Ike

and

Ice

The Kentucky Public Service Commission
Report on the
September 2008 Wind Storm and the
January 2009 Ice Storm

November 19, 2009

This report is dedicated
to the memory of

the four people who died in Kentucky
as a result of the 2008 wind storm

and

the 36 people who died in Kentucky
as a result of the 2009 ice storm

and especially

to

Stephen Allen McMath,
who died while working to restore power
in Louisville following the wind storm

and

Andy Reichwein
who died while working to restore power
in western Kentucky following the ice storm

ACKNOWLEDGEMENTS

The Kentucky Public Service Commission wishes to thank the following:

The employees of the affected utilities, who worked tirelessly to restore service to their customers.

The utility workers from outside the state who left their homes and families for days or weeks to assist in the restoration effort.

The thousands of volunteers who assisted in our state's recovery from the two disasters that are the subject of this report, including the ham radio operators who provided a vital service during the ice storm.

The public safety and other government workers, including members of the Kentucky National Guard, who were at the center of the disaster response.

The utilities that provided forthright and detailed responses to the data requests issued in the preparation of this report.

All others, especially consumers, local officials and legislators, the Kentucky Association of Electric Cooperatives, the Tennessee Valley Authority, the Kentucky Municipal Utilities Association, the Kentucky Industrial Utility Customers, Inc., the National Weather Service and the Kentucky Department of Parks, who took the time to provide information for this report.

The members of the Kentucky Public Service Commission staff, both those who spent many hours working on this report and those who supported them by ensuring that this Commission's other work continued uninterrupted.

COVER PHOTOS: top—Kentucky Public Service Commission
bottom—courtesy of Kenergy Corp.

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EXECUTIVE SUMMARY

Immediately after the September 2008 wind storm caused by the remnants of Hurricane Ike, the Kentucky Public Service Commission (PSC) initiated a review of utility performance. The topics addressed included disaster preparedness, power restoration, customer relations, public information and others. Requests for information were sent to affected utilities and local officials in October. Responses were received in November and December.

By early January 2009, PSC staff had begun reviewing the responses and formulating needed follow-up information requests. That work was suspended with the arrival of a catastrophic ice storm on January 26, pending a decision on whether to combine the review of the two events.

In late February, the PSC determined that the wind storm and ice storm should be examined together, with the review of electric utilities expanded to cover several additional topics. These included a comprehensive look at the feasibility and advisability of burying many or all above-ground electric lines, possible approaches to system hardening, revisions to construction standards, vegetation management and cost recovery. Also added were an examination of outage reporting procedures, including the PSC's reporting system, and a consideration of individual customer disaster preparedness.

Because of substantial telecommunication outages and a number of water or wastewater system outages during the ice storm, the scope of the review also was expanded to include these utility sectors.

Initial data requests to utilities were issued in late March, with responses due April 30. The information requests were far lengthier than those issued after the wind storm. The most extensive data request - 217 questions, many with multiple parts – went to electric utilities. Telecommunication and water or wastewater utilities received briefer, but detailed, data requests. Requests for information also were sent to state legislators and local officials in affected communities. Follow-up data requests were issued in June and July as needed.

Additional information was obtained from the Kentucky Association of Electric Cooperatives, the Tennessee Valley Authority, the Kentucky Municipal Utilities Association, the Kentucky Industrial Utility Customers Inc., the National Weather Service and the Kentucky Department of Parks and other state agencies. This report also draws from consumer complaints and comments made to the PSC, from the responses to an online survey on the PSC Web site and from news accounts.

The report is organized into sections dealing with issues unique to electric, telecommunication and water or wastewater utilities. Customer service, public information and individual citizen preparedness are addressed in separate chapters.

This executive summary presents the key findings and recommendations contained in the report. It is organized into findings and recommendations requiring responses from all utilities, those requiring responses from designated utilities, those pertaining to the PSC, those recommending action by other government entities and those directed at the general public. Each finding and recommendation is cross-referenced by page number to the report itself.

ALL UTILITIES –
FINDINGS AND RECOMMENDATIONS REQUIRING A RESPONSE

A1. PARTICIPATION IN DISASTER PREPAREDNESS DRILLS *(47)*

Finding: A number of utilities indicated that prior participation in local, regional or state emergency preparedness drills was valuable to them as they responded to the 2008 wind storm and 2009 ice storm. The ability to immediately identify key emergency management personnel with whom utilities must coordinate in weather emergencies and other disasters can and does help utilities obtain needed assistance in road clearing, traffic management, vehicle and equipment acquisition, communications coordination, manpower acquisition, and all other areas of assistance that the Kentucky Division of Emergency Management (DEM) and its associated local and state organizations can provide. The Commission is certain that such efforts will enable utilities to restore power in future disaster situations in a much quicker and, ultimately, safer manner, eliminating delays and complications caused by a lack of preparedness.

Recommendation: The Commission strongly recommends that all jurisdictional utilities avail themselves of opportunities to participate in emergency planning exercises. The Commission also encourages organizers of such exercises to solicit utility participation.

A2. EXCHANGE OF CONTACT INFORMATION WITH LOCAL EMERGENCY MANAGEMENT OFFICIALS *(42) (54)*

Finding: Communications between utilities and local governments were on occasion impeded by lack of current contact information.

Recommendation: Utilities should exchange and update emergency contact information on at least an annual basis in order to maintain adequate lines of communication.

A3. SATELLITE-BASED TELECOMMUNICATIONS *(58)*

Finding: Widespread landline and wireless telecommunication outages made it difficult for some utilities to provide information to emergency managers and to request assistance.

Recommendation: Utilities should arrange to have access to satellite telecommunications during emergencies.

A4. PARTICIPATION IN KENTUCKY 811 PROGRAM *(116)*

Finding: Any increase in buried utility facilities is likely to be accompanied by a concomitant increase in damage from excavation activities.

Recommendation: All owners of underground facilities should be members of Kentucky 811, the state underground utility location service.

A5. RECOVERY OF UNREIMBURSED STORM EXPENSES *(126)*

Finding: A number of utilities have unreimbursed storm expenses that have not been submitted to the Commission for accounting deferral and possible consideration for recovery in a future rate case.

Recommendation: Any utility wishing to recover unreimbursed storm restoration expenses should request Commission authorization to defer such expenses as soon as practical.

ELECTRIC UTILITIES -
FINDINGS AND RECOMMENDATIONS REQUIRING A RESPONSE

B1. UPGRADING TO HEAVY LOADING STANDARD *(83)*

Finding: Most utility facilities constructed to both the medium and heavy standards found in the National Electric Safety Code simply could not withstand the physical stresses placed upon them by both the weather conditions and the attendant loadings from falling trees and limbs. However, construction to heavy loading standards, rather than the medium loading standard required in Kentucky, appears to have improved system durability in some instances.

Recommendation: Jurisdictional utilities should consider upgrading to heavy loading standards in some circumstances. For example, it may be beneficial to shorten span lengths when building lines in treed areas, thus improving the ability of those lines to sustain the weight of fallen vegetation.

B2. SYSTEM HARDENING *(83)*

Finding: Many utilities currently evaluate the appropriateness of system hardening practices for particular areas or circuits that suffer repeated weather-related outages. These practices include a variety of measures such as placing selected lines underground or decreasing distances between poles that are intended to reduce vulnerability to storm damage.

Recommendation: All utilities should use their routine system evaluations as an opportunity to evaluate the need for and potential effectiveness of system hardening, and to implement those system hardening practices where indicated. Utilities should track outage data for those portions of their systems that have undergone system hardening in order to determine the overall effectiveness of system hardening practices in preventing outages on those circuits. All jurisdictional utilities should evaluate system circuits serving critical infrastructure such as hospitals, police stations, emergency response facilities, drinking water system facilities, fuel locations, and predetermined lodging or staging facilities used during storm restoration and evaluate the potential effectiveness of hardening those critical circuits.

B3. UNDERGROUND PLACEMENT OF NEW RESIDENTIAL SERVICES *(112)*

Finding: PSC regulations include provisions governing the technical and financial aspects of the construction of underground electric facilities to serve new residential customers.

Recommendation: Utilities should continue their current practice of placing new facilities underground when the cost differential is recovered through a contribution in aid of construction. Utilities also should continue to replace existing overhead facilities with underground facilities when the requesting party pays the conversion costs.

B4. UNDERGROUND PLACEMENT OF EXISTING SERVICE DROPS *(115)*

Finding: E.ON US is considering the effectiveness of undergrounding existing service drops as a means of mitigating outages due to extreme weather events. Installation of all new service drops underground where feasible may mitigate future outages.

Recommendation: All electric utilities should assess the effectiveness of undergrounding existing service drops as a means of mitigating outages due to extreme weather events. Utilities should consider, on an ongoing basis, the feasibility of undergrounding other overhead facilities that have shown themselves over time to be particularly prone to weather-related outages. Utilities should evaluate the impacts on their systems and their customers of placing all new service drops underground, where feasible.

B5. HAZARD TREE REMOVAL OUTSIDE RIGHTS-OF-WAY (ROW) *(107)*
Finding: A program to address hazardous trees outside electric utility ROWs has the potential to reduce weather-related outages.
Recommendation: All jurisdictional electric utilities should take steps to increase removal of such hazard trees and those steps are to be reported to the PSC as updates to utility vegetation management plans.

B6. THIRD-PARTY POLE ATTACHMENTS *(92)*
Finding: Jurisdictional electric utilities, as pole-route owners, are responsible for ensuring the safety and integrity of their infrastructure. This includes evaluating the impact of attaching facilities to determine compliance with industry and regulatory standards. The obligation of those utilities to make their facilities available for third-party attachments in no way alleviates their responsibility to provide for the safe and reliable operation of their own systems.
Recommendation: Electric utilities should conduct regular audits and inspections of pole routes to ensure continued compliance with applicable standards, including evaluations of structure loadings and facility clearances. In instances in which the pole-route owner determines that third-party attachments are inappropriate or unsafe, the Commission expects the attaching party to be notified of the specific location(s) and details for each area of concern, and advised of the precise procedures necessary to correct the deficiency. If the identity of the attaching party cannot be obtained, or the attaching party refuses to engage in actions necessary to correct the deficiency, the utility may take steps, in accordance with its pole attachments tariff, to remove the attachments. The Commission expects attaching parties to notify the pole-route owner of each specific intention to make attachments and to seek approval of such attachments pursuant to governing agreements or tariffs prior to placement. Such required notifications include circumstances where additional facilities will be placed in pole-attachment space already occupied pursuant to an approved pole-attachment arrangement.

B7. INSPECTION PROCEDURES *(96)*
Finding: On-the-ground inspections are necessary to assure safe and reliable utility operations. On-the-ground inspections are more detailed and involve a more effective qualitative assessment of a utility's electric facilities than aerial inspections.
Recommendation: The Commission will amend its regulations to clarify that on-the-ground inspections are to be the primary method of system inspection. In the interim, the Commission recommends that jurisdictional utilities use on-the-ground inspections as the primary means of system inspection.

B8. POST-RESTORATION INSPECTIONS *(98)*
Finding: Post-restoration inspections are critical for ensuring continued reliability and operational safety.
Recommendation: Jurisdictional electric utilities should conduct formal post-restoration inspections subsequent to any future major outage event and report their findings as may be directed by the Commission.

B9. TRACKING DAMAGE TO SERVICE CONNECTIONS *(114)*
Finding: While damage to service drops may not be the sole cause of any single customer's electrical outage, assessing damage to service drops is important to understanding how ice storms and other weather events affect Kentucky's electric infrastructure.
Recommendation: In all future weather-related outages, electric utilities should accurately record the number of overhead and underground service drops requiring separate repairs in order to restore service.

B10. ACQUISITION OF OUTAGE MANAGEMENT SYSTEMS (OMS) *(61)*

Finding: Electronic outage management systems (OMS) provide utility management with an immediate overall display of the location of outages, as opposed to the traditional, time-consuming method of using paper maps to locate outages. Utilities with OMS report that the systems allow quicker and more efficient deployment of restoration crews and resources. OMS does the work that used to require many utility personnel to accomplish, thus freeing those personnel to assist in the restoration and repair of the distribution systems.

Recommendation: Every jurisdictional electric utility should acquire an OMS.

B11. OMS SYSTEM UPDATES *(61)*

Finding: In order for an OMS to function efficiently, it must contain current data. Utilities reported problems with older systems during the ice storm.

Recommendation: Utilities with an OMS should ensure that the OMS electrical model is kept current so that it can accurately make outage predictions and also accurately keep track of which customers are out and which are restored.

B12. PARTICIPATION IN NATIONAL WEATHER SERVICE (NWS) BRIEFINGS *(37)*

Finding: Advance warning of severe weather is essential to emergency preparedness. It would be beneficial for all jurisdictional utilities to familiarize themselves with the weather data the NWS provides in advance of and during major weather events. The PSC intends to organize a meeting at which NWS officials will be invited to provide an overview of their services to jurisdictional utilities.

Recommendation: Every jurisdictional electric utility company should contact the NWS office covering its service area to establish e-mail notification of conference calls conducted in advance of anticipated severe weather events and participate in such calls when notified. Jurisdictional utilities should plan to attend the meeting with the NWS.

B13. LOGISTICAL SUPPORT ASSISTANCE *(71)*

Finding: The ability to devote personnel to logistical support such as worker housing, feeding and resupply expedites restoration.

Recommendation: Utilities that do not have sufficient personnel to devote solely to logistical support during a major outage event should take steps to determine as part of their emergency planning whether such logistical support personnel are available through mutual aid assistance or other sources, and, if so, how such personnel can be best utilized.

B14. VEHICLE/GENERATOR FUEL PROCUREMENT *(47)*

Finding: An inability to obtain vehicle or generator fuel can complicate restoration efforts.

Recommendation: Electric utilities should examine their Emergency Response Plans to ensure that they have adequate provisions for either dedicated fuel tankers or other fuel sources during emergency restoration operations.

B15. INSURANCE COVERAGE *(123)*

Finding: Insurance to cover the cost of restoration after major storms is not readily available at any cost to investor-owned utilities (IOUs).

Recommendation: IOUs should monitor insurance markets for the development of catastrophic coverage and other potentially applicable products. As such products become available, the IOUs should evaluate the cost-effectiveness of obtaining coverage.

B16. CUSTOMER SERVICE OPERATIONS *(141)*
Finding: Many customers had trouble contacting electric utility customer service centers following the two storms.
Recommendation: Electric utilities should take the necessary steps to improve customer access to customer service functions. Utilities should review their disaster response plans and make any changes needed to provide for adequate staffing of customer service functions during outages, including cross-training of employees to supplement consumer service staff, extending consumer service hours and providing for third-party backup if necessary. Utilities should provide for backup power in order to maintain call center operations in the event that the utility offices lose power.

B17. ELECTRIC UTILITY WEB SITES *(152)*
Finding: Some electric utilities did not use their Web sites effectively following the storms. In some cases, little or no outage information was provided. Others Web sites were not updated to provide current information.
Recommendation: Electric distribution utilities should include on their Web sites a section specifically for outage information. On an ongoing basis, this section should include information for customers regarding electric safety and disaster preparedness. During major outages, the Web site should be used to provide information on the location of outages, restoration efforts and expected duration of outages. At a minimum, the information should be specific to county or, in urban areas, ZIP code. Information should be presented on a map if possible and should be updated at least daily. Utilities should post press releases on the Web site as well.

B18. USE OF SOCIAL NETWORKING TOOLS *(153)*
Finding: Duke Energy Kentucky's use of Twitter.com demonstrated the effectiveness of social networking tools in providing information to customers following a major outage.
Recommendation: All utilities should examine the possibility of establishing their own accounts with Twitter.com, Facebook.com or any similar social networking services, utilize these services as a means of disseminating outage-related information and inform their customers about the availability of information via these services.

B19. INFORMATION DELIVERY VIA OUTBOUND CALLING *(154)*
Finding: Automated outbound calling (similar to reverse 911 systems) could serve as an effective means of providing customer-specific restoration updates.
Recommendation: Utilities which currently utilize automated outage reporting via telephone should explore the possibility of using the same systems to deliver restoration information to consumers on a targeted basis. The Commission also recommends that utilities explore the possibility of developing such outbound information services based on e-mails or text messages to wireless devices designated by customers.

B20. SERVICE ENTRANCE REPAIR INFORMATION *(156)*
Finding: It is very important for the jurisdictional utilities to share information about the customer's responsibility to repair meter bases, mastheads and other service entrance components should they be damaged. The utilities' efforts to communicate this information to their customers has paid dividends, as evidenced by the much lower number of customer complaints regarding this issue during the Hurricane Ike wind storm and the 2009 ice storm.
Recommendation: Electric utilities should include service entrance repair information on their Web sites and, for the investor-owned utilities, in at least two bill inserts per year. Electric cooperatives are also encouraged to include service entrance repair information in monthly publications or, if feasible, in at least two bill inserts per year.

B21. OUTAGE REPORTING EDUCATION *(74)*

Finding: As was seen during both storms, confusion over outage reporting procedures can impede effective assessment of outages, hamper call center operations and increase customer frustration.

Recommendation: Utilities should provide customers with information about outage reporting procedures. At a minimum, this should include:

- *The number or numbers to call to report an outage.*
- *The availability, if any, of outage reporting via e-mail or text message from wireless devices.*
- *An explanation of automated outage reporting, if applicable, and why it is important that customers use it.*
- *A request that every customer who loses power calls to report an outage, but that customers make only one such report.*
- *Instructions on when a call to 911 is appropriate and when it is not.*

B22. ESTIMATED BILLS DURING OUTAGES *(143)*

Finding: As at least one utility found after the ice storm, estimation of bills, while necessary following outages, can lead to customer confusion and anger due to an unfamiliarity with the process.

Recommendation: Utilities should inform customers when severe weather or other circumstances require large numbers of bills to be based on estimates instead of actual readings. This information should be incorporated into utility communications regarding safety and other outage-related topics.

B23. KAEC CLEARINGHOUSE (DISTRIBUTION COOPERATIVES ONLY) *(40)*

Finding: The Kentucky Association of Electric Cooperatives (KAEC) served as an effective clearinghouse for information and assistance during these major storms.

Recommendation: Any electric cooperative that has not availed itself of this service in the past should immediately take steps to ensure that it does so in the future.

ELECTRIC UTILITIES - FINDINGS AND RECOMMENDATIONS NOT REQUIRING A RESPONSE

C1. UNDERGROUND PLACEMENT OF FACILITIES *(110)*

Finding: Based on the added cost, it is not economically justifiable to require the burying of all or even a substantial portion of the electric transmission and distribution facilities owned and operated by Kentucky's jurisdictional utilities.

Recommendation: Undergrounding of all overhead electric facilities should not be pursued.

C2. NATIONAL ELECTRIC SAFETY CODE (NESC) LOADING ZONE *(83)*

Finding: As noted earlier, construction to the NESC heavy loading zone standard, rather than the medium standard required in Kentucky, was of some benefit in certain circumstances, but it would not be cost-effective to do so in all instances.

Recommendation: Kentucky should not be placed into the heavy loading zone in the NESC. See Recommendations B1 and B2 for a more detailed discussion of recommendations to electric utilities regarding building to heavier standards and system hardening.

C3. RESTORATION TO PRE-EXISTING STANDARD *(84)*
Finding: Requiring upgrading of electric facilities as they are restored to any higher standards included in the current NESC code, rather than to the pre-damage condition, would delay restoration and may be impractical under many circumstances.
Recommendation: There is no reason to alter the current practice of restoring facilities to pre-existing condition as governed by the NESC.

C4. UNIFORM VEGETATION MANAGEMENT STANDARDS *(106-107)*
Finding: The unprecedented nature of both the 2008 wind storm and the 2009 ice storm make it unlikely that utilities could have utilized additional reasonable and cost-effective vegetation management methods within their rights-of-way that would have minimized the damage from these storms. The Commission does not believe that these storms provide any additional justification for the imposition of uniform vegetation management standards in Kentucky. The Commission continues to believe that the widely varied topography, vegetation types and development patterns across Kentucky make it impossible to craft universally applicable vegetation management standards that would be equally effective under all circumstances.
Recommendation: Uniform vegetation management standards are not justified at this time. However, as it stated in its 2007 order, the Commission will continue to assess the reliability of electric utilities and remains open to further exploration of this issue if data suggest that reliability or safety could be improved by prescribing vegetation management standards.

C5. INSPECTION PROCEDURES *(94)*
Finding: With the exception related to aerial inspections noted earlier, existing pole construction, inspection and maintenance standards are adequate and reasonable.
Recommendation: Pole construction, inspection and maintenance standards do not need further revisions.

C6. INSURANCE COVERAGE FOR ELECTRIC COOPERATIVES *(123)*
Finding: Electric cooperatives are effectively insured through their eligibility for federal and state disaster assistance.
Recommendation: There is little reason for electric cooperatives to pursue additional insurance for storm-related damages.

C7. OUTAGE REPORTING FREQUENCY *(145)*
Finding: The frequency of outage reporting must be governed by the operational needs of the state Emergency Operations Center.
Recommendation: No changes should be made to the current process for determining the number of outage reports required daily under the PSC's Emergency Service Function 12 responsibilities during an activation of the state Emergency Operations Center.

C8. DECLINED OFFERS OF ASSISTANCE *(66)*
Finding: Turning away offers of assistance may create a public perception that a utility is not doing all it can to restore power. However, in the instances noted in this report, the Commission finds that utilities acted reasonably in declining assistance.

WATER AND WASTEWATER UTILITIES - FINDINGS AND RECOMMENDATIONS REQUIRING A RESPONSE

D1. BACKUP POWER AT CRITICAL WASTEWATER FACILITIES *(129)*
Finding: Lack of backup power led to a number of discharges of untreated wastewater into streams from wastewater facilities following the ice storm.
Recommendation: In order to prevent future discharges of untreated wastewater in the event of power outages, all wastewater systems should consider the feasibility of upgrading pump stations to include detention capability and connections for bypass pumps or generators.

D2. USE OF STORAGE CAPACITY *(130)*
Finding: Filling existing storage to capacity in advance was an effective way to minimize service disruptions when water systems lost power following the ice storm. This is a straightforward preventive measure for water utilities to implement. The Commission notes that its regulations require water utilities to have, at a minimum, one day's storage capabilities. A day's worth of water in storage may allow service to continue uninterrupted while power restoration occurs, particularly if customers are concurrently asked to conserve water.
Recommendation: All water utilities should ensure that existing storage is at maximum capacity in advance of events that could disrupt service.

D3. INTERCONNECTIONS *(131)*
Finding: Even if there is no intent to supply water during non-emergency conditions, interconnections could be a cost-effective means to provide continued water service to customers in emergencies. The Commission notes that it has encouraged such interconnections for a number of years.
Recommendation: All water utilities should consider establishing adequate interconnections with neighboring water suppliers. Equally important, water utilities should annually review their agreements with other interconnected utilities to ensure the agreements remain current and mutually acceptable.

D4. ACCESS TO MUTUAL AID AND EMERGENCY EQUIPMENT *(131)*
Finding: By joining Kentucky Water/Wastewater Response Network (KYWARN) or a similar mutual assistance group, water utilities may be able to get necessary assistance from neighboring utilities that have resources to spare. KYWARN members have access to a database of other utility systems within the Commonwealth and their resources and trained personnel that they may need in an emergency.
Recommendation: Water and wastewater utilities should identify local resources, particularly potential suppliers of portable electric generators, in order to expeditiously obtain emergency assistance. Water and wastewater utilities should consider joining an industry-wide group such as KYWARN. In addition, utilities located near other states may want to contact sister utilities in neighboring states to learn of each others' resources.

D5. EMERGENCY RESPONSE PLANS *(132)*
Finding: Water utilities with a current emergency response plan found the plans helpful in managing disaster response.
Recommendation: Every water and wastewater utility should have a written emergency response plan and have its personnel review that plan on a regular basis. In addition, the Commission recommends that utility personnel be adequately trained in crisis management. Local emergency management organizations regularly hold table-top and practical training missions in which utility personnel could participate and become better prepared for catastrophic events.

D6. BOIL WATER ADVISORIES *(130)*
Finding: As the ice storm showed, dissemination of information during power outages is often difficult and unreliable. It may be impossible to issue boil water advisories using the normal procedure.
Recommendation: Water utilities should consider issuing consumer advisories prior to events that create a high potential for service disruptions. Such an advisory can act as a public service announcement and should be worded properly to ensure accurate information is conveyed without eroding consumer confidence or heightening stress. For example, prior to the ice storm, a utility could have issued the following advisory:

> *Severe weather is forecast for this area. Water consumers should be advised that the water utility will strive to continue to provide safe, reliable service throughout inclement weather. Nevertheless, external factors may affect our ability to provide service. The system has reliable water storage, but that storage is not limitless. If electrical power is out for a lengthy period, the water system and the ability to communicate with consumers may be compromised. If this is the case, consumers should take steps to limit water use and consider boiling water for at least three minutes prior to consumption to be on the safe side.*

LANDLINE TELEPHONE UTILITIES - FINDINGS AND RECOMMENDATIONS REQUIRING A RESPONSE

E1. BACKUP GENERATORS AT KEY FACILITIES *(135)*
Finding: Extended power outages at network service nodes led to service disruptions following the ice storm.
Recommendation: Landline telephone utilities should consider expanding the availability of fixed, on-site, back-up generators at critical network service nodes in order to alleviate the immediate impact on utility services from loss of commercial power for extended periods.

E2. EMERGENCY PLANNING *(135)*
Finding: The lack of commercial power disrupted the ability of telecommunication utilities to perform common and routine tasks. For example, telecommunication utilities had difficulty obtaining fuel, food and lodging from the usual commercial sources and there was limited or no ability to accept non-cash payments such as credit card purchases.
Recommendation: In order for utilities to be adequately prepared for similar emergency situations in the future, they should consider making adequate plans and provisions for addressing such circumstances.

E3. VEGETATION MANAGEMENT/UNDERGROUND FACILITIES *(135)*
Finding: Telephone service was disrupted due to trees and limbs falling on and breaking lines.
Recommendation: Telephone utilities should ensure that vegetation management (tree-trimming) practices are sufficient to effectively control damage to aerial facilities and consider underground facilities where practical.

WIRELESS TELEPHONE PROVIDERS – ADVISORY RECOMMENDATIONS

F1. BACKUP GENERATORS AT CELL SITES *(136)*
Finding: Wireless utilities that relied on backup generators rather than batteries to provide service continuity at cellular sites generally experienced fewer service disruptions as a result of extended power outages.
Recommendation: Although the Commission's authority over wireless carriers has been limited by statute, the Commission nonetheless feels compelled to recommend that wireless providers consider expanding the number of cell sites equipped with permanent, on-site, back-up generators, where such generators are technically feasible. This could alleviate some of the immediate impact on a wireless carrier's network from the loss of commercial power.

F2. REDUNDANCY OF INTERCONNECTING FACILITIES *(136)*
Finding: Loss of interconnection was a major contributor to wireless service outages following the ice storm.
Recommendation: Enhancing the redundancy of interconnecting facilities, whether owned or leased from third-party providers, between cell sites and central switching offices would help ensure the integrity of the wireless network.

KENTUCKY PUBLIC SERVICE COMMISSION – FINDINGS AND ACTION ITEMS

G1. IMPROVEMENTS TO OUTAGE REPORTING SYSTEM *(146)*
Finding: The PSC's current Web-based outage reporting system needs to be improved, both in terms of ease of use and ease of access.
Recommendation: The PSC will convert to an e-mail-based system that will permit data submission from handheld devices while retaining the function of providing outage information on the PSC Web site as it is reported.

G2. CHANGES IN CUSTOMER COMPLAINT PROCEDURES *(142)*
Finding: Major power outages justify a suspension of business as usual in complaint procedures in order to alleviate the burden on affected utilities.
Recommendation: In the event of an emergency, an extended response time should be in effect. For this purpose, an emergency is defined as an event that has led to an activation of the Kentucky Emergency Operations Center (EOC), if that event has occurred within the utility's service territory and has required activation of Emergency Service Function 12 (ESF-12), which applies to electric utilities. The expected response time will be extended to seven calendar days or for as long as the ESF-12 activation remains in effect. In order to further reduce demands on utility personnel, the PSC will aggregate non-urgent consumer complaints and convey them to the utility once daily, rather than as they are received. However, the PSC notes that it will continue to convey urgent consumer inquiries to utilities as soon as they are received and will expect urgent matters which may pose a threat to health or safety to be addressed as quickly as possible.

G3. OUTAGE REPORTING FREQUENCY *(145)*
Finding: Current outage reporting frequencies were adequate to meet emergency operation needs.
Recommendation: No changes are needed to the current process for determining the number of outage reports required daily under the PSC's ESF-12 responsibilities during an activation of the state EOC.

G4. PSC ROLE AS INFORMATION CLEARINGHOUSE *(53)*
Finding: The PSC is not positioned to function as an information clearinghouse for local officials. During an emergency or disaster the PSC's primary duty under the state emergency management system is to monitor and report on outages and the progress of power restoration. During such outages, the PSC does field many questions from local officials in the affected areas.
Recommendation: The PSC is not in position to assume a formal role as an information conduit between utilities and local officials. Utilities bear the primary responsibility for communicating effectively and working with state and local officials until the restoration operations are completed.

G5. PSC ROLE IN EMERGENCY PREPAREDNESS *(48)*
Finding: The Kentucky Division of Emergency Management (DEM) is the state agency with primary authority and responsibility for coordinating the annual regional or statewide emergency management drills in which the Commission has recommended utility participation.
Recommendation: The PSC, in its capacity as the regulatory agency over many of Kentucky's electric, water, wastewater, gas, and telecommunication utility companies, is prepared to assist DEM in these efforts.

OTHER LOCAL OR STATE GOVERNMENT ENTITIES – RECOMMENDATIONS

H1. REGIONAL EMERGENCY PLANNING *(54)*
Finding: Previous participation in emergency planning proved beneficial in coordinating disaster response between utilities and local and regional emergency managers.
Recommendation: Communities, with the help of Local Area Development Districts, should engage in regional emergency planning. Cities and counties should work together to develop and implement effective emergency response plans and should coordinate their emergency planning with their local utility providers, regional Kentucky Division of Emergency Management personnel, and local schools.

H2. UTILITY PARTICIPATION IN EMERGENCY EXERCISES *(47)*
Finding: Disaster drills were a highly effective tool for emergency planning and facilitated communication between utilities and local officials following the wind storm and ice storm,
Recommendation: Disaster drills (both table-top and field exercises) conducted at the local, regional and state level should include the appropriate jurisdictional and non-jurisdictional utilities and utilities should actively seek participation in such drills. An essential component of these drills should be the establishment of routine communication protocols between utilities and emergency managers and the development of contingency plans in the event that normal lines of communication are not available. Emergency contact information should be exchanged and updated on a regular basis. Power restoration priorities should be identified, documented in advance and made available to utilities.

H3. LOCAL EMERGENCY PREPARATION *(54)*

Finding: As was seen during the 2009 ice storm, lack of current emergency contact information can hinder restoration efforts. Access to working emergency generators is important in maintaining government operations. Satellite telecommunication capabilities can provide a link to regional and state disaster responders when other communication links are disrupted.

Recommendation: Local officials should update their emergency contact information on a regular basis, make sure that any emergency generators are in working order and arrange for access to satellite telecommunications.

H4. BACKUP POWER AT STATE RESORT PARKS (SRPs) *(69)*

Finding: State resort parks (SRPs) can serve a critical role as housing and staging areas during major disasters, provided that they themselves retain full operational capabilities.

Recommendation: The executive branch and Kentucky General Assembly should consider funding to provide emergency generators to selected Kentucky SRPs in order to make those parks fully functional during major outage situations and thus allow them to be used by utility crews for housing and staging areas. This funding would be supplemental to any monies that the Parks Department may obtain through grants for that purpose.

H5. ELECTRIC OUTAGE REPORTING REQUIREMENTS *(55) (146)*

Finding: A lack of outage information from non-jurisdictional utilities contributed to an incomplete picture of the disaster in the initial days following the ice storm. This complicated the process of assessing needs and prioritizing response.

Recommendation: The necessary executive or legislative actions should be taken to require all electric providers to report county-by-county outage information to Emergency Service Function 12 whenever that function is activated in connection with the activation of the Kentucky Emergency Operations Center as the result of a public emergency within a county in which the provider has customers.

H6. FUNDING FOR EMERGENCY EQUIPMENT FOR WATER UTILITIES *(132)*

Finding: Many small water systems lack the funds needed to acquire backup generators and other equipment needed to provide adequate service during emergencies.

Recommendation: As the Commonwealth nears former Governor Paul Patton’s goal of providing a supply of potable water to every Kentuckian by 2020, the Commission encourages funding agencies such as the Kentucky Infrastructure Authority to consider funding requests to improve water systems to meet emergency situations.

H7. RESTORATION OF FUNDING FOR PSC PARTICIPATION IN THE KENTUCKY BROADCASTERS ASSOCIATION (KBA) PUBLIC EDUCATION PROGRAM (PEP) *(159)*

Finding: Renewed access to the services provided through the year 2007 by the KBA PEP program would enable the PSC to quickly provide relevant emergency information throughout Kentucky during disasters and would guarantee dissemination of that information via radio, which is the most commonly utilized news source during disasters.

Recommendation: High priority should be given to the restoration of full funding for PSC participation in the KBA PEP program as soon as possible.

H8. MANDATORY MEMBERSHIP IN CALL-BEFORE-YOU-DIG PROGRAM *(116)*
Finding: The voluntary nature of participation by underground facility owners in the Kentucky call-before-you-dig program (Kentucky 811), leaves significant gaps in the database needed to provide effective protection for underground facilities. This problem could potentially worsen if more facilities are placed underground.
Recommendation: State statutes should be amended to make the current voluntary membership in the Kentucky 811 program mandatory for all owners of underground utility facilities.

GENERAL PUBLIC - RECOMMENDATIONS

J1. INDIVIDUAL EMERGENCY PREPAREDNESS *(158)*
Finding: Many Kentuckians were unprepared for the extended power outages that followed the 2008 wind storm and 2009 ice storm. Unfamiliarity with the proper and safe operation of portable generators and other devices commonly employed in emergency situations led to a large number of entirely preventable deaths and serious illnesses.
Recommendation: The Commission believes that emergency preparedness is a responsibility shared by all Kentuckians. Therefore, the Commission urges all Kentucky residents to take the following measures to better prepare themselves for extreme weather events and other emergencies that may lead to extended power outages:

- *Maintain a supply of flashlights and batteries.*
- *Keep several days worth of potable water and non-perishable food on hand.*
- *Users of portable generators and heating devices must be thoroughly familiar with the rules for their safe operation.*
- *Residents should have a contingency plan for seeking alternate shelter.*
- *Customers should familiarize themselves with the procedures their utilities use for reporting outages and downed lines and should know how the utility provides information on restoration efforts.*
- *Households should have a means of maintaining telecommunication service. This can be a traditional landline phone that plugs directly into the wall or a wireless phone or other device that can be charged from a vehicle battery if necessary.*
- *Every household should have a battery-operated radio, preferably one that is capable of automatically receiving area-specific emergency weather alerts.*

J2. KNOWLEDGE OF ELECTRIC OUTAGE REPORTING PROCEDURES *(74) (141)*
Finding: Electric utilities report that it is extremely important that each individual electric utility customer call the service provider to report an individual outage event in order to facilitate proper functioning of the utility's outage response system and that customers understand the outage reporting process for the utility providing their electric service.
Recommendation: Utility customers should familiarize themselves with the steps they should take to report outages.

J3. MEDICALLY DEPENDENT ELECTRIC UTILITY CUSTOMERS *(142)*
Finding: Electric providers often are unaware of customers who are medically dependent on electric devices and thus cannot prioritize restoration of service to those customers. It is the responsibility of the customer to advise their electric provider of their status.
Recommendation: Customers who are medically dependent on electric devices should take steps to notify their electric service provider. The Commission notes that the electric provider may require documentation from a medical professional. The Commission further notes that in the event that a power interruption leads to a life-threatening situation, the proper course of action is to call 911.

J4. RELIABILITY OF WIRELESS TELECOMMUNICATION SERVICES *(138) (149)*
Finding: Absent the necessary oversight authority, the Commission is unable to adequately determine whether or not critical wireless telecommunications systems are secure and robust enough to survive major and potentially catastrophic events. Thus, it falls to those users most dependent on these systems to assess reliability and to make a determination as to the need for alternative arrangements for effective emergency communications.
Recommendation: Any purchaser of wireless services - whether for individual, business or governmental use – should inquire as to and consider the reliability of the service offered in the event of a major disruption of electrical power or other emergency. Anyone, including government entities, who may need to rely upon that service in an emergency should consider making their purchasing decisions accordingly and should consider using reliability as a criterion when evaluating bids from competing vendors.

INTRODUCTION

In a five-month period spanning late 2008 and early 2009, Kentucky experienced the two largest electric power outages in its history. While both outages were the result of extreme weather events, the two natural disasters were distinctly different in appearance and aftermath.

The September 14, 2008, wind storm created from the remnants of Hurricane Ike arrived unexpectedly, lasted only a few hours and was followed by many days of ideal weather which both lessened the impact of the power loss on those affected and eased restoration efforts.

In contrast, the ice storm which entered Kentucky on January 26, 2009, was forecasted days in advance, lasted for two days and was followed by days of extremely cold weather that exacerbated the misery and danger for affected residents and restoration workers alike.

Immediately after the September 2008 wind storm, the Kentucky Public Service Commission (PSC) initiated a review of utility performance following the storm. The topics addressed included disaster preparedness, power restoration, customer relations, public information and others. Requests for information were sent to affected utilities and local officials in October. Responses were received in November and December.

ADDING UP THE DAMAGE COSTS

	2008 wind storm	2009 ice storm	total
Damage to jurisdictional utilities	$44.7 million	$240 million	$284.7 million
All insured losses[1]	$533 million	$335 million	$868 million
Local government losses[2]	$17.3 million	$41 million	$58.3 million
TOTAL[3]	***$595 million***	***$616 million***	***$1.21 billion***

ALL FIGURES ARE ESTIMATES

1— Source: Property Claim Services, a unit of Insurance Services Office, Inc.

2— Source: Federal Emergency Management Agency

3— Totals do NOT include non-jurisdictional electric providers (TVA system, municipals) or private property losses not covered by insurance or disaster assistance

By early January 2009, PSC staff had begun reviewing the responses and formulating needed follow-up information requests. That work was suspended with the arrival of the ice storm, pending a decision on whether to combine the review of the two events.

In late February, the PSC determined that the wind storm and ice storm should be examined together, with the review of electric utilities expanded to cover several additional topics. These included a comprehensive look at the feasibility and advisability of burying many or all above-ground electric lines, possible approaches to system hardening, revisions to construction standards, vegetation management and cost recovery. Also added were an examination of outage reporting procedures, including the PSC's reporting system, and a consideration of individual customer disaster preparedness.

Because of substantial telecommunication outages and a number of water or wastewater system outages during the ice storm, the scope of the review also was expanded to include these utility sectors.

Initial data requests to utilities were issued in late March, with responses due April 30. The information requests were far lengthier than for the wind storm. The most extensive data request - 217 questions, many with multiple parts – went to electric utilities.

Telecommunication and water or wastewater utilities received briefer, but detailed, data requests. Requests for information also were sent to state legislators and local officials in affected communities. Follow-up data requests were issued in June and July as needed.

Information also was obtained from other state agencies and from the National Weather Service. This report also draws from consumer complaints and comments made to the PSC, from the responses to an online survey on the PSC Web site and from news accounts.

The report is organized into sections dealing with issues unique to electric, telecommunication and water or wastewater utilities. Customer service, public information and individual preparedness are addressed in separate chapters.

THE 2008 WIND STORM

On September 13, 2008, Hurricane Ike, reduced to a tropical storm, was making its way across Texas and Arkansas. In Kentucky, National Weather Service (NWS) forecasters in Louisville and Paducah issued advisories for winds ranging from 35 to 45 miles per hour to affect the Ohio River valley the next day.

Winds of that strength are not unusual in Kentucky, although they more typically arrive in the company of strong thunderstorms, rather than the decaying remnants of hurricanes. The advisories were not an occasion for undue concern or significant advance preparation on the part of utility companies, emergency managers or the public.

Within 24 hours, however, due to an unprecedented convergence of meteorological events, what was initially predicted to be a benign event had been transformed into a blast of hurricane-force winds that caused a power outage that would stand, for a mere 135 days, as the largest in Kentucky history.

“This was a unique event, not duplicated anywhere else in the United States,” John Gordon, chief of the NWS office in Louisville, would later say. “It was the most extreme event I have ever seen.”

The ingredients that came together to create the wind storm were:

- The remnants of Hurricane Ike, which approached from the south-southwest and created an area of low pressure near the ground.

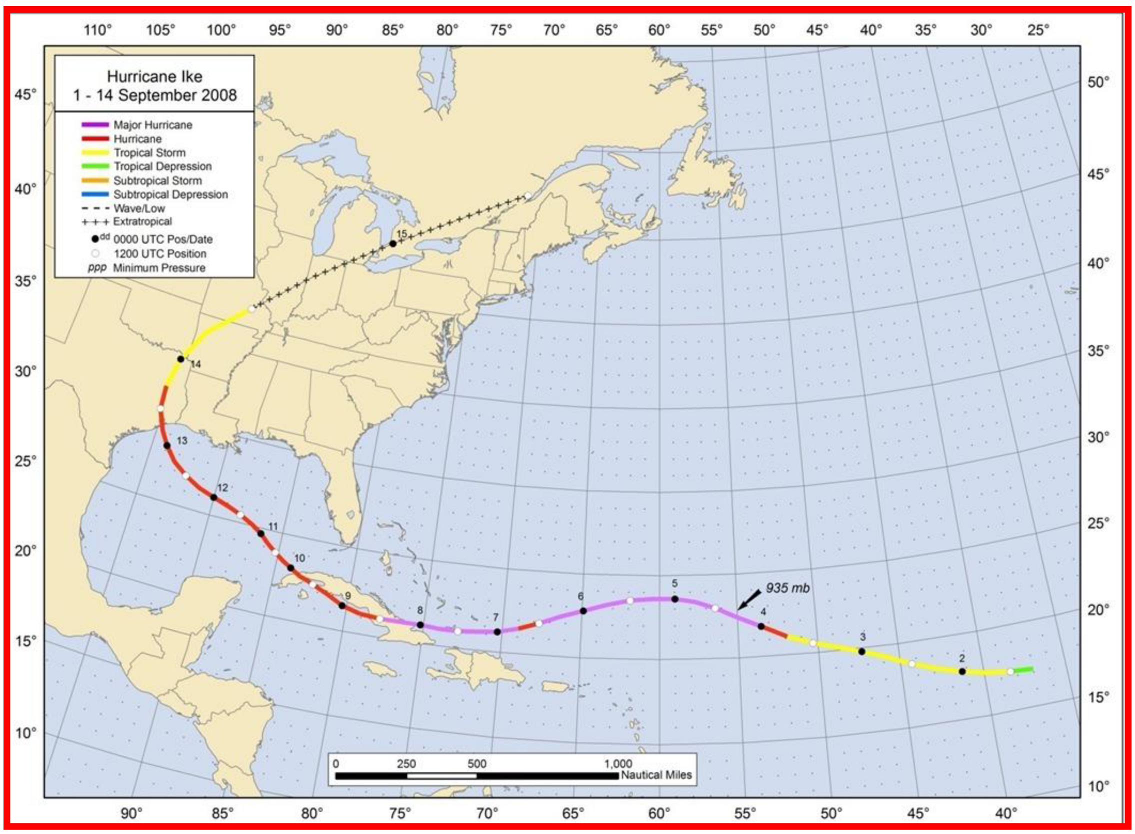

Figure 1: The path of Hurricane Ike

Image courtesy of National Weather Service

- A strong cold front, with powerful winds at higher altitudes, moving in from the north-west, overriding the low and creating an extreme pressure differential.
- Thick clouds that blocked sunlight and prevented formation of thunderstorms along the cold front and mixing of the two air masses.
- A small patch of clear sky that acted like a vent, allowing the warm air carried by Hurricane Ike to escape upward, to be replaced by a rush of cold air from the on-coming front.

It was not until the morning of September 14th, when forecasters first detected that opening in the clouds, that they were able to recognize what was about to occur. By that time, sustained winds of 50 miles per hour or more, with gusts in excess of 70 miles per hour, had begun raking western Kentucky.

The first high wind warning was issued by the NWS Paducah office at 7:22 a.m. CDT. The Louisville office issued a high wind warning at 11:54 a.m. EDT, followed by Indianapolis at 12:22 p.m. EDT and Wilmington, Ohio, near Cincinnati, at 1:49 p.m. EDT. As forecasters would later note, the winds and the warnings arrived nearly simultaneously. By 2:15 p.m., Louisville was experiencing sustained near-hurricane-force winds, with a maximum gust of 75 miles per hour. An hour or two later, similar winds would hit the northern Kentucky, with a peak gust of 74 miles per hour recorded at the Cincinnati-Northern Kentucky International Airport in Boone County.

In the half day that it took the storm to traverse Kentucky, its winds interrupted electric power to about 600,000 customers. That was double the number of customers affected by the previous record outage: the February 2003 ice storm in central and northeast Kentucky.

Governor Steve Beshear declared a state of emergency in Kentucky on the evening of September 14th. The declaration included the activation of the Kentucky Emergency Operations Center (EOC). Kentucky Public Service Commission (PSC) staff were mobilized to participate in the EOC, and affected electric utilities were placed on notice to file twice-daily updates on their outages.

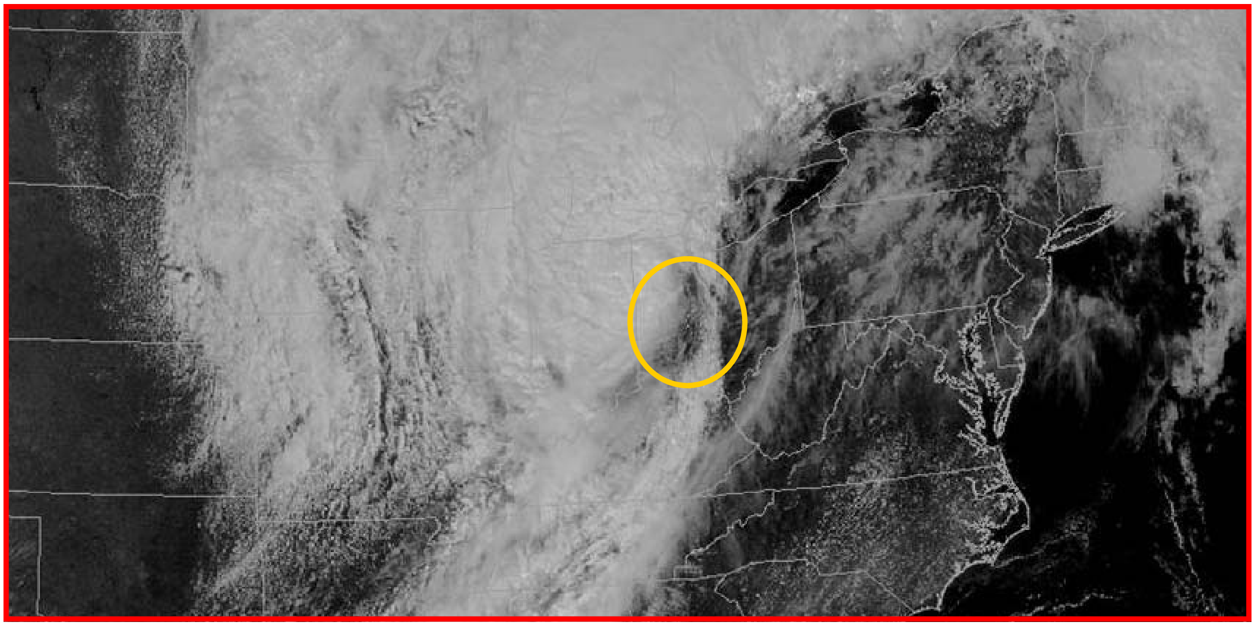

Figure 2: Satellite photo of Hurricane Ike on Sept. 14, 2008. The opening in the clouds that created the intense winds is indicated by the circle.

Image courtesy of National Weather Service

The unexpected nature of the wind storm meant that utilities had no opportunity to prepare for large-scale restoration efforts. There was no time to pre-position equipment and crews or to seek additional crews through mutual-aid partnerships.

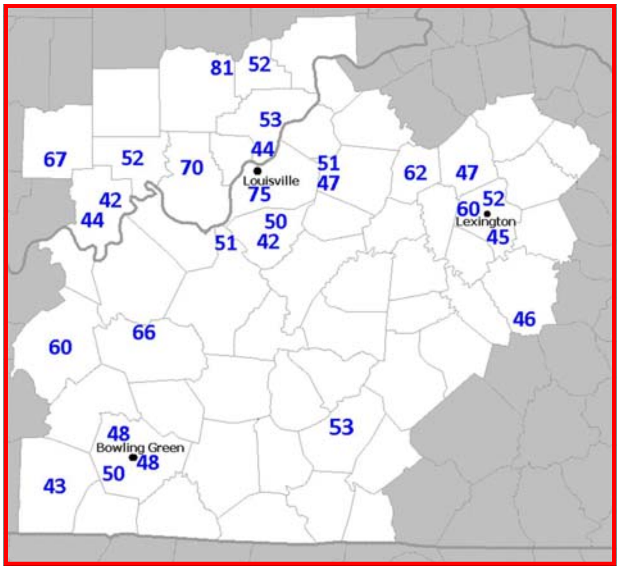

Figure 3: Peak wind gusts on Sept. 14, 2008, within the National Weather Service's Louisville office coverage area

Image courtesy of National Weather Service

In fact, a number of utilities had less than the full complement of crews available as the result of having dispatched crews to assist with restoration on the Texas Gulf Coast and other areas earlier affected by Hurricane Ike. For example, Duke Energy had released 263 contract employees normally working in the Midwest to assist with restoration on the Gulf Coast. Louisville Gas & Electric Co. (LG&E) also had several of its company and contract crews working on the Gulf Coast. Those crews were all recalled immediately and were at work restoring power in Kentucky within 24 hours of the storm. Utilities stated that the initial unavailability of some crews had minimal impact on restoration efforts.

The broad impact of Hurricane Ike itself and the related wind storm may have limited the availability of restoration resources. Crews from 31 states were mobilized to assist with restoration efforts in Louisiana and Texas. In both states, restoration from Hurricane Gustav, which made landfall on September 1, 2008, was not yet completed when Hurricane Ike arrived 12 days later. In Texas, the power outage from Hurricane Ike was the largest in that state's history, with three million customers without electricity.

Restoration resources were further strained when Hurricane Ike's winds arrived in the Midwest. In addition to the 600,000 customers without power in Kentucky, 2.6 million customers lost power in Ohio and 100,000 Indiana customers lost power. Large outages also occurred in central Pennsylvania (260,000 customers) and upstate New York (100,000 customers). A spokesman for LG&E, the hardest-hit utility in Kentucky, said on September 14th that outside assistance would be hard to come by.

One Kentuckian died in the storm – a child in Shelby County who was struck by a falling limb. Two deaths in Louisville were later indirectly attributed to the storm – a woman who succumbed to carbon monoxide poisoning from a portable generator being operated inside the home, and a woman who had left flammable material on a turned-on electric stove and died in a fire that began after power was restored to her home.

Damage and outages from the wind storm were worst in the Louisville area. Three-fourths of LG&E's customers – 301,000 out of 400,000 – lost power. Other hard-hit utilities included Duke Energy Kentucky (Duke Kentucky), with 128,000 customers without power in the Kentucky counties near Cincinnati, and Kentucky Utilities Co. (KU), with 75,000 customers without power, mostly in western Kentucky. Electric cooperatives hit hard by the storm included Owen Electric Cooperative Corp. (28,000 customers) Salt River Electric Cooperative Corp. (25,000 customers) and Kenergy Corp. (19,000 customers).

“This was a unique event, not duplicated anywhere else in the United States. It was the most extreme event I have ever seen.”

John Gordon, National Weather Service, Louisville

Restoration efforts began as soon as the high winds abated. Almost all of the damage was to the distribution system, and most of that damage was due to falling trees or limbs. For example, LG&E reported more than 6,000 lines down across its service area, but only one of those was a transmission line.

By Monday, September 15th, repairs were well underway. LG&E had restored service to 71,000 customers, leaving 230,000 without power. Power to all Louisville hospitals was restored within less than 24 hours. LG&E’s sister company KU was more than halfway to full restoration, with 45,000 customers back in service and 30,000 remaining without power. Duke Kentucky was also about halfway to full restoration. Owen Electric had restored power to 16,000 customers, with 12,000 remaining to be restored.

Restoration assistance began to arrive in substantial quantity by September 15th and 16th. On the afternoon of September 16th, LG&E reported that it had over 1,070 people, with 390 trucks, working on restoring power, including 750 outside contractors and mutual aid personnel. The number of LG&E customers without power had been reduced to 182,000; KU was left with 18,000 and Duke Kentucky was down to 32,000. Progress in the KU area was good enough that crews were being transferred to work in LG&E’s territory.

But further efforts to obtain additional outside assistance were stymied by the widespread damage in other areas. In conversations with the PSC, Duke Kentucky officials reported on the 16th that mutual aid was “tapped out” as the result of “everybody vying for the same resources.” However, Duke Kentucky said its restoration efforts moved fairly quickly because it was able to bring in significant numbers of crews from its sister companies in the Carolinas. By the 16th, Duke Energy had 1,500 restoration workers in northern Kentucky and southwest Ohio.

Utility customer service functions also were strained by the storm. LG&E and KU received 225,000 calls to their combined customer service center in the first 48 hours after the storm. Two-thirds were handled through an automated outage reporting system. The companies had 134 service representatives taking calls and reported that most calls were answered within five seconds. Duke Energy also reported extremely high call volumes, with waits of up to a minute on the day of the storm.

Telecommunication facilities also were affected, though to a lesser degree. The most widespread outages appeared to be in the Cincinnati area, where Cincinnati Bell Telephone reported that 10 percent to 20 percent of landline customers were without service immediately following the wind storm, and about 25 percent of cell towers were not functioning due to power loss. Those numbers were cut in half within the first 48 hours of restoration efforts, and restoration was nearly complete within five days of the wind storm. With more assistance arriving every day, restoration picked up speed on September 16th and 17th. Salt River Electric completed restoration on the 16th and dispatched 15 employees to assist LG&E.

LG&E passed the halfway mark to full restoration on the 17th, with total outages down to 129,000 on the morning of September 18th. KU had only 6,000 customers without power, almost all of them in western Kentucky, and had begun shifting most of its workers to LG&E's service territory. By the morning of the 18th, LG&E had a total of 1,883 restoration workers in the field, with another 370 providing back-office support. Restoration assistance had arrived from as far away as Chicago and Orlando, LG&E officials reported. More than 800 vehicles were being used in the restoration effort, with most of them based in staging areas at the Kentucky Fair and Exposition Center and at E.P. "Tom" Sawyer State Park.

Similar progress was being made elsewhere in Kentucky. Kenergy had fewer than 1,500 customers without power on September 18th. Duke Kentucky had fewer than 23,000 customers still without power. By September 19th, Owen Electric had completed restoration work and released crews to assist Duke Kentucky.

Repairing a broken distribution system pole in Louisville.

PSC photo

Throughout the restoration effort, workers and affected customers had the benefit of favorable weather. In the 10 days following the wind storm, high temperatures in Louisville ranged from 70 degrees to 87 degrees, and lows were from 53 degrees to 62 degrees.

There was no precipitation during the period. As restoration progressed, life in affected communities began to return to normal. Although all public schools in Jefferson County remained closed for the entire week following the storm, schools in many other affected communities closed for only a day or two, if at all. In Louisville, the Ryder Cup golf tournament went on as scheduled on September 19th; the venue was in one of the few parts of city that had not lost power at all on September 14th.

Restoration efforts in Louisville peaked on September 20th and 21st. About 2,300 workers were restoring power or clearing fallen trees and limbs. About 1,300 vehicles were being used in the effort.

Eight days after the storm, the LG&E and KU customer service centers had received a total of 405,000 calls, or an average of more than 2,100 per hour.

On Monday, September 22nd, LG&E reported only 15,000 customers without power. Duke Kentucky had only a few hundred customers waiting for power. KU and the affected electric cooperatives had completed restoration. Remaining LG&E customers had power back by September 25th.

Restoration costs for jurisdictional utilities totaled about $44.7 million, with the three investor-owned utilities accounting for $40.4 million, or about 90 percent. More than two-thirds of the total damage – $35.1 million – was incurred by the two E.ON US entities, LG&E and KU. Together, the two utilities capitalized $8.4 million in restoration expenses and deferred $26.7 million in costs. Of the latter amount, LG&E accounted for $24.1 million. Duke Kentucky incurred $5.3 million in costs, with $5.1 million of that amount deferred. The Commission authorized all three of the investor-owned utilities to establish regulatory assets for the purpose of deferring the wind storm costs. The amount to be recovered through rates will be determined in each utility's next rate case. None of the investor-owned utilities expected to recover any costs through insurance, nor are they eligible for federal or state disaster assistance reimbursements.

Electric cooperatives incurred about $4.3 million in wind storm costs. Kenergy had the largest amount - $1.8 million. Unlike the investor-owned utilities, the cooperatives are eligible to receive federal and state assistance, totaling up to 87 percent (75 percent federal, 12 percent state.) The remaining

Typical damage in Louisville following the Sept. 14, 2008, wind storm. Fallen trees and limbs were the main cause of downed lines.

PSC photo

costs would come from their own resources. The eligibility for federal assistance came as the result of a federal disaster declaration made on October 9, 2008. It would eventually apply to 34 counties.

Insurance industry estimates put the insured losses from the wind storm in Kentucky at $533 million. When those losses are combined with the $17 million in costs incurred by local governments as identified by the Federal Emergency Management Agency, and the costs to utilities, the damage total rises to nearly $595 million. This number does not include the millions more in losses suffered by Kentucky residents and businesses that were not covered by insurance or disaster assistance.

In the weeks following the wind storm, public discussion and media reports focused on two issues that have surfaced in the wake of other major weather-caused power outages. The first was whether power lines should be placed underground to protect them from storm damage and thus reduce outages. The second was the way in which utilities communicate with their customers about the progress of restoration. As might be expected, because it was the utility most affected by the storm, criticism in this regard focused primarily on LG&E. Customers complained – in the news media and in comments to the PSC – that LG&E would not provide more than general estimates of when restoration would be complete, and would not provide any precise information about expected restoration in a given area.

Utility communications practices and the costs and benefits of burying electric lines were among the questions the PSC set out to address in its review of utility performance after the wind storm. Within a few months, that review would have to be expanded to include an even more catastrophic storm and outage.

A crew from Allegheny Power works to replace a broken pole and transformer in western Louisville on Sept. 18, 2008.

PSC photo

JANUARY 2009 ICE STORM

Unlike the September 14, 2008, wind storm, the ice storm that struck Kentucky on January 26th through 28th of 2009 was not unexpected. What was not anticipated was that it would cause the largest power outage in the state's history.

"This one was well-advertised and (the forecast) was consistent," John Gordon, head of the National Weather Service (NWS) office in Louisville said some months later. "But it was a highly anomalous event. It was the biggest ice storm in Kentucky history."

Weather forecasters saw it coming nearly a week earlier. The first indication of possible ice was in the forecast issued on January 21st. Three days later, the forecast was more explicit – calling for accumulations of ice mixed with snow and sleet. On the 25th and 26th of January, both the Louisville and Paducah NWS offices convened conference calls that are conducted whenever there is a threat of severe weather. Participants included emergency management officials and utility companies, notably Louisville Gas & Electric Co. (LG&E) and Kentucky Utilities Co. (KU).

With increasingly dire forecasts coming from both the NWS and other forecasters, including in-house meteorologists at the parent companies of Duke Kentucky and Kentucky Power Co. (American Electric Power Co.), utilities began to prepare for significant outages and subsequent restoration efforts. LG&E, KU, Duke Kentucky and Kentucky Power all held over crews past regular work hours and called in additional restoration crews and support staff in preparation for the storm. Utilities also notified contractors and mutual aid partners to prepare for a major storm.

Rural electric cooperatives also began preparations as the storm approached. In western Kentucky, Jackson Purchase Energy Corp. began calling in additional crews and summoning mutual aid. Kenergy Corp. filled all its fuel storage tanks, fueled vehicles and equipment, fueled and tested portable generators and secured hotel rooms to house anticipated crews arriving from mutual aid partners.

Farther east, Farmers Rural Electric Cooperative Corp. (RECC) requested additional crews. Jackson Energy Corp. manned its call center and placed extra dispatchers on duty. Inter-County Energy Corp. tested fax communications with local emergency dispatchers in anticipation of jammed voice lines when the storm arrived. The Kentucky Association of Electric Cooperatives (KAEC) reminded its members that it was prepared to act as a clearinghouse for requests for supplies and additional personnel.

"This one was well-advertised...But it was a highly anomalous event. It was the biggest ice storm in Kentucky history."

John Gordon, National Weather Service, Louisville

Governor Steve Beshear declared a statewide emergency as the storm began. This activated the Kentucky Emergency Operations Center (EOC) and put state resources at the ready to assist county and city emergency managers and responders.

The storm struck first with a mixture of snow, followed by sleet. Late on January 26th in western Kentucky and on the morning of January 27th in the Louisville area, the precipitation turned to freezing rain. According to the NWS, conditions had developed perfectly into a classic ice storm scenario.

A layer of relatively warm air several thousand feet thick was sandwiched between cold, snow-producing air above it and cold air near the surface. As snow fell through the warm air, it melted, turning into a cold rain. Early in the storm, the snow refroze as it neared the ground, becoming sleet. However, as the thickness of the air layers changed, the melted snow did not have time to refreeze, becoming supercooled liquid. When it landed on surfaces that were now at temperatures well below freezing, the rain instantly became ice.

While ice is a feature of nearly every winter storm in Kentucky, the January 2009 storm was unusual because it moved very slowly. The cold front propelling the storm stalled over the state, allowing the layer of warm air to override it, creating the severe icing conditions.

By the time the warm air layer dissipated, as much as two inches of ice coated every surface in some areas. Only the southeast corner of the state escaped significant ice accumulations. Total precipitation from the storm ranged from two inches to five inches, with the heaviest total in south central Kentucky, where much of it fell as rain. Snow depths increased along a south-to-north gradient, with many areas near the Tennessee border receiving no snow, while counties along the Ohio River received six to eight inches.

In the areas with the heaviest ice accumulations, (see Figure 5) the effect on utility infrastructure was immediate and devastating. Unlike the wind storm, in which most of the damage was caused by falling trees and limbs, the ice itself was heavy enough to bring down electric distribution lines and poles. Disintegrating trees magnified the problem, adding more weight as they toppled across lines.

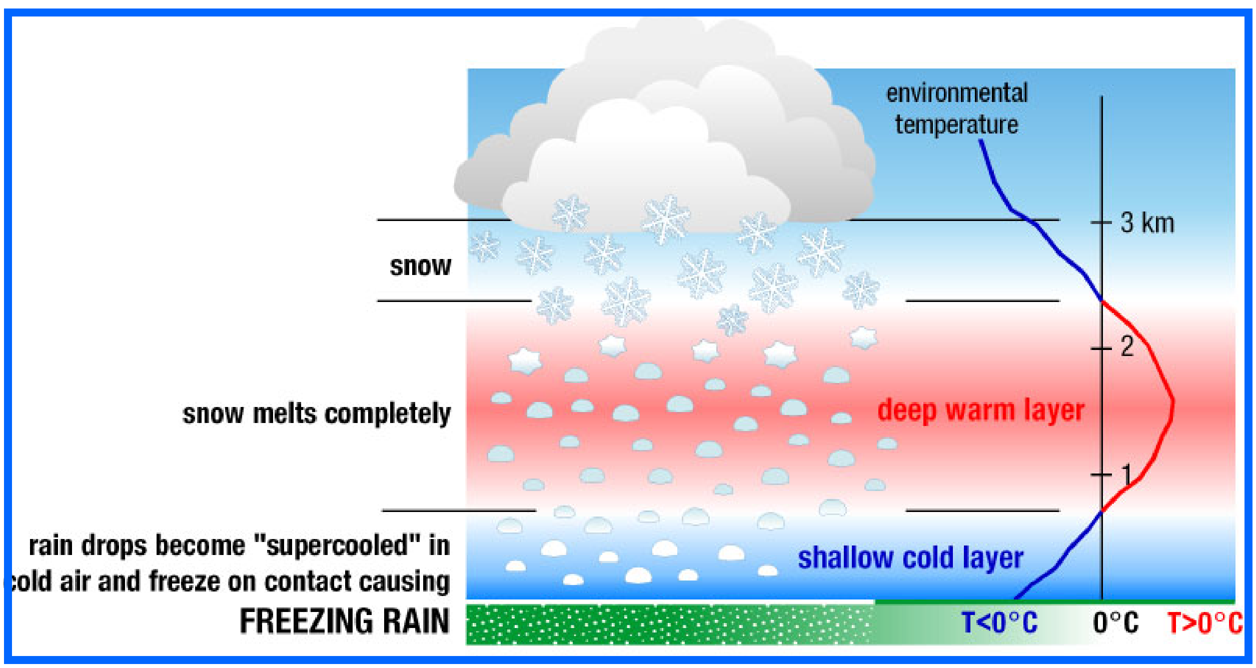

Figure 4: How freezing rain forms

Image courtesy of National Weather Service

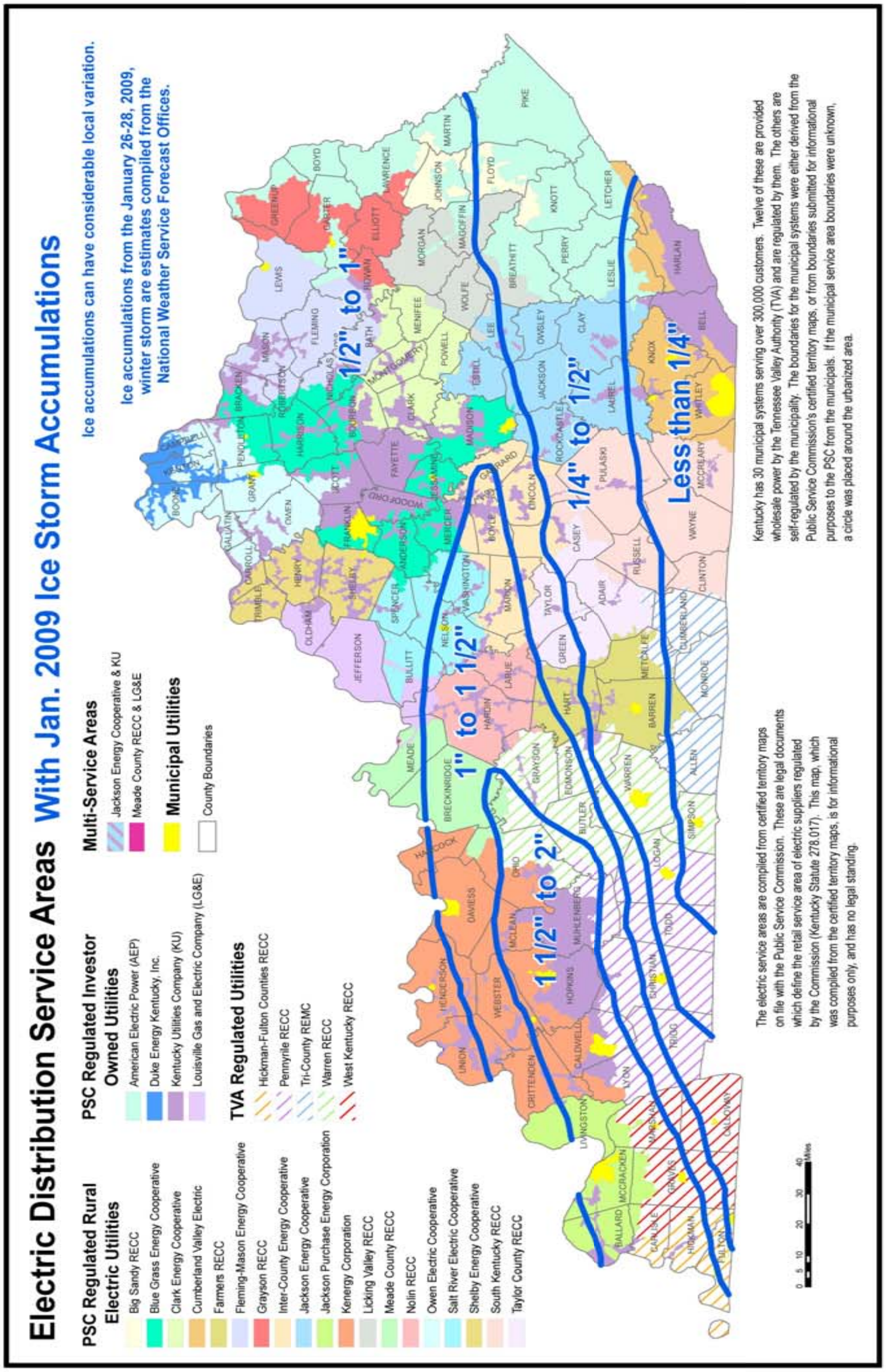

Figure 5: Ice accumulations during the January 2009 storm. The base map shows electric distribution utility service territories. Jurisdictional utilities are solid colors. Non-jurisdictional electric cooperatives have diagonal lines. Municipal utilities are in yellow.

PSC map

In all, the storm toppled about 10,600 poles in the distribution systems of jurisdictional electric utilities. Spaced 200 feet apart that number of poles would carry 381 miles of line – enough to stretch from one end of Kentucky to the other.

Electric transmission lines, which had largely withstood the 2008 wind storm, were far more vulnerable to the effects of ice, especially when amplified by the strong winds which followed within 48 to 72 hours. With low temperatures preventing any melting, the combined load of the ice and winds in excess of 40 miles per hour was enough to buckle transmission towers and snap bolts at section joints on steel monopole structures. In the first two or three days following the storm, most of the electric transmission grid west of Interstate 65 was out of service. At one point, KU had no functioning transmission lines west of Owensboro.

Another significant difference between the ice storm and the wind storm was the extent of damage to telecommunications. Some communities in western Kentucky were nearly cut off from the outside world for as long as three days. While local landline phone service generally continued uninterrupted, long-distance trunk lines ceased to function. Wireless phones also failed in many areas, usually due to some combination of icing on towers, loss of power or loss of interconnectivity with the larger phone network.

As a result, many communities had difficulty communicating their situation and emergency needs to regional or state disaster response officials. The mayor of Fulton reported driving into Tennessee in order to find a location where his cell phone would work. Other communities relied on shortwave radio (ham) operators for contact with the outside world for several days.

The weight of the ice, combined with strong winds, was enough to topple both metal and wooden transmission line structures in western Kentucky.

Photo courtesy of Kentucky Utilities Co.

Initial damage assessments proved difficult. Communication outages prevented a number of jurisdictional utilities from reporting outages to the Kentucky Public Service Commission (PSC) until January 29th or 30th. That in turn made it difficult for the PSC to provide a complete picture to the Kentucky EOC, for which the PSC has the responsibility of monitoring the status of jurisdictional electric utilities.

Further muddying the picture was the fact that non-jurisdictional utilities, which are not required to report outages to the PSC, were hit hard by the storm. These include the five rural electric cooperatives in western and south-central Kentucky that are part of the Tennessee Valley Authority (TVA) system, and 28 municipal utilities, many of them also served by the TVA. By February 2nd, the PSC had made arrangements for non-jurisdictional utilities to provide it with outage reports.

When all of the outage numbers were compiled, it was determined that nearly 770,000 customers – nearly one-third of all electric customers in Kentucky - were without power at the height of the storm. Of those, 162,000, or more than one-fifth – were served by non-jurisdictional utilities.

At least nine jurisdictional utilities – eight rural electric cooperatives and LG&E – saw more than half their customers lose power. Some of the hardest-hit utilities, including Kenergy, Jackson Purchase Energy and Inter-County Energy, had almost their entire systems without power in the initial hours of the storm.

Temperatures remained below freezing over most of the ice-covered area until January 31st. Not only did more lines and poles break under the continuing strain, but the persistent ice also created hazardous working conditions and greatly complicated recovery efforts. Recovery work was further complicated by the large number of roads blocked by fallen trees or power lines. By late afternoon on January 31st, jurisdictional utilities were reporting that 433,000 of their customers remained without power.

The situation improved rapidly as temperatures rose and ice began to melt. By the afternoon of February 1st, the outage total for jurisdictional utilities had fallen to 284,000 customers, meaning that nearly 150,000 customers had power restored in a 24-hour period. Much of that progress came as the result of repairs to transmission lines, which allowed large areas to be put back into service.

Typical ice accumulation in western Kentucky.

Photo courtesy of Jackson Purchase Energy

The progress also was due to a massive mobilization of restoration resources. Unlike September 2008, when both the Gulf Coast and neighboring states were recovering from major storms and outages, the ice storm struck mainly in Kentucky, with much smaller outages in Arkansas, Missouri, Indiana and Ohio. There were more resources available and less competition for them.

LG&E reported that it had 2,500 workers committed to the restoration effort by February 1st, while sister company KU reported a work force of 1,400, including nearly 400 transmission line repair specialists. Most of the restoration workers were contractors or mutual aid workers, including 700 from Southern Company alone.

The combined work force for the two E.ON US companies peaked on February 5th at 6,200. By then, LG&E was down to 2,000 workers, from a peak of 2,850, as restoration was completed in Louisville and personnel were shifted to western Kentucky. KU had 2,000 workers staged out of a regional operations center in Earlington, a number that posed logistical challenges, especially in keeping them housed and fed.

Fallen vegetation across roads was a major obstacle for restoration workers.

PSC photo

Altogether, about 10,000 utility workers were committed to the restoration effort in Kentucky. Hundreds more were engaged in providing logistical and back-office support and in customer service. Even with ongoing telecommunication disruptions in western Kentucky, huge numbers of calls were received. In the first week after the storm, LG&E recorded 365,000 calls, while KU received 268,000 calls. Combined, that amounts to about one call every second for seven days.

While electric utilities were most directly affected by the storm, other utilities also experienced service outages, often due to loss of power. As noted above, telecommunication services were severely disrupted in western Kentucky. Wireless providers who relied on backup generators to provide power to their towers generally fared better than those relying on battery backup. While batteries lasted only a few hours, towers could operate independently on generators for at least a day or two. However, even generators were no guarantee of service continuity. Localized fuel shortages were reported as a result of lack of power to operate pumps at retail locations, and a number of wireless providers reported difficulty in refueling generators because of fallen trees blocking access roads.

Water and wastewater utilities were affected largely as the result of power losses at treatment or pumping facilities. Many utilities reported that they were able to provide continuous service through a combination of preparation – filling tanks to capacity before the storm hit, for example – and the use of backup generators. A total of 32,765 customers of jurisdictional water utilities lost full service as a result of the storm, either through total water loss or because of low pressure that necessitated the issuance of boil-water advisories. The majority of the service disruptions lasted only a day or two. The total number of customers affected, as provided here, almost certainly understates the impact on water customers, because most Kentuckians are served by municipal utilities that are not within the PSC's jurisdiction and thus would not be covered in this report.

The first fatalities related to the ice storm were reported on January 29th. Three deaths occurred in northern Kentucky and one in Christian County. All were the result of carbon monoxide poisoning. An Owen County man was found dead in a home in which a propane heater was in use. In Harrison County, a couple died in their home after running a gasoline-powered portable generator in their basement. The Christian County death was the result of a generator being operated in a utility room.

The improper use of generators and heaters would account for about a third of the 36 deaths attributable to the ice storm in Kentucky. Despite repeated warnings from utilities, local officials and the PSC about the dangers associated with improper use of portable generators, carbon monoxide poisonings occurred throughout the three-week span of electric outages. Three deaths occurred in a single home in Louisville on January 30th. A generator was being operated in a garage. Two days later, a Louisville man died in a home in which a charcoal grill was being used to provide heat.

While no records were kept of hospitalizations due to carbon monoxide poisoning, newspaper accounts suggests they numbered in the scores, if not the hundreds. In one incident in Spencer County, 11 people in a single home were sickened by carbon monoxide from a generator being operated in the basement. A number of deaths were averted by Kentucky National Guard personnel or emergency workers conducting door-to-door checks in areas without power.

On February 5th, President Barack Obama declared a major disaster in Kentucky, making the state eligible for federal assistance. The declaration eventually was expanded to cover 103 of Kentucky's 120 counties. The declaration meant that the state, local governments, water districts and rural electric cooperatives would be eligible for reimbursement of a major portion of their storm-related costs.

At the time that the disaster declaration was made, total outages in the state had fallen to 137,000, with the vast majority in western Kentucky. LG&E had only about 1,900 customers left without power.

By February 9th – two weeks after the storm began – most of the snow and ice was gone and restoration workers had taken advantage of a stretch of warm weather to reduce total outages to 76,000. Restoration was nearing completion in the Louisville area. About one-fourth of those remaining without power were customers of Kenergy. KU, which had nearly completed restoration efforts in western Kentucky, had begun releasing crews to assist Kenergy in completing repairs to its system.

With 29,000 outages remaining and full power restoration seemingly a few days away, February 11th arrived with a weather forecast that included thunderstorms and strong winds sweeping across the state that afternoon. With trees weakened by the ice and many only-temporary repairs in place, local officials and utility companies braced for another round of outages.

When the thunderstorms hit, they brought winds gusting to 60 miles per hour. Within a few hours, an additional 142,000 customers lost power – many of them for the second time since the ice storm. In Louisville, strong winds toppled poles for entire blocks south of downtown. About 37,000 LG&E customers lost power.

Although the thunderstorms created new outages as far west as Hopkins County, their impact was concentrated east of Interstate 65. Kentucky Power had more customers affected by the wind from the thunderstorm than by the ice storm. The situation was similar for South Kentucky RECC.

With ample resources still available, power restoration in the wake of the high winds was completed in a matter of days. LG&E had completed restoration by February 14th. By February 16th, the number of customers still without power from the high winds stood at about 2,000 statewide – roughly the same number as were still waiting for power to be restored following the ice storm.

Full restoration was achieved within another week, with the exception of the customers who still required repairs to their homes before the electricity could be turned back on. Tragically, the final days of the recovery effort also brought the only restoration-related death. A lineman from a Minnesota electric cooperative was fatally injured while working to restore power for Jackson Purchase Energy.

Even after restoration was completed, customers of some utilities continued to feel the effects of the ice storm. Because normal utility operations had been suspended during the recovery effort, customers who were seeking to conduct routine business, such as opening, closing or transferring accounts, experienced delays.

Because many utilities had not read meters during the storm, large numbers of customers received estimated bills. The PSC received many complaints about the practice from customers who were unhappy that they were being charged for estimated electric usage for a period during which they had no power at all for a number of days. Inter-County Energy was the focus of many such complaints, with the problem exacerbated by the utility's billing software, which did not have the capability to adjust for both delayed billing dates and estimated readings, and thus produced inordinately high bills in a number of instances. The PSC investigated the problem and worked with Inter-County Energy to address it.

While some costs are still being tallied at the time of this report, it is clear that the ice storm was the costliest power outage in Kentucky's history. The total costs incurred by jurisdictional electric utilities were at least $240 million, with non-jurisdictional entities likely accounting for several tens of millions of additional costs. Of the $240 million, more than $162 million was incurred by investor-owned utilities and more than $77 million by electric cooperatives.

Nearly two-thirds of the total damage – $150 million – was incurred by the two E.ON US entities, LG&E and KU, with the latter accounting for $96 million of that sum. Together, the two utilities capitalized $36 million in restoration expenses and deferred $103.5 million in costs. Of the latter amount, KU accounted for $60.1 million. The PSC granted requests from LG&E and KU to establish regulatory assets for the purpose of deferring the storm costs.

Kentucky Power incurred $10.5 million in costs, with $4 million of that amount deferred. A request from Kentucky Power to establish a regulatory asset is pending before the Commission.

The amount of deferred storm-related costs to be recovered through rates will be determined in each utility's next rate case. None of the investor-owned utilities expected to recover any costs through insurance, nor are they eligible for federal or state disaster assistance reimbursements.

Kenergy ($29.5 million) and Jackson Purchase Energy ($12.5 million) accounted for more than half of the storm-related costs incurred by electric cooperatives. They and the other cooperatives expect to recover the majority of their costs through state and federal disaster assistance. Kenergy indicated to the PSC that it expects to recover $25.6 million, while Jackson Purchase Energy expects to recover $10.8 million. Together, the cooperatives expect to receive reimbursement for $65.6 million, or nearly 86 percent of their storm-related costs.

Insurance industry estimates put the insured losses from the ice storm in Kentucky at $335 million. When those losses are combined with the $41 million in costs incurred by local governments as identified by the Federal Emergency Management Agency, and the costs to jurisdictional utilities, the damage total rises to at least $616 million. This number does not include the millions in damage to non-jurisdictional utilities. Nor does it take into account the millions more in losses suffered by Kentucky residents and businesses that were not covered by insurance or disaster assistance. For example, a single large industrial facility in Ballard County reported losing $4.3 million as a result of being without full power for several days following the ice storm.

ELECTRIC UTILITIES

INTRODUCTION AND ELECTRIC SYSTEMS OVERVIEW

This section of the Kentucky Public Service Commission's (PSC) report on the 2008 wind storm and 2009 ice storm addresses issues related to electric utilities. It addresses the following issues:

- Preparedness and restoration
- Construction and maintenance standards and practices
- Vegetation management
- Underground utilities
- Cost recovery

The following explanation of the structure and function of electric systems is intended to equip the reader with information that will allow a fuller understanding of these issues.

Most electricity is generated at power plants by large turbine engines which are powered by the combustion of fossil fuels. In Kentucky, coal is the primary fuel, accounting for about 95 percent of all electric generation. Natural gas is a distant second. Combustion of these fuels heats water to make steam, which is then forced through a turbine to spin a generator, producing electricity.

Electricity is measured in volts, and the electricity emerges from a large generator usually at around 20,000-35,000 volts (20-35 kilovolts, or kV). The electricity from the generator is then transmitted through conductive metal (usually copper) wires to a "step-up" transmission substation in which the voltage is boosted to a much higher level, between 69 kV and 765 kV. The higher the voltage, the further the electricity can be transmitted over the electric transmission grid.

Electricity at these high voltages can be sent over long distances, often hundreds of miles. The electricity is sent out of the transmission substation over large transmission power lines, which may be supported by large steel towers or large wooden structures joined by cross-arms.

After the electricity has been stepped-up for long-distance transmission, the voltage is far too high to be used directly by industrial plants, commercial businesses, or residential customers. In order to be used by utility customers, the high-voltage transmission electricity must be "stepped down" to a lower voltage. Most heavy industrial machinery runs on electricity between 2,400 to 4,160 volts. Industrial plants often have dedicated substations to step down the voltage from the transmission line to the necessary level for use at the plant.

Business and residential customers use electricity at even lower voltages. For those customers, the transmission line delivers high-voltage electricity to a distribution substation which steps down the voltage, usually to between 14.4 kV to 2.4 kV. The electricity is then sent out of the substation through electric distribution power lines, which are usually suspended from the familiar utility poles (usually wood or steel) seen along most roadways.

When a distribution line reaches a business or residence, the electricity goes into a transformer - a pole-mounted drum or box, or, for underground electric service lines, a ground-level transformer box mounted on a concrete pad. In the same manner that a substation steps down the voltage from a transmission line, a transformer steps down the voltage of the distribution line to the end-use voltage of 120/240 volts, which powers most business machinery and household appliances and electronics. Some businesses using large machinery or air conditioning systems may require 3-phase lines to power 3-phase motors. The reduced-voltage electricity is then delivered to the business or residence through a single-phase property connection, often referred to as a “service drop.”

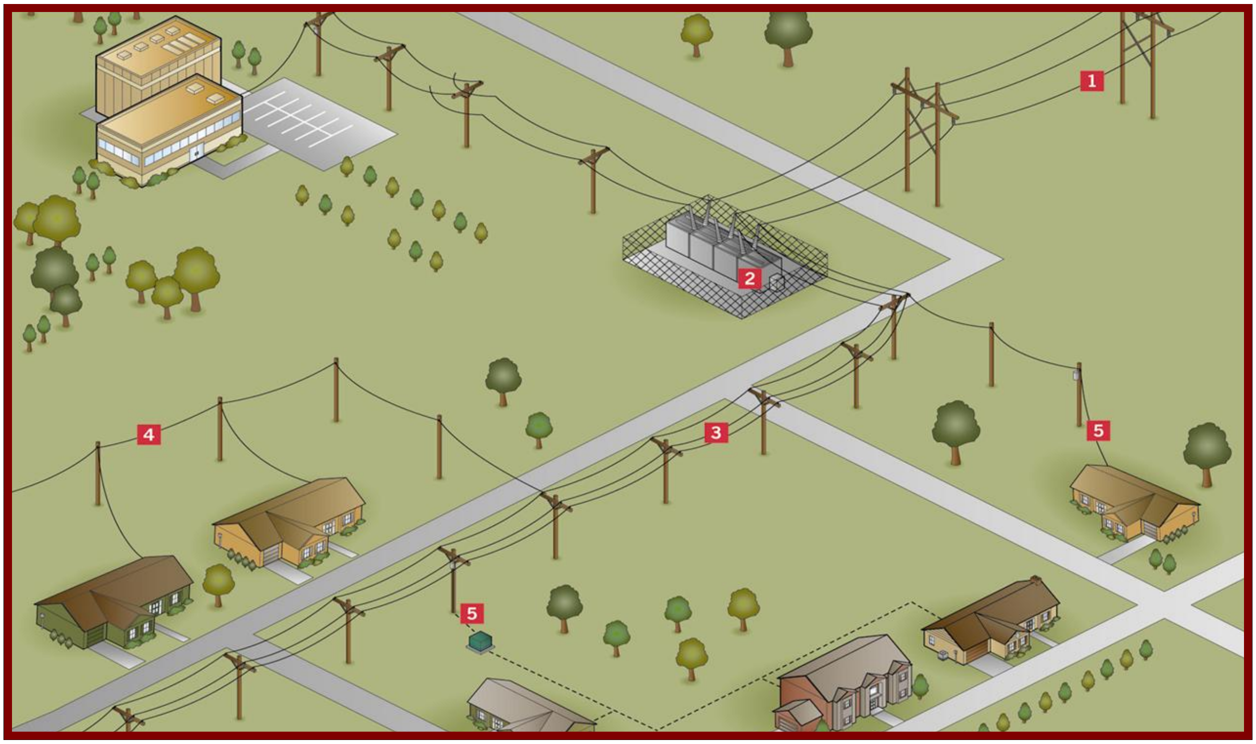

Figure 6: Electric distribution system

Transmission lines (1) carry electricity at high voltages to distribution substations (2). Primary distribution lines (3) carry power to large customers or to neighborhood distribution lines (4). Distribution line voltages are stepped down at either a pole-mounted or pad-mounted transformer and delivered to residential customers through an overhead or underground service connection (5), also known as a service drop. Transmission lines, substations and primary distribution lines are rarely underground, but neighborhood distribution lines and service drops are sometimes buried.

Diagram courtesy of Duke Energy Kentucky

ELECTRIC UTILITIES

PREPAREDNESS

Monitoring/Forecasting Weather Conditions

Prior to Hurricane Ike

That Kentucky's jurisdictional utilities were largely caught off-guard by the September 14, 2008, Hurricane Ike wind storm is not surprising. The National Weather Service (NWS) itself failed to foresee the intensity of the storm until just before it struck.

Jackson Purchase Energy Corp. noted that before the storm (and even as it was occurring) local and national forecasters were predicting winds of only 25 to 35 miles per hour in its western Kentucky service area. Kenergy Corp. stated that none of the various media sources monitored by their management and control center personnel predicted Hurricane Ike to slam into Kentucky with sustained winds of 60 miles per hour and gusts in excess of 70 miles per hour.

The Hurricane Ike wind storm was one of the most unusual weather phenomena the Commonwealth has ever seen. NWS research into the storm has found nothing in Kentucky's history to compare to it.

The unexpected nature of the wind storm, in turn, delayed utilities' restoration response efforts. Owen Electric Corp. stated that if it had been aware of the sheer magnitude of the outages the storm was going to cause, it would have pulled its resources together sooner, reducing restoration times. Shelby Energy Corp. said that a lack of advanced warning of the wind storm may have delayed its initial call-up of additional restoration crews.

Although larger utilities such as Duke Energy Kentucky (Duke Kentucky), Louisville Gas & Electric Co. (LG&E) and Kentucky Utilities Co. (KU) have internal weather monitoring capabilities and several personnel assigned to monitor and analyze weather information, even they were surprised by the ferocity of the winds. Duke Kentucky's parent corporation, Duke Energy, has its own staff of five meteorologists "whose job is to monitor weather conditions twenty-four hours a day, providing the company with needed information for both planning and trouble response." However, their up-to-the-minute weather reports did not predict the sudden turn that the storm took.

LG&E and KU's account of the pre-storm events dramatically illustrates the surprise with which Hurricane Ike visited the Commonwealth on September 14, 2008:

> *Early on September 13th, NOAA predicted the path of Ike to proceed just north of Kentucky as it moved inland September 13. However, LG&E and KU continued to monitor weather forecasts and storm predictions to anticipate the potential for changes to the forecast and any impact to the companies' systems. Then, on September 14th, NOAA's predictions put Ike well north of Kentucky as it moved inland.*

Indeed, that same day the winds associated with the storm were forecast to be less than 35 to 45 mph on September 14 through the next six days.

In Kentucky, the early morning forecast on September 14 predicted winds that would not be unusual for the region as of 5:00 a.m. EDT that day, NOAA Advisory Number 53 predicted that Hurricane Ike would be downgraded to a tropical depression with maximum wind speeds falling below 39 mph. (See figures … provided as part of' Advisory Number 53). The storm was shown as a tropical depression with winds of less than 39 mph passing to the north of Kentucky and not significantly impacting the companies' service areas). Advisory Number 53 also included an Intensity (Maximum Wind Speed) Probability Table. That table described maximum forecast winds of 45 mph and placed the probability of Hurricane-force winds between the time Advisory Number 53 was issued and midday September 15 at less than one percent.

Despite those forecasts, the remnants of Hurricane Ike combined with a cold front crossing the Ohio Valley to cause extremely strong surface winds that blew through the KU and LG&E service areas beginning later in the morning of September 14. That phenomenon resulted from 50-80 mph winds around 3,000-6,000 feet above the ground, i.e., a low-level jet stream associated with and ahead of the remnants of Hurricane Ike, being directed downward as surface heating (due to some sunshine) resulted in steep low-level lapse rates (temperatures decreasing rapidly with height from the surface to the level of these maximum winds). Such lapse rates allowed winds aloft to mix down to the surface causing the strong, damaging wind gusts. ... While extraordinary wind speeds were recorded across much of the area, the maps show a gust of 75 mph recorded in Jefferson County, the heart of LG&E's service territory, and gusts of 70-80 mph just east of Paducah where the greatest concentration of wind damage and power outages in the KU service territory occurred.

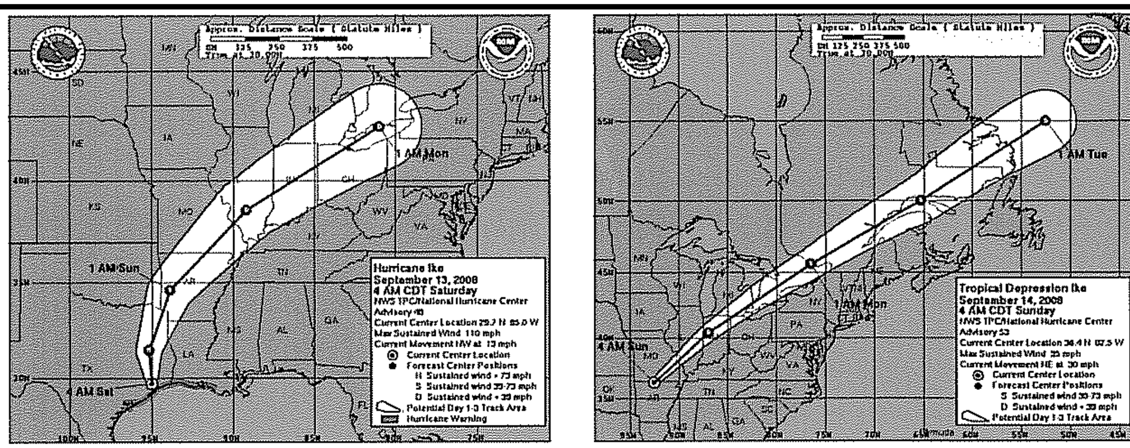

Figure 4 - NOAA Projected Ike Path, September 13[7] **Figure 5 - NOAA Projected IKE Path September 14[8]**

Figure 7: Predicted Hurricane Ike storm tracks, as referenced by LG&E and KU in their narrative of the weather forecasts prior to the wind storm.

Image courtesy of E.ON US

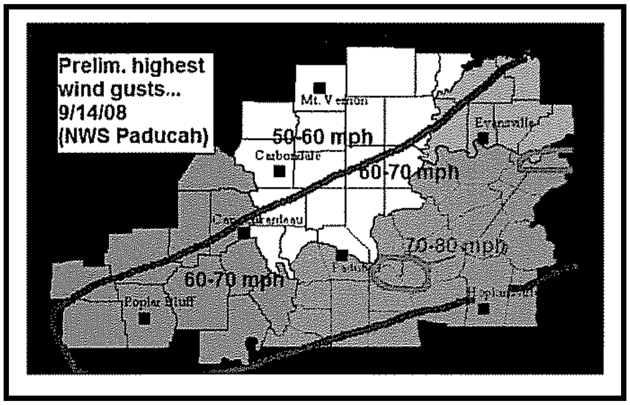

Figure 8: Maximum wind gusts in western Kentucky

Image courtesy of National Weather Service

The very high sustained winds of the Hurricane Ike wind storm made conditions too hazardous for some of the utilities to begin their restoration efforts on the day of the storm. Kenergy reported that “high winds made working conditions unsafe and impossible for crews to actually restore power for most of the first day….” Kenergy said it was only marginally successful in making its initial damage assessment because “new damage was happening while the assessments were taking place.” Owen Electric called in its construction crews and damage assessors during the storm but, due to safety concerns, it did not send them out to the field until after the storm subsided.

Prior to 2009 ice storm

Unlike the Hurricane Ike wind storm, the massive ice storm which struck Kentucky on January 26, 2009, was predicted well in advance. This gave utility companies and cooperatives the opportunity to prepare for their restoration efforts. The extent of the devastation, however, was unforseen.

Utilities had much more advanced notice that a major ice storm was approaching the area. While the intensity of the ice storm was not evident until the storm struck, the utilities know that even less intense ice storms are capable of producing major outages. Thus, the utilities knew at least a day or two before the storm struck that they should prepare for the need to restore service once the ice storm hit.

Big Rivers Electric Corp. (BREC) began monitoring the approach of the ice storm on January 23, 2009, some three days prior to its arrival, as did several other utilities, including LG&E and KU. According to LG&E and KU’s account, they monitored the weather very closely throughout the weekend, by the end of which forecasters were calling for a quarter inch or more of ice across Kentucky. On Monday, January 26, 2009, LG&E and KU participated in two NWS conference calls, including one hosted by the NWS office in Paducah, which predicted that the storm could be “the worst storm of the decade.”

Meteorologists at the Louisville NWS office reported that a number of utilities in Kentucky participate in their severe weather conference calls and said that they would welcome wider participation by utilities.

The Commission recommends that every jurisdictional electric utility company contact the NWS office covering its service area to establish e-mail notification of such conference calls and participate in such calls when notified. The PSC believes it would be beneficial for all jurisdictional utilities to familiarize themselves with the weather data the NWS provides in advance of and during major weather events. The PSC intends to organize a meeting at which NWS officials will be invited to provide an overview of their services to jurisdictional utilities.

In addition to the Louisville NWS office, which covers 49 counties, there are NWS offices in Paducah (22 counties) and Jackson, Kentucky (33 counties). Greenup, Boyd, Carter and Lawrence Counties are covered by the Charleston, West Virginia, NWS office, and twelve northern central counties are covered by the Wilmington, Ohio, NWS office. The Kentucky counties covered by each NWS office can be found at the following NWS Web sites:

Louisville:
http://www.crh.noaa.gov/lmk/?n=lmk_cwa
Paducah:
http://www.crh.noaa.gov/pah/?n=officeinfo
Jackson:
http://www.crh.noaa.gov/jkl/?n=forecast_area
Wilmington, Ohio:
http://www.erh.noaa.gov/er/iln/graphmap.htm
Charleston, West Virginia:
http://www.erh.noaa.gov/rlx/

Jackson Purchase Energy noted that weather forecasts leading up to the ice storm were beginning to call it a 10-year storm. Jackson Purchase Energy said that it was anticipating a severe weather event "similar to (or possibly a little worse than) the ice storm of February 2008." The February 11-12, 2008, ice storm caused outages to over 58,000 electric customers in parts of western Kentucky. The damage was confined to a relatively limited area of western Kentucky.

By Monday afternoon, January 26th, NWS predictions for western Kentucky were calling for one half inch to one inch of ice to the west of I-65 and two inches to the west of the Edward T. Breathitt Parkway, with ice changing over to snow late Tuesday night and continuing until mid-day Wednesday. It was evident by then that the 2009 ice storm would turn out to be one of the most devastating weather events to ever strike Kentucky.

Storm Preparations

Most utilities took a number of proactive measures in advance of the storm, which helped them prepare for the restoration effort. Meade County RECC made sure all of its crews and trucks had the necessary equipment, material, and fuel to move and respond to outages and emergencies.

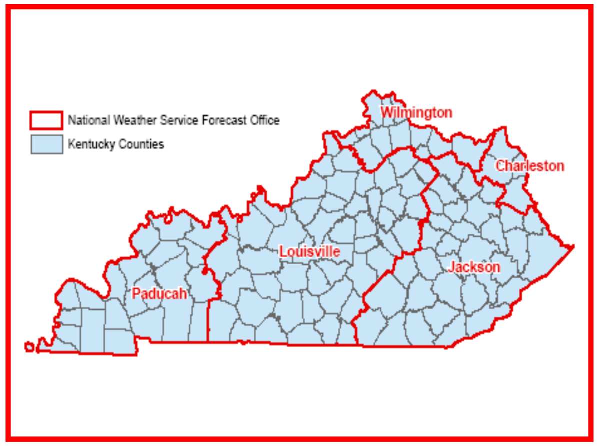

Figure 9: National Weather Service offices serving Kentucky

PSC map

In the days leading up to the ice storm, Shelby Energy disseminated all of the information it had gathered about the storm to all of its employees who might become involved in restoration efforts. Shelby Energy instructed all of its employees and contractors who were not already on call to be on alert and to respond as quickly as possible if called. Shelby Energy also informed its contract and construction crews about the ice storm so that they could prepare their work sites where construction was then currently underway before the ice storm arrived.

Shelby Energy also double-checked its material stocks in its warehouse to be sure that they had enough materials for storm restoration operations. Shelby Energy believes that its weather monitoring and information gathering prior to the 2009 ice storm helped it prepare for the storm and facilitated its restoration efforts after the storm hit.

The investor-owned utilities also made preparations for the ice storm, aiding their response to the outages. Duke Kentucky stated that, as the ice storm approached and the impact area became more clearly defined, it held storm preparation calls to notify all of its internal resources, contractors, and material vendors. After they had informed and prepared their own personnel for the ice storm, Duke Kentucky contacted its mutual assistance members "to compare forecasts and to determine potential outside resource availability." Duke Kentucky credits early notification of the ice storm with providing the company the necessary time to identify and prepare the resources it needed to quickly and safely perform its restoration operations.

Kentucky Power's management and local office personnel analyzed the information relayed to its dispatch personnel from the American Electric Power Co. (its parent entity) meteorologist and used that information to call in and hold crews past their regular work hours. LG&E and KU also began holding over its restoration crews and support employees as the forecasts continued to indicate the increasing severity of the ice storm.

Most of the utilities used their advanced knowledge of the oncoming ice storm to ensure sufficient extra personnel were on hand to deal with the post-storm restoration efforts. Farmers Rural Electric Cooperative Corp. (RECC) expedited its request for additional work crews based on the weather forecasts and the reports from their field personnel. Jackson Energy Corp. had its call center manned early, had extra dispatchers on duty, and prepared its vehicles for the icy conditions.

Inter-County Energy Corp. used the time provided by the advanced storm warning to contact all the emergency 911 dispatchers in its service territory to notify them of the forecasted weather and to determine whether Inter-County Energy had current fax numbers for each of the dispatchers. After determining the correct fax number for all six of the 911 dispatchers in its area, Inter-County Energy sent a test fax to each of them on the afternoon of Monday, January 26th to ensure that they could communicate by fax when the telephone lines would likely be jammed with calls from persons seeking emergency help.

Based on the weather forecasts it was monitoring, Jackson Purchase Energy held one line crew, two dispatchers, a supervisor, and an engineer over to work on the night of January 26, 2009. Jackson Purchase Energy states that this preparation allowed it to begin calling in additional crews and calling for outside assistance a few hours earlier than if it had not been closely monitoring the weather forecasts.

On January 26, 2009, Kenergy secured hotel rooms in anticipation of the need to house its outside assistance personnel and placed all of its employees and its construction contractors on alert for "prolonged outage work." Prior to the ice storm, Kenergy also fueled its vehicles and equipment to be used for restoration operations, filled and tested its on site generators, and replenished its fuel storage tanks. Kenergy also sent some of its employees home in company-owned vehicles to reduce their response time the following morning.

Several of the electric cooperatives, all of whom are members of the Kentucky Association of Electric Cooperatives (KAEC), took time before the ice storm to talk with representatives at KAEC. Meade County RECC stated that "KAEC was reminding the cooperatives about the Association's role in assisting, which included the supply of materials and the organizing of outside restoration help." Clark Energy and Shelby Energy stated that they kept in close contact with KAEC, and Jackson Purchase Energy stated that it called KAEC the day before the ice storm "to ensure they would be ready to coordinate assistance if required."

KAEC located four crews from cooperatives in Virginia to help Shelby Energy with storm restoration, and KAEC helped work out the details necessary to bring the crews to Kentucky. KAEC has close ties with similar, sister organizations in other states, and these entities work together to help cooperatives with manpower needs during storm restoration efforts.

Shelby Energy more fully explained the role that KAEC plays during major outage events affecting multiple rural electric cooperatives:

> *KAEC serves in a type of clearinghouse role concerning manpower needs for Kentucky cooperatives during storm restoration efforts and other emergencies. This is positive for all Kentucky cooperatives, because it helps to avoid duplication of effort, helps to prioritize needs, and assists with limiting confusion and/or improper coordination. Immediately following the 2009 Ice Storm, KAEC organized and held daily statewide conference calls for all Kentucky cooperatives for as long as the cooperatives deemed it necessary. These conference calls were very beneficial to cooperatives in many ways.*

The KAEC served as an effective clearinghouse for information and assistance during these major storms. The PSC strongly recommends that any electric cooperative that has not availed themselves of this service in the past take steps to ensure that they do so in the future.

A scene in Kenergy's service territory the day after the ice storm.

Photo courtesy of Kenergy Corp.

Coordination with equipment/materials suppliers

Jurisdictional electric utilities have a wide variety of methods to coordinate the acquisition of materials and equipment. Some utilities have "storm stock," which is equipment that is dedicated for use only during storm situations. Others utilities increase the amounts of their normal stock levels to insure adequate materials until shipments of additional material can be obtained. Many of the rural electric cooperatives use United Utility Supply, which is affiliated with KAEC, as a major source of transformers.

Access to and acquisition of materials was not an issue in either the Hurricane Ike wind storm or the 2009 ice storm. Utilities have not reported any problems in previous major outages. Thus, it is reasonable to conclude that utilities are adequately prepared when it comes to coordinating the acquisition of materials and supplies.

Requests for mutual aid and outside assistance

A number of different approaches are used by the electric utilities in determining when to make a request for mutual aid restoration crews. In one case, a utility's board of directors has set an anticipated eight-hour restoration time as the trigger for requesting mutual aid.

In some cases, a utility's senior staff evaluate the extent of the outages and make the decision on calling for mutual aid. Many of the jurisdictional electric utilities use their emergency restoration plan to determine when it becomes necessary to request mutual assistance. The regulated electric utilities have had these standards in place for many years, but they are constantly evolving. Some of the utilities stated that they are reviewing their standards or requirements for requesting mutual aid.

Larger utilities are able to draw on company resources in other service territories or states before requesting mutual aid. Other regulated electric utilities set a baseline for estimated restoration times such as 12 hours, 24 hours or 48 hours. These timeframes are determined by different criteria such as using their Supervisory Control and Data Acquisition (SCADA) system to track the number of substations and circuits that are off line. A SCADA control center performs centralized monitoring and control for field sites over long-distance communications networks, including monitoring alarms and processing status data.

Based on information received from remote stations, automated or operator-driven supervisory commands can be sent to remote station control devices, which are often referred to as field devices. Field devices control local operations such as opening and closing switches and breakers, collecting data from sensor systems, and monitoring the local environment for alarm conditions.

Crews from Sumter Utilities of South Carolina were among those working in Jefferson County to repair damage from the 2008 wind storm.

PSC photo

Exchange and updating of emergency contact information.

Most jurisdictional utilities reported exchanging and updating emergency contact information with local and state emergency management officials, and local government officials annually. A few utilities update their information less regularly.

The PSC recommends that emergency contact information be exchanged and updated on an annual basis in order to maintain adequate lines of communication.

Pre-positioning equipment, materials and restoration crews.

Pre-positioning of equipment, material and personnel prior to a major event is not a practice used by regulated electric utilities. Most of the utilities have multiple offices and operation centers throughout their service territories which allow them to have ready access to materials and equipment on a day-to-day basis. Utilities believe that they can rely on their established locations during major events and add to the number of resources at each location to meet the added need. Some utilities establish additional staging areas during severe events.

Planning for extreme weather events due to climate change

Only one utility indicated that it has evaluated the increased possibility of extreme weather events or climate change as part of its long-term risk management. Owen Electric Corp. stated that its strategic plan recognizes an increase in major outages. Owen Electric has made key action items a part of the strategic plan, budget, personal performance plans, and compensation plans.

As a result they have proactively made many enhancements to their reliability and member support programs:

- Weekly member questions/issues meetings during which a team proactively addresses each question or issue.
- Initiated a circuit hardening program in which guy insulators, add/change cut-outs, upgrade arresters, and animal protection, etc. are added.
- Added a mid-cycle trim for the first section of each circuit out from a substation.
- Created a new Manager of System Operation over the control room area to increase manpower and focus on that area.
- Started deploying new electronic reclosers for improved coordination and sequence coordination.
- They have changed materials to improve reliability.
- Performed a new coordination study to find ways to improve protective coordination.
- Reorganized a small conductor change-out program to focus on the ten worst performing circuits, the most distant circuits, and the areas with the longest spans.
- They have been more aggressive with the right-of-way trimming program with the additions of the Hydro-Axe, Sky Trim, improved spray program, and yard trees.
- Used automatic meter reading data for blink monitoring, transformer overloads, and voltage monitoring.
- They are piloting a project with one of the software vendors with load flow analysis using AMI data that will significantly improve its accuracy resulting in better coordination and more timely system upgrades.
- Every shift’s outage report is sent to staff members for review to assure everything is working properly.

- They have periodic Reliability Team meetings to look for trends and system modifications that can be made to improve reliability.
- They have rebuilt the control room to make it more efficient.
- They are upgrading their substation SCADA systems to bring back fault current data so they can calculate the location of the fault and send crews directly to the site. They have also purchased additional fault indicators to help locate faults.

The PSC notes that while there is a scientific consensus that the Earth's climate is generally growing warmer, it notes also that there is far less agreement on the implications of that change on the likelihood and intensity of extreme weather events in any given location. Meteorologists consulted by the PSC suggested that too much uncertainty remains to conclude that extreme weather events are becoming more frequent or severe.

Should that prove to be the case, utilities may be forced to reconsider the adequacy of current measures intended to provide system reliability in the face of extreme weather.

Emergency Planning Exercises

Electric utilities were asked whether they had participated in any emergency planning drills with state and local emergency officials between January 1, 2006 and January 1, 2009. Only nine of the 23 utilities responded that they had: Clark Energy, Farmers RECC, Inter-County Energy, Licking Valley RECC, LG&E, KU, Meade County RECC, Nolin RECC and Salt River Electric Corp.

Nearly half of the utilities reported that they do not undertake any regularly scheduled emergency planning with local or state emergency planning officials. This figure includes not only many small distribution cooperatives but also some of the larger investor-owned utilities as well.

BREC stated that it did not participate in any emergency planning drills or any "table-top" exercises designed to coordinate emergency response efforts with local and/or state officials. Kentucky Power, Big Sandy RECC, Blue Grass Energy Cooperative, Jackson Purchase Energy, South Kentucky RECC, and Taylor County RECC reported that they had not participated in any emergency planning exercises.

Cumberland Valley Electric Corp. said that it had not conducted any drills with local emergency management officials, but said that its experiences in actual emergency events provided better emergency planning preparation than would emergency drills. Cumberland Valley Electric admits, though, that "[t]hese actual events did not necessarily include any coordination or communication with emergency management officials."

Duke Kentucky said that while it did not participate in any "official" emergency planning drills or table top drills with local or state emergency officials from January 1, 2006 to January 1, 2009, after the Hurricane Ike wind storm it did meet with local fire and emergency management departments to discuss any concerns that they had during the restoration efforts.

Owen Electric said that it had not participated in any emergency training with state or local officials from 2006 to 2009. However, it said that in 2006 several of its employees attended National Incident Management System ("NIMS") training at a locally-offered seminar. Shelby Energy stated that it has conducted in-house emergency drills but has not participated in any drills with state or local government.

Some utilities indicated that they have not done cooperative emergency planning with state or local emergency management officials because they had not been invited to do so by those local or state officials. Clark Energy stated that "[t]he reason for not attending more meetings is because we have not been contacted to do so." Cumberland Valley Electric stated that it is not aware of any regularly scheduled emergency planning drills with local or state emergency officials and also unaware of any "participation requirement." Jackson Purchase Energy said that it "had not been invited to participate in any such exercises prior to this [ice storm] event."

Licking Valley RECC said that it had not been able to schedule emergency planning drills with local officials, and Owen Electric said that there was no specific reason it had not participated in prior emergency planning drills, "other than [such drills have] never been organized." BREC said that it was unaware of any emergency planning drills within its service territory during 2006-2009 in which it was requested to participate. Fleming-Mason Energy said that it "would support any local and/or state emergency drills but have not been approached to do so."

Other utilities point to their own in-house emergency planning or during-event practices as being sufficient. East Kentucky Power Cooperative (EKPC) stated that:

> *Typically, EKPC directly contacts local and/or state emergency officials on an as-needed basis for any emergency assistance required during transmission restoration activities. To date, this process has been found sufficient to coordinate any assistance with these entities during transmission outages regardless of their extent. Given this history and wide range of transmission outage scenarios possible, large scale drills with emergency officials have not been conducted.*

Kenergy noted that it conducts an annual in-house "table-top" test of its Emergency Restoration Plan. Jackson Energy conducted annual "table-top" exercises in 2006, 2007, and 2008, and after each exercise it revised its Emergency Response Plan, including updating contact information for all state and local emergency personnel. Shelby Energy also stated that it conducts in-house emergency drills. One utility, Taylor County RECC, stated that they simply had not been able to coordinate a time for such emergency planning. ("At no fault of local officials we have not been able to coordinate a time.") Taylor County RECC said that it "could do a better job in coordinating/participating in drills."

None of the utilities stated that cost was a factor which has prevented them from conducting emergency drills with local and state officials. However, some utilities indicated that they have had some problems in coordinating such planning with local and state officials. Jackson Energy said that it has not conducted emergency drills with local and state officials "due to coordination issues." Jackson Energy also expressed its concern that if such emergency training was to take place that all necessary emergency officials might not participate: "Would all officials participate and what benefit would the drill be if only a few participated?" Salt River also noted that "[s]cheduling is sometimes an issue due to the disruption to normal operations."

Some utilities stated that they have now contacted local emergency management officials in order to do emergency planning in the future, including Big Sandy RECC, Clark Energy and Cumberland Valley. Big Sandy RECC said that it has contacted local emergency management officials to facilitate future planning. Clark Energy stated that its lack of prior emergency planning "simply appears to be a problem of no one taking the initiative to set up such meetings," and it stated that it would "make an effort to further such relationships in the future." Cumberland Valley Electric said that its management team does communicate with local emergency officials during major events and suggested that "[a]s for possible solutions, it seems that the assumption of coordination responsibility by some person or entity would be an appropriate beginning."

Among the more instructive responses from the utilities concerning emergency training were those of Meade County RECC, Nolin RECC, and Salt River Electric. In April 2007 those utilities and others participated in a region-wide emergency planning event entitled, "Area 5 'Lincoln Trail on the Rocks.'" "Area 5" refers to the Kentucky Division of Emergency Management (DEM) Area Office 5, which at the time encompassed Breckinridge, Grayson, Green, Hardin, Larue, Marion, Meade, Nelson, Taylor, and Washington Counties.

The "Lincoln Trail on the Rocks" exercise was a mock disaster drill, including an ice storm, coupled with a train derailment and the collapse of a roof at a local high school. Along with the three RECCs mentioned above, other utility participants included, Warren RECC, Inter-County Energy, Texas Gas of Breckinridge County, Leitchfield Public Utilities, and Bardstown Municipal Electric Light and Gas. State and local emergency officials who participated included DEM, the Kentucky Transportation Cabinet, the Kentucky Department of Agriculture, Kentucky State Police, Kentucky National Guard, Kentucky Fire Marshall's Office, representatives of Fort Knox, Region 5 Hazmat officials, the Meade County Judge-Executive, the mayor of Brandenburg, other local law enforcement offices, emergency medical services, county school system personnel, and county road departments.

Ice on Jackson Purchase Energy distribution lines

Photo courtesy of Jackson Purchase Energy

Meade County RECC describes "Lincoln Trail on the Rocks" as a "mostly tabletop exercise" in which each entity would respond to the various emergency scenarios they were given with the actions it would or could perform. Nolin RECC said that during the event the Compliance Coordinator was in the emergency Command Center and "as situations developed (i.e. poles broken across major road ways, hospitals without service) the Compliance Coordinator would 'dispatch' simulated crews and estimate response times." Salt River Electric said that it worked with personnel from the Nelson County Works Department who would clear the roadways of snow and trees so that Salt River's crews could reach the outage sites and perform repairs.

Meade County RECC and Nolin RECC found their participation in the "Lincoln Trail on the Rocks" exercise to be beneficial, although primarily from the standpoint of improving their contacts and communication with state and local emergency officials. Nolin RECC noted that most of its emergency preparedness steps have been implemented due to "real world situations," not emergency planning drills, but that such drills do provide the utility the opportunity to test these emergency steps and make improvements—especially in the areas of enhancing communications with employees and members during a major weather event. Meade County RECC said that "learning and meeting who the people we need to contact in such emergencies was a help," but found the overall experience somewhat "limited" in its usefulness.

Meade County RECC said that as a result of its participation in the "Lincoln Trail on the Rocks" exercise and the 2009 ice storm, it will be adding the local fuel supplier with the fuel tanker to its list of contacts. Nolin RECC said that it updated its emergency contact list as a result of its participation in "Lincoln Trail on the Rocks."

Salt River Electric said that its participation in the "Lincoln Trail on the Rocks" exercise did not make it more prepared for the 2009 ice storm. However, it said that the contacts it established with local Nelson County officials "did help keep the lines of communication open during the ice storm restoration." Salt River Electric did not make any changes to its emergency response plan as a result of participating in "Lincoln Trail on the Rocks."

None of the utilities noted any major expenses associated with their participation in the emergency planning drill. Meade County RECC said that it cost less than $1,000, while Salt River Electric counted only its daily wages for its training and safety coordinator, and Nolin RECC said that there was "no cost," for its participation.

Utilities participating in the "Area 5 'Lincoln Trail on the Rocks'" exercise stated they would participate in similar events in the future.

Broken crossarms on LG&E pole in Louisville
After 2008 wind storm

PSC photo

The PSC believes that the experiences related above demonstrate the value of participation in local, regional and statewide emergency planning drills. The Commission strongly recommends that that all jurisdictional utilities avail themselves of opportunities to participate in such exercises. The Commission also encourages organizers of such exercises to solicit utility participation.

The ability to immediately identify key emergency management personnel with whom utilities must coordinate in weather emergencies and other disasters will help utilities obtain needed assistance in road clearing, traffic management, vehicle and equipment acquisition, communications coordination, manpower acquisition, and all other areas of assistance that the Kentucky Division of Emergency Management (DEM) and its associated local and state organizations can provide. The Commission is certain that such efforts will enable utilities to restore power in future disaster situations in a much quicker and, ultimately, safer manner, eliminating delays and complications caused by a lack of preparedness.

The Commission recommends that all electric utilities examine their Emergency Response Plans to ensure that they have adequate provisions for either dedicated fuel tankers or other vehicle fuel sources during emergency restoration operations.

All jurisdictional electric utilities indicated a willingness to support and participate in annual or semi-annual regional or statewide emergency drills with local and state emergency management officials and local government officials.

The Commission notes that the Kentucky General Assembly has mandated the creation of a statewide emergency management system capable of dealing with disasters and emergency occurrences, including, specifically, ice storms, power failure or energy shortages, and major utility system failure. Pursuant to KRS 39A.030, the Kentucky Division of Emergency Management was created by the General Assembly.

Under KRS 39A.050, DEM is given the responsibility for coordinating "all matters pertaining to the comprehensive emergency management program and disaster and emergency response of the Commonwealth." DEM is also required by statute to "institute public information and education programs, emergency management training programs, and exercise programs to test and evaluate emergency operations plans and disaster and emergency response and recovery capabilities."

Therefore, the Commission believes DEM is the state agency with primary authority and responsibility for coordinating the annual regional or statewide emergency management drills in which the Commission has recommended utility participation. The PSC, in its capacity as the regulatory agency over many of Kentucky's electric, water, wastewater, gas, and telecommunication utility companies, stands ready to assist DEM in these efforts.

Ice coats lines in western Kentucky.

Photo courtesy of Jackson Purchase Energy

ELECTRIC UTILITIES

RESTORATION

INITIAL DAMAGE ASSESSMENTS - 2009 ICE STORM

After the ice storm struck Kentucky, transmission utilities used radio-controlled line switching to isolate the damage and dispatched field personnel to repair the transmission lines. Due to the inclement weather conditions on January 27, 2009, through January 29, 2009, the utilities were not able to effectively utilize helicopters for aerial reconnaissance work.

Thus, all information gathering for evaluation and assessment of the damages on the transmission system was done by ground inspection and by monitoring their SCADA systems. As soon as the weather permitted, aerial patrols were used to assess damage to significant portions of the system.

Distribution system operators indicated that outages received through their outage management systems, customer calls, utility crews, and emergency management calls were used to assess the damages to their distribution system. An outage management system (OMS) is a software program that provides a utility with an overall display of the status of its system and the location of outages. Management and utility personnel used the information from their OMS to evaluate the need for outside assistance crews and to determine where crews should be assigned to begin the restoration effort.

The utilities without OMS relied on their employees' knowledge of their systems to manually sort through the outages and determine the locations where damage to their systems had occurred.

COORDINATION WITH GOVERNMENT ENTITIES

Coordination with state and local emergency managers

Many of the jurisdictional electric utilities worked closely with local officials to assist in community emergency response efforts. Some of these utilities provided staff to support the local Emergency Operation Centers (EOCs). During the first days following the ice storm some of the utilities were without basic communications and were unable to communicate with the PSC through the outage reporting system. Most of the utilities which experienced such communication difficulties provided outage information to PSC staff by cell phones, if service was available.

During an emergency situation involving major utility outages, DEM activates the state EOC located at Boone National Guard Center in Frankfort. DEM directly notifies the PSC's appointed representatives of the EOC activation and advises the EOC representatives on the level of participation required. When requested by DEM, the PSC's EOC representatives go to the EOC in order to provide on-site representation for the PSC.

Other PSC staff members are advised of the utility areas that are affected and are directed to provide support and assist the PSC's EOC representative(s) with utility outage-related matters.

During EOC activation, the PSC's EOC representative disseminates utility outage information through the EOC and coordinates requests for assistance and information involving utility services and facilities. Other PSC personnel establish contact with affected utilities, monitor outage reports and solicit updated information as required, and respond to requests for assistance and information from the EOC by contacting utilities for action and/or response.

During the communication outage following the ice storm, the utilities supported their local EOCs by assigning staff or through daily visits to participate in meetings. Once telephone communications had been restored, they provided updates via telephone. Many of these telephone updates took place multiple times per day during the restoration efforts. Daily telephone conferences were held by the utilities with the emergency management agencies across the state throughout the 2009 ice storm restoration.

During both the 2008 wind storm and 2009 ice storm, utilities reported outage information to the PSC twice daily. These outage updates were then sent to the PSC representative at the state EOC. This outage information was used to determine if any state assistance or support would be needed in a particular area of the state, and to help coordinate any critical or priority restorations needs.

Coordination with other state and local government officials

As the PSC noted in its report on the 2003 ice storm in central and northeast Kentucky, ensuring "that elected officials and local communities fully understand the situation and have current estimates of when critical services will be restored is very important."

State and local elected officials are often the first persons that members of the public turn to in for information when a disaster occurs.

Many state and local government agencies need to know information about restoration times and how they can provide assistance to the utilities. For example, the Kentucky Division of Water needs to know when power to sewage treatment and drinking water facilities has been cut off and when it will likely be restored so that officials can take appropriate steps to warn the public of any health hazards associated with a lack of clean water or from sewage spills into the creeks and streams into which wastewater facilities normally discharge their treated effluent.

Likewise, the Kentucky DEM has local and regional officers who coordinate the physical resources and the needs at the local level. (see Figure 10 on facing page) 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 that can be used to help utility crews access repair sites. Therefore, it is very important for all utilities to know who the emergency coordinators located in their service territories are long before an emergency situation arises. This facilitates effective communication during an emergency and alerts the emergency coordinators to what needs the utilities have, thus allowing efficient distribution of resources.

During the 2009 ice storm, the jurisdictional utilities had varying degrees of success in maintaining communication with and coordinating their efforts with state and local government officials. BREC, for example, did a very good job of keeping in contact with both elected officials and members of Kentucky state agencies and county and local government officials. On January 29, 2009, at the height of their outages, BREC personnel met with the Henderson County emergency services director, Henderson County engineer,

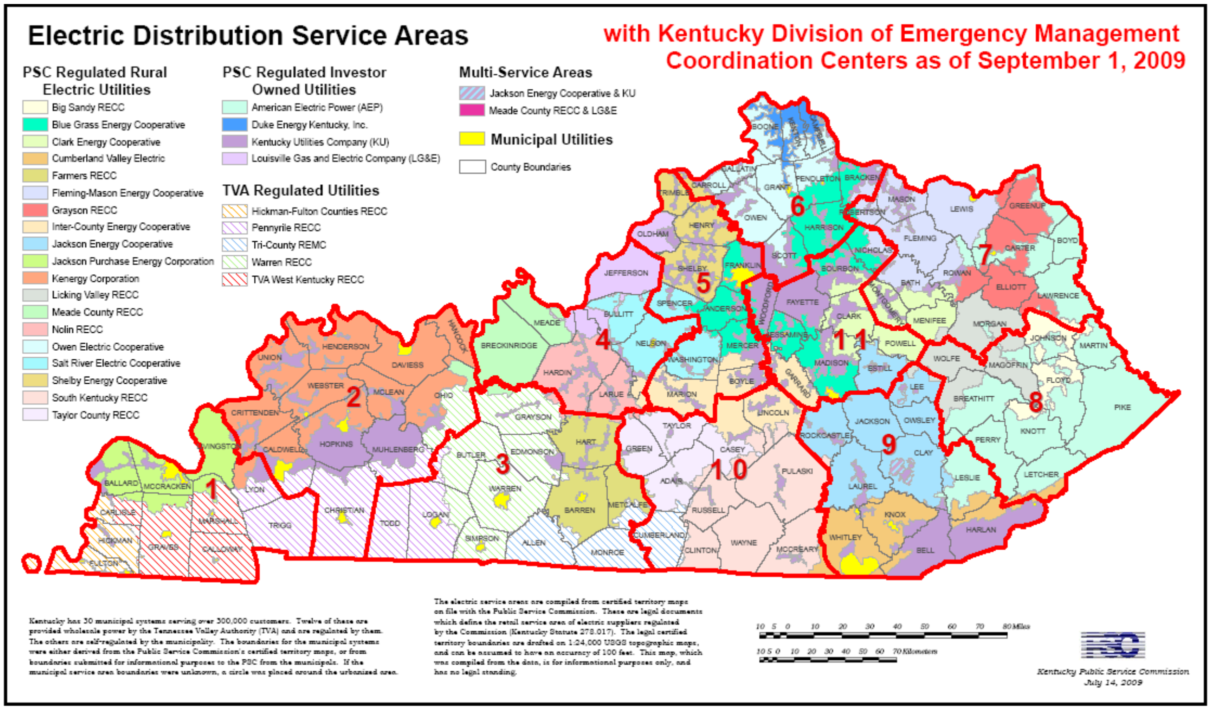

Figure 10: Kentucky Division of Emergency Management regional office coordination areas

PSC map

Henderson County judge/executive, a state senator and representative from BREC's service area, Kentucky Air National Guard (to coordinate helicopter assistance to inspect BREC transmission lines), Kentucky Governor Steve Beshear, and Kentucky Adjutant General Edward Tonini (to update them on the status of BREC system and request helicopter assistance). BREC also spoke by phone with U.S. Coast Guard officials regarding a downed transmission line blocking barge traffic on the Cumberland River.

By all accounts, Duke Kentucky did a very good job of keeping in contact with a variety of local, state and federal officials regarding the progress of their restoration efforts. Much of their communication efforts were via e-mail, as opposed to direct contact or telephone briefings.

While the information provided by the utilities regarding their communications was reasonably detailed, the Commission was not able to draw any conclusions regarding the efficacy of e-mail communications over telephone or direct briefings by or discussions with utility officials. However, utilities may find that communicating by e-mail to local and state officials may help the utility to "speak with one voice" and to avoid miscommunication or contradictory information being passed on. As it was, Duke Kentucky was able to communicate with many different agencies and organizations in a number of counties.

During the first few days following the ice storm, Duke Kentucky sent daily or twice daily e-mail updates to the emergency management directors in Boone, Campbell and Kenton counties. They supplemented their e-mail communications with phone calls on January 28th, 29th, and 30th. In addition, Duke Kentucky e-mailed and called the county judge-executives of Boone, Campbell, and Kenton Counties, as well as all mayors in the various localities throughout those three counties. Duke Kentucky also sent e-mail alerts to the following public officials in its service area: city administrators and clerks, county commissioners and county administrators for Boone, Kenton and Campbell counties, economic development organizations, Northern Kentucky University Chamber president, Northern Kentucky Area Development District director, university and college presidents, school superintendents - including the Covington Diocese, the general manager for Sanitation District No. 1, and the Northern Kentucky Water District.

The Commission believes that Duke Kentucky deserves recognition for the thoroughness of its efforts to keep state and local officials informed about its restoration efforts during the 2009 ice storm and its diligence in documenting those efforts, allowing for both this review and Duke Kentucky's own internal evaluation and improvement during the next major outage event.

Other utilities were less successful in either maintaining regular contact with state and local officials or documenting their efforts. Taylor County RECC made contact with the PSC to report numerous outages and with the Kentucky National Guard to request assistance in road clearing but otherwise did not make contact with any other officials. Similarly, Shelby Energy made contact only with the PSC through its Web site outage reporting system.

Some of the smaller utilities, such as Big Sandy RECC, Clark Energy, Farmers RECC, Inter-County Energy, and Licking Valley RECC maintained contact with the PSC as required and provided daily updates to their local judge-executives and mayors by way of e-mail, fax, or telephone calls. However, they did not keep written records of those contacts.

LG&E and KU did not keep written records of their contacts with state and local officials either. However, the companies stated that they maintained regular contact with local government officials including emergency management personnel across the affected portions of their service territories. The companies stated that they made approximately 300 individual contacts with mayors and/or judge-executives across their service territories as well as many contacts with officials in Lexington and Louisville. LG&E and KU also coordinated their communications with local school systems to advise them when power might be restored to their facilities. The companies also coordinated their restoration efforts with affected wastewater and water districts to set restoration priorities and provide regular updates on service restoration.

Kentucky Power stated that it contacted a number of state and local officials on a daily basis throughout the 2009 ice storm, including the emergency management directors of Grayson, Johnson and Greenup Counties; the City of Ashland Utility Director; county judge-executives (who were faxed press releases concerning outage numbers, restoration efforts and estimated times of restoration); and the mayors in the affected areas. Kentucky Power's customer service representatives contacted the magistrates, mayors, and judge-executives to ensure that the government agencies knew how to utilize Kentucky Power's Web site to determine the number of customers out of service in their respective county. These officials, in turn, checked with Kentucky Power to determine whether to establish shelters and which roads were in need of clearing or salting for crews to be able to access repair sites and to find out when water pumps and power to other vital infrastructure would be restored.

Kentucky Power noted that, since its Distribution Dispatch Center reports its restoration efforts to the PSC twice daily during major outages like the 2009 ice storm, it might be more efficient for the PSC to "serve as a clearinghouse from which all state and local officials can receive information on restoration efforts," as opposed to having the utilities be responsible for making all of the various contacts.

While the Commission understands Kentucky Power's concerns, it does not agree that the PSC should serve as information clearinghouse or conduit between local officials and utilities. During an emergency or disaster the PSC's primary duty under the state emergency management system is to monitor outages and the progress of power restoration. During such outages, the PSC does field many questions from local officials in the affected areas, but that does not relieve the utilities from the responsibility of communicating effectively and working with state and local officials until the restoration operations are completed. This is an area which the Commission expects to be greatly improved by better emergency planning and participation in regional/statewide emergency drills, as discussed earlier.

Kenergy's service area includes all or parts of 14 counties in the western part of Kentucky, which, as discussed later in this report, took a devastating blow to its landline and cellular telephone service facilities. Kenergy noted that "[v]ery little phone communication was available during this time," so it provided the county judge-executives in its service area updated outage reports three times daily by e-mail. Kenergy representatives also attended several county emergency management meetings throughout its service territory during the course of the storm. All emergency management associations were updated with outage numbers three times daily and daily telephone conferences were held with emergency management personnel along with the county judge-executives. Maps indicating the areas where Kenergy crews were working to restore power were also provided to the judge-executives on a daily basis.

As discussed previously, Meade County. RECC, Nolin RECC, and Salt River Electric participated in a region-wide emergency drill entitled "Lincoln Trail on the Rocks" in April 2007. Those utilities appear to have benefited from that experience, as all three reported that they had ongoing communication with their respective local DEM representatives, as well as some contact with the Kentucky National Guard, a briefing with Governor Beshear, and numerous telephone and e-mail contacts with local mayors and county judge-executives. In addition, during the first week following the ice storm, Nolin RECC met twice daily with the commanding general at Ft. Knox, to which it supplies power, to provide restoration progress updates. Meade County RECC also made contact with local sheriffs' departments regarding location and phone numbers of available shelters as well as outage updates and assistance with road clearing and possible security issues.

LOCAL COMMUNITY EMERGENCY PLANNING

The PSC asked local officials to respond to a number of questions regarding their communities' planning and preparedness for emergencies. The City of Madisonville's emergency planning and response to the 2009 ice storm serve as a model of good local practices.

Madisonville conducts routine emergency table top exercises involving other local government officials. The city also has a disaster plan that includes a priority list for power restoration to reestablish critical services to the community. Madisonville also has a utility vegetation management plan in place for its municipal electric system, which the city believes helped to lessen the severity of the damage caused by the 2009 ice storm. Madisonville officials also used innovative communication methods to provide information to the public and emergency management personnel during the storm and the restoration effort that followed. Mayor Bill Cox used the social networking site Facebook to communicate with constituents. He posted topics such as utility crew locations, boil water advisories, traffic information and shelter updates. Because of its planning and local government leadership, Madisonville was able to effectively implement its emergency disaster plan and was able to modify the plan as conditions mandated.

Willisburg had a priority restoration list that was well known to the local emergency management committee. The mayor stated that the listing "really helped to know what repairs were first to be done."

Many communities have disaster plans in place and do conduct yearly emergency exercises. Louisville stated that it conducts both table-top exercises and field emergency drills each year. Louisville's largest annual event is Thunder Over Louisville, held during the week prior to the Kentucky Derby. Louisville officials use Thunder Over Louisville as a planned event exercise. Mayor Abramson believes this planning benefited Louisville's emergency response during the ice storm.

Many local officials who responded said their community had portable electric generators but that they were not in working order. And one county stated that it has a satellite phone but, during the ice storm, when it was needed most, the county judge-executive could not find it.

One problem noted by many local government officials was the lack of utility involvement in their emergency exercises. However, there were several exceptions. In fact, two communities stated that their field exercise had included ice storm operations with utility participation. Georgetown stated that they felt the exercises were very valuable in showing the strengths and weaknesses of their disaster plan.

Owen County conducts yearly field and table top exercises which include local school system personnel. Owen County feels that the schools' involvement had a very positive effect on their disaster response during the 2009 ice storm.

The cities and counties that were able to pool resources and work together fared much better than communities that had to work alone. Even some of the smaller cities, such as the City of Island and some smaller counties, such as McLean County, found that they could accomplish much more when they worked together.

It is clear from the local officials' responses to the PSC's questions that those communities which had disaster plans in place fared much better in the 2009 ice storms than those which did not have such plans.

The Commission recommends that communities, with the help of Local Area Development Districts, engage in regional emergency planning. Cities and counties should work together to develop and implement effective emergency response plans and should coordinate their emergency planning with their local utility providers, regional DEM personnel, and local schools which, as evidenced by Owen County's response, helps to reinforce the importance of disaster planning for families.

The Commission recommends that all local officials update their emergency contact information on a regular basis, make sure that any emergency generators are in working order and arrange for access to satellite telecommunications. The Commission further recommends that communities in their disaster planning have a priority list in place for restoring electric power.

CONTACTS/COORDINATION WITH PSC

In addition to providing reports through the PSC's outage reporting system (addressed later in this report), a number of the state's larger utilities provided briefings to the Commissioners and commission staff. During the aftermath of the Hurricane Ike wind storm, LG&E and KU and Duke Kentucky held a number of telephone conferences with the Commissioners and commission staff.

From September 15th to September 18th, 2008, LG&E and KU held six teleconferences with the PSC to inform Commissioners and staff about the number of customers without power, the number of utility workers and mutual aid crews responding to the outages, the companies' responses to customer calls, and other issues. Duke Kentucky held a teleconference with Commissioners and staff on September 16th in which many of the same issues were discussed. In addition, the PSC also held a teleconference with officials from KAEC and representatives of a number of the electric cooperatives, including Kenergy and Jackson Purchase Energy.

LG&E and KU also held a number of teleconferences with Commissioners and commission staff in the days following the 2009 ice storm. Teleconferences were held daily with LG&E and KU from February 1st through 5th and February 9th. At the Commission's invitation, representatives of the Tennessee Valley Authority and their member cooperatives (Hickman-Fulton Counties RECC, Tri-County Electric, Pennyrile RECC, Warren RECC, and West Kentucky RECC) also held a teleconference with Commissioners and commission staff on February 2, 2009, to discuss the damage that their systems had suffered.

Although TVA and its cooperatives are not under the PSC's jurisdiction, the Commission needed their information in order to understand the full scope of the outage situation following the ice storm and to provide that information to the EOC as directed. Since the 2009 ice storm, TVA has committed to work with the Commission in the future to facilitate outage reporting in its Kentucky service areas during major events.

LG&E		Bullitt	3000	Jefferson	158,200	Hardin	350	Meade	800	
Date	1/30	Shelby	50	Trimble	50	Henry	50	Oldham	9500	
Time	9:01:36									172,000

Figure 11: Example of how the PSC records outages. This is the LG&E portion of the report for 9 a.m. on January 30

EMERGENCY RESPONSE PLANS

Jurisdictional electric utilities are required to file Emergency Response Plans (ERPs) with the PSC.

Believing that each utility is uniquely situated, the PSC imposes no uniform requirements for ERPs, leaving utilities free to design their ERPs to fit their individual needs, based on the distinct characteristics of their service territories.

However, even though each ERP contains some unique aspects, most cover the same general issues and processes the utilities follow during storm restoration. Most of the utilities' ERPs contain provisions for dealing with outages caused by such weather events as major thunderstorms, tornados, flooding or winter storms.

A typical ERP might contain the following:

I. Introduction
II. Service Restoration Plan
  - Determination of Level of Involvement
  - Response Procedures
  - Employee Assignments

III. Hours of Service
IV. Communications Plan
  - Designated Spokesperson
  - Media Releases
  - PSC Notification
  - Other Communications

V. Local Phone/Pager/E-Mail/Address Lists
  - Emergency Agencies
  - Employee/Board
  - Office Phone Numbers and Addresses
  - Truck List
  - Key Accounts Contact List

VI. Substation/Feeder Information
VII. Lodging/Meals
VIII. Cooperative Contacts
IX. Financial Records
X. Cyber Migration
XI. PSC Regulations
XII. Fire
XIII. Terrorism
XIV. Violence
XV. Spill Prevention Control Measures
XVI. Emergency Energy Curtailment
XVII. Propane Gas Response Plan
XVIII. Schools
XIX. Emergency Services
XX. Utilities
XXI. Forms
XXII. Caterers
XXIII. Mail Room Security
XXIV. U.S. Government Phone Numbers
XXV. Threat Alert
XXVI. Radio Repair
XXVII. Pandemic Flu
XXVIII. Electrical Inspectors
XXIX. Tornado
XXX. Earthquake

Appendix
  - A. Spill Prevention/Control Plan
  - B. Nonessential Uses
  - C. Complete Switching and Tagging
  - D. Complete Propane Plan
  - E. Emergency Crew Forms

Use of emergency response plans during the 2009 ice storm

As the ice storm of 2009 developed, affected jurisdictional utilities began implementing their ERP's. In accordance with their ERPs, utilities identify priority customers on their automated Outage Management System (OMS) software or, for those without OMS, on their system maps. That information, along with information from local, state, and emergency officials, is used to establish priorities as service is restored. Utilities using outage management software could identify special needs facilities and locations that were without service from the information supplied by incoming calls. The utilities that use outage management software still must rely on a phone call to identify the outage.

High priority locations are known and are given attention from the onset of the event. However, during an outage of the magnitude of the 2009 ice storm, service must be restored to the main facilities serving these areas prior to working on the individual facilities. This may result in other customers being restored prior to the high priority locations.

After the 2009 ice storm, some utilities re-evaluated their ERP's and identified needs for improvement.

Jackson Purchase Energy is working to improve in several areas. These include communication with the media and emergency management resources in each county served by Jackson Purchase Energy; orientation with guest workers as they arrive; evaluating replacement of current ORS and revision of current Interactive Voice Response (IVR) scripts; structured daily management meetings/briefings; communication from Operations to Customer Service and Public Relations about current system status, crew working locations, and restoration expectations; ERP contact information for local hotels and restaurants used in support of outside assistance.

Blue Grass Energy staff and supervisors met after the ice storm restoration process was completed to discuss areas for improvement. Areas noted were personal necessities such as meals and lodging. Additional guidelines to be added to the plan include receipt management and training for those who do not normally answer the phones.

Clark Energy conducted a post-storm meeting to evaluate and assess all procedures pertaining to emergencies such as the ice storm. The cooperative made a number of adjustments such as installing a cell phone signal booster in its dispatch center to improve communications and assessing what the maximum number of crews might be considering the current workforce.

Duke Kentucky identified several lessons learned during Hurricane Ike, and began implementing the following changes to address these items:

(1) Damage Assessment - identify and train more resources to fill this role during large events.
(2) Off-system resource tracking - identify a better tracking method for resources as they come onto the system and are moved about.
(3) Systems (technology) - ensure that storm applications can address large volumes of data/activity during extremely large events.
(4) External Communications - improve processes for communicating storm-related data internally and externally for large events.
(5) Restoration Strategy of Ohio/Kentucky ("OH/KY") - identify a better method of dividing the OH/KY service territory into smaller quadrants to facilitate restoration and external communication for estimated times of repair.

Meade County RECC stated that it is expanding its refueling opportunities, determining how to acquire more hotel rooms, acquiring cots for temporary sleeping arrangements for mutual assistance crews, and obtaining food providers.

Having experienced a major problem with call volume in their dispatch center, Shelby Energy has re-evaluated its "back door" telephone numbers and has given those numbers to key individuals so that they can report severe emergencies and safety hazards.

EMERGENCY COMMUNICATION EQUIPMENT

All of the jurisdictional utilities rely upon two-way radio systems and cell phones for emergency communication purposes. Most of the utilities have adequate emergency power available for essential operations, including radio communications. Both BREC and EKPC utilize microwave systems in their communications network. A limited number of utilities utilize satellite phones for emergency communications.

Some of the utilities experienced problems with their two-way radio communications during the ice storm. BREC, Duke Kentucky, Fleming-Mason Energy, Jackson Purchase Energy, KU, LG&E, Licking Valley RECC, Shelby Energy and Taylor County RECC each reported limited disruptions in two-way radio communications. Most of those disruptions were due to power failures which were minimized through the use of stand-by generators. Only one utility, Big Sandy RECC, has no emergency power available. Cumberland Valley Energy acknowledged that improvements are warranted in its operations regarding emergency power. KU and LG&E experienced some further problems with two-way radio communications when the availability of fuel for generators became an issue. Farmers RECC encountered many deficiencies in its two-way mobile radio system during the 2009 ice storm and is in the process of replacing the system.

Cellular phone service was described by most utilities east of Interstate 65 as adequate during the ice storm. However, BREC, Blue Grass Energy, Jackson Purchase Energy , Kenergy, KU and LG&E experienced prolonged outages in cell phone service throughout their operational territories. Cellular service was not operational in some areas of Kenergy's service area for up to 10 days.

BREC experienced some communication problems due to the loss of power to some microwave station sites. BREC uses its digital microwave system as a transport medium for its 2-way radio system. BREC stated that its available portable generators and manpower resources were marginally adequate to keep its communications system functional.

Satellite phones are maintained for use by coordinators and restoration crews by Kenergy, Kentucky Power, KU and LG&E. Satellite phones can be accessed through emergency management centers by Jackson Purchase Energy and Shelby Energy. Owen is evaluating the use of satellite phones.

The Commission recommends that utilities arrange to have access to satellite telecommunications during emergencies.

OUTAGE TRACKING AND RESPONSE SOFTWARE

An Outage Management System (OMS) is a software application designed to improve the electricity restoration process during emergencies. An OMS integrates data that often exists in separate systems or components: (1) a Customer Information System (CIS), (2) SCADA, (3) an Interactive Voice Response system (IVR / trouble call system), and a Geographic Information System (GIS) or network map. The core of a modern OMS is a detailed network model of the distribution system. By combining the locations of outage calls from customers, a rules engine is used to predict the locations of outages. For instance, since the distribution system is primarily tree-like or radial in design, all calls in a particular area downstream of a fuse could be inferred to be caused by a single fuse or circuit breaker upstream of the calls.

Gartner, Inc., an information technology research and advisory company, offers the following description of the advantages of using an OMS:

> *OMSs provide timely, accurate customer and distribution network-specific outage information to help utilities be more responsive to unplanned network outages. OMSs track, group and display outages; track crew assignments to the outages; and monitor the state of the restoration activities to safely and efficiently manage emergency-related work. In addition, they provide relevant information to stakeholders (such as utility personnel, consumers, media and regulators) on the state of the restoration process. OMSs tightly integrate with call centers to receive trouble calls and provide customer-specific network status, including the estimated restoration time. Based on a network connectivity model and trouble call patterns, OMSs identify the likely location of the faults, eliminating the costly and time-consuming "bird dogging" to find the outage. OMSs also integrate with SCADA systems for real-time network status to analyze the downstream impact of SCADA-reported switching actions. OMSs are also commonly used for historical outage reporting and automated calculation of reliability indexes, such as the system average interruption duration index (SAIDI) and system average interruption frequency index (SAIFI), based on time-stamped network switching operations, as well as customer-related interruption indexes such as the customer average interruption duration index (CAIDI).*

All four transmission and distribution investor-owned utilities use "leading edge" software. Duke Kentucky purchased its first OMS in 1998; Kentucky Power implemented its system in 2002, KU in 2003, and LG&E in 2004. All four evaluated the performance of their OMSs positively during the 2009 ice storm. Kentucky Power's OMS did "a good job in helping dispatchers track the life cycle of outages from the prediction of outage location, through the assignment of crews, to the restoration of the outage." Duke Kentucky said that its OMS was "very effective" and was "a critical part of our service restoration efforts." LG&E and KU said that their OMS, "performed extremely well in this event despite the magnitude of the storm," which was particulary severe in the KU service area in western Kentucky.

The two transmission cooperatives, EKPC and BREC, do not use a commercially available OMS because OMSs are primarily designed for distribution systems. EKPC said that, "simple spreadsheets developed at the time proved adequate to keep track of transmission lines and distribution substations that were out of service." However, the two transmission cooperatives have SCADA systems that provide real-time data on the status of substations and the grid which allow them to identify and locate outage problems immediately when they happen.

Half of the electric distribution cooperatives use an OMS. Two of the three distribution cooperative members of BREC and seven of EKPC's sixteen distribution cooperatives use an OMS. Bluegrass Energy, Clark Energy, Jackson Energy, and Owen Electric use Milsoft DisSPatch; Jackson Purchase Energy, Kenergy, and South Kentucky RECC use Trimble UtilityCenter, Nolin RECC uses National Information Solutions Cooperative ("NISC") iVue Visual Utility OMS, and Salt River Electric uses software developed in house in conjunction with Partner Map viewing software. Meade County RECC, Big Sandy RECC, Cumberland Valley Energy, Farmers RECC, Fleming-Mason Energy, Grayson RECC, Inter-County Energy, Licking Valley RECC, Shelby Energy, and Taylor County RECC did not use OMS during the ice storm. Farmers RECC has budgeted for an OMS system to be installed in 2010.

The software used by the electric distribution cooperatives is developed and priced for the "niche market" of small utilities, as distinct from the software used by the large investor-

owned utilities.
The Commission asked electric utilities to evaluate the performance of their OMSs during the ice storm. The reports on the performance of OMSs should not be used to compare software packages, since not all of the products were used in areas with extreme outages. The information should be used by current OMS users to test and evaluate their systems, and by prospective users to pose intelligent questions to vendors.

Three electric cooperatives which used OMS - Jackson Purchase Energy, Kenergy, and Nolin RECC - are in the western portion of the state that was the most severely impacted by the 2009 ice storm. This large outage situation was an extreme test of the software, as well as the staff entering and utilizing the information. All three cooperatives reported some problems. Jackson Purchase Energy purchased its software in 2003, Kenergy in 2006, and Nolin RECC in 2005, so there was adequate time to install, convert or develop a network model, train personnel, test, and use the OMS.

Jackson Purchase Energy (using Trimble software) reported that its OMS did not perform adequately. "Due to the extensive damage on our system, we cut a lot of new open points into lines to allow for back-feeding and faster restoration of small line sections. Our OMS did not provide an efficient method to add open points or backfeed sections of line. Therefore, we were not able to utilize this software effectively during this event and were not able to keep accurate records of customer outages."

Kenergy (using Trimble software) reported that its OMS performed as expected. Problems Kenergy previously identified with the Trimble Build 83 did reoccur during this storm. However, Kenergy is in the process of installing a new Trimble Build for the GIS and the OMS. The new system should help eliminate problems that occur on a regular basis when a large outage situation is encountered. Despite some problems, Kenergy recognized the value of using its OMS in the restoration process: "The OMS Build 83 that Kenergy is currently using provided superior results over using 'paper outages' as in the past. With the OMS, all circuits were easily tracked and crew assignments were readily available with just a quick glance from the System Controllers. The process of predicting outages and restoring outages is far superior to any other method that has been used in the past. With the OMS, the largest number of customers affected by an outage can be readily detected. This allows crews to be assigned where the most customers are without power. The record keeping process is more easily accomplished than when 'paper outage tickets' were used. This allows the System Controller to be much more effective in keeping the restoration process on track and flowing as efficiently as possible."

Nolin (using NICS software) reported that its OMS server had to be restarted two times during the first 72 hours of the 2009 Ice Storm. It is Nolin's opinion that the database connection between the OMS server and the CIS server did not handle the volume of outages as it should have. Steps have been implemented by software vendors to ensure that the connection will not be overwhelmed in the future: however, live testing has not occurred.

Four rural electric utilities in the north-central and northeastern part of Kentucky had significant outages due to ice. Salt River RECC said that their in-house OMS was invaluable during restoration efforts. Blue Grass Energy, Clark Energy, and Owen RECC purchased and implemented Milsoft software after the 2003 ice storm. All three utilities had very positive reports on the performance of their software:

> *Blue Grass Energy: The system performed exceptionally. It was valuable in showing the extent of the situation. It allowed us to deploy additional resources in a safe and effective manner.*

Clark Energy: As information is entered into the OTRS by dispatchers or the IVR (integrated voice response) computer via direct phone contact the software highlights special needs members and critical infrastructure while making predictions of what areas are affected and whether they are a part of a big outage or an individual. This allows dispatchers to concentrate on the placement of manpower and equipment to restore service in an orderly manner rather than sort through piles of paper tickets that must be grouped and identified. Outages are tracked and restoration time recorded in real time rather than after the fact. In terms of decreasing service restoration time and increasing crew safety by being able to track the crews by outage location, this could be the single most important software tool in our arsenal.

Owen Electric: Our OMS system is a critical system allowing for efficient and centralized information collection and during this outage it performed exceptionally well. We work very closely with our vendor to ensure that any problems identified with the software are quickly resolved when they do occur.

Based on the information gathered from utilities, the Commission recommends that every jurisdictional electric utility acquire an OMS. These systems provide utility management with an immediate overall display of the location of outages, as opposed to the traditional, time-consuming method of using paper maps to locate outages. This, in turn, allows quicker and more efficient deployment of restoration crews and resources. OMS does the work that used to require many utility personnel to accomplish, thus freeing those personnel to assist in the restoration and repair of the distribution systems.

For utilities with an OMS systems, the Commission recommends that the outage management system electrical model be kept current so that it can accurately make outage predictions and also accurately keep track of which customers are out and which are restored.

Coordinating Response Efforts of Utility Crews and Mutual Aid Crews

Hurricane Ike mutual assistance

Prior to the arrival of Hurricane Ike winds in Kentucky on September 14, 2008, Hurricane Ike made landfall over Galveston, Texas, on September 13th, devastating areas of coastal Texas and Louisiana (which was also recovering from Hurricane Gustav, which hit the area just two weeks before, on September 1, 2009). Between 2.8 million and 4.5 million electric customers were without power in Texas, Louisiana, and Arkansas due to Hurricane Ike. As a result, mutual assistance crews from utilities in the Midwest had been dispatched to assist with the restoration efforts in those states. They included crews from Duke Kentucky, LG&E, KU, Kenergy, Owen Electric, and Jackson Purchase Energy.

LG&E and KU are members of a number of regional mutual assistance groups (RMAGs) including Great Lakes Mutual Assistance (GLMA), the South Eastern Exchange (SEE), and Midwest Mutual Assistance (MMA) groups. As a result of its RMAG memberships, LG&E and KU had deployed or released 14 company and approximately 40 contractor line technicians and 160 contractor tree trimmers to assist with the Hurricane Gustav restoration efforts on the Gulf Coast.

However, on the night of September 14th, the companies recalled all of those resources to assist with restoration efforts on the LG&E and KU systems.

According to Duke Kentucky, which is a member of GLMA, in days prior to Hurricane Ike reaching Kentucky, Duke Energy had released approximately 173 line contractors to respond to Hurricane Ike in Texas and Louisiana. Duke Energy recalled those contractors and directed them to return to work on Ohio, Kentucky and Indiana restoration once Hurricane Ike winds struck those areas. Duke Kentucky believes that the release of contractors to Texas and Louisiana had “minimal negative impact” on its overall restoration efforts, and it stated that the mutual assistance processes facilitated obtaining additional resources and shortened its restoration efforts following the September 14th wind storm.

Kenergy had dispatched 10 of its employees to Baton Rouge, Louisiana prior to the Hurricane Ike wind storm. However, Kenergy recalled all of them, and they were back in Kentucky by September 12, 2008. Kenergy had also released two contract crews to help with Hurricane Ike restoration in southern states, but it recalled them to work on restoring service to Kenergy's system on September 14th. They returned to Kentucky and began work the following day. As a result, Kenergy says that it did not experience any negative impacts from its participation in mutual aid assistance during that time.

Some of Kentucky’s smaller electric cooperatives were also involved with the Gulf Coast restoration efforts when Hurricane Ike made its way toward the state. Owen Electric sent 10 employees to Louisiana following Hurricane Gustav, but it recalled all of them on September 13th, and they were available for Owen Electric’s own response efforts on September 14th. Jackson Purchase Energy stated that after the Hurricane Ike wind storm struck its service area, contract crews were not immediately available due to assisting with storm restoration in Texas and Louisiana.

Jackson Purchase Energy said that it did locate available utility crews in Tennessee, but that, as it does not normally call for assistance from Tennessee contract crews, “organization and mobilization to get these crews from Tennessee took longer than we would normally expect.”

Participation in RMAGs is clearly beneficial to utilities in Kentucky, as by their membership in such organizations, they are offered help when their own systems need restoration following major weather events.

The Commission commends the jurisdictional utilities for such efforts in other states and encourages all utilities which are able to offer mutual assistance to other out-of-state utilities in times of need to do so. The Commission also commends the utilities which had released workers to help with the Gulf Coast restoration efforts in early September 2008 for their vigilance and foresight in recalling those work crews when it became evident that Hurricane Ike would impact utility facilities in Kentucky.

Availability of utility and contract crews during the 2009 ice storm

The 2009 ice storm was the only major weather event in the United States at that time. Not only were all local personnel available to help with the restoration efforts, Kentucky was the recipient of a great deal of mutual assistance from contract and utility crews throughout the region. Duke Kentucky states that the mutual assistance processes in which it participates “facilitated obtaining additional resources which decreased time needed to restore power to our customers.”

Utility companies within the state also provided aid to one other. Grayson RECC (headquartered in Carter County) said that after the ice storm hit, it determined that its own work crews could restore all of its system outages. Grayson RECC is a participant in

Figure 12: During both the 2008 wind storm and 2009 ice storm, Kentucky received assistance from utilities in at least two dozen states. This map shows origin of assistance to the state's two largest electric utilities.

Image courtesy of E.ON US; PSC photo

KAEC's mutual aid assistance program. So, believing that its contractors "were needed much worse" in western Kentucky, and, under the direction of its statewide safety coordinator, Grayson RECC made the decision to send its contractor crews to help Kenergy restore power to its customers.

The 2009 ice storm restoration effort was a massive undertaking by any standard. The utilities employed hundreds of workers to get the towers, poles, and wires back up and the power restored. The table on the following page shows the personnel used during the ice storm restoration per company, and the dates that each company reached a peak number of personnel used during the restoration period. These numbers represent the total restoration workforce: company personnel, local contract personnel, and mutual assistance personnel from outside the state.

Table 1: Restoration workforce during the 2009 ice storm

COMPANY	1/26/2009	1/27/2009	1/28/2009	1/29/2009	1/30/2009	1/31/2009	2/1/2009	2/2/2009	2/3/2009	2/4/2009	2/5/2009
AEP/Kentucky Power		442	946	966	972	1,028	1,040	917	493	0	
Big Rivers Electric Corp.		34	51	60	72	72	73	68	62	62	
Big Sandy RECC		29	39	67	67	67	67	74	96	96	92
Blue Grass Energy		117	169	327	328	335	429	429	373	372	245
Clark Energy		82	110	110	110	118	119	130	142	142	142
Duke**		945	1,355	1,364	1,064	639					
EKPC		105	144	145	113	105					
Farmers RECC		46	97	101	104	106	101	103	128	122	117
Fleming Mason Energy		33	84	85	63	58	61	52	49		
Grayson RECC			95	104	104	133	137	167	167	131	93
InterCounty Energy		89	118	127	127	126	138	149	162	181	247
Jackson Energy		121	172	161	166	151	148	129			
Jackson Purchase Energy		62	121	137	137	148	153	155	180	215	261
Kenergy			321	323	420	536	551	600	620	647	694
LG&E/KU - Transmission					390	525	448	470	469	461	430
LG&E/KU - Distribution			1,421	3,481	4,568	4,952	5,553	5,888	6,295	6,313	6,638
Licking Valley RECC		20	25	27	27	27	27	27	27	27	27
Meade County RECC		78	103	104	104	105	123	136	141	147	149
Nolin RECC	8	78	139	183	180	180	188	202	227	232	236
Owen Electric			60	110	153	153	153	67			
Salt River Electric		64	81	160	231	231	231	258	258	258	258
Shelby Energy		11	38	22	47	29	42	36	42	42	49
South Kentucky RECC		111									
Taylor County RECC	45	55	55	55	55	49					
DAILY TOTAL	53	2,522	5,744	8,219	9,602	9,873	9,782	10,057	9,931	9,448	9,678

COMPANY	2/6/2009	2/7/2009	2/8/2009	2/9/2009	2/10/2009	2/11/2009	2/12/2009	2/13/2009	2/14/2009	2/15/2009	2/16/2009
AEP/Kentucky Power											
Big Rivers Electric Corp.											
Big Sandy RECC	92	92	92	71	52						
Blue Grass Energy	106										
Clark Energy	142	105	95								
Duke**											
EKPC											
Farmers RECC											
Fleming Mason Energy											
Grayson RECC	87	83	83	83	82	82	82	82			
InterCounty Energy	269	244	235	231	223	205	187	163			
Jackson Energy											
Jackson Purchase Energy	289	294	300	326	348	342	341	351	347	345	341
Kenergy	753	870	902	1,005	1,104	1,106	1,049	1,049	957	1,012	907
LG&E/KU - Transmission	437	437	373								
LG&E/KU - Distribution	5,162	4,379	2,874	2,755							
Licking Valley RECC	27	27	27	25	25	25	21	20	15		
Meade County RECC	159	141	134	179	186	187	175	153	123	121	116
Nolin RECC	242	231	224	232	234	234	216	199	114	34	56
Owen Electric											
Salt River Electric	274	225	209	71	71	71	71				
Shelby Energy	36	39	22	14	10	0	8				
South Kentucky RECC											
Taylor County RECC											
DAILY TOTAL	8,075	7,167	5,570	4,992	2,335	2,252	2,150	2,017	1,556	1,512	1,420
** Numbers are for Kentucky and Ohio											
Peak # of personnel during restoration Company & Contractor											

Several utilities indicated that they had, for a variety of reasons, turned down offers of outside assistance that were proffered outside of the usual mutual-aid channels. In some instances, the utility already had enough help. EKPC stated that it had enough outside crews already under contract and working to restore its system and thus declined any unsolicited offers of assistance. Owen Electric noted that, “[s]everal crews became available towards the end of our restoration process,” but that they “were many hours away and were not needed.”

Several other utilities stated that they turned down offers of assistance because they were not familiar with the contractor crews and their safety records or their quality of work. Farmers RECC said that it did ultimately turn down some offers for outside help, mainly because it did not have enough of its own employees to send with contractor crews to ensure proper restoration work is done: “Assisting crews must be accompanied by a Farmers’ representative with operational experience to insure proper location of assigned work and proper completion.”

Inter-County Energy said that “[a]t the beginning of the event, crews from the state of Texas were turned down because of projected cost and there was no knowledge of their work ethic.” Inter-County Energy further explained that the Texas crews estimated their costs at over 50% higher than comparable quotes, and that KAEC had already found a sufficient number of contractors to assist Inter-County Energy before the Texas crew called.

Salt River Electric said it was contacted by several independent contractors wanting to assist in the restoration effort, but it turned those offers down. Salt River Electric said that it “did not have a prior relationship with any of the companies, and therefore did not feel comfortable employing them.” Like Farmers RECC, Salt River Electric said that it had also “reached the point of saturation for being able to manage additional crews.”

Shelby Energy reported that it also turned down several offers from outside sources, because “we were not familiar with these companies and did not know if they would be trustworthy to work safely.”

Even Jackson Purchase Energy, which suffered some of the worst damage, also turned down some offers of outside assistance during the ice storm:

> *Offers of assistance made by contractors unfamiliar to (Jackson Purchase Energy) were declined following our initial requests for outside assistance. We did accept a contractor’s assistance at the beginning of this event. Once the contractor was on site working, we discovered they were not familiar with our construction specifications and could not work efficiently. We replaced these crews with mutual-aid crews from other cooperatives as soon as possible. Following this incident, we were particular concerning the assistance we would accept to work on our system.*

Meade County RECC was simply too overwhelmed by the task of assessing the damage from the ice storm to accept help from a Georgia crew that came “unannounced”:

> *On either the 29th or 30th of January [2009], a Cobb Electric crew from Georgia arrived basically unannounced with almost 30 crew members and more than 20 vehicles. (Meade County) RECC did not have any electrical power to 90–95% of its territory, including to hotels, fuel stations, or food suppliers. The Cooperative was still assessing the damage, working with the power supplier to restore power to the substations, and repairing some critical infrastructure and dangerous lines at that time. The crew traveled onward to Owensboro to assist Kenergy, where they did have lodging available in that city. (Meade County) RECC had also requested service crews at that time; however, this crew was a construction crew with large bucket and digger trucks.*

The Commission notes that turning away offers of assistance may create a public perception that a utility is not doing all it can to restore power. However, in the instances cited above, the Commission finds that utilities acted reasonably in declining assistance.

Injuries and deaths due to construction crew accidents during the 2009 system restoration

During the restoration efforts following the Hurricane Ike wind storm, there were no utility construction crew injuries attributable to the construction activities themselves. However, one individual, Stephen Allen McMath, died from a heart attack while working on a restoration repair for LG&E. The Commission recognizes Mr. McMath's sacrifice and his service to the Commonwealth in helping return power to utility customers in Louisville following the Hurricane Ike wind storm. We express our deepest sympathy to his family for their loss.

During the 2009 ice storm restoration effort, there were four reported injuries to utility construction crew members at utility construction sites. Unfortunately, this number includes one death. An accident at a Jackson Purchase Energy construction site took the life of Andy Reichwein, a contract worker from Minnesota. The Commission recognizes Mr. Reichwein's sacrifice and service to Kentucky and we express our deepest sympathy to his family.

Logistical difficulties in providing food, shelter and other needs for mutual aid and outside assistance crews

Providing housing, food and other necessities for their restoration crews proved to be a very difficult task for many of the utilities - both large and small. Eight of the 24 responding utilities specifically listed "housing" as one of their largest challenges during the ice storm response.

BREC reported that the only difficulties it encountered in serving the day-to-day needs of outside crews was housing. BREC stated that during the first two days one of its contract crews was on-site, BREC was unable to find motel rooms closer than one and one half hours away. Blue Grass Energy's biggest concern with regard to logistics was housing its outside crews during the storm. Blue Grass Energy reported that most of the hotels were without power or the rooms were taken by customers leaving their homes to stay in hotels. Outside crews commuted from other counties for a distance of 15 to 30 miles. Sometimes the laundry requirements were larger than the local laundromat could handle and other arrangements had to be made elsewhere.

Many other utilities had difficulties housing their crews as well:

> *EKPC: EKPC had difficulties securing housing for EKPC crews and contract crews that were working in the hardest hit areas. Local citizens without power booked housing early causing EKPC employees and contractors to drive significant distances to secure housing. Additionally, many of the hotels in the hardest hit areas were without power themselves.*
>
> *Inter-County Energy: Housing was an issue at the beginning of the storm. [Neither] the City of Danville nor the City of Lebanon had power and other hotels in*

the area were filled with people trying to find shelter because they did not have power. With the return of power to the area hotel housing became less of an issue.

Jackson Purchase Energy: (Jackson Purchase Energy) experienced difficulties in housing outside assistance crews. Hotel rooms were difficult to obtain. We had to utilize rooms at several different hotels due to the quantities required. This housing situation was difficult to manage properly.

Kenergy: Due to no power or communications for the first few days, Kenergy experienced difficulty obtaining fuel and food and housing for outside assistance crews. One district was forced to relocate all operations to an off-site location requiring the rental of showers and communications equipment, housing set up in a school, transportation of materials, and on-site preparation of food. Another district opened a second facility including a warehouse to position crews closer to heavily damaged areas, minimizing travel and restoration times.

Meade County RECC: [H]ousing with power was nonexistent for almost one week. (Meade County) RECC's service area had only two small motels that were open. The Rough River State Park area has more but they were without power longer and many of those facilities were closed for the winter. This service area also has no laundry service facilities. (Meade County) RECC personnel laundered the servicemen's clothes themselves throughout the restoration by using the machines at the two offices and taking the clothes to their homes and washing them. Once power was restored to the business areas (into the 3rd day) food was available locally, including restaurants. (Meade County) RECC personnel brought in food from their homes and cooked it at the offices in the early stages. Later, with help from office personnel, local restaurants were solicited to furnish meals at the offices.

Nolin RECC: The first night of crew arrivals motel rooms were not available due to power outages. Line Technicians were housed at our office, sleeping on air mattresses. Beyond day one no problems were encountered.

Among the more difficult issues posed during major outages is the competition for housing between utilities and their own customers displaced from their homes by a lack of power. When hotel rooms are needed to house out-of-town utility crews, should utility companies get the first available rooms, and, if so, how should state and local government enforce such restrictions? Such questions should be the subject of discussion between government officials, legislators, utility companies, and citizens, as the choices are not easy and may not satisfy any of the stakeholders completely. One possible solution to this problem identified by the Commission was the possibility of using state park facilities for long-term housing of restoration workers during extended outages.

Kentucky has 52 state parks and 17 state resort parks (SRPs). Including the main lodge at all SRPs, as well as secondary accommodations at several parks, there are 890 rooms in Kentucky's park facilities. There are also 311 cottages (1, 2 and 3 bedrooms), more than half of which are the 2-bedroom models. All SRPs have a full-service lodge and dining room, and all of the SRPs are open during the winter, except for a few days in December during the week before and the week after Christmas.

Several of Kentucky's SRPs were used by utility crews for housing during the 2009 ice storm, including Kenlake SRP, Lake Barkley SRP, Kentucky Dam Village SRP, Pennyrile Forest SRP and Rough River Dam SRP.

On January 27th, as the 2009 ice storm expanded across the state, Rough River, Pennyrile, Lake Barkley, and Kenlake SRPs all lost electric power. Complicating matters further, when the ice storm first began most of the state parks were without their head managers, because most were at a park managers meeting at Cumberland Falls SRP in southeast Kentucky. They left the meeting to return to their parks as soon as the severity of the storm became apparent, but their absence at the beginning of the ice storm made it difficult for Parks Department officials to effectively manage their recovery and response in the first few days following the storm.

According to Parks officials, very few of the SRPs have backup generators, and those that do have only small generators that are sufficient only for emergency lighting, food refrigeration, telephones, and other small applications. None of the SRPs have generators large enough to provide heat and lighting for all of their rooms and cabins. However, as power was restored to each facility, it became available for housing utility crews.

In the several days following the ice storm, the deputy commissioner of parks stayed in contact with the EOC in Frankfort, sending daily reports to the EOC on how many resort park rooms were available for the response crews to use. However, all of the parks in western Kentucky were affected by the massive cell tower outages as well as power outages. The lack of cell phone availability made it even more difficult for the Frankfort-based Parks officials to communicate with park personnel and to get an accurate assessment of damage and room availability at each park in the first few days after the storm. Parks officials noted that the damage to the communications infrastructure in western Kentucky was so bad that utility crews housed at Kentucky Dam Village had to drive to Hopkinsville over 50 miles away to make a phone call due to the cell phone service being out.

The Parks Department is currently working with the NWS and DEM to become a Storm Ready Supporter, which is an affiliate program to the NWS's Storm Ready Communities program. Under the program, personnel at the state parks will receive emergency training and weather tracking training. The Parks Department will also post informational signs and provide emergency preparedness information to park patrons. After receiving the Storm Ready Supporter designation, they will have a re-evaluation every two years to make sure that their personnel and their systems remain prepared for emergencies.

Lake Cumberland SRP and Dale Hollow SRP are expected to receive their Storm Ready Supporter designations in the near future and are awaiting the results of an inspection by the NWS. These two parks were chosen primarily because of their proximity to Wolf Creek Dam, the propensity for inclement weather in that area, and their size. Ultimately, the Parks Department plans to have 37 parks certified as Storm Ready Supporters. Notably, Kentucky is the first state to seek the Storm Ready Supporter designation, but since the Parks Department began the process, Parks personnel have been contacted by several other interested states.

The Parks Department currently has agreements with several county judge-executives designating park facilities as staging areas in times of weather emergencies or other disasters. For example, if the Wolf Creek Dam failed, the emergency operations personnel in the surrounding counties and the Army Corps of Engineers would use the facilities at Lake Cumberland SRP.

The Parks Department is also applying for a $500,000 grant to pay for 10 storm sirens to be placed at several state parks to provide storm warnings and emergency instructions to park patrons and citizens in the surrounding areas.

They are also examining whether or not they can apply for grants to buy new generators at some of the parks which would be big enough to power more of the park facilities than the small generators they currently have.

Commission staff asked Parks personnel whether there is any existing policy to request that patrons staying at park facilities vacate those facilities when an emergency occurs in order to provide rooms for emergency personnel and relief crews. The Parks Department does not have such a policy. Parks personnel expressed concern that such a policy might actually hinder emergency crews from reaching the parks if, for example, the roadways were significantly blocked by downed trees and there was considerable traffic trying to exit the parks under order.

As to the possibility that park facilities being used as utility crew housing and staging areas might be damaged, the Parks Department pointed out that during the Hurricane Ike wind storm E.P. "Tom" Sawyer State Park was used as a staging area by KU and LG&E crews. While they were there, the crews actually made several improvements—re-wiring lights, fixing bathroom facilities, etc. According to Parks Department officials, the park was actually in better condition when the KU and LG&E crews left than when they arrived.

The Commission recommends that the executive branch and the Kentucky General Assembly consider funding for emergency generators to be provided to selected Kentucky SRPs in order to make those parks fully functional during major outage situations and thus allow them to be used by utility crews for housing and staging areas. This funding would be supplemental to any monies that the Parks Department may obtain through the possible grant proposal discussed above for that purpose.

STORM PLANNING PRACTICES

As large, investor-owned companies, LG&E and KU have an advantage over smaller utilities with regard to their ability to marshal personnel and resources to respond to emergencies. However, their description of their storm planning, preparation and response illustrates some practices that smaller companies may also be able to implement in their own storm readiness planning. For example, LG&E and KU explain that during storm planning they identify specific properties that can be used for response staging areas and work with the property owners to arrange for such emergency use upon just a few hours notice. The Companies established 13 staging areas throughout Kentucky during the ice storm (11 more than the companies had ever established during a major restoration event), each accommodating 125-800 workers. The companies also assisted Southern Company in establishing a staging area at Papa John's Cardinal Stadium in Louisville, as Southern Company was providing mutual assistance resources to LG&E.

LG&E and KU established three centralized crew staging areas in the Louisville area and 10 more throughout KU's territory. These centralized staging areas and facilities provide efficiencies with regard to vehicle fueling, serving meals, providing bathing facilities, and distributing other necessary materials to the restoration crews. The companies utilized storm response trailers equipped with generators, fuel, lights and signs, and specialized contractors were utilized to set up staging areas and provide catering and housing arrangements for the majority of crews dispatched to the area.

Kentucky Utilities ice storm staging area and operations center in Dawson Springs

PSC photo

Many utilities across the state used facilities like the one shown above as staging areas for company lineman and/or mutual aid assistance employees. Large facilities, like the one shown in the photo at Dawson Springs, were used by Kentucky Utilities as a staging facility for fueling, lodging, feeding, bathing or just to park and store vehicles or equipment used by the utilities. This site shown in this photo was used for line and tree trimming crews. The facility was used from February 3-10, 2009. The number of crew members changed daily, but each day the facility supported anywhere from 175 to approximately 600 crew members. The use of such facilities is usually a prearranged agreement between the utility and local officials or business owners. This is not always a sure plan due to the possibility that the staging area or facility would be damaged by a major event.

If the agreed-upon area is not an option, then most utilities would have a back-up facility or find a suitable area that would support the utility's needs during major events such as the Ike wind storm and the ice storm. With the limited availability of lodging in some areas across the state during the ice storm, local city parks, large parking areas, and large warehouses became temporary homes for many utility workers.

Lodging, however, presented as daunting a problem to the E.ON companies as it did for many of the other utilities throughout Kentucky:

> *The primary and preferred method to lodge external crews is to utilize local hotels and motels. This strategy was used until it became apparent that the large number of external personnel would outnumber the number of available hotel rooms. The total number of hotel rooms utilized across Kentucky throughout the restoration period exceeded 20,000 (cumulative nights).*

The magnitude of LG&E and KU's response effort is illustrated by some notable statistics. Their restoration efforts required about 284,000 gallons of motor vehicle fuel. A typical tanker truck carries between 5,500 and 9,000 gallons of fuel. Therefore, LG&E and KU's restoration operations utilized between 31 and 52 tanker trucks of fuel. The companies also provided more than 80,000 meals to work crews. LG&E and KU fed their crews in local restaurants, dispersed crew staging areas, and regular operations facilities (with food provided by caterers) until the centralized crew staging areas were established and placed in operation.

With regard to fuel, LG&E and KU followed their normal practice of fueling their vehicles at the retail locations of a specific supplier at the beginning of the ice storm restoration. However, they found that arrangement to be incompatible with the circumstances. Fuel was in short supply during the first days following the storm, and, according to the companies, they "did not want to solely rely on one supplier for fuel because of the large number of contractors' vehicles in the area, the inefficiency of stationary fueling in a major restoration effort, and/or to avoid any conflicts with the consuming public in obtaining fuel." So, over the course of the restoration operation, the companies secured three additional fuel suppliers to help with providing stationary and mobile fuel services. They also established a fueling station for both diesel and unleaded gasoline at the Kentucky Exposition Center in Louisville, which they staffed around the clock with mechanics from the companies' vehicle maintenance contractor who could both fuel vehicles and provide minor maintenance services for contractor vehicles.

LG&E, KU and other larger electric utilities have logistics teams that assume the task of providing multiple services to the large number of mutual aid crews. These services include lodging, food, laundry services, medical assistance/filling prescriptions, remote fueling, transportation, and getting necessary materials to the crews in the field.

Most of the smaller utilities must rely on in-house administrative personnel to fill the role of providing the logistic services. However, one electric utility was able to obtain logistic support from mutual aid assistance. This assistance freed up many utility personnel to perform other skilled tasks.

The Commission recommends that utilities which do not have sufficient personnel to devote solely to logistical support during a major outage event should determine whether such logistical support personnel are available through mutual aid assistance or other sources, and, if so, how such personnel can be best utilized.

RESTORATION PRIORITIZATION AND WORK FLOW

The utilities were asked to explain how they assigned restoration work to their work crews. The transmission companies and distribution companies answered the question differently as the restoration of transmission line, poles and towers differs from restoring power to distribution systems.

For the transmission companies, the main priority was in restoring their larger transmission lines and transmission circuits. LG&E and KU stated that the two primary objectives of their initial restoration efforts were "first to restore higher voltage 138kV and 161kV network transmission lines and interconnections and second to restore load serving capability via 69kV transmission lines." All five of the transmission companies prioritized repairs based on the location of the needed work, along with the availability of work crews, the presence of hazardous conditions, and the location of critical loads.

LG&E and KU field crews assessed the severity of the damage to their accessible transmission facilities, after which they dispatched work crews to those areas that could be returned to service "in the most expeditious time frame possible." Kentucky Power assessors first checked for hazardous conditions and determined what repairs and materials were needed for each transmission circuit. Kentucky Power then created "work packets" which were assigned to a "circuit general - a linemen in charge of an entire circuit. The circuit general then distributed the work packets to the "crew guides" who led the contract crews to the work sites. In order to ensure safety and to avoid electrocutions, the crew guides reported back to the circuit generals when work was completed and only then were the transmission line sections re-energized.

LG&E and KU noted that the need to reestablish power to its customers outweighed the need to provide redundant circuit feeds. So, in the days following the ice storm, LG&E and KU crews initially restored power to many of its customers whose distribution circuits are normally served by multiple transmission loop feeds with more simple radial feeds fed from

Initial efforts to restore Kentucky Utilities transmission lines in western Kentucky were complicated by cold weather and muddy ground.

PSC photo

a single transmission line. As the number of customers without service decreased and crews became available, LG&E and KU put more emphasis on rebuilding their network transmission facilities and improving redundant paths to their customers.

Generally, the distribution companies restored electric service in a top-down manner, largest facilities to smallest—substations, circuits, three phase feeders, single phase lines, and, finally, service drops to individual customers. They also prioritized their restoration efforts based on the number of customers that will be restored by completing a particular work order. In other words, those restoration jobs that will return power to the most customers are given first priority. Given the choice between working on a restoration project that will restore power to only one customer and working on another project that will restore power to 100 customers, the utility gives priority to the latter, and the individual customer must wait.

Other considerations include restoration of power to critical-need customers (customers needing electric power for home medical equipment), the availability of crews and their location relative to the needed work, and whether the crews can get access to the work site due to downed trees or other hazards. Some utilities assigned their contractor crews and mutual assistance crews to more straightforward repair work, such as replacing broken utility poles and hanging power lines. Meade County RECC described its work assignment process as follows:

> *As contractor crews arrived, they were assigned work that generally entailed pole and/or wire replacements that usually did not require (Meade County) RECC personnel to accompany them. As those larger repair jobs were completed, cooperative personnel were assigned to accompany them to multiple areas later in the restoration process. In order to accomplish this, many inside personnel were used and existing MCRECC crews were split up.*

Some of the utilities noted their use of OMS computer software in the restoration process. LG&E and KU stated that:

> *At the onset of the event, restoration personnel were dispatched by the Distribution Control Center (DCC) to circuit outages identified as serving critical customers in accordance with the company's Emergency Response Plan. Where feasible, damaged circuitry was isolated and unaffected circuitry re-energized. Readily observable system damage was communicated back to the DCC and commented on the Outage Management System (OMS) outage event. As system damage assessments were completed, the assessments were organized by circuit, not work order. Circuit maps with identified damages and associated OMS data were combined to create a work packet. Restoration personnel were assigned to the work packet in a number proportionate to amount of damages identified to be repaired.*

Restoration work began before the storm ended. Here a Clark Energy crew repairs damaged distribution lines.

Photo courtesy of Clark Energy

Blue Grass Energy used its OMS to assess the main feeder circuits that were out and assigned its crews to begin repairs on its 3-phase lines. Jackson Energy used its OMS to assign crews to the largest outages (such as entire circuits) first and let that crew remain in the area to work the remaining smaller outages before moving the crew into another area.

The utilities were also asked to describe how the number of work orders generated compared with the number of crews available to do the work. With the exception of Fleming-Mason Energy and Jackson Energy, the utilities uniformly stated that the number of work orders greatly outpaced the number of restoration crews on most of the days following the ice storm, until the work began to stabilize and decline a week to two weeks after the storm. Fleming-Mason Energy stated that the ratio of work orders to crews to complete the jobs was very manageable and that its work order process was well structured to meet the restoration work demands. Jackson Energy said that it had only 57 work orders for broken poles and that it had an adequate number of crews to complete the work in a timely manner.

In major outage situations such as the Hurricane Ike wind storm and the 2009 ice storm, utility customers sometimes do not call their service provider to report their individual outage. The reasons are varied: they believe that their phone call to the utility will be ignored; their neighbor has already reported an outage on their street and their phone call would be redundant; or the utility personnel will be aggravated by their phone calls and would retaliate against them by delaying their restoration time.

However, most of utilities indicated that the customer's telephone call is the key to initiating their restoration response. As Nolin RECC emphasized:

> *The member's telephone call reporting an outage is vital because it will be combined with other members' calls and computer programs will analyze that information to make a prediction as to what lines or other equipment may be out of service. This helps our line crews find the locations of the outages more quickly.*

For those utilities with computerized outage tracking and response software, it is especially important for the customers to call in and report their outages. The information received from the customer about the location and cause of the outage, as well as any other information about any potentially hazardous situations involved with the outage are fed into the utility's system. This data, in turn, is used by the utility to generate the work orders and assign the necessary personnel to fix the problems. Without the individual outage report, a customer may have to wait much longer for service to be restored, because the utility's method of prioritizing service restoration depends upon full and accurate data about the entire scope of an outage. If a neighborhood containing 500 houses is without power, but only 20 customers call in to report their outages, that neighborhood would be prioritized lower than a neighborhood of only 100 houses where 90 customers call in their outages.

The Commission believes that it is extremely important to emphasize to the public that each individual electric utility customer call the service provider to report an individual outage event in order to facilitate proper functioning of the utility's outage response system.

Representative restoration process flow charts are shown on pages 75 and 76.

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D. Outage Restoration Process

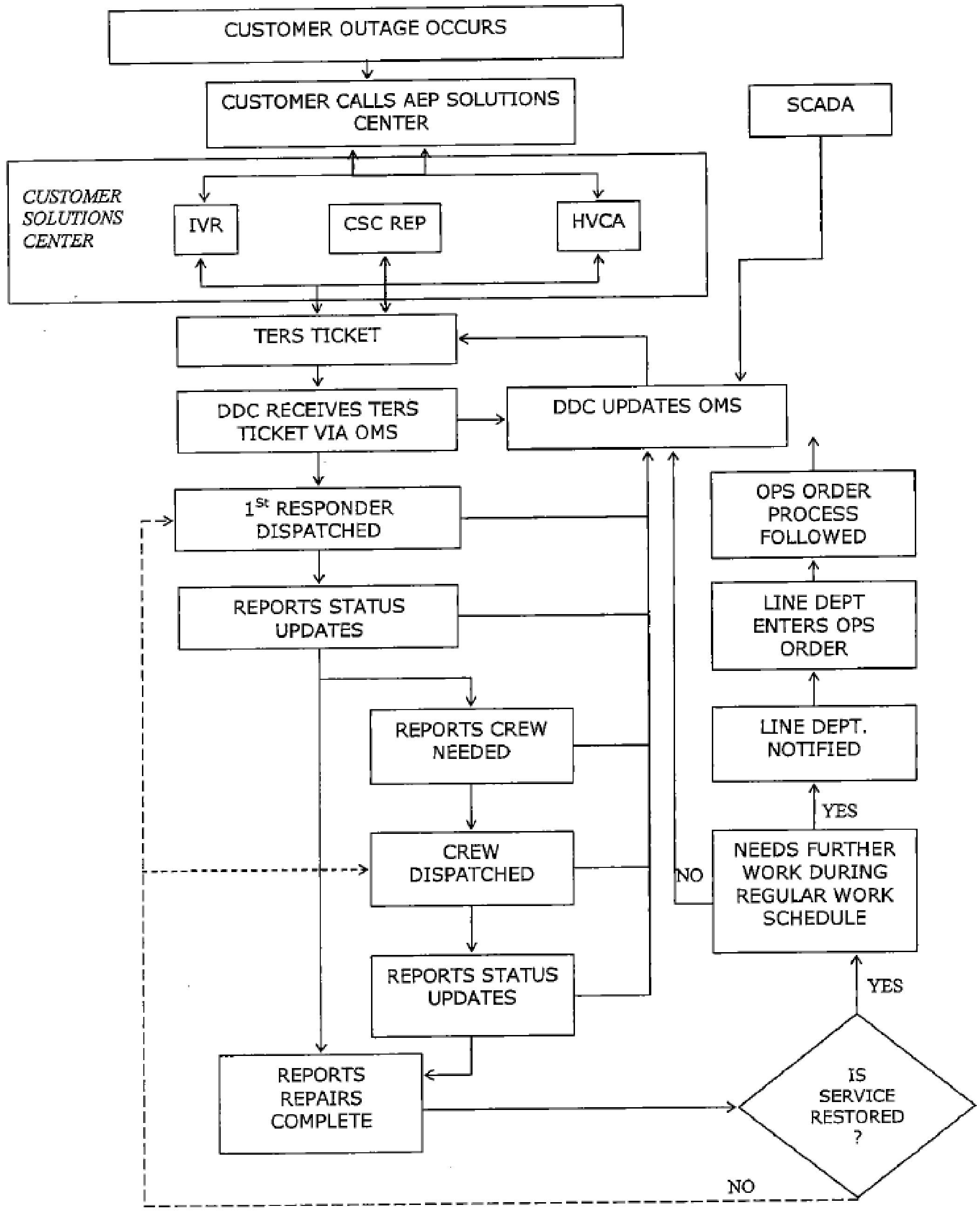


Figure 13: Kentucky Power (American Electric Power) restoration flow chart

Courtesy of Kentucky Power

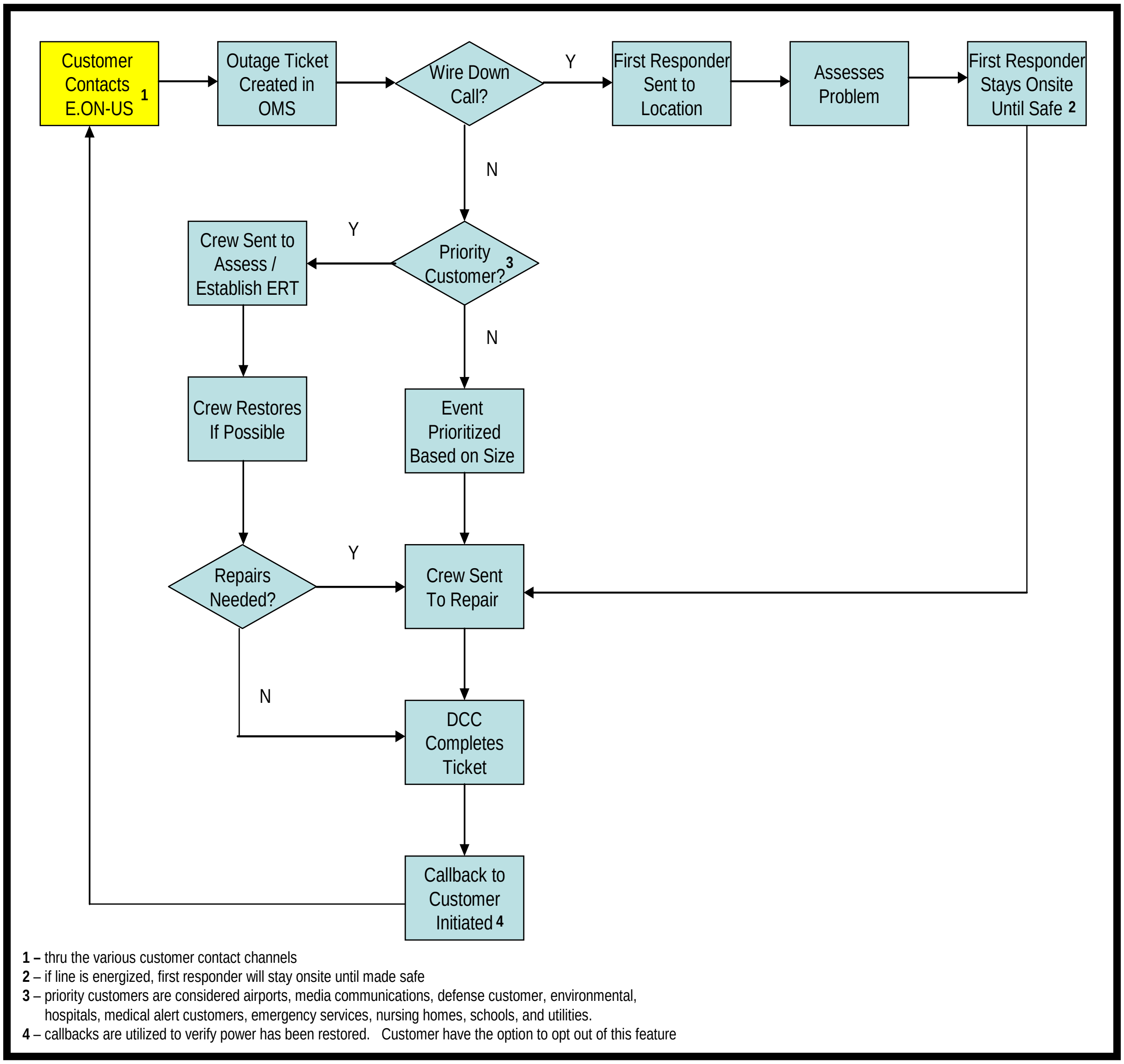


Figure 14: Louisville Gas & Electric/Kentucky Utilities restoration flow chart

Courtesy of E.ON US

EMERGENCY "BIRD DOGS"

Utilities were asked whether it would be feasible or advisable for the utilities to train local, non-utility or retired utility personnel to be "bird dogs" for outside contract workers who are brought in to perform restoration service following major outage events. A "bird dog" is a person assigned by a utility to guide restoration crews in the field, pointing out utility facilities, hazardous terrain, and providing other necessary information about the utility's system that outside utility crews may not have readily available.

Most of the utilities stated that they do, in fact, use retired line workers as bird dogs to aid their mutual assistance crews. Salt River Electric, in particular, noted that the eight retired employees it used during the ice storm restoration were "invaluable in helping to expedite the restoration efforts."

The utilities uniformly rejected the idea of training non-utility persons to serve as bird dogs during major outages. Most of the utilities cited safety concerns and liability issues that would make using such individuals impractical. Duke Kentucky stated that it sometimes uses personnel from its gas operations to serve as bird dogs and storm damage assessors but that it does not use non-utility personnel for such services. Duke Kentucky said that it is also pursuing a contract with an engineering firm to provide additional bird dogs and assessors during storm events but that such firms usually employ retired utility workers as well.

Clark Energy, Nolin RECC, and Shelby Energy all stated that lack of bird dogs is not a major concern during major restoration efforts. Rather, the most pressing problem that they encounter in managing outside utility crews is "keeping track of the crews and managing them from the command center in a manner that ensures safety and productivity."

The Commission commends those utility retirees who assisted Kentucky's utilities in the days following the 2009 ice storm. Their invaluable experience and knowledge helped the utilities restore power more quickly and helped the mutual assistance contractor crews working in the state do their jobs more safely.

Restoration work could be challenging for crews unfamiliar with an area.

Photo courtesy of Kenergy Corp.

ELECTRIC UTILITIES

CONSTRUCTION AND MAINTENANCE STANDARDS

NATIONAL ELECTRIC SAFETY CODE (NESC)

The National Electric Safety Code (NESC) is a voluntary safety code for the electrical industry. However, Kentucky statute adopts the NESC as the safety standard for the 25 jurisdictional utilities and grants the Kentucky Public Service Commission (PSC) authority to enforce the NESC standards. The statute states that:

> *Except as otherwise provided by law, the commission shall, in enforcing service adequacy and safety standards for electric utilities, ensure that each electric utility constructs and maintains its plant and facilities in accordance with accepted engineering practices as set forth in the commission's administrative regulations and orders and in the most recent edition of the NESC.*

Under the NESC's general rules, all jurisdictional electric utilities and their authorized contractors are required to design, construct, operate and maintain all electric supply and communication lines and equipment to meet the requirements of the NESC. For particular issues not specifically addressed by the NESC rules, the NESC requires that all construction and maintenance be "done in accordance with accepted good practice for the given local conditions known at the time by those responsible for the construction or maintenance of the communication or supply lines and equipment."

The PSC has for decades required electric utilities to construct and maintain their plants and facilities in accordance with accepted good engineering practices.

The Institute of Electrical and Electronic Engineers (IEEE) is the entity responsible for the development and revision of the NESC. The Rural Utility Service (RUS), Electric Staff Division, maintains membership on NESC subcommittees to ensure the NESC includes an appropriate perspective concerning the installation and operation of electric facilities by rural electric cooperatives.

The NESC establishes three grades of construction, designated A, B and C. The more robust standards apply to situations in which increased strength is required; for example, to cross a major transportation right-of-way. Differing maximum mechanical loadings are assumed based upon the grade of construction.

In addition to the grades of construction, the NESC divides the United States into three loading, or clearance, zones that are delineated on the basis of historical weather data for ice and wind. According to the NESC Handbook, both climatic data and the extensive experience of companies which design and operate overhead lines were used as a basis for the selection of the loading assumptions contained in the NESC.

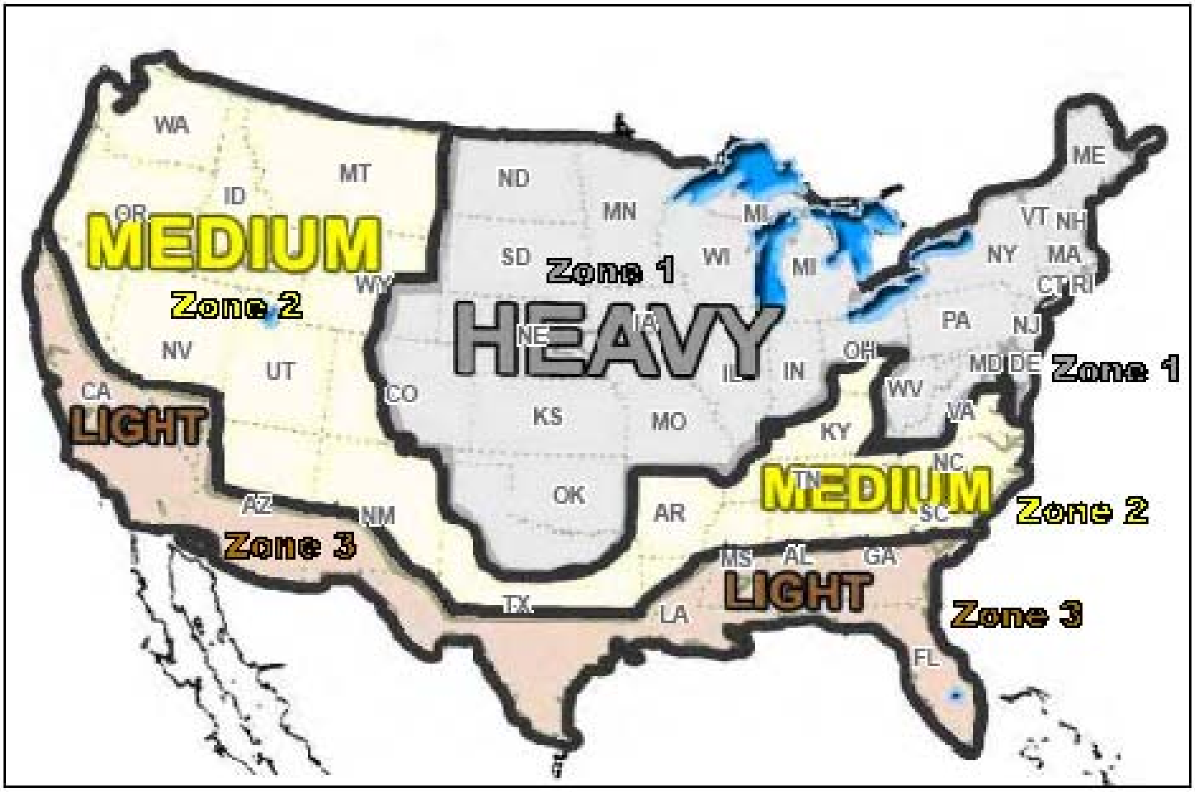


Figure 15: NESC loading zones

Example: Heavy Loading (Zone 1): ½ inch of ice, 40 mph horizontal wind, and 0° F.

Example: Medium Loading (Zone 2): ¼ inch of ice, 40 mph horizontal wind, and + 15° F.

Source: National Electric Safety Code

These loading zones are designated as Heavy (Zone 1), Medium (Zone 2), and Light (Zone 3). Kentucky is in the medium loading zone. Utilities that construct overhead facilities in Kentucky are required to build those facilities to meet the minimum requirements of medium loading construction as specified in the NESC. Indiana and some portions of Ohio are located in the heavy loading zone.

In Kentucky, current NESC medium loading and Class B construction standards apply to all structures at the time of design. Some utilities construct to a heavier loading standard in order to improve reliability and durability of their facilities and structures.

According to data provided by several utilities, the cost of construction to meet the heavy standards ranges from 10 percent to 30 percent higher than the cost of constructing comparable facilities to a medium loading standard.

The NESC serves as the basis for the minimum mechanical strength and electrical clearance requirements for the design of new distribution line construction and the minimum strength limitations for in-service distribution lines. For design purposes the NESC requires poles, crossarms, pins, insulators and conductor fastenings to bear their own weight plus the weight that they support, including all conductors and cables, as well as loading due to radial accumulation of ice.

Ice is assumed to weigh 57 pounds per cubic foot. In addition to the radial ice, for heavy and medium loading, the poles, crossarms, pins, insulators and conductor fastenings must also have sufficient strength to support the force exerted by a 4 pound-per-square-foot wind (approximately 40 miles per hour) blowing perpendicular to the conductors and cables. In determining the required structural component strengths, the appropriate strength and load factors are applied to the calculated loadings according to the type of structural component and the required grade of construction.

Utilities have reported that during major storms the mechanical loading experienced from tree contact is the primary cause of the majority of outages and damage to distribution and transmission lines. That analysis was not altered by the Hurricane Ike wind storm of 2008 and the 2009 ice storm. In both those events, utilities reported that tree contact with lines is the major cause of customer outages and the major contributor to damage to the distribution and transmission lines, regardless of wind and ice loadings on structures.

To illustrate how application of loading criteria affects structure design, consider the following example, which uses two common distribution line pole/conductor combinations: a single-phase tangent pole (35 ft/class 5) with #2 Aluminum Conductor Steel Reinforced (ACSR) phase and neutral conductors at maximum allowed tension (60% of rated breaking strength), and a three-phase tangent pole (35 ft/class 5) with #1/0 ACSR phase and neutral conductors also at maximum allowed tension.

Figure 16: Single-phase and three-phase construction

The term “single-phase” refers to a type of construction on a distribution circuit. A single-phase construction consists of two conductors: a primary phase conductor and a neutral conductor. “Multiphase” or “Three-phase” construction consists of 2 or 3 primary phase conductors and a neutral conductor. Some three-phase systems may or may not have a neutral wire.

PSC photos/graphics

Using the medium ice and wind loading requirements, the maximum allowable horizontal span (based on pole strength) would be 1,162 ft. for the single-phase example, and 470 ft. for the three-phase example. For the corresponding examples using heavy loading requirements, the results would be 720 ft. for the single-phase example, and 302 ft. for the three-phase example. Thus, the pole spacing requirements and resulting span lengths are roughly one-third more stringent for the heavy loading zone than for the medium zone.

As shown in Figure 17 below, below, the NESC imposes a further requirement for extreme ice with concurrent wind pressure loading for structures exceeding 60 feet in height. This requirement varies with location. For most of Kentucky, it requires that structures be built to withstand 0.75 inch radial ice thickness loading with 2.3 lb/sq.ft. horizontal wind pressure for the majority of the state. A 0.5 inch radial ice thickness standard is in place for the extreme eastern counties, while a 1.0 inch radial ice thickness is assumed for the extreme western counties. This requirement applies primarily to transmission structures.

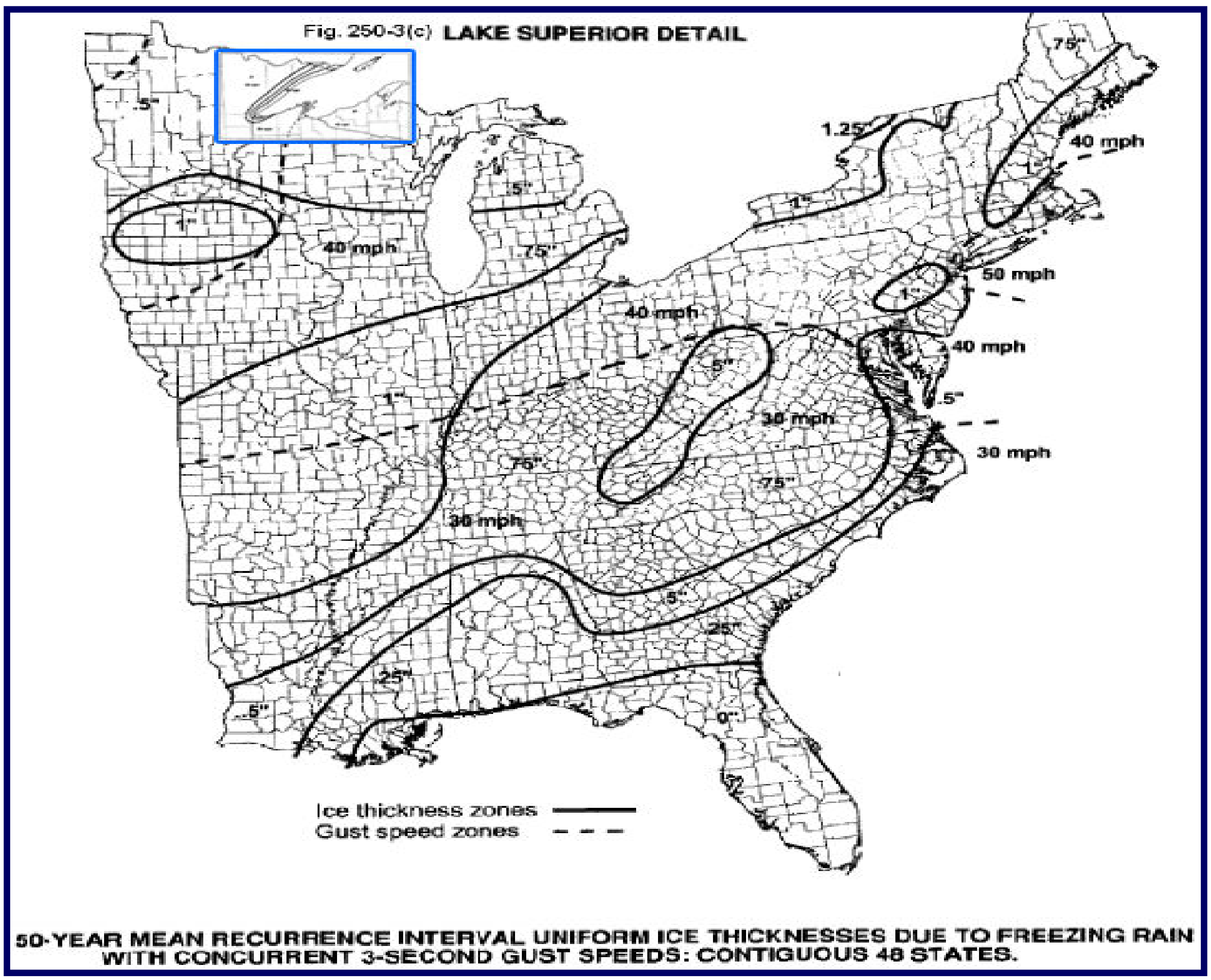


Figure 17: NESC Figure 250-3(b) - extreme ice loading

Example: Medium Loading (Zone 2) for structures above sixty feet could be shown as 3/4 inch of ice, 30 mph horizontal wind, and + 15° F.

Source: National Electric Safety Code

Most jurisdictional electric utilities facilities are constructed specifically to meet medium loading standards as required by the NESC. However, Kentucky Utilities Co. (KU), Louisville Gas & Electric Co. (LG&E), Duke Energy Kentucky (Duke Kentucky), and Kentucky Power have developed their own construction standards that meet or exceed the NESC.

The rural electric cooperatives build their facilities to meet or exceed the NESC and RUS construction standards. However, there are design requirements applicable to these construction standards that actually produce facilities which meet many, but not all, aspects of the heavy loading standards, depending on the circumstances under which they are constructed. For example, poles, spacing of poles, crossarms, guying, and other material used during the construction could meet the heavy loading requirements. However, because distance-to-ground (sag) specifications vary, utilities may not be able to meet that aspect of heavy loading standards while meeting it in all other respects.

The six jurisdictional utilities with transmission facilities – Big Rivers Electric Corp. (BREC), Duke Kentucky, East Kentucky Power Cooperative (EKPC), Kentucky Power, KU, and LG&E – all have a mix of transmission lines meeting either the medium or heavy loading standards. In recent years, most of these utilities have decided to build their transmission lines above 69 kilovolts to meet the heavy loading requirements. Nonetheless, severe wind loading and mechanical loading from trees contacting conductors caused conductor or structure failures during the 2008 wind storm.

Kenergy Corp., a distribution cooperative, utilizes the heavy loading standard for all feeders and major three-phase extensions. The medium loading standard is utilized for single phase construction and individual extensions. Kenergy observed no difference between the damage done to facilities constructed under the medium loading standard, as opposed to facilities constructed to meet the heavy loading standard, in either the Hurricane Ike wind storm or the 2009 ice storm. It appears that within Kenergy's service area, both these storms were so severe that the loading conditions exceeded those anticipated even under the most stringent construction standards, leading to massive structural failure throughout the system.

In the areas hardest hit by the ice storm – western and central Kentucky – the LG&E and KU transmission systems were built prior to 2003 and were designed to meet the NESC medium loading standard. These transmission systems suffered several structure failures due to extreme weight from excessive ice loading. Since the 2003 ice storm, KU and LG&E have revised their transmission system construction standards for new construction and line upgrades and are meeting or exceeding the heavy loading requirements of the NESC.

Due to its experience in the 2003 ice storm, Fleming-Mason Energy now constructs all new facilities to meet the NESC's heavy loading requirements, and upgrades to heavy loading requirements when replacing older facilities. During the 2009 ice storm, most damage to the Fleming-Mason Energy system was due to ice loading on older conductors. Fleming-Mason Energy is continuing to re-conductor the system to eliminate aged copper and aluminum conductors. The poles that were broken on the system were mostly older poles that failed due to longer span lengths. The three-phase circuits built for both heavy and medium loading performed well due to shorter span lengths.

In assessing whether the use of more stringent loading standards to govern electric system construction in Kentucky would have mitigated the damage from the two storms, the PSC reviewed the extent of damage in Indiana and Ohio. Both states experienced significant accumulations of ice during the 2009 storm, and the 2008 wind storm affected most of Ohio. Even though utilities in those states construct their facilities to the heavy loading standard, both states suffered significant outages during the ice storm. Outages in Ohio as a result of the wind storm were more extensive than in Kentucky.

The PSC finds that most utility facilities constructed to both the medium and heavy standards simply could not withstand the physical stresses placed upon them by both the weather conditions and the attendant loadings from falling trees and limbs during the wind storm and ice storm. The PSC does not believe that Kentucky should be placed into the heavy loading zone in the NESC.

However, construction to heavy loading standards, rather than the medium loading standard required in Kentucky, appears to have improved system durability in some instances.

Therefore, the PSC recommends that jurisdictional utilities should consider upgrading to heavy loading standards in some circumstances. For example, it may be beneficial to shorten span lengths when building lines in treed areas, thus improving the ability of those lines to sustain the weight of fallen vegetation.

SYSTEM HARDENING

Hardening is the term used to refer to improvements that could be made to current design and construction practices to improve electric system resilience to both wind and ice.

While utilities continue to evaluate their systems in order to improve reliability, and reduce the number of outages across its system during storm related events, all the jurisdictional utilities felt the systems in place during the 2008 wind storm and 2009 ice storm performed better than expected. Utilities overwhelmingly believe that system hardening, either within or outside the context of loading standards, would have done little to improve system performance during those extreme storms.

In considering the various methods currently being used to harden or strengthen electric systems and the cost and ultimate value of those methods, utilities stated that system resiliency could be improved, but at a cost that would be prohibitive if implemented across entire systems. Most utilities take the position that they are employing best practices and that their current efforts to minimize outages are reasonable.

Overhead systems can be hardened by using a heavier class of pole, along with its supporting components, reduced span lengths, and increased guying. The concern with system hardening is the cost compared to the overall benefit to the rate payer. It may not be cost effective to harden the entire system, but the benefit of focusing on critical parts of a utilities system could be an affective component of system hardening.

The Commission recognizes that many utilities evaluate the appropriateness of system hardening practices for particular areas or circuits that suffer repeated weather-related outages. The Commission recommends that all utilities use their routine system evaluations as an opportunity to evaluate the need for and potential effectiveness of system hardening, and to implement those system hardening practices where indicated. Utilities should track outage data for those portions of their systems that have undergone system hardening in order to determine the overall effectiveness of system hardening practices in preventing outages on those circuits. All jurisdictional utilities should evaluate system circuits serving critical infrastructure such as hospitals, police stations, emergency response facilities, fuel locations, and predetermined lodging or staging facilities used during storm restoration and evaluate the potential effectiveness of hardening those critical circuits.

CONSTRUCTION STANDARDS DURING RESTORATION

Although all jurisdictional utilities in Kentucky are required to comply with the NESC, this does not produce uniformity across utility systems, or even within the systems of single utilities. This is because the NESC changes over time. However, the design and construction of utility facilities is dependent on the NESC as it existed when the facilities were built. Once lines and facilities are installed, operators must inspect and maintain their facilities to make sure that they remain in compliance with the original standard.

During the restoration and replacement of structures in the state of Kentucky following the 2008 wind storm and 2009 ice storm, most utilities' distribution and transmission systems were restored to the standard to which they were designed. That is because the 2007 NESC allows replacement of structures to be in accordance with the version of the code that was in place at the time of the original construction, or to the highest standard to which the facility has been previously upgraded. The significant exception to this rule occurs if a higher-standard replacement is needed for safety reasons.

All utilities in their responses indicated that damaged distribution and transmission facilities were replaced in adherence to the original design and construction. Replacement with identical or near-identical facilities expedited repairs and minimized problems of integrating replaced structures into existing lines.

While allowing utilities to replace damaged facilities with new facilities that do not meet the most current NESC standards may seem counter-intuitive, there are valid reasons for this provision. The time required to restore power would be greatly increased in many instances if the utility had to redesign and reconstruct facilities to meet a newer NESC standard. Some circuits might have to be completely re-designed if such requirements were in place, and the time required to perform such engineering would further delay restoration. If practical, post-restoration consideration can be given to upgrading facilities.

In some instances it may be physically impossible for a utility to rebuild its facilities to meet the most recent NESC requirements. For example, if LG&E was required to rebuild its distribution system along Bardstown Road in Louisville (see photo below) to the current clearance standards, it would have to relocate its poles to the middle of the street, which it clearly could not do. Other options, such as a complete relocation of the lines or placing them underground, would create unacceptably long restoration times while dramatically increasing costs.

The PSC finds no reason to alter the current practice of restoring facilities to pre-existing condition as governed by the NESC. Requiring upgrading of electric facilities as they are restored to any higher standards included in the current NESC code would delay restoration and may be impractical under many circumstances.

Bardstown Road, Louisville

Photo courtesy of LG&E

TRANSMISSION SYSTEM DESIGN

The experience of one utility during the 2009 ice storm demonstrates how transmission system design can affect reliability. Inter-County Energy in central Kentucky experienced outages across its distribution system due to transmission outages on the EKPC system. Inter-County Energy's system has several substations that receive only a one-way, or radial, feed from EKPC's transmission system.

Most transmission systems employ loop feeds, which provide redundancy by supplying power to distribution substations through two or more transmission lines. Thus, a failure of one line does not mean that the substation loses power. Customers served by a radially fed substation will lose power when the single transmission line fails and will not have power restored until it is repaired.

While radial feeds are less reliable and thus less desirable than loop feeds, topography and cost make it impractical to eliminate all radial feeds. It is therefore useful to develop criteria that can be used to determine the relative risk, or "exposure", associated with radial lines throughout a system.

Typical distribution substation

PSC photo

Two critical factors in assessing the exposure are the length of the radial line and the amount of electric demand that is served by the line. The length is important for two reasons. The probability of a forced outage is proportional to the length of the line. A two-mile line is exposed to more hazards and thus more likely to have a forced outage than a one-mile line. The length of the line also can affect the duration of a forced outage due to longer restoration times caused by increased time in identifying the cause of the outage. The criticality of the length of the line results in some utilities weighting this factor more than the amount of load/number of customers served from the line.

For example, EKPC uses a maximum exposure index of 100 megawatt (MW)-miles. EKPC does not allow the product of the line length and the peak demand served from a radial line to exceed 100 MW-miles. Once the exposure index for a radial exceeds this value, EKPC designs and builds a new transmission line to provide a second source for the substations served from the radial line. This could involve looping the existing radial line (constructing a parallel line to the radial to provide two sources) or constructing a new independent line from another area of the system.

In its 10-year transmission expansion plan, EKPC plans to address one of these radial feed line sections, for the H.T. Adams substation, since it has a longer radial exposure than the other lines serving Inter-County Energy. The preliminary plan is to construct a new 69 kV line from their existing Van Arsdell Substation to the Mercer County Industrial Substation, reducing the radial exposure for H.T. Adams from 5.07 miles to 0.56 miles. EKPC's Transmission Planning Department estimates that this project will be necessary by 2015.

POLES AND STRUCTURES

Failure of wooden poles is often the most visible component of storm damage to electric and telecommunication utility systems. For this report, the PSC assessed whether differences in the treatment and age of utility poles produced differential failure rates.

Kentucky's jurisdictional utilities have a total of about two million poles and towers in their systems. During the 2009 ice storm, 10,638 of these poles and towers broke or collapsed, a failure rate of about 0.55 percent.

Jurisdictional utilities in Kentucky obtain poles and other wooden structures from a variety of suppliers who employ various preservative treatments. The poles and structures are treated either through pressure or thermal impregnation with preservative chemicals to guard against decay, fungi, bacteria, insects, and marine borers. Preservative treatment processes include pentachlorophenol (Penta), chromated copper arsenate (CCA), creosote, copper azole, copper napthanate, and CCA with an emulsion treatment, which is referred to as CCA-ET. Poles and structures are manufactured according to standards and specifications set forth in RUS Bulletin 1728F-700, American National Standards Institute (ANSI) 05.1.2008, and the American Wood Protection Association (AWPA).

The National Rural Electric Cooperative Association (NRECA) operates a pole inspection program called Wood Quality Control, Inc. (WQC). WQC is the utility industry's leading third-party quality assurance/inspection program for the inspection of wood poles and cross arms. The WQC program is designed to ensure its customers receive high-quality treated wood utility products that will provide decades of reliable service.

Manufacturers test poles for compliance with the applicable standards. For example, McFarland Cascade, Bell Lumber & Pole, and Cobb Lumber test 100 percent of wood poles to check for adequate penetration of preservative.

Wooden poles must meet or exceed ANSI and AWPA standards for quality assurance, both before and after the poles are treated. Poles are inspected by the manufacturer's certified lab personnel, and independent testing companies, such as WQC, to ensure that the power company's specifications are fully met.

Manufacturer	Treatment Process				
	Penta	CCA	Creosote	Copper Azole	CCA-ET
McFarland Cascade	X	X	X	X	
Bell Lumber	X	X			
Kopper, Inc.	X	X	X		X
Cobb Lumber	X	X	X		
Caroline Pole					X
Brownwood Poles	X	X			
TR Miller Mill Co.	X	X			
Langdale Forest Products Company		X			
Atlantic Wood	X	X	X		X
Huxford Pole	X				

Table 2: Wooden preservative methods used on utility poles in Kentucky

Utilities reported no noticeable differences in failure rates among poles treated with different wood preservatives. All of the four major preservatives – creosote, pentachlorophenol, copper napthanate and CCA – are used by one or more utilities in Kentucky. Many utilities reported having several types of preservatives represented in their pole inventories.

The PSC contacted several independent experts who stated that there is no evidence of differential failure rates in utility poles based on the type of preservative used, if the preservative is applied properly. William Smith, Professor of Wood Product Engineering in the College of Environmental Science and Forestry at the State University of New York in Syracuse, noted that all utility poles must meet the same strength specifications regardless of the preservative used.

Similarly, Michael Barnes, Professor of Wood Science at Mississippi State University, said that “a properly treated, properly (situated) pole, with proper inspection and maintenance, should not fail under normal circumstances.” Barnes, who viewed storm damage in western Kentucky, said the pole failures he observed were clearly the result of extreme

“A properly treated, properly (situated) pole, with proper inspection and maintenance, should not fail under normal circumstances.”

Michael Barnes, Professor of Wood Science at Mississippi State University

ice and wind loadings that far exceeded the stresses the poles were designed to withstand.

Distribution system poles - types, sizes, age in system

Utilities reported that the types of materials used for distribution poles in Kentucky include wood, steel, aluminum, fiberglass, and concrete. The height of the distribution poles ranges from 14 to 120 feet. The age of the distribution poles range from brand new up to 70 years old. Wooden poles of all ages and size failed during the ice storm.

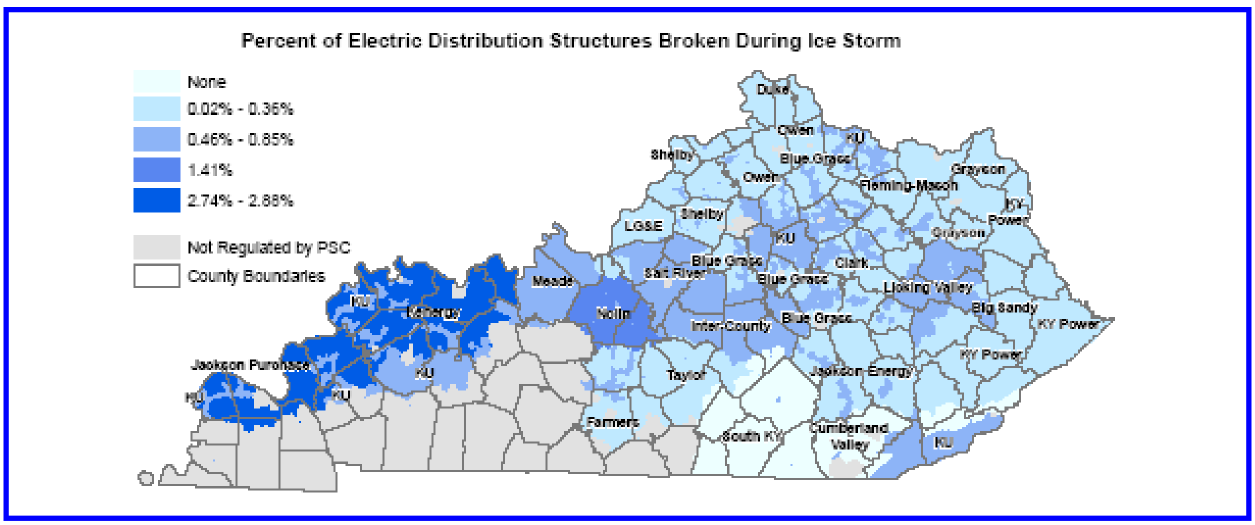


Figure 18: Percentage of broken poles by utility during 2009 ice storm

PSC map compiled from utility data

Company	**Approximate # of Broken Poles**
Kentucky Power	245
Big Sandy RECC	102
Blue Grass Energy	127
Clark Energy	73
Cumberland Valley Energy	No Damage Reported
Duke Kentucky	10
Farmers RECC	220
Fleming Mason RECC	68
Grayson RECC	59
Inter-County Energy	431
Jackson Energy	57
Jackson Purchase Energy	1710
KU	2006
LG&E	377
Kenergy	3169
Licking Valley RECC	222
Meade County RECC	432
Nolin RECC	683
Owen Electric	26
Salt River Electric	300
Shelby Energy	65
South Kentucky RECC	No Damage Reported
Taylor County RECC	41
Total	**10,423**

Table 3: Broken distribution system poles, by utility—2009 ice storm

Data compiled by PSC from utility reports

Transmission poles - types, sizes, age in system

Transmission pole types include wood, steel, lattice steel, tubular steel, fiberglass, and concrete. The height of the transmission poles ranges from 35 to 235 feet, and the age of the transmission poles ranges from brand new to 100 years old with the majority in the age range of 20-64 years old. Less than 3% of the transmission poles in use today are greater than 100 years old.

Company	**Broken Poles**
Kentucky Power	No Damage Reported
BREC	24
Duke Kentucky	No Damage Reported
EKPC	3
KU	183
LG&E	5
Total	**215**

Table 4: Broken transmission system poles, by utility—2009 ice storm

Data compiled by PSC from utility reports

Pole Maintenance Programs

Pole inspection and maintenance procedures vary greatly among utilities. Inspection procedures also differ for transmission and distribution lines. There is no uniform standard or consistency in frequency or nature of inspections or maintenance. Some utilities use third-party contractors, while others have no set process in place.

The types of inspections reported include aerial infrared, foot patrols, climbing and ground line inspections. Visual inspections are used to identify excessive lean, external damage, unauthorized foreign attachments, lack of foundation integrity and excessive corrosion.

Frequency of inspections varies substantially. For example:

- Jackson Energy inspects on a two-year cycle.
- Kenergy is on a 10-year cycle.
- Big Sandy RECC inspects approximately 10 percent of its poles annually.
- Taylor County RECC inspects all circuits served by one substation each year.
- Fleming-Mason Energy uses an eight-year inspection cycle.
- EKPC inspects its transmission system poles initially at the 16-year point and at 12-year intervals thereafter.
- Duke Kentucky has three different types of inspection: 1) transmission lines are inspected every two years by a line patrol, helicopter survey and aerial inspections; 2) distribution lines are visually inspected every two years; and 3) distribution lines are ground-line inspected every 12 years.

As with the type and frequency of inspections, utilities also take varying approaches to the preservation of poles after installation:

- Outside contractors are used by some of the utilities (i.e., Blue Grass Energy, Inter-County Energy, and Jackson Purchase Energy) to determine if pole treatment is necessary.
- South Kentucky RECC, Taylor County RECC, Salt River Electric, Jackson Energy, Cumberland Valley Electric, Farmers RECC, Grayson RECC, and Licking Valley RECC do not have pole treatment programs.
- Kentucky Power inspects and maintains its poles in accordance with AEP (parent company) Specification 125

"Specification for Inspection & Ground line Treatment of Standing Wood Poles," which includes treatment with pesticide and preservatives with a bandage arrangement around the base of the pole.

Kenergy and EKPC use treatments that include the application of supplemental paste preservative directly to the ground line area which is most susceptible of decay. Big Sandy RECC does boring, visual inspection, fumigation and ground line treatment.

The main components of a pole installation include the pole foundation, the pole itself, conductors, guys and anchors. Some utilities stated that the weakest component of a pole installation varies by the predominant type of load (wind, ice, combined wind and ice, etc.) and resistance to unanticipated loads such as trees falling on lines and structures which exceed design loads. Other utilities stated that the weakest component of any particular pole installation will be the component for which the applied loads most nearly reach its allowable loads, which will vary depending on the application and the arrangement of the various components.

LG&E pole snapped by the 2008 wind storm

PSC photo

A number of utilities provided very similar assessments, with several noting that C.H. Guernsey & Company, an engineering consulting firm, had assisted in the preparation of the following response:

> *Each pole installation's group of components are arranged and sized to work together to support the applied loads. Often the strength capacity of one component will rely greatly on the use of other components for support. It is very situation specific, but failure of an individual component within a group can ultimately lead to complete failure of the structure and, furthermore, failure of complete sections of line. The measure of integrity that remains in a structure following the failure of one of its components will vary depending on the application and the arrangement of its components.*

However, EKPC and Duke Kentucky both stated that the weakest component is the "pole itself." Duke stated:

> *A typical distribution structure consists of pole, cross arm, cross arm braces, insulators and hardware to assemble the structure. Loads applied to the structure include transverse, vertical and longitudinal forces. During the design process, three-dimensional modeling software is used to evaluate the loads a structure would be subject to based on NESC requirements. This software will also display the percentage that a structure is loaded by component. For a typical tangent structure, the greatest structure load is usually generated by the transverse wind load when applied with ice loading. For transverse wind loading the limiting factor is usually the pole not the cross arm, cross arm braces or the insulators.*

EKPC responded:

> *Failures that occur with transmission lines are normally the result of weather conditions- high wind events, ice storms, etc.*

These failures happen as a result of overloads which have been concentrated at the points of support. The wires serve to transfer the loads to these support points. As an example, during heavy ice loading conditions the weight of the ice on the wire is transferred to the supporting structures resulting in increased loads on those structures.
The wires rarely ever experience loadings that would cause them to fail (break) since they are normally designed for tension of approximately 50% or less of the rated breaking strength. Also, wires have a certain amount of elasticity (stretch) before failure. The insulators and hardware support only one wire and, thus are subjected to only the loads transferred by that one wire. However, the supporting structure is subjected to the loads transferred from all the wires that are attached. Insulators and hardware are specified and designed such that they rarely ever fail before the supporting structure. Some supporting structures may include *crossarms or davit arms. In some cases these arms will fail prior to the poles failing. Thus, poles and arms (if present) are normally the most critical components of a structure.*

LG&E, KU, Big Sandy, BREC, Taylor County RECC, Fleming-Mason Energy, Shelby Energy and Nolin RECC all stated that their pole installations are not designed with planned failure points that minimize overall damage. These utilities pointed out that a multitude of different weather and environmental conditions can affect various components of a structure in different ways. Designing certain components to fail first could result in creating more outages due to the possibility of premature release at times other than storm events and cause wires to break and/or sag low to the ground. This could present a serious hazard to the public that might not have otherwise existed.

Kenergy pole with multiple failure points during 2009 ice storm

Photo courtesy of Kenergy

The utilities were asked to identify other issues related to pole failures that may not typically be considered during the design and inspection process. Most did not identify other such issues. Clark Energy, however, described several factors that may contribute to pole failures:

- Location of poles: some soils may not have the ability to hold poles in place properly when the pole is subjected to wind or other similar forces in a storm.
- Some of the routes used for pole placement are not ideal.
- Creeks, rivers, and other streams can cut into banks over time and during a severe weather event the poles can be "washed out."
- Deterioration of pole tops may also be overlooked, but can break and cause outages.

Joint-use pole attachments

Joint-use attachments are generally steel messenger wire and cable facilities, owned by telephone and cable companies, which are attached to existing electric utility poles by the telecommunication companies. Such attachments may have a detrimental impact on the overall strength of the pole due to multiple holes being drilled through the poles. Overhead pole attachments are generally less expensive to install and may be deployed much faster than underground facilities.

Pole attachments have proliferated since the 1960s with the advent of cable television and, later, fiber-optic cables for high-volume data transmission. Twenty years ago, it was uncommon to see more than three joint-use attachments – electric, telephone and cable - on a utility pole. Today, with the increase in companies offering communication, information or entertainment services, it is not uncommon to see twice that number of companies using the same pole.

Several electric utilities expressed concern over the impact that third-party attachments on their poles may have had on the survivability of portions of their electric system. During the 2009 ice storm, BREC experienced multiple broken poles on a 69 kV transmission line that carried an under-built distribution line. BREC believes that the presence of the joint-use attachments on that circuit may have contributed to the damage to this section of line.

Many electric distribution utilities experienced a significant number of poles that were broken at the point of attachment of telephone or cable television facilities. Meade County RECC claimed that the biggest "on-the-pole" issues encountered were third-party attachments. Jackson Purchase Energy and Meade County RECC indicated that many attachments were being made without notice to, or approval by, the underlying electric utility pole-route owner.

Several utilities stated that their ability to control the quantity or nature of pole attachments has been compromised by state and federal requirements that the pole-route owner accommodate such attachments. The electric utilities routinely consider and review attachments to ensure compliance with NESC standards for both structural loadings and facility clearances.

The Commission finds that jurisdictional electric utilities, as pole-route owners, are responsible for ensuring the safety and integrity of their infrastructure. This includes evaluating the impact of attaching facilities to determine compliance with industry and regulatory standards. The obligation of those utilities to make their facilities available for third-party attachments in no way alleviates their responsibility to provide for the safe and reliable operation of their own systems.

The Commission recommends that electric utilities conduct regular audits and inspections of pole routes to ensure continued compliance with applicable standards, including evaluations of structure

loadings and facility clearances. In instances in which the pole-route owner determines that attachments are inappropriate or unsafe, the PSC expects the attaching party to be notified of the specific location(s) and details for each area of concern and advised of the precise procedures necessary to correct the deficiency. If the identity of the attaching party cannot be obtained, or the attaching party refuses to engage in actions necessary to correct the deficiency, the utility may take steps, in accordance with its pole attachments tariff, to remove the attachments.

The PSC expects attaching parties to notify the pole-route owner of each specific intention to make attachments and to seek approval of such attachments pursuant to governing agreements or tariffs prior to placement. Such required notifications include circumstances where additional facilities will be placed in pole-attachment space already occupied pursuant to an approved pole-attachment arrangement.

General system maintenance practices

PSC investigators conducted field visits in the days following the ice storm and observed no evidence that poles and other supporting structures failed due to lack of maintenance. Commission investigators further observed that poles typically broke not at ground level, but at heights of six to eight feet, with many poles broken in multiple locations. This supports the conclusion that extreme ice and mechanical loadings were the major causes of pole failures.

There was consensus among responding utilities that additional pole inspection and pole maintenance programs would not have prevented outages that resulted from the extreme weather conditions experienced during the 2008 wind storm and 2009 ice storm. Although utilities take varying approaches to pole inspection and pole maintenance, no single approach was observed to be more effective than the others.

LG&E pole that snapped during 2008 wind storm. Note joint-use attachment just below break.

PSC photo

Given the severity of the storm, the relatively low overall failure rate of poles and other supporting structures suggests that the jurisdictional utilities generally are maintaining these structures to an acceptable level.

The PSC finds that existing pole construction, inspection and maintenance standards are reasonable and does not recommend further revisions.

ELECTRICAL SYSTEM MAINTENANCE PRACTICES

System inspections

PSC regulations (807 KAR 5:006, Section 25 (1)) require each utility to adopt inspection procedures to assure safe and adequate operation of its facilities and compliance with Commission rules and regulations. The regulation also requires each electric utility to file their inspection procedures with the Commission for review. Section 25(4) further requires jurisdictional electric utilities to make the following systematic inspections of their systems to insure that the Commission's safety requirements are being met.

- As a part of operating procedure, each utility shall continuously monitor and inspect all production facilities regularly operated and manned.
- Every six months, each utility shall inspect: (1) unmanned production facilities, (2) substations with primary voltage of greater than 69 kV for damage or deterioration to components, (3) underground network transformers and network protectors in vaults, and (4) electric lines operating at 69 kV or greater for damage or deterioration.
- At intervals not to exceed one year, each electric utility shall thoroughly inspect: (1) all production facilities, except for remotely controlled facilities, and (2) substations with primary voltage of 15 to 68 kV.
- At intervals not to exceed two years, each electric utility shall inspect electric lines operating at voltages of less than 69 kV, including insulators, conductors and supporting facilities.
- With one minor exception – an inspection delay caused by inclement weather - all jurisdictional electric utilities indicated that they were in compliance with the system inspections requirements of 807 KAR 5:006, Section 25 prior to the 2009 ice storm.

Inspection practices vary among utilities.

For example, Kentucky Power performs routine aerial inspections of all transmission lines in Kentucky every six months, regardless of voltage. Kentucky Power annually conducts a comprehensive inspection of approximately 10 percent of its steel transmission structures and 20 percent of its wooden transmission structures. Kentucky Power also performs routine visual inspections of overhead and underground distribution facilities every two years. The objective of this program is to identify deficiencies and make necessary corrections for the safety of Kentucky Power's employees and the public under the conditions specified in the NESC and for system reliability.

Kentucky Power indicated that it utilizes a contractor for its distribution pole ground line inspection and maintenance program. The contractor uses boring and visual inspection to check for rot and remaining wood thickness. The inspected pole is then chemically treated if doing so will enable the pole to last another 10 years. If not, the pole is recommended for replacement.

EKPC conducts aerial patrols of its entire system three times per year. EKPC also conducts foot patrol and structure inspections of 20 percent of its system annually in the Bardstown, Burnside, and Crittenden Service Center area and conducts foot patrols and structure inspections of 25 percent of it system annually in the Winchester Service Center area. EKPC states that this inspection process exceeds the PSC's requirements.

BREC inspects its substations three times in every six-month period, which exceeds the once-every-six-month inspection schedule required under the regulation. BREC's transmission lines are inspected at least once every six months, while communication sites are inspected three times every six months, which exceeds the annual inspection requirements in the regulation.

Duke Kentucky conducts a walking inspection of electric lines operating at 69 kV or greater each year. Insulators, conductors and supporting facilities are checked for damages or deterioration during this inspection. Electric lines operating at voltages of less than 69 kV, including their associated apparatus, are inspected every other year. Duke Kentucky conducts visual inspections of all substation equipment, structures, fences, and monitoring devices on a monthly basis.

LG&E and KU patrol their 345 and 500 kV lines six times per year. All other transmission lines of lower voltages are patrolled three or four times per year, and substations are inspected on a quarterly basis.

Jackson Energy is representative of the inspection procedures implemented by distribution cooperatives. Jackson Energy visually inspects its entire system every two years, including checking all poles, lines, meters, and right of ways for hazardous conditions. Any deficiencies discovered during the inspection process are corrected via a service or work order.

LG&E, KU, EKPC and Duke Kentucky all noted that their system inspections occur on a more frequent basis than is required under the regulation.

Several distribution cooperatives stated that their inspection processes exceed the regulatory requirements. South Kentucky RECC, Inter-County Energy, Clark Energy, Taylor County RECC, Fleming-Mason Energy, Big Sandy RECC, Salt River Electric, Shelby Energy and Licking Valley RECC indicated that their systems are inspected every three years by an RUS field representative as part of the RUS Operations and Maintenance Survey.

Typical wooden transmission structure

PSC photo

Aerial inspections

Although not required under PSC regulations, several electric utilities conduct aerial inspections of their systems. Because PSC regulations do not permit sole reliance on aerial inspections, these utilities perform aerial inspections in addition to ground inspections of their systems.

Transmission system operators conduct aerial inspections of their transmission system on at least an annual basis. Duke Kentucky and Kentucky Power both perform aerial inspections of their transmission systems twice a year. LG&E and KU perform aerial inspections of their transmission lines at least three or four times a year. EKPC conducts aerial inspections on its entire system three times a year. Duke Kentucky, Kentucky Power, LG&E and KU do not conduct aerial inspections of their distribution systems.

Several distribution cooperatives reported that they perform aerial inspections of their systems. Kenergy indicated that aerial inspections are performed only in post-storm assessment to identify potentially hazardous conditions. Salt River Electric conducts aerial inspections of its system on a bi-annual basis. Shelby Energy aerially inspects 25 percent of its system each year. Shelby Energy maintains that aerial inspections are useful in inspecting cross-arms, insulator ties, and pole tops as well as being a very effective tool for detecting problems with guy wires and right-of-way issues. Shelby Energy also inspects its system each year by visual ground patrol and 50 percent of its system is inspected when poles are treated at the ground line. By combining these two inspection methods, Shelby Energy inspects its entire system every two years or less.

The Commission believes that on-the-ground inspections are necessary to assure safe and reliable utility operations. On-the-ground inspections are more detailed and involve a greater qualitative assessment of a utility's electric facilities than aerial inspections. The Commission will amend its regulations to clarify that on-the-ground inspections are to be the primary method of system inspection. In the interim, the Commission recommends that jurisdictional utilities use on-the-ground inspections as the primary means of system inspection.

Use of inspection data

Inspections are intended to collect information in order to identify any deficiencies in the electric system and to take the appropriate corrective measures.

For example, LG&E and KU enter their transmission patrol reports into a database that is then reviewed by the construction department and vegetation management group to identify any necessary corrective action to insure system reliability. LG&E and KU state that their inspection process identifies specific issues related to the distribution system circuit being inspected. The companies' operation centers review the inspection data, correct system deficiencies and report any systemic issues to management and to the standards team in order to evaluate the impact of the corrections across the system. In addition, systemic issues are identified by analyzing reliability data from the outage management system. Items that are identified as systemic issues are addressed by asset management, and action plans are then issued.

BREC analyzes the information collected during its wood pole inspection process and makes a decision at the time of the inspection on whether to use the pole for an additional five years. Inspection documentation with respect to repairs performed is recorded in a pole database for review by department supervision and management. BREC notes that a determination of larger systemic issues is possible through the review of this database information.

Duke Kentucky collects inspection data to identify leading indicators of potential system maintenance and reliability concerns. Once potential concerns are validated, they are addressed programmatically to insure safe and reliable operations.

Clark Energy stated that key engineering and operations personnel analyze the data collected through system inspections. The analysis is focused on finding any condition that Clark Energy would consider to be abnormal. For instance, if Clark Energy were to find a large number of poles that had deteriorated at the ground line, the company would review the effectiveness of its pole treatment program and conduct further investigation.

Similarly, Cumberland Valley Electric noted that each deficiency identified by inspection procedures is addressed and corrected by issuance of a work order or maintenance order. When evaluation of inspection data reveals potential systemic issues, Cumberland Valley would then take appropriate remedial actions to address such problems.

Post-restoration Inspections

After a major outage, most electric utilities usually conduct post-restoration inspections to confirm that system repairs were properly performed. This is essential in insuring that system damage or dangerous situations do not remain after storm repairs have been completed.

Utilities in Kentucky have experienced several major weather events over the past two years, and the compounding of damage can lead to facility failures and accidents due to sagging lines, broken poles, and other problems. At this time, there is no regulatory requirement that utilities conduct such inspections or assessments.

Most jurisdictional utilities do not routinely produce a formal written post-restoration assessment of the condition of their system following a major outage. Although about half of the responding utilities indicated that they performed some type of post-restoration assessment of their system after the 2009 ice storm, most of those utilities produced no written report.

Duke Kentucky stated that facilities affected by a major outage are checked at the time of repair to ensure that they meet safety standards and provide reliable service. LG&E and KU patrol transmission lines in the areas affected by a storm event. For example, following the 2009 ice storm, LG&E and KU patrolled every line in the affected area after service had been restored to verify all repairs were complete and in safe condition. LG&E and KU also perform a post-storm sweep on the distribution circuits located in the areas that incurred significant damage to the facilities. LG&E and KU inspectors identify facility problems and vegetation issues that could affect system reliability and public safety.

Kentucky Power gathers data from fault recorders, the SCADA system, aerial patrols and ground patrols following a major storm outage. Kentucky Power monitors the restoration process to confirm that Kentucky Power standards are met for either temporary or permanent repairs. Kentucky Power combines inspections with follow-up corrective maintenance to ensure safety and provide for continued system reliability.

EKPC conducts two types of inspections that run concurrently with the restoration of the system. The cooperative conducts aerial patrols during the restoration effort. Experienced service center supervisors and line crew leaders are on the site ensuring that the supplies and materials have been delivered and are properly installed at each location where an outage has occurred.

Fleming-Mason Energy performs a post-restoration assessment to evaluate the condition of its system. Each feeder circuit is evaluated in its entirety and any damage is noted and reported to the assessment coordinator.

Work is then scheduled on a priority basis to make repairs to problem areas. Other distribution cooperatives, such as Clark Energy, Cumberland Valley Electric and Shelby Energy, perform a complete visual inspection of their overhead systems using qualified employees and contractors. If any issues requiring immediate attention are identified, the crew would contact the office and guard the location until the company could send help to address the situation. Situations that did not require immediate attention were documented and prioritized for repairs at a later date.

In light of the significant magnitude of the outages experienced in Kenergy's service territory during the 2009 ice storm, the company retained an independent engineering consultant to conduct a full post-restoration assessment of its system. The post-restoration inspection generated more than 5,000 work orders requiring $1.5 million in additional repairs. Kenergy noted that it will seek reimbursement from the Federal Emergency Management Agency for the added costs.

The Commission finds that post-restoration inspections are critical for ensuring continued reliability and operational safety. Thus, the Commission recommends that jurisdictional electric utilities conduct formal post-restoration inspections subsequent to any future major outage event and report their findings as the Commission may direct.

Transmission and distribution substation inspections

As previously noted, PSC regulations require that substations and transmission lines be inspected at certain intervals. Substations in which the primary voltage is 69 kV or greater are required to be inspected every six months. Substations with primary voltages between 15 and 68 kV must be inspected yearly, and electric lines operating at 69 kV or greater must be inspected at intervals not to exceed six months.

Jurisdictional utilities were asked to evaluate whether maintenance problems in transmission and distribution stations might have contributed to outages or hampered restoration efforts as a result of the two storms. No utilities identified any such issues.

Big Rivers Electric Meade County substation after 2009 ice storm

Photo courtesy of Big Rivers Electric Corp.

ELECTRIC UTILITIES

VEGETATION MANAGEMENT

The vast majority of electric distribution system outages during both the 2008 Hurricane Ike wind storm and the 2009 ice storm were caused by limbs or entire trees sagging or falling on electric lines. Falling vegetation played a smaller, though significant role, in transmission system outages as well.

These storms have again highlighted the effect of vegetation management practices on electric system reliability.

The primary goal of an electric utility's vegetation management plan is the creation of a cost-effective program which will minimize public safety hazards and maximize service reliability. Proper management of the vegetation under and around electric power facilities is extremely important in maintaining a reliable electric transmission and distribution system, and in providing consistent service to customers.

Permanent removal of trees that may grow into electric lines, while the most effective form of vegetation management, is not always practical. Utilities must constantly engage in a balancing act that weighs system safety and reliability against the understandable desire of property owners both beneath and adjacent to utility lines to preserve trees and maintain an aesthetically pleasing landscape.

This chapter examines utility vegetation management standards and practices and, in doing so, considers whether it is appropriate to tilt that balance in favor of more aggressive vegetation management practices.

VEGETATION MANAGEMENT PRACTICES AND STANDARDS

Rights-of-way

The term right-of-way (ROW) refers to the property used by a utility to construct, maintain, repair, or replace the facilities needed to provide electric service. The ROW allows an electric utility to provide clearance from trees, buildings, and other structures that could interfere with the installation, maintenance, and operation of the electric facilities. ROWs may run under, on, or above public or private property.

An electric utility usually acquires an ROW from landowners through an express easement. An express easement is a written legal document by which the property owner grants an electric utility a permanent right to use land for a specific purpose, such as to install and maintain the facilities necessary to transmit and distribute electricity. Normally, an express easement contains language describing the specific rights that a utility has with regard to the ROW. For example, an express easement will specifically provide that the utility has the right to enter and exit over the grantor's property and the right to trim and cut trees in the defined area of the easement.

Although a utility may purchase the land in order to acquire ROW, most often utilities simply obtain permission from the landowners to install and maintain the needed facilities.

An easement runs with the land, which means it stays with the property even if ownership of the property changes.

A utility also may acquire ROW by operation of law through a prescriptive easement. Where the use is uninterrupted for 15 consecutive years in an open and obvious manner without any objection by the landowner, the user obtains an easement by prescription to continue that use.

A utility ROW may be part of a platted easement, which is filed with a subdivision plat as a designated space for utilities. Provisions in a platted easement typically include the right to do those things necessary to construct, maintain, and repair the electric facilities.

In addition to easements, distribution cooperative usually will require potential members to execute an application for service which provides, among other things, that the applicant will grant the distribution cooperative a ROW easement allowing access to the applicant's property and also granting the distribution cooperative the right to clear vegetation in the ROW.

Distribution systems

Distribution lines carry electricity at low voltages (below 69 kilovolts, or kV) from substations to residential, commercial, and industrial customers. These require many miles of ROW.

Electric distribution utilities indicated that they prefer to maintain clearance widths around both single-phase and three-phase distribution lines ranging from 10 feet to 60 feet. The width chosen by a utility for any part of its system varies with a multitude of factors, including, but not limited to, landowner cooperation, population density, topography, terrain and local ordinances.

For example, Duke Kentucky maintains a clearance width of 10 feet from branch to wire for both single-phase and three-phase lines. Kentucky Power stated that its clearance widths were in accordance with arboricultural standards which provide appropriate clearance by species. Kentucky Utilities Co. (KU) and Louisville Gas & Electric Co. (LG&E) reported that they desire clearance widths from 15 feet to 20 feet for single-phase lines and from 30 feet to 40 feet for three-phase lines. Licking Valley RECC stated that its clearance widths for single- and three-phase lines are 60 feet.

Detailed information on line clearance widths, clearance standards and vegetation management practices used by jurisdictional utilities can be found in the chart at the conclusion of this chapter.

All of Kentucky's jurisdictional electric distribution utilities have filed vegetation management plans with the Kentucky Public Service Commission (PSC) within the past three years. The PSC required such plans in its final order in Administrative Case No. 2006-00494, An Investigation of the Reliability Measures of Kentucky's Jurisdictional Electric Distribution Utilities and Certain Reliability Maintenance Practices. In that proceeding, the PSC investigated the measures used by Kentucky's jurisdictional electric utilities to assess the reliability of their distribution systems and the vegetation management practices for those electric distribution systems.

The vegetation plans required by the order must include, at a minimum, the utility's ROW clearing cycle, tree trimming practices, ROW clearance criteria, and its inspection methods and cycles. It must also identify the reliability criteria and reliability reports used by the utility in developing the plan. In addition, the Commission established annual reliability reporting requirements for all jurisdictional utilities. As a part of the annual reporting of reliability, each utility is required to describe the implementation of its vegetation management plan over the past year and what changes to the plan may be implemented, based on the effectiveness of the existing plan.

Transmission systems

Transmission lines carry electricity at higher voltages (69 kV or above) from generating plants to substations. These power lines may also carry power between substations. Transmission ROW corridors typically range in width from 50 feet to 500 feet. ROW widths vary significantly among the reporting transmission owners, typically increasing as the line voltage increases, as well as varying with different topographic conditions and company policy. Higher voltage lines require wider ROW because greater separation is needed between conductors.

Unlike most distribution ROWs, the vast majority of transmission ROWs have documented provisions allowing the utility to clear and maintain vegetation in order to provide safe and reliable electric power. This gives the utility a greater amount of control over the landscape than it has with regard to distribution ROWs. These documented rights on transmission ROWs also give the utilities freedom to make greater use of mechanical and chemical vegetation management tools, including various types of mechanical mowers and the wider use of appropriate herbicides.

Transmission lines showing cleared right-of-way

PSC photo

Vegetation clearance practices

Electric utility vegetation management practices employ chemical, manual, and mechanical techniques to control undesirable vegetation. These may include natural or directional pruning, use of environmentally safe herbicides, and tree removal.

While easements allow utilities to access and maintain their facilities, they do not necessarily convey legal rights to remove trees or branches beyond what is necessary to maintain operational safety. Thus, utilities can not prevent homeowners from planting trees in the ROW. However, the utilities do attempt to encourage their customers and other property owners to plant appropriate, low-growing tree species that will not grow into the power lines.

During routine maintenance cycle, utilities will remove all dead, diseased, dying, and damaged limbs hanging near power lines, and will attempt to remove all hazardous trees that are deemed at risk of uprooting, falling, or blowing onto the lines from outside of the ROW. Urban and residential areas pose the most difficult challenge in obtaining required ROW clearances. Landowners are not uniformly cooperative and may make it difficult for the utility to obtain adequate clearing widths.

If a landowner objects to allowing a utility to trim trees in order to obtain necessary clearances, the utility workers are instructed to explain the necessity of proper vegetation management. This may or may not lead to a mutually agreeable solution.

Duke Kentucky noted that it continually reviews its tree trimming practices for possible improvements and makes appropriate changes when necessary. Jackson Energy's policy is to clear every circuit during each clearing cycle and to clear any area not maintained as a yard of all woody vegetation. If a property owners consents, adequate clearance will be obtained through proper pruning techniques.

Jackson Purchase Energy uses arborist-recommended tree trimming practices, such as v-cutting and side-trimming to maintain clearance widths. Where possible, easements are clear-cut to minimize vegetation near lines and to provide the greatest ease in accessing lines for maintenance and restoration. In addition, chemical spraying is used on easements, when possible, to minimize vegetation management costs. Farmers Rural Electric Cooperative Corp. (RECC) annually reviews system reliability data to determine when a circuit is experiencing a higher outage rate due to vegetation in the ROW.

Kentucky Power performs ROW widening on selected line segments based upon accessibility, the history of reliability on a particular segment, and the number of customers served by the line. "Danger trees" that are considered an imminent threat to Kentucky Power facilities are removed where possible, and the stumps are treated with herbicides, where practical.

ROW crew structure and budgets

The number of utility personnel dedicated to ROW clearing and maintenance work in Kentucky has remained steady or increased slightly from 2004 through 2008. Not all utilities provided exact head counts when contractors were being used. In some cases, the changing number of direct utility employees or a shift to the use of contractors can be seen in changes in utilities' annual budgets and expenditures.

The type of equipment utilized for ROW clearance and maintenance work was consistent across the utilities. Standard equipment usually includes bucket trucks, dump trucks, chippers, various saws and hand tools, mowers and sprayers.

All of the utilities' ROW clearance and maintenance budgets are commensurate to the size of their service territories. Among distribution cooperatives, Kenergy Corp. had both the largest ROW budget and actual ROW management expenditures in 2008.

Kenergy's 2008 budget was $3,888,475 and it spent $3,469,433. In 2008, Jackson Energy, Blue Grass Energy and South Kentucky RECC also had ROW budgets and expenditures in excess of $2.0 million. The smallest distribution cooperative ROW budget was Shelby Energy's, at just under $500,000. Big Sandy had the smallest amount of actual ROW expenditures in 2008 at just under $400,000.

The following table provides the 2008 crew structure, budgets and actual expenditures for the electric utilities.

Electric Utilities ROW Crew Structure and Budget for 2008				
	Employee	Contractor	Budget	Actual
DISTRIBUTION				
Big Sandy RECC	20 to 22	14 to 17	586,000	392,178
Blue Grass Energy	45	0	2,092,350	2,132,667
Clark Energy	0	14	829,000	880,670
Cumberland Valley Electric	0	25	966,000	1,027,458
Farmers RECC	2	0	NA	728,161
Fleming-Mason Energy	1	Yes	1,274,195	1,213,155
Grayson RECC	23	8 to 12	1,180,000	1,160,000
Inter-County Energy	40	16	756,504	703,670
Jackson Energy	1	57	2,853,085	2,817,452
Jackson Purchase Energy	0	30	1,645,000	1,762,006
Kenergy	3	Yes	3,888,475	3,469,433
Licking Valley RECC	25	28	539,783	661,293
Meade County RECC	1	16 to 47	1,017,648	974,392
Nolin RECC	1	Yes	NA	1,255,098
Owen Electric	29	10 to 14	1,606,723	1,571,312
Salt River Electric	20 to 30	0	1,157,000	1,221,606
Shelby Energy	0	14	499,767	510,143
South Kentucky RECC	60	0	2,566,336	2,125,334
Taylor County RECC	34	0	618,000	596,502
Duke Kentucky	0	at least 50	2,536,665	2,777,570
Kentucky Power	5	261	11,888,567 est.	11,314,443 est.
KU / LG&E	14	360 D / 60 T	19,270,000 est.	18,708,000 est.
TRANSMISSION				
BREC 2009			640,000	NA
EKPC			1,850,000 est.	NA
KU and LG&E did not separate ROW crews and contractors.				
Transmission and Distribution data are combined for Duke Kentucky, Kentucky Power, KU, and LG&E. Transmission is a small part of the estimated total amounts.				

Table 5: Jurisdictional utility right-of-way budgets for 2008 Compiled by PSC from utility data

Clearing cycles

A vegetation management clearing cycle is the interval over which a utility completes the pruning and removal of trees or other vegetation on a utility's entire transmission and distribution system.

Jurisdictional utilities clear their distribution systems on cycles ranging from two to seven years, with the majority reporting a cycle of about four years. While most utilities have cycles of relatively fixed duration, Kentucky Power bases its trimming cycles on tree-caused interruption data and circuit and line characteristics. Kentucky Power said that that this allows resources to be allocated in order to gain the most benefit.

Transmission clearing cycles also vary. Duke Kentucky, LG&E and KU all operate on a six-year cycle for transmission lines. Kentucky Power reported that its transmission ROW clearing is on a three- to four-year cycle.

For planning purposes, visual inspections, outage data, circuit reliability performance data, and maintenance history are all criteria generally used to determine the development of the vegetation management plan for the coming year. Typically, the electric utilities also rely on line inspections, visual patrols, reported outages, requests from customers, as well as any vegetation management issues noted by employees to address between-cycle vegetation issues.

Inspections

As noted earlier in this report, utilities are required to inspect their systems at regular intervals. These inspections include assessments of vegetation management needs.

For example, Duke Kentucky inspects its distribution circuits for "danger trees" prior to its regularly scheduled maintenance cycle. Jackson Energy reported that its ROW is inspected yearly to assess any potential hazards, which it notes are a constant concern.

At Nolin RECC, "hot spots" or immediate problems are reported by linemen, servicemen, and ROW crews.

Kenergy's vegetation line inspections are typically conducted as a part of its overall line inspection program, when the ROW contractor completes routine maintenance on a specific circuit and, in addition, at the end of each year as part of the development of the next year's vegetation management scope of work. Kentucky Power forestry personnel conduct formal vegetation line inspections of feeder line circuit breaker zones on an annual basis. Starting in 2009, Kentucky Power's formal inspections will include the twenty recloser circuit breaker zones with the most customers in each operational area, with other inspections performed as needed to address reliability issues.

Transmission system inspections also focused on vegetation hazards. Big Rivers Electric Corp.'s (BREC) aerial inspections are intended to locate both general line problems and ROW maintenance problems, including the presence and location of dead, dying, or compromised trees. East Kentucky Power Cooperative (EKPC) conducts vegetation management aerial patrols of its system three times per year. KU and LG&E stated that the primary purpose of their aerial patrols is to identify hazard trees within or outside the transmission ROW.

Obstacles to effective vegetation management

While most electric utilities stated that there were no federal, state, or local laws or regulations that hinder management of vegetation within their ROW, several utilities identified the U.S. Forest Service prohibition against the use of herbicide in national forest areas. Fleming-Mason, Jackson Energy and South Kentucky, which all have ROWs within the Daniel Boone National Forest, noted this prohibition.

Kentucky Power, LG&E and KU believe that the Forest Service's herbicide prohibition negatively affects the safety and reliability of their transmission lines, adds increased cost and manpower in controlling brush growth, and hinders their ability to convert tall-growing plant communities in ROWs to low-growing, compatible plant communities.

LG&E and KU pointed out that state and federal statutes restrict tree trimming and removal where endangered Indiana bats exist. The laws require notification and approval from federal and state wildlife agencies to trim and remove certain trees. While these restrictions do not prohibit vegetation management, they restrict it to certain seasons and require compensation to the Indiana bat conservation program.

LG&E and KU also noted that a number of local jurisdictions, including the cities of Louisville, Lexington, Anchorage, Audubon Park, Indian Hills, and Druid Hills, require utilities to obtain permission to remove trees. The companies assert that this requirement creates additional administrative efforts in order to gain approval from tree boards, city foresters, or other public officials before clearing ROWs.

The Commission notes that 47 of 70 elected officials who provided information for this report stated that they would favor the imposition of uniform and statewide vegetation management requirements upon electric utilities. This is further evidence of the often-contradictory dynamic that affects utilities in their efforts to balance the competing desires for improved reliability and preservation of urban and suburban landscapes.

Restoration work in Jefferson County following a 2004 storm illustrates the difficulty of maintaining and restoring power in suburban areas with restrictions on vegetation management.

PSC photo

IMPACT OF VEGETATION MANAGEMENT PRACTICES ON STORM-RELATED OUTAGES

Hurricane Ike

Utilities impacted by Hurricane Ike reported that their vegetation management practices lessened the extent of damages caused by the unusually high winds. LG&E and KU noted that much of the damage was caused by trees and limbs that fell from outside the ROWs. Similarly, Jackson Purchase Energy stated that outages were primarily caused by fallen or broken trees from outside of its ROW. Preventing such damage would require removal of all vegetation that could potentially fall across its lines, the utility said.

Utilities reported that aggressive ROW clearing can help expedite restoration. For example, Meade County RECC clears vegetation from ROWs on a "ground-to-sky" basis except in residential yards. Meade County RECC believes that this policy substantially reduced the amount of time needed to restore power by improving ROW access.

2009 Ice Storm

A majority of affected jurisdictional electric utilities reported that their vegetation management practices lessened the impact of the 2009 ice storm. ROW clearing and vegetation management practices limited the number of tree-related outages or allowed the restoration crews easier access to repair outages.

The transmission utilities indicated that the majority of transmission outages caused by trees were due to trees falling from outside the ROW. For example, BREC put the figure at 80 percent.

Similarly high percentages were reported by many distribution utilities. Farmers RECC determined that 95 percent of tree-caused outages in its system were caused by falling trees from outside the ROW. Jackson Energy determined that 90 percent of its 376 individual instances of system damage were caused by vegetation, with approximately 65 percent caused by trees outside of the ROW. Kentucky Power reported that 60 percent of vegetation-related outages were caused by trees outside of the ROW.

Salt River Electric estimated that 90 to 95 percent its outages were due to out of ROW trees. Salt River Electric further stated that it is not aware of any trees in the ROW that were the sole cause of an outage.

Jackson Energy reported that its practice of clearing any unlandscaped ROW of all woody vegetation and herbicide treatment of its ROW allowed its linemen and contractors to have greater access for restoration during the 2009 ice storm, minimizing the amount of time needed for repairs.

Kenergy stated that restoration on recently-cleared circuits was easier than on those awaiting vegetation clearance. Circuits that had been cleared recently had less debris and less entanglement of conductors in vegetation.

Jurisdictional utilities reported that their efforts to address vegetation management and ROW clearing issues with their customers are becoming more effective. The jurisdictional electric utilities reported that customers appear to be more willing to allow access to property for clearing and restoration efforts during and immediately after major storms. Whether this is a permanent or transitory effect of the recent storms remains to be seen. The jurisdictional electric utilities indicated that they emphasize the importance of vegetation management to their customers throughout the year and will continue to do so.

The Commission finds that the unprecedented nature of both the 2008 wind storm and the 2009 ice storm make it unlikely that utilities could have utilized additional reasonable and cost-effective vegetation management methods that would have minimized the damage from these storms. The Commission does not believe that these storms provide any additional justification for the imposition of uniform vegetation management standards in Kentucky and does not recommend such standards at this time.

The Commission continues to believe that the widely varied topography, vegetation types and development patterns across Kentucky make it impossible to craft universally applicable vegetation management standards that would be equally effective under all circumstances. However, as it stated in its 2007 administrative order, the PSC will continue to monitor and assess the reliability of electric utilities and remains open to further exploration of this issue if data suggest that reliability could be improved by prescribing vegetation management standards.

While utility vegetation management practices within ROWs appear to be adequate, they do not address the problem of damage caused by trees outside the ROW. Such trees pose a particular problem because utilities have far less latitude to trim or remove them. In many cases, the trees may be on property on which the utility has no ROW and thus no right of access.

A number of utilities stated that they intend to increase efforts to manage trees outside their ROWs, particularly those trees that pose an obvious hazard. For example, Jackson Energy indicated that it would concentrate its inspection on areas with a high volume of pine trees on the outer edges of its ROWs and would attempt to remove those trees that pose a greater risk of failure during an ice storm.

Similarly, Kentucky Power stated that it would place more emphasis on widening ROWs adjacent to pine groves.

A system hardening study conducted for LG&E and KU by an independent engineering firm, Davies Consulting, recommended that the two utilities place increased emphasis on the removal of hazard trees. Davies Consulting recommends expansion of the current hazard tree removal program to include aggressive pursuit of the removal of “danger trees” located outside of the ROWs on the LG&E and KU distribution systems. “Danger trees” are defined as those that are diseased, dying, or weakened and that have a high probability of breaking and falling onto the power lines as a result of high winds or ice loading.

According to Davies Consulting, there are about 80,000 danger trees posing threats to the LG&E and KU systems. The companies estimate that, with greater cooperation from property owners, up to 50 percent of those trees and trees with significant overhang can be removed, at an estimated cost of $30 million over five years. LG&E and KU believe this will reduce the probability of outages caused by trees outside the ROWs

The PSC agrees that a program to address hazardous trees outside electric utility ROWs has the potential to reduce weather-related outages. Therefore, the PSC recommends that all jurisdictional electric utilities take steps to increase removal of such trees and directs that those steps be reported to the PSC as updates to utility vegetation management plans.

ELECTRIC UTILITIES

UNDERGROUND UTILITIES

After experiencing the major power outages during the September 2008 Hurricane Ike wind storm and the 2009 ice storm, utility customers and public officials have asked whether it would be possible to prevent or reduce future power outages by requiring electric utilities to place all or a portion of their electricity facilities underground. In response to these questions and concerns, the Kentucky Public Service Commission (PSC) has devoted a major portion of this review to the technical feasibility and economic impacts of burying, or "undergrounding," all existing electric power facilities in Kentucky.

This assessment included a review of Kentucky's topography, the reliability of underground facilities as compared to overhead facilities, the increased costs associated with mandatory undergrounding of power lines, and the impact those increased costs would have on the utilities and their ratepayers. The assessment did not include any facilities owned or operated by municipal utilities or rural electric cooperatives served by the Tennessee Valley Authority (TVA) because these entities are not within PSC jurisdiction.

With the sharing of utility poles by multiple utilities and collocation of equipment and line strands on poles by non-utility companies (e.g., cable television), clearing the landscape of all overhead facilities is a daunting prospect. Although some of the benefits of underground facilities, such as improved aesthetics, do not relate to improved reliability, this assessment is based on the premise that the primary advantage of underground facilities is their ability to withstand storm damage. Thus, this report compares the estimated costs of underground facilities to the quantifiable economic benefit in damage avoided to the electrical grid during major weather disasters such as the Hurricane Ike wind storm and the 2009 ice storm.

The PSC obtained information from the state's four investor owned utilities - Kentucky Utilities Co. (KU), Louisville Gas & Electric Co. (LG&E) Duke Kentucky (Duke Kentucky), and Kentucky Power – all of which operate both transmission and distribution facilities. Of the 21 jurisdictional rural electric cooperatives, two – Big Rivers Electric Corp. (BREC) and East Kentucky Power Cooperative (EKPC) – operate only transmission facilities. The other 19 cooperatives operate only distribution facilities. The Commission asked the jurisdictional utilities to provide estimated costs regarding the burying of both transmission and distribution lines.

PSC staff asked all distribution utilities to categorize outages resulting from the two storms based on which portion of the distribution system was damaged: main feeder circuits emanating from transmission-fed substations, lower-voltage distribution-level transmission circuits, branch circuits, or individual homeowner service drops. This was done in the hope of identifying outage trends. However, utilities are not required by statute or regulation to track or maintain such detailed outage information, and generally do not do so. Although many of the utilities were able to provide some detailed outage information, others responded that their focus during restoration operations is on repairing damage rather than categorizing it.

COST DETERMINATION

Based on the information provided by the utilities, the total cost to underground all existing overhead electric power lines would be approximately $217 billion dollars. These are detailed in Table 5. The total does not include some transmission lines operated at very high voltages, because they cannot be buried due to physical constraints tied to high operating temperatures.

For example, Kentucky Power Co. noted in response to the PSC's data request that "technology does not presently exist at any cost that would enable Kentucky Power to bury and sufficiently cool its 257.81 miles of transmission lines operating at 765 kV."

In contrast, the total costs to all jurisdictional utilities for rebuilding their electric systems and restoring power following the 2009 ice storm was approximately $240 million—just slightly more than one-tenth of one percent (0.1%) of the $217 billion cost of burying the lines. The repair and restoration costs following the September 2008 wind storm were substantially smaller, totaling $44.7 million for all jurisdictional utilities.

Estimated Cost to Replace Overhead Electric Conductors with Underground

Jurisdictional Utilities	Transmission Conductors	Distribution Conductors	Transmission & Distribution
Investor Owned			
Kentucky Power*	26,600,000,000	10,511,117,000	37,111,117,000
Duke Kentucky	780,000,000	2,226,330,430	3,006,330,430
KU and LG&E	39,904,000,000	24,598,000,000	64,502,000,000
Cooperatives			
Big Rivers Electric Cooperative	2,210,000,000		15,773,559,600
Jackson Purchase Energy Corp.		2,858,559,600	
Kenergy Corp.		6,210,000,000	
Meade County RECC		4,495,000,000	
East Kentucky Power Cooperative	11,065,000,000		96,910,145,690
Big Sandy RECC		1,960,880,000	
Blue Grass Energy Cooperative		8,506,850,384	
Clark Energy Cooperative		3,559,106,250	
Cumberland Valley Electric		2,727,000,000	
Farmers RECC		3,448,952,440	
Fleming-Mason Energy Cooperative		5,619,226,716	
Grayson RECC		4,759,380,000	
Inter-County Energy Cooperative		5,612,440,000	
Jackson Energy Cooperative		10,427,114,500	
Licking Valley RECC		5,344,170,000	
Nolin RECC		5,290,000,000	
Owen Electric Cooperative		1,340,000,000	
Salt River Electric Cooperative		5,034,220,000	
Shelby Energy Cooperative		4,010,540,000	
South Kentucky RECC		12,089,520,000	
Taylor County RECC		6,115,745,400	
Totals	$80,559,000,000	$136,744,152,720	$217,303,152,720

* Excludes EHV Transmission

Table 6: Estimated cost of placing existing electric lines underground in Kentucky

Chart compiled by PSC from utility information

Based on this cost comparison, the PSC does not believe that it is economically justifiable to require the burying of all or even a substantial portion of the existing electric transmission and distribution facilities owned and operated by Kentucky's jurisdictional utilities. However, as discussed in detail later in this report, the PSC finds that it often may be desirable to place lines underground on a selective basis.

This finding is in accord with conclusions reached by several other state utility regulatory commissions. Other states have concluded that the burial of all electric power lines is neither economically feasible nor technically possible.

In its June 2008 "Inquiry Into Undergrounding Electric Facilities in the State of Oklahoma" *(for the full report, see http://www.occ.state.ok.us/Divisions/PUD/Underground%20Report.pdf)* the Oklahoma Corporation Commission gathered information from Oklahoma's jurisdictional utilities to evaluate the possibility of placing utility services underground in order to prevent future storm-related outages. The Oklahoma Commission's staff also reviewed publicly available reference material pertaining to the placement of electric facilities underground. From the information gathered from the utilities and the various studies the Oklahoma Commission concluded that requiring utilities to place all electric facilities underground is not a feasible solution, because the cost would run into the billions, with long-term and significant rate impacts on customers.

The Michigan Public Service Commission reached a similar conclusion in 2007. *(see http://efile.mpsc.state.mi.us/efile/viewcase.php?casenum=15279).* Its study examined the costs and benefits of requiring expanded underground facilities in future development. The study included secondary line extensions, rights-of-way along roads undergoing construction, and poorly performing circuits. The Michigan Commission found that undergrounding costs about $1 million per mile of distribution line. The Michigan Commission also concluded that reliability benefits associated with burying existing overhead power lines are uncertain and, in most instances, do not appear to be sufficient to justify the cost.

In March 2005 the Florida Public Service Commission released a report *(see http://www.floridapsc.com/publications/pdf/electricgas/Underground_Wiring.pdf)* on the possibility of mitigating storm damage to its jurisdictional utilities through underground utility placement. The Florida Commission estimated that a workforce of 3,600 individuals working 2,000 hours per year for 10 years would be required to underground the state's existing overhead electric wires at a cost of $95 billion for distribution and an added $52 billion for transmission.

After a massive ice storm in North Carolina in December 2002, the North Carolina Utilities Commission studied the feasibility of requiring its jurisdictional utilities to underground all of their distribution facilities. *(see http://www.ncuc.commerce.state.nc.us/reports/undergroundreport.pdf)* The North Carolina Commission did not recommend that its utilities undertake the wholesale conversion of their overhead distribution systems to underground. However, the commission did advocate that its utilities review circuits experiencing multiple recurring outages for placement underground when cost-effective. It also encouraged utilities to continue reviewing the feasibility of underground placement in new installations.

In January 2005, the Virginia State Corporation Commission released a study on undergrounding electric utility facilities. *(see http://www.scc.virginia.gov/comm/reports/report_hjr153.pdf)* The study concluded that the primary benefit of undergrounding utility lines is aesthetic, but acknowledged that undergrounding does result in some overall improvement to system reliability. However, the Virginia Commission concluded that a major undergrounding program could take several decades to complete and appeared to be unreasonable from an economic standpoint.

OPERATIONAL ISSUES

Overhead facilities

Electric service in Kentucky and other states was initially provided more than a century ago through an overhead, three-phase, electric transmission and distribution system. In the early years of the system, undergrounding electric facilities was not an option due to equipment and construction limitations. Over time, as electric utilities became more experienced in operating and servicing the electric grid, it became apparent that overhead systems were more economic to install and maintain and, at the time, more reliable.

Overhead lines continue to offer many advantages. A well maintained overhead system has a life expectancy of more than 50 years. As outages occur, linemen can visually locate the problem and make prompt repairs. Individual components are easy to repair or replace. Utilities employ a trained workforce that has installed overhead lines for decades. The utilities understand the systems and their idiosyncrasies. There is a familiarity with the installation and maintenance of equipment and time-tested knowledge of the electric properties of the conductors and related equipment. Duke Kentucky estimates that on average, it takes two to three hours per overhead repair versus three to four hours per underground repair. Farmers Rural Electric Cooperative Corp. (RECC) estimates an overhead service repair takes approximately one hour and an underground repair requires three-and-a-half to four hours.

Underground facilities

In their responses to the Commission's data requests, the jurisdictional electric utilities expressed some conditional support for burying electric power lines. They recognize the aesthetic, safety, and reliability benefits of underground electric service. They have experienced continued improvements to underground conductors which have improved reliability. However, the utilities also pointed out many economic and physical factors which continue to impede widespread deployment of underground facilities.

Information submitted by the utilities confirms that underground facilities experience generally fewer outages per mile of line than overhead service. For example, KU reported that, over the last five years, it has recorded an average of 0.514 outages per mile in its overhead system, versus 0.137 outages per mile in its underground system. On a per-mile basis, underground facilities in the KU system had 70 percent fewer outages. However, due to the longer repair times for underground facilities, overhead facilities generally experience shorter service outages.

The life expectancy of underground electric facilities has also increased as cable and insulation materials have improved. But it still trails the average lifespan of comparable overhead facilities. The North Carolina study referenced earlier estimates that underground facilities can be expected to last 30 years while overhead lines should last about 50 years. A Maryland report estimates underground life span at 40 years and overhead life span about 60 years. Kentucky Power estimates the life expectancy of its underground lines at 30 years whereas it estimates the approximate lifespan of its overhead primary conductors at 60-80 years. However, Kentucky Power notes that the lifespan of its secondary insulated conductors may be only 30-40 years.

While underground systems usually have fewer outages related to weather, vegetation or vehicle accidents, the duration of outages tends to be longer. Locating and repairing outages on underground distribution facilities is generally more difficult and takes more time than on overhead facilities. The reasons include:

(1) It is much more difficult to identify and locate the cause of an outage on the underground system as you cannot see the conductors and related equipment.
(2) Enclosures must be opened to investigate for problems inside them. If the problem is not in an enclosure, specialized equipment is required to identify the location of the fault in the length of cable responsible for the outage.
(3) Once a fault is located in a cable, excavating equipment must be used to expose the underground cable at the fault location.
(4) Underground cable systems are more difficult to isolate and ground for the protection of workers. Before work can begin, the cable must be marked at the work location to ensure the proper cable has been isolated and grounded.
(5) Depending upon the amount of damage at the fault site, one or two splices are required to make the repairs. These splices are fully insulated and require more cable preparation and splice time than performing an equivalent splice on an overhead system.

The PSC notes that one aspect of "smart grid" technology now being developed and deployed is focused on improving the detection of electric system outages and making it easier to identify the cause and location of the outage. This may facilitate and ease restoration of outages in underground facilities. It also should be noted that the current cost estimates for placing facilities underground do not factor in the cost of including such new technologic capabilities.

Many utilities support the underground placement of new facilities and encourage the practice of using a common trench for multiple services when such work is done in accordance with the National Electric Safety Code. The service providers share the trench plan and follow standardized procedures in placing and working on individual systems. As more utilities adopt this practice, reliability of the network may increase by placing more services underground.

The Commission notes that its regulations include provisions governing the construction of underground electric facilities to serve new residential customers. The Commission recommends that utilities continue their current practice of placing new facilities underground when the cost differential is recovered through a contribution in aid of construction. Utilities also should continue to replace existing overhead facilities with underground facilities when the requesting party pays the conversion costs.

Connection from overhead lines to underground distribution system

PSC photo

Topography

Topography and geology are a primary factors in determining the feasibility of underground electric service. Kentucky Power notes that in its eastern Kentucky service territory, underground placement is severely hindered by rocky soils and areas in which bedrock is close to the surface. Where reclaimed strip mines are being redeveloped, placing underground facilities is difficult because large boulders in the fill make it impractical to dig trenches for underground facilities. Kenergy stated that trenching is possible in most of its territory, which is in western Kentucky, but that several counties have rocky soils that generally preclude trenching. KU said that trenching is feasible throughout most of the central Kentucky portion of its service territory.

Other factors to be considered in constructing underground facilities are streets, sidewalks, driveways, rivers, and established landscaping. Underground lines may be more susceptible to animal damage than overhead lines; tree roots may grow into underground lines, causing shorts; and excavation activities are a threat to both reliability and public safety. Long-term system outages such as those associated with a major storm may also allow moisture to seep into underground cables, and this moisture can cause the cables to fail once the system is re-energized.

Utilities avoid placing underground service in flood plains and flood-prone areas. When flooding does occur in areas with underground electric facilities, restoration can be a lengthy and complicated process, as Georgia Power Co. learned earlier this year when flash floods inundated portions of its service territory near Atlanta. Mike Faulkenberg, Georgia Power's principal engineer, said in an interview with PSC staff that restoration of power in areas with underground service took "much, much longer" than in areas with overhead lines.

Overhead lines had little or no damage, and the only obstacle to restoring power was damage within the flooded homes themselves that made it unsafe to have electricity back on, he said. In flooded areas, every piece of equipment had to be inspected, and even then there may be hidden damage, Faulkenberg said. "You don't know about corrosion," he said. "It could be months before you know."

The amount of underground electric facilities vary widely from utility to utility in Kentucky. As discussed above, geography and geology are major factors that affect the historical practices of each utility. Cost also plays an important role.

Information provided by the state's generation and transmission cooperatives, BREC and EKPC, illustrates the magnitude of the investment needed to convert overhead transmission systems to underground. BREC, which serves three distribution cooperatives, estimates that it would cost approximately $2.2 billion to underground its transmission system. EKPC, with a larger system serving 16 member distribution cooperatives, placed its cost at $11.1 billion. That is nearly four times the current value of EKPC's total physical assets, including its generating facilities.

On a cost-per-mile basis, BREC estimated that underground transmission lines are 10 times more expensive than overhead lines - $1,750,000 per mile as opposed to $175,000 per mile. Duke Kentucky submitted system-specific information that placed the average calculated cost differential per mile of new underground distribution line at 1.7 to 4.5 times the cost of a comparable overhead distribution line. This evaluation is for new construction only and does not take into account other considerations in building an underground distribution system. For example, it did not consider space limitations in or around road ROW, the need for private easements, visible and buried obstructions, other existing utilities, restoration and the expense to the customer in installing and maintaining their underground service.

Customer service drops

The PSC asked utilities to identify the number of outages during the ice storm that were caused by damage to service drops, the lines that run from a distribution system transformer to an individual customer. Many stated that they did not record this information separately, as service drops were often repaired in the course of other restoration work.

Among utilities that did provide data, the percentage of service drops incurring damage varied widely, from a high of 75 percent of all outages on the Nolin RECC system, to less than 1 percent for Grayson RECC, Duke Kentucky and several other utilities. Kentucky Power reported 22.6 percent of the outage cases reported during the ice storm were due to damaged service drops, while Big Sandy RECC, which serves an adjacent area, estimated that 15 percent of its customer outages were caused by downed service drops.

The PSC also asked the utilities to estimate the percentage of those service outages caused by damage service drops that may have been avoided if all service drops were underground. KU, LG&E, and Licking Valley RECC responded that all of their service-drop-related outages could have been avoided. Meade County RECC estimated that such outages would have been 89 percent lower, while Nolin RECC estimated a 75 percent reduction in service-drop-related outages. Duke Kentucky reported that only two of 101 outages tied to service drop damage occurred with underground facilities.

Utilities noted that outages often involve damage at multiple points, with the service drop only the final broken link in a lengthy chain that may be broken at one or more points in the transmission and distribution systems. While that is undoubtedly true, it is also true that service drop repairs provide the lowest return per unit of restoration effort, as they typically involve restoration to a single customer. Reducing the need to repair service drops has the potential to speed overall restoration efforts.

It also bears noting that, in many cases, damage to overhead service drops is accompanied by damage to the customer's service entrance, which may include a masthead or weatherhead and a meter base. Repairs to the service entrance are the customer's responsibility. Service entrances from underground facilities are generally less susceptible to weather damage than those receiving service from overhead lines.

While damage to service drops may not be the sole cause of any single customer's electrical outage, the PSC believes that assessing damage to service drops is important to understanding how ice storms and other weather events affect Kentucky's electric infrastructure. The PSC recommends that in all future weather-related outages, electric utilities accurately record the number of overhead and underground service drops requiring separate repairs in order to restore service.

Undergrounding and system hardening

In June 2009, as a supplement to responses to the Commission's initial data request, LG&E and KU filed a report entitled "E.ON US Hardening Report." (E.ON US is the non-jurisdictional parent company of the two jurisdictional utilities.) The report, prepared by Davies Consulting, includes an evaluation of the costs and benefits of converting the existing overhead electric system to underground construction. The E.ON report concludes that, although the LG&E and KU systems comply with all applicable industry and governmental standards, there may be some system enhancements which can be reasonably implemented that will result in additional system reliability.

The E.ON report found that placing all services underground is cost prohibitive. But it also evaluated measures that could reduce the overall number and duration of outages during a major weather event. The report proposed a pilot program to convert 500 overhead service lines to underground.

With an estimated average cost of converting one residential overhead service to underground at $2,850, the pilot would cost about $1.6 million. This includes an additional $200,000 required for data collection and program evaluation. During the pilot program, LG&E and KU would examine the actual costs of converting overhead service drops to underground, determine the acceptance of the program by residential customers, and evaluate reductions in outage frequency and length of time to restore service in storm and non-storm conditions.

Parameters of the proposed E.ON pilot include:

- Pay for the entire conversion for pilot participants only
- Focus on a small geographic area with high vegetation density
- Convert only residential services
- Convert primarily services at the back of the property
- Convert 500 services over two years
- Collect data for at least two years thereafter

At the conclusion of the evaluation period, E.ON would assess the results to determine the cost-effectiveness of undergrounding service drops in areas with dense tree cover. Based on that evaluation, E.ON would decide whether to terminate the initiative or propose to move forward with a system-wide program. If a decision is made to implement a system-wide program, E.ON would conduct a survey to determine the customer willingness to pay for the cost of the conversions.

The Commission commends E.ON for its willingness to consider the effectiveness of undergrounding existing service drops as a means of mitigating outages due to extreme weather events. The Commission encourages all electric utilities to consider conducting similar pilot projects. The Commission also recommends that utilities consider, on an ongoing basis, the feasibility of placing underground other overhead facilities that have shown themselves over time to be particularly prone to weather-related outages. Furthermore, the Commission believes that it may be possible to mitigate future outages by installing all new service drops underground where feasible. The Commission recommends that utilities evaluate the impacts of placing all new service drops underground, where feasible, on their systems and their customers.

PROTECTION OF UNDERGROUND FACILITIES

Any increase in the number of underground electric facilities raises the prospect of an increase in the number of accidents due to excavators hitting those facilities. Although Kentucky has an established system for protecting underground facilities, thousands of such accidents occur every year.

Kentucky Underground Protection, Inc. operates Kentucky’s “call before you dig” program, now known as Kentucky 811. It has 234 members, most of them entities which own or operate underground utility facilities. The non-profit organization provides a free utility location service to excavators. Members provide information on the location of their facilities to the Kentucky 811 call center, which then relays the data to the service which marks the facilities prior to excavation.

Kentucky law requires anyone planning to conduct an excavation in the vicinity of buried utility lines to call two days in advance in order to have the lines located. Violation of this requirement can lead to citations and fines. Anyone who damages underground lines is also liable for the cost of repairs.

Owners of underground facilities are not required to become members of the Kentucky 811. The location of facilities owned by non-members is not available to the Kentucky 811 call center. If more utility facilities are placed underground, it will become increasingly important that the location of those facilities be available to the Kentucky 811 call center.

Therefore, the Commission strongly recommends that all owners of underground facilities be members of Kentucky 811. The Commission also recommends that state statutes be amended to make the current voluntary membership mandatory.

Damage to Jackson Purchase Energy distribution lines in 2009 ice storm

Photo courtesy of Jackson Purchase Energy

ELECTRIC UTILITIES

COST RECOVERY

The effects of both the September 2008 wind storm and January 2009 ice storm varied among individual jurisdictional utilities. All but a few utilities in southeast Kentucky were affected by the ice storm. The wind storm generally was felt mostly in the Ohio River valley. Although it caused extensive outages, the damage to electric utility facilities was less severe.

Accordingly, the costs expended by the utilities to restore service also varied greatly. This section of the report discusses the electric utilities' costs of restoration, reimbursement of restoration costs, lost revenues, and potential recovery of those costs.
All jurisdictional utilities were asked to provide the Kentucky Public Service Commission (PSC) with their total costs to restore service following both storms.

RESTORATION COSTS

2009 ice storm

Restoration costs for jurisdictional utilities following the ice storm are shown in Table 7. The restoration costs shown in this table are divided into four categories: 1) capitalized, 2) accumulated depreciation, 3) expensed, and 4) deferred.

Generally, the amounts capitalized represent the cost of installing new facilities to replace those facilities damaged by the storm. Expenditures that are capitalized will be placed in rate base and depreciated over time. The amounts in the accumulated depreciation column represent the cost of removing existing facilities that were damaged by the storm.

The costs that were expensed are for repairs to existing plant that did not extend the original life expectancy of the assets repaired. These costs will be charged against income as incurred.

The amounts deferred represent costs that the utility wishes to establish as a regulatory asset as allowed by Statement of Financial Accounting Standards No. 71. A regulatory asset is an accounting tool that allows unusual or one-time costs to be excluded from expenses in the current period and to be deferred on a company's balance sheet for possible future recovery through rates. The jurisdictional electric utilities are required to account for storm restoration costs in accordance with the requirements set forth in the Uniform System of Accounts (USoA) prescribed by the PSC or the Rural Utilities Service (RUS).

The estimated 2009 ice storm restoration costs total nearly $240 million. Of the total restoration costs, $53,630,172 represented utility in-house labor, labor overhead charges, and materials and supplies, while $186,228,220 was for outside, contracted services provided by other utilities and independent contractors. Many of the utilities responding to the request had not received and paid all contractor invoices or performed the final accounting for all 2009 ice storm related costs at the time they filed their responses. For these reasons, only estimates were available. In total, the restoration of electrical service after the 2009 ice storm required well over 1 million labor hours to complete.

	Estimate Restoration Costs				
		Charged to		Deferred as	
	Capitalized	Accum. Dep.	Expensed	Reg. Asset	Total
Investor Owned					
American Electric Power	$ 2,800,000	$ 600,000	$ 3,100,000	$ 4,000,000	$ 10,500,000
Duke	37,592	3,130	1,746,805		1,787,527
Kentucky Utilities	25,754,744	8,033,460	2,014,802	60,199,179	96,002,185
Louisville Gas & Electric	7,374,791	1,549,440	1,792,846	43,362,083	54,079,160
Total Investor Owned	$ 35,967,127	$ 10,186,030	$ 8,654,453	$ 107,561,262	$ 162,368,872
Cooperatives					
Big Rivers Electric Cooperative	357,277	326,312	1,716,412		2,400,000
East Kentucky Power Cooperative			712,874		712,874
Big Sandy RECC	236,805	25,818	1,518,527	46,692	1,827,842
Blue Grass Energy Cooperative	361,423	40,159	3,698,418		4,100,000
Clark Energy Cooperative	115,407		1,527,418		1,642,825
Cumberland Valley Electric	No damage caused by the 2009 ice storm.				
Farmers RECC	656,433	366,206	582,925		1,605,564
Fleming-Mason Energy Cooperative	189,305	49,897	558,417		797,619
Grayson RECC			762,376		762,376
Inter-County Energy Cooperative	2,190,836		1,789,339		3,980,175
Jackson Energy Cooperative	81,301	20,555	1,165,200		1,267,056
Jackson Purchase Energy Corp.	5,996,242	445,802	6,021,217		12,463,261
Kenergy Corp.	19,049,881	2,011,508	8,440,389		29,501,778
Licking Valley RECC	1,297,672				1,297,672
Meade County RECC	2,730,196		1,370,242		4,100,438
Nolin RECC	628,415	58,595	4,250,186		4,937,196
Owen Electric Cooperative	52,396	13,545	703,349		769,290
Salt River Electric Cooperative	2,208,340	174,342	1,566,612		3,949,294
Shelby Energy Cooperative	306,055	9,308	657,106		972,469
South Kentucky RECC	11,206		72,459		83,665
Taylor County RECC	42,729	4,832	270,559		318,120
Total Cooperative	$ 36,511,919	$ 3,546,878	$ 37,384,025	$ 46,692	$ 77,489,514
Grand Total	$ 72,479,046	$ 13,732,908	$ 46,038,478	$ 107,607,954	$ 239,858,386

Table 7: Estimated 2009 ice storm restoration costs for jurisdictional utilities

Compiled by PSC from utility data

	Estimated Restoration Costs			
	Capitalized	Expensed	Deferred as Reg. Asset	Total
Duke	$ 200,000		$ 5,100,000	$ 5,300,000
KU and LG&E combined	8,400,000		26,700,000	35,100,000
Total Cost to Investor Owned Utilities	$ 8,600,000	$ -	$ 31,800,000	$ 40,400,000
Jackson Purchase Energy Corp.	18,000	$ 737,000		755,000
Kenergy Corp.	500,000	1,300,000		1,800,000
Meade County RECC		531,702		531,702
Owen Electric Cooperative	121,200	594,300		715,500
Salt River Electric Cooperative		215,000		215,000
Shelby Energy Cooperative	61,586	218,100		279,686
Total Cost to Cooperatives	$ 700,786	$ 3,596,102	$ -	$ 4,296,888
Grand Total	$ 9,300,786	$ 3,596,102	$ 31,800,000	$ 44,696,888

Table 8: Estimated 2008 wind storm restoration costs for jurisdictional utilities

Compiled by PSC from utility data

2008 wind storm

The PSC requested all jurisdictional utilities affected by the September 2009 wind storm related to Hurricane Ike to provide a summary of their restoration costs. The responses to this request are summarized in Table 8 above.
The nine jurisdictional electric utilities affected reported restoration costs totaling $44.6 million. The restoration costs are calculated similarly to those for the ice storm, with the exception that accumulated depreciation costs are omitted.

REIMBURSEMENT OF SERVICE RESTORATION COSTS

Big Rivers Electric Corp. (BREC) and its three distribution cooperatives and East Kentucky Power Cooperative (EKPC) and its 16 distribution cooperatives receive funding through RUS. Therefore, they are eligible to apply for reimbursement through the Federal Emergency Management Agency (FEMA) and the Kentucky Emergency Management Agency (KEMA). A total of 87 percent of eligible storm related restoration costs may be reimbursed, with FEMA providing 75 percent and KEMA providing 12 percent. These are the only outside sources for reimbursement of restoration costs for most cooperatives. The 13 percent of storm related restoration costs not recovered through these government sources will come from an individual cooperative's own resources or private insurance. The four jurisdictional investor-owned utilities (IOUs) - Duke Energy Kentucky (Duke Kentucky), Kentucky Power Co., Kentucky Utilities Co. (KU) and Louisville Gas & Electric Co. (LG&E) reported that they did not expect to recover any of their storm related damage costs from either private insurance or government sources. The IOUs are not eligible for reimbursement by FEMA. (For purposes of this chapter, further references to FEMA include both FEMA and KEMA.)

Under FEMA's reimbursement process, a county must be declared a disaster area before a cooperative can request reimbursement. All restoration costs are charged to appropriate job orders and the cooperative provides FEMA with the support for all charges such as copies of time sheets, invoices, cancelled checks, mileage sheets, etc. FEMA prepares a project worksheet and reviews all the documentation. After all documentation has been provided and its review has been completed, FEMA determines the amount of reimbursement the cooperative is to receive.

Expenses eligible for FEMA reimbursement are those incurred as a direct result of the storm. Expenses for equipment or for operations that would have been incurred by the utility during its normal course of business are disallowed and netted out of total restoration costs. For example, tools purchased during the storm restoration process, such as saws, may be ruled ineligible because the utility may have purchased them anyway for their line crews and the saws can continue to be used in the future. Also, certain administrative costs are not reimbursed by FEMA. Several utilities reported that a portion of their total storm restoration costs were disallowed by FEMA.

The cooperatives are required to follow RUS guidelines in accounting for funds reimbursed by FEMA. RUS accounting policies and procedures are established in accordance with the USoA prescribed by RUS. The RUS accounting requirements for storm damage and FEMA funds are described in several RUS bulletins and procedures. RUS requires that FEMA funds received relating to storm damage "should be accounted for by first applying the funds received as a credit to maintenance expense and administrative and general costs" incurred as a result of the storm damage. "Any remaining funds should then be applied as a credit to construction and retirement costs," incurred in the restoration of damaged facilities.

Table 9 below compares the total restoration costs with the expected FEMA reimbursement for the individual cooperatives. The expected FEMA reimbursement does not equal 87 percent of the total restoration costs because of the FEMA eligibility requirements discussed previously.

	Total Restoration Costs	Expected FEMA Reimbursement
Big Rivers Electric Cooperative	$2,400,000	$1,131,000
East Kentucky Power Cooperative	712,874	593,884
Big Sandy RECC	1,827,842	1,554,947
Blue Grass Energy Cooperative	4,100,000	3,480,000
Clark Energy Cooperative	1,642,825	1,408,160
Cumberland Valley Electric	No Damage Reported	0
Farmers RECC	1,605,564	1,300,000
Fleming-Mason Energy Cooperative	797,619	642,523
Grayson RECC	762,376	663,267
Inter-County Energy Cooperative	3,980,175	3,325,812
Jackson Energy Cooperative	1,267,056	935,000
Jackson Purchase Energy Corp.	12,463,261	10,843,037
Kenergy Corp.	29,501,778	25,666,547
Licking Valley RECC	1,297,672	1,113,693
Meade County RECC	4,100,438	3,712,965
Nolin RECC	4,937,196	4,295,361
Owen Electric Cooperative	769,290	652,852
Salt River Electric Cooperative	3,949,294	3,202,741
Shelby Energy Cooperative	972,469	846,166
South Kentucky RECC	83,665	8,914
Taylor County RECC	318,120	236,292
Total	$77,489,514	$65,613,161

Table 9: Anticipated 2009 ice storm restoration cost FEMA Reimbursements for jurisdictional utilities

Compiled by PSC from utility data

Cumberland Valley Electric was the only electric utility to report that it did not experience any system damage resulting from the 2009 ice storm.

Duke Kentucky reported that it had approximately $1,787,527 in 2009 ice storm restoration costs. It is not eligible for FEMA reimbursement and does not maintain insurance coverage for storm damage to its distribution and transmission systems. Kentucky Power, which incurred storm-related costs of $7,082,457, reported that traditionally it has not received any funds for reimbursement of major storm costs from governmental agencies, insurance carriers or other sources. At this time, it does not expect any reimbursement from such sources. KU and LG&E stated they had $96,002,185 and $54,079,160, respectively, in storm related costs. Neither utility is eligible for FEMA reimbursement.

As previously stated, the manner in which the jurisdictional electric utilities account for storm restoration costs is covered by the USoA prescribed for each utility. In the case of the electric cooperatives who are RUS borrowers the manner in which to account for the storm restoration costs and FEMA reimbursements is specified in RUS bulletins and procedures. The PSC reminds electric utilities to account for their restorations costs in accordance with the USoA prescribed by this Commission or by RUS, as appropriate.

INSURANCE COVERAGE

None of Kentucky's jurisdictional electric utilities have insurance which includes coverage specifically for damages to utility poles and lines incurred due to storms. Most of the distribution cooperatives reported that Federated Rural Electric Insurance Exchange (Federated) was their carrier for general liability and umbrella coverage. This coverage excludes "acts of God," such as damage caused by storms. In addition, most distribution cooperatives reported that they did not carry insurance to cover storm damage to lines and poles because either they were unaware of its availability or the cost was prohibitive. Thus FEMA is essentially serving the role of storm damage insurance provider for damage to poles and lines. BREC and EKPC have property and casualty insurance with FM Global. These policies cover buildings, substations and other facilities within 1,000 feet of their generating stations but specifically exclude electric transmission and distribution lines and the attendant conduit, static wire, hardware and structures. EKPC also has coverage through AEGIS.

BREC, Meade County Rural Electric Cooperative Corp. (RECC), Kenergy and Shelby Energy were the only utilities expecting to receive reimbursement from an insurance company. BREC reported that it anticipates reimbursement of approximately $1,100,000 from its property and casualty insurance carrier, FM Global. The claim submitted to FM Global was for damage to BREC's Livingston County Substation, its Crider Repeater Tower, and the Reid Substation Breaker.

Meade County RECC reported that it expected to receive reimbursement of approximately $1,071 from Federated for a bucket truck that was damaged during the restoration effort. Similarly, Kenergy reported that it expects to receive $13,000 from its property insurance provider to cover equipment damage on one of its towers. Shelby Energy reported that it has received $4,955 from Federated to cover damage to its trucks and to members' property as a result of storm restoration activity.

Duke Kentucky reported that it has not maintained storm damage insurance coverage for its distribution and transmission systems (lines and poles) for the last five years. Duke Kentucky stated that such coverage was not available from its insurance carriers. However, its general property insurance provides coverage for generators and substations and for facilities, including lines, poles, transformers, towers, etc. within 1,000 feet of its generators, substations and other real property expressly covered under its existing insurance policies.

Kentucky Power's general property insurance covers damage to facilities within 1,000 feet of its substations and generating stations, similar to the coverage of BREC, EKPC and Duke Kentucky. Kentucky Power reported that insurance companies providing coverage to it and its parent, American Electric Power Corp., exclude storm damage to transmission and distribution facilities. The purchase of insurance for such facilities has not been cost effective due to high rates, high deductibles and modest limits of liability. Kentucky Power stated that it was less expensive and more efficient to utilize other mechanisms such as recovery of specific storm damage costs and creating a storm/catastrophe reserve.

KU and LG&E reported that insurance coverage expressly for storm damage to distribution and transmission assets was generally unavailable in the commercial insurance market prior to 2001. From 2001 through 2003, KU and LG&E purchased such coverage from Ergon Insurance Limited. At that time, the coverage terms from Ergon were a $15 million limit per occurrence with a $30 million annual aggregate limit. The policy had a $2 million per occurrence deductible and an annual premium of $375,000. Following an ice storm loss in 2003, the renewal terms from Ergon for 2004 changed to $15 million limit per occurrence with a $15 million annual aggregate limit. The policy had a $2 million per occurrence deductible and an annual premium of $3 million. KU and LG&E declined the coverage, as any single loss would have to exceed $5 million to be of benefit.

Neither KU nor LG&E solicited proposals from other insurance carriers after the renewal proposal from Ergon was declined. Based on the opinion of the companies' insurance consultant, Risk Management Services Co., it is their understanding that the standard commercial insurance markets have not traditionally provided property insurance specifically for storm damage to the distribution and transmission assets of electric utilities because the exposure to catastrophic loss is too great. The general property insurance carried by LG&E and KU provides coverage on facilities within 1,000 feet of their generating stations and on their substations, similar to the coverage of the other IOUs and BREC and EKPC.

KU and LG&E also reported that there have been attempts through the years by the electric utility industry to create a specialty insurance program limited to property coverage for storm-related damage of distribution and transmission systems. The focus of these programs has been to provide catastrophic coverage. However, their structure, high minimum deductible, and the premium costs have not been an efficient option for KU and LG&E based on the companies' traditional annual storm damage costs. The companies had reviewed several of these industry programs in the past and most had a minimum annual deductible of $5 million and premiums in excess of $2 million. Very few of these industry insurance programs attracted enough participation to be viable programs. Also, due to massive hurricane damage in a number of areas of the country over the last several years the terms of these programs have been altered, significantly diminishing the benefits to their participants.

KU and LG&E stated that there is a new industry program designed to provide this type of catastrophic coverage. The program currently provides coverage for wind storm damage only, with no coverage for other events. The premium and deductible structure are determined by modeling each company's exposure profile, asset values and historical loss experience. The model structures the insurance coverage based on the 75 year high loss level. There is currently only one utility participating in this program and it has a deductible of $100 million. KU and LG&E are evaluating whether to go through the underwriting modeling to get an indication of premium cost and deductible structure under this program.

Generally, property insurance that covers transmission or distribution poles and lines is not available to electric utilities. The IOUs report industry efforts to establish catastrophic coverage policies have not been successful historically and that, due to major hurricane-related losses in recent years, current efforts to establish this type of coverage appear to be limited in nature and expensively priced.

The Commission finds that, given their eligibility for FEMA reimbursement, there is little reason for electric cooperatives to pursue additional insurance for storm-related damages. However, the Commission recommends that investor-owned utilities should monitor insurance markets for the development of catastrophic coverage and other potentially applicable products. As such products become available, the IOUs should evaluate the cost-effectiveness of obtaining such coverage.

LOST SALES AND REVENUE

While no utility is proposing to recover revenues lost due to outages resulting from the storm, the Commission requested that the utilities estimate those losses. The lost revenue estimates are gross revenues and do not reflect any related production, transmission or distribution expenses. Expenses would be extremely difficult to quantify and therefore were not requested. The estimated lost residential revenues and total lost revenues for each responding utility are shown in Table 10.

Total lost revenue shown in Table 10 for Kentucky Power, KU and LG&E may include some amount of revenue for wholesale sales. Estimated total residential customer revenue lost is in excess of $11 million. Nolin RECC was able to estimate total revenue lost, but did not provide an estimate of residential revenue lost.

Based on information provided in data responses, Kentucky's jurisdictional electric utilities estimated total sales and revenues lost as a result of the 2009 ice storm are 242,082,561 kWh, and $15,831,970, respectively. Of the 23 retail utilities surveyed, 22 were able to estimate losses or reported only insignificant damage or no damage at all. Losses for Grayson RECC, the one cooperative that was not able to estimate losses, would not appreciably affect the aggregate estimated total revenue losses.

With regard to wholesale power sales, BREC was unable to estimate any losses of wholesale power sales due to the 2009 ice storm because of the complicated lease structure with Western Kentucky Energy, Inc. prior to the recent termination of that arrangement. EKPC reported off-system power sales losses estimated at 5,200,000 kWh and lost revenue of $220,800.

Ice storm damage in Jackson Purchase Energy service territory

Photo courtesy of Jackson Purchase Energy

	Estimated Lost Sales (kWh)	Estimated Lost Residential Revenue	Estimated Total Lost Revenue
Kentucky Power	11,073,810	$396,588	$860,854
Duke Kentucky	0	0	0
Kentucky Utilities	67,900,000	$1,400,000	$1,800,000
LG&E	34,900,000	$1,200,000	$1,600,000
Big Sandy RECC	8,227,000	$524,880	$746,720
Blue Grass Energy	10,923,725	$765,166	$1,016,025
Clark Energy	3,293,161	$233,821	$307,724
Cumberland Valley Electric	0	0	0
Farmers RECC	1,225,000	$110,250	$110,250
Fleming-Mason Energy	557,395	$40,348	$51,480
Grayson RECC	0	0	0
Inter-County Energy	8,547,363	$720,078	$816,268
Jackson Energy	901,266	$79,836	$91,140
Jackson Purchase Energy	16,675,198	$717,039	$1,087,373
Kenergy	31,722,909	$1,524,159	$2,136,538
Licking Valley RECC	4,647,970	$1.797,180	$2,211,197
Meade County RECC	9,100,702	$456,948	$553,098
Nolin RECC	12,641,964	0	$958,710
Owen Electric	4,394,815	$220,478	$312,387
Salt River Electric	13,442,064	$765,219	$1,013,356
Shelby Energy	1,401,204	$115,501	$115,501
South Kentucky RECC	0	0	0
Taylor County RECC	507,015	30,927	43,349
Totals	242,082,561	$11,098,418	$15,831,970

Table 10: Estimated lost sales and revenue to jurisdictional utilities in 2009 ice storm

Duke Kentucky provided no estimates due to the short duration of outages.
Cumberland Valley had no outages resulting from the storms.
Grayson indicated that it is unable to estimate losses.
South Kentucky reported only insignificant losses.

Compiled by PSC from utility data

RECOVERY OF RESTORATION COSTS

2009 ice storm

None of the 25 jurisdictional electric utilities reported that the costs incurred to restore power due to the 2009 ice storm would require an expedited filing for an increase in base rates. Most utilities stated that no early increase would be necessary, while others provided more detailed responses. As noted above, BREC and its three distribution cooperatives as well as EKPC and its 16 distribution cooperatives are all eligible for reimbursement from FEMA of their restoration costs. This minimizes the need for any rate increase.

BREC reported that the unreimbursed costs of restoring electric service following the 2009 ice storm were not of such magnitude as to require the expedited filing of a rate case. BREC indicated that it expects to be reimbursed by either its property insurance carrier, FM Global, or by FEMA for a significant portion of its $2,400,000 restoration costs. It expects to receive approximately $1,100,000 from FM Global and 87 percent of its remaining $1,131,000 restoration costs from FEMA.

Clark Energy stated that the costs of the 2009 ice storm will not require that it file for a base rate increase due to the fact that part of its costs will be reimbursed by FEMA. Cumberland Valley Electric reported that there would be no impact to base rates since it did not experience any system damage resulting from the 2009 ice storm. Inter-County Energy stated that it is yet to be determined if the costs incurred for restoration would cause it to expedite the filing of a rate case.

Inter-County Energy stated that the majority of the net cost of the 2009 ice storm, after FEMA reimbursement of roughly $3,000,000 will be capitalized, with the only lasting effect being capital carrying costs (interest) and increased depreciation. Inter-County Energy expects this should be somewhat offset by reduced operating cost of maintaining newer plant. Jackson Purchase Energy reported that it could not predict when a rate case will next be filed. Kenergy reported that it does not anticipate filing for an increase earlier than it would have otherwise, due to FEMA reimbursing up to 87 percent of eligible expenses.

At the time of the ice storm, Licking Valley RECC was in the process of preparing a rate case, which was filed on July 13, 2009. Licking Valley RECC's rate request was based on a December 31, 2008, historical test year which includes no costs for the 2009 ice storm. As noted earlier, Licking Valley RECC indicated that it expected 87 percent of its restoration costs to be reimbursed by FEMA.

Nolin RECC reported that it is too early to determine whether it will have to expedite the filing of a rate case, and that this will depend on when it receives FEMA reimbursement funds. Shelby Energy stated that its plans to file for a rate increase in 2009 have not changed because of the 2009 ice storm.

Kentucky Power, KU and LG&E are the only jurisdictional electric utilities that have indicated that they will seek authorization to defer incremental restoration costs for later recovery in base rates. The base rates for Kentucky Power, KU and LG&E include an amount for "normal" storm damage expenses. Incremental costs are defined as the costs incurred beyond that normal amount.

Duke Kentucky does not plan to seek authorization to defer any storm restoration costs. Duke Kentucky stated that the 2009 ice storm will not impact the timing of its next electric rate case filing. As stated earlier, the 2009 ice storm related outages on Duke Kentucky's system were of short duration with service restored to most of the affected customers within a day.

Kentucky Power reported that it plans to request authority from the Commission to defer $4.0 million, the amount of the total 2009 ice storm costs that exceed the level of storm expense included in rates in its most recent rate case. In addition, Kentucky Power reported that it experienced a wind storm in 2009 that was classified as an Institute of Electrical and Electronics Engineers, Inc. (IEEE) Major Event (one that exceeds reasonable design and or operational limits of the electrical power system) and that it plans on including these costs ($2.5 million) when it files with the Commission for authority to defer the 2009 ice storm restoration costs. Kentucky Power also experienced significant damage from a severe thunderstorm in May 2009. As a result of the combined impact of these three events, on August 31, 2009, Kentucky Power submitted a formal application requesting that the Commission authorize the company to establish a regulatory asset for the incremental cost of restoration in the amount of $9,813,278 for later recovery through base rates.

KU and LG&E stated that it is likely that they will need to file a rate case to recover the costs of the new Trimble County 2 generating facility in the near future. They anticipate seeking recovery of the 2009 ice storm expenses in that same rate case. On April 30, 2009, KU and LG&E submitted applications to establish regulatory assets to defer expenses associated with the restoration following the 2009 ice storm for later rate recovery. KU sought to defer approximately $61.8 million in incremental costs above the storm damage expenses currently included in its base rates. LG&E sought to defer approximately $45.2 million in such incremental costs. Both companies' requests were recently approved by the Commission.

2008 wind storm

As with the restoration costs resulting from the 2009 ice storm, the jurisdictional IOUs reported that they did not expect to recover any of the costs related to the 2008 wind storm from either private insurance or government sources. Duke Kentucky, KU and LG&E each received PSC approval to create regulatory assets in order to defer Hurricane Ike related costs for future amortization and recovery through rates. The electric cooperatives indicated that they expected to apply for reimbursement through FEMA, which is the only outside source of reimbursement funds for restoration costs for most of the cooperatives. The 13 percent of storm related restoration costs not covered through government sources will come from the individual cooperatives' own resources. Jackson Purchase Energy, Kenergy, Meade County RECC, and Shelby Energy estimated their total FEMA reimbursements would be $579,000; $1,200,000; $462,581; and $243,327, respectively. Owen Electric and Salt River Electric did not provide estimates of their anticipated FEMA reimbursements.

While Hurricane Ike and the 2009 ice storm will have a significant financial impact, the direct impact to customers is not as great because the electric cooperatives will have 87 percent of their restoration costs reimbursed by FEMA. In addition, while the utilities lost revenue due to the outages, none of the utilities plan to request authority to recover lost sales revenue.

As for the IOUs, Duke Kentucky, KU and LG&E received approval in 2008 to defer costs related to Hurricane Ike for possible future rate recovery. KU and LG&E have received approval to defer costs related to the 2009 ice storm for possible future recovery as well. Kentucky Power has filed a request to defer costs related to the 2009 ice storm for later recovery in base rates, a request presently pending before the Commission. In the case of such requests, if the Commission later authorizes rate recovery, the expenses will likely be amortized, or spread, over a period of years. In that manner, the direct costs to the customers will be prorated over a period of time longer than one year.
Generally, expenses that occur outside of a test-year are generally not considered for inclusion in rates unless a prior authorization to defer such expenses has been granted.

The Commission recommends that any utility wishing to recover unreimbursed storm restoration expenses should request Commission authorization to defer such expenses as soon as practical.

WATER AND WASTEWATER UTILITIES

Among the most significant impacts of the 2009 ice storm was the disruption of water service to many Kentuckians. The inability of a water utility to deliver clean, potable water creates a significant public health emergency and fire protection concern that must be resolved immediately. Many water utilities across the state faced that challenge during the 2009 storm. Similarly, poor weather conditions threatened the reliability of wastewater service and treatment. In contrast, the September 2008 wind storm caused fewer disruptions in water service.

The Kentucky Public Service Commission (PSC) regulates approximately 150 water utilities - water districts, water associations, and investor-owned utilities - throughout the state. The PSC does not regulate the retail operations of municipal water utilities, which serve a majority of Kentuckians. Thus, this report is, by its nature, limited in the scope of its assessment.

Sixty percent of the jurisdictional water utilities responding to the PSC's data request stated that they were affected by the ice storm. The severity of impact on the water utilities varied greatly.

For example, Hickory Water District (WD) in Graves County reported that none of its customers could receive water service at some point during the storm and its aftermath. In contrast, Water Service Corporation, which serves customers in nearby Hickman County, reported that no customers in its service area were without water during that time. Although Hickory WD had approximately 48 hours of water storage capacity filled, it did not have generators on site when it ran out of its storage capacity. Water Service Corporation, on the other hand, had emergency generators for all of its treatment facilities and pump stations.

In total, water utilities reported that a total of 32,765 customers were without water during the period. Water utilities experienced the most water outages on January 29, 2009, with the most severe problems concentrated in the western Kentucky.

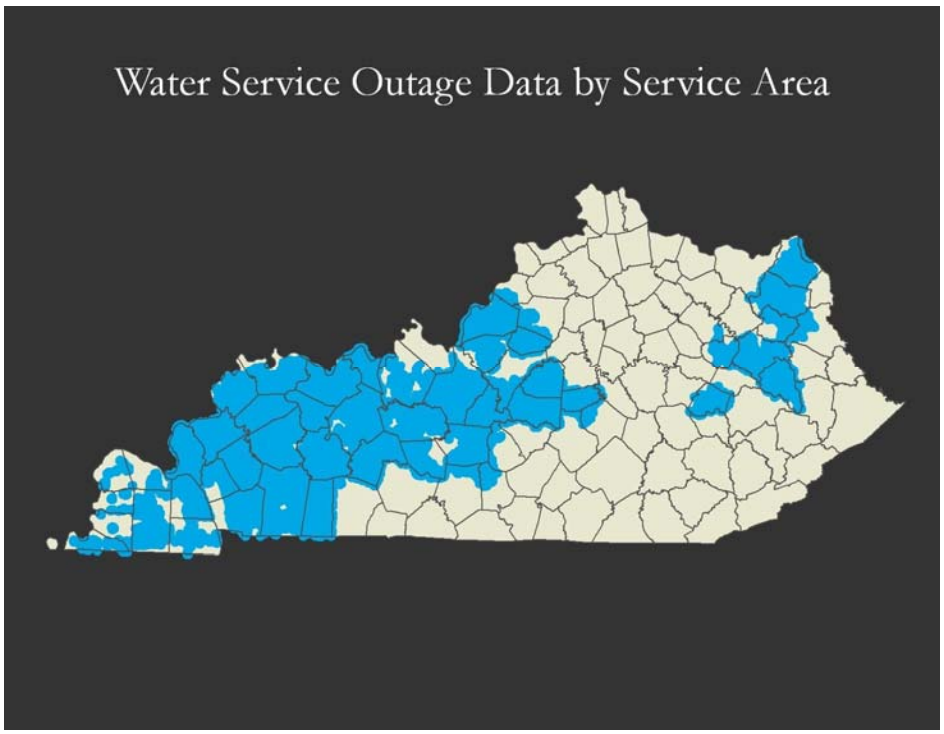


Figure 19: Areas of the state that experienced some loss of water service on January 29th

The water utilities worked diligently to restore service. As seen in Figure 20, a significant portion of customers who did not have water service on January 29th had service restored by the next day.

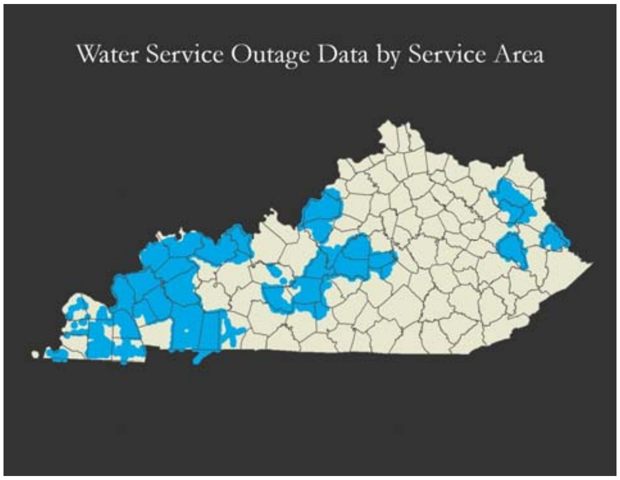


Figure 20: Areas of the state that had loss of water service on January 30th

Nearly all customers had service restored during the next week, as shown in Figure 21.

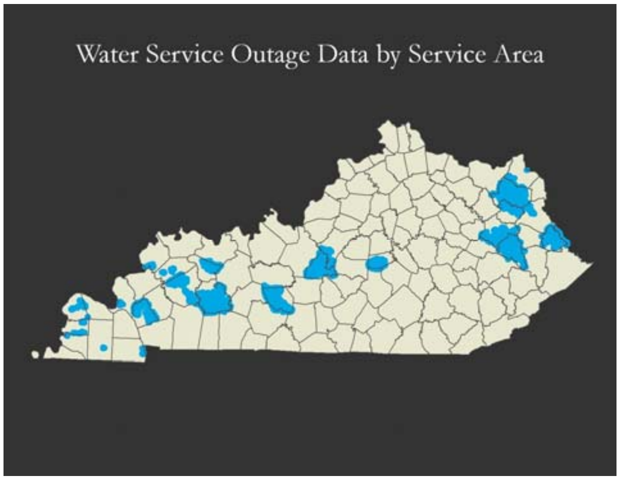


Figure 21: Areas of the state that had loss of water service on February 6th

The most common problems that water and wastewater utilities faced came from the loss of electrical power needed to operate pumping and treatment facilities. Nearly all of the water utilities that reported problems identified loss of electrical service as the primary cause of water service outages. In some cases, electric power restoration occurred quickly enough that the water utility was able to maintain service without resorting to other measures.

The Commission commends electric utilities for their efforts to prioritize restoration of power to the water utilities. Due to the severe nature of the storm, nearly all of affected water utilities were forced to resort to the use of temporary generators in order to provide water to customers while awaiting restoration of electric service.

Ledbetter WD's situation was representative of many utilities. Ledbetter WD has a treatment facility and storage tank that serves approximately 850 of its 1,200 customers. It lost power to these facilities early in the morning on January 27th. Ledbetter WD borrowed a portable generator on that day from a local business to ensure continued service, but the generator was not connected and operational until the morning of January 28th.

Late in the evening on January 27th, Ledbetter WD's facilities lost pressure as a result of the power outage. This caused a 12-hour interruption of water service to about 850 customers. The generator acquired from the local business worked intermittently, which was sufficient to maintain service. On January 30th, Ledbetter WD acquired and installed a more reliable generator from the emergency operations center in McCracken County. Many other water utilities resorted to similar measures in an effort to maintain service continuity.

Some water utilities that do not produce their own water also had problems providing water to their customers when the utilities' water supplier could not provide water to the utility.

Ledbetter WD encountered this problem as well. It purchases water from Crittenden-Livingston WD to help serve approximately 388 customers on Highway 60 in Livingston County.

Crittenden-Livingston WD lost power to its facilities on January 29th. Typically, Ledbetter WD has the back-up capability to pump water from the treatment plant to the Highway 60 area when Crittenden-Livingston WD has interruptions in service, but problems with the temporary generator acquired by Ledbetter WD resulted in an insufficient volume of water to pump to that location. Only when Crittenden-Livingston WD restored service was Ledbetter WD able to serve its customers on Highway 60.

Wastewater utilities reported fewer problems with the provision of wastewater service to their customers. Wastewater utilities responding to the PSC's data request serve a total of 16,691 customers, only a very small number of whom suffered service interruptions. Each of the customers experiencing a loss of service did so as the result of the loss of power to grinder pumps at their individual residences, rather than as the result of a failure of pump stations or other facilities.

Although nearly all customers continued to receive wastewater service, some wastewater facilities experienced problems in treating the effluent before discharge. As with many of the problems associated with the water utilities, the primary problem for wastewater utilities was a result of power outages. These utilities reported over 1,000,000 gallons of untreated effluent that was discharged from both lift stations and treatment plants. The discharge of untreated sewage into surface and ground water has the potential for creating health hazards.

A significant portion of the untreated wastewater discharge flowed from the pump stations that lost power. Kentucky Division of Water (DOW) regulations require that "[a] pump station shall provide a minimum of two (2) hours of detention, based on the average design flow, above the high level alarm elevation or provide an alternate source of power with wet well storage providing sufficient time for the alternative power source to be activated." Moreover, the DOW now requires all new pump stations to have quick connections for a bypass pump or generator. This requirement does not apply to existing pump stations, however, which led to the untreated discharges at such facilities.

In order to prevent untreated wastewater discharges in the event of power outages, the Commission recommends that all wastewater systems consider the feasibility of upgrading pump stations to include detention capability and connections for bypass pumps or generators.

Water utilities reported several challenges in managing emergency response. Most significantly, the ice storm greatly affected internal communications. Water utilities commonly provide their field staff with wireless phones, enabling staff to report updates and conditions in the field. Because of disruptions of wireless service, many utilities reported that wireless phone service was unreliable. As a result, field staff were often required to return to the base of operations in order to provide utility managers necessary information. Hardin County WD No. 1's Sewer Division, however, recognized that its cell phone service was not operational and purchased pre-paid phones from a different communications provider that could be utilized during the storm.

In addition, communications and electrical outages often forced utility managers to relocate to somewhere other than their normal headquarters. For example, Hardin County WD No. 1 moved its operations center to Hardin County WD No. 2 because only the latter had power and working phones. Similarly, Crittenden-Livingston WD moved its operations to the Crittenden County Emergency Management Center.

Communication and electrical difficulties may have also impacted dissemination of boil water advisories. Boil water advisories inform consumers that the water provided by a utility may cause adverse human health effects due to possible biological contamination if consumed, unless it is first boiled for three minutes at a rolling boil. They are issued when tests indicate that there is a problem with the treatment plant or distribution system or when conditions exist that could permit infiltration of harmful agents or bacteria into the system. For example, main breaks, pump failures, or other malfunctions can create areas in a water system with negative pressure, which can allow external contaminants to flow into the system. The DOW recommends that a boil water advisory be issued when portions of the system are without water because power to the water plant had been out for a day or more, creating pressure loss in portions of the system.

At least 33 water utilities had part or all of their systems on a boil water advisory during the aftermath of the storm. Utilities reported issuing those advisories to local radio and television stations. While the loss of power impacts the effectiveness of using broadcast media to disseminate information, a PSC survey suggested that a substantial portion of Kentucky residents rely on battery-powered radios as a primary source of information during power outages. Nevertheless, the Commission is concerned that consumers may not know about the potential problems with their drinking water.

Because dissemination of information during power outages is often difficult and unreliable, the Commission recommends that utilities issue consumer advisories prior to events which create a high potential for service disruptions. Such an advisory acts as a public service announcement and should be worded properly to ensure accurate information is conveyed without eroding consumer confidence or heightening stress. For example, prior to the ice storm, a utility could have issued the following advisory:

> **Severe weather is forecasted for this area. Water customers should be advised that the water utility will strive to continue to provide safe, reliable service throughout inclement weather. Nevertheless, external factors may affect our ability to provide service. The system has reliable water storage, but that storage is not limitless. If electrical power is out for a lengthy period, the water system and the ability to communicate with consumers may be compromised. If this is the case, consumers should take steps to limit water use and consider boiling water for at least three minutes prior to consumption to be on the safe side.**

While all water utilities worked diligently to resolve service disruptions, some provided excellent examples of disaster preparedness. Grayson County WD reported that no customers lost service during the storm or its aftermath, even though its treatment facility lost power for about 36 hours and power was lost to the entire system for about 24 hours. One of Grayson County WD's greatest assets is storage capacity for twice its daily average use of 1,000,000 gallons of water. On the day prior to the storm, Grayson County WD personnel ensured that its storage tanks and clear well were filled to capacity.

The Commission recommends that all water utilities insure that existing storage is at maximum capacity in advance of events that could disrupt service. This is a straightforward preventative measure for water utilities to implement. The Commission notes that its regulations require water utilities to have, at a minimum, one day's storage capabilities. A day's worth of water in storage may allow service to continue uninterrupted while power restoration occurs, particularly if customers are concurrently asked to conserve water.

Grayson County WD also provides an example of good contingency planning. It has interconnections with four other water utilities, including one with the City of Leitchfield. Grayson County WD has a contractual right to purchase up to 1,000,000 gallons of water per day from Leitchfield in times of an emergency. This contract is particularly beneficial because Leitchfield's water facilities rely on a different power provider than Grayson County WD, and thus Leitchfield may have power when Grayson County WD does not.

The Commission recommends that all water utilities consider establishing adequate interconnections with neighboring water suppliers. The Commission notes that it has encouraged such interconnections for a number of years. Even if there is no intent to supply water during non-emergency conditions, interconnections could be a cost-effective means to provide continued water service to customers in emergencies. Equally important, water utilities should annually review their agreements with other interconnected utilities to ensure the agreements remain current and mutually acceptable.

Grayson County WD's facilities also have advanced electrical components that include a two-way feed available at each plant station. Each feed is supplied by a different electric substation. In addition, there are disconnects in place at the plant to utilize a generator, and Grayson County WD has an agreement with Aggreko, a major supplier of emergency generators, that would enable the utility to obtain generators if necessary. The utility also reported that local businesses offered to lend generators to ensure continued water service.

Identifying sources of temporary generators is an essential preparatory measure. Most of the water and wastewater utilities that reported outages found generators from various vendors, governmental agencies, and local business and were able to restore or continue service when power was out at vital facilities. However, several utilities reported difficulties in locating and acquiring generators during the ice storm.

The Commission recommends that all water and wastewater utilities identify local resources, particularly potential suppliers of portable electric generators, in order to expeditiously obtain emergency assistance. Water and wastewater utilities should consider joining an industry-wide group, such as Kentucky Water/ Wastewater Response Network (KYWARN), a mutual aid network of utilities. KYWARN members have access to a database of other utility systems within the Commonwealth and their resources (pumps, generators, chlorinators, evacuators, etc.) and trained personnel that they may need in an emergency. By joining KYWARN or a similar group, water utilities may be able to get necessary assistance from neighboring utilities that have resources to spare. In addition, utilities located near other states may want to contact sister utilities in neighboring states to learn of each others' resources. Many utilities reported using generators and other equipment that was shipped in from out of state during the 2009 ice storm.

Grayson County WD was also prepared with extra rechargeable batteries to ensure adequate monitoring of its water system. The water district uses a Supervisory Control and Data Acquisition (SCADA) system to monitor information related to its system. Even though power was out at some of its storage tanks for as many as 20 days, Grayson County WD was able to provide fresh batteries at the remote locations twice daily to guarantee that the flow of information continued.

Grayson County WD's impressive preparedness is a model for water and wastewater utilities facing potentially debilitating weather conditions. Many other water utilities across the Commonwealth were similarly well-prepared, and they either continually served their customer base or restored service in a timely manner. Nevertheless, utilities should regularly review preparedness plans to identify opportunities for improvement.

The burden for preparedness does not rest on utilities alone. Utilities often require the assistance of outside sources to obtain low-cost funding for projects that would improve service continuity. Agencies such as the Kentucky Infrastructure Authority have been crucial in extending potable water service to nearly all residences in the Commonwealth.

As the Commonwealth nears former Governor Paul Patton's goal of providing a supply of potable water to every Kentuckian by 2020, the Commission encourages funding agencies such as the Kentucky Infrastructure Authority to consider funding requests to improve systems to meet emergency situations.

When considering various contingency plans and preparedness options, utilities must remember to weigh the costs and benefits of various system improvements. For example, one water utility with approximately 4,000 customers stated that it would cost $1,800,000 to upgrade its system to provide a high degree of certainty that water service would not be interrupted by a future event of a magnitude similar to the ice storm. Such an upgrade may not be in the best interests of a utility and its customers. Similarly, most wastewater utilities agreed that the necessary upgrades affiliated with permanent back-up power generation would be cost-prohibitive.

Certainly one cost-effective, preventative measure is to have a written emergency response plan in place. Several utilities reported referring to their emergency plans during the ice storm. Crittenden-Livingston WD, for example, utilized the emergency response plan template that is available from the Kentucky Rural Water Association. Written emergency response plans provide utility personnel with a quick reference guide of what to do in circumstances that do not frequently occur.

The Commission recommends that all water and wastewater utilities have a written emergency response plan and have its personnel review that plan on a regular basis. In addition, the Commission recommends that utility personnel be adequately trained on crisis management. Local emergency management organizations regularly hold table-top and practical training missions through which utility personnel could participate and become better prepared for catastrophic events.

TELECOMMUNICATIONS

Both the September 2008 wind storm due to the remnants of Hurricane Ike and the ice storm in January 2009 had similar impacts on telecommunications utilities in the affected areas of Kentucky. However, the ice storm resulted in considerably more damage to utility infrastructure and necessitated significantly greater recovery and restoration efforts. This section analyzes and evaluates primarily the aftermath of the ice storm, but the discussion applies, generally, to both events.

LOCAL EXCHANGE CARRIERS

The local exchange carriers ("telephone utilities") surveyed during this review included the 20 incumbent (primary) wireline voice telephone service providers and the competitive facilities-based eligible telecommunications carriers (ETCs) certified and registered to provide wireline voice telephone services in Kentucky. Pursuant to Kentucky Public Service Commission (PSC) statutes, regulations and policies, including KRS 278.040, each of these carriers has an obligation to serve telephone subscribers in their respective operating territories and is further required to maintain safe, reasonable and adequate service.

Preparation

During the days and hours prior to the impending ice storm, telephone utilities operating in Kentucky uniformly reported that they monitored weather conditions and began preparing resources for the response. AT&T Kentucky, WindStream Kentucky East, and Cincinnati Bell, who serve the largest numbers of subscribers in Kentucky, maintain staff dedicated to monitoring weather reports. Some carriers also relied on contracted weather services to communicate conditions affecting their areas of business.

Regional and local central operations centers were alerted and organizational plans and procedures were activated to coordinate planning and restoration efforts. Smaller utilities prioritized responsibilities for available staff and relied on television and radio broadcast media along with other publicly available resources to monitor weather conditions and begin preparation efforts.

Typical resources mobilized by telephone utilities prior to the ice storm included portable generators, utility vehicles, equipment and personnel. Vehicles and generators were fueled and equipment checked and readied for transport. Utility personnel were assigned responsibilities and, if feasible, stationed in or near the expected areas of impact.

Some utilities began to consider the logistics issues related to personnel and fueling resources required for a significant, long-term, event. Many utilities took this opportunity prior to the storm's arrival to remind personnel of emergency operating procedures and safe working practices.

It appears that the telephone utilities, as a whole, were adequately informed and reasonably prepared for the ice storm event. Unlike the circumstances surrounding the September 2008 wind storm, most of the utilities were able to recognize from the weather reports that the brunt of the ice storm would likely affect far western to north-central portions of Kentucky.

This information was critical for the utilities' ability to effectively plan and prepare for the ice storm event. The utilities took advantage of the forecasts to begin staging resources and assigning responsibilities prior to the event, and this effort contributed positively to the restoration efforts.

Infrastructure and services

The telephone utilities located in the far western region were impacted the most while utilities in central and north-central regions of the Commonwealth experienced less extensive damage to facilities and thus far fewer service outages. Unlike electric wires, telecommunications lines that have limbs hanging on them or fall to the ground will continue to function unless severed. Thus, telecommunication outages were less widespread in the areas with less ice and less damage.

The main concerns immediately evident for telephone utilities affected by the storms were the loss of commercial power and/or downed drop wires serving individual customer locations. All major service nodes in the telecommunications network typically rely on battery-supplied power for operations and have battery reserves. Battery back-up supplies typically provide 4-to-8 hours of back-up power in addition to any alternative back-up power source that may be available.

The primary central switching equipment (central offices) that serve high-density subscriber bases and provide for inter-office (and inter-carrier) connectivity are equipped with permanent, on-site, back-up power generators in addition to battery back-up. Secondary service nodes or remote switches (‘remotes’ or ‘digital loop carriers’) serving low-density subscriber bases may have battery back-up for short term power interruptions but typically rely on portable generators for alternative power during lengthy power outages. Many of the smaller telephone utilities advised that all or most of their remote sites are also equipped with fixed, on-site, generators.

Overall, the telecommunications infrastructure itself was not severely damaged during the ice storm event. In many instances, telecommunications facilities remained intact and operational even when supporting structures, i.e. poles owned and/or leased from other utilities were damaged by ice or trees. However, utilities in the hardest hit regions reported damaged aerial distribution cables and substantial numbers of aerial service drops to customer premises that needed to be repaired or replaced. Some telephone utilities reported damaged inter-office facilities, however, the vast majority of these facilities remained operational without any noticeable impact on the availability of services. AT&T Kentucky reported that - as a result of six damaged inter-office facilities - only two communities, Drakesboro and New Haven, experienced a loss of toll (long-distance) service. However, their local dial-tone service was unaffected.

Response, recovery and restoration

Once the effects of the ice storm became evident, the utilities began the process of evaluating damage and planning specific restoration efforts. Most utilities invoked all or portions of their emergency operations/response plans during preparations prior to the storm event. Emergency response plans generally provide the policies and procedures to be followed during emergency events and often prescribe areas of responsibility and courses of action to be taken to restore utility services. Some response plans go into considerable detail and attempt to identify specific types of events and the precise procedures to be followed.

Nevertheless, those utilities experiencing the worst impact from the ice storm were unable to immediately or fully effectuate their emergency response plan due to inadequate resources and/or the inability to perform necessary functions. For example, Ballard Rural Telephone Cooperative Corp. (RTCC) (serving Ballard and portions of McCracken counties) explained that communities it served were severely disabled by the ice storm due to limited or no availability of electricity, fuel or food. That hampered the utility’s ability to recover and restore services. Hazardous driving conditions made some utility service areas unsafe to reach and further delayed restoration efforts. Due to the impact the storm also had on the electric utility infrastructure, which is often shared by telecommunications utilities, efforts to restore services had to be coordinated with electric utility crews to ensure repairs were made safely and efficiently.

Once utilities were able to survey operating territories after the brunt of the storm had passed, the network facilities without commercial power were the first to be identified. Portable generators were deployed, on a priority basis, to facilities lacking permanent on-site backup power. Plans were developed to fuel and maintain this equipment during the event. Telecommunications utilities maintain priority restoration guidelines as part of their emergency operations plan.

These guidelines vary slightly from utility to utility but typically prioritize restoration efforts to include E-911 call centers, emergency services (police, fire, EMS/rescue), hospitals and emergency medical facilities, essential government services and other high priority points of service. Gaining access to some of the affected areas proved difficult due to downed trees along roadways and many utilities resorted to clearing roadways themselves in order to reach portions of their system.

Blocked roadways also hampered deployment of portable generators and refueling efforts to locations where ice-laden trees and/or utility poles had fallen. As the event progressed, the affected telephone utilities were able to focus more attention on specific customer issues and begin repairing damaged/downed drop lines to individual locations.

Overall, the wireline telephone utilities' response and restoration efforts during the ice storm were exemplary. The effects of the storm, particularly in the early stages, wreaked havoc on nearly all aspects of the telephone utilities' recovery and restoration efforts, making a tough job ever more difficult. The utilities in the hardest hit areas were not only responsible for their own restoration efforts but often assisted other emergency response personnel. West Kentucky RTCC reported that its business office in Graves County operated around the clock throughout the event while serving as the local government's command center and headquarters for the National Guard deployed to the area. Ballard RTCC also reported accommodating National Guardsmen during the event.

Many of the utilities have identified and, in some instances already corrected, areas of their operations they recognize could be improved as a result of this major storm event. The Commission believes certain measures merit consideration by all utilities.

The Commission recommends that utilities consider expanding the availability of fixed, on-site, back-up generators at network service nodes in order to alleviate the immediate impact on utility services from loss of commercial power for extended periods. The lack of commercial power not only affected utility services but also disrupted the utility's ability to perform common and routine tasks. For example, fuel, food and lodging were often unavailable from the usual commercial sources and there was limited or no ability to accept non-cash payments such as credit card purchases. In order for utilities to be adequately prepared for similar emergency situations in the future, they should consider plans and provisions for addressing such circumstances. Telephone utilities should also ensure that vegetation management (tree-trimming) practices are sufficient to effectively control damage to aerial facilities, and consider constructing underground facilities where practical.

WIRELESS CARRIERS

The Commission surveyed the majority of wireless carriers operating in Kentucky during this review. Responses were received from most carriers surveyed, although many carriers invoked confidentiality protections, as discussed in greater detail below.

According to contemporaneous news reports, many communities in western Kentucky were completely isolated during the first days of the ice storm due to the total disruption of communications. Among all wireless carriers, AT&T Kentucky appeared to be the most affected in the region. The loss of wireless services it provides to state and local governments complicated the already difficult task of responding to the disaster. Many local officials complained that the lack of communications with emergency operation coordinators in Frankfort during the event frustrated their ability to convey their needs and request assistance and to serve the communities hardest hit by the ice storm.

Preparation

Wireless carriers reported that they began monitoring weather reports and preparing resources prior to the ice storm. Personnel and equipment were prepared, mobilized and staged where feasible.

Wireless carrier networks rely on the availability of commercial power in substantially the same manner as the telephone utilities. The wireless carriers reported having four to eight hours hours of battery back-up power at all cell site locations, in addition to the capability to connect portable generators for long-term loss of commercial power.

Permanent, on-site, back-up generators are typically installed at central switching offices and at other selected points of service. For example, Verizon Wireless indicated that the vast majority of cell sites and its central switching offices located in Kentucky were equipped with permanent, on-site, back-up generators. Each of the wireless carriers planned and prepared for the deployment of portable generators to cell site locations by staging supplies near the areas expected to be impacted by the storm.

Infrastructure and services

As would be expected, the areas in which wireless carrier networks were impacted coincided with those for telephone utilities. The duration and extent of the outages varied by carrier, but the primary causes of wireless service interruptions were the loss of commercial power and storm-related damage to third-party telecommunications facilities relied on for interconnecting cell sites with central switching offices.

Wireless carriers reported some intermittent or short-term problems with individual cell sites due to ice-laden antennae or back-up generator malfunctions, but those situations were quickly resolved and did not result in any long-term or area-wide service outages. In addition, no wireless carriers reported damage to any supporting structures during the event.

All but one wireless carrier reported experiencing significant disruption to wireless service due to the loss of commercial power and subsequent exhaustion of battery back-up supplies at cell sites. For most wireless carriers, service problems were compounded by storm-related damages sustained by third-party telecommunications network providers that are relied upon to interconnect cell sites with the wireless carrier’s central switching offices.

The loss of third-party telecommunications service restricted the availability of wireless services and limited the carriers’ ability to remotely monitor cell sites during the event. For example, AT&T Mobility/New Cingular reported that outages experienced in its hardest hit service areas of western Kentucky (affecting the communities of Paducah, Bowling Green, Madisonville and portions of Hopkinsville) were primarily the result of storm-related damage to third-party telecommunications facilities and not the direct result of the loss of commercial power at individual cell sites.

Response, recovery and restoration

As with the telephone utilities, emergency response plans were executed by wireless carriers in preparation for the ice storm event. The emergency response plans for wireless carriers primarily revolve around the monitoring of network conditions and the distribution of back-up generators, as well as ensuring equipment remains fueled and operational during an event. Most wireless carriers reported obtaining necessary resources from unaffected operating regions in order to respond to the event.

The primary resources initially dispatched were portable generators for those cell sites determined to be without commercial power. In addition, significant wireless carrier personnel and contractors were required for installing and maintaining the portable generators at the affected cell sites. As experienced by all utilities during the early stages of the event, delays in restoring services often occurred due to hazardous or impassable road conditions.

While ensuring that portable generators were being delivered as needed, the wireless carriers also focused attention on restoring connectivity for those cell sites affected by damaged third-party telecommunications facilities. In some instances, alternative arrangements were found to by-pass the damaged facilities. In others, the carriers had to wait for repairs by the third-party carrier to be completed before service could be fully restored.

Most of the wireless carriers were able to call upon vast resources from regional or national operating affiliates during the recovery and restoration. Even though the early stages of the event proved challenging as ice storm related issues affected nearly every aspect of the wireless carriers' response, the recovery and restoration efforts remained diligent and focused.

REGULATORY ISSUES

As defined in 47 U.S.C.§ 332 and the accompanying federal regulations, the Federal Communications Commission (FCC) authorizes wireless carriers to operate facilities and provide services in designated geographic service areas, or markets, covering Kentucky. Although wireless service markets are intended to be competitive, each wireless carrier remains obligated to provide subscribers with adequate and reasonable service.

Most of the wireless carriers responding to the PSC's questionnaires did so 'voluntarily' citing lack of Commission jurisdiction pursuant to KRS 278.54611. In addition, nearly all of the wireless carriers petitioned the Commission for confidential protection of all or portions of their responses by asserting the proprietary and competitively sensitive nature of the information. The confidentiality requests often included information that the carriers had freely provided to news outlets during the ice storm. For example, several carriers, including Verizon Wireless and AT&T Kentucky, provided news outlets with information about the number of non-functioning cell towers in their systems, but sought confidentiality for that same information from the Commission.

Pursuant to KRS 278.040(2) and KRS 278.280, the Commission maintains the general authority to oversee the service of utilities, which includes ensuring that a utility maintain safe, reasonable, and adequate service. However, presently the Commission does not have the authority to conduct routine inspections or evaluations of cell facilities in Kentucky, as KRS 278.54611(1) specifically states that availability of cell facilities and equipment cannot be regulated by the Commission, thereby nullifying a portion of KRS 278.040(2). Also, no state statutes exist currently which specifically compel wireless providers to maintain certain levels of resiliency or reliability for wireless facilities as it pertains to back-up power.

Additionally, there are no enforceable federal statutes or regulations compelling wireless carriers to maintain emergency back-up power generation at tower sites. In 2007, the FCC promulgated 47 C.F.R. §12.2 titled "Backup Power," wherein it sought to compel many of the largest wireless carriers in the U.S. to have emergency back-up power for assets that are normally powered from local AC commercial power, including central switching offices and cell sites. However, several wireless telephone providers filed a federal lawsuit to challenge the FCC's authority to promulgate a rule of this nature. In 2008, the FCC's rule on mandatory back-up power was declared void due to a section of the rule centering on the collection and reporting of certain information.

The FCC did not seek to appeal that finding, and, instead, has chosen to simply not enforce the rule or any of the provisions contained therein upon wireless carriers. To date, the FCC has not promulgated any new rules, nor has Congress passed any new legislation focused exclusively on emergency back-up power requirements for cell towers. The current arrangements for back-up power which various wireless carriers maintain for their facilities are based upon the individual decisions of each company, not due to any specific mandates of the state or federal government.

It is clear that the availability of telecommunications services during major emergencies is an absolute necessity. The efforts of emergency responders as well as the coordination of resources among state and local officials were severely hampered by the loss of wireless services.

It is obvious that the availability of critical telecommunications services during emergency events must be sustainable in order for an effective response to occur. Many of the wireless carriers have already identified areas of their operations that may be improved to better prepare for similar emergency events in the future.

Although the Commission's authority over wireless carriers has been limited by statute, the Commission nonetheless feels compelled to offer the following recommendations. Wireless providers should consider expanding the number of cell sites equipped with permanent, on-site, back-up generators, where such generators are technically feasible. This could alleviate some of the immediate impact on a wireless carrier's network from the loss of commercial power. Second, enhancing the redundancy of interconnecting facilities, whether owned or leased from third-party providers, between cell sites and central switching offices would also help to ensure the integrity of the wireless network.

Absent the necessary oversight authority, the Commission is unable to adequately determine whether or not critical telecommunications systems are secure and robust enough to survive major and potentially catastrophic events. Thus, it falls to those users most dependent on these systems to assess reliability and to make a determination as to the need for alternative arrangements for effective emergency communications. The Commission recommends that any purchaser of wireless services - whether for individual, business or governmental use – should inquire as to and consider the reliability of the service offered in the event of a major disruption of electrical power or other emergency. Anyone, including government entities, who may need to rely upon that service in an emergency should consider making their purchasing decisions accordingly and should consider using reliability as a criterion when evaluating bids from competing vendors.

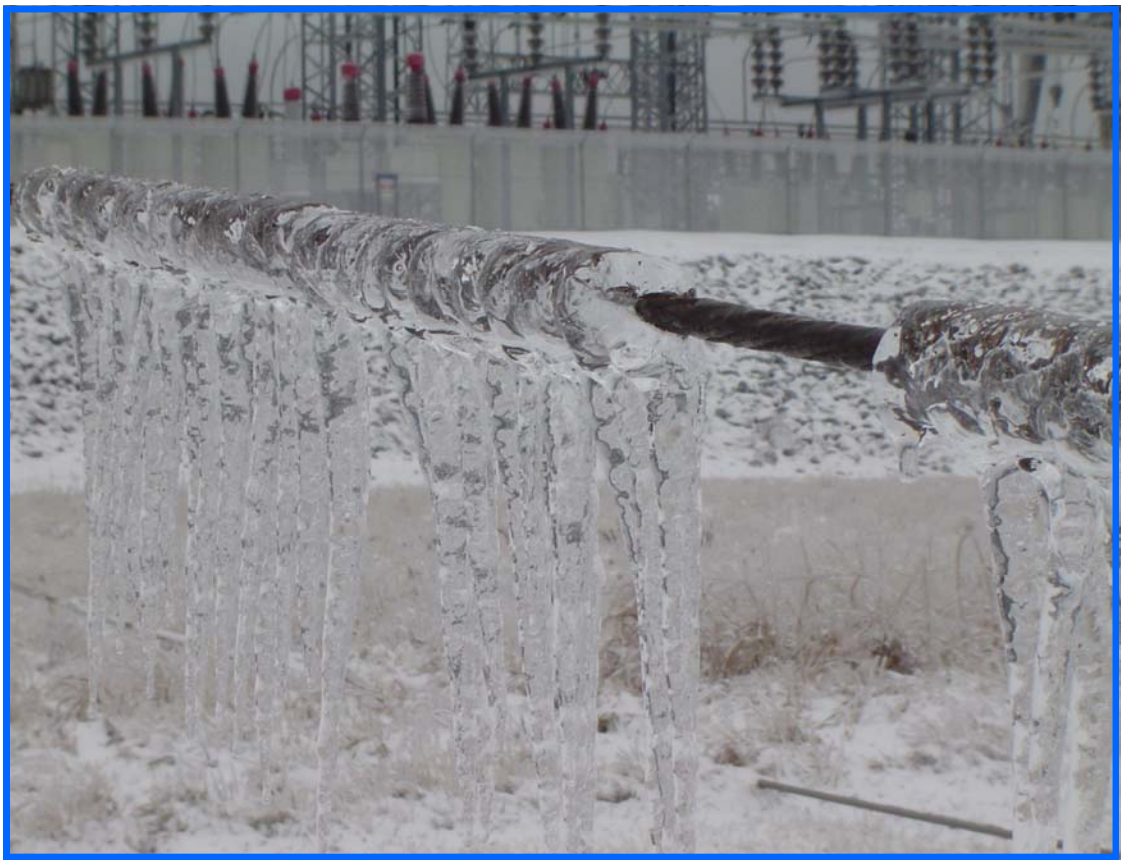
CUSTOMER SERVICE FUNCTIONS

Utility company communications can be viewed as a two-pronged function. Communications initiated by the utility with customers, government entities, news media, other parties and the public at large generally fall into the realm of public information. Communications initiated by customers fall under the purview of a utility's customer service function.

Both communication functions take on heightened importance during service outages and other emergencies. This chapter examines the performance of utility customer service functions during the September 2008 wind storm and the January 2009 ice storm. Public information functions are addressed in a subsequent chapter.

With each of the two storms creating outages that were twice as large as any previously recorded in Kentucky, utility customer service functions were placed under enormous strain. Many utilities saw a majority of their customers lose service, with many of those customers calling to report outages and then making repeated follow-up calls to inquire about restoration progress and other issues.

Call center operations are at the core of customer service during outages. Utilities have various operational models for their call centers. These include on-site centers staffed by utility personnel, off-site centers operated by the utility, off-site centers operated by a third party and off-site third-party call centers used



Heavy ice accumulation at Big Rivers Electric Corp.'s Barkley Lake Dam substation

Photo courtesy of Big Rivers Electric

only on a contingency basis. Many utilities use some combination of two or more types of call centers.

A number of utilities reported that phone systems became inoperable as the result of power outages at their offices, making it impossible for customers to reach the utility.

Every utility significantly affected by the two storms reported a significant increase in call volume. For example, Louisville Gas & Electric Co. (LG&E) and Kentucky Utilities Co. (KU), both subsidiaries of E.ON US, reported receiving a combined 385,000 customer calls in the first four days following the ice storm. The number would have been higher if not for the significant telephone outages over much of KU's service territory in western Kentucky, company officials said. By February 5th, LG&E had received 370,000 customer calls, while KU had received 280,000 calls.

For most utilities, the volume of calls led to significantly longer hold times and an increase in the number of dropped calls. This in turn led to increased customer dissatisfaction, utilities reported.

Some utilities restricted calls to those related to the restoration process, asking callers with other concerns to call back later. Others maintained business as usual and fielded all types of calls including disconnects, reconnects and billing questions. Most of the utilities used an Interactive Voice Response ("IVR") to route the calls to the proper department and to give information on certain topics. Some of the utilities used e-mail to allow the customers to e-mail questions or concerns and to receive responses via e-mail.

Most utilities handled calls in the order received. However, for any life-threatening situations, the consumer was advised to call 911 or the utility would call 911 for them. Safety issues were prioritized based on the specific situation.

Many utilities had systems in place to identify facilities that had a high priority for restoration. These included hospitals, nursing homes and public safety facilities. Other utilities did not maintain such lists, or had lists with outdated information.

Many of the utilities were able to call in additional personnel or divert personnel from one area to another to help with restoration efforts and to answer phones. Others offered overtime to employees in order to be staffed appropriately during the restoration process.

Utilities took various steps to attempt to accommodate the high volume of calls. Off-site call centers were utilized at rates far higher than normal. Many utilities extended office hours, and some were staffed around the clock. Larger utilities were able to draw on a pool of cross-trained personnel to supplement the customer service staff.

Following the ice storm, the Kentucky Public Service Commission's (PSC) Consumer Services Division received a large number of calls from utility customers who were unable to contact their electric service provider to report an outage or to obtain restoration information. Although the problem was particularly acute in western Kentucky, where telecommunication system failures left a number of utilities without telephone service for several days, it was not confined to any one part of the state. Kenergy Corp. was the subject of many such complaints, as were Inter-County Energy, Salt River Electric Cooperative, Big Sandy Rural Electric Cooperative Corporation (RECC) and LG&E. All of these utilities were among those that sustained the heaviest damage in the ice storm.

The PSC also received complaints about the failure of landline and wireless telephone service over large portions of western Kentucky and the inability to contact telephone company customer service centers. Although these were far less numerous than complaints about electric service, many customers said the telephone outages were a greater concern than the loss of power. Many of these complaints concerned AT&T Kentucky, which lost both landline and wireless service in some areas. Callers often noted that Verizon Wireless phones continued to operate in parts of the state where AT&T Wireless phones did not. Some consumers in western Kentucky relied on citizens' band (CB) radios for communication, or had to travel to Tennessee to have phone service. AT&T offered free phone calls to customers at their retail stores and issued bill credits to customers that called and requested them.

The overloading of electric utility company consumer service systems appears to be exacerbated, at least in part, by a self-reinforcing phenomenon. Customers who cannot get through initially to report an outage, or who do not trust automated outage reporting systems, make repeated calls to the utility. Even after reporting the outage, customers continue to call seeking information about restoration. Because utilities are reluctant to make definitive predictions about restoration times, customers call repeatedly in order to receive the latest information. Thus, the harder it becomes for customers to get through to the utility or to receive sought-after information, the more likely they are to make repeated calls, which overloads the system and perpetuates the problem.

It is in the interest both of utilities and their customers to ease outage reporting and improve access to customer service functions. Several utilities noted that the number of customer calls diminished as better information about the progress of restoration efforts and estimated restoration times was provided by other means, such as company Web sites. (This is described in greater detail in the following chapter.)

The Commission recommends that electric utilities take the necessary steps to improve access to customer service functions. Utilities should review their disaster response plans and make any changes needed to provide for adequate staffing of customer service functions during outages, including cross-training of employees to supplement consumer service staff, extending consumer service hours and providing for third-party backup if necessary. Utilities should provide for backup power in order to maintain call center operations in the event that the utility offices lose power.

The Commission recommends that utilities provide customers with information about outage reporting procedures. At a minimum, this should include:

- **The number or numbers to call to report an outage.**
- **The availability, if any, of outage reporting via e-mail or text message from wireless devices.**
- **An explanation of automated outage reporting, if applicable, and why it is important that customers use it.**
- **A request that every customer who loses power calls to report an outage, but that customers make only one such report.**
- **Instructions on when a call to 911 is appropriate and when it is not.**

The PSC fully understands the inconvenience, frustration and anxiety that accompany extended power outages. (Commissioners and a substantial portion of the PSC staff were without power during one or both of these storms.) The PSC notes, however, that customer impatience, however understandable, can impede the efficient operation of utility customer service functions.

The Commission recommends that utility customers familiarize themselves with the steps they should take to report outages.

A recurring problem in outages, regardless of scale, is the plight of customers who are dependent on electricity to power home medical devices, some of which may be necessary for life support. During both the 2008 wind storm and the 2009 ice storm the PSC received, both directly and indirectly, requests for assistance from customers with such devices. In many instances, the customers had been unable to contact the utility. The PSC conveyed the requests to the utilities, which led to expedited power restoration. The PSC notes that electric utilities maintain lists of customers who are medically dependent on electrically powered devices. These lists serve to both alert the utility to the presence of such customers when planned outages are necessary for system maintenance and to help establish restoration priorities in the event of unplanned outages. Based on the PSC's experiences during these two storms, it appears that utilities are often unaware of such medically dependent customers because those customers have not identified themselves to the utility.

The Commission recommends that all customers who are medically dependent on electric devices advise their electric provider of their status. The Commission notes that the electric provider may require documentation from a medical professional. The Commission further notes that in the event that a power interruption leads to a life-threatening situation, the proper course of action is to call 911.

The high volume of complaints received by the PSC Consumer Services Division during the two storms complicated the process of addressing such complaints. Under normal circumstances, an informal complaint to the PSC generates a telephone call or e-mail from the PSC to the liaison for the company in question. The PSC generally expects an initial response to the customer in a timely fashion, although the response time varies greatly across utilities. During the two storms, response times to customers lengthened and, in a few cases, the PSC was unable to contact anyone at the utility to convey the customer's concern.

In their responses to the PSC data requests, a number of electric utilities stated that customer complaints conveyed by the PSC placed an undue burden on utility personnel who are focused on and struggling with restoration efforts. Several utilities requested that consumer complaints not be transmitted to them by the PSC during major power outages, or that they be relieved of the expectation of providing a timely response to the customer while restoration is in progress.

The Commission finds that major power outages justify a suspension of business as usual in complaint procedures in order to alleviate the burden on affected utilities. In the event of an emergency, an extended response time should be in effect. For this purpose, an emergency is defined as an event that has led to an activation of the Kentucky Emergency Operations Center (EOC), if that event has occurred within the utility's service territory and has required activation of Emergency Service Function 12 (ESF-12), which applies to electric utilities. The expected response time will be extended to seven calendar days or for as long as the ESF-12 activation remains in effect. In order to further reduce demands on utility personnel, the PSC will aggregate non-urgent consumer complaints and convey them to the utility once daily, rather than as they are received. However, the Commission notes that it will continue to convey urgent consumer inquiries to utilities as soon as they are received and will expect urgent matters which may pose a threat to health or safety to be addressed as quickly as possible.

The Commission further notes that the number of customer complaints that necessitate referral to the utility could be reduced if the PSC Consumer Services Division staff had access to detailed restoration information from utilities, including daily updates on restoration completed and upcoming restoration work plans.

Restoration of power did not bring an end to customer complaints. The principal concern stemmed from the estimated bills many customers received from their electric utility. Because of the inability to access meters and the diversion of meter readers to other tasks, many utilities were forced to estimate bills for those customers whose billing cycles ended within a week or two of the ice storm. The result was that many customers received bills that were much larger than expected, particularly given that many of those customers had used no electricity during a significant portion of the billing period.

While many utilities were the subject of such complaints, a disproportionate number came from customers of Inter-County Energy in central Kentucky. The PSC investigated and discovered that the problem originated with the utility's billing software, which was incapable of adjusting for estimated readings in combination with delayed billing dates. As a result, some customers received inordinately large bills. Inter-County Energy was the only utility in Kentucky using that billing system and was in the process of changing to another system that would minimize the possibility of such billing errors in the future. Inter-County Energy worked with affected customers to adjust bills.

The Commission recommends that utilities inform customers when severe weather or other circumstances require large numbers of bills to be based on estimates instead of actual readings. This information should be incorporated into utility communications regarding safety and other outage-related topics.

Repairing LG&E transmission lines in Jefferson County after the 2008 wind storm

PSC photo

PUBLIC INFORMATION AND INDIVIDUAL PREPAREDNESS

Managing information flow is central to effective disaster response. Information streams in major disasters are multi-tiered and multi-directional. Disruption of any one information stream is likely to have consequences that will affect multiple aspects of the disaster response.

Both the September 2008 wind storm and the January 2009 ice storm posed significant information management challenges. In the latter, the challenges were magnified both by the larger geographic extent of the outages and by the significant disruption of telecommunication infrastructure in the hardest-hit areas.

This chapter examines how well affected utilities and the Kentucky Public Service Commission (PSC) communicated with each other, with key state agencies involved in disaster response, with local officials, with affected customers and with the public in general. It also will consider what information is necessary for individual residents to better provide for their own safety and health in the event of future power disruptions of this magnitude. Specific topics to be addressed include:

- Outage reporting by utilities to the PSC and by the PSC to the Kentucky Division of Emergency Management's (DEM) Emergency Operations Center (EOC).
- Communication between utilities and local officials, including both elected officials and emergency responders.
- Telecommunication capabilities
- Public information provided by utilities regarding the status of restoration efforts and anticipated restoration times.
- Efforts to provide the public with safety and health information, as well as information about individual property owner responsibilities with respect to restoration requirements.

Heavy ice also accumulated in central Kentucky Photo courtesy of Inter-County Energy

OUTAGE REPORTING

PSC regulations (807 KAR 5:006 (26)) require jurisdictional electric and telephone utilities to report, within two hours, all outages that affect 500 or more customers for four or more hours. The utilities may do so by telephone, fax or electronic means. To facilitate reporting, the PSC in 2006 established a Web-based outage reporting system that not only allows utilities to report outage information, but also posts that information on a public portion of the PSC Web site in real time and generates e-mail notifications to key PSC staff members.

All jurisdictional electric utilities and most local telephone companies use the Web site to report outages. The PSC's outage reporting requirement does not extend to the 28 municipal utilities that provide electric service or to the five electric distribution cooperatives that are within the Tennessee Valley Authority (TVA) system.

The gathering of outage information is a primary function of the PSC in state emergency response. The Kentucky EOC is organized into Emergency Support Functions, or ESFs. When the Kentucky EOC is activated by the DEM or by order of the governor, only those ESFs that are necessary for response to the specific emergency are mobilized and staffed.

The PSC fulfills Emergency Support Function 12 - Energy (ESF-12) during an activation of the Kentucky EOC. ESF-12 coordinates response involving electric power and natural gas supply. While ESF-12 is not activated during every EOC activation, it served as a key information hub during both the Hurricane Ike event and the ice storm.

Because the EOC work cycle included twice-daily situation reports during both events, the PSC required all utilities to update their outage reports at least twice daily for at least the first week after each storm. As utilities reduced outages to below the reportable level, they were no longer required to report.

In their responses to the PSC for this report, several electric cooperatives suggested that they be required to submit no more than one outage update per day, due to the time needed to compile and transmit the information. The Commission notes that the PSC's reporting requirements are driven by the needs of the managers of the EOC and that it must align its reporting requirements to those needs under its ESF-12 functions.

The Commission recommends that no changes be made to the current process for determining the number of outage reports required daily under its ESF-12 responsibilities during an activation of the EOC.

The vast majority of the electric outages caused by the remnants of Hurricane Ike were within the service territories of utilities within the PSC's jurisdiction. Of the 600,000 customers who lost power, fewer than 10 percent were served by non-jurisdictional utilities. Therefore, the PSC made no effort to collect outage information from those utilities and the absence of that information did not affect the ability of the EOC to allocate recovery resources.

The ice storm presented a vastly different situation. Of the nearly 770,000 customers who were without power at the peak of the storm, about 162,000 (21 percent) were served by non-jurisdictional utilities that did not report outage numbers to the PSC. The vast majority of those were in the hardest-hit areas in western Kentucky.

In the first 24 to 72 hours of the ice storm, the PSC was unable to provide a complete picture of the extent of the electric system disruption to the emergency manager in the EOC. This was in part due to the near-total loss of telecommunication service in parts of western Kentucky. For example, both Kenergy Corp. and Jackson Purchase Energy Corp. were unable to provide outage information until Jan. 29th, three days into the event.

The lack of information from non-jurisdictional utilities also proved to be a significant issue during the initial response. In providing outage numbers to both the EOC and to other state officials – including the governor's office - as well as to the news media, the PSC had to repeatedly emphasize that the picture was incomplete due to the lack of information from non-jurisdictional electric service providers. DEM officials voiced frustration to PSC staff regarding the resulting confusion and difficulty in providing a clear assessment of emergency response needs and priorities.

In an effort to provide a more comprehensive and useful outage assessment, the PSC contacted the TVA, the Kentucky Association of Electric Cooperatives (KAEC) and the Kentucky Municipal Utilities Association (KMUA). All agreed to provide their independently collected information to the PSC, which then was able to include it in the overall assessment compiled under ESF-12. This informal arrangement was fully implemented by February 2nd and continued through the duration of EOC activation. Its effectiveness was limited somewhat by the fact that not all non-jurisdictional utilities provided information on a county-by-county basis, as required by the PSC of utilities within its jurisdiction. The county information is used by the EOC to allocate disaster recovery resources.

While there were no specific difficulties in emergency response that could be attributed solely to a lack of information from non-jurisdictional electric utilities, it seems evident that it is important to have as comprehensive a situation assessment as possible from the earliest stages of a disaster and response. In the event of a widespread disruption of electric service, such an assessment must include both jurisdictional and non-jurisdictional utilities.

The Commission recommends that the necessary executive or legislative actions be taken to require all electric providers to report county-by-county outage information to ESF-12 whenever that function is activated in connection with the activation of the Kentucky EOC as the result of a public emergency within a county in which the provider has customers.

A number of utilities reported difficulties with the PSC's outage reporting system during the ice storm. Several utilities in western Kentucky noted that telecommunication disruptions included Internet service, making the PSC Web site completely inaccessible to them. Other problems included apparent access issues related to heavy Web traffic and unspecified technical issues. A number of utilities suggested that the site be made more readily accessible from handheld devices such as smart phones or personal digital assistants.

The Commission agrees. It notes the need for improvements to the current outage reporting system, both in terms of ease of use and ease of access. The PSC will convert to an e-mail-based system that will permit data submission from handheld devices while retaining the function of providing outage information on the PSC Web site as it is reported.

UTILITY COMMUNICATIONS WITH LOCAL OFFICIALS

Utility communications with local officials were a major problem during the February 2003 ice storm in central and eastern Kentucky. The PSC received complaints that utility officials were unavailable to local elected officials and emergency response personnel, particularly during the initial hours of the storm. The PSC recommended that utilities take steps to improve such communications in the future.

Partly in order to assess whether the recommendation made following the 2003 storm had been implemented, the PSC surveyed local officials, as well as state legislators, in the areas affected by Hurricane Ike and the ice storm. Responses were received from 75 cities and 29 counties affected by the ice storm, as well as from four legislators and nine city council members in Louisville and Lexington. A total of 32 elected officials responded to the inquiries regarding Hurricane Ike. Both the Kentucky Association of Counties and the League of Cities assisted in the information gathering.

The responses suggest that utilities learned the lessons of the 2003 ice storm with respect to communications with local government. It appears that the recommendations made following the 2003 ice storm were heeded. With one notable exception, there were no significant communication breakdowns between utilities and local officials, other than those that were the inevitable consequence of telecommunication system disruptions.

The one consequential communication breakdown occurred between Jackson Purchase Energy Corp. and officials in McCracken County, which is home to 40 percent of the utility's customers. In its response to the PSC, Jackson Purchase Energy said that it did not communicate with any government entity from the beginning of the ice storm on January 26th until January 29th.

Jackson Purchase Energy stated that its office facilities had no power for approximately 18 hours after the ice storm and that it had no telephone service - land lines or cellular service - for three days. Jackson Purchase Energy said that for the first three days of the event, it had little or no contact with anyone outside the utility except for "occasional status updates" provided to local mayors and county judge-executives through unspecified means.

Restoration efforts in western Kentucky after the 2009 ice storm continued into mid-February

Photo courtesy of Kenergy Corp.

Contact with McCracken County emergency response officials did not occur until January 29th, when, as Jackson Purchase Energy stated in its response to the PSC, utility officials acted after "hearing a plea on WPSD-TV (which we [Jackson Purchase Energy] were monitoring in our office) for someone from [Jackson Purchase Energy] to contact" the McCracken County EOC. Once communications were established, emergency managers "offered us assistance in procuring needed equipment and providing traffic control."

Ultimately, McCracken County was able to provide Jackson Purchase Energy with several all-terrain vehicles. Additional assistance was provided by Marshall County after Jackson Purchase Energy contacted that county's EOC.

The utility's delay in making contact with local emergency management officials undoubtedly delayed Jackson Purchase Energy's restoration efforts, as it is clear from Jackson Purchase Energy's response to the PSC staff's questions that the emergency management center was able to provide the utility with equipment, manpower, and access to communications with the public after the utility contacted the local EOC.

The Commission believes that Jackson Purchase Energy's experience in the 2009 ice storm reiterates the need for all utilities in Kentucky (jurisdictional and otherwise) to develop plans to communicate with local emergency managers in the event of a major disaster. Ideally, such plans would be the natural consequence of participation in annual emergency management planning drills. It is during such drills that contingency planning for the disruption of normal communications can be addressed.

Those communities that have disaster plans in place and conduct yearly exercises reported that both facilitated effective response to the ice storm. Several noted that local utilities do not participate in the exercises. However, two communities stated that their disaster preparedness exercises had included an ice storm simulation with utility participation. The city of Georgetown stated that it felt the disaster drill was very valuable in showing strengths and weaknesses of their response plan. The city of Willisburg reported that the availability of a community-wide power restoration priority list, developed in advance by emergency managers, facilitated disaster response.

The Commission recommends that disaster drills (both table-top and field exercises) conducted at the local, regional and state level include the appropriate jurisdictional and non-jurisdictional utilities and that utilities actively seek participation in such drills. An essential component of these drills should be the establishment of routine communication protocols between utilities and emergency managers and the development of contingency plans in the event that normal lines of communication are not available. Emergency contact information should be exchanged and updated on a regular basis. Power restoration priorities should be identified, documented in advance and made available to utilities.

TELECOMMUNICATION CAPABILITIES

As noted earlier in this report, both the 2008 wind storm and the 2009 ice storm created telecommunication outages. The outages during the ice storm were more widespread, affected more telecommunication services and lasted longer. The loss of wireless telephone service in particular had a significant impact on government entities, on utilities and other businesses and on individual citizens.

It is important to note here a significant distinction between landline and wireless telephone service. Companies providing local landline telephone service are jurisdictional utilities subject to PSC regulation with respect to reliability of service. This is not the case with wireless telephone providers.

Wireless telephone services are sold in an unregulated market and, like any other commodity, are subject to pricing competition and other market forces. Consumers often make purchasing decisions on the basis of price and perceived value, with factors such as coverage or reliability given less emphasis.

The Commission notes that there were significant differences among wireless providers in terms of providing continuity of service in the aftermath of the 2009 ice storm.

The Commission reiterates its recommendation that any purchaser of wireless services - whether for individual, business or governmental use – should inquire as to and consider the reliability of the service offered in the event of a major disruption of electrical power or other emergency. Anyone, including government entities, who may need to rely upon that service in an emergency should consider making their purchasing decisions accordingly and should consider using reliability as a criterion when evaluating bids from competing vendors.

PUBLIC INFORMATION

Perhaps the most common public complaint during an extended electric outage is “My power company won’t tell me when my power will be restored.” That was certainly the case during both the September 2008 wind storm and the January 2009 ice storm.

Following the 2003 ice storm, the PSC recommended that utilities make concerted efforts to improve both the availability and accuracy of restoration information. The PSC suggested that utilities make better use of Web sites and other electronic information tools to disseminate information to the public and the news media.

The information gathered by the PSC following Hurricane Ike and the 2009 ice storm indicates that some utilities have moved aggressively to utilize both established and emerging communication tools to improve the flow of information. Others have not made significant improvements.

Every electric utility affected by the two storms maintains a Web site. Nearly all reported that the Web site content includes general information about electric safety during outages. Utilities that issued news releases generally posted them on their Web sites. Utilization of Web sites to provide restoration-related information varied greatly. An overview of utility approaches during the ice storm follows:

Louisville Gas & Electric Co. (LG&E) and Kentucky Utilities Co. (KU) – While time-of-restoration estimates were not provided, LG&E and KU, both subsidiaries of E.ON US, used their Web sites to provide general information about the extent of restoration efforts. Customers in Jefferson County (LG&E) and Fayette County (KU) could find information on restoration efforts in individual ZIP codes. The KU Web site was used to provide information on damage to transmission lines in western Kentucky and restoration efforts on those lines.

Duke Kentucky – Estimated restoration times for customers in the Cincinnati area were posted on a map on the company’s Web site. These were updated daily. Outage numbers on a county-by-county basis were updated every five minutes based on reports from field crews and posted to the web site in real time.

Kentucky Power/American Electric Power – Kentucky Power updated information on its "Storms and Outage" page, usually three times a day. The Web site includes an interactive map of the service territory, with real time outage numbers by county 24 hours a day. The map did not show restoration information. Those estimates were provided separately by community service area or county.

East Kentucky Power Cooperative (EKPC) – EKPC relied on its member distribution cooperatives to communicate directly with their customers regarding restoration efforts. It posted summary information on outages on its Web site.

Big Sandy Rural Electric Cooperative Corporation (RECC) – The Web site was not utilized during the ice storm. A site redesign is in progress and the Web site will be used to provide information in future outages.

Blue Grass Energy Cooperative – Restoration information was posted to a special section on the Web site, but not in the hours immediately following the ice storm. Because customer calls decreased as soon as the information was made available, Blue Grass Energy stated it would post information more quickly in future major outages.

Clark Energy Cooperative – Restoration progress was updated daily. Mapping of information is being considered.

Farmers Rural Electric Cooperative Corporation (RECC) – Farmers reported that it did not use its Web site to provide restoration information. However, it is updating its Web site to allow the use of the Twitter social networking tool in future emergencies.

Fleming-Mason Energy Cooperative – Fleming-Mason Energy made only limited use of its Web site, providing no restoration information and limited safety information. The utility stated it would rely more heavily on the Web site to communicate with customers and the news media in the future.

Grayson RECC – Grayson RECC did not provide any information on its Web site following the ice storm. However, it found that Web traffic increased following the storm, prompting the utility to post restoration information on the Web site in the aftermath of the wind storm that struck on February 11.

Inter-County Energy Cooperative – Due to telecommunication outages, Inter-County Energy's Web site was unavailable for several days following the storm. When the Web site was restored, information on restoration efforts by location was posted, but no map was provided.

Jackson Energy Cooperative– Using the Web site to provide updated outage numbers and restoration information reduced customer calls, Jackson Energy stated. The utility plans to add a recorded message directing customers to the web site for information during future outages.

Jackson Purchase Energy – Because Jackson Purchase Energy uses an off-site Web hosting service, its Web site remained visible throughout the ice storm, but inaccessible to the utility for several days. When connectivity was restored, general outage information was provided.

Kenergy Corp. – Kenergy was unable to access its Web site for the first three days following the storm. When the Web site became available, maps were posted with outage and restoration information.

Meade County RECC – Information on restoration efforts was posted to the Web page. Meade County RECC did not provide any estimated restoration times, stating that it cannot be done with sufficient specificity.

Nolin RECC – General restoration information, including daily updates on crew locations by community or road, was provided on the Web site.

Owen Electric Cooperative – Owen Electric updated its Web site every four hours with information on remaining outages and restoration efforts. Owen stated that it is developing a mapping function that will allow the information to be presented graphically in the future.

Salt River Electric Cooperative – Restoration updates were posted to the Web page.

Shelby Energy Cooperative – Stated that only infrequent and very general Web updates were provided, with no specific restoration information.

South Kentucky RECC – Although South Kentucky RECC experienced only minor damage and all power was restored within 14 hours, it stated it would rely on the Web site to communicate with customers in the event of a severe disruption.

Taylor RECC – Posted no information on its Web site, saying it relied on field personnel to communicate with customers.

The degree of detail about restoration efforts and estimated restoration times varied greatly. A number of utilities expressed concern about the potentially negative consequences of providing highly specific information about the location of continuing outages and restoration crews. Utilities cited both worker safety and the potential liabilities associated with identifying areas in which power had not been restored and which might be presumed to be depopulated and thus vulnerable to theft or vandalism. The latter concern also was cited as a reason for not providing specific information about expected restoration times.

Several utilities also stated that, although they recognize the customer desire for precise restoration times, the consequences of making erroneous predictions can lead to even greater customer dissatisfaction. Overly optimistic estimates will be disappointing. Conversely, an overly pessimistic estimate that leads customers to unnecessarily seek temporary accommodations or purchase emergency supplies also will generate customer complaints.

Restoring Kentucky Utilities transmission lines in western Kentucky after the 2009 ice storm

PSC photo

The Commission is sympathetic to these concerns. However, the Commission also believes that utilities should provide as much information as possible to customers affected by major service disruptions. In today's information environment, Web sites should be a primary tool for conveying such information.

The Commission recommends that all electric distribution utilities include on their Web sites a section specifically for outage information. On an ongoing basis, this section should include information for customers regarding electric safety and disaster preparedness. During major outages, the Web site should be used to provide information on the location of outages, restoration efforts and expected duration of outages. At a minimum, the information should be specific to county or, in urban areas, ZIP code. (Possible means of safely providing more specific information is discussed later in this chapter.) Information should be presented on a map if possible and should be updated at least daily. Utilities should post press releases on the Web site as well.

Several utilities used other Internet or Web-based technologies to communicate with customers during the ice storm. LG&E and KU provided updates through e-mail blasts and text messages to customers who had signed up to receive information via those media. Both utilities monitored selected blogs and Twitter.com, but did not use those media to provide information.

The utility that has fully embraced social networking sites as a means of contacting customers is Duke Kentucky. Duke Kentucky used the Twitter.com Web site to communicate with its customers during the 2009 ice storm. During the ice storm Duke Kentucky regularly posted updates (commonly referred to as "tweets") to its account. Duke Kentucky's Tweets included links to outage maps, estimated restoration times, safety tips, and Duke's Kentucky's toll-free outage reporting numbers.

Duke Kentucky provided a number of examples of tweets posted during the ice storm:

- *100s of workers spread out across the Midwest assessing damage and beginning repairs.*
- *Restoration info: http://tinyurl.com/cvt78d11:15_AM_Jan_28th from web*
- *In Indiana, Duke Energy makes progress on restorations even as the storm continues: http://tinyurl.com/cfgvfb #snOMG10:17 AM Jan 28th from web*
- *In OH & KY: Duke Energy customers who see a downed line should assume it's energized, avoid it and report it by calling 1-800-543-5599. 5:24 AM Jan 29th from web*
- *In OH & KY, we are getting calls from media & customers about generator safety. See http://tinyurl.com/awktub for safety tips. #snOMG 8:18 AM Jan 30th from web*
- *When will the power be back on in the Cinci area? Duke Energy has a map with estimates. Check it out: http://tinyurl.com/d34e5t #snOMG 11:57 AM Jan 29th from web*

Duke Kentucky maintains an archive of all its storm-related tweets online at: http://twitter.com/DukeEnergyStorm.

During the 2009 ice storm, Duke Kentucky posted tweets (or "tweeted") 16 times from 9:33 a.m. on January 28, 2009 to 12:38 p.m. on February 2, 2009, after power had been restored to the vast majority of Duke Kentucky's customers.

At the PSC staff's request, Duke Kentucky described the process by which its customers can sign up for the free Twitter.com service. Customers simply go to the Twitter.com website, create a free account for themselves, and then search for "Duke Energy" under the "Find People" link.

Duke Kentucky noted that if a customer already has a Twitter account and sees one of its tweets, the customer may be able to subscribe by simply clicking on the “Follow” link, but the exact steps depend somewhat on the type of Web interface the customer is using. Twitter.com is accessible through portable data devices, including many cellular telephones and “smart phones” with Internet access. Duke Kentucky also pointed out that there are a number of applications or “apps” which can be downloaded for use with particular types of cellular telephones or portable data devices. In an electricity outage situation such devices and applications may make accessing the internet feasible, whereas accessing the internet through a desktop or laptop computer may not be possible. However, as was the case for some areas of Kentucky during the 2009 ice storm, there may be some outages where cellular telephone service is not available either due to power loss at cellular towers or the towers themselves being damaged.

Duke Kentucky has taken a number of steps to make its customers aware that they can obtain outage and/or restoration information from its Twitter.com account. During the storm it included a link to its Twitter feed in its news releases and it added a link to its Twitter feed to the service outage page on its Web site. Duke Kentucky also included the “hashtag” “#snOMG” in its tweets during the ice storm, as people around the Midwest were using that hashtag to discuss the storm.

Hashtags are a Twitter convention that allows people to follow a conversation on Twitter.com based on the keyword that follows the hashtag or number symbol (#). By including it in Duke Kentucky tweets, anyone following general Midwest storm news on Twitter would also see their tweets in the stream of #snOMG tweets. This helped spread the word that Duke Kentucky was providing outage and restoration information via Twitter.com. Also during the ice storm, several media outlets, including the Cincinnati Enquirer, re-tweeted Duke Kentucky’s tweets to their network of followers, as did a number of private citizens.

Since the 2009 ice storm, Duke Kentucky has added its Twitter feed to WeFollow, which is a directory of Twitter feeds, under the keywords “Cincinnati,” “Indiana’’ and “Charlotte.” Duke Kentucky likens WeFollow to an online directory assistance, such as the Yellow Pages. As such, a person looking for Twitter feeds to follow in the Cincinnati-metro area would find Duke Kentucky at: http://wefollow.com/twitter/Cincinnati. Duke Energy said that it also promotes its Twitter feed through its electronic newsletter distributed to small business customers in the Midwest and the Carolinas.

The E.ON U.S. companies established a Twitter.com account in the aftermath of the 2009 ice storm. Others utilities have expressed interest in establishing Twitter accounts of their own to provide customers with outage reports and restoration estimates.

At least one local government also used a social networking site to effectively communicate with constituents. Madisonville Mayor Bill Cox used Facebook.com to provide information on utility crew locations, boil water advisories, traffic conditions and emergency shelters.

The Commission notes that Duke Kentucky’s use of Twitter.com is an innovative and beneficial approach to keeping its customers informed during outages. The Commission recommends that all utilities examine the possibility of establishing their own accounts with Twitter.com, Facebook.com or any similar social networking services, that they utilize these services as a means of disseminating outage-related information and that they inform their customers about the availability of information via these services.

LG&E and KU utilize an automated outage reporting system that uses caller identification technology to determine the location of an outage. The default location is the address linked to a particular landline number. However, recognizing that numbers are now portable and that linkages may no longer be accurate, and that many customers now use only wireless telephones, the companies allow customers to manually link any phone number to their address. When the customer calls to report an outage, the system asks for confirmation of the address. The addresses are associated within the outage reporting system to particular circuits, allowing company employees to readily identify the extent of an outage.

LG&E and KU also use the system for outbound calling. Customers can request a return call to confirm that their power has been restored. However, neither LG&E nor KU utilize the system as a means of communicating with large numbers of customer - on a circuit-by-circuit basis.

PSC staff asked LG&E and KU whether it is technically feasible to adapt the outage reporting system to serve an outbound restoration information function, similar to the "reverse 911" system that many communities use to alert residents to emergency situations. LG&E and KU's initial response was that there does not appear to be a technological barrier to such a use.

The PSC believes that an outbound calling system similar to a "reverse 911" holds great promise as a way of surmounting many of the issues related to providing customers with accurate information about estimated restoration times. Because the customer locations are aggregated by circuit, and could potentially be aggregated into even smaller groups, restoration estimates could be tied more directly to the progress of restoration work and could be made more precise. Security concerns would be allayed because only those customers in a given area would receive the precise information.

Furthermore, because customers could choose to have this information relayed to a wireless phone, the ability to reach them would be independent of their physical location. Such outbound systems also could be used in conjunction with e-mails or text messages to wireless devices.

As LG&E and KU noted in conversations with PSC staff, even such a system would have limitations. For example, restoration estimates for a particular circuit would need to be couched in terms that accounted for individual circumstances such as damaged service connections that could delay restoration for some customers.

Recognizing that limitations exist, the Commission nevertheless recommends that utilities which currently utilize automated outage reporting via telephone explore the possibility of using the same systems to deliver restoration information to consumers on a targeted basis. The Commission also recommends that utilities explore the possibility of developing such outbound information services based on e-mails or text messages to wireless devices designated by customers.

The September 2008 wind storm and the January 2009 ice storm both attracted intense media interest. The former event drew primarily local and regional news outlets, as the national media were focused on the much more severe damage from Hurricane Ike on the Texas Gulf Coast. However, the ice storm was the focus of coverage from national news organizations, including the four major broadcast networks and the major cable news networks, particularly the Weather Channel. The mayor of Paducah was reported to have said that the presence of a Weather Channel crew in his city the day before the ice storm alerted him to likelihood of a major winter storm. LG&E and KU reported that their combined media relations department fielded more than 1,500 calls from reporters in the three weeks following the storm.

Utilities appeared to communicate effectively with news organizations during both events. All electric utilities reported that they employ one or more designated spokespersons who have established relationships with local news media. The same was true for local telephone companies and larger water utilities. Smaller water utilities relied on system managers or other employees.

Electric utilities generally issued one or more news releases each day until nearly all power was restored. These contained updates on restoration efforts, safety information and advice for consumers. Utilities also participated in news briefings with local elected leaders and emergency management officials, television and radio call-in shows. LG&E and KU conducted daily media briefings in three locations across the state.

The only difficulties in communicating with news media were noted by utilities in areas with severe damage to telecommunication infrastructure. Recognizing the problem, KU dispatched two media relations employees to western Kentucky to make in-person visits to media outlets that were operating, but that had no ability to make or receive telephone calls.

A number of water utilities noted their reliance on local radio stations as the most effective means of communicating information on outages and boil water advisories to their customers. Several electric utilities also cited the importance of local radio, particularly through call-in shows that enabled them to answer customer questions.

A particular point of emphasis in information disseminated by electric utilities was customer responsibility for repairs to electric service entrances.

Outside service entrances are vulnerable to damage from falling limbs and trees

PSC photo

PSC regulations (807 KAR 5:041, Section 10 (1)) place responsibility for such repairs with individual customers. While this is a universal requirement among electric utilities, customers are sometimes unaware of their responsibilities for repairing storm damage to their service entrances. In past events, notably the 2003 ice storm, utility customers went without power for extended periods of time because they did not understand the need to have a licensed electrician repair their service entrances and have the repairs inspected before their utility companies could restore power to their homes.

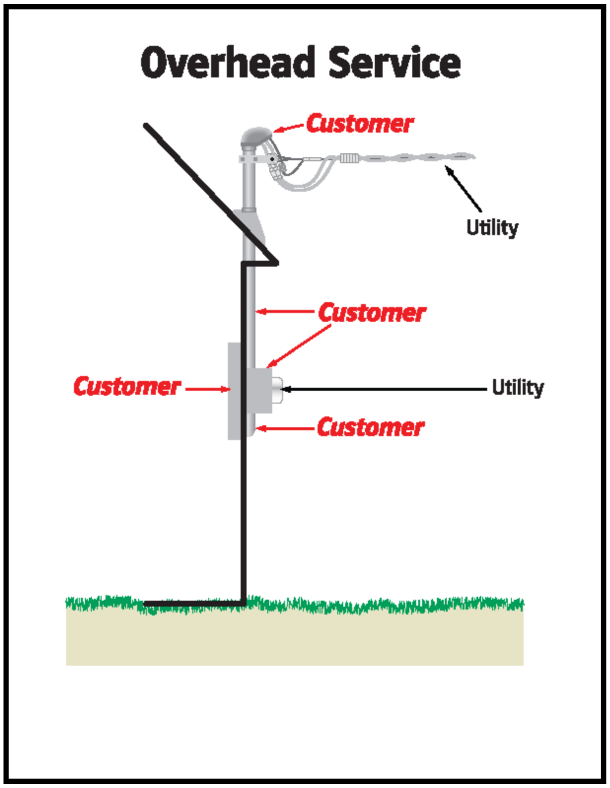


Figure 22: Overhead service entrance

Image courtesy of E.ON US

In its report on the 2003 ice storm, the PSC recommended that electric utilities emphasize to their customers their responsibility for repairs to their service connections. The emphasis on this aspect of power restoration appears to have paid off. A few smaller utilities report that some of their customers remain uninformed about their responsibilities for repairing their service entrances. However, the majority of the utilities stated that their customers are well-informed about their responsibilities and report few complaints arising from the 2009 ice storm restoration process related to this issue.

In an online survey conducted after the ice storm by the PSC, 79 of 1,262 respondents reported damaged service entrance connections. Repair costs ranged from zero to $10,000, with a median cost of $500 and average cost of $783.42.

KU and LG&E include information on customer responsibility on their website and in bill inserts sent to customers several times throughout the year. Similarly, Kentucky Power provides such information on its website and is open to including information in bill inserts if deemed necessary by the Commission. Several of the EKPC member cooperatives recommended that information about customer responsibility for service entrance repairs be included in their monthly cooperative publication, Kentucky Living Magazine, as opposed to bill inserts, which many noted can be expensive to produce.

Duke Kentucky, on the other hand, does not distribute information on service entrance repairs on a regular basis, but, rather on an as-needed basis during major storm events. Duke Kentucky believes that it is not practical to provide advanced notice to its customers regarding service entrance repairs because it believes its customers are not interested in the information unless they have an immediate need for it. Therefore, Duke Kentucky suggests that “just in time training and communication” are more useful in conveying the information to its customers.

The Commission believes that it is very important for the jurisdictional utilities to share information about service entrance repairs with utility customers on a regular basis. The utilities’ efforts to communicate this information to their customers

have paid dividends, as evidenced by the much lower number of customer complaints regarding this issue during the Hurricane Ike wind storm and the 2009 ice storm. The Commission recommends that electric utilities include service entrance repair information on their Web sites and, for the investor-owned utilities, in at least two bill inserts per year. Electric cooperatives are also encouraged to include service entrance repair information in monthly publications or, if feasible, in at least two bill inserts per year.

INDIVIDUAL PREPAREDNESS AND SAFETY

The Hurricane Ike wind storm produced a small number of deaths and injuries – mostly from falling trees and limbs. At least 30 deaths and many times more injuries were attributed to the ice storm. This higher toll was the consequence of the much harsher weather conditions during and after the ice storm.

Nonetheless, a significant proportion of the ice storm casualties were entirely preventable, notably the approximately 10 deaths and dozens of hospitalizations that were the result of carbon monoxide poisoning. Most of these were attributable to the improper use of portable generators, with others due to misguided efforts to heat interior spaces. Among the instances noted in news reports were portable generators operated in basements, garages and inside living spaces.

These incidents suggest a substantial shortfall in individual knowledge of emergency preparedness and post-disaster safety.

In order to better assess the extent of individual preparedness and potential solutions, the PSC made available on its Web site a survey that allowed respondents to indicate the extent of their disaster preparedness prior to the ice storm, describe the information sources they relied upon for necessary information and provide comments on their experiences. While this survey did not provide statistically valid information, the 1,262 responses provide useful insights. Of the 1,262 respondents:

- 933 said that they DID NOT have a portable electric generator
- 725 said that they DID NOT have arrangements for alternate shelter in the event of a power outage
- 453 said that they DID NOT have emergency supplies of food and water
- 162 said that they DID NOT have flashlights or batteries
- 83 said they DID NOT have any of the above four preparedness options in place at the time of the ice storm

Disaster preparedness has been a point of emphasis for state government, local emergency preparedness agencies and utilities for a number of years, with that emphasis increasing following the September 11, 2001, terrorist attacks and the 2005 hurricane season. Nevertheless, it appears that a substantial proportion of Kentucky residents remain under-prepared for extended power outages.

Furthermore, there appears to be a lack of understanding of some basic safety precautions, although other often-repeated safety instructions appear to be general knowledge. For example, the lack of deaths or injuries due to contacts with downed power lines suggests that most people are well aware of the need to avoid any fallen lines.

Other points of emphasis appear to have been less effective. Particularly troubling during the ice storm were the ongoing incidents of carbon monoxide poisoning despite continued warnings by public officials and the news media about the dangers of improper use of portable generators and heaters.

Another point of misunderstanding appears to be the functionality of landline telephones in a power outage. Landline phone service often continues uninterrupted even when lines have fallen. However, many customers do not appear to understand that portable handsets – unlike phones that plug directly into the wall connection - will cease to function when their batteries lose power, despite the fact that the base unit is plugged into a wall connection. Similarly, phone-over-cable landlines also rely on on back-up battery power in the modem and have a limited lifespan during a power outage. Thus, simply having a landline phone is no guarantee of service continuity.

There also remains ongoing confusion about who to call to report outages and downed lines. Emergency officials and utility companies continually emphasize that the 911 number should be used only in cases of true emergency. Outages should be reported to the service provider, as should downed lines, unless those lines pose a threat to public health or safety – for example, if they are sparking or obstructing a road.

Nonetheless, Inter-County Energy noted that 911 lines in its service territory often are overwhelmed by non-emergency calls, many of them apparently from callers reporting loss of power or downed lines. The utility reported that it communicates with local emergency service dispatchers by fax in order to avoid using voice lines into the local 911 call centers.

The PSC recognizes that most electric utilities provide safety and emergency preparedness information to their customers on an ongoing basis through Web sites, bill inserts, public service announcements and other means. The PSC also recognizes that these messages receive additional emphasis during outages and other emergencies. Finally, the PSC shares in the frustration of utilities and emergency management officials that these messages all too often go unheeded.

The Commission encourages utilities and state and local officials to continue to provide emergency preparedness information to the public and to seek out more effective ways to do so. However, the Commission also believes that emergency preparedness is a responsibility shared by individual Kentuckians.

The Commission urges all Kentucky residents to take the following measures to better prepare themselves for extreme weather events and other emergencies that may lead to extended power outages:

- **Maintain a supply of flashlights and batteries.**
- **Keep several days worth of potable water and non-perishable food on hand.**
- **Users of portable generators and heating devices must be thoroughly familiar with the rules for their safe operation.**
- **Residents should have a contingency plan for seeking alternate shelter.**
- **Customers should familiarize themselves with the procedures their utilities use for reporting outages and downed lines and should know how the utility provides information on restoration efforts.**
- **Households should have a means of maintaining telecommunication service. This can be a traditional landline phone that plugs directly into the wall or a wireless phone or other device that can be charged from a vehicle battery if necessary.**
- **Every household should have a battery-operated radio, preferably one that is capable of automatically receiving area-specific emergency weather alerts.**

As noted above, utilities reported that radio was their most effective means of providing information to the general public. This was reinforced by the PSC's online survey. Local radio stations were mentioned most often as the source of reliable and timely information related to the ice storm.

The PSC's public information efforts during the two storms spanned all media. The PSC issued press releases on the progress of restoration efforts, on safety measures and on customer responsibility for repairs to electric service entrances. The PSC's public information officer responded to numerous inquiries from local, state and national media and was available to news media on a 24/7 basis throughout both events.

However, the PSC notes that one important communication tool was no longer available. Through 2007, the PSC had an ongoing contract with the Kentucky Broadcasters Association (KBA) for radio public service announcements through the Public Education Partnership (PEP) program. The PSC paid an annual fee to the KBA and, in return, received air time on KBA member stations across Kentucky. The contract carried a guarantee of air time valued at five times the amount of the flat fee; more typically the value-to-fee ratio was seven or eight to one.

The PSC used the service to air announcements on issues of interest to the general public such as natural gas prices, deceptive marketing practices in the telecommunication industry and the Kentucky call-before-you-dig program. Messages could be added or discontinued as communication needs changed. Due to state budgetary constraints, the PSC was forced to discontinue its participation in the program in 2008.

Had it remained available, the KBA PEP program could have been a valuable communication tool during both the wind storm and ice storm. With the computer software currently available to the PSC and the e-mail distribution of sound files, it is possible to record, disseminate and air statewide a new radio public service announcement within a few hours. This would provide a rapid response capability to emerging issues during emergency situations. For example, when portable generator safety issues emerged during the ice storm, it would have been possible to record a message regarding proper operation and have it on the air across Kentucky within less than 24 hours.

The Commission recommends that high priority be given to the restoration of full funding for its participation in the KBA PEP program as soon as possible.

Photo courtesy of Clark Energy

GLOSSARY OF TERMS

Accumulated Depreciation Restoration Costs: the costs of removing existing facilities damaged or destroyed in a major weather event or other disaster event.

AEP: American Electric Power, the parent corporation of Kentucky Power Company.

Affiliate: An entity which is directly or indirectly owned, operated, or controlled by another entity.

ANSI: the American National Standards Institute.

AWPA: the American Wood Protection Association.

Avoided costs: Incremental cost to an electric utility of electric energy or capacity or both, if not for the qualifying facility, the utility would generate itself or purchase from another source.

Basis points: a measure of return on investment in which one point equates to one hundredth of a percent, such that 25 basis points represents 0.25 percent, or 200 basis points represents 2.0 percent.

Big Rivers (BREC): Big Rivers Electric Corporation, a generation and transmission electric cooperative which is owned by and serves 3 distribution cooperatives in western Kentucky.

Big Sandy RECC: Big Sandy Rural Electric Cooperative Corporation.

Bird Dog: a person assigned by a utility to guide restoration crews in the field, pointing out utility facilities, hazardous terrain, and providing other necessary information about the utility's system that outside utility crews may not have readily available.

Blue Grass Energy: Blue Grass Energy Cooperative.

Boil Water Advisory: a warning issued by a drinking water utility informing consumers that the water provided by the utility may be unsafe to consume and may cause adverse human health effects due to possible biological contamination.

Capitalized Restoration Costs: generally, the costs of installing new facilities to replace damaged facilities.

Carbon Monoxide Poisoning: potentially deadly poisoning caused by inhalation of carbon monoxide (CO) gas. CO is produced by the combustion of carbon-containing substances, such as the combustion of gasoline or diesel fuel in a portable generator—a cause of several accidental deaths during the 2009 ice storm.

CCA: chromated copper arsenate—a wood preservative used to treat utility poles to guard against decay, fungi, bacteria, insects, and marine borers.

CCA-ET: CCA with an emulsion treatment—a wood preservative used to treat utility poles to guard against decay, fungi, bacteria, insects, and marine borers.

Certificate of Public Convenience and Necessity ("CPCN"): authorization sought from the Commission under KRS 278.020 to construct an electric generating facility or electric transmission line, or to transfer control of a utility to another person or entity.

Clark Energy: Clark Energy Cooperative.

Climate Change: a generic phrase usually related to global warming and/or the factors blamed for causing global warming. It is also used to refer to changes in climate that are characterized as being caused by global warming.

Copper Azole: a wood preservative used to treat utility poles to guard against decay, fungi, bacteria, insects, and marine borers.

Copper Napthanate: a wood preservative used to treat utility poles to guard against decay, fungi, bacteria, insects, and marine borers.

Creosote: a wood preservative used to treat utility poles to guard against decay, fungi, bacteria, insects, and marine borers.

Cumberland Valley Electric: Cumberland Valley Electric Cooperative.

Danger Tree: a live or dead tree whose trunk, root system or branches have deteriorated or been damaged to such an extent as to be a potential fall hazard to transmission or distribution lines or other utility facilities.

Deferred Restoration Costs: restoration costs that a utility wishes to establish as a regulatory asset as allowed by Statement of Financial Accounting Standards No. 71. A regulatory asset is an accounting tool that allows unusual or one-time costs to be excluded from expenses in the current period and to be deferred on a company's balance sheet for possible future recovery through base rates.

DEM: the Kentucky Division of Emergency Management.
Distribution system: The portion of the transmission and facilities of an electric system that is dedicated to delivering electric energy to an end-user.

DOE: the United States Department of Energy.

Duke Energy Kentucky: Duke Energy Kentucky, Inc., a wholly-owned subsidiary of Duke Energy Ohio, Inc., which provides service to 133,000 electric customers and 94,000 natural gas customers in 7 northern Kentucky counties.

EKPC (East Kentucky Power): East Kentucky Power Cooperative, Inc., a generation and transmission electric cooperative owned by and serving 16 distribution cooperatives in central and eastern Kentucky.

EOC: Emergency Operation Center operated and staffed by Kentucky Division of Emergency Management (DEM) personnel. EOC headquarters is located at Boone National Guard Center in Frankfort, Kentucky.

E.ON US: Parent company of Louisville Gas & Electric Co. and Kentucky Utilities Co.

ERP: Emergency Response Plan. A response plan for restoration of utility service following a service outage caused by a major weather event or other emergency occurrence.

ESF-12: Emergency Support Function number 12. One of 15 primary mechanisms, as determined by the Kentucky Division of Emergency Management, used by DEM to organize and provide assistance during emergency situations. ESF-12 concerns the state's energy infrastructure.

ETC: an Eligible Telecommunications Carrier as defined by 47 U.S.C. Section 214(e). An ETC is a common carrier of telecommunications service that has received authorization from the Commission to provide services that are supported by the Federal universal service support mechanisms provided for in 47 U.S.C. Section 254.

Expensed Restoration Costs: costs for repairs to a utility's existing plant that did not extend the original life expectancy of the assets repaired.

Farmers RECC: Farmers Rural Electric Cooperative Corporation.

FEMA: the Federal Emergency Management Agency.

Fleming-Mason Energy: Fleming-Mason Energy Cooperative.

G & T cooperatives: cooperative organizations which are engaged in generating ("G") electricity and transmitting ("T") electricity to other electric systems, which are engaged in the distribution of electricity to the retail end-use customer.

Grayson RECC: Grayson Rural Electric Cooperative Corporation.

Guy Wire: a cable used to offset tensions and pressures to which a utility pole is subjected. One end of the guy wire is attached to the pole and the other end is attached to an anchor rod set in the ground.

IEEE: the Institute of Electrical and Electronics Engineers, Inc.

Interconnection (water utilities): a physical connection between two water supply systems. An interconnection may serve as an alternate supply of water during normal operations to reduce demand from a system's primary supply source and/or as an emergency supply, should the need arise.

Inter-County: Inter-County Energy Cooperative.

IOU: Investor-Owned Utility. An electric utility company owned and operated by private investors or stockholders. IOUs in Kentucky are Louisville Gas & Electric; Kentucky Utilities; Duke Energy Kentucky, Inc.; and Kentucky Power Company, a.k.a. American Electric Power.

IVR: Interactive Voice Response system. An IVR is an automated telephony system that interacts with callers, gathers information and routes calls to the appropriate recipient. Many utilities use an IVR system to route customer calls to the proper department and to give information on certain topics such as service outages.

Jackson Energy: Jackson Energy Cooperative.

Jackson Purchase Energy: Jackson Purchase Energy Cooperative.

Joint-use Attachments: steel messenger wire and cable facilities, owned by telephone and cable companies, which are attached to existing electric utility poles by the telecommunication companies.

KAEC: the Kentucky Association of Electric Cooperatives.

KEMA: the Kentucky Emergency Management Agency.

Kenergy: Kenergy Corporation

Kentucky Power: Kentucky Power Company, a wholly-owned subsidiary of American Electric Power Company.

KIUC: the Kentucky Inustrial Utilty Customers, Inc.

KU: Kentucky Utilities Company. An investor-owned utility wholly owned by E.ON US.

KYWARN: the Kentucky Water/Wastewater Response Network. A mutual aid network for water and wastewater utilities.

LG&E: Louisville Gas & Electric Co. An investor-owned utility wholly owned by E.ON US.

Licking Valley RECC: Licking Valley Rural Electric Cooperative Corporation.

Loop Feed: A redundant circuit facility. Loop feeds deliver electricity over two circuits as opposed to one and are designed to make circuits and loads less vulnerable to outages**.**

Major Event: an event that exceeds reasonable design and or operational limits of the utility system.

Meade County RECC: Meade County Rural Electric Cooperative Corporation.

Megawatt (MW): one million watts. This term is generally used to measure the flows or capacity of power plants and transmission lines.

Municipal utility: A not-for-profit utility owned and operated by a municipal government in the community it serves. Municipal utilities serve Frankfort, Bowling Green, Owensboro and Bardstown, among other cities in Kentucky.

Mutual Aid/Assistance Crew: a utility construction crew from another area of the state or from outside the state which offers assistance to a utility during a major outage situation, often through a mutual assistance group. In Kentucky KU and LG&E are members of a number of Regional Mutual Assistance Groups ("RMAG") including Great Lakes Mutual Assistance Group ("GLMA"), the South Eastern Exchange ("SEE"), and Midwest Mutual Assistance ("MMA") groups.

NESC: the National Electric Safety Code, which is a voluntary safety code for the electrical industry, which has been incorporated in Kentucky by KRS 278.042.

Nolin RECC: Nolin Rural Electric Cooperative Corporation.

NWS: the National Weather Service.

OMS: an Outage Management System. An OMS is a computer software program that provides a utility with an overall visual display of the status of its system and the location of outages.

Owen Electric: Owen Electric Cooperative.

Penta: pentachlorophenol—a wood preservative used to treat utility poles to guard against decay, fungi, bacteria, insects, and marine borers.

PSC: the Kentucky Public Service Commission. The Commission regulates the intrastate rates and services of investor-owned electric, natural gas, telephone, water and wastewater utilities, customer-owned electric and telephone cooperatives, water districts and associations, and certain aspects of gas pipelines.

Pump Station: a structure containing pumps and appurtenant piping, valves and other mechanical and electrical equipment for pumping water or wastewater. Also called "lift station".

Radial (ice) Accumulation: the measure (in inches) of ice accumulation around a central axis, such as a tree branch or a power line. The thickness of the ice is measured from the edge of the central axis to the outside edge of the ice.

Radial Feed: a single line circuit facility. A radial feed delivers electricity over a single circuit as opposed to two circuits in a loop feed situation. Circuits that are served by radial feed are more vulnerable to outages as there are no redundant facilities to deliver electricity if the single circuit is damaged.

RECC: a Rural Electric Cooperative Corporation organized pursuant to KRS Chapter 279.

Regulatory Asset/Liability: Specific costs or revenues that a regulatory agency permits a utility to defer to its balance sheet. These amounts would otherwise be shown on the utility's income statement and charged against its current expenses or revenues.

Revenue requirement: The total revenue that the utility is authorized an opportunity to recover, which includes operating expenses and a reasonable return on rate base.

ROW: rights-of-way. ROW refers to the property used by a utility to construct, maintain, repair, or replace the facilities needed to provide service.

RTCC: Rural Telephone Cooperative Corporation.

RUS: the U.S. Rural Utilities Service. RUS is a federal agency within the United States Department of Agriculture (USDA). It is one of the executive departments of the federal government charged with providing public utilities to rural areas in the United States via public-private partnerships.

Salt River Electric (Salt River): Salt River Electric Cooperative.

SCADA: a Supervisory Control and Data Acquisition system. A highly distributed system used to control geographically dispersed assets, often scattered over thousands of square kilometers, where centralized data acquisition and control are critical to system operation. They are used in distribution systems such as water distribution and wastewater collection systems, oil and gas pipelines, electrical power grids, and railway transportation systems.

Service Drop: the overhead service conductors from the last pole or other aerial support, which connect to the point of service of a utility customer.

Service Entrance: the service conductors and conduit/cable between the terminals of the service equipment and point of attachment of the service drop. A service entrance usually includes a masthead (weatherhead) and a meter base.

Shelby Energy: Shelby Energy Cooperative.

South Kentucky RECC: South Kentucky Rural Electric Cooperative Corporation.

SRP: a state resort park in the Kentucky state park system which has permanent cabins or lodge rooms to accommodate overnight park visitors.

Substation: equipment that switches, changes or regulates electric voltage.

Tariff: A published volume of rate schedules and general terms and conditions under which a product or service will be supplied.

Taylor County RECC: Taylor County Rural Electric Cooperative Corporation.

Test year: A 12-month period, which may be adjusted for known and measurable changes, that is used to determine a utility's annual revenue requirement. The test year may be an actual historical test year or a forecasted test year which looks 12 months beyond the time of the Commission decision.

Tennessee Valley Authority (TVA): a federal corporation and the country's largest public power company, serving Tennessee and portions of six other states, including several counties in south central and western Kentucky.

Transmission: the movement or transfer of electric energy over an interconnected group of lines and associated equipment between points of supply and points at which it is transformed for delivery to consumers, or is delivered to other electric systems.

The 2009 ice storm did extensive damage to transmission lines in western Kentucky.

PSC photos

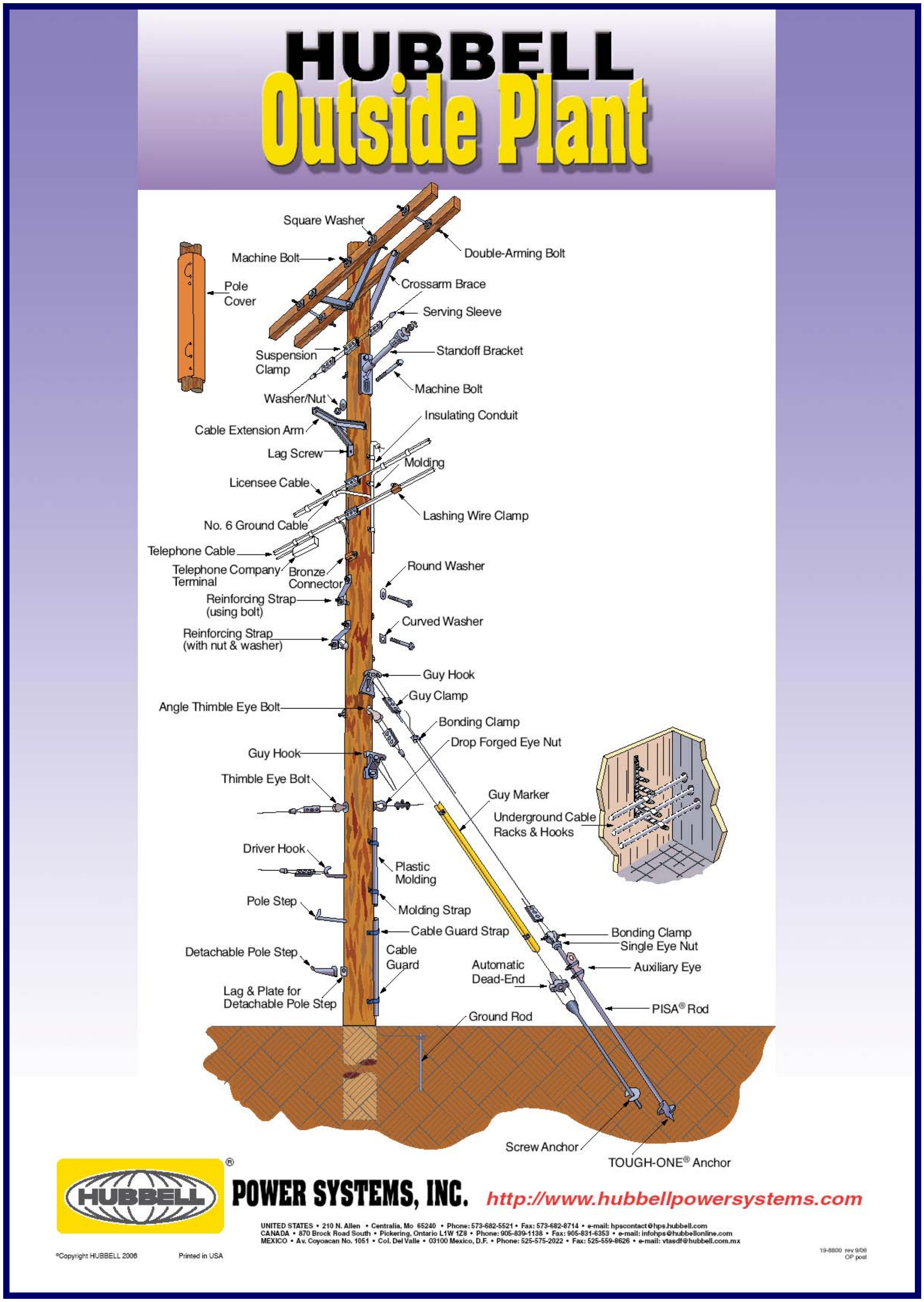


Figure 23: The parts of a power pole Image courtesy of Hubbell Power Systems

This 161-kV transmission line came down when the weight of ice combined with high winds to shear the bolts holding the middle section to the base.

Photos courtesy of E.ON US

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