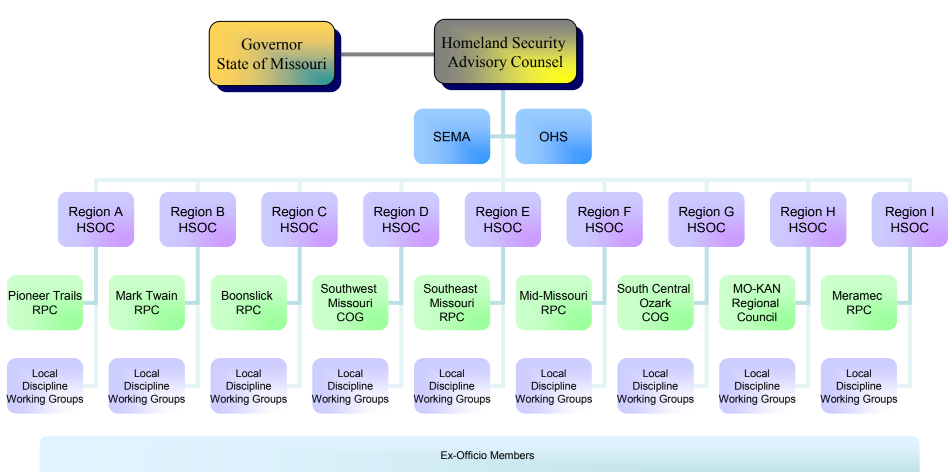
- Northwest MO
- Green Hills
- Northeast MO
- MO-Kan
- Mid-America
- Pioneer Trails
- Mid-MO
- Mark Twain
- Boonslick
- East-West Gateway
- Meramec
- Lake of the Ozarks
- Kaysinger Basin
- Harry S. Truman
- Southwest MO
- South-Central Ozark
- Ozark Foothills
- Southeast MO
- Bootheel



Regional Planning Commissions (RPCs)

Regionalization Partners

Regionalization Organization Chart



Troop A
Kansas City
Clay Co./Northland Fire Chief's Assoc.
Lee's Summit
Sedalia/Pettis County
Johnson County
Tri-District FPD

Troop B
Kirksville
Hannibal

Troop C
St Charles / Warren County
St Louis County
St. Louis City
Jefferson County
Franklin County

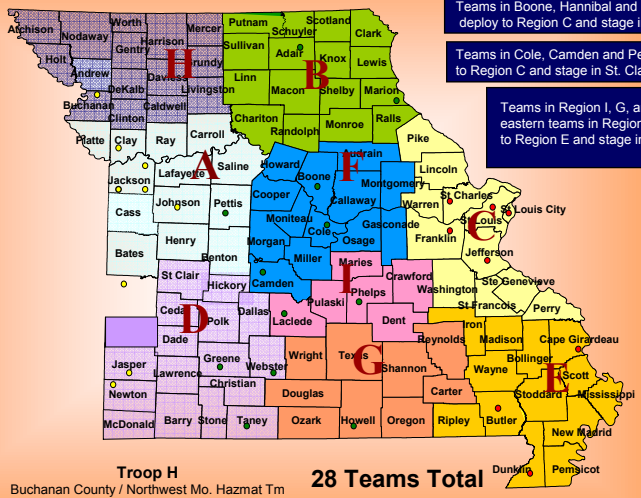
Troop D
Springfield
Logan-Rogersville
Joplin
Nevada
Taney County / Branson
City of Neosho

Troop E
City of Jackson /
SEMO Hazmat Team
Ozark Regional Hazmat
WMD Team
City of Kennett

Troop F
Columbia / Boone Co
Camden Co Hazmat Tm
Cole Co Hazmat Tm

Troop G
West Plains

Homeland Security Response Teams (HSRT) Deployment Strategy



HSRT Teams on alert
HSRT Teams Responding
HSRT Teams Out of Service

Teams in Boone, Hannibal and Kirksville will deploy to Region C and stage in Wentzville.

Teams in Cole, Camden and Pettis will deploy to Region C and stage in St. Clair.

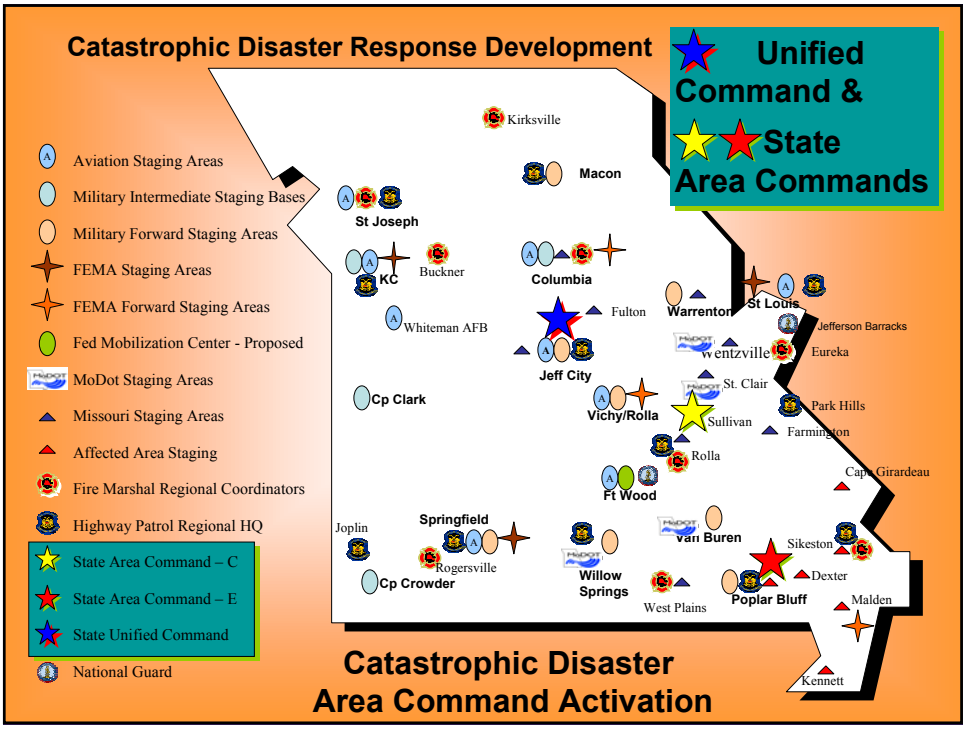
Teams in Region I, G, and the three eastern teams in Region D will deploy to Region E and stage in Poplar Bluff.

Troop H
Buchanan County / Northwest Mo. Hazmat Tm

Troop I
Rolla / Phelps Co
City of Lebanon

28 Teams Total
8 Teams in affected area
11 Teams initially deployed
9 Teams for replenishment

Available National Guard units from Missouri & other States provide disaster support.



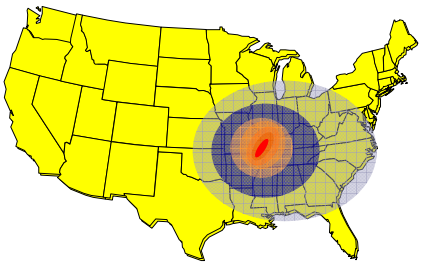
SEMA Conducted
204 Courses in FY 06

Emergency Management Training

Exercise Scope

- Event – Catastrophic Earthquake – M7.6 +/-
- Challenges – Disaster & SONS Response
- Multi-state – MO, KS, New Madrid States
- Exercise Type – Functional but Flexible
- Date/Length – Week of June 18, 2007

Exercises



MNMX '07

SEOC Life Support

Kitchen

Bath/Shower

Water Filtration

Power

Air Filtration

CRT Tele / Radio Switching

Nuclear Power Plant Lines

Weather Radar Display

Control Room

Computer Stations

EAS Access

State/National Warning Lines

Phone Recorders

16 CHANNEL TV NETWORK TO ALL BUILDINGS IN THE COMPLEX

MULTI-MEDIA PROJECTORS

10 FT. X 10 FT. IMAGES

CLOSED CIRCUIT SEOC TELEVISION BROADCAST

HF, UHF Radios

Satellite Phones

Federal HF Radios

National Guard Radio System

Conventional & Cellular Services

Message Center

HOW CAN ELECTRIC UTILITIES HELP SEMA IN DISASTERS ?

•DURING MAJOR WIDE-SPREAD OUTAGES, INSERT LNO INTO EOC

•KEEP POINTS OF CONTACT FOR ASSOCIATION UPDATED OFTEN

•ASSIST WITH IDENTIFYING SPECIAL NEEDS FACILITIES FOR POWER RESTORATION EFFORTS, LIKE NURSING HOMES, ELDER CARE FACILITIES, WATER AND SEWER PLANTS

*PARTICIPATE IN EXERCISES

*PROVIDE EMPLOYEES BASIC NIMS TRAINING

*PARTICIPATE IN AFTER-ACTION REVIEWS WITH LOCALS AND STATE

*DEVELOP AND MAINTAIN GOOD WORKING RELATIONSHIPS NOW

*LET US KNOW HOW WE CAN HELP YOU HELP YOUR CUSTOMERS

*IT TAKES STRONG PARTNERSHIPS TO WORK DISASTER RESPONSE

"INTO EACH LIFE A LITTLE RAIN MUST FALL; LET'S US GROW TALL"

QUESTIONS, COMMENTS, FEEDBACK, COMPLAINTS?

CONTACT INFORMATION:

STEVE MOODY, OPERATIONS CHIEF

STATE EMERGENCY MANAGEMENT AGENCY

OFFICE: 5573 526 9100 24 HR. DUTY #: 573 751 2748

MEMBER CO-MO ELECTRIC COOPERATIVE SINCE 1997,

OZARK BORDER ELECTRIC CO-OP SINCE 1977

4.a

What is General Service Reliability and How is it Measured?

Electric Utility Roundtable on Storm Outage Planning and Restoration & General Service Reliability

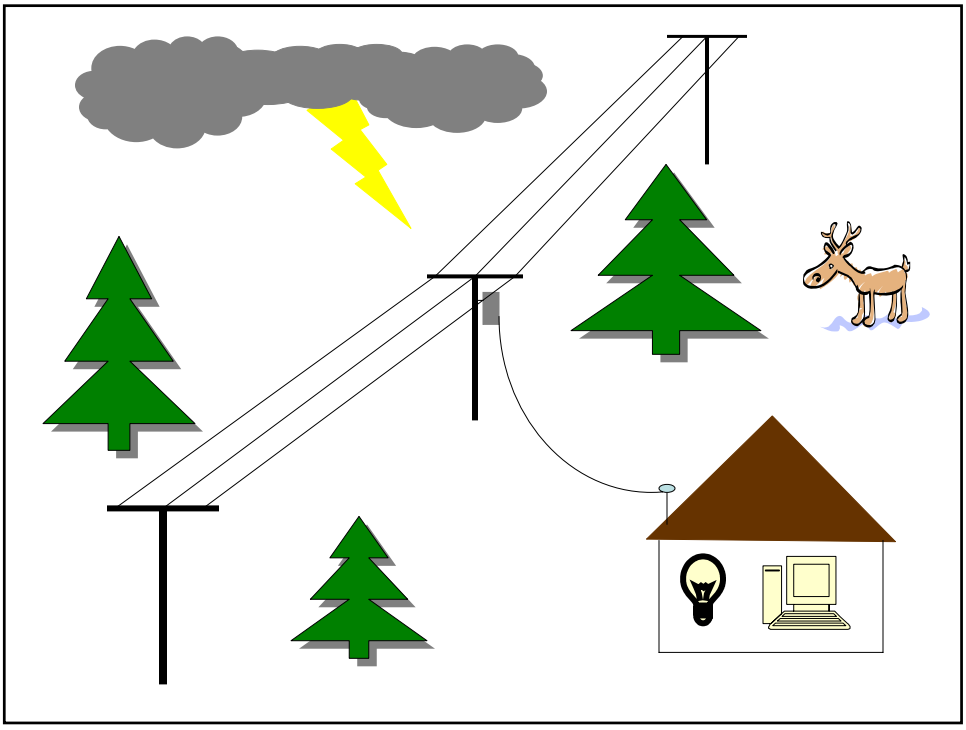
By Mike Taylor, PSC Staff Engineer
Missouri Public Service Commission
June 1, 2007

General Service Reliability

- General—pertaining to every member of a category
- Service—providing the use of something
- Reliability—dependability

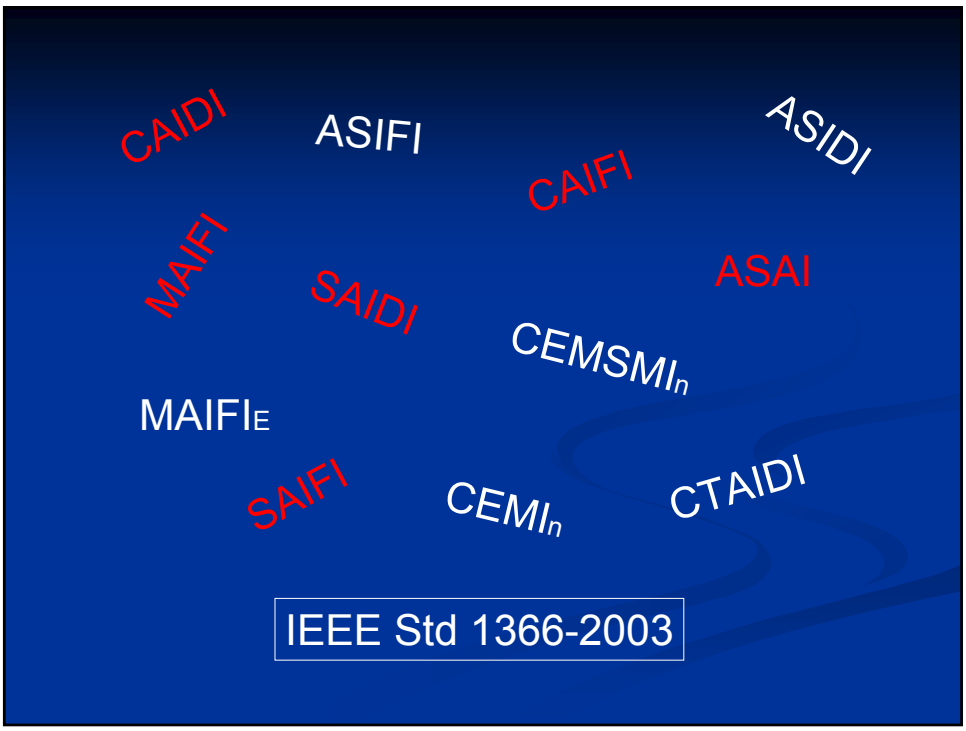
General Service Reliability

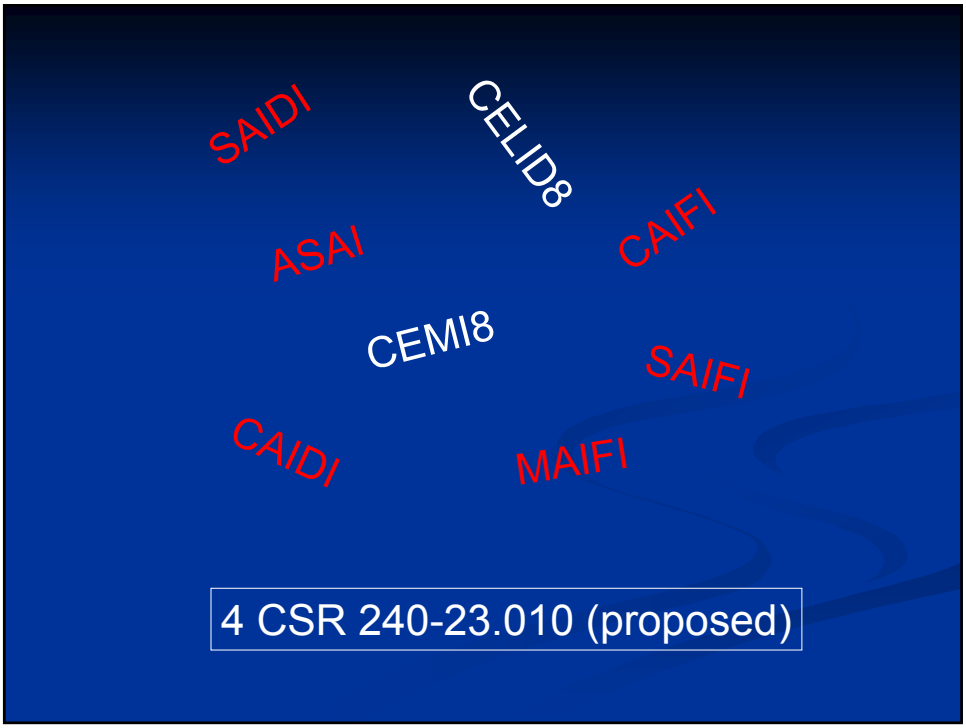
Providing the use of something (electricity) to every member of a category (customers) dependably (with minimal interruptions)



How is General Service Reliability Measured?

- IEEE Std 1366-2003 (IEEE Guide for Electric Power Distribution Reliability Indices)
- 4 CSR 240-23.010 {proposed} (Reliability Rules)
- Other definitions





System Average Interruption Frequency Index (SAIFI)

$$SAIFI = \frac{\Sigma \text{ Total Number of Customers Interrupted}}{\text{Total Number of Customers Served}}$$

System Average Interruption Duration Index (SAIDI)

$$SAIDI = \frac{\Sigma \text{ Customer Interruption Durations}}{\text{Total Number of Customers Served}}$$

Customer Average Interruption Frequency Index (CAIFI)

$$CAIFI = \frac{\Sigma \text{ Total Number of Customer Interruptions}}{\text{Total Number of Customers Interrupted*}}$$

* The customer is counted once regardless of the number of times interrupted.

Customer Average Interruption Duration Index (CAIDI)

$$CAIDI = \frac{\Sigma \text{ Customer Interruption Durations}}{\text{Total Number of Customers Interrupted}} = \frac{SAIDI}{SAIFI}$$

Average Service Availability Index (ASAI)

$$ASAI = \frac{\text{Customer Hours Service Availability}}{\text{Customer Hours Service Demands}}$$

Momentary Average Interruption Frequency Index (MAIFI)

$$MAIFI = \frac{\Sigma \text{ Total Number of Customer Momentary Interruptions}}{\text{Total Number of Customers Served}}$$

Customers Experiencing Long Interruption Durations 8 (CELID8)

The total number of customers that have experienced a cumulative total of more than eights hours of outages.

Customers Experiencing Multiple Interruptions 8 (CEMI8)

$$CEMI8 = \frac{\text{Total number of customers that experienced >8 sustained interruptions}}{\text{Total number of customers served}}$$

Adjusted vs. Not Adjusted

- Allow major events to be studied separately from daily operation
- Eliminate large statistical effect of major events
- Various definitions for “major event”
- Other adjustments

Major Event Day Classification

A Major Event Day is a day in which the daily system SAIDI exceeds a threshold value (T_{MED})

T_{MED} = threshold value for major event day

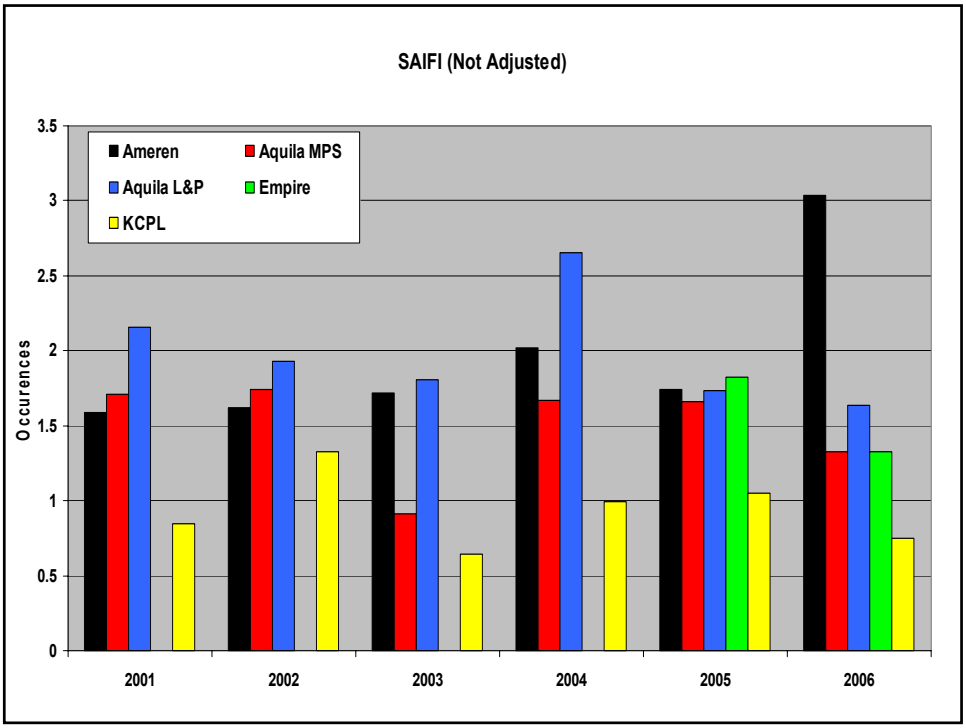
$$T_{MED} = e^{(\alpha + 2.5\,\beta)}$$

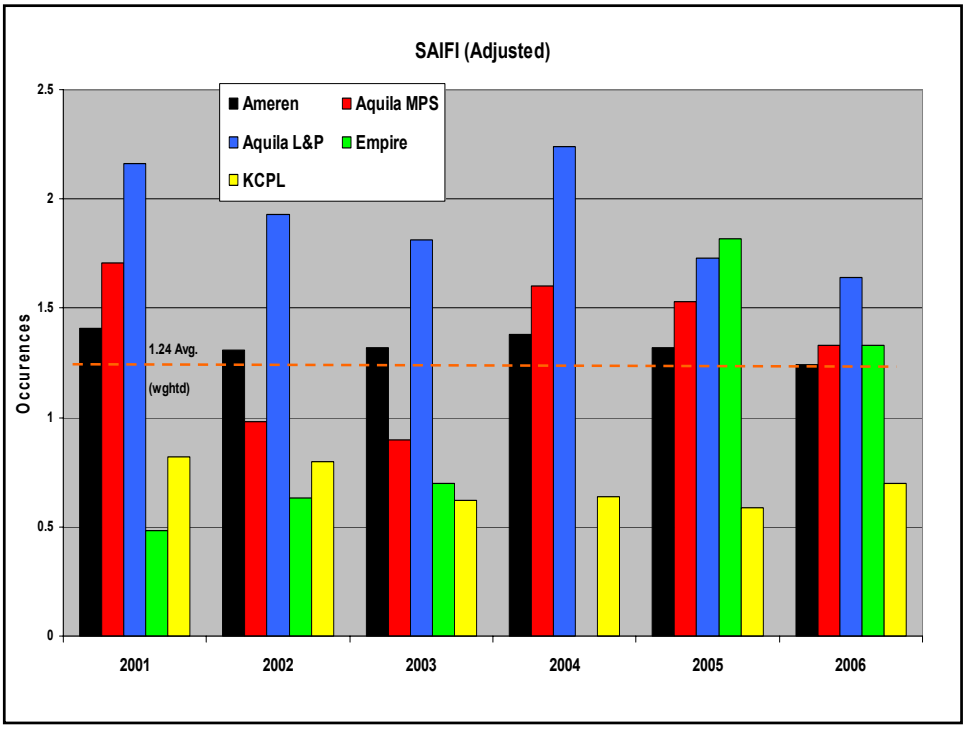
IEEE Std 1366-2003

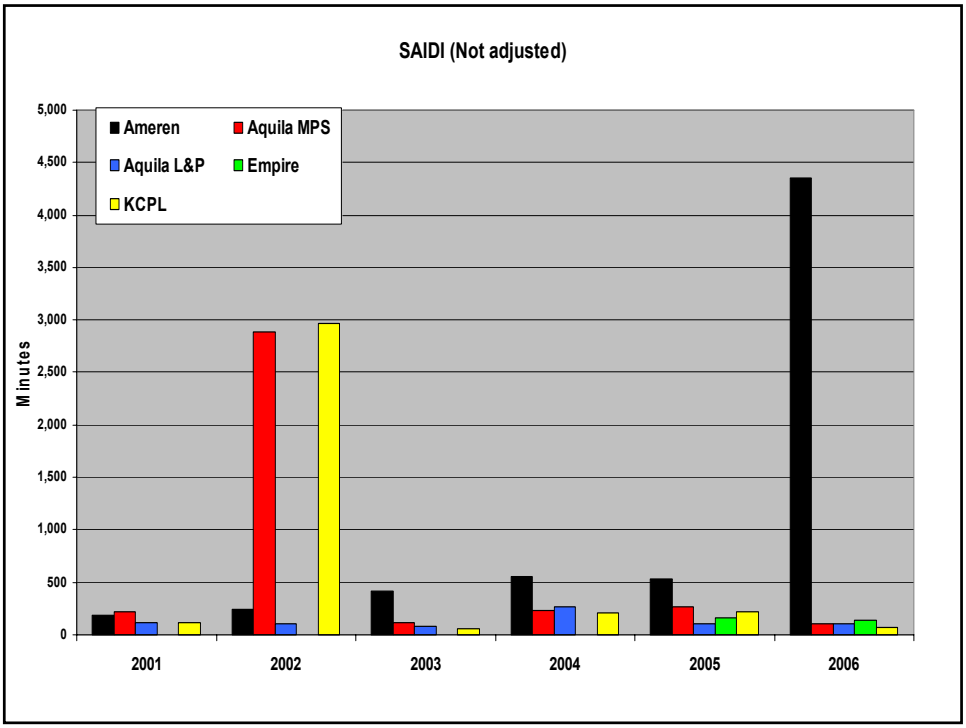
Major Event

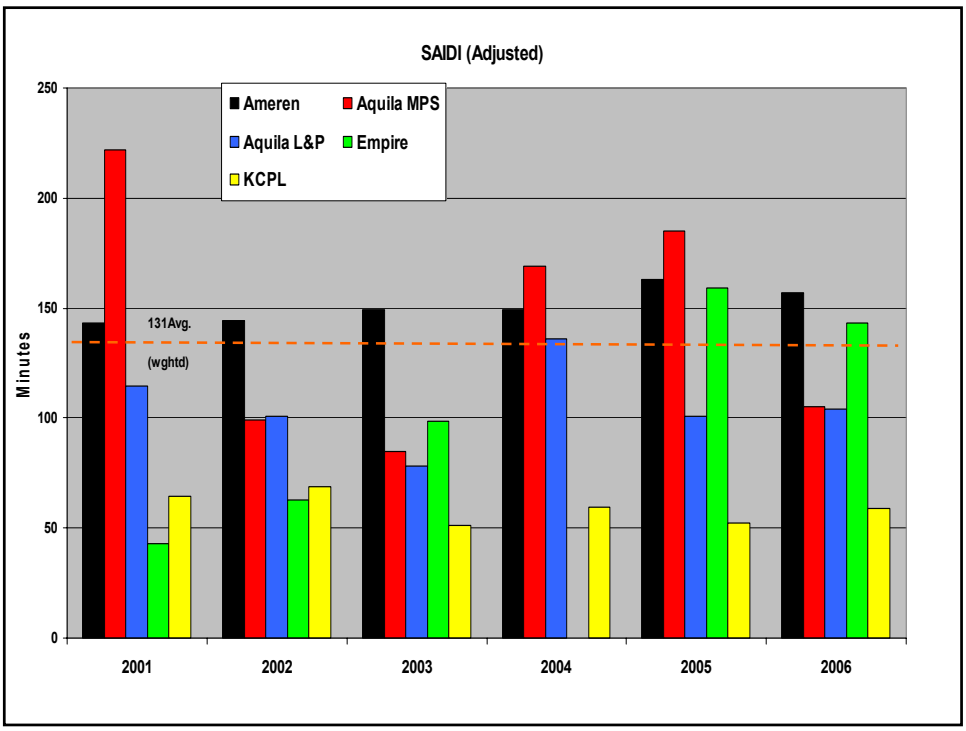
1. Sustained interruption; conditions beyond the control of the utility; ≥ 10% of customers
2. Unscheduled interruption resulting from action taken by utility (ISO, prevention, or emergency)
3. State of emergency or disaster declaration
4. Mutual aid being provided

4 CSR 240-23.010 {proposed}


SAIFI (Not Adjusted)
Ameren
Aquila MPS
Aquila L&P
Empire
KCPL
Occurences
3.5
3
2.5
2
1.5
1
0.5
0
2001
2002
2003
2004
2005
2006


SAIFI (Adjusted)
Ameren
Aquila MPS
Aquila L&P
Empire
KCPL
Occurences
2.5
2
1.5
1
0.5
0
1.24 Avg.
(wghtd)
2001
2002
2003
2004
2005
2006


SAIDI (Not adjusted)
Ameren
Aquila MPS
Aquila L&P
Empire
KCPL
Minutes
5,000
4,500
4,000
3,500
3,000
2,500
2,000
1,500
1,000
500
0
2001
2002
2003
2004
2005
2006


SAIDI (Adjusted)
Ameren
Aquila MPS
Aquila L&P
Empire
KCPL
Minutes
131Avg.
(wghtd)
250
200
150
100
50
0
2001
2002
2003
2004
2005
2006

Underground Distribution

- Installation and maintenance costs are higher
- Fewer interruptions from typical sources, e.g., vegetation, storms, animals (SAIFI ↓)
- Increased time to locate and correct faults (SAIDI ↑)

$$CAIDI = \frac{SAIDI}{SAIFI} \rightarrow SAIFI\downarrow + SAIDI\uparrow \rightarrow CAIDI\uparrow\uparrow$$

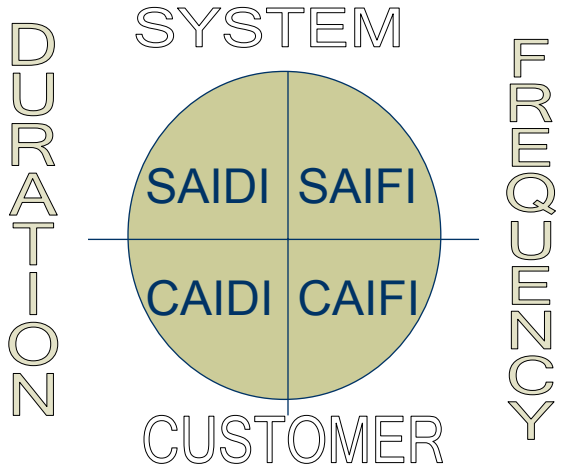
4.b

Line Sectionalizing for Improved Reliability

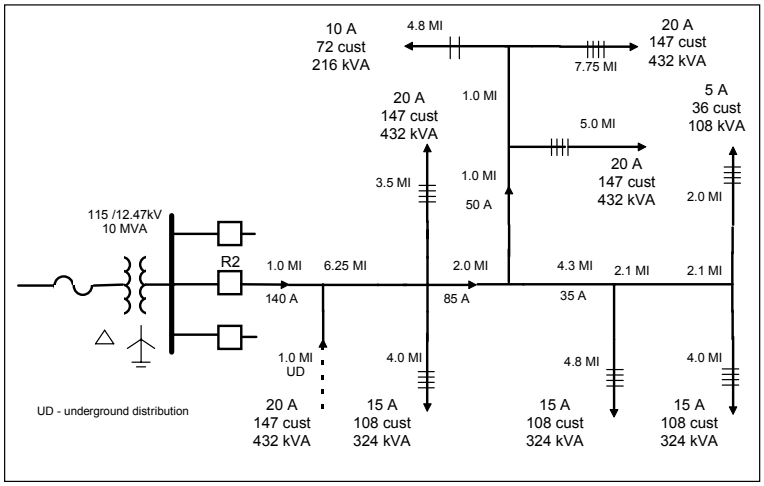
Missouri Public Service Commission
Round Table Meeting
June 1, 2007

Jerry Josken
Regional Power Systems Engineer
Greg Palmer
Sales Engineer

GOAL: Reduce Outage Rates



PHILOSOPHY: Sacrifice the Faulted Section of Line on the Radial System

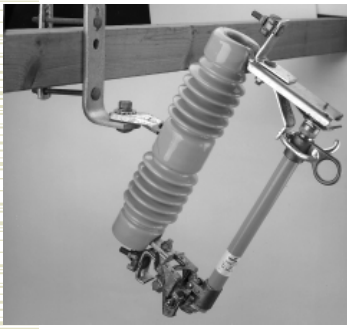


Distribution Reliability Components

- Fault Prevention
  - Vegetation Management
  - Line Construction
    - Good construction practices
    - Regular maintenance
- Fault Management
  - Line Sectionalizing
  - Fault Restoration Plan

COOPER Power Systems

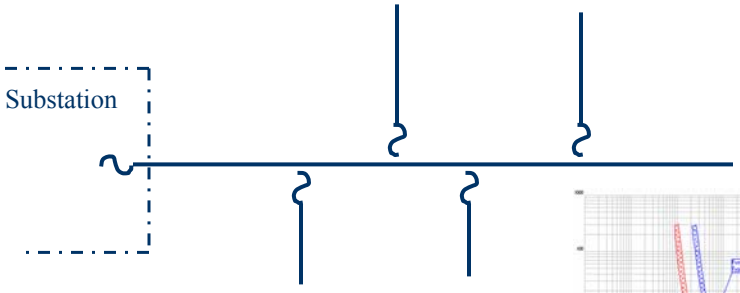
The Fuse Cutout

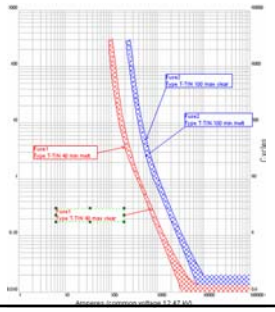


- Simplest form of overcurrent protection.
- Effective for permanent faults
- Temporary fault create nuisance outage.

COOPER Power Systems

Simple Feeder Protection Scheme





Causes of Temporary Faults

- Wind & Trees 46%
- Lightning 19%
- Equipment & Wiring 11%
- Miscellaneous 24%

COOPER Power Systems

One Year's Fault Experience

Fault Experienced	Successful Reclosers	Percent of Total
896	First	88.7
46	Second	4.5
13	Third	1.3
55	Lockout	5.5
1010		100.0%

COOPER Power Systems

Basic Rules for Line Sectionalizing

- Allow a fault to be temporary
- Lockout for permanent faults
- Sectionalize the fault to the smallest possible area.

COOPER Power Systems

What does the Recloser do?

- Sense fault current
- Interrupt fault current
- Reclose (4 shots max.)
- Resets for temp faults
- Lockout on permanent faults
- Dual Timing (fast/slow operations)

Sectionalizers

◆Definition of a sectionalizer

A device that automatically opens the distribution circuit after sensing a count of successive fault currents greater than a preset actuating current. It opens while the distribution circuit is de-energized.

◆Design, construction, and testing is defined by ANSI/IEEE C37.62-1984

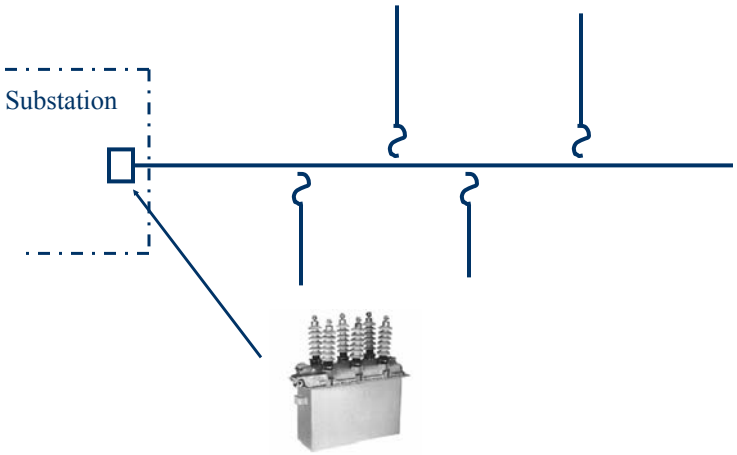
COOPER Power Systems

Sectionalizers

Demonstration Software

COOPER Power Systems

Three Phase Recloser for Substation Feeder Protection



Momentary Outages

- Fast Trips may cause nuisance momentary blinks
- SCADA link can switch control profiles
  - Good Weather – No Fast Trips
  - Storms – Fast Trips Enabled

Mid Line Recloser Technique

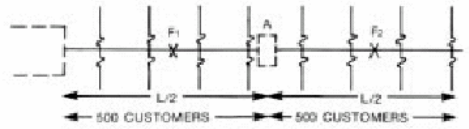


Figure 3.
Calculating reliability.

With No Line Recloser:
Fault at F1: 1000 customers x 1 hr. = 1000 cust. hrs.
Fault at F2: 1000 customers x 1 hr. = 1000 cust. hrs.
Outage Total = 2000 cust. hrs.

OPTION TO IMPROVE SERVICE RELIABILITY

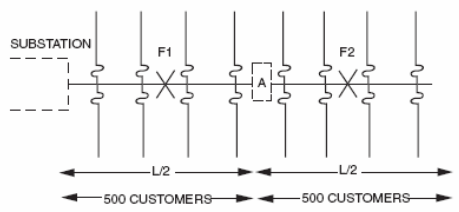
1. Refer to Figure 3. Add a recloser at point A as a main line sectionalizing device to reduce outage rates caused by faults on the main feeder.

With Recloser At A:
Fault at F1: 1000 customers x 1 hr. = 1000 cust. hrs.
Fault at F2: 500 customers x 1 hr. = 500 cust. hrs.
Outage Total = 1500 cust. hrs.

Outage rate with line recloser equals 1500/2000 or 75% of rate without line recloser; or: 500/2000 = 25% reduction in outage rate.

COOPER Power Systems

Mid Line Recloser Technique



Without Midline Recloser

Each outage = 1 hour in length (time required to locate fault and restore service).

With No Line Recloser:

Fault at F1: 1000 customers x 1 hr. = 1000 cust. hrs.

Fault at F2: 1000 customers x 1 hr. = 1000 cust. hrs.

Outage Total = 2000 cust. hrs.

Option to Improve Service Reliability

Adding a recloser at point A, shown in Figure 3, as a main-line-sectionalizing device will reduce outage rates caused by faults on the main feeder.

With Recloser at A:

Fault at F1: 1000 customers x 1 hr. = 1000 cust. hrs.

Fault at F2: 500 customers x 1 hr. = 500 cust. hrs.

Outage Total = 1500 customer hours

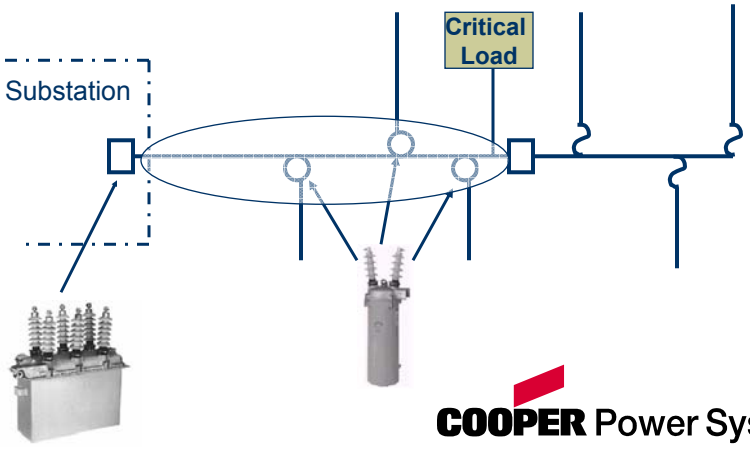
Outage rate with line recloser equals 1500/2000 or 75% of rate without line recloser; or: 500/2000 = 25% reduction in outage rate.

Create High Reliability Zones

- Emphasize reliability near substation
  - * Mid Line Recloser
  - * Replace Fused Taps with Single Phase Recloser
  - * Activate Substation Recloser Sequence Coordination Feature

COOPER Power Systems

High Reliability Zone



COOPER Power Systems

Single vs. Three Phase Sectionalizing

Single phase Advantage

- 2/3 More Reliableonly one ph out

Three Phase Advantages

- Ground Fault Sensing
- Three phase trip and lockout

Single phase Disadvantages

- No Ground Fault Sensing
- Single Phasing of 3 ph customers

Three Phase Disadvantages

* Less Reliable - ph to grd fault LO all 3 pha

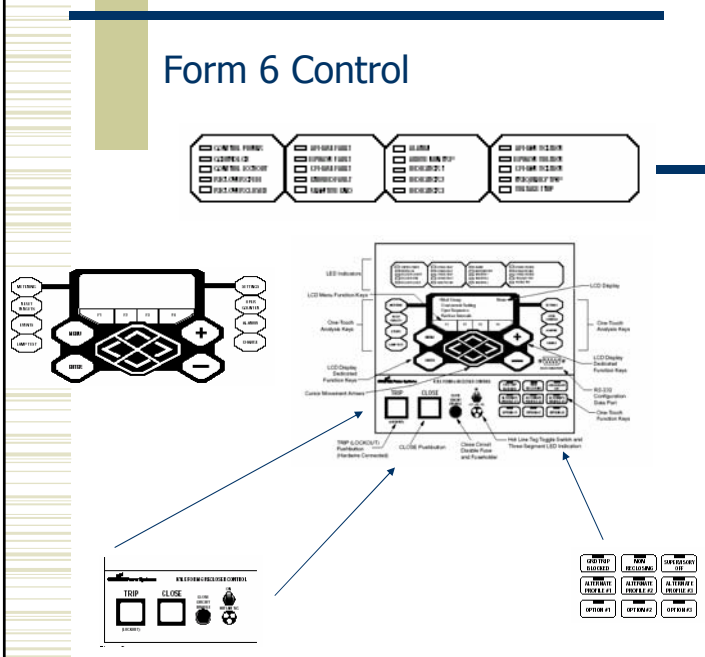
The Answer is Triple/Single Reclosers

- Three modes of operation
  - * 1 Phase Trip & 1 Phase L.O.
  - * 3 Phase Trip & 3 Phase L.O.
  - * 1 Phase Trip & 3 Phase L.O.

All three Phases trip for Ground Trip.

COOPER Power Systems

Form 6 Control



Questions?????

COOPER Power Systems

Contact Information

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COOPER Power Systems

Regional Power Systems Engineer

630-717-4505

jjosken@cooperpower.com

4.c

Vegetation Management Programs Structures and Objectives

Electric Utility Roundtable
Jefferson City, MO
June 1, 2007

Jeff Wolf
Director Resource Management
Kansas City Power & Light Co.

Presentation Overview

- KCP&L System Overview
- Contracting Philosophy and Performance Management
- Program Strategies, Specifications, and Guidelines
- Implementation of Best Practices
- Customer Satisfaction and Community Programs

KCP&L System Profile

- Distribution: ~ 8,500 miles of overhead 12kV & 35kV lines
- Transmission
  - 69KV: ~75 miles
  - 161KV: ~1,000 miles
  - 345KV: ~300 miles

- ***65%*** of the metro tree workload is inaccessible to bucket trucks (industry average 27%)
- Tree density
  - METRO
    - 115 trees per mile
    - 4,000 square feet of brush per mile
  - RURAL
    - 35 trees per mile
    - 2,700 square feet of brush per mile
  - Industry average ~80 trees per mile
  - Missouri utility average ~100 trees/mile

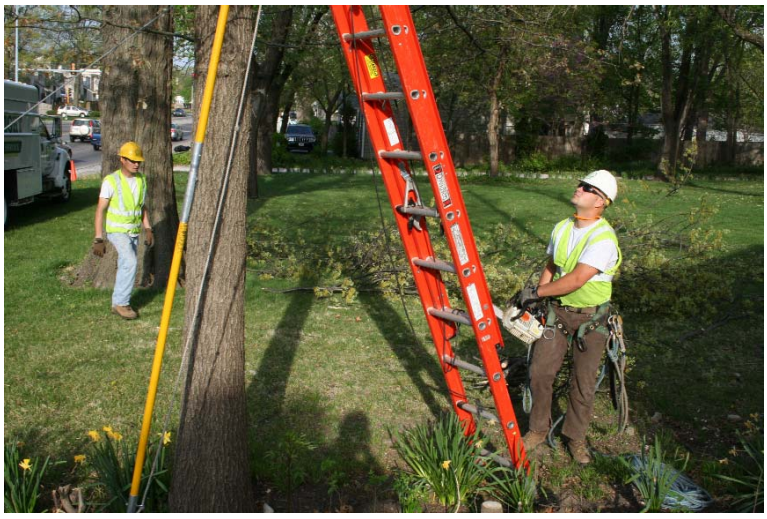
Accessible: 2-man crew, can drive to and trim with bucket truck

Trimming from the bucket

Trimming from the bucket

Inaccessible: 3 man crew, must carry equipment to back yard……

…..manually climb the trees……



….and tie off and trim in the tree

Don’t try this at home!

Bottom line – 30 to 40% more time to manually trim

Proactive contractor management improves efficiency and decreases cost

- KCP&L contracts with a vegetation management specialist, Environmental Consultants, Inc. (ECI) to manage the program
  - Overall line clearance strategy
  - On-site program supervision, administration, and record-keeping
  - Staffed with degreed foresters and/or ISA Certified Arborists
  - Tree-trimming contractor scheduling and contract administration
- KCP&L uses three line clearance contractors to trim trees
  - Keeps costs in check by using multiple contractors to ensure competition
  - Use performance-based contracting and evaluate performance regularly
  - Contractors are provided comprehensive specifications with species-specific clearance guidelines
- Vendor incentives are aligned with KCP&L service objectives to better manage their performance
  - If program costs are under budget, savings are shared between KCP&L and ECI, assuming:
    - Reliability is at or above target
    - Trimming is on schedule
  - Tree trimming contractors have incentives for productivity

Our program is based on clearly defined strategies, specifications, and guidelines

Systematic preventive maintenance focused on maintaining high reliability while controlling costs

- Distribution - long-term preventive maintenance strategy based on outage risk and customer impact
  - 2-year backbone patrol & selective maintenance schedule
  - 4-year Metro backbone schedule
  - 5-year Metro lateral /rural schedule
- Transmission
  - Annual patrols/inspections and selective maintenance
  - 2-year urban trimming cycle
  - 3-year rural trimming cycle
- Reliability-based trimming means that work is planned based on risk and importance of specific lines, rather than using the same cycle for trees on all lines
  - Worst-performing circuits and laterals incorporated into scheduling criteria
  - Proactive and preventive scheduling, rather than reactive maintenance
  - Prescriptive work selection in advance of tree trimming crew assignments

Prescriptive work selection means pre-planning each tree that will be maintained……..

….using a hand-held device to capture tree-specific data

Trees are identified by species and growth rates…..

Species	Growth Rate
Ailanthus (Tree of Heaven)	F
Ash (all species)	S
Baldcypress	S
Birch (all species)	S
Box-elder	F
Catalpa	F
Cherry, black	S
Coffeetree, Kentucky	S
Cottonwood (and all other poplars)	F
Crabapple (all varieties)	S
Elm (all species)	F
Fir (all species)	S
Ginkgo	S
Golden Rain Tree	S
Hackberry	F
Hawthorn (all species)	S
Hemlock (all species)	S
Hickory (all species, including Pecan)	S
Hophornbeam	S
Honeylocust	F
Linden (all species, including Basswoods)	F
Locust, black	F

…then trimmed to meet program clearance guidelines

Clearance Guidelines (in feet)

Clearance from trees	Rate of Growth	Primary Voltage (2-25 KV)	34 KV	69 KV	161 KV	345 KV
SIDE	Slow Fast	8 12	10 15	10 10	25 25	35 35
OVER	Slow Fast	(a) (a)	None None	None None	None None	None None
UNDER	Slow Fast	6 8	10 12	10 10	15 15	20 20

(a) Remove all hazardous overhang, and all overhang within 15 feet of the conductors that could contact them if weakened or broken. Remove all overhang on 3-phase lines.

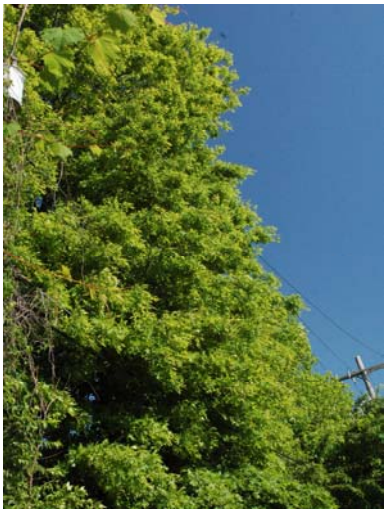
(b) Special clearances may be needed at times because of field conditions.

12 KV Distribution Line (3-phase): A hedge tree before trimming….

….and after

12 KV Distribution Line (3-phase): Two maple trees before and after trimming

12 KV Distribution Line (3-phase): An oak tree before and after trimming



12 KV Distribution Line (Single-phase): An ailanthus tree before and after trimming

Contractor safety is a critical element of the program

- All contractors conduct accident investigations and perform root cause analysis on OSHA recordables
- Formal results from tree contractor are shared with ECI who creates a safety message for the other contractor
- Each will schedule appropriate training to reduce chances of repetitive occurrence
- KCP&L and ECI receive monthly OSHA reports from tree contractor
- Standard daily tailgate sessions are performed in the field
- Every VM meeting begins with a safety topic

Use of industry best-practices is another key to our program

- Strategic plan built specifically for the vegetation management program, addressing both long and short-term goals
- Workload data for budget forecasting, allocation of crew resources and development of management tactics
- Staff consisting of degreed foresters and/or ISA Certified Arborists
- Appropriate maintenance cycle based on tree re-growth rates, clearance and reliability metrics
- Prescriptive work selection in advance of crews
- Clearance guidelines established
- Tree selectivity based on individual tree outage risk
- Tree removal criteria established
- Initiated foliar and cut stump herbicide program
- Brush control techniques varied and appropriate to conditions
- Mechanical Equipment (Jarraff & Mowers)
- Proper pruning techniques implemented (ANSI A-300)

Specialized equipment - Jarraff trimmer

Specialized equipment – Track Bandit

Specialized equipment – brush mower

Herbicide application

Herbicide application

We focus on maintaining customer satisfaction as we complete our vegetation management work

- Customers notified in advance of tree maintenance
- Follow-up communication to answer questions and resolve problems before crews arrive
- Written permission for all removals over 4” in diameter
- Customer satisfaction surveys average over 90% satisfaction with line clearance tree maintenance
- Vegetation Management representatives provide plant pest & disease diagnosis and solution to homeowners
- Tree replacement program on valued landscape trees
- Customer Assisted Removal for off cycle trees

Customer notification door hanger

Tree Trimming Required

Your trees could cause a power outage

Dear KCP&L Customer:

When not maintained, trees growing into power lines become one of the leading causes of power outages. Tree care professionals working for KCP&L will be in your neighborhood trimming and/or removing any trees that may interfere with our distribution lines.

KCP&L provides this regular maintenance, at no extra cost to you, as part of our commitment to supply safe and reliable electrical service.

All trees are trimmed according to KCP&L guidelines as recommended by tree care experts and endorsed by Horticultural standards set forth for the industry.

Trimming Examples

Side Trim

Before

After

Top Trim

Before

After

The goal of KCP&L's Vegetation Management program is to help ensure that you have safe, reliable electric service.

IF YOU HAVE ANY QUESTIONS OR CONCERNS PLEASE CALL THE PHONE NUMBER LISTED ON THE BACK OF THIS CARD.

Kansas City Power & Light
ENERGIZING LIFE

Tree Work Required

There is no charge for this service

KCP&L Vegetation Management professionals will be in your neighborhood the next few weeks. Using horticulturally approved trimming methods crews will work carefully in your trees to reduce the chance of power failures caused by tree contact with the wires.

KCP&L keeps power lines clear to help assure a safe and uninterrupted supply of electricity to your home. We take this responsibility very seriously because you need electric power all the time — day and night and in good and bad weather.

One of the most common causes of power outages is a tree growing into or near power lines and can affect entire communities. Trees growing into power lines can also create a safety hazard.

The removal of young tall growing trees may be necessary to prevent future outages. KCP&L will remove these trees, leave any suitable firewood and treat the stumps to prevent regrowth.

Written below is the type of maintenance work that will be complete by KCP&L, at no cost to you, on this property. The trees noted below may have orange paint on them for easier identification.

Trim(s) _____

_____

_____

_____

_____

☐ **We have identified tree(s) on your property that will cause problems in the future. Please sign the included removal form and mail back to us.**

If you have any questions about the work required on your property please call us within the next five business days. If we do not hear from you the work will proceed as scheduled.

KCP&L Vegetation Management

Clearing the way for safe reliable energy

Kansas City Power & Light
ENERGIZING LIFE

TREE LINE USA

Customer satisfaction survey card

We'd Like Your Opinion

Thank you for your cooperation during our recent tree trimming near electric lines in your area. Our work helps ensure safe, reliable electric service. Now that we're done, we would appreciate you taking the time to complete the short survey below. And, for information on replacing or planting trees in the future, visit **kcpl.com** and search "Right Tree."

Kansas City Power & Light
ENERGIZING LIFE

Please check the box that best describes how you feel about each statement, detach stub and drop in any mailbox.

	As Outlined	Agree	Disagree
I was satisfied with the advance notice provided	☐	☐	☐
The tree crew workers were friendly and courteous	☐	☐	☐
My property was left in good condition	☐	☐	☐
Overall, I was pleased with my tree trimming experience with KCP&L	☐	☐	☐
I believe KCP&L's service seems to be improving	☐	☐	☐

COMMENTS:

Circuit # _____ Crew # _____

Would you like to receive (Options):

☐ *A call from KCP&L concerning the recent work*

☐ *A copy of KCP&L's booklet on Trees and Powerlines*

☐ *A load of tree chips*

Name _____ Date _____

Address _____

City _____ State _____ ZIP _____

Phone (day) _____ Phone (evening) _____

Kansas City Power & Light
ENERGIZING LIFE

We also have a strong community focus as part of our vegetation management program

- "Tree Line USA" recognition since 2003
- Development of an Utility Arboretum in Shawnee, KS
- Issued a new and more comprehensive "The Right Tree in the Right Place" booklet in March 2007
- Community tree plantings - Arbor Day and Earth Day plus other events in tandem with local agencies such as Heartland Tree Alliance, MO Dept of Conservation and KS Forest Service
- Distribution of wood chips
- Working with KCPL stakeholders to develop a tree grow-out farm
- Tree Replacement Program
  - About 10% of all trees addressed by the VM program each year are removed.
  - The vast majority of these trees are not of landscape quality (homeowner planted), but were propagated naturally.
  - KCP&L's tree replacement program secures 'hard-to-get' removals of landscaped trees.
  - Tree replacement vouchers for local nurseries up to $250

Yes, sometimes tree trimmers are even appreciated!

QUESTIONS?

4.d

INFRASTRUCTURE INSPECTION

Poles, Circuits & Devices

Aquila Inc.
NYSE: ILA
www.aquila.com

James J. McBee, P.E.
Sr. Planning Engineer
819-737-7170
Jim.McBee@aquila.com

Aquila
Providing Energy For Better Living

System Components

7700 miles of OH line
2600 miles of UG line
200,000 Poles
600 capacitor banks
1000 reclosers
650 regulators
70,000 transformer installations
10,000 switches

Distribution Patrol

- Patrol all components of the distribution system both overhead & underground on a 5 year cycle
- Visual Inspection
- Patrols at parks and Schools conducted annually
- Files of deficiencies found maintained
- Repairs of deficiencies made are documented and maintained in the files

DISTRIBUTION PATROL REPORT

Town/Area:				Date:	
Substation:		Feeder:		Week Ending Date:	
☐	No Obvious Problems Found			Inspector (Initials):	

	Location	Code	Comment	Activity/ J.O.	Date Corrected

DISTRIBUTION INSPECTION CHECKLIST CODES

OVERHEAD

1. **Poles**
   - A. Broken or Severely Rotted
   - B. Leaning Severely

2. **Crossarms**
   - A. Crossarms or Braces Broken

3. **Guys & Anchors**
   - A. Loose or Damaged
   - B. Guy Insulator Height

4. **Equipment / Other**
   - A. Transformer, Capacitor or Other Equipment Leaking Oil
   - B. Arrester Blown

5. **Conductor Clearance (see Guidelines below)**
   - A. Low Clearance from Ground □
   - B. Too Close to Building, Sign, other Structure □

6. **Conductor Damage**
   - A. Wire Frayed, Burned Marks or Other Damage
   - B. Insulator Damaged or Broken
   - C. Floater

UNDERGROUND

7. **Underground Equipment**
   - A. Lock Missing
   - B. Access Blocked.
   - C. Sliding off Pad
   - D. Leaking Oil
   - E. Secondary Pedestals, missing or broken lid

8. **Underground Cable**
   - A. Cable Exposed
   - B. Conduit Broken

□ CONDUCTOR GROUND CLEARANCE LISTED		
Primary	-	If less than 19 feet
Secondary	-	If less than 17 feet
Services	-	If less than 16 feet over road or drive
Services	-	If less than 9.5 feet across yard
Over RR Track	-	If less than 27 feet

□ Structure Clearance	Clearance	0-600 Volt Triplex/Quadruple	Open Supply 0-750 Volt	Line Conductor Over 750V-22kV
Over/Under Roofs, not Accessible to Pedestrians	Horiz.	4.5 ft	5.5	7.5
	Vert.	3.0	10.5	12.5
Over/Under Roof, Accessible to Pedestrians/Vehicle Traffic	Vert.	10.5	11.5	13.5
Signs, Chimneys, Antennas, Tanks, Other Structures	Horiz.	3.0	5.5	7.5
	Vert.	3.0	6.0	8.0
Swimming Pools	Vert.	22.0	22.0	25.0

Capacitors

Inspected 3 times annually to ensure proper operation

Overhead Conductors

Reviewed for replacement when more than 2 failures/1000' have occurred

Underground Conductors

- **Terminations inspected during distribution Patrol**
- **Replacement Methodology:**
  - Section 300' or less – Replace after second fault
  - Cable Loops – more than 4 failures in the loop and the entire loop averages more than 2 failure per 1000'
  - Replace elbows when replacing cable
- **Currently evaluating cable injection as an alternative to cable replacement**

Cutouts, Insulators & Lightning Arresters

Switches

Additional inspection during the normal course of construction and system maintenance

Reclosers

Monthly – each installation is visually inspected & counter reading recorded

Regulators

Visual inspection is performed each month

Counter reading, drag hand position and current state are recorded

LINE/STATION VOLTAGE REGULATORS
AND LTC TRANSFORMERS

Year _____

REGULATOR COUNTER READING & INSPECTION REPORT

Substation _____
Location _____
Regulator # _____ State _____
TYPE _____ Region _____
KVA _____ District _____
VOLTAGE _____
SERIAL NO. _____

CHECK ONE

□ Single Regulator
□ This regulator is part of a 3∅ bank

What Phase???

□ A □ B □ C

Date	Counter Reading	Difference	Position Indicator			Comments*	Reported by
			Max Raise	Present Position	Max Lower		
Jan							
Feb							
Mar							
Apr							
May							
Jun							
Jul							
Aug							
Sep							
Oct							
Nov							
Dec							

Check and report if:

1) Line or load side arrester failure;
2) Arrester failure between S&L bushing;
3) Tank vents are not clear;
4) Low oil level as shown in sight glass;
5) Oil seeps or leaks;
6) Control box unlocked;
7) Cracked or broken bushing;
8) Pole/Platform is leaning;
9) Regulator stuck in position;
10) Position indicator operates correctly;
11) All gauges are in good condition;
12) Control cabinet gaskets seal.

Transformers

Distribution Pole Inspection & Treatment

- **Dedicated inspection program in addition to 5 year distribution patrol**
- **Why do pole inspection & treatment?**
  - Identify system deficiencies and correct them before problems arise
  - Stop the proliferation of decay, extending the useful life of the infrastructure
- **What is looked for during inspection?**
- **How often should inspection be done?**
  - Ultimately targeting a 10 year cycle

Types of Pole Inspection

Visual

Sound & Bore

Partial Excavation

- 4-6” excavation plus sound & bore

Full Excavation

- 18-24” excavation plus sound and bore with surface treatment of remedial preservatives

Pole Treatments

- **External Treatment - a wood preservative is applied to the pole and then a shield moisture barrier is applied to prevent intrusion of moisture and allow the treatment to penetrate the pole**
- **Internal Treatment – additional holes are drilled in the pole and fumigant or insect treatment is injected as necessary. Then treated plugs are inserted in holes**

Pole After Treatment

Final Inspection Step

Poles are tagged to indicate the year of inspection, type of inspection and treatment if any

Terms

- **Reject Pole**

  Pole that had been deemed to have a shell thickness below 2” or less than 87.5% of original ground line circumference

- **Priority Pole**

  Pole that has been determined to have a shell thickness below 1” or less than 67% of original ground line circumference.

- **Reinforceable Reject Pole**

  Pole that has been found to be deteriorated below required strength but can be restored utilizing a pole truss

Pole Restoration

Rejected poles will either be replaced or trussed, depending upon condition of the structure.

Aquila Distribution Pole Inspection Program

- Began inspection in 2000 with 3 phase poles only
- Single phase poles were added to the inspection in 2004 – subsequent to the ice storm in 2002
- Approximately 75,000 distribution poles inspected through 2006
- Reject rate 3.4%
- Treatment rate 3.6%
- Reinforced rather than replaced 770 poles – resulting in a deferred capital investment of approximately $850K
- As an added benefit, the inspection program is being utilized to populate pole data into the mapping system

Summary

- Majority of components inspected on 5 year cycle
- Many components on a distribution system that fail require replacement, repair is not an option
- Components that can be fixed are considered for repair if the repair cost is less than 75% of the replacement cost
- Over the last 3 years, of the 19 outage categories tracked, outages attributable to material/structure failure was fourth on the list of outage causes at 12.5% and third on the list of total minutes interrupted at 10.9%
- Going forward, subdividing the material category in order to obtain better tracking for the types of material failures that are causing outages

5

Electric Reliability Roundtable
June 1, 2007
Attendance List

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Electric Reliability Roundtable
June 1, 2007
Attendance List

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