FINAL REPORT
February 6, 2004

Assessment of the February 2003 Ice Storm

Following the February 2003 Ice Storm, the Kentucky Public Service Commission ("KPSC") Staff reviewed storm responses and recovery efforts of the regulated utilities that were most severely affected. This review assessed all aspects of utility response, from disaster planning and preparedness through the final stages of restoring service to customers. The Utilities responded to requests for information concerning their forecasting, response planning, damage assessment, mobilization, repair activity, and customer service before and during the ice storm, as well as their general operation and maintenance practices and overall emergency preparedness. Staff reviewed the data, and where necessary, reviewed supplementary documentation requested during the review process. This assessment relies upon and draws from the provided documentation, utility inspections, site visits, and interviews with utility personnel, and upon the knowledge and experience of the KPSC staff. The following report contains the results of this review. It includes lessons learned, changes made by the Utilities as a result of the ice storm, and additional recommendations made by the KPSC staff.

A. THE STORM IMPACT

Figure 1 indicates the storm's path across Kentucky during the late night hours of February 15, 2003. At approximately 10:30 PM, ice started layering onto all exposed surfaces in the Lexington area. Radial ice approximately 2 inches thick was deposited along much of the storm track.

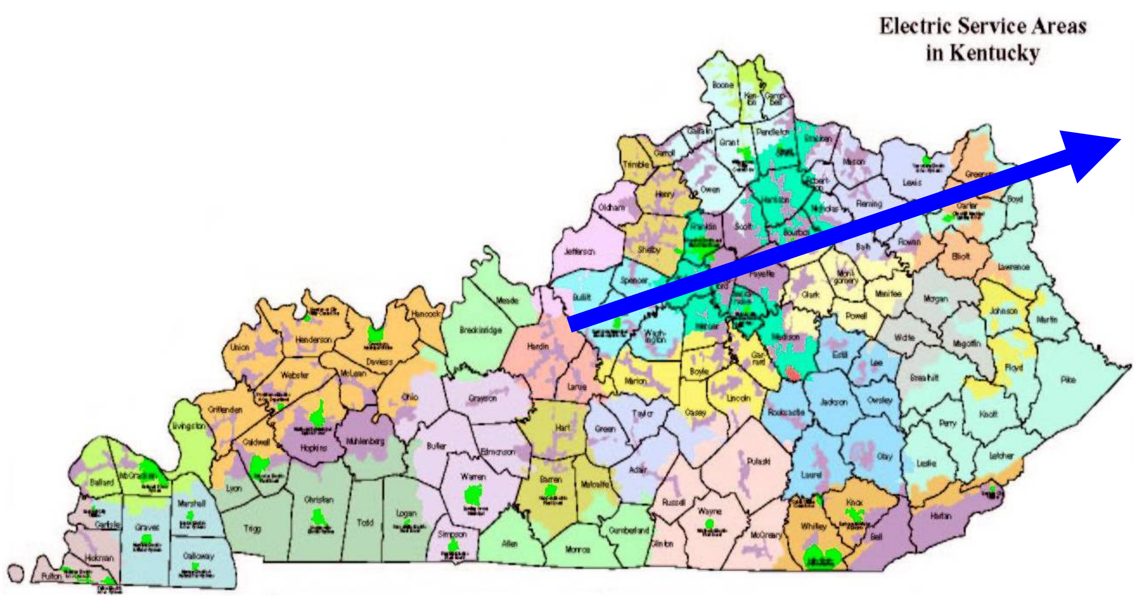


FIGURE 1: February 15 & 16 Ice Storm Track Across Kentucky

The ice storm began late on February 15, 2003, and continued into the afternoon of February 16. Two days prior to the storm, initial weather forecasts called for ¼ inch ice accumulations over a large part of the Commonwealth. As the storm approached, weather forecasts changed to predict ¼ to ½ inch accumulations, with possible accumulations of up to ¾ inch in central Kentucky. By the end of the storm on the afternoon of February 16, accumulations were more than double the expected buildup in most of north-central Kentucky. Much of the heaviest accumulation occurred within KU's Lexington service territory, which includes the cities of Lexington, Midway, Versailles, Lawrenceburg and Nicholasville. Several other utilities also were severely affected. The impacted areas within the KU service territory included some of the most populous areas of the state.

UTILITY	CONSUMERS OUT	PERCENTAGE OUT
Alltel	24,436	9 %
BELLSOUTH	2,103	0.1 %
Blue Grass	15,000	31 %
CINergy	8,000	6 %
Clark	16,860	70 %
Fleming-Mason	17,348	80 %
Grayson	16,000	100 %
Inter-County	3,259	14 %
Kentucky Power	17,000	10 %
Kentucky Utilities[1]	146,000	30 %
Licking Valley	5,300	32 %
Nolin	1,658	6 %
Owen	3,190	7 %
Salt River	5,000	13 %
TOTALS	**281,154**	**8 %**

Table 1: Peak Percentage of Reporting Utility Customers Without Service

The peak number of customers[2] without service as a result of the ice storm was 281,154 on February 16. **See TABLE 1**. The regulated utilities primarily impacted were two investor-owned telephone utilities, three investor-owned electric utilities and nine cooperatives. The peak number of Kentucky electric customers in the reporting utilities' territories without service was 254,615. The affected cooperatives are provided electric generation and transmission service from East Kentucky Power Cooperative (EKPC). EKPC consists of 16 member cooperatives serving about 45% of the state's area and 480,000 customers. The member systems suffered 83,615 outages (17%) across central and eastern Kentucky. Most of the damage to the affected utility systems was caused by widespread and pervasive damage to their distribution systems, i.e., the lines, poles, (**See TABLE 2**) transformers, fuses, conductors and insulators that are needed to distribute power to businesses and neighborhoods. Distribution systems located in wooded areas suffered extensive

UTILITY	POLES REPLACED	TRANSFORMERS REPLACED
Alltel	701	N/A
BELLSOUTH	32	N/A
Blue Grass	165	53
CINergy	0	0
Clark	74	75
Fleming-Mason	397	151
Grayson	850	180
Inter-County	1	0
Kentucky Power	275	93
LGE/KU	547	236
Licking Valley	40	5
Nolin	2	1
Owen	2	0
Salt River	23	5
TOTALS	**3,109**	**799**

Table 2: Utility Equipment Damaged

[1] The totals include 5000 customers of LG&E, KU's sister company.
[2] Regulated electric and telephone utilities customers only.

damage from falling limbs and trees. Transmission lines of the affected utilities and EKPC, which are high voltage lines that move power between localities, are typically located in cleared right-of-ways, and suffered almost no damage.

Typically, the vast majority of outages associated with ¼ inch or less of ice accumulation are widely scattered and are usually caused by fallen evergreen tree limbs and leaning evergreen trees. But when ice accumulation reaches ½ inch or more, the number of outages climbs rapidly due to breakage of deciduous trees. Ice accumulation of ¾ inch to 1 inch or more causes much more structural damage to trees, including breakage of major tree limbs and damage to hardwood treetops. In this storm, damage due to uprooted trees was exacerbated by the soil saturation from the preceding heavy rains. **See PHOTO 1**. The numerous photos throughout this report demonstrate the severity of this storm.

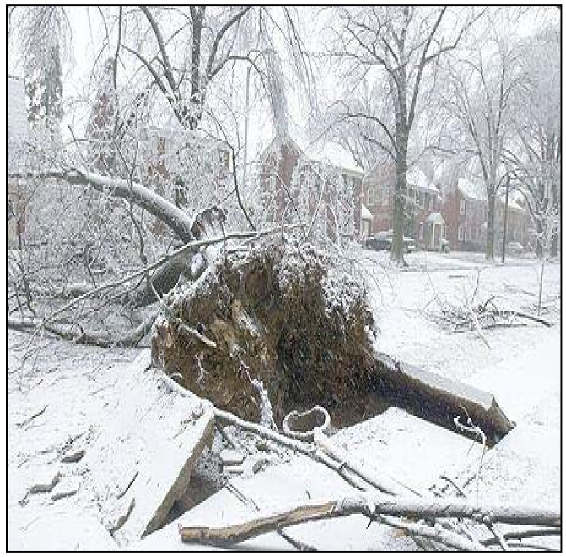


PHOTO 1: Uprooted Tree in Lexington, KY

The February 2003 ice storm that struck Central Kentucky demonstrated both the vulnerability of overhead transmission and distribution systems and the major impact they play in our everyday lives. **See PHOTO 2**.

PHOTO 2: Typical Road Access Into Most Rural Areas Hit By The February Storm

A major ice storm can seriously impact a utility's electric system. Trees and limbs fall onto the wires, and wires and structures easily break due to the massive ice loads imposed by freezing rain. Damage covers large areas, and ice conditions make restoration difficult and time-consuming. Outages can easily last several days and conditions often become dangerous because loss of power can shut off heating systems and needed services during extremely cold weather.

Kentucky quickly discovered that super cooled rain falling on cold surfaces quickly creates extreme conditions. Here is a portion of WLEX-TV Chief Meteorologist Bill Meck's explanation of the 2003 Valentine's weekend storm: "*For a freezing rainstorm, Mother Nature does things backwards. It is warmer in the clouds than down at the ground. This is called an inversion.* ***See FIGURE 2; next page***.

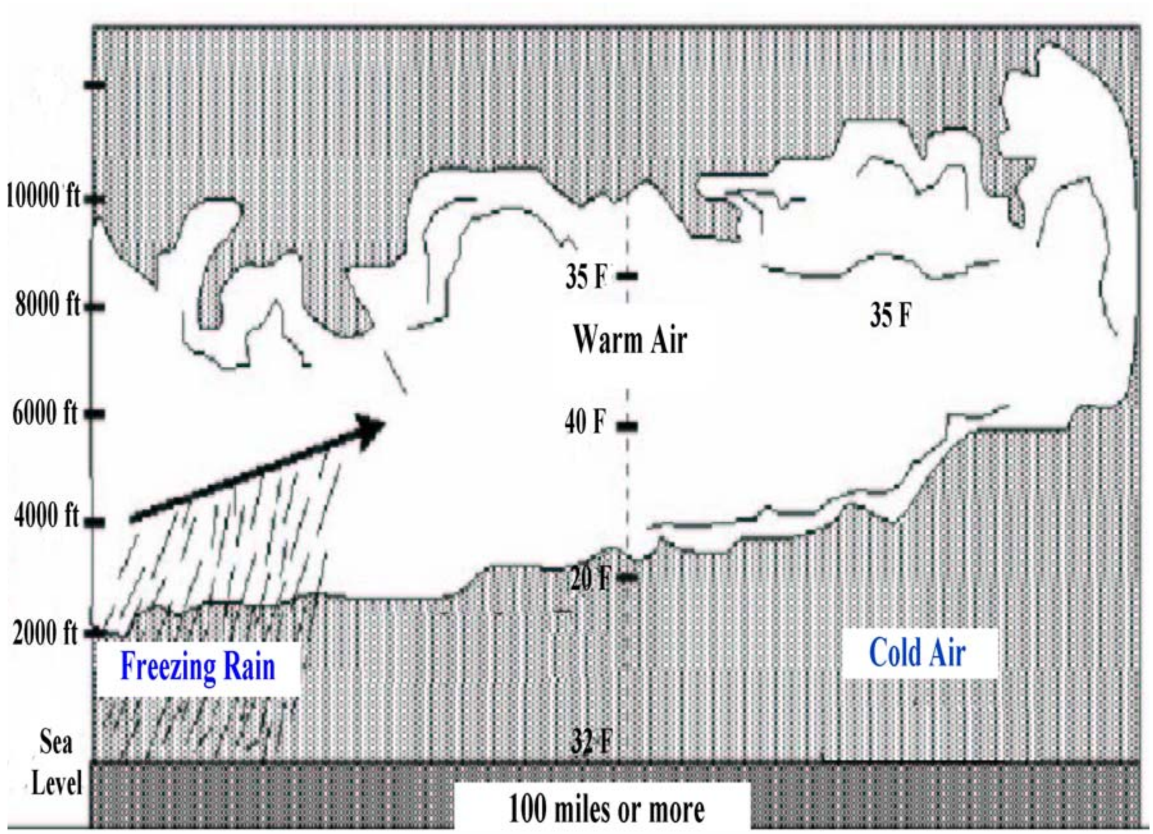


FIGURE 2: Ice-Producing "Inversion Front" (NOAA)

For freezing rain, the cold air is shallow, so the raindrop can't freeze on the way down but rather it freezes after it hits something like a tree branch or power line. When the cold air is thicker, it can turn to a pellet of ice, which is sleet. Another amazing feature of this storm is how sharp a line it was from just being a very cold rain with minor ice like in Harrodsburg, Danville, Richmond and Morehead to a weather event you can tell your grandkids about in places like Lexington, Nicholasville, Winchester, Paris and Cynthiana. The Kentucky River was a pretty approximate boundary. By the way, the further north and west you went, the cold air got thicker so places like Cincinnati and Louisville ended up with sleet storms. That's no picnic either, but certainly preferable to freezing rain. For those of us who were without power for more than a week, it is something we'll never forget. Not only the weather itself, but how everyone in the community came together to help neighbors out."

Kentucky has a history of occasional severe ice storms. Factors affecting the extent of the damage and disruption are the specific geographical location hit, the maximum radial thickness of the ice and the characteristics of the infrastructure of the time.

This storm was referred to by many in Kentucky as the "*ice storm of the century*". However, it was only slightly more severe than other ice storms that have devastated the state on several occasions over the past century. In 1951 Kentucky experienced an ice storm of a magnitude approaching that of the February 2003 storm.

Following is a pictorial representation of the accumulated ice from the so-called "Great Ice Storm of 1951". **See FIGURE 3**.

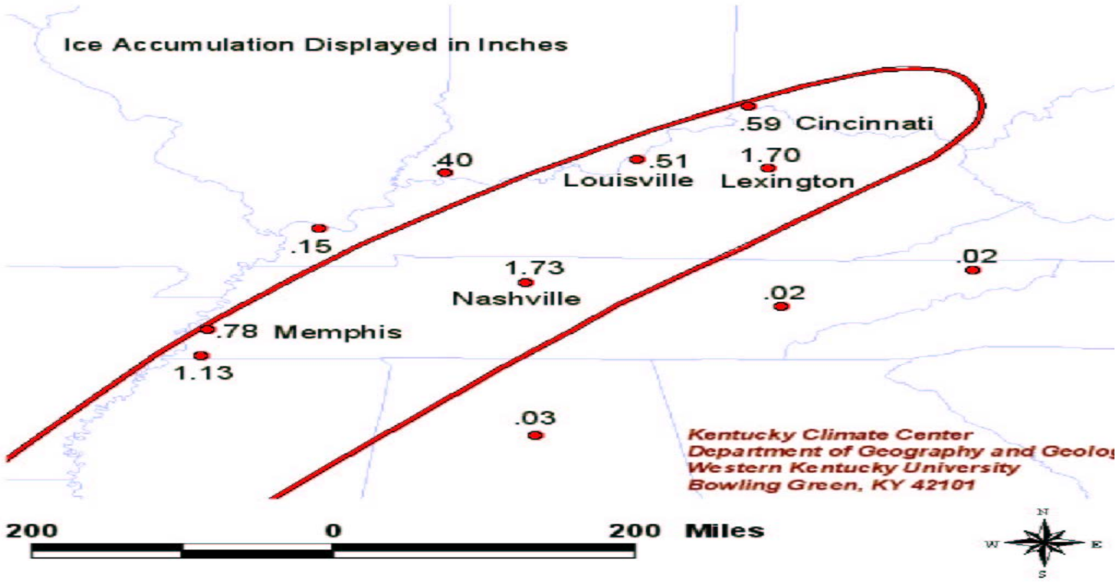


FIGURE 3: Area Affected by the "Great Ice Storm of 1951"

B. THE IMPACT OF ICE ON OVERHEAD DISTRIBUTION FACILITIES

A little ice goes a long way. Ice will build up on all exposed surfaces, but tree limbs and wires are the critical surfaces that impact electric facilities. As ice reaches a thickness of more than 1/4 inch, trees will begin to sag and start breaking. Very flexible trees such as birch trees will often sag to the ground without breaking. **See PHOTO 3**. When trees sag or break onto overhead wires, a very large vertical load is imposed on the wires, breaking cross arms, wires and other structures. Ice can also accumulate on the wires themselves, increasing the tension in each wire. Smaller conductors such as # 4 ACSR[3] will reach breaking strength when loaded with a little more than 1 inch of radial ice (radial ice is the measurement of uniform thickness of ice coating a conductor). Small copper wire will break at ice loads much less than this. Clamps, hardware and cross arms may break at ice loads of less than 1 inch.

PHOTO 3: Trees Start Sagging to the Ground as the Vertical Weight of the Ice Increases

[3] # 4 Aluminum Conductor Steel Reinforced (ACSR) – Normally the smallest aluminum conductor used.

Ice storms can cover large areas, often resulting in widespread damage to overhead facilities. This storm broke more than 3,109 distribution poles across central and eastern Kentucky. This damage was a direct result of excessive vertical loads imposed by the ice (estimated at up to 2-inch radial plus icicles; **See Cover PHOTO**) onto overhead facilities, as well as from falling trees and limbs. **See APPENDIX A**. Several design/operating parameters can have a decisive effect on how well a utility's overhead facilities survives the accumulation of ice.

TABLE 3 shows that the accumulation in this storm added weight to the conductor resulting in loads 4000 percent over normal loads and 1800 percent over the weight for which the lines and poles are designed. **APPENDIX A.**

TABLE 3: Increase in Loads Due to Ice

	Diameter (Inches)	Weight/Foot (Pounds)	% Increase Over Normal	% Increase* Over Design
Without Ice	0.398	0.1452		
With 2" of Radial Ice	4.398	5.9641		
Include Icicles	(See above)	0.3238		
Total Weight/Foot	N/A	6.2879	4,331 %	1,814 %

- *Medium NESC Load Design (.25 inch ice, 4 pounds wind)
- 1/0 ACSR Conductor
- The icicles are assumed to be 5 inches in length, a maximum diameter of 1 inch and spaced uniformly for a quantity of 10 per linear foot of conductor.
- The density of ice is 57 pounds per cubic foot

These dramatic load increases are transferred through to the poles, guy wires and anchors causing them to possibly fail. **See FIGURES 4 and 5.**

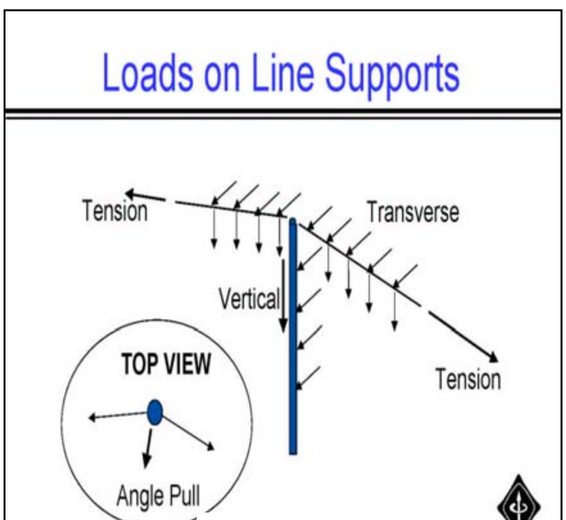


FIGURE 4

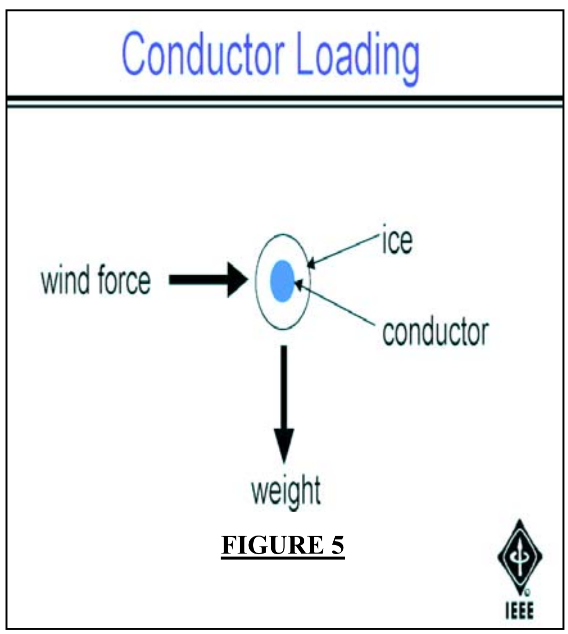


FIGURE 5

The percentage increase in the weight of tree limbs can be even more drastic due to the complexity of limb patterns that allow ice to build up more as a mass than as individual limbs. **See PHOTOS 4, 5 and 6.**



PHOTOS 4, 5 and 6: Ice Loading on Trees and Limbs

During ice storms, super cooled rain falls and freezes on contact with surfaces at or below the freezing point. Ice accumulation generally ranges between traces to 1 inch in additional diameter. Accumulations of 1-inch radial ice on trees can increase branch weight by a factor of as much as 30. Accumulations of between 1/4 inch and 1/2 inch can break small branches and faulty limbs, while 1/2 inch to 1-inch thick accumulations can


PHOTOS 7 and 8: Trees Damaged by Weight of Ice – Lexington, KY

cause significant breakage of large limbs. The 2-inches of radial ice deposited during the February storm increased normal branch and tree weights by a factor of as much as 120. **See PHOTO 7 and 8**. Branch failure occurs when loading exceeds wood resistance or when constant loading further compromises a weakened area in a branch. Strong winds increase the potential for damage from ice accumulation. Various tree species react differently to the increasing weight of the ice. **See APPENDIX B**. Because falling trees and limbs are a major factor in the damage of a utility's overhead facility the proper attention must be afforded to tree growth near electric lines. This will be discussed in greater depth in the section dealing with R/W maintenance.

C. UTILITY RESPONSE

C. 1. Planning

Each utility maintains an emergency operations plan (EOP) or emergency response plan (ERP) to prepare them for contingences and service restoration from widespread damage. Each utility followed the guidelines contained in its EOP at the time of the February 2003 ice storm. There is an understandable disparity in the level of detail of the various utilities EOPs, given the differences in customer base, geographic area, terrain, and organizational structure. The KPSC staff recommends that these EOP's be reviewed annually and after major emergency events, and updated and filed with the KPSC as necessary.

Blue Grass Energy Cooperative Corporation (BGECC) recently adopted a new EOP that could serve as a model plan for other utilities that have not made significant updates to their plans recently. **See FIGURE 6**. BGECC's plan contains the information essential to an EOP including command and control procedures, assessment of damage, priority customers, procedures for requesting additional utility workers and logistics for managing and maintaining a large workforce. It is contained in **APPENDIX K** of this report[4].

2003

Blue Grass Energy

Emergency Response Plan

Table Of Contents ("T/C")

FIGURE 6: Table of Contents from Blue Grass Energy's ERP

Utility managers must make critical decisions in the early stages of a large outage event. Determinations have to be made regarding how many, if any, additional crews to request from Mutual Aid Agreements[5], surrounding utilities, contractor crews, right-of-way crews, etc. The availability of material resources must be determined quickly due to the ability of a major storm to rapidly deplete a

[4] Please contact the management of BGECC for approval to use its EOP as a format.

[5] Mutual-Aid is an agreement between utilities that state the conditions under which a utility will "loan" its workers to another utility. It establishes the type of employee, the equipment and the billing practices to be used.

storeroom of needed hardware. Additional concerns include logistical problems such as hotels and restaurants for out-of-town crews, staging areas for crews, special contractors (i.e. bulldozers, heavy equipment operators, etc.), refueling and repair sites for trucks, and the availability of qualified "bird-dogs," or guides for crews unfamiliar with the service area. Amid all these concerns, the utility must also ensure ongoing public and worker safety, communication with government officials and the public, and proper tracking of crew locations and personnel involved in restoration efforts.

A wide variety of tools are available to help manage outages. Some of the software programs used by various utilities during the ice storm included: *Power-On, Milsoft, Porsche, SCADA, Gemini,* etc. **See APPENDIX J**. It should be noted that several utilities have upgraded their outage management systems since the ice storm, including KU. Additionally, Utility Geographical Information Systems (GIS) are utilized to track crew locations, track outage restoration progress and denote critical infrastructure locations.

Typically, additional office and outage management assistance is obtained by reassigning company personnel during large outage situations. In some of the smaller co-ops in the state, it is not uncommon for every employee to work on outage restoration or management support while an outage is ongoing. This was the case for the February 2003 ice storm. For example, LG&E / KU reassigned many staff from Louisville to Lexington to help manage the restoration while Grayson RECC utilized all 39 of their employees for the duration of the storm.

The KPSC staff recommends that the above management functions be detailed in each utility's EOP.

C. 2. Monitoring and Mobilization

Each of the utilities reported that their supervisory operations staff monitors weather services, including the National Weather Service, satellite weather services, and Internet weather services. Upon receiving forecasts on February 14 and 15 of the possibility of a winter storm with the potential of producing significant ice accumulations, each of the utilities alerted their management and standby crews of the potential for outages.

Kentucky Utilities (LG&E) Central Dispatch alerted each of their operations areas to prepare for the storm. The operations supervisors reported to their area offices and notified standby personnel on the evening of February 15. As the storm unfolded, the crews and resources were mobilized to the most heavily impacted areas. In addition to KU's permanent crews, crews from LG&E and other surrounding utilities were brought in.

C. 3. Damage Assessment

The ice storm of February 2003 required 4,800 workers to become involved in restoration efforts at the affected utilities. Nearly 300,000 Kentuckians lost electric and/or phone service at some point during the storm.

PHOTO 9: Alltel Repair Crew ~ Lexington, KY

This section outlines the general procedures used for damage assessment by each of the utilities affected and describes the problems presented by the ice storm damage. The principal focus is on the electric utilities and their efforts, although similar processes are in place for telephone utilities. **See PHOTO 9**. However, in most cases, safety considerations require that telephone utilities wait for electric facility repairs to be completed before starting their restoration work. For example, Alltel stated, "*Safety was a prime consideration when prioritizing repairs. Great care was taken to ensure that Alltel employees were not placed in harm's way or that Alltel crews did not interfere with the restoration efforts of the power companies. Downed power lines had to be cleared before Alltel personnel were allowed to enter an area to begin restoring telephone service.*" **See APPENDIX N1**.

Following a large storm or catastrophic event, a company's first job is to analyze the magnitude and location(s) of system damage. Top priority is given to evaluating what resources will be needed as well as to addressing unsafe conditions. Utilities implement procedures established in their Emergency Operation Plans (EOP) or Disaster Plans. **See APPENDIX K and FIGURE 6; page 8**. Emergency plans usually define the area's "critical loads" or priority customers. These include hospitals, fire / police stations, communication centers, etc. Public safety must be stressed in areas of widespread damage. Downed lines and sparking wire calls always take priority over other outage calls.

Key to a quick and accurate evaluation of a storm's damage is the availability of knowledgeable field personnel. Field personnel must effectively communicate the field conditions and damage to the management team to enable them to effectively direct the restoration efforts.

KPSC staff recommends the utilities evaluate their respective engineering and operations staffs' capacity to evaluate system damage.

C. 4. Prioritization of Repairs

After initial storm assessments are reviewed and unsafe conditions addressed, utilities generally follow a similar process in restoring services. Beginning with substation and transmission infrastructure and continuing to single house services, those circuits and lines serving the most customers are restored first. Nolin RECC's response states, "*Nolin prioritizes by transmission, substation, distribution feeders, taps & individual customers. Priority is given to medical alerts and public safety.*"

Nolin's response is typical of most utilities approach during restoration efforts. The utilities' restoration priorities were to address all safety-related situations and attempt to first restore services to all critical facilities such as hospitals, water treatment facilities and police/fire stations. Restoration efforts then focused on areas with larger customer concentrations, followed by less populated areas and finally single customer outages. **See FIGURE 7 and 7A.** As an example, KU's established and tariffed priority levels are:

I. Essential Health and Safety Facilities
II. Critical Commercial and Industrial User
III. Residential Use
IV. Non-Critical Commercial and Industrial Use
V. Non-Essential Uses

The utilities utilized these priorities to schedule repairs. In many instances large circuits that were repaired to restore power to a Priority I customer also enabled large blocks of lower priority customers to be put back into service due to the fact that they were also supplied service by the same section of line.

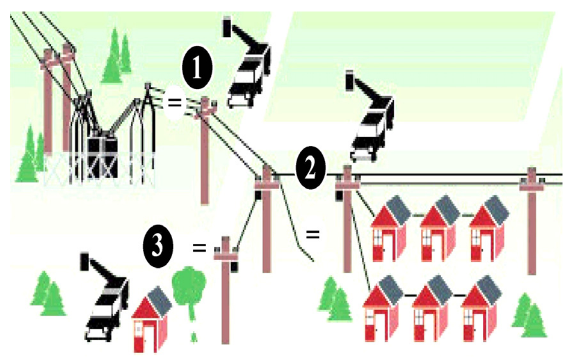
The diagram to the right and on the following page is a generic view of how power is restored:

1. Crews will begin repairs at the main line from the substation. This will usually restore power to a large number of customers. Because this line feeds others, it's necessary to start repairs here before other problem areas can be fixed. See (1) in graphic above and (3) in graphic at left.

2. Once the main line is fixed, the crew moves to the next troubled area where the most customers are without power. At this stage, repairs are made to individual main phases and major secondary lines known as "taps." While a crew may pass other trouble spots on the way, repairing the service that feeds an entire subdivision will get a larger number of customers on more quickly. See (4) in graphic above and (2) in graphic at left.

3. Crews will next make repairs to smaller tap lines. Making repairs to this tap line will restore power to individual homes.

4. After tap lines are repaired, crews will focus attention on making repairs to individual service lines that run from a pole to a member's meter. Individual repairs affecting a single member usually come after other problems are addressed because the utility will generally prioritize outages affecting the largest number of members first. This can be frustrating for a member to see his neighbors' power restored while a crew passes by his house, but often a repair that restores power to a single member can take as long as one that brings power back to an entire street or subdivision, which is why outages are often addressed in terms of number of members affected. See (3) in graphic at left.



In any outage, the first priorty is to get the greatest number of people back on line as quickly as possible. That's why electric utilities follow a sequence of repairs that restores power to large groups of consumers before tackling smaller groups and individual consumers. This fictitious example details a typical repair sequence.

1. The main distribution line from the substation must be fixed before anyone can have their power restored.

2. Next, repair crews fix the lines that restore power to the greatest number of people in an area.

3. After larger pockets of consumers are back on line, crews fix lines to individual homes.

FIGURE 7: Typical Procedures for Restoration of a Power Outage

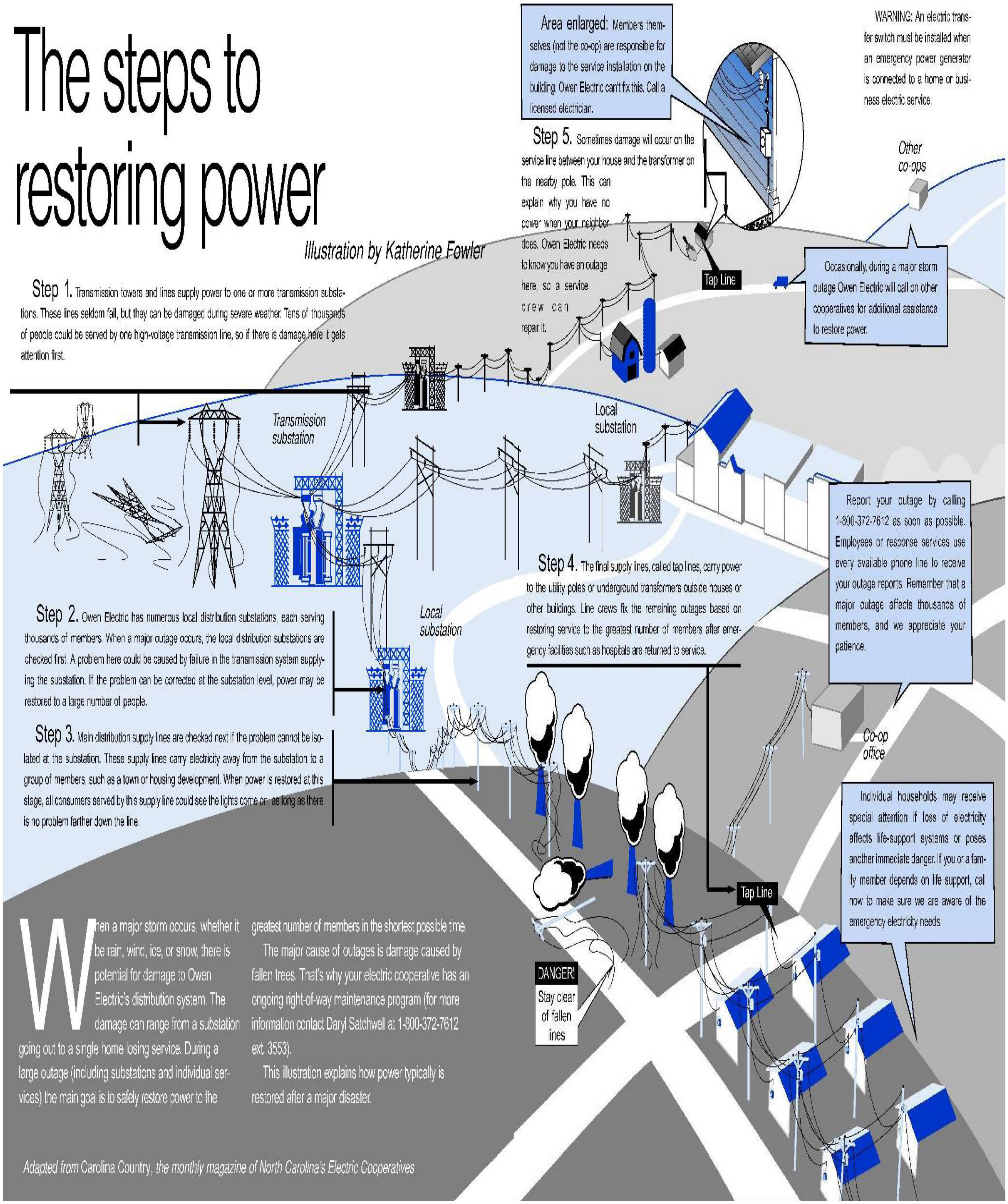


FIGURE 7A: Typical Procedures for Restoration of a Power Outage

C. 5. Contract Labor

Each of utilities affected by the ice storm has established relationships with contract labor and other utilities to assist in emergency situations. Most utilities routinely utilize some contract labor for maintenance work and service extensions. The utilities called upon these contractors to help in the restoration effort. Many of the contractors were able to mobilize additional crews from areas outside of the storm's path.

All of the electric utilities participate in mutual aid programs. These programs set defined terms for one utility to call upon others for the use of employees and equipment. The investor-owned utilities, KU and Kentucky Power Company (KPC), belong to a mutual aid program run by the Edison Electric Institute. KU relied on this for many workers while KPC was able to obtain assistance from sister American Electric Power (AEP) companies from Indiana, Virginia West Virginia, Ohio and Tennessee. The Cooperatives participate in a similar mutual aid program that is coordinated by the Kentucky Association of Electric Cooperatives and/or East Kentucky Power. The hardest hit cooperatives relied on this arrangement for necessary restoration workers. A detailed discussion of each utility’s restoration workforce is provided later in this report.

C. 6. Materials and Supplies

Each of the utilities had an adequate supply chain in place to provide materials needed for this restoration. None of the utilities reported any problems with the availability of materials and supplies. Their inventories and suppliers were able to supply all necessary items in a timely fashion.

Material handling for KU presented a challenge because of the massive amounts of materials needed for repairs, as well as supplies to support over 2,000 employees engaged in the restoration. **See PHOTO 10**.

KU and LG&E jointly operate a distribution system across the state. The distribution supply chain personnel normally operate out of both Louisville and Lexington. Louisville based supply personnel were mobilized to the Stone Road and the Midway operations centers in Lexington. The supply chain staff at these two locations managed the mobilization of out-of-state contractor, laundry, miscellaneous equipment, lodging and meals for the workers.

PHOTO 10: KU / LGE Transformer Storage Facility

The utilities stated in their self-assessments that suppliers delivered required materials as needed and that no materials interruptions occurred during the restoration effort. They gave credit to the supply chain staff and the relationships with their suppliers for allowing operations management personnel to concentrate on restoring service.

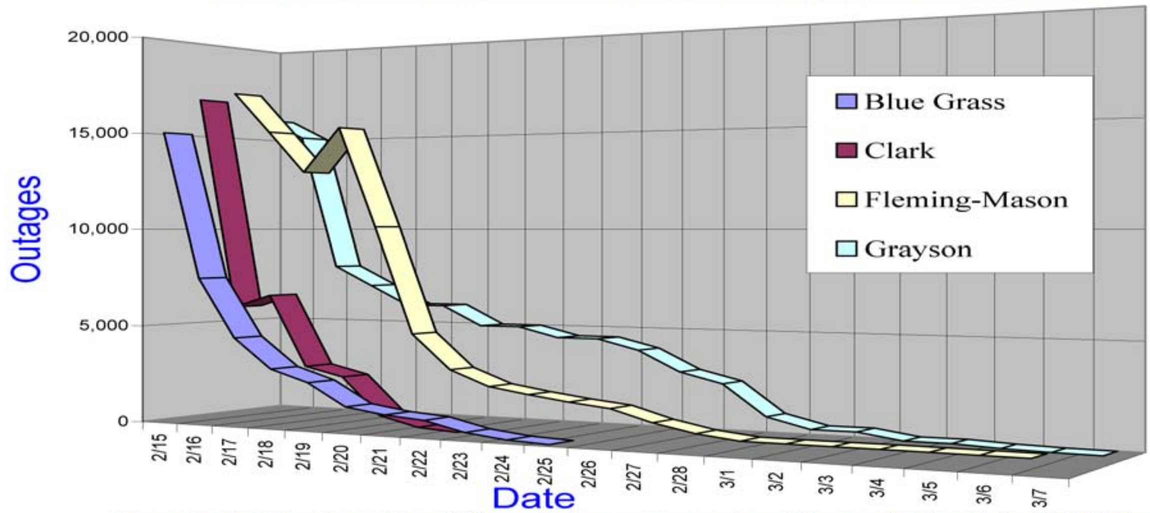
D. UTILITY RESTORATION SUMMARIES

Restoration efforts began almost immediately, even before the storm ceased, although working conditions were especially dangerous as limbs, trees, ice and power lines continued to fall. Working with county, state and municipal work forces, repair crews had to clear fallen trees from roadways before the utilities could gain access to downed power lines. **See Photo 11**. The extremely slick roads, muddy field / yard conditions and cold weather for several days following the storm also impeded the work of most R/W and repair crews.

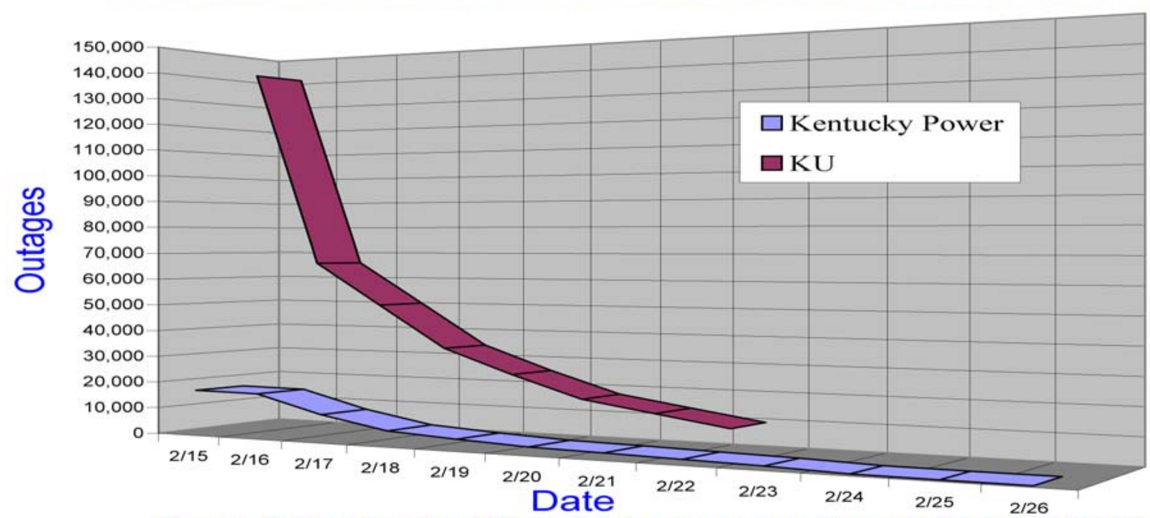
PHOTO 11: Fallen Trees on the Streets of Lexington, Kentucky Made Timely Response to Outages Difficult and Dangerous

GRAPHS 2, 3 and 4; page 15 depict the restoration timelines for the utilities most seriously affected by the ice storm. Of note is the increase in number of outages reported on the Alltel timeline during the first week following the storm. **See GRAPH 4; page 16**. This rise in outages, while electric outage numbers were decreasing, is attributable to several factors. Primarily, the increases are due to the fact that telephone repair crews usually had to wait until damaged areas were cleared of downed electrical lines in order to insure the safety of their workers making repairs. Secondly, many customers left their homes when it became obvious that electric service might not be restored for days or even weeks in some cases. As more electrical services was restored and customers returned to their homes, more telephone service outages were reported to Alltel. Notifications leveled off approximately 10 days after the storm occurred. Telephone service restorations began to increase a few days afterward. Also noticeable is the brief increase in electric customers out on the Fleming-Mason timeline seen in **GRAPH 2; page 15**. This was attributed to ice melting from lines and limbs causing additional outages as the falling ice initiated contact between the energized and neutral conductors.

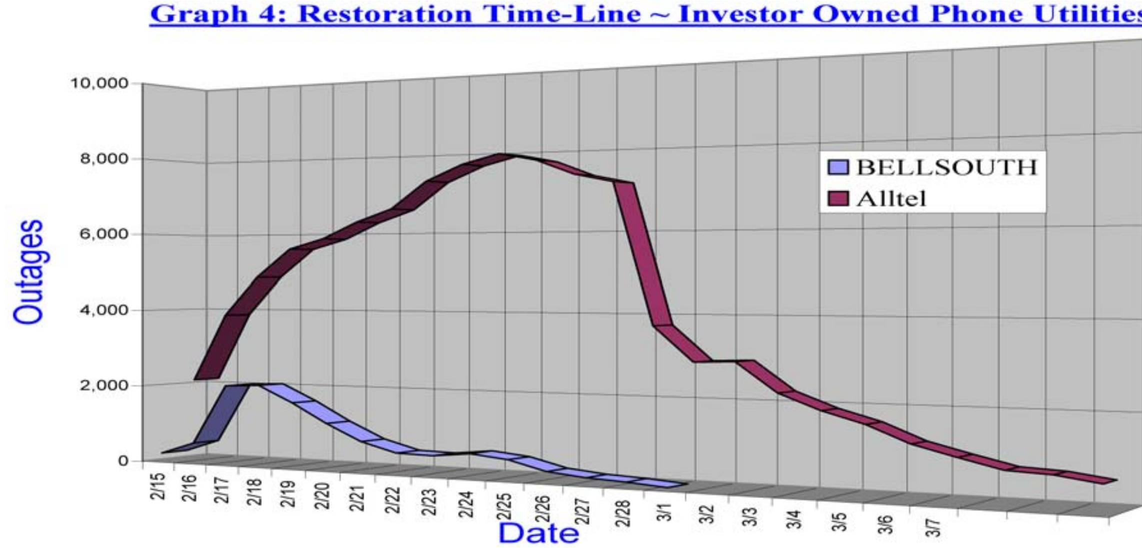
Graph 2: Restoration Time-Line ~ Electric Cooperatives



Graph 3: Restoration Time-Line ~ Investor Owned Electric Utilities

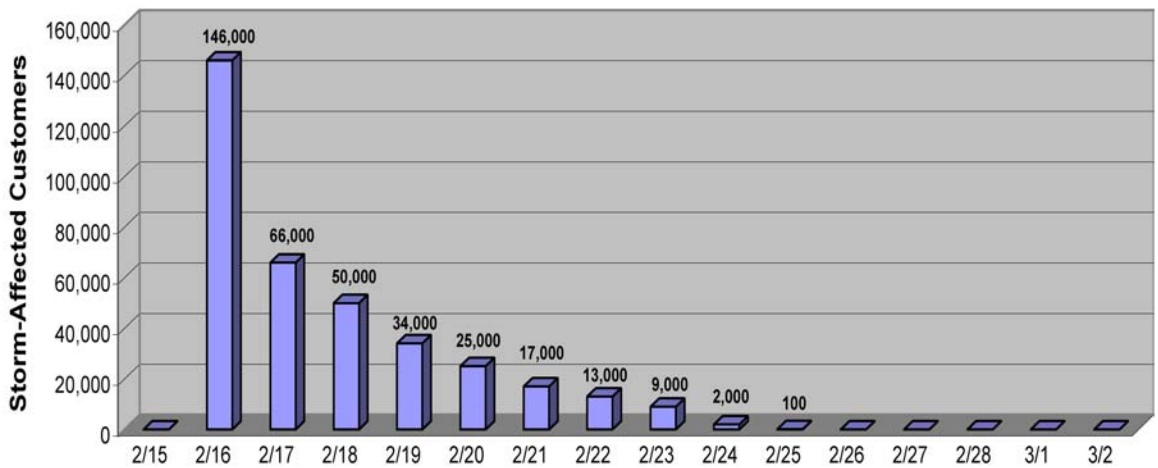


Graph 4: Restoration Time-Line ~ Investor Owned Phone Utilities



D. 1) Kentucky Utilities (KU)

The freezing rain that began falling during the evening of February 15 resulted in 146,000 KU customers without power on Sunday, February 16. The efforts of 483 KU employees and 544 contract employees reduced the number of customers without power to 66,000 by Monday, February 17. Contract crews were added until Thursday, February 20, bringing the total number of workers to 2,334. As the number of mutual aid crews increased, KU employees were shifted to "bird dog" or guide those crews around the system. This level of staffing was maintained until Sunday, February 25, when substantially all customers were back in service. **GRAPH 5** shows the number of customers without service on each day.



GRAPH 5: Timeline of KU Outage Restoration

KU followed the restoration priorities that were identified in its EOP. After the essential health, safety and commercial facilities were addressed; the repairs were prioritized identifying the circuits that would restore the most customers. This resulted in more densely populated areas being restored before less densely populated areas.

KU established a control center on Saturday, February 15, at its Stone Road Operations Center in Lexington. Management and operations personnel from both Louisville and Lexington staffed the control center. The Stone Road facility served as the nerve center of KU's restoration effort. From that location the customer outages and system damages were tracked, restoration priorities established, and work crews dispatched.

KU established two major staging areas in its Lexington Service Area (Fayette, Woodford, Anderson, Jessamine, Scott and Bourbon counties). One was located at the Stone Road facility, the other at its Midway Operations Center located on US 421 between Lexington and Midway. KU also used Fayette Mall parking lot to stage 600 pieces of equipment. KU conducted a massive materials and supply operation at these sites. They were able to provide materials and supplies to repair 5,725 spans of wire that came down during the event, replace 547 poles, 236 transformers and 187,000 feet of conductor (wire). During a normal week, 12 poles, 10 transformers, and 14,000 feet of conductor are installed by KU.

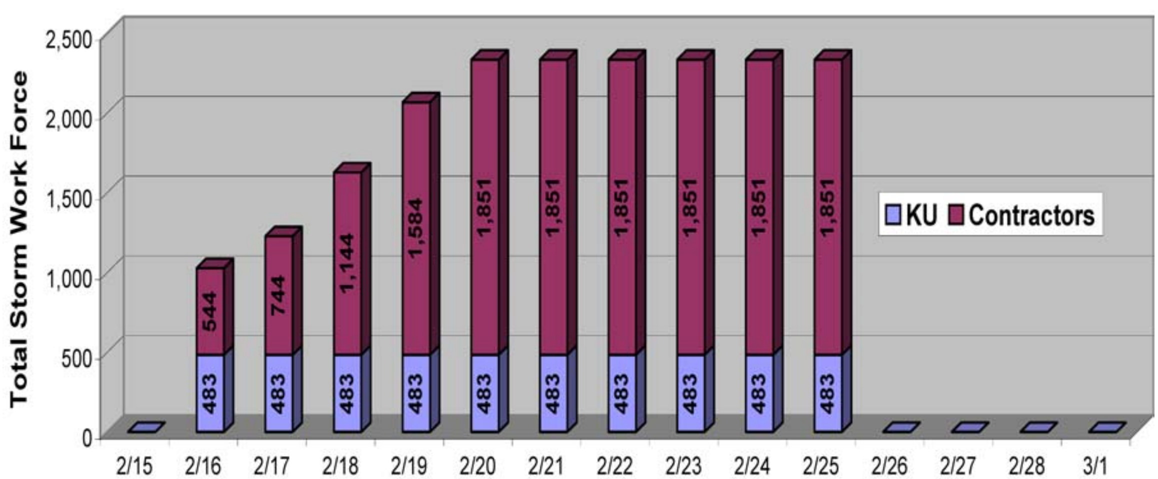
During the restoration the supply chain staff coordinated as many as 1,300 hotel rooms per day, served 80,000 meals, provided 20,000 gallons of fuel, 17 shipments of poles and 14 shipments of electrical supplies were delivered to the staging areas.

In addition to restoring the power, KU worked to keep the public informed. Twice daily throughout the restoration effort, KU participated with government officials in joint media briefings. KU also provided restoration updates and held conference calls with the KPSC and staff.

KU opened communications with the Lexington-Fayette Urban County Government immediately, while the communications with less populous government officials were delayed. The KPSC staff recommends that KU designate a contact person to communicate with officials in each of the counties it serves.

KU reports that the storm resulted in an estimated 8,000,000 consumer-hours of interruption and that the cost incurred for restoration activities was $22.5 million. Those estimates result in $2.81 of cost per consumer-hour of interruption to restore power to its customers.

GRAPH 6 shows the number of employees and contractors responding to the restoration work for each day of the storm and subsequent restoration period. KU and LG&E had 483 employees working as linemen, support personnel, tree trimmers, safety supervisors, contract coordinators, communicators, coordinators and logistics to provide restoration of the electrical system. KU is a member of the Edison Institute (EEI) Mutual Aid Organization. The Mutual Aid Organization was established so that utilities can assist each other with storm restoration by providing skilled workers familiar with electrical system characteristics to restore structural damage to the utility's facilities.



GRAPH 6: KU Work Force Timeline for Storm Restoration

The Commission Staff has determined that, given the extent of the damage caused by the storm, KU's restoration efforts were satisfactory. The restoration efforts were hampered by the duration of the storm (ice accumulated for approximately 36 hours) and by the same and additional lines being further damaged as the ice thawed and fell or allowed trees to snap back into place. Several circuits had to be repaired more than once.

Following the February 2003 ice storm, KU completed implementation of a new Outage Management System in Lexington. This system is a component of GEMINI, which began in 2000 and is the one of the largest IT investment initiatives undertaken by the utilities in Kentucky. This initiative integrates work management, outage management, a geographic information system, and a graphical work design system. With the new Outage Management System, implemented in 2003, many changes and improvements were made in the Kentucky Utilities Network Restoration Department (KU Central Dispatch).

The location of the existing dispatch center was at Stone Road in Lexington and had space for only 3 workstations. During October 2003, the dispatch center was relocated to the 4th floor at Quality Street (KU main office downtown) where a state-of-the-art facility was installed. This facility includes 12 workstations, a weather satellite feed, and technical support on site. Additionally, the dispatch center is now co-located with the KU Call Center which will enhance the ability to communicate during adverse conditions.

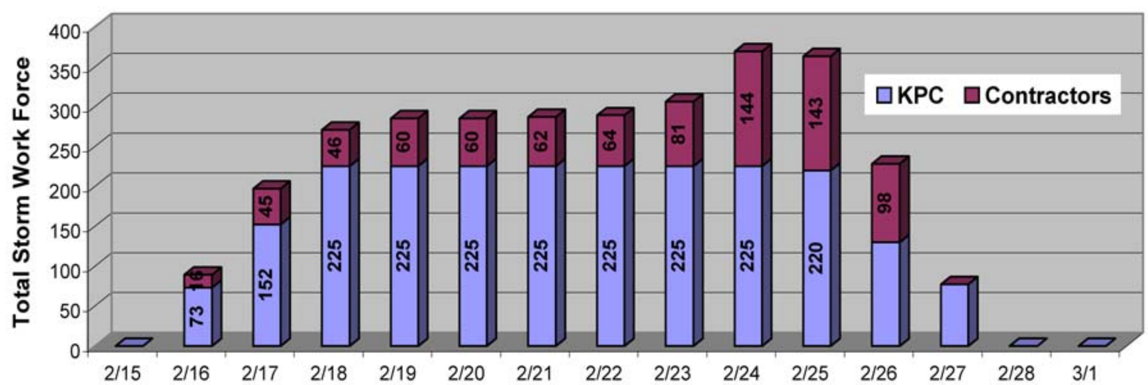
In November of 2003, the new Outage Management Software (Centricity by CES) was successfully deployed for the Lexington and Maysville Operations Centers. In addition, a completely new Trouble Order Entry tool was implemented to improve customers' trouble reporting and status feedback. The remaining Operations Centers for KU will be deployed in a phased approach according to the reported project schedule. KU Outage Management will be fully deployed by year-end 2004. Most recently, the new applications and processes have been deployed at the Danville and Richmond Operations Centers. Additional Restoration Coordinators (Dispatchers) were hired at the end of 2003 and are currently being trained.

D. 2) [Kentucky Power (KPC) – Subsidiary of American Electric Power]

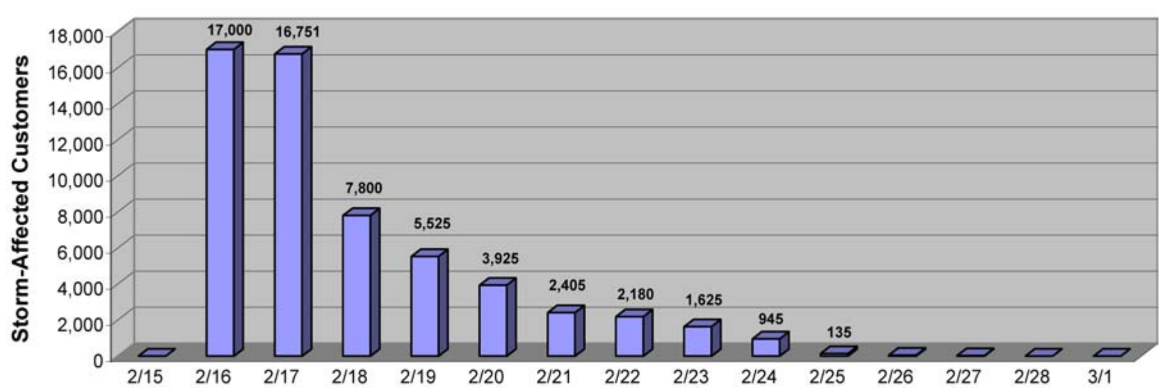
The first day of the ice storm, Sunday February 16, KPC experienced more than 17,000 customer outages. KPC utilized 73 AEP personnel and 16 contract personnel to reduce that number to 15,200 by the next morning. KPC added personnel from its sister companies in surrounding states and additional contract crews over the next week, reaching a maximum workforce of 369 workers on Monday, February 24. **GRAPH 7** shows the daily totals of personnel used by KPC to restore service to its customers.

During the period beginning Sunday, February 16 and Thursday, February 27 KPC replaced 275 poles and 93 transformers. KPC reports that the storm resulted in 1,521,929 consumer-hours of interruption and that its cost incurred for restoration activities was $6.6 million. The cost per consumer-hour of interruption was $4.34.

Kentucky Power Company's restoration efforts were slowed by the duration of the storm and falling ice and rebounding trees as the ice melted. **Graph 8** shows the net number of customers restored to service, as customers were restored others lost service.



GRAPH 7: KPC Work Force Timeline for Storm Restoration



GRAPH 8: Timeline of KPC Outage Restoration

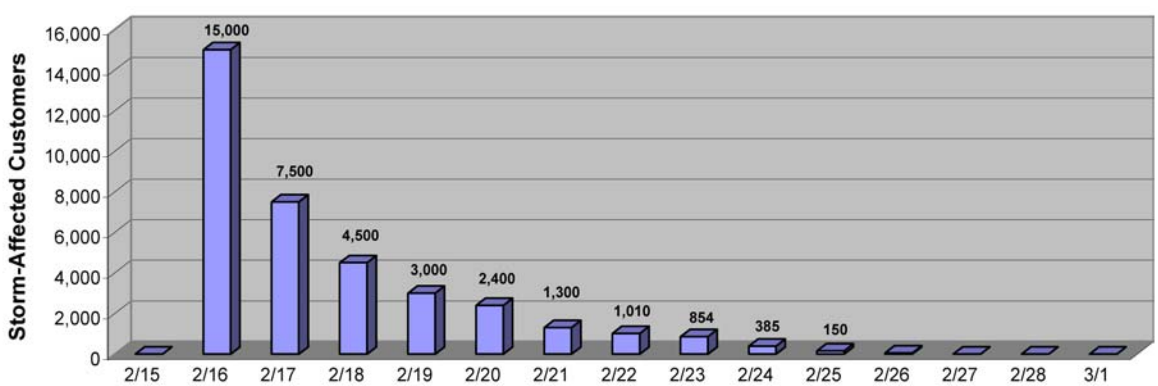
D. 3) Blue Grass Energy Corporation (BGEC)

The first day of the ice storm, Sunday February 16, BGEC responded to the storm with all 70 of its personnel. On Monday, BGEC tallied 15,000 customer outages. BGEC added 146 contract personnel and 12 mutual aid personnel for the duration of the restoration process. BGEC used a total of 155 outside personnel in the restoration effort. The contractors included not only electrical line workers but also local heavy equipment operators who assisted in pulling the utility trucks and equipment through the fields in order to access distribution lines. BGEC was able to reduce the number of customers without service to 7,500 by the next morning (Tuesday, February 18) and made steady progress through Friday, February 28, when all power was restored. **GRAPH 9** shows the daily totals of customers without service during the storm and restoration process.

BGEC reported that it was assisted in its restoration efforts by local government agencies in clearing the roads of debris and reporting broken poles and downed wires. BGEC also received help from volunteers who prepared and served meals for the workers.

During the period from Sunday, February 16 to Thursday, February 28, BGEC reported replacing 165 poles and 53 transformers. About one-third of the BGEC system was affected by the storm. BGEC reported that the storm resulted in 849,196 consumer-hours of interruption and that its cost incurred for restoration activities was $1.64 million, or $1.93 per consumer-hour of interruption.

BGEC's restoration efforts were slowed by the duration of the storm, falling ice, and rebounding trees as the ice melted. Much of its system is in rural areas that are not easily accessible by road. The saturated ground made access to its facilities difficult and time consuming.



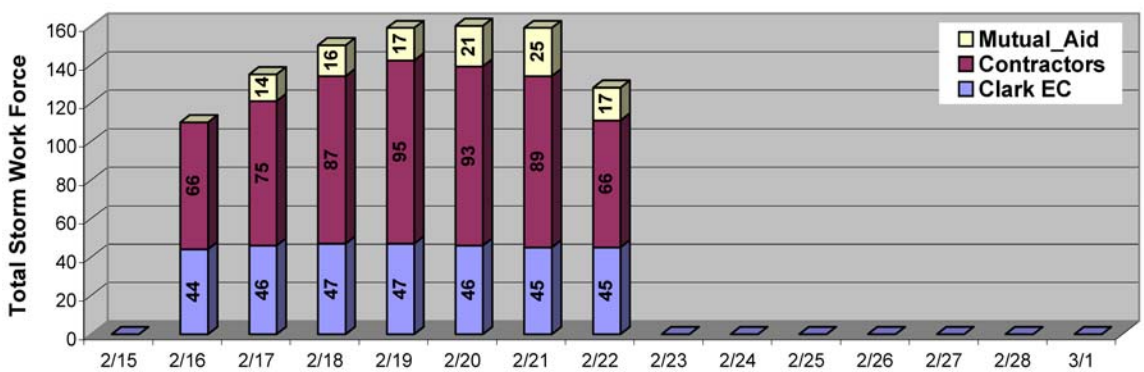
GRAPH 9: Timeline of BGEC Outage Restoration

D. 4) Clark Energy

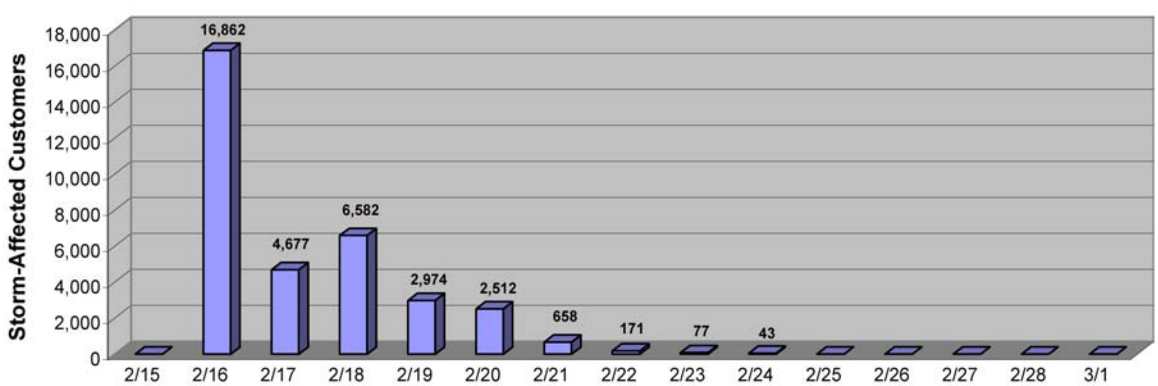
The first day of the ice storm, Sunday February 16, Clark reported 16,862 customer outages. The day before the storm, Clark arranged for 44 in-house personnel, 66 contract personnel and equipment to be in place Sunday morning. These personnel were able to reduce the number of outages to 4,577 by the end of Sunday. Clark began adding contract and mutual aid personnel on Monday, February 17 and maintained a workforce of between 135 and 160 until the restoration was complete on February 22. **Graph 10** shows the daily totals of personnel used by Clark to restore service to its customers.

During the period beginning Sunday, February 16 to Thursday, February 22 Clark replaced 74 poles and about 75 transformers. Clark estimates that the storm resulted in 272,161 consumer-hours of interruption and that its cost incurred for restoration activities was $713,150, or $2.62 per consumer-hour of interruption.

Clark's restoration efforts were slowed by the duration of the storm and falling ice and rebounding trees as the ice melted. Approximately 70 percent of Clark's customers lost power during the event. **GRAPH 11** shows the net number of customers restored to service, as customers were restored others lost service.



GRAPH 10: Clark Energy Work Force Timeline for Storm Restoration



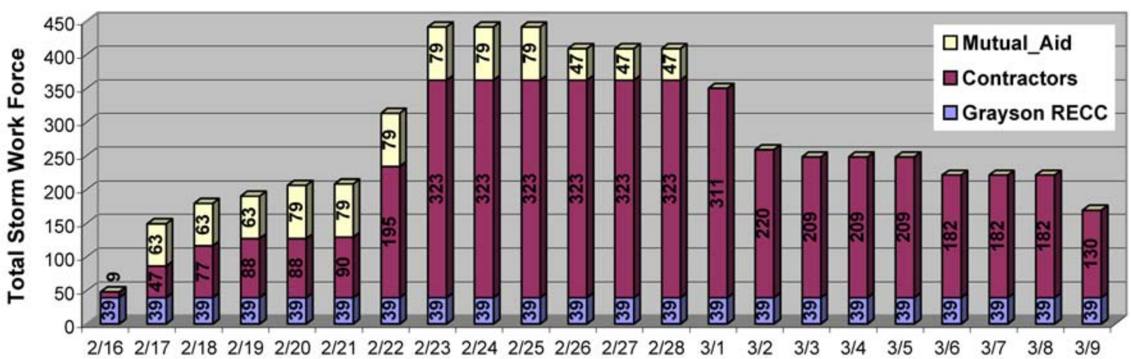
GRAPH 11: Timeline of Clark Energy Outage Restoration

D. 5) Grayson RECC

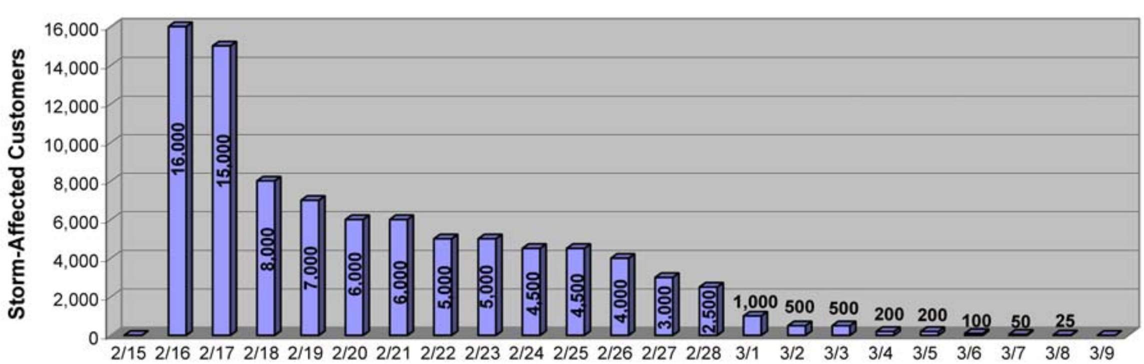
By Sunday February 16, Grayson had lost power to 100 percent of its system of more than 16,000 customers. Grayson mobilized its entire workforce of 39 personnel, its regular contractors and approximately 70 mutual aid workers. The roads in Grayson's territory were impassable due to ice and debris. This prevented the workers from making significant progress on the restoration until Monday, February 17, when they were able to reduce the number of outages to approximately 8,000 customers. Grayson maintained a work force of approximately 150 until February 22. On this date they were able to add a significant number of contract employees that had been released from other utilities in the area. **GRAPH 12** shows the daily totals of personnel used by Grayson to restore service to its customers.

During the period from Sunday, February 16, to Thursday, February 22, Grayson replaced over 800 poles.

Grayson's restoration efforts were slowed by the condition of the roads, the duration of the storm, and falling ice and rebounding trees as the ice melted. Grayson also did not have access to all of the contract labor that it could have used. Grayson reported that it has had no reason in recent years to form relationships with contractors outside of the few that routinely do work for them. Other contractors were obligated to serve the utilities with which they have current contractual relationships. **GRAPH 13** shows the net customers restored to service, as customers were restored others lost service.



GRAPH 12: Grayson RECC Work Force Timeline for Storm Restoration



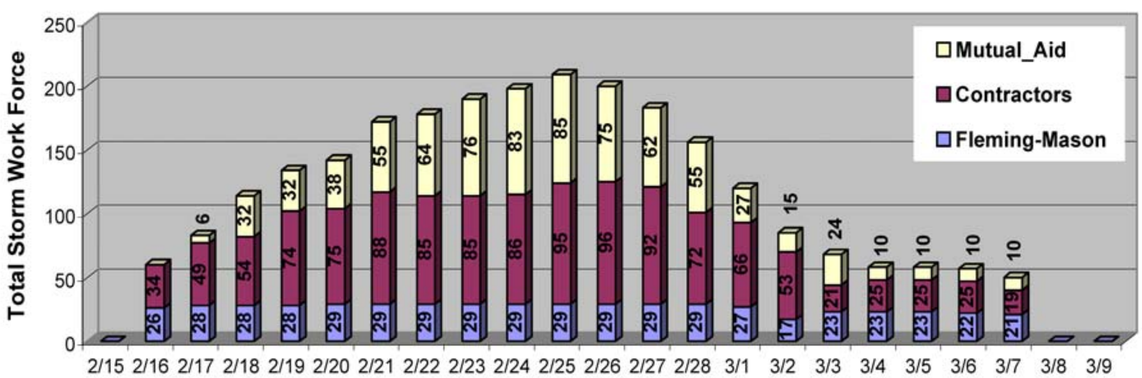
GRAPH 13: Timeline of Grayson RECC Energy Outage Restoration

## D. 6)		Fleming-Mason Energy

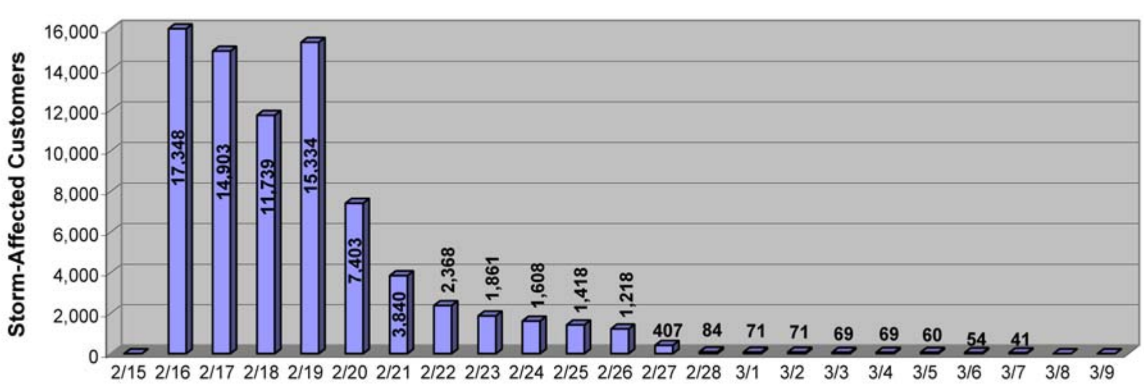
By Sunday, February 16, Fleming-Mason had lost power to 17,348 customers. Fleming-Mason utilized 26 of its personnel and 34 contract personnel to reduce that number to 15,211 by the next morning. Fleming-Mason began adding contract and mutual aid personnel on Monday, February 17 and maintained a workforce of between 114 and 209 until the restoration to all residential customers was completed on March 1. There were 71 uninhabited services without power on March 1; the last of these was restored on March 7. **GRAPH 14** shows the daily totals of personnel used by Fleming-Mason to restore service to its customers.

During the period from Sunday, February 16, to March 7, Fleming-Mason replaced 397 poles and 151 transformers. Fleming-Mason estimated that the storm resulted in 1,806,950 consumer-hours of interruption and that its cost incurred for restoration activities was $ 2,493,591, or $1.38 per consumer-hour of interruption.

Fleming-Mason's restoration efforts were slowed by the duration of the storm and falling ice and rebounding trees as the ice melted. Fleming-Mason suffered damage in each of the 8 counties it serves. **GRAPH 15** shows the net customers restored to service, as customers were restored others lost service.



GRAPH 14: Fleming-Mason Energy Work Force Timeline for Storm Restoration



GRAPH 15: Timeline of Fleming-Mason Energy Outage Restoration

D. 7) Utilities With Less Severe Damage

Salt River Electric Cooperative had a peak outage of 2,740 customers on February 17. By February 19 only scattered outages remained.

Inter-County Energy had a peak outage of 3,259 customers on February 16. By February 17 only scattered outages remained.

Licking Valley Electric Cooperative had a peak outage of 5,300 customers on February 16. By February 17 only scattered outages remained.

Nolin Electric Cooperative had a peak outage of 1,658 customers on February 16. By February 17 only scattered outages remained.

Owen Electric Cooperative had a peak outage of 1,299 customers in the early morning of February 17. By the end of the day only scattered outages remained.

ULH&P's (Cinergy) experienced only a brief outage on February 16 affecting approximately 8,000 customers was reported. This outage was caused by a problem with one substation. These customers were restored later that day.

E. TYPICAL RESTORATION WORK PROCESS

Once a damaged line section has been identified and accessed, restoration work usually begins with clearing downed trees and limbs in and near the right-of-way (R/W). Cuts are made to clear a path for the new or repaired lines to be installed. Utility crews are responsible for making sure any downed or damaged lines near a R/W crew are not energized in order not to endanger any workers. Fallen limbs and trees are cut clear of the electric line's path. Because the first priority is to get service restored, a full R/W-wide trim usually is not performed at this point. Lines can often be strung through narrow R/W's in order to re-establish service. Crews come back to fully clear lines later. Likewise, cut brush is not removed until later. R/W crews are moved to the next job after clearing lines. Construction crews then begin their job of repairing downed lines, setting poles, etc. As mentioned in the Vegetation Management section of this report, existing clear-cut R/W's proved to be a benefit to those crews working them. Not having to stumble over old brush and wood provided a safer and easier work zone, the result of which were quicker restoration times.

Even on the best of days, line clearance is not an easy task. Climbing crews have to work in trees near electric lines and with chain saws while sometimes working 50 feet or more in the air. **See PHOTO 12**. Icy and cold conditions significantly hinder such work and increase its danger significantly.

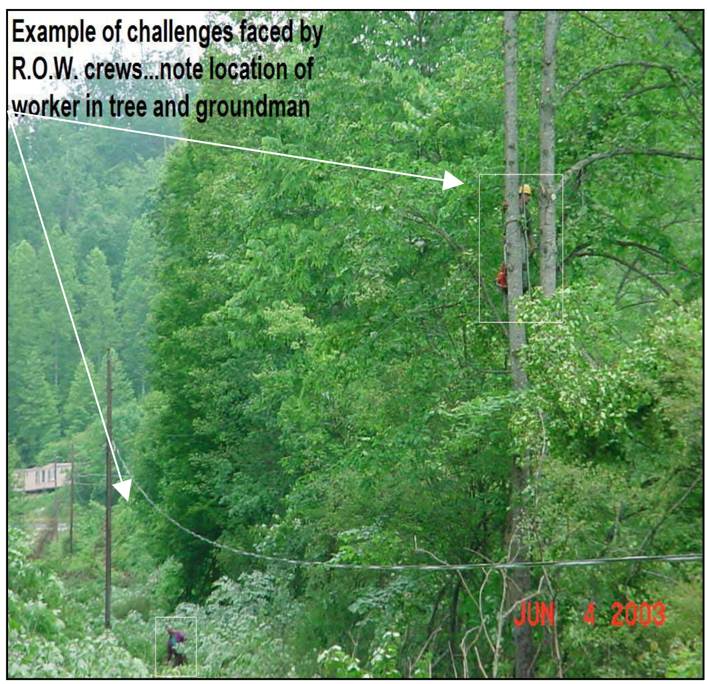


PHOTO 12: Typical Line Clearance Work

After trees have been cleared, line crews are able to set new poles, repair downed lines and continue the restoration process. Lines are always to be grounded and work clearances established in order to ensure worker safety. Each of these necessary steps is time consuming and, when combined with poor accessibility to damaged areas, contributes to increased total outage times. Crews will work on circuits that enable the greatest number of customers to be restored first. Priorities established in pre-existing emergency operation plans denote these circuits. Three-phase lines and tie circuits are re-established first. Later, single-phase lines and services are repaired. In some remote areas, the days of outages stretched to weeks. Generally, the final areas to be restored are camps, barns, and other rarely used facilities, as noted in Salt River RECC's response. **See APPENDIX N14**.

PHOTO 13: Lewis County, KY ~ Pike Contractor and Grayson Crew… Note Lineman in Distant R/W

Rural areas of Lewis, Carter, Fleming, and Greenup counties were some of the last to be restored (**APPENDIX N6 / O6; Fleming-Mason Energy and APPENDIX N7 / O7; Grayson RECC**) due to the remote nature of some of the lines in those areas. **PHOTO 13** shows a repair crew in rural Lewis County following the ice storm. Hours of work in such areas may result in only a few homes being restored. This is typical of many Rural Electric Co-op ("RECC") and rural areas of Investor Owned Utilities (KU, AEP, etc.) in the state.

The processes previously described typify the work that all the affected electric utilities followed during their restoration work. This work "template" varies little from company to company, regardless of the utility's size. The restoration activity is similar for a rural co-op such as Licking Valley RECC (<16,000 customers) and a large investor-owned utility such as KU (>500,000).

Any ice storm leaves challenges in its wake, but for the sections of Kentucky affected by the February 2003 storm, the results were unmatched in recent history. Ice storms leave more widespread damage than typical summer thunderstorms. Transportation, communication and even a lineman's ability to climb poles become severely hampered by a coating of ice. Electric companies had to replace nearly 800 transformers and more than 3,000 poles in the state as a result of the icy damage.

To combat these challenges, crews used a variety of non-conventional methods to gain access to remote work areas. Bulldozers were used to clear R/W's and pull trucks in and out of fields. Bulldozers also aided some areas in clearing or even establishing new R/W's. **PHOTO 14** shows an example of this from Lewis County during the days of restoration work following the storm. Other vehicles like 4-wheelers

PHOTO 14: Lewis County, KY ~ Bulldozer Clearing R/W

PHOTO 15: "All-Terrain" Tracked Digger-Derrick

and all-terrain tracked digger-derrick units provided some assistance to crews in spite of the harsh conditions. **See PHOTO 15**. However, most companies and contractors do not commonly maintain large numbers of these or similar units. Carrying tools, clearing the downed limbs and trees, and untangling wires and branches by manual labor remained the standard means of restoration. Even without the ice, the ground was saturated with moisture limiting normal accessibility for trucks and equipment.

Excessive ground moisture and rainwater saturated soil also contributed to whole trees uprooting and falling on lines in many cases. **See PHOTO 16**. The wet conditions also caused newly set poles to settle or lean, allowing lines to sag to the point that additional repairs were needed later.

PHOTO 16: Lexington, KY ~ Uprooted Tree

Ice storms result in more widespread damage than narrowly focused storms. Utilities are able to focus assets, manpower, and equipment in a smaller area of damage following a tornado or similar outage event. Paths of destruction are often better defined - unlike an ice storm's wide blanket of damage. Transportation delays caused by unsafe road conditions further delay restoration efforts following an ice storm.

One particularly frustrating and dangerous event for field workers after an ice storm is the thawing of lines and branches. As tree limbs thaw, they often break and fall on lines that were repaired only hours before, causing repeat outages on lines previously thought to be repaired. **See PHOTO 17; page 28**. Wires may "jump" or "gallop" as accumulated ice falls away. This action sometimes results in hardware failure due to the added stress caused by the action of the wires. Large pieces of falling ice also make for hazardous working conditions.

PHOTO 17 - Lewis County, KY ~ Tree on Line

The weight of the ice can also cause a "domino" effect on structures laden with a layer of ice. As one structure fails, the added stress causes adjacent structures to fail as well. Such action can result in outages on lines well clear of tree contact. An example of this took place on KU's system just west of the Fayette Mall along Reynolds Road. Several spans of "spacer" or "bundled" cable fell due to the cascading effect of hardware failure resulting from the weight of the ice on the structures.

E. 1) Post Storm Inspection and Clean-Up

Nearly all of the affected utilities continued to work jobs associated with this past winter's ice storm well into the summer months. Lines that were "temporarily" fixed in order to restore service had to be permanently repaired. Poles that may have been "spliced" were replaced. R/W work is also included in this type of follow-up work. Lines are often cleared just enough to restore service during the initial restoration process. Vegetation management practices take a back seat to getting power back on during storm work. The result is quicker repair times, but it is essential that utilities document and return to areas that need further trimming. Danger trees, which are those with hanging limbs, dead sections, etc., still pose a threat to electric lines even months after the storm. This is especially true in windy conditions.

Often temporary repairs are made in order to get service restored quickly. The permanent fixes and repairs have to be made later. Expedited line inspections in the aftermath of the ice storm were crucial to the safety and timeliness of recovery for distribution systems suffering losses in the storm. Most companies performed line inspections prior to energizing damaged circuits. These are usually brief overviews to insure safe conditions and provide confidence that the line will "hold" when energized. Sometimes the closing of one switch may energize several miles of a circuit. Utilities cannot be expected to check every service line prior to energizing a circuit. This would cause restoration times for the affected consumers to extend to an unacceptable level. Follow-up inspections to identify any missed repairs or unsafe conditions must be stressed in areas affected by an ice storm.

As large sections of lines are repaired, utilities generally allow inspection waivers to be granted for customers who have had repair work done to their services due to storm damage. Otherwise, these homes would be left without service until a local inspector could check each of the repaired wiring jobs. Homeowners could be left waiting for electric power, despite the availability of a repaired line from the providing utility. The widespread nature of this storm pointed out the need for better communication and increased public awareness with respect to a customer's area of responsibility for service lines. The KU Lexington area experienced much confusion on this subject. Media reports, local government interaction, and a lack of understanding on the public's behalf, led to numerous customer complaints and a general misunderstanding of the ongoing repair process.

Of specific concern in this storm's aftermath was the presence of "open neutral" (i.e. service neutrals separated from connection to main line grounding/neutral systems) situations and improperly wired customer repairs not detected by an inspection process. Both undetected open neutral situations and faulty wiring repairs were factors in four house fires in the Lexington area investigated by KPSC staff on February 26, 2003. KPSC staff's investigation into the house fires did not deem utility practices to be directly responsible for these fires. However, the methods of re-energizing services and communication procedures with local inspectors need to be reviewed in a timely manner in order to limit the possibility of similar incidents in the future.

Clean up issues also are continuing concerns. Following the ice storm, one of the crucial problems quickly became debris disposal. Road clearing crews, R/W crews and utility crews moved limbs, brush and debris just enough to restore service. However, local and state agencies soon became over-burdened by the amount of debris that needed to be removed. Environmental issues of streams and creeks becoming clogged, hazardous material disposal, and brush burning areas are all concerns that need to be addressed within the framework of future emergency action plans.

From a utility standpoint, the clearing of ground R/Ws should not be overlooked. Though certainly not a main priority during restoration, it is important not to overlook the task of cleaning up work sites. R/W brush removal, public property clean up, and the removal and proper disposal of all damaged hardware must be addressed following major storms. **See PHOTO 18**. Proper removal and attention to damaged facilities prevents hazardous conditions and ensures safe R/Ws. Public complaints are also mitigated by timely clean ups after power has been restored. For the most part, this was accomplished by the electric utilities within the state.

PHOTO 18 – Fleming County ~ Damaged Material Left While Repair Work Continued Elsewhere

F. PREVENTIVE MEASURES AND PROCEDURES

What can a utility do to better handle the next ice storm? Unfortunately, the existing weather data system does not include historically accurate information concerning ice accumulation. **FIGURE 8** reflects the most up-to-date data on radial ice accumulation in the United States. This map was prepared for use in the manual - *Minimum Design Loads for Buildings and Other Structures,* and modified for use on overhead utility lines. It depicts the ice and wind loads that can be expected with a 1 in 50 chance of occurrence in any one year.

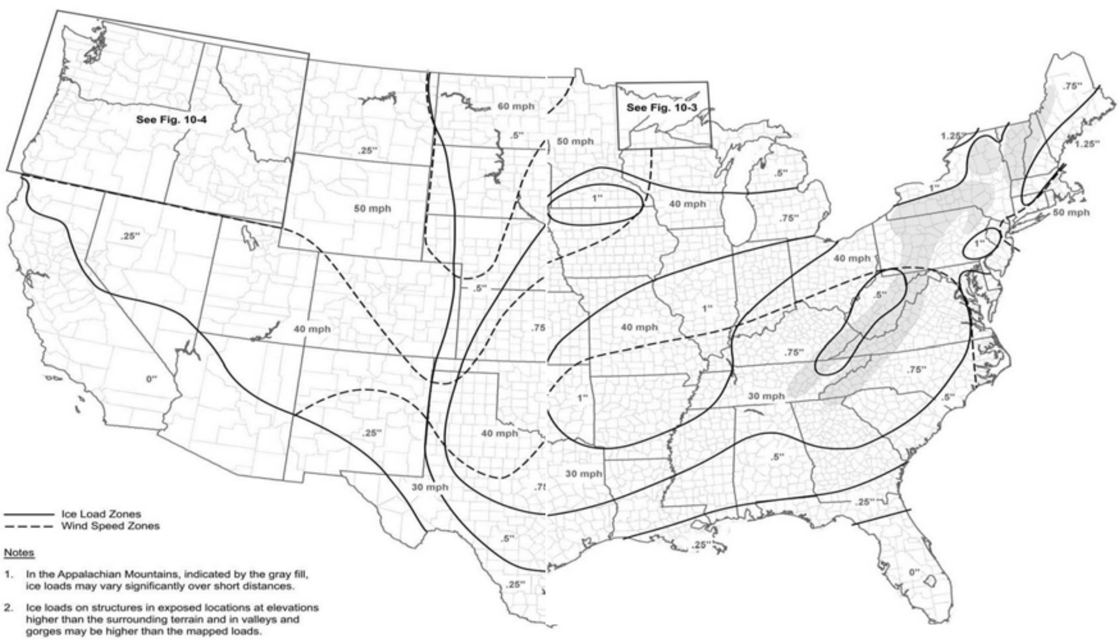


FIGURE 8: Proposed NESC Ice and Wind Combination Loading Map

Utilities in Kentucky currently design their distribution systems for ice in accordance with the National Electrical Safety Code (NESC) medium loading district. **(See APPENDIX A, FIGURE 9 and TABLE 4, page 31)** The maximum amount of ice that can accumulate on a wire has been disputed by field observations during past ice storms. Some suggest that ice accumulation can increase indefinitely, depending on the storm's duration. At some point the weight of the ice will exceed the strength of the ice, with the result that the ice will break away. Most small-diameter conductor will break when the radial ice thickness exceeds one inch.

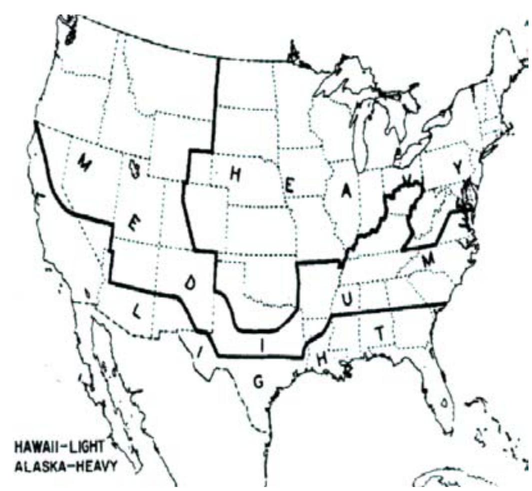


FIGURE 9: NESC Ice and Wind Loads

The major problem associated with damage to distribution lines due to an ice event is the long period of time required to restore service. This is due to the large area where broken wires, structures, insulators, and crossarms occur; the time required to remove downed trees and limbs; and the time needed to obtain large quantities of poles, wire, insulators and other critical materials needed to repair the lines.

TABLE 4: NESC Loading Factors

Load District And Grade*	Radial Ice Load (Inches)	Wind Load (PSI)	Vertical Overload Factor	Transverse Overload Factor
Light - Grade B	0	9	1.50	2.50
Light - Grade C	0	9	1.50	1.70
Medium - Grade B	0.25	4	1.50	2.50
Medium - Grade C	0.25	4	1.50	1.70
Heavy - Grade B	0.50	4	1.50	2.50
Heavy - Grade C	0.50	4	1.50	1.70

* Grade B is normally used for transmission and Grade C is normally used for distribution

Actions that utilities can take to lessen the effects of a severe ice event. These can be grouped into three areas:

- Improve planning/response to storm restoration
- Improve/modify existing facilities to lessen the detrimental effects induced by ice loading events
- Design/build new facilities to provide more resistance to ice damage

F. 1) Joint-Use Attachment

Multiple service providers, including electric and telephone utilities and cable TV providers, utilize most utility pole routes. The attachment of facilities to utility poles is governed by regulatory policy and through "joint-use" agreements between the pole owner and the attaching party. At the outset, the impact of additional facilities must be considered in the design of the pole route prior to any attachments being performed. Ultimately, it is the responsibility of the utility, as owner of the pole/route, to ensure that attachments to its poles are appropriate, safe and that any necessary make-ready work is performed to protect the integrity of the pole and the route.

Yearly inspections can ensure that joint attachments remain safe and proper. Fortunately, the present reports filed by the utilities indicate that attachments, for the most part, have been performed properly. No utility reported that joint-use attachments were contributing factors in any substantial manner to pole failures during the ice storm. Some utilities alluded to isolated instances where multiple attachments may have hampered restoration efforts due to difficulties in accessing poles and coordinating personnel activities.

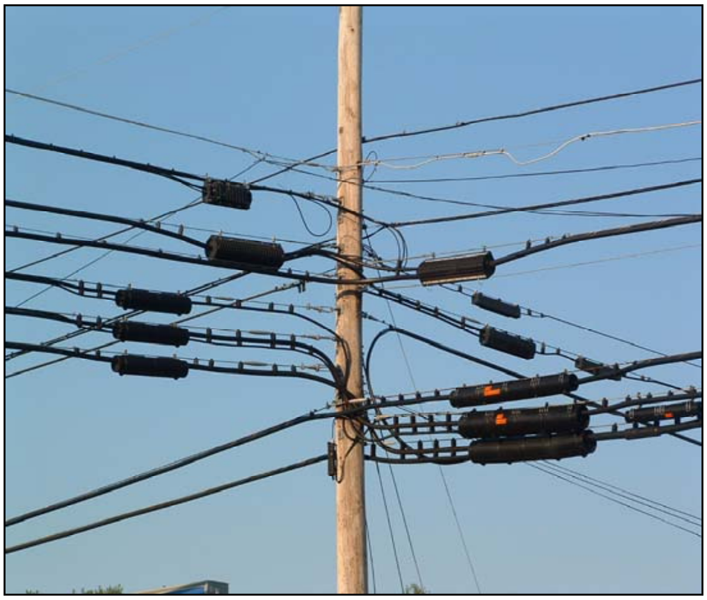


PHOTO 19: Questionable Joint Attachment Loading

During a severe outage situation, like the February 2003 ice storm, communication between affected service providers becomes an essential issue. Contact with appropriate personnel for the coordination of restoration efforts can be difficult without proper planning. It is imperative that the utility pole owner maintains current contact information for all of its tenant service providers. **See Photo 19.** Obtaining this information immediately following a crisis can be challenging at best and often wastes valuable resources and time. It appears that the utilities and attaching service providers coordinated their activities well during the restoration effort. Recognizing that there is always room for improvement, utilities should review their emergency planning process to ensure that proper contacts for affected parties are kept current and that their agreements adequately cover proper procedures during emergency situations.

Joint utility ice loading capacity must be assured by all utilities or companies attached to poles. Insufficient guy and anchor strength can oftentimes lead to unacceptable ground clearances or worse. **See PHOTO 20**.

PHOTO 20: Pole Broken at Point of Joint Attachment by possible improper loading

F. 2) Vegetation Management

Electric utilities operate their systems along many miles of right-of-way (R/W) and deeded easements throughout the state. In order to provide safe, consistent electric service, these lines must be kept clear of contact with tree branches and limbs. The National Electric Safety Code (NESC) states: "*Trees that interfere with ungrounded supply conductors should be trimmed or removed*."[i] Trimming trees is an essential part of maintaining a reliable system for any electric utility. This section will outline the most common practices being used in Kentucky and describe the affects of tree trimming processes on the impact of the ice storm of 2003.

Utility company tree trimming practices and R/W policies are sometimes categorized as Vegetation Management (VM) programs. These programs incorporate a number of aspects, including:

- Tree Contractor Companies (i.e. – *Asplundh, Nelson*, *Townsend,* etc.)
- Chemical sprays and herbicides.
- Public Awareness Programs (tree removal/replacement, public safety, property access plans, etc.).
- Company identification of problem areas and direction of funding for targeted areas, as well as ongoing programs.
- Forestry personnel input for proper tree management.
- Balance of company resources with reliability, environmental concerns, cost-effectiveness, etc.

The efforts of VM programs are generally defined in two areas:

1. Transmission R/W (For the purposes of this review, transmission lines will be those at, or above 69,000 volts).
2. Distribution R/W (For the purposes of this review, distribution lines will be those below 69,000 volts).

F. 2) (a) Overhead Transmission VM

Although there were some interruptions during the ice storm caused by damaged transmission lines, the vast majority of outages were due to failures on distribution systems. Transmission circuits avoided the catastrophic results that befell other lines for a number of reasons. Taller structures allowed cables to clear most of the tress that fell. Heavier construction designs allowed more stress to be absorbed by the lines, poles and towers without failure on transmission structures. But, most significantly, R/W for these lines is much wider, better established and more strictly maintained. **See PHOTO 21**.

PHOTO 21: Typical 69kV Transmission Line in Rural KY

Transmission lines have much wider R/W's than distribution lines (100 – 150 foot widths not uncommon). The pathways traversed by these high voltage lines are well known R/W's. Significant resources are dedicated to maintaining these lines in order to solidify the integrity of the transmission grid throughout the state. VM practices are employed on transmission R/W's as well, enabling these critical tie lines to provide electricity between substations.

F. 2) (b) Overhead Distribution VM

PHOTO 22: Lexington, KY Street

Damage to the state's electric distribution system from the 2003 ice storm was tremendous. An estimated 255,000 electric customers lost power at some point during the week of February 16–22. Some of the damage included over 3,100 poles that were broken within the affected areas. Most of these were damaged by either the weight of the ice on the lines or by the ice causing trees and limbs to fall onto the poles and wires. **See PHOTO 22**.

In reviewing each utility's R/W program after the ice storm, specific attention was given to the best practices in use with respect to the following issues: trim cycles, trim widths, equipment and methods used, and customer issues. While each plays a role in the effectiveness of a successful VM plan, the overall result is a reflection of a company's ability to manage all portions of a credible VM plan.

F. 2) (c) R/W Trim Cycles

Cycle refers to the frequency that a circuit is trimmed. This differs somewhat from company to company. For example, Clark Energy targets a 6-to-7-year cycle, while KU's goal is a 3.5-year cycle (see Appendix N-5 & N-10). On average, a 4-to-5-year cycle is the current goal of most utilities. This also varies depending on the location of the line itself. Rural areas typically have longer cycles (7-9 years) than urban areas. Other variables include:

- Geography of the land traversed by the electric line.
- Quality of the previous trimming job (Poorly cut limbs will present problems sooner than properly trimmed jobs. Good follow-up inspections are critical to insuring well-trimmed circuits.).
- Weather factors contributing to the speed of tree growth.
- Availability of qualified workforce.
- Types of vegetation within R/W.
- Determination/dedication of personnel and management.

An extension of cycle time is not necessarily an indication of lessening reliability. Increased cut zones, enhanced oversight, herbicide use, better pruning practices and improved contracts with trimming companies have allowed utilities to increase their trim cycles (and cut costs) in recent years. However, without these enhancements, an extended cycle time frame could certainly have an adverse affect on most distribution system.

Some companies have begun to trim lines based on reliability factors. **See AEP's policy; APPENDIX O9**. Targeted areas are cut based on line failures and outage statistics. While this practice limits the costs of trimming, the long-term effectiveness of this method remains to be seen.

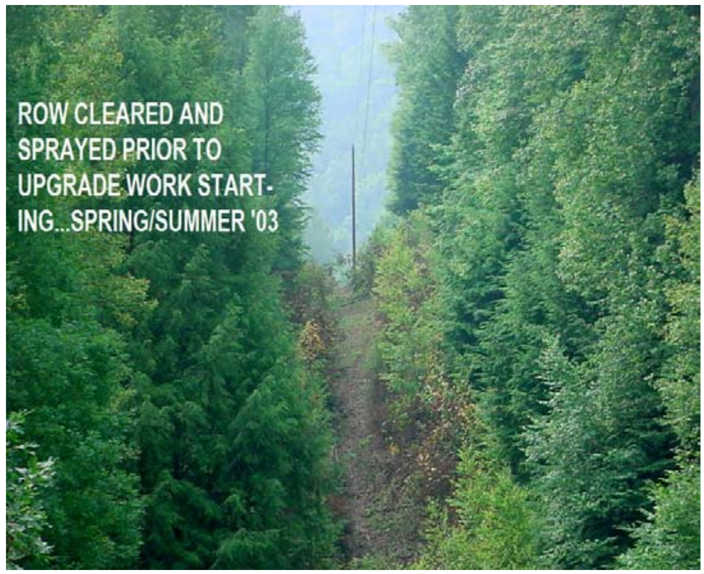


Photo 23: Narrow R/W

F. 2) (d) R/W Widths

Trimmed R/W widths differ throughout the state. There is currently no "standard" cut width mandated by Kentucky law or by NESC codes. Typical best practices place three-phase lines at 40-foot widths and single-phase lines in 30-foot wide R/W's. Some variety in cutting practices is based on company VM policies, geography / terrain, easement widths, line voltages, property owner issues, etc. **PHOTOS 23 and 24** depicts the varied width of two separate single-phase lines. In **PHOTO 23**, the line crosses a heavily wooded and hilly section. Line clearance in these areas is more time-consuming and costly to the utility. **PHOTO 24** has a line that was trimmed on the upper side to help prevent some of the trees from falling into the line. But even with a 40-foot horizontal clearance, some trees could still fall into the line. It is not practical for any further trim clearance on such a line, yet the potential for damage still exists.

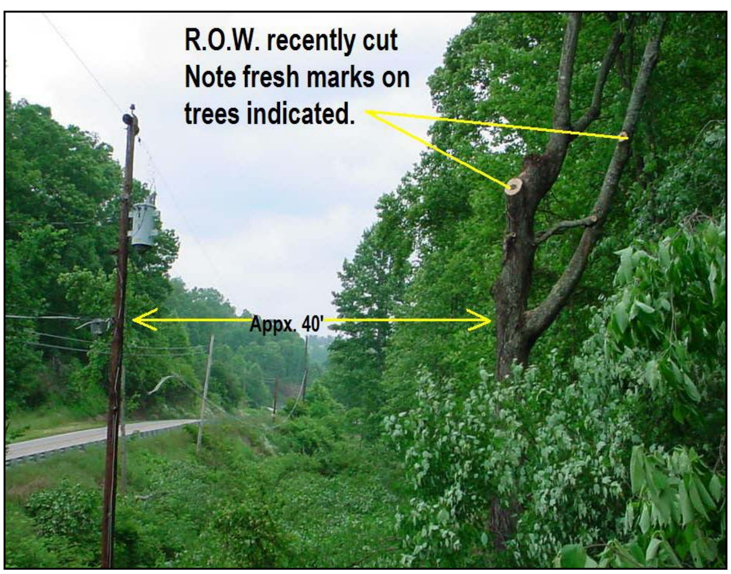


PHOTO 24: Recently Trimmed R/W

F. 2) (e) Equipment And Methods for VM

Most VM programs include herbicide spray applications to areas following a trimming. This allows the vegetation's growth to be limited, thus lessening the need for future trimming. An additional benefit of spraying is a more accessible R/W for maintenance and repair purposes. **PHOTO 25** shows R/W that was recently trimmed and sprayed. Underbrush and smaller vegetation is minimized with properly applied sprays and chemical treatments. Spray treatments are somewhat limited in their use due to environmental concerns and precautions. Rural areas away from streams and creeks are the most likely places to have the full benefit of herbicide treatments.

PHOTO 25: Benefits of Herbicide Treatment

R/W accessibility can benefit a utility in a number of ways. Quicker restoration times, more thorough line inspections, and more efficient future R/W trims are all potential improvements garnered from maintaining cleared ground R/W's where possible. Trimming practices also enhance the future accessibility of clear R/W's. By not throwing cut brush in the R/W, tree trimmers allow a more accessible and workable R/W. Some utilities include this provision in their VM plans. For example, *"All brush and wood will be left at the side of the right-of-way or chipped…"*. **PHOTO 26** shows a R/W where there has been some effort made to remove the cut limbs and brush. Bush-hogging the ground under a R/W is also a common practice to maintain accessibility where applicable. While some of these practices take extra time and effort initially, those areas that have incorporated such plans into their VM programs reap the benefits of later cost savings and fewer outage hours.

Tree removal programs are also an essential part of a useful R/W plan. "Danger trees" (i.e. dead or dying trees near lines) must be removed to avoid unnecessary outages. Forestry and VM personnel can identify these trees during tree counts or routine inspections. Removal of frequently trimmed trees is also advantageous to the utility. By removing those trees they eliminate time and expense during the next cycle and further reduce a potential outage cause. This issue will be further discussed later in "Customer Issues".

PHOTO 26: Bush-Hogged R/W

Trimming crews usually consist of climbing crews and bucket crews. Climbing crews have 3-5 men that climb into the trees to make the appropriate trims. Bucket crews usually have 2-3 men that cut more accessible lines using bucket trucks. "Hot spot" crews are also used to take care of routine daily jobs that come up.

The main tools of the trade are bucket trucks, pruning tools, saws, etc. There is a variety of other equipment available that helps provide accessibility to electric lines needing trimming. **See PHOTOS 27 and 28.** Trucks with robotic arms and helicopters with spinning saw blades are examples of equipment often used to cut areas with limited accessibility. These types of units can be used in remote areas if R/W accessibility allows. Hourly rates for such units are costly, yet will usually be less expensive than climbing, or manual cut crews.

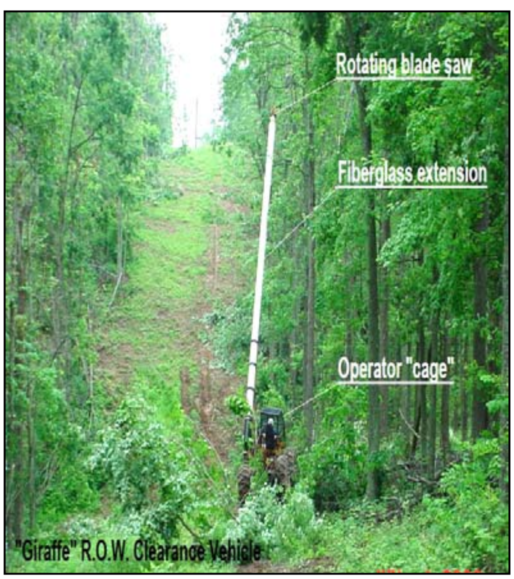


PHOTO 27: "Jarraff" R/W Trimmer

PHOTO 28: "A-Tab" All Wheel Drive

F. 2) (f) Customer Issues of VM

Tree trimming presents the electric companies with some of their greatest customer relation challenges. Property owners can be very reluctant to allow access to their properties or give permission to have trees cut or removed. In addition, environmental, ecological, and aesthetic issues factor into R/W management.

Some utilities have defined easements that include tree trimming and accessibility clarifications with property owners. Others have broad property access easements for electric lines crossing a property. Older lines may not have any record of a granted easement or R/W access recorded. These inconsistencies result in a non-uniform method of R/W trimming and management. What passes for adequate VM in one corner of a county may not be achievable in another section of the same county. Certain uncooperative customer's properties are avoided or lightly trimmed. Narrow R/W widths and accessibility problems result. The end result becomes outage-prone areas due to constant tree damage to lines.

Utilities attempt to combat this with "uniform" VM plans, but for the most part, tree trimming is done on a case-by-case basis. Examples of R/W width varying from line section to line section within the same circuit are not uncommon. Several states have laws mandating R/W policies (IL, CA, OR, etc.). Kentucky currently does not have any such regulations. Utilities are expected to operate their system by safe, reliable, cost-effective means.

F. 2) (g) Customer Relations for VM

Current programs usually consist of company notifications to customers of the need to cut trees in their area. Door hangers, personal notification and mailed letters are common forms of contact with property owners. Those unwilling to allow trimming are often by-passed or have limited trimming performed on their properties. The result is that portions of circuits continue to have danger trees and areas of heavy tree interruption.

One attempt in recent years to alleviate such problems has been tree replacement programs. If a company removes a tree, it is replaced with a smaller stature species (Dogwood, Bradford Pear, Redbud, etc.). This allows the customer to retain a tree, yet the growth of the new tree does not impair the function of the electric lines. To this point, these programs have met with limited success.

PHOTO 29: Typical "V-Notched" Tree Trimming

PHOTO 29 shows trees that have been "topped" for several years. The property owner or utility has been unwilling to have the trees removed.

The resulting line clearance trimmings have left the trees in a "V-notch" condition. This trimming procedure may allow for minimal initial cost to trim but the present-worth of the ongoing cost can be much greater. Also, while this may maintain clearance to avoid tree contact with the energized conductors it does have the possibility of increased liability due to public contact with and/or increased restoration time for downed lines.

One key to successful R/W plans is consistent contact with property owners. Customers with whom the utility has an established working relationship are much more likely to allow proper tree trimming. The utilities, in turn, must be good stewards of the owner's premises. Debris clean-up, proper notification, and general respect for the grounds are minimum expectations for tree contractors. Problems tend to arise when too much of a tree was cut; ruts were left in a yard, etc.

Agreements with local agencies regarding tree trimming practices is also a viable means of ensuring good sources of communications for electric companies. Making officials aware of trimming goals and necessities allows for better relationships.

F. 2) (h) Forestry Analysis

Forestry experts stated that in rural areas nearly all types of trees were susceptible to high levels of damage. Meanwhile, urban locations saw significant losses in the populations of pin oaks, elms, and silver maples[4]. Not surprisingly, areas with the most significant tree damage were those with substantial utility system failures (i.e. Fayette, Lewis, Carter, Greenup counties). Mature trees caused more damage due to their height and weight. Further investigation of fallen trees often revealed previously undetected weaknesses such as rotten limbs or hollow spots within the trunks. The street trees in urban areas that had received proper trimming and pruning were found to have survived the storm more often than those that did not have similar treatments. But, not unlike the utility's R/W systems, even the best practices could not have yielded a trouble-free event in the face of the ice accumulation that occurred in February 2003.

PHOTO 30: Lewis County, KY

Geographically, the Northeastern and Central counties of Kentucky saw the most build-up of ice during the days of February15-16. A total of 51 counties were declared disaster areas as a result of the ice storm's damage. Utility line damage was widespread but particularly bad in Lewis, Carter, Greenup, and Fayette counties. **PHOTOS 30 and 31** provide some example of tree damage in Lewis and Fayette counties.

[4] Interviews with Kentucky State Forester Diana Olszowy and Lexington City Forester Tim Queary.

F. 2) (i) Continuing Problem of VM

As the memory of the ice storm fades, the damage to trees remains. Many trees that did not fall during the storm still suffered damage. Hanging or broken limbs continue to represent a safety issue as well as a danger to property and utility lines. It is important for utilities to assess the conditions of their R/Ws. Likewise, property owners should evaluate the damage done to larger trees on their property that could pose a threat to human life, buildings or utility lines.

PHOTO 31: Fayette County, KY

The KPSC staff, along with the utilities, makes the following suggestions to property owners. *"Tree trimming near electric lines should only be done by properly trained personnel"!* Since the ice storm, the Kentucky Public Service Commission has recorded a higher than normal incident rate of public contact with electric lines during tree trimming. Unfortunately, these incidents include three fatalities. It is imperative to adhere to power line safety practices and maintain proper clearances. Customers must be encouraged to contact local utilities if any question exists regarding trees and limbs near electric lines.

Damaged trees may need to be replaced in the aftermath of the ice storm. Care should be taken to ensure that new trees are planted in locations that will not pose a threat to existing electric lines. Caution must also be exercised when digging holes for replacement trees to ensure that no underground facilities exist in the immediate area. Always contact all serving utilities to ascertain assurance of the location of any underground facilities. Planting smaller growth species or placing new trees away from utility R/W's will allow vegetation and electric lines to coexist.

F. 2) (j) VM Summary

February's ice storm had virtually unprecedented effects on the electric utility systems in Central and Northeastern Kentucky. Some companies had initial outages covering more than 80% of their service areas. Facilities were damaged by the added weight of ice on wires and poles. Ice-laden trees and branches falling on already ice-stressed lines also broke poles. The preceding heavy rain also added to the devastation as saturated soil allowed trees to uproot and fall onto roads and power lines. Prior R/W practices could not have prevented all of these outages. Even if best practices are adhered to and lines are well trimmed, tree damage would have still been substantial to the distribution systems affected by this storm. However, based on field observations, proper R/W clearance in some sections lessened the effect of the storm.

PHOTO 32 shows a single-phase R/W in Greenup County that had been trimmed shortly before the ice storm hit. Despite the adequate trimming job, numerous trees still fell across this line causing an outage. This is very typical of lines that had received proper attention before the storm yet still suffered damage due to the severity of the storm.

The status of each company's R/W and VM plans were put to a supreme test by the ice storm of 2003. Those R/W's that were well maintained with properly managed and consistently trimmed R/W fared better than those that had not received such attention prior to the storm. Nevertheless, even those in good shape before the storm suffered significant damage. In many cases, whole trees plagued R/Ws, falling from outside R/W limits across lines and causing outages. Good R/W practices did lessen the effects of the storm. But it is unrealistic to expect a distribution VM program to completely prevent outages in the event of an ice storm of the magnitude that occurred in February 2003.

PHOTO 32: Normally Adequate R/W Wasn't Enough to Ward Off Devastation Inflicted by this Ice Storm

Utility management should guide a VM program toward the goal of lessening the effects of major storms, which also leads to increasing reliability and consumer satisfaction. The balance of cost-effectiveness, customer expectations, outage mitigation, environmental concerns, etc., continues to present challenges to companies charged with providing safe and reliable service to customers in Kentucky. Aggressive R/W trimming is not always possible due to a variety of factors, including property owner reluctance. Therefore KPSC staff recommends that utilities promote such programs. Long outages, in the wake of this storm's damage, may have convinced many customers to be more willing to have trees trimmed or removed.

It is hoped that the lessons learned during the ice storm will translate to an improved system of trimming and R/W clearance throughout the state. Companies are encouraged to revisit and revise their current VM plans. Implementation of best practices being deployed within the industry is encouraged, if not already being followed. Meanwhile, the KPSC staff will continue to monitor each utility's R/W and VM program. During routine inspections, added emphasis will be placed on the condition of a system's R/W and tree trimming practices. Staffing levels, annual budgets for VM programs, visual inspections, outage record evaluations, etc., will continue to be stressed. The result will not be a perfect solution, but outage times can be reduced and the effects of major storms can be lessened with proper R/W management.

F. 3) Line Maintenance And Inspection

Proper maintenance and inspection of any system is the key to providing long-term reliability. Attaining a dependable, suitably functioning system is worth the investment of time and money. Utility operations are no exception. Without consistent maintenance and inspections, normal aging and wear results in problems. Decreased reliability, safety concerns, and the potential for unnecessary losses of revenue are eventual penalties of poorly maintained facilities.

With knowledge of the potential consequences that result from improper maintenance and inspection of system utilities, the regulations of the Kentucky Public Service Commission have long mandated that regulated utilities inspect their systems. 807 KAR 5:006 Section 25 provides the rules for utilities to follow with respect to inspecting their systems.

Other prominent sources also cite the need for system inspections. The National Electric Safety Code states: *"Lines and equipment shall be inspected at such intervals as experience has shown to be necessary*." The Rural Utility Service (RUS) has long cited the need to provide quality maintenance inspections. A RUS bulletin from 1975 states:

"Effective maintenance requires:

- *A clear commitment that the work will be done, and that includes budgeting of funds and manpower*
- *Assigning qualified people and making their time available for systematic inspections*
- *Finding the time to get the work done*
- *Establishing a continuing record and effective controls so that maintenance needs and work progress will be known at all times"*

Even this 28-year-old document defines some of the modern day problems with inspections. More recent manuals continue to stress the need for inspection programs. The Louisville Gas & Electric (LG&E) manual for inspection programs begins by saying:

"The objectives of the transmission and distribution system inspection program are to: a) Provide early detection of damaged or deficient T & D equipment in order to maintain safe operating conditions, improve system efficiency and reliability, and prevent equipment damage." And *"The inspection of electric transmission and distribution facilities is intended to identify all types of problems or potential problems which could have an adverse effect on safety, customer service, orderly and efficient system maintenance, or a combination of these."*

Combined with proper engineering and design, line inspection and maintenance are crucial to the survivability of an electric system in the event of any catastrophic event similar to the ice storm of 2003.

Distribution lines received the most damage during the 2003 ice storm. While utilities are required to perform maintenance on power plants, transmission lines, substations, etc., those areas were not significantly affected by the ice storm. Therefore, distribution line maintenance will be the main focus of review by this assessment.

F. 3) (a) Distribution Line Inspections

While the need for performing system maintenance and inspections is well known, the methods by which utilities accomplish this task vary somewhat. KPSC regulations mandate that distribution voltage circuits (those < 69kV) shall be inspected at least every two years. Typically a serviceman or crew is assigned an area or a circuit to patrol. Visual inspections are documented and needed repairs logged and assigned. Some minor problems may be repaired during the inspection itself. Most utilities have a checklist or worksheet that is completed in the field.

Specific items checked include poles, wire, hardware, and equipment, each of which will be detailed later. Additional tools and/or methods of inspection include:

- Aerial inspections via airplane or helicopter. These are common methods for transmission line inspections and are sometimes used for distribution lines.
- An increasing number of companies are using contractors to perform part or all of their required field inspections. Methods are comparable to company employee processes; however, contractors are usually dedicated to the inspection task only, working a designated line section at a time.
- Meter readers, whether company or contractor, are also relied upon to examine service lines, meter bases, etc. An observant meter reader can notice problems during his/her daily routine if trained in recognizing potential hazards.
- Four-wheel drive vehicles are often used to access remote lines during the line patrol and pole inspection process.

Utilities must ensure that quality inspections are being done. Periodic field checks by supervisors can help limit "drive-by", or poorly performed inspections. Analysis of outage trends due to mechanical and structural failures also provides managers with a tool to evaluate sections of a line needing increased attention. The targeting of older line sections or circuits is also a common practice in attempting to reduce problems. Sometimes it may be beneficial to bring an inspector from outside a utility's region or district to check an area. Often a different perspective from another part of the company may see things that need attention that others have grown accustom to overlooking.

Proper inspections only assure that items are being found. Companies must take the next step and verify that needed repairs are being done in a timely manner. This involves manpower, equipment and funding from a management level. All too often, maintenance dollars are victims during budget cuts. A utility can increase its liability by finding problems and not repairing them. A combination of proper inspection and timely repair ensures quality maintenance and is one of the ways the KPSC monitors utility performance.

F. 3) (b) Poles

PHOTO 33: Wood Pecker Holes Limit the Strength and Shorten the Life of Wood Poles

An electric company's backbone is its distribution poles. Poles must provide proper ground clearance, enable safe distribution of electricity, and withstand the stresses that weather and hardware place upon them. Decay rates for poles depend on factors such as wood type, age of pole, size of pole, chemical preservative, soil type, and a variety of other factors, including geographical location. Decay can occur from woodpecker holes or insect infestations. **See PHOTO 33**. Exposure to lightning strikes also limits the life and strength of a pole.

Pole inspection methods include visual inspections, sounding, boring, ground line checks, and excavation-based examinations. In addition, linemen are required to check poles before climbing them to insure their safety. Most poles are thoroughly checked by sounding, ground line excavations or boring methods every 8-12 years. This is in addition to the mandated 2-year visual inspection per KPSC regulations. Most utilities utilize contracting companies that do the extensive pole treatments and checks as a part of their system inspection/maintenance plan.

F. 3) (c) Conductors

Inspections for wires/conductors attached to poles are primarily done by visually checking the lines. A well-trained worker can quickly spot a span that is "out of sag" (i.e. not pulled up to the correct tension), or see frayed points. Conductor types are also a concern. Older copper conductor is gradually being phased out and upgraded to aluminum on most systems in Kentucky. Rural and older urban areas still have hundreds of miles of copper in use. Those locations are usually sections that have not had upgrades or new lines installed since original conductors were strung. While companies target sections of these lines each year to upgrade it is not uncommon to find miles of copper conductor still in service.

PHOTO 34: Ice Accumulation on #2ACSR Wire Near Lexington, KY

Most companies began installing aluminum conductor (usually with inner steel strands for strength) in the 1970's and 1980's. Aluminum provides a better conductor for electric current, is cheaper to purchase, and is easier to use than most forms of copper conductor. From a maintenance standpoint, fewer breakdowns are seen when using aluminum conductor on distribution lines. Reliability tends to suffer with copper wires, especially in colder weather. This is due to the fact that copper conductors tend to constrict and snap causing lines to fall during especially cold temperatures. Additionally, some copper conductors are 50-60 years old or older and their functional life is expiring. As a result, copper conductor replacement projects are an ongoing part of maintenance programs throughout the state. However, these jobs are not cost-effective. They usually involve miles and miles of line with few customers. Therefore, these projects often get "back burner" treatment. New construction plans provide a more attractive alternative when resources are distributed. It is important that a company not ignore their copper conductor upgrades. In most cases, those areas served by copper conductor have the higher outage and repair histories.

Ice forms on all types of wires, especially when exposed to moisture prior to temperatures falling below freezing. **See PHOTO 34**. Some design variations, like twisted or stranded wire, supposedly alleviate the potential for ice damage and add strength to the wire but increase the material cost of the line.

F. 3) (d) Hardware And Equipment

Supply catalogs are filled with thousands of different types of hardware and equipment available to companies to enhance their power delivery process. It is an inherent responsibility of the utility to insure the functionality of these items. Financial benefits are gained by maintaining the long-term usefulness of outside plant facilities. This is achieved by performing proper maintenance and inspections.

Pole-mounted electrical equipment generally consists of metal tanks filled with oil. Examples of these devices include transformers, reclosers, capacitors, regulators, switchgear, etc. **See PHOTOS 35 and 36**. Each type of apparatus has its own maintenance schedule and operating criteria. Line reclosers and/or sectionalizing devices are often temporarily removed from service in order to perform maintenance. Other pieces of equipment such as transformers are merely visually inspected on a regular basis.

PHOTO 35: 34.5 x 12.4 kV Transformers

PHOTO 36: Reclosers

Hardware and material generally found on poles include:

- Conductor/wire
- Cross-arms and braces
- Insulators and brackets
- Ground wire
- Bolts, etc.

Such items help maintain the strength and integrity of a pole. Devices like cutouts, fuses, disconnect blades, air break switches, etc. are used to sectionalize lines and limit outages to smaller areas. The majority of these are visually inspected on a routine basis. **See PHOTO 37**.

PHOTO 37: Three-Phase Distribution Pole and Hardware (insulators, cross-arm & braces, insulators & brackets, conductors, bolts, etc.)

F. 3) (e) Past And Present Inspection / Maintenance Trends

A review of updated maintenance and inspection plans in use by the regulated utilities in the state provides a useful tool in gauging the adequacy of a company's overall service and reliability. Combined with evaluations of right-of-way trimming practices and field staffing levels, a relatively accurate conclusion may be drawn with respect to outage frequency, interruption histories and, consequently, customer complaints. Simply stated, those companies with better maintenance and other related programs tend to have better service reliability records. Unfortunately, ice storms, tornadoes and other catastrophic events do not differentiate their damage from system to system. This was certainly the case in the 2003 ice storm.

The destruction spread as February's ice build-up increased. Those utilities with excellent inspection histories fell victim to the storm almost as quickly as those whose systems typically lag behind in maintenance efforts. However, circuits with well-maintained lines tended to have shorter outage durations following the storm.

Additionally, restoration efforts were sometimes enhanced in areas that had been properly maintained and designed. Rural areas with long spans of old copper wire, for example, were often some of the last customers to be restored in many cases. That was partially due to the correct decision on the utilities' part to repair sections that would reestablish service to a higher number of customers first. Repairing lines is very time-consuming at best following a storm, especially one of a magnitude that occurred in February.

A particular example of a problem associated with the repair work done immediately following the storm was pole settling. New poles that were set in loose or damp soil would later settle or pull over. As the tension of new or repaired lines gradually pull poles inward the lines often sag, thus sometimes causing unnecessary repeat outages. Clearance problems may also exist in areas where similar repairs were undertaken. Diligent line inspections on these circuits were stressed in the months after restorations were completed. These and other post-repair jobs can only be identified by prudent line inspections. While system checks should always be an important part of a utility's routine, a concentrated effort in ice storm areas is especially critical in the months following such an event.

The direct correlation between maintenance/inspection processes and the effects of major storms on a distribution system are difficult to determine. It could be asked, "*Was the storm so bad that damage was widespread and severe?*" or "*Was the system in such poor shape that the storm damaged more than it should have?*" Utilities tend to trumpet the former, while customers often cite the latter when complaining about outage times. In the case of the 2003 ice storm, the storm's devastation was nearly unparalleled in the regions it affected.

F. 4) <u>Recommendations From The 1994 Ice Storm</u>

In 1994 the KPSC performed a similar evaluation of the state's utilities and their responses to a series of ice/winter storms that occurred from January 1994 – March 1994. **See APPENDIX M**. Several of the recommendations listed in that report remain applicable to the assessment of the 2003 ice storm. The 1994 report noted that improvements could be made in several aspects of storm preparedness and restoration.

KPSC staff reviewed the 1994 report and finds, for the most part, that the recommendations and suggested improvements have been acted upon by the utilities. Following is a non-inclusive list of some suggestions/recommendations from the 1994 report that were acted upon:

- Aged conductor replacement
- Aged pole replacement program
- Increased use of tie-lines
- Decrease in span lengths
- Mutual-Aid agreement
- Procured outage software
- Increased attention to R/W
- More sectionalizing
- Review line relocation procedure
- EOP under review
- Procured storm work equipment
- Review of underground policies

It should be noted that most of these recommendations are long term in nature. Review and discussion of these and other related items are conducted via system work-plan reviews and routine system inspections. Continued review and follow-up to ensure implementation must be ongoing by the KPSC.

F. 5) Preventive Measures Summary

Companies may avoid maintenance costs by eliminating or reducing some programs. Significant effects of such cutbacks may not be evident for years. However, such practices are often clearly revealed during times of increased stress on distribution systems (i.e. severe storms, ice, severe heat and cold, etc.). It is during those events that customers tend to have the least patience with long-term outages. By limiting maintenance and inspection programs, the challenge of providing the electric company's basic function of keeping the lights on becomes unnecessarily more difficult.

Because of the extent of the damage, it is difficult to identify specific instances of inspection processes and maintenance programs directly affecting system vulnerability to February's ice storm. However, it is unquestionable that those systems with histories of proper preventive maintenance and inspection programs fared better than those without such records. Still, the effects of the storm were such that all systems in the storm's path suffered severe losses and damage. No inspection or maintenance program could have totally eliminated outages during such a storm.

The lessons learned from this event should certainly include a utility's evaluation of its current programs. Some items that were particularly susceptible to damage included the older copper lines, longer spans of wire, aging poles and hardware, inaccessible line sections, etc. These are issues that can and should be addressed during the routine inspection process. Future maintenance programs should target similar portions of the system. Emphasis should be placed on solutions and timely repairs, not merely identifying the problems without corrective action.

Additionally, diligence on the utilities' part to perform post-storm follow-up repairs is crucial to the continued integrity of the distributions systems affected by storm damage. Processes to attempt to detect and identify open neutral situations should be pursued. Local inspectors and government agencies should be included in ongoing reviews of how companies restore power to customers.

The KPSC is charged with overseeing the regulated utilities within the state of Kentucky. Monitoring a company's maintenance practices has always been an important part of the KPSC's job as evidenced by KAR 5:006 Section 25. To this end the inspection plans, maintenance programs and outage restoration processes will continue to be addressed during routine KPSC field inspections and other staff evaluations.

G. COMMUNICATIONS

Effective public communications are essential in any natural disaster to insuring public safety, developing understanding of relief efforts and building confidence in the ability of government and private institutions to deal with the situation. Communication efforts must be coordinated to insure that needed information is provided in a timely manner and with a consistent message.

G. 1) Public / Customer Communication

For the most part, the utilities affected by the February 2003 ice storm communicated effectively with their affected customers. This was particularly true in Fayette County, where the utilities had the advantage of multiple electronic media outlets vying for listeners and viewers by providing the most current information. The utilities were able to use this media interest to their advantage in communicating with the public. However, there were difficulties with respect to communication with local government officials in the portions of the KU service territory outside Fayette County. Some local officials were unable to contact KU management for 24 to 72 hours after the storm. Thus, the officials were unable to convey concerns to the company or obtain information about the progress of restoration efforts. Less information is available about the effectiveness of communication efforts by the electric cooperatives serving rural areas.

Several aspects of the communication effort are worth noting:

- In Fayette County, utility officials participated with government officials in regular joint media briefings. These briefings, which were held at least twice a day through February 27, proved to be valuable both in providing information and in identifying issues that required additional attention.
- Utility officials were careful to provide realistic assessments of when service would be restored. While this may not have been what frustrated customers wanted to hear, it forestalled the creation of unrealistic expectations.
- For years, Kentucky's electric utilities have emphasized safety precautions that should be taken around downed power lines. The message, which was emphasized from the outset during the ice storm, clearly has taken hold in the public consciousness, as evidenced by the absence of any injuries caused by downed lines.
- KU employees distributed pamphlets about the repair of service connections and the proper use of electric generators. Not only was this an effective way to disseminate important information, but also it appeared to carry a fringe benefit in the realm of customer relations.
- Utilities serving largely rural areas compiled restoration data into news releases that were faxed several times a day to all media outlets in the service territory. For example, American Electric Power's Kentucky Power unit issued three news releases a day, while the Bluegrass and Grayson RECC's issued two news releases a day and supplemented these with daily status reports on local radio and television stations. These efforts proved to be effective means of providing regular information to widely dispersed media outlets.

Several areas of concern also emerged. They are described below:

- There was a delay by Kentucky Utilities in communicating certain issues regarding repair of property connections, specifically the fact that property owners are responsible for repairs to meter bases and mastheads. It was learned that customers generally do not understand where the utility's responsibility ends and theirs begins. **See FIGURE 10**. For example, some customers were awaiting service restoration only to find out that they needed to contact a contractor to repair the service (masthead) and/or meter to their house before restoration could be completed. Likewise, it is extremely important for customers calling in outages to let the utility know if damage has occurred to the service entering their home.

  KPSC staff believes that this issue should be a point of emphasis in initial communication efforts in future events that damage significant numbers of property connections. Communicating customer service connection damage enables the utility to take some extra precautions upon restoring service to assure everyone's safety. Improving customer education about their responsibility will help utilities restore power safely and decrease customer frustration.

- Confusion over approval of completed repairs on the non-utility side of property connections created potentially dangerous situations in Fayette County. Inconsistent and changing information from local government in the first 24-48 hours created confusion over the need for inspection of repairs prior to restoration of electricity.

  Utilities and local government should address this issue in disaster-response planning and communicate clearly to the public the requirement that repairs must be inspected prior to power being reconnected.

- A major point of public frustration in Central Kentucky was the difficulty in obtaining information about the progress of restoration in specific areas. There was no means available of conveying real-time information about restoration efforts. As a consequence, there was considerable misinformation about alleged understaffing of restoration efforts, etc.

  Utilities should consider establishing "Restoration Information" Web sites that could convey the following information:

    - A system map showing the circuits in each service area. For security reasons, only the geographic area of each circuit, not the power lines themselves, should be indicated.
    - The status of each circuit could be indicated by color – green for fully operation, yellow for partly operation, red for out of service. Expected dates/times of full restoration could be indicated for each circuit.
    - The number of crews working on restoration efforts. This could be benchmarked against previous events.

- Restoration statistics, such as poles and transformers replaced, miles of cable restrung, etc.

- KPSC staff encourages companies to monitor local media and respond as quickly as possible to misinformation. KU did so to a considerable extent, but it proved impossible to cover every media outlet. In the initial stages of a disaster, it may be worthwhile to make company officials available to as many as possible of the media outlets conducting call-in shows in order to insure that correct information reaches the public. Because this likely would overwhelm the regular media relation's staff, it may be worthwhile to provide media training to a number of other personnel who could fulfill this function in case of emergency.

- In the first 24-48 hours, residents of outlying areas, particularly those served by Kentucky Utilities, felt that their problems were not being addressed while KU focused on restoring service in Fayette County. This feeling of isolation was exacerbated by the news media focus on events in the urban area. There was little attention in either the Lexington print or electronic media on events in outlying counties.

  It was inevitable that the regional news media, centered as it is in Lexington, devoted most of its attention to events in Fayette County. Utility spokespeople can counter this urban-centered coverage by making a point of drawing attention to outages and restoration efforts in other areas, thereby at least giving a measure of acknowledgement to customers who might otherwise feel their needs are being ignored.

- News media showed limited understanding of how utilities respond to major natural disasters. Briefings and facility tours for members of the media could familiarize them with disaster response. This could be an event linked to the onset either of winter or the spring severe storm season. Topics covered could be mutual aid agreements, pre-positioning of material, disaster plans and safety issues.

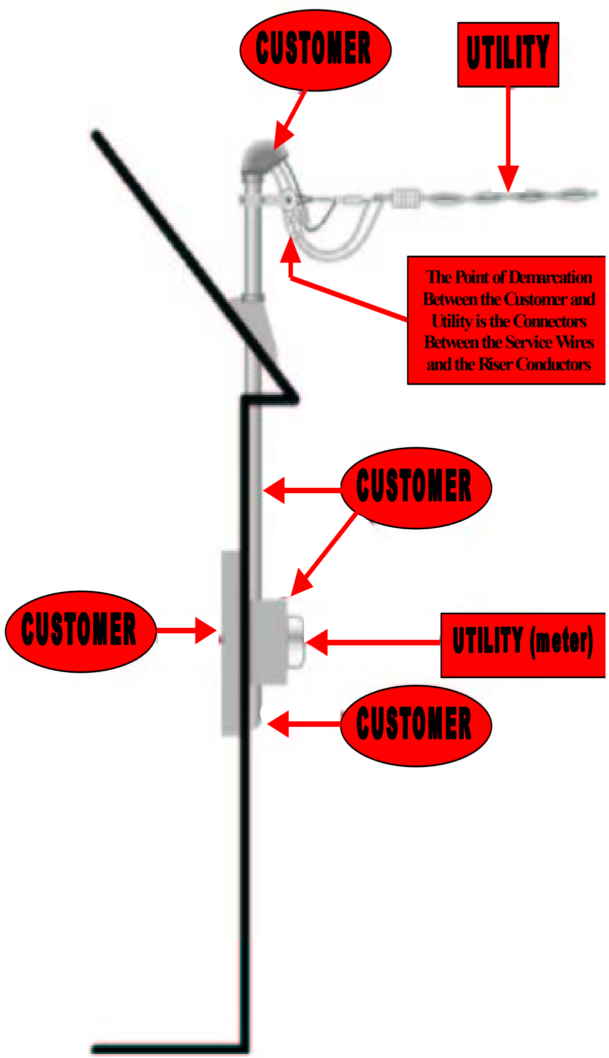
- Safety problems arose after the storm was over and power had been fully restored. The most serious problem – which led to several fatalities – was tree trimming or removal by untrained personnel or property owners themselves.

  The KPSC staff urges utilities to make safety during extended storm cleanup a public information point of emphasis for an extended period, perhaps on an ongoing basis. Guidance should be provided on selecting qualified tree care contractors (this could be as simple as not hiring anyone who shows up with an aluminum ladder), on precautions to take while working around power lines and on utility tree trimming policies.

- Communication with Spanish-speaking customers was problematic. With the proliferation of Spanish-language print and electronic media outlets in central Kentucky, KU/LG&E should consider adding a Spanish speaker to its communication staff.

- Finally, the Kentucky Public Service Commission's role in post-disaster response merits some examination. In the first 24-36 hours, while KPSC engineering and other staff was actively involved in providing assistance and guidance to affected utilities, the KPSC's role in communications was generally reactive, consisting principally of responding to media inquiries. When the KPSC took a more pro-active role, appearing at media briefings and on call-in radio shows, the agency's presence was effective in bring a credible, third party voice to the discussion and in helping to correct misinformation.

  In major disasters affecting utilities, the KPSC, working in close cooperation with the affected utilities, should quickly take an active role in informing the public about safety issues, restoration efforts and other areas within its purview. KPSC staff should be available as needed to reinforce and supplement communication efforts by utilities. The KPSC also should make a spokesperson available as needed at media briefings in the affected area.



<u>FIGURE 10</u>: This sketch depicts a typical home or building electrical entrance indicating the ownership and responsible parties for various portions of the electrical service, meter and base. Misunderstanding in regard to the repair process and procedures led to timely and expensive undertakings by many homeowners. The customer equipment, wiring and installation must meet the National Electrical Code ("NEC") while the electric and telephone utility equipment, wiring and installation must meet the National Electrical Safety Code ("NESC").

G. 2) Public Official Communication

The ice storm of 2003 affected many local governments across Kentucky. Many counties and cities received numerous phone calls about problems with their utility services. The KPSC felt that it was important for the elected officials in areas affected by the storm to share their insights on what utilities across the state did well, as well as what improvements would have helped their local residents. The Commission sent a letter to the Mayors, County Judge Executives, and Emergency Area Managers in the affected areas.

The local elected officials who responded to the letter were generally pleased with the efforts put forth by all the utility companies. Most stated that the crews endured extreme and dangerous weather conditions to get services back to the residents of the community. All the elected officials expressed their understanding that the conditions the utilities faced were unique and difficult, and that they felt that the companies did the best job they could.

Many of the smaller counties and communities stated that the initial utility response to their communities was slow, due to the utilities concentrating efforts in areas with greater population. They expressed a need for greater communication between the utility executives in charge of recovery efforts and local officials so that timely information could be provided to the residents of their communities. Many suggestions for improvements were made to assist the residents in local communities.

All the elected officials commended the effort of the companies, even calling the crews' efforts "***heroic***". They knew the situation that the utilities were facing and respected the efforts put forth in restoring services. <u>The one area that all the local leaders agree needs improvement is in communication. They stressed the importance of keeping them informed on the progress of restoration efforts.</u> When the initial outages occurred, elected officials were receiving calls from local residents, but had no basic information to pass on. Local officials suggested that utilities assign high priority to communication efforts in each portion of the affected service territory. Local radio stations became critical for citizens when they are without other services, and it should be a high priority to convey the latest information to those stations.. This will go a long way in making sure that local residents are getting current information. Some public officials suggested more aggressive tree trimming to ensure clear power lines before the next storm.

Public officials understood the extent of the devastation that occurred and the challenges the companies faced. Judge Executive Steven Applegate of Lewis County commended the utilities in his area saying, "*The employees of the utility companies suffered long hours, cold weather, and not much appreciation for what they had accomplished*." Judge Executive Gormley of Woodford County commented, "*Communication is the linchpin to success in every endeavor*." Improving the communication between elected officials and prioritizing mass media outlets in the restoration efforts will better serve those residents without critical services. Elected officials understood the tremendous pressure the utilities were under and were pleased with the speed with which the utilities worked to restore service in their respective communities.

PHOTO 38: Inside the Metro Fayette County EOC

After reviewing comments from elected officials, utilities, and the Division of Emergency Management, KPSC Staff encourages interested parties to consider discussing ways to improve communication priorities and channels. Ensuring that elected officials and local communities fully understand the situation and have current estimates when critical services will be restored is very important. Increased education for elected officials to improve their knowledge of utilities' policies and procedures for emergency situations is also important. The Commission believes the following suggestions would better prepare all parties for the next emergency situation.

- Provide collaborative training between the Commission, Division of Emergency Management, and local community leaders.
- Have the utilities establish a designated contact person for community leaders.
- Create a team of all necessary participants to create the best mechanisms for keeping the public informed.

G. 3) DEM / KPSC Communications

The Kentucky Division of Emergency Management ("DEM") is responsible for coordinating the state and local response to emergencies, such as severe winter storms, within the Commonwealth. When a storm or other situation escalates to a certain level the DEM activates its Emergency Operations Center ("EOC") in Frankfort. Upon activation of the EOC, DEM calls in representatives from other state agencies to assist with the management of the emergency response. The KPSC staff serves as a liaison between the electric, telephone, a natural gas providers and DEM when called upon to staff the EOC.

On Sunday, February 16 DEM notified KPSC staff that that they had activated the EOC due to the ice storm. They informed staff that the storm had caused significant electric system outages in Central Kentucky and requested that KPSC staff gather information from the affected utilities and report it to the EOC on a regular interval. Staff contacted the electric and telephone utilities by telephone and obtained an initial report of the number of customers that were without service, expected restoration time (if known), the type of problems that they were experiencing (i.e. broken poles, downed wires, transmission versus distribution facilities) and forwarded this information to the EOC. Monday, February 17 KPSC sent staff to the EOC and began gathering information and reporting it at briefings held twice daily at 9:00AM and 4:00 PM. KPSC staff continued this task and were on-call throughout the restoration effort.

The Kentucky Association of Electric Co-operatives ("KAEC") began sending updates directly to the EOC on Sunday. KAEC had developed a spreadsheet form to make uniform reports for each of their member utilities. KPSC staff modified this form to accommodate all the utilities that were reporting outages and distributed it via e-mail.

This e-mail form was very beneficial in making the reports uniform and saved the utilities time in reporting to the EOC. The utilities were able to update the form twice daily and e-mail it to the KPSC staff, saving time-consuming phone calls. This allowed them to remain focused directly on their restoration efforts.

The utilities were instructed to provide updated forms to the KPSC staff at 7:30 each morning and 3:30 each afternoon. The reporting times were coordinated with press conferences the Lexington-Fayette Urban County Government held each day. Collecting the information in this way made the information coming from government sources more consistent.

KPSC staff used these updated forms to provide timely statewide reports for the EOC briefings. The utility reports provide necessary information to the EOC and the Governor. The reports are used to make decisions concerning formal declaration of emergency, opening emergency shelters, delivering potable water and other health and safety related actions as well as to keep the media and public informed. KPSC staff provided the utility report updates twice daily at the EOC briefings.

PHOTO 39: Dunbar High School Shelter

G. 3) (a) Local and Regional Emergency Response Coordinators

DEM also has local and regional officers that coordinate the physical resources and the needs at the local level. These emergency response coordinators are familiar with the response plans for the counties for which they have responsibility and know which state and county resources are available. They are the point of contact for requests for assistance for manpower or equipment. Utilities should familiarize themselves with the emergency coordinators in their service territory prior to an emergency situation so that they can communicate efficiently with them during an emergency.

KPSC staff queried the utilities about any special equipment they needed to aid their restoration efforts. Specialized truck pulling equipment was obtained for Fleming-Mason Electric Co-op through DEM to pull their bucket and digger trucks along the R/W through the ice and mud. If a utility does request assistance through DEM, they should ask what reimbursements are expected, if any, for the assistance.

The Communications from the utilities through the KPSC to the EOC were efficient particularly after the email reporting method was established. It is recommended that the KPSC staff review the update forms annually and the contact lists to ensure their accuracy.
Utility management should contact and discuss their EOP or other emergency plans with the local or regional DEM officers in each county that they provide service.

H. ASSESSMENT CONCLUSIONS, FINDINGS AND RECOMMENDATIONS

The KPSC staff concludes that the utilities were adequately prepared for the February 2003 ice storm, given its extreme severity, and that the utilities' restoration efforts were diligent, effective, and well managed on the whole. The utilities' performance, though not flawless, was commendable. The utilities have made changes in their outage prevention and restoration programs, which the Commission staff endorses. Additional changes recommended by the Commission staff that should improve these practices are detailed on the following pages.

Finally, the assessment concludes that the utilities' line workers and field personnel deserve special recognition for their part in the restoration effort. These men and women spent long hours performing dangerous tasks under difficult conditions in order to restore power to hundreds of thousands of Kentuckians. They can be proud of their achievements and assured of the public's gratitude.

H. 1) KEY FINDINGS

The assessment by the Commission staff resulted in the following key findings:

1. The severity of the ice storm, as measured by the number of customer outages and damage to distribution facilities, was unprecedented on a statewide basis.

2. Trees or limbs falling onto distribution lines caused the majority of outages during the ice storm. There is a direct correlation between the proximity of trees to utility lines and the integrity of the lines. Adequate right-of-way maintenance and tree trimming are essential in order to minimize the number and severity of outages due to storms. However, even more aggressive trimming would have had little effect in lessening the devastation of this major storm.

3. The cost of the restoration estimated by the utilities was approximately \$22.5 million for KU and approximately \$24.7 million for the other utilities combined. The majority of the electric cooperatives expenses are eligible for Federal Emergency Management Administration ("FEMA") reimbursement.

4. A major point of frustration among some local officials was the difficulty in obtaining information about the progress of restoration in specific areas. There were no means available of conveying real-time information about restoration efforts. Utility internet sites were of limited use to customers and news media reports during the restoration process, but potential exists for this medium. Communication problems with local officials were particularly evident in portions of the KU service territory outside Fayette County. Some local officials reported difficulty in reaching KU management during the first 24 to 36 hours of the storm event.

5. The regional utility equipment and supply providers seemingly did an excellent job obtaining and delivering all needed supplies (poles, wire, transformers & hardware).

6. KPSC staff had difficulty at times making contact with utility management in a timely manner.

7. The utilities have appropriate procedures in place for making advance plans for severe weather events and obtaining restoration assistance from other utilities (i.e. Mutual-Aid Agreements). Their plans were disrupted to some extent in this case because the storm unexpectedly increased in intensity and breadth as it moved through the state. Also, most neighboring utilities were hesitant to release their force and contract crews until they were certain that the ice would not be damaging to their own system.

8. Some of the affected utilities had not reviewed and updated their Emergency Operation Plan ("EOP") recently.

9. Some of the affected utilities did not have access to information concerning available contractors and equipment rental services.

10. The utilities' efforts to deal with the high volume of telephone calls they received were commendable, but additional resources should be allocated to this purpose by the utilities in general.

11. As a result of the ice storm, a need for improved communications with Spanish-speaking customers was identified.

12. Assertions have been made that improvement in the design, inspection and maintenance of the utilities' electric distribution systems would make them less vulnerable to major storms. While there may be isolated areas that need improvement, the assessment did not indicate that significant outages during the ice storm were attributable to the design or age of the distribution systems or to pre-existing conditions on the systems. Similarly, areas of underground utilities were not locally affected but possibly experienced outages due to damage of overhead facilities that provided incoming power or phone service. The conversion from overhead to underground utilities, while being a possible tool to reduce future storm damages, is very difficult to economically and operationally justify except in specific instances. This subject is much too complex to be included in this assessment to any greater extent.

13. Increasing the use of alternate feeds, as proposed by some customers, would not be of significant benefit in reducing outages during storms of this magnitude. Similarly, greater use of distributed generation would be of limited benefit in reducing weather-related outages.

14. Assertions have been made that some of the utilities assigned fewer restoration workers to certain areas than to other parts of their service territory that incurred similar damage from the ice storm. The assessment indicates that the ice buildup in some areas peaked later than in other areas and was greater than anticipated.

15. This assessment found no discrimination among geographical areas by any of the utilities in their storm restoration efforts. There were fewer restoration workers per outage in some parts of the utilities' systems during the first day of storm restoration due to several factors, including the fact that the ice storm began on one side of the area and passed across the utilities territory. Consequently, the first available off-system resources were deployed in population centers where initial damages were defined. The utility assessment teams must ensure that all population centers are included in the initial assessment. KU initially focused nearly all of its resources in Fayette County delaying restoration of power in the communities of Anderson and Woodford counties. The restoration efforts were also controlled by the limited access due to road closings and travel restrictions.

16. The utilities' restoration priorities of addressing safety-related situations, emergency services, and critical infrastructure needs, and then to restore service to the largest numbers of customers in the shortest period of time were deemed appropriate by KPSC staff.

17. Predicting restoration times for customers is a very difficult and unreliable process. Customers tend to be very frustrated when they find themselves still without power at the predicted restoration time. Their anxiety can be alleviated somewhat by the utilities' ability to provide accurate status updates of the existing outages to the extent practical and to educational preparedness/training of the customer prior to such conditions.

18. At the time their power lines were damaged by the storm, or at the time their power was restored, a small percentage of customers suffered property damage because of open neutral conditions or other related service abnormalities. Prudent inspections prior to re-energizing lines, good communications with local electrical inspectors and public awareness can reduce or prevent such instances in the future.

19. Kentucky's electric utilities have emphasized safety precautions that should be taken around downed power lines. The message, which was emphasized from the outset during the ice storm, clearly has taken hold in the public consciousness, as evidenced by the absence of any injuries caused by downed lines.

20. There was some delay by utilities in communicating the fact that property owners are responsible for repairs to property connections. It was learned that customers generally do not understand where the utility's responsibility ends and theirs begins.

21. Tree trimming or removal of trees near power lines by property owners themselves or their contractors resulted in two fatalities shortly after the restoration was completed.

22. The utilities' line workers and field personnel deserve special recognition for their extraordinary work during the restoration effort. The safety record of all line workers, tree crews, and other personnel is to be commended. Despite the long duration of the ice storm restoration process, and work being conducted in very hazardous conditions, there were <u>no serious injuries</u> or accidents reported to the KPSC.

Commission staff congratulates the utilities in their attention to safety during the restoration process.

H. 2) RECOMMENDATIONS

The Commission staff makes the following recommendations based upon their findings and experience that should improve the utilities' prevention and restoration practices. In addition, the utilities have identified lessons learned from the storm and are implementing changes as well. The Commission staff has reviewed these changes and endorses them.

1. In planning for future storms utilities should make every effort to ensure that an adequate number, based on the individual utilities' need, of telephone lines are available to customers for incoming calls to the call centers, as well as having sufficient queue size for efficient management of the call volume imposed by major storms. The number of customers is steadily increasing; thus, the utilities cannot appropriately assume that the February 2003 Ice Storm is the worst storm they will ever face. Telephone systems and call center personnel adequate to meet the requirements of the February 2003 Ice Storm may not be sufficient for future planning purposes.

2. The addition of Spanish-speaking employees to customer service and public communication staffs should be considered.

3. The utilities should give additional attention to right-of-way maintenance and system inspections to maintain and improve system reliability. Consideration should be given to the clearing of rights-of-way versus merely trimming. A proper balance must be attained between aesthetic benefits to the community and the risk of substantial societal costs associated with the types of major storms to which Kentucky is vulnerable. All utilities should carefully examine their tree-trimming practices and their interpretation, as well as enforcement of those practices to determine whether improvements can be made to minimize the risk of damage to utility distribution systems during storms.

4. A below-ground-line pole inspection and treatment program should be ongoing at the industry recommended interval.

5. A program to replace all excessively aged and/or damaged conductors is highly recommended.

6. It is noted that the use and installation of "bundled conductor" for primary feeders has been on the increase for several years. KPSC staff recommends that the engineering design criteria for this construction be reviewed to ascertain that adequate safety/overload factors are being used in light of the increased ice loading that Kentucky has experienced in recent years. The increased ice loading subjects the mounting bracket on each pole to extreme stress. Failure of a single bracket can initiate a cascading mechanical failure of adjoining structures such as the one occurring near Fayette Mall in Lexington during the 2003 ice storm.

7. A high degree of emphasis should be placed on R/W clearing and inspection / maintenance for three-phase feeder circuits. In general, if these circuits remain intact and energized the remainder of the distribution system can be repaired/re-energized much sooner.

8. The utilities should develop, continually maintain, update and review their Emergency Operations Plans (EOP).

9. The utilities should continue their policy of providing increased assistance to customers with medical needs. As storms approach, the Utilities should contact medical alert customers, or their caretakers, at the earliest time the impact and extent of a major storm becomes known to the utilities and encourage them to make alternative shelter arrangements. The utilities should continue to evaluate each storm, seek customer feedback, and determine the most effective means of contacting medical alert customers.

10. The Commission staff recommends that the utilities ensure that elected officials in all areas of their service territory have a means of access to information regarding storm restoration progress.

11. A storm preparedness position or contact employee should be established at each utility. This person should be responsible and accountable for establishing, reviewing and maintaining the utilities disaster preparedness and restoration procedures. <u>This person should also make regular contact with the Kentucky Emergency Management offices in their territory.</u> They could also serve collectively with their peers on a statewide disaster planning/restoration task force.

12. The utilities should make an effort to detect and eliminate improper or damaged neutral and/or grounding connections during the power restoration process. In particular, utilities should inspect their distribution tap lines for connections that may have the neutral disconnected from the utility's main line neutral (this is known as an "open neutral" condition) or other similar circumstances. Prudent inspections prior to re-energizing lines, good communications with local electrical inspectors, and public awareness can reduce the number of incidents resulting from damaged customer service lines.

13. An inspection and all necessary follow-up work should be conducted for aerial crossings of limited access highways. It should be ascertained that all such crossings are in accordance with the National Electrical Safety Code (NESC) requirements that they be constructed to meet Grade B standards.

14. Each utility should at least have a limited working relationship with two or more construction contractors providing services in the state. This allows for much quicker and smoother emergency assistance when needed. It would also be beneficial to have a working agreement or Storm Work contract in place with all details such as billing, crew size, safety rules, etc. agreed upon in advanced.

15. Information about the customer's responsibility for repairs to property connections, and proper inspection of those repairs, should be a point of emphasis in initial communication efforts in future events that damage significant numbers of property connections. Improving customer education about their responsibility will help utilities restore power safely and decrease customer frustration.

16. Utilities should consider establishing "Restoration Information" Web sites that could convey the information about the status of restoration efforts in specific areas.

17. Safety during extended storm cleanup should be a public information point of emphasis.

18. Utilities should monitor local media and respond as quickly as possible to misinformation. In the initial stages of a disaster, it may be worthwhile to make company officials available to as many as possible of the media outlets conducting call-in shows in order to insure that correct information reaches the public. Because this likely would overwhelm the regular media relation's staff, it may be worthwhile to provide media training to a number of other personnel who could fulfill this function in case of emergency.

19. Utilities should consider conducting briefings and facility tours for members of the media in order to familiarize them with disaster response. This could be an event linked to the onset either of winter or the spring severe storm season. Topics covered could be mutual aid agreements, pre-positioning of material, disaster plans and safety issues.

20. In major disasters affecting utilities, the KPSC, working in close cooperation with the affected utilities, should quickly take an active role in informing the public about safety issues, restoration efforts and other areas within its purview. KPSC staff should be available as needed to reinforce and supplement communication efforts by utilities. The KPSC also should make a spokesperson available as needed at media briefings in the affected area.

21. The communications from the utilities through the KPSC to the Kentucky Emergency Operations Center in Frankfort were efficient particularly after an email reporting method was established. It is recommended that the KPSC staff review the update forms annually and the contact lists to ensure their accuracy.

22. Commission Staff should amend its periodic utility inspection program to include ascertaining that the utilities' Emergency Operations Plans have been adequately reviewed.