

**Final Report on the
Investigation of Wind and
Ice Storm Preparedness and Restoration of the
Ameren Illinois Companies**

Presented to the:

Illinois Commerce Commission

By:



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Executive Summary

After storms in the summer and early winter of 2006 caused many, lengthy service interruptions in the territory served by the three Ameren companies in Illinois, the Illinois Commerce Commission (ICC) asked for an investigation to determine whether those companies:

- Appropriately planned, designed, constructed, inspected, and maintained their electricity delivery systems
- Adequately planned, prepared, and executed service restoration efforts following the July 2006 windstorms and the November/December 2006 ice storm.

In late August 2007, the ICC and The Liberty Consulting Group (Liberty) executed a contract for that investigation. This report provides the results of Phase 1 of Liberty's investigation. Phase 2 consists of Liberty's verification of Ameren's implementation of the recommendations in this report.

The three Ameren companies in Illinois are the former Central Illinois Public Service Company (including the former Union Electric territories in Alton and East St. Louis), the former Central Illinois Light Company, and the former Illinois Power Company. In this report, Liberty refers to these companies as Ameren-CIPS, Ameren-CILCO, and Ameren-IP. Liberty found that while some practices from the legacy companies exist, Ameren in Illinois operates as one electric utility. Liberty refers to that utility as Ameren-IL. Ameren-IL receives services from the corporate parent, Ameren, which also owns and operates the former Union Electric Company in Missouri.

This report contains some positive findings and many opportunities for improvement regarding Ameren-IL's electric delivery system and the response to the 2006 storms. The report contains nearly 160 recommendations for improvement. A few of those recommendations refer to initiatives that Ameren-IL has undertaken since the 2006 storms. Liberty included those recommendations as a means to track Ameren-IL's implementation of those initiatives in Phase 2 of the investigation.

Despite the large number of areas in which Ameren-IL can improve, Liberty's overall conclusions are that Ameren-IL acceptably planned, designed, constructed, and maintained its electric delivery systems, and that it worked very hard to restore its customers' service following the 2006 storms.

The interference of vegetation with overhead electric facilities caused much of the storm damage. Ameren-IL could not have reasonably avoided some of this damage. However, improvements to vegetation management practices, such as ensuring that contractors do a better job trimming and removing trees, will improve service reliability and lessen the consequences of future storms. In addition, prior to the 2006 storms, Ameren-IL did not systematically inspect all of its electric poles for strength. It is likely that weak poles contributed to the negative effects of the storms.

Ameren-IL experienced significant failures in its call center telephony systems during the extremely high volume of calls received during 2006 storms. These problems contributed to customer dissatisfaction with Ameren-IL's performance during the storms.

Liberty organized its work and the contents of this report in the following areas:

- Storm Description and Analysis
- Emergency Planning
- Restoration Performance
- Transmission & Distribution Planning, Design, Protection, and Construction
- Maintenance, Inspection, and System Conditions

Storm Description and Analysis

High winds and thunderstorms on July 19 and 21, 2006, and a snow and ice storm at the end of November 2006 caused damage to the poles, wires, and other parts of the system that delivers electric power to Ameren-IL's customers.

The onset of the July 19 storm came with little warning and early storm reports contained conflicting predictions of the coming severity. A second storm on July 21 complicated and extended Ameren-IL's restoration work. In total, the July storms interrupted more customers, caused more damage, and took longer to restore than recent, documented storms. Ameren-IL personnel repeatedly said that the storms were the worst in their experience. Thus, the storms presented challenges that came without the benefit of actual experiences. The widespread nature of the storms and the extent of the storm damage significantly affected the amount of time Ameren-IL took to restore service to all customers.

Starting in the evening on November 30, 2006, another storm came to the Ameren-IL service territory. This one came with more warning, but it also brought icing conditions that are particularly hazardous to power lines and trees near power lines. This storm interrupted even more customers than did the July storm. It also caused more damage to the system that delivers electricity, over 370,000 customers were without power, and the cold and icy conditions affected the speed of power restoration.

Liberty found that making better use of weather intelligence and tools could help Ameren-IL to prepare better for future storms. In addition, improved analysis of weather and its effects on the electric delivery system could help Ameren-IL to mitigate the consequences of future storms.

Ameren-IL's Outage Analysis System (OAS) records and tracks service interruptions, assists in managing service restoration, and records outage causes and problems. The system works well in normal day-to-day operations. However, when there are literally hundreds of thousands of customers without service such as occurred during the 2006 storms, the system does not provide accurate information. This caused inaccuracies in Ameren-IL's internal and external reports on the effects of the 2006 storms. It also results in some inaccuracy in Ameren-IL's regular reporting of service reliability.

Emergency Planning

All utilities have experience in responding to common outages. However, major outage events bring more and greater challenges for which utilities need to be prepared. Comprehensive

emergency plans address all aspects of the response process beginning with pre-event activities, cover all aspects of the restoration, and describe activities that should occur after restoration. Emergency plans also address major outage events other than those related to storms.

Ameren-IL recognized the importance of emergency plans and committed considerable effort and resources to developing and maintaining them. These plans included the corporate Electric Emergency Restoration Plan (EERP), a corporate communications emergency plan, a distribution dispatch emergency plan, and a plan for each of Ameren-IL's operating divisions.

Liberty found that Ameren-IL's emergency plans were deficient in some areas, and identified many items that Ameren-IL could improve. Plan deficiencies and a lack of familiarity with and use of the plans had a negative effect on the Ameren restoration effort in the 2006 storms. Liberty also found that Ameren-IL's various emergency plans were not coordinated and consistent, Ameren-IL was inconsistent in emergency plan training, and Ameren-IL did not use post-event critiques consistently and effectively.

Restoration Performance

Liberty found that Ameren-IL's workforce during the July storms was too small given the severity and extent of the storm damage. Several factors beyond Ameren-IL's control contributed to the small workforce. The initial weather reports were conflicting, other utilities in the area were experiencing severe heat and needed their own workforce, and Ameren-IL had not experienced a storm of this magnitude in recent years. Nevertheless, Liberty concluded that Ameren-IL should have been more aggressive and proactive in mobilizing outside resources to assist in the July storms.

Ameren-IL's process to develop and offer estimated restoration times was non-existent during the 2006 storms. This was a key reason why customers were highly dissatisfied with Ameren's storm response. In addition, Ameren-IL failed to identify "critical care customers" or "critical infrastructures" in its Outage Analysis System prior to the July or November/December 2006 storms, making it difficult for field personnel to prioritize restoration efforts appropriately.

Ameren-IL's staffing at the call centers during the storms was insufficient to handle the volume of calls received. Liberty found that Ameren's high-volume, outage-overflow service could not cope with the high volume of calls received during the 2006 storms. As a result, there were many blocked customer calls, including many emergency calls reporting downed wires. The Ameren-IL call centers had no emergency storm plan in place and were unable to ramp up staffing as quickly as needed during the 2006 storms to respond to customer calls.

Ameren-IL's safety management and performance during the 2006 storm restorations was very good.

Liberty's analysis of the total restoration times showed that Ameren-IL's restoration from the July storms was too long but that the length of the restoration to the November/December 2006 storm was reasonable. Two other important findings related to the restoration process in the field were that (1) Ameren-IL's field workforce did not report the status of the restoration and update

the Outage Analysis System in a timely and accurate manner during the storms, and (2) Ameren-IL did not have enough help in the deployment and coordination of the large number of outside workers brought in to assist in the two 2006 major outage restorations. The decision by Ameren-IL to replace the existing radio systems with one system that allows communications between all legacy companies will correct one constraint that existed during the 2006 restoration efforts.

Liberty found that Ameren-IL's post-event ramp-down from the storms went reasonably well. Ameren-IL needs to formalize some of the procedures and guidance available for this phase of the restoration. It also needs to do a better job at acquiring and tracking improvement opportunities from post-event critiques.

Transmission & Distribution Planning, Design, Protection, and Construction

Liberty found that Ameren-IL's planning processes, load forecasting, and analyses of the capability and stability of the electric delivery system were generally acceptable and in line with industry practices. Liberty recommends that Ameren-IL make some changes in its use of weather data for load forecasting, and determine whether it is adequately prepared for an accident that causes a total loss of a substation.

Ameren-IL would benefit from greater standardization in practices across the three Illinois companies and from uniformity in standards and manuals. Liberty believes that Ameren-IL plans to standardize and eliminate inconsistencies.

Ameren-IL's standards for system protection were generally adequate. The lightning protection provided for older and smaller substations and some older transmission lines was not adequate.

In general, Ameren-IL's T&D system planning, construction, and protection did not contribute to the significance of the 2006 storms. The way that Ameren-IL planned and designed the distribution system affected the consequences of the 2006 storms, but alternative planning criteria or design configurations are not practical. The fact that some tap lines off the main distribution system did not contain fuses likely made the effects of the 2006 storms worse. Liberty determined that the July 2006 storms were so severe that they may have created some areas in which environmental conditions exceeded the conservative design basis of the electric delivery system. The November/December 2006 storm did not exceed design basis conditions.

Maintenance, Inspection, and System Conditions

The organization of Ameren-IL's inspection and maintenance work was complex and presented unique management challenges. Ameren-IL managed its inspection and maintenance work like one electric utility receiving support from corporate organizations. Ameren-IL's service territory contained seven distribution divisions, three substation areas, and two transmission areas. However, it also contained differing cultures, methods, and standards from the legacy Ameren companies and differing work rules from seven union agreements. Responsibilities for important parts of the electric delivery system, the transmission system and substations, were with an organization that did not report to the head of Ameren-IL.

Ameren-IL adequately staffed its distribution divisions and substation and relay areas with linemen, substation electricians, technicians, and contractors. However, Ameren-IL may need to increase its workforce because recent improvements in inspections methods will likely increase workloads. The staffing of substation maintenance engineers and relay engineers was not adequate to provide an acceptable amount in-the-field technical guidance to the workforces.

Ameren-IL's substation vegetation-management standards were reasonable and fully implemented. Ameren-IL's distribution and sub-transmission vegetation-management standards were also reasonable, but its transmission clearance standards were confusing and difficult to implement. Liberty observed distribution system vegetation-management problems related to mid-cycle trimming, trimming along back-lot lines, and tree removals. Ameren-IL needs to inspect more of the contractors' work to ensure that they implement Ameren-IL's standards.

With some exceptions, the overall condition of Ameren-IL's electric delivery system was reasonably good. Liberty did not observe an unusually large number of items needing repair. With the exception of ungrounded guy wires in the Ameren-IP area, the number of issues related to compliance with the National Electrical Safety Code was not large or atypical. The number of condition issues noted on main lines was typical of aged distribution systems. On the transmission system, there were no specific, systemic condition issues and it was apparent that Ameren-IL had adequately maintained the system. The minor condition issues found at Ameren-IL's substations were small in number.

There were exceptions to the generally good system conditions. Weaknesses in maintenance practices adversely affected conditions in Ameren-IL's substations, particularly noticed by low oil levels, bad equipment paint conditions, and the protection provided against outages caused by animals and lightning. Ameren-IL's inspection and repair practices had not maintained the condition of distribution tap lines in consistently good condition. The poles, conductors, and equipment on the tap circuits were more aged and under-maintained than those found on the mainline circuits. Ameren-IL's distribution circuits also needed more protection from outages caused by animals and lightning.

Ameren-IL's failure to inspect distribution poles, deficiencies in lightning protection on the distribution system, substation circuit breaker maintenance, vegetation practices on parts of the distribution system, and maintenance that permitted poor conditions of some distribution tap lines all contributed to the consequences of the storms.

After 2006, Ameren-IL implemented changes and improvements in its inspection and maintenance practices, including centralized management of distribution and sub-transmission line-patrol inspections, special inspections for National Electrical Safety Code compliance, and regular distribution pole inspections. Inspection and maintenance should also benefit from new local labor union agreements and Ameren-IL's monthly monitoring of maintenance and reliability work performance.

I. Introduction

A. The Storms in 2006

On July 19, 2006, a band of thunderstorms formed across northern Illinois and propagated southwest across west-central Illinois and eastern Missouri. The thunderstorm complex produced straight-line winds or downbursts that created widespread wind damage from central Illinois across the St. Louis metropolitan area and into the eastern Ozarks. The damage sustained in the St. Louis metropolitan area was consistent with wind speeds between 70 and 80 miles per hour (mph). Areas of damage across Illinois suggested that wind speeds could have approached 90 mph. There were two tornado tracks in southwest Illinois near the towns of Bunker Hill and Edwardsville. There were reports of power outages affecting 500,000 customers.

Another complex of severe thunderstorms formed across central Missouri during the morning of July 21, 2006. This cluster of thunderstorms pushed across the St. Louis metropolitan area, producing another path of wind damage from central Missouri to central Illinois. The strong circulation of storms produced several tornadoes. This led to many additional power outages and affected restoration efforts from the July 19 storm damage. Some customers who just had their electric service restored from the previous storm were once again without power and the total number of customers affected again rose above 500,000.

An early season winter storm produced significant amounts of snow and ice across much of the middle of the country on November 30 and December 1, 2006. Over a foot of snow fell from Oklahoma to southeastern Wisconsin, and accumulations of sleet and freezing rain in excess of 2 inches were common across eastern Missouri and western Illinois. The precipitation changed over to all snow during the evening hours of November 30 over central and northeast Missouri as well as west-central Illinois.

The combination of accumulated ice on trees and power lines and gusty northwest winds produced widespread downed trees and power outages. Over 500,000 households and businesses were without power from the St. Louis metropolitan area into central Illinois. The freezing rain and sleet affected many locations in central Illinois west of Interstate-57. Eleven counties in central Illinois reported ice ranging from ¼ inch to 2 inches thick, with the thickest ice around Decatur, Taylorville, Clinton, and Mount Pulaski. Eight counties reported heavy sleet ranging in depth from ½ to 2 inches. The heaviest snow occurred along and west of the Illinois River, where snow accumulations were 8 to 16 inches. The result included numerous traffic accidents and downed power lines.

B. The Companies

St. Louis-based Ameren Corporation is among the nation's largest investor-owned electric and gas utilities, with approximately \$17 billion in assets. The largest electric utility in Missouri and the second largest in Illinois, Ameren companies provide energy services to 2.3 million electric and 900,000 natural gas customers throughout its 64,000 square-mile territory. Created by the year-end 1997 merger of Union Electric Company and Central Illinois Public Service Company,

the company grew in 2003 with the acquisition of Central Illinois Light Company and again in 2004 with the acquisition of Illinois Power Company.

Ameren is the parent of Ameren-CILCO, based in Peoria, Ameren-CIPS, based in Springfield, and Ameren-IP, based in Decatur. Ameren-CILCO provides electricity to approximately 215,000 customers in 19 counties, serving towns in east and central Illinois. Founded in 1913 through a series of mergers involving seven existing gas and electric companies, Ameren-CILCO provides gas and electric services to Peoria and 26 surrounding communities. Ameren-CILCO's distribution facilities consist of 109 substations that supply 307 distribution circuits and about 7,850 miles of line. Approximately 74 percent of these miles are overhead, and 26 percent are underground. Ameren-CILCO operates and maintains 14 transmission and switching substations, and 34 industrial/wholesale substations.

Ameren-CIPS provides electric service in 70 counties throughout a 20,500 square-mile area. Founded in 1902, Ameren-CIPS today serves nearly 400,000 retail electric customers in 576 communities with a service territory that includes more than 7 percent of the state's population and 35 percent of its surface area—including Quincy and East St. Louis to the west, and Mattoon and Marion to the east and south. Ameren-CIPS' electric distribution system consists of approximately 12,000 miles of overhead conductor and 1,400 miles of underground circuits. The previous Ameren-UE-Illinois electric system, now a part of Ameren-CIPS, includes approximately 1,400 distribution circuit-miles. Ameren-CIPS has 1,129 electric distribution circuits.

Founded in 1923, Ameren-IP provides electric service to about 625,000 electric customers—an aggregate population of 1.4 million—in 313 incorporated municipalities across 15,000 square miles of central, east central, and southern Illinois. About 89 percent of Ameren-IP's customers are residential. Ameren-IP provides service to nine cities with populations greater than 30,000, including Danville, Decatur, Belleville, Bloomington-Normal, Champaign-Urbana, Galesburg, and Granite City. Approximately 88 percent of Ameren-IP's electric distribution system is overhead, with the remaining 12 percent being underground. Ameren-IP has 885 electric distribution circuits.

C. The Investigation

The Illinois Commerce Commission (ICC or Commission) asked for an investigation to determine whether each Ameren utility in Illinois:

1. Appropriately planned, designed, constructed, inspected, and maintained their electricity delivery systems.
2. Adequately planned, prepared, and executed service restoration efforts following July 2006 windstorms and November 2006 ice storm.

The ICC wanted the investigation to focus first on the utilities' electricity delivery system conditions and the utilities' policies, practices, and actions as they existed just prior to the storms and as they occurred during the storms. The ICC required that the investigation recognize any changes that Ameren implemented or is proposing for the future, but that they should not become

the basis for omitting a full investigation and full reporting of the previously existing conditions, policies, practices, and actions or for omitting recommendations for improvement.

The ICC specified that the end-result of the investigation would be one comprehensive written report with separate findings and recommendations for each of the three utilities. The report must also include the investigations' conclusions, the above described determinations, detailed recommendations for improvement that each utility can implement and that the ICC can verify, and a timetable for utility implementation of the recommendations.

On August 29, 2007, the ICC Staff and The Liberty Consulting Group (Liberty) executed a contract for the investigation. In early September, representatives of the ICC Staff, Liberty, and Ameren met to discuss expectations and plans for the investigation. Liberty submitted its 122 initial data requests to Ameren. Over the course of the investigation, Liberty submitted and Ameren responded to nearly 800 requests for information. Liberty interviewed Ameren personnel and inspected Ameren's facilities. Liberty tracked these interviews and inspections in 180 total requests.

Ameren made an introductory presentation to the Liberty team on October 2 in Decatur. During that presentation, the president of Ameren-Illinois indicated that Ameren would cooperate with Liberty's investigation and that he wanted Liberty's advice on areas in which Ameren could improve its performance. Over the next nine months, Ameren responded to data requests promptly and completely and made its employees and facilities available to Liberty. Ameren created a cooperative and open environment for Liberty's work.

To respond to the requirements of the ICC's Request for Proposals, Liberty prepared a detailed work plan for the investigation. The plan included investigations in the following areas:

- Storm Description and Analysis
- Emergency Planning
- Restoration Performance
- Transmission & Distribution Planning, Design, Protection, and Construction
- Maintenance, Inspection, and System Conditions

After this introduction, the chapters in the report follow this same organization.

D. Ameren-IL

Liberty uses the term Ameren-IL to mean all three of the Ameren companies in Illinois and to mean the consolidated plans, efforts, and work by the entity that encompasses the three companies. In many ways, Ameren-IL operated as one utility that shared some services and received support from the Ameren Corporation. Ameren-IL distribution divisions and its transmission and substation areas all cross the boundaries of the three companies. Ameren-IL has one President and CEO, and two vice presidents of regional operations who each have responsibilities that cover the entire Illinois footprint.¹

¹ Response to Data Request #123.

Ameren-IL has informed its employees about changing the name of the business segment that makes up the Illinois utilities.² Ameren-IL has also expressed the goal of continuing to standardize practices across the entire Illinois service territory.³ Liberty concurs that there can be many advantages to furthering the assimilation of the three companies and implementing the best practices of each, over the Illinois service territory.

The ICC required that Liberty make recommendations for improvement that each utility could implement. However, Liberty found that because of Ameren-IL's organization, it was most appropriate to direct all of the recommendations toward Ameren-IL. Liberty's report describes the differences in practices that remained from the three companies in 2006 and in the present. The implementation of some of Liberty's recommendations will require changes that affect Ameren in its entirety. For example, aspects of emergency planning are common to both Illinois and Missouri. Nevertheless, Liberty directs its recommendations at Ameren-IL because the ICC has authority over Ameren-IL.

In assimilating the three companies, one of the challenges faced by Ameren-IL was three different sets of standards and policies for construction, maintenance, and inspection of the electric delivery systems. In 2006, Ameren-IL had efforts underway to bring standardization across its Illinois service territory. Later chapters of this report discuss these efforts. However, there was no quality assurance program to help ensure that Ameren-IL applied consistency and common solutions.

In May 2007, Ameren-IL launched its Electric Delivery Quality Assurance (EDQA) program.⁴ Ameren-IL said that the objectives of the EDQA included ensuring field compliance with the National Electrical Safety Code (NESC) and with Ameren construction standards. Ameren-IL also aimed the EDQA at facilitating a consistent application of identified best practices and common solutions across all Illinois operating divisions.

This initiative resulted in a Liberty conclusion and recommendation that did not specifically fit in any of the remaining chapters of this report.

Conclusions

1. Ameren-IL did not have a quality assurance program that would help ensure that it applied consistency, common solutions, and best practices to its electric delivery systems. (Recommendation I-1)

Particularly because three separate utility companies make up Ameren-IL, there was a need to improve service reliability by applying consistent standards and practices across the Illinois footprint. An effective quality assurance program that applies to all three companies and all six service divisions would help ensure that Ameren-IL meets this need. Ameren-IL said that in May 2007, it established such a program called the Electric Delivery Quality Assurance (EDQA)

² Response to Data Request #796.

³ Interview #180, June 4, 2008.

⁴ Response to Data Request #299.

program. The specific focus of the EDQA was to verify that line construction personnel executed the work in the field in accordance with applicable plans, standards, and codes.⁵ There should be a similar focus on maintenance and inspection.

Recommendations

I-1 Establish an effective quality assurance program that is applicable to all of Ameren-IL and that ensures consistency in construction, maintenance, inspection, design, and planning of the electric delivery systems.

Ameren-IL said that it established a quality assurance program in May 2007. This occurred after the timeframe of Liberty’s investigation and Liberty did not review the program’s effectiveness. Ameren-IL said that a focus of the program was line construction. This is a reasonable and important heart of a quality assurance program. However, the program’s applicability to maintenance, inspection, and design could yield significant benefits. In its comments on the draft of this report, Ameren-IL indicated that it accepted this recommendation and would establish a formalized QA/QC process in areas such as transmission line design, construction projects, vegetation management, and transmission system design and planning. Within one year of the date of this report, Ameren-IL should be able to demonstrate significant progress in implementing an effective and extensive quality assurance program.

E. Recommendations

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⁵ Response to Data Request #299.

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Several of Liberty’s recommendations propose that Ameren-IL submit reports to the ICC. Those recommendations are II-4, IV-44, and IV-45.