Final Report

Best Practices for Utility Storm Response

DSTAR Project 11-7

June 2008
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FOREWORD

This project was conducted by General Electric International, Inc. for a consortium of utility companies and utility organizations known as the Distribution Systems Testing, Application, and Research (DSTAR) group as part of DSTAR Program 11. The participating companies are:

- Ameren Corporation
- Aquila
- Duke Energy
- National Rural Electric Cooperative Association, Cooperative Research Network
- PacifiCorp
- Progress Energy
- Southern Company
- South Carolina Electric and Gas
- We Energies
- Wisconsin Public Service Corporation

This project was performed under the guidance of a Project Review Committee whose membership is comprised by representatives of the companies listed above. This committee is responsible for both the Program 11 research and long-range goals of the DSTAR program. We’d like to offer a special thanks to those who provided information for inclusion in this report.
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EXECUTIVE SUMMARY

This report examines the practices, procedures and experiences of U.S. utilities during major storm occurrences with the goal of understanding and conveying what went right and what went wrong during the build-up, restoration and ramp-down phases. This includes appreciating how utilities harden their systems to withstand storm elements, how they prepare, train and drill storm-duty personnel, available tools and processes for storm tracking and damage prediction, how they organize and manage response activities, procedures for assessment, repairing and switching, communications and technology use.

The investigation included: a detailed survey of DSTAR member utilities on a wide range of storm response issues; interviews with utility personnel, vendors, manufacturers, researchers and consultants; extensive review of relevant literature including industry publications, conference proceedings, whitepapers, utility storm reports and public commission assessments; and examination of utility, vendor and manufacturer websites. The result is comprehensive discussion of many important aspects of storm restoration with an emphasis on best practices and lessons-learned from past experiences. The findings have been summarized as 144 line-items in Section7, Summary. Some of the key items are summarized below, organized by the Chapter/Section where they are discussed in more detail.

Storm Hardening

- Trimming trees along the ROW improves and maintains reliability under “normal” operating conditions, but experience has shown that it has less impact than expected on reducing the number of outages in major storms.
- Other aspects of vegetation management, that may have greater potential to reduce storm outages include: tree removal programs that focus on dead trees, dangerous live trees, and large overhangs; negotiating with landowners to obtain the right to trim or remove trees outside the ROW or expand the ROW; treating younger trees with chemicals to slow, limit or retard growth
- Design and maintenance practices have the greatest potential to reduce storm impacts, including such activities as incorporating equipment and material strength in designs, undergrounding and/or re-routing lines where it makes sense, configuration changes, pole inspection/replacement programs, using local backup generation, and others.

Preparation and Training

- Develop and maintain a comprehensive emergency response plan (ERP), to guide response during major events. The ERP provides a uniform, corporate-wide approach for managing an emergency, defining roles, responsibilities and accountability, documenting recovery procedures and providing a business continuity plan (BCP) to maintain or re-establish business operations following a disruptive event.
- Provide flexible training options for storm duty personnel, budget and track training costs (not just assign to overhead), and evaluate training effectiveness by testing and measuring.
- Conduct annual storm drills to exercise and refine all phases of the ERP; coordinate drills externally with the media, local and state officials, and other emergency response organizations if feasible; use outside consultants or advisors to observe storm drills and make recommendations.

Storm Tracking and Damage Prediction

- Use storm detection and tracking technology for early warning. Although it is inherently difficult to predict and forecast certain storm events, there is a wide range of products and services that can provide advanced warning to allow for better planning and mobilizing.
• While there is a vast amount of publicly available information on all types of storms, the volume of data and complexity of the models often require a trained individual in the loop to resolve conflicts, provide a sanity check, and translate information for local impact.

• Use damage prediction methods to forecast damage severity and location, resource needs and approximate restoration times. Prediction tools range from simple storm classification, based on current data and past information, to more sophisticated computer models that take into account other system variables. Damage prediction provides triggers for storm center activation and crew mobilization.

The Storm Organization, Activation and Mobilization

• Most utilities have an emergency operations center (EOC) that sets and directs the restoration strategy, and operations bases where the response strategy is actually executed. Wherever it makes sense, push EOC functions down to the operations bases to improve efficiency. During major incidents, it may be more efficient to subdivide operating areas into smaller units and use the capability of modern outage management systems (OMS) to command and control distributed, decentralized restoration efforts.

• Develop an internal mutual assistance plan that is integrated into the emergency response plan, and have strong mutual assistance agreements in place with groups of peer utilities and contractors. Maintain relationships with mutual aid partners before and outside of storm events, and explore mutual aid relationships with cooperatives.

• Proactively exercise mutual assistance agreements to receive timely commitments before the storm and expand requests to include groups and utilities not threatened by the storm as soon as possible.

Materials Management and Logistics

• Materials management and logistics form the backbone of a utility’s restoration effort, addressing all work and personnel needs without which the effort would grind to a screeching halt. Therefore it is important to have a formal logistic and materials management plan that is incorporated into the ERP.

• Pre-order and pre-stage materials near areas likely to be affected by the event, so that work can begin as soon as possible. Use inventory control applications to manage the flow between central purchasing and the field; continuously monitor stock levels during the event so that prompt action on heavily-used items

• The staging site is a fully equipped and self-supporting service center for all logistic functions pertaining to restoration. Possible sites should be scouted, verified and selected before the storm season and agreements signed, and updated each year. For all sites under agreement, a physical layout should be developed in accordance with the characteristics of the land.

• You can’t work more people than you can logistically house and feed! Establish and maintain support procedures and relationships, including agreements and long-standing contracts with lodging facilities and catering services, but have contingency plans in place for limited availability.
**Damage Assessment and Public Safety Processes**

- Time to restore the system is highly dependant on a quick and accurate assessment of damage. Most utilities perform damage assessment in at least two (maybe three) phases: (1) initial or quick assessment in 1 to 4 hours (2) detailed or full assessment in 24 to 48 hours obeying the 20-40-40 rule, and sometimes (3) field checkers working ahead of line crews to provide pole-to-pole evaluations.

- Develop processes and technology to efficiently collect and transfer damage data to operations centers. These could range from standard damage assessment forms to document the location and extent of damage, to the use of mobile communication technology to streamline field assessment collection and reporting. Use smart meter data, where available, to enhance damage assessment.

- The goal of the public safety process is to protect the public and make as many hazardous situations safe in the shortest possible time. The most common public safety hazard on overhead systems is from arcing or downed wires.

- Perform safety process functions in parallel with damage assessment. As far as practically possible, detect and eliminate open neutral conditions on secondary wires, inspect flooded meters and educate customers about risk associated with flooding beyond the meter.

**Crew Deployment and Service Restoration**

- Crews are dispatched to repair damage and restore service after the damage assessment data is analyzed to determine the best strategy. Deploy crews in proportion to damage and not just to outages, because sometimes the areas with the most damage may not necessarily have the highest customer outages.

- Continually assess needs and redeploy crews as restoration progresses. Initial deployment decisions are based on damage assessment results, but as the restoration work progresses, the situation needs to be continually reassessed so that work in some regions do not lag too far behind others.

- Coordinate tree crew movements with line crews needs. They can be dispatched to work directly with, or just ahead of line crews when tree damage is heavy and localized. Use heavy machinery to help clear heavy damage in harsh conditions; deploy crew guides with external crews.

- There is a wide range of opinions as to what the proper balance is between allowing crews to work autonomously to speed up restoration, and centrally controlling crew activities to ensure safety and efficiency. Subdivide areas and push responsibility down the line, where it makes sense. Coordinate switching and clearance activities to achieve best maximum efficiency.

**External Communications**

- External communications comprises all contact outside of the utility, with customers, government officials, community leaders, the media, public safety organizations, other utilities and emergency management organizations.

- When the power goes out, customers typically what to know three things: Does the electric company know my power is out? When will the power be back on? What caused the outage? Studies have shown that the more information customers receive about outages the more they are satisfied. Provide customers with additional information about the outage when they call to report.

- Plan your outage communications to run pre-event, during the event, and post-event. Educate customers on how the electric system works, about the utility restoration process, and about
where utility responsibility ends and where consumer responsibility begins. Provide safety-related announcements to the public before and shortly after major storms. Solicit feedback after the event and remember to thank customers, vendors and suppliers.

- When communicating with the media, the goal is to provide all the necessary information for public consumption, and to establish a favorable impression of the restoration effort. Be proactive in taking your story to the media, especially stories that highlight the restoration workers. Educate the media about what happens during a storm outage and consider giving them controlled access to certain areas of activity.

- Communicate early and often with government officials and other affected utilities. Be consistent and proactive in providing information. Maintain a contacts database of officials and update at least annually and after each election. Designate liaisons to provide updates, give out a direct number to key officials; coordinate with electric cooperatives and other resellers that rely on the utility for power.

- The availability of timely and accurate estimated times of restoration (ETR) directly affect customers’ perception of restoration efforts. Customers need estimates to make alternative plans, so delayed and overestimated ETRs lead to frustration. However, it may be better to avoid providing specific ETRs if they are not reliable.

**Internal Communications**

- Internal communication systems, within the utility enterprise, are needed to manage and coordinate the storm response. Poor or no internal communications can potentially hobble the entire effort.

- Experience has shown that if you want to depend on a system, be sure it is a system that your personnel can restore to service. During recent major events, utility private communication systems continued to function while many commercial wireless, landline telephone and other telecommunications networks were unavailable. Utilities that have some measure of control over critical-to-mission communication systems fare much better than those who don’t.

- Even though utilities’ private communication systems tend to be more resilient than commercial systems, it is good practice to have backup systems should the in-place network become inoperable. Utilities should be prepared to deploy backup communication systems, such as mobile communications trailer with satellite communications packages.

**Technology Use**

- There is a wide array of modern applications and technologies that have the potential to improve efficiency and reduce cost during storm restoration, and many of these are becoming a more common part of the process. The greatest potential, however, lies in the integration of these applications to seamlessly move data between the field, operations and back office. Some of the more widely used tools include IVR/VRU, OMS, AMR/AMI, mobile computing, GIS. Mobile Workforce Management, WMS and AVL.

- Customers expect their utility to make effective use of the Internet and mobile technology to communicate outage and restoration information. A leading practice is to provide storm center portal where customers can get information about planning for emergencies, utility preparation, the restoration process, and (in some cases) outage information and estimated restoration times. Among DSTAR utilities responding to the survey, only three reported placing real-time outage and restoration data on their storm center Websites.
After the Storm

- The post-event period may be broken into three phases: ramp-down, clean-up and review. During the ramp-down phase of post-storm recovery, resources must be demobilized in a rational, intelligent way to complete outstanding tasks and not incur unnecessary costs. It may not be economical to hold onto external resources during this period, but if they are released too soon, some outages and clean-up may be prolonged, and customer satisfaction may be affected.

- During the restoration phase, temporary repairs are sometimes made to restore service quickly, with the goal of making permanent repairs later. Follow-up inspections should be performed on these repairs during ramp-down. Any temporary or ad-hoc repairs should be noted, as well as non-standard construction and equipment, changes in topology and other items that may need to be eventually redressed.

- Clean up is one of the more underestimated activities of storm recovery. After storms that cause widespread damage, it is not uncommon for utilities to be cleaning up downed trees, broken limbs and debris, and making facilities repairs for months after actual system restoration. Plan debris disposal during restoration to ease the clean-up nightmare after; clean-up rights-of-way and work sites that may have been neglected during restoration; perform an extensive survey of repaired system and implement a standardization plan.

- The same GIS and GPS-enabled technology mobile technology that is useful for locating and logging damage during damage assessment can be used in the post-storm survey to locate and document new equipment and configurations, and upload data to a central database.

- Every storm is unique and there are important lessons to be learned from each experience. The post-event phase provides the perfect opportunity for self-assessment, peer review and sharing of lessons-learned. Shortly after the storm, findings need to be assembled and documented for the benefit of future storm responses, for response to regulatory requests, and for public dissemination.

- Some of the recommended practices for obtaining post-event feedback include surveying mutual-aid utility personnel and off-system contractors, conducting town-hall meetings in various locations, surveying customers on their storm experience, and preparing or commissioning a comprehensive assessment report on major events with issues and recommendations.
1. INTRODUCTION

Power delivery systems, and particularly distribution systems in the United States, whether they are overhead or underground, have always been vulnerable to the effects of major storms.

In each of the last three years Ameren has been hit with severe wind and ice storms that have caused tremendous infrastructure damage and disrupted millions of customers in Missouri and Illinois, some for up to eight days. In 2005, Hurricane Katrina swept through Florida and then slammed into Louisiana, Mississippi and Alabama destroying entire communities, devastating lives and causing millions of outages across several utility systems, many lasting as long as months. In 2004, Florida was hit with three hurricanes within a month that caused widespread outages for weeks on Florida Power & Light and Progress Energy Florida systems. In 2003, Hurricane Isabel struck the mid-Atlantic causing power outages to more than 3 million customers in Maryland, Virginia and Washington DC for 1 to 2 weeks. In December 2002, a major ice storm in the Carolinas disrupted power to nearly 2 million Duke and Progress Energy Carolinas electric customers, some for over two weeks. These are just a few examples of the types of events that utilities all across the country must prepare for and respond to every year.

Virtually every utility has had to respond to a major storm event in its history. Some utilities, because of their geography, must deal with such events nearly every year. For the DSTAR member utilities, “storm events” include hurricanes, tornadoes, windstorms, thunderstorms, lightning, sleet, snow and ice. Some of the major storms reported by DSTAR utilities over the last ten years are summarized in the Appendix.

The graphics below, from a 2006 report by Macrosoft Inc.a show the number of outage events per year and the primary cause of outages, from a survey of 45 utilities across North America. The results of the study confirms that a majority of utilities (87%) face an emergency outage event at least once per year and 23% face it more than 5 times per year. Weather events are identified as the primary cause of outages, primarily wind, thunderstorms/lightning and ice.

When these events occur, utilities are under tremendous pressure to restore customers as quickly as possible prolonged outages severely impact the economy, safety, physical and psychological health of the affected areas (and beyond). Virtually every utility across the US, and most utilities worldwide, have a plan in place to restore customers as quickly and efficiently as possible after a major event. Storm

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restoration activities are under more scrutiny these days due to a number of recent particularly devastating
events, increasing customer awareness, and customer demand for better performance and service. However, it is not clear that storms are any worse today than they have ever been or that utilities are
responding more poorly. In fact, a 2004 study released by the Edison Electric Institute (EEI) examined the
trends in storm occurrences and restoration proficiency. The report concluded that based on equipment
damage, recent storms are not any more or less severe than storms in the past. But, the rate at which
responding utilities can restore systems has increased, even while as the number of restoration workers
deployed has decreased. This is a key finding, because it speaks to the ability of modern utilities to “do
more with less” even while facing unique regulatory, economic, workforce, infrastructure and consumer-
related challenges.

This report examines the practices, procedures and experiences of U.S. utilities during major storm
occurrences with the goal of understanding and conveying what went right and what went wrong during
the build-up, restoration and ramp-down phases. This includes appreciating how utilities harden their
systems to withstand storm elements, how they prepare, train and drill storm-duty personnel, available
tools and processes for storm tracking and damage prediction, how they organize and manage response
activities, procedures for assessment, repairing and switching, the role of communications and the use of
technology.

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b Brad Johnson, *Utility Storm Restoration Response*, for Edison Electric Institute, January 2004
2. BEFORE THE STORM – PREPARATION

Storm response begins long before an event occurs and continues long after the worst is over. The term “response” is specifically chosen to encompass everything the utility does to actively prepare for, combat and recover from a storm event.

Although technically outside the scope of this paper, the most important factor that determines the impact of a storm event is how the electrical system is designed, constructed, and maintained to withstand storm forces and elements. As such, this chapter begins with a cursory overview of storm-hardening activities typically undertaken by utilities during normal operation. The overview is included to give a flavor of, and perspective for, such activities, which can be loosely be classified as passive storm response.

Active storm response, the focus of this study, includes everything from pre-storm preparation and training through post-storm ramp-down and clean up. This chapter covers the important aspects of preparation and best practices in evidence for training and developing emergency action plans. Early detection, storm alert/warning and tracking systems will be discussed, as well as how they impact the planning horizon for various types of storms. Methods for predicting the impact of different types of storms will be examined and compared including homegrown, empirically based evaluations and commercial-grade applications. The chapter concludes with a discussion of the response timeline and the overall organization and planning process, including mobilization of internal and external resources, preemptive communications and establishment of command and control structures.

2.1 Storm Hardening

No pun intended, but trees are the root cause of the problem.

~ Ameren Executive, following a major ice storm

Storm-hardening activities aim to reduce the impact of future storms by assessing the infrastructure to identify ways to make it more resilient. State Utility Commissions are beginning to pay more attention to storm hardening as a result of the fallout from recent, particularly devastating storms, and the increase in customer complaints. For example, on April 25, 2006, the Florida PSC issued Order No. PSC-06-0351-PAA-E1, requiring the investor-owned electric utilities to file plans and estimated implementation costs for ten ongoing storm preparedness initiatives on or before June 1, 2006. Among the ten ongoing initiatives were several measures aimed at hardening the transmission and distribution system: a three-year vegetation management cycle for distribution circuits; an audit of joint-use attachment agreements; a six-year transmission structure inspection program; and hardening of existing transmission structures.

A full treatment of storm hardening is outside the scope of this paper, but the most commonly mentioned activities are briefly discussed.

Tree trimming and vegetation management – Discussions of distribution storm damage often begin (and sometimes ends) with trees. Trees account for a large majority of storm outages, mostly because of falling trees and branches breaking overhead facilities, or limbs brushing against lines causing contact faults. After a major ice storm in November 2006, Ameren sustained significant damage to its overhead facilities in Missouri and Illinois because tens of thousands of trees – some of them 100 years old and over 80 feet high – fell on poles and lines. 520,000 customers in both states lost power for up to eight days. In a previous storm report, released just before the November ice storm, the Missouri
Public Service Commission staff acknowledged, “the density of large old-growth trees represents a risk to utility service following storms with high winds or heavy ice.” Not surprisingly, the utility was roundly criticized for not having trimmed the trees more frequently and fully to minimize the outages. In response, Ameren maintained that because the utility is very constrained (as are most utilities) in how they can trim trees, no amount of trimming would have made any difference.

Along distribution circuits, utilities can only trim tress to the limits of their easements, which are several feet from the centerline of the pole in most cases. In Ameren’s case, they could not legally remove trees, even those planted within their easements. According to remarks by their CEO, there are literally millions of large trees planted within a few yards of overhead distribution lines, and countless more close enough to lines to knock them down in a bad storm. When a 60-foot tree which is 40 feet from a power line falls on that line, no amount of tree trimming is going to prevent an outage.a In fact, in its response to Ameren’s report on earlier storms in July 2006, The Missouri Public Service Commission noted:

“It must, however, be emphasized that even if all of the trees in AmerenUE’s service territory were trimmed per current procedures immediately before these storms hit the St. Louis area, much of the damage observed would have still occurred. Significant damage to AmerenUE’s system was caused by trees and tree limbs that would not be removed by AmerenUE’s current trimming programs or are not on AmerenUE’s right-of-way.”

The best way to significantly reduce the number of outages is to identify and remove trees that could fall on distribution lines during a storm. But this could mean removing all trees over a certain height within striking distance of the lines – literally millions of trees in some service territories alone! Not only does the utility lack the necessary authority, but this would also be socially (and perhaps environmentally) unacceptable. So most utilities settle for trimming trees within the right-of-way (ROW). This improves and maintains reliability under “normal” operating conditions, but experience has shown that it has less impact on reducing the number of outages in major storms. In the July 2006 storm report, the Missouri PSC recognized that, “while the vegetation management programs of AmerenUE can improve day-to-day reliability, in their current form, they will not significantly reduce the severity of outages following major storms.”

That being said, utility tree-trimming practices are nevertheless scrutinized after widespread storm outages because (1) trimming does have some impact, even if less than expected, on storm outages, and (2) trimming potentially improves restoration response by reducing congestion in the ROW. On the first point, there are many cases where customer outages are avoided because limbs and branches that may have damaged secondaries and service drops, or created contact faults, were trimmed back. Also, trimmed trees experience less ice and wind loading and may be less likely to fall. On the second point, when the

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a Report on AmerenUE’s Storm Outage Planning and Restoration Effort Following the Storms on July 19 and 21, 2006, Case No. EO-2007-0037 Missouri Public Service Commission Staff, November 17, 2006

ROW is trimmed and properly cleared, it is beneficial to the crews who clear and repair lines after storm outages. The lack of excessive vegetation can make line clearing easier, safer and more efficient, which speeds up repair and restoration.

Other aspects of vegetation management, (besides trimming), that may have great potential to reduce storm outages include:

- Tree removal programs that focus on dead trees, live trees that pose a real danger, and large overhangs.
- Negotiations with landowners to obtain the right to trim or remove trees outside the ROW, or expand the rights within the ROW. It has even been suggested (by the Texas PUC after Hurricane Rita) that, in some cases, utilities consider using the power of eminent domain.
- Treat younger trees with chemicals to slow, limit or retard their growth
- Establish a buffer zone and educate customers about the “right” types of trees to plant near lines.

**System design changes and maintenance actions** – On the distribution side, design and maintenance practices have the greatest potential to reduce storm impacts. These include such activities as incorporating equipment and material strength in designs, undergrounding and/or re-routing lines, using local backup generation, and others.

- **Burying overhead lines** – In the aftermath of major storms, there is almost always a public demand for burying power lines. As far as the public is concerned, this should be a no-brainer, but the situation is actually more complex than that. Underground power systems do have fewer outages than overhead systems, but the outages tend to be longer. Burying lines does not completely protect customers from storm-related outages, but it helps in some situations, especially where vegetation is a problem. On the other hand, depending on the location of facilities, underground systems may sustain more damage than overhead systems. For example, systems located near the coast (see image to the right) may suffer significant damage from storm surge. Finally, many studies show that the cost of burying power lines is so large, about $1 million/mile, (10 times the cost to install overhead lines), that the benefits may simply not justify the cost. Nevertheless, this is an issue that continues to be discussed and studied as a way to make it economically feasible, or to provide a mechanism for communities with the means to be able fund it themselves.

- **Inspecting and replacing wood poles** – A formal, documented pole inspection/replacement program will help eliminate weak or undersized poles more likely to come down during a storm. As part of the Florida PSC mandate, all IOUs are required to have a formal pole inspection program, on an eight-year cycle, and file annual inspection reports by March 1\(^{st}\). The reports must include: methods used to determine NESC compliance with regard to strength and structural

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integrity; an explanation of the poles inspected; selection criteria; location and rationale; cause(s) of each pole failure; and specific corrective actions.\(^d\)

- **Designing/constructing a more robust system** – This typically includes a range of activities, primarily aimed at distribution poles and lines. After Hurricane Wilma caused extensive damage to FPL’s infrastructure, a comprehensive study was commissioned to review and benchmark infrastructure performance and make recommendations for storm hardening. Some recommendations from the study include:\(^e\) using stronger poles, such as Grade B wood or extreme wind velocity (145 mph) concrete or wood poles, or upgrading to steel poles; using more guying on poles; reducing the span between poles; increasing mechanical strength of wires to prevent breakage (but there is anecdotal evidence from Ameren’s storm experiences that the breakage of smaller, weaker wire kept poles from being pulled down); using fewer attachments and auditing joint-use facilities. Other design/construction activities include re-routing or relocating critical line sections exposed to tree damage; replacing overhead facilities near the coast (AEP in Texas proposes to replace overhead distribution infrastructure within 30 miles of coast); upgrading wood crossarms to fiberglass or steel; additional use of insulated covering on substation buses; and designing additional capability to back feed or provide alternate supply paths to major blocks of customers.

**Backup and standby generation** – This is often referred to as local hardening and may be the best way to ensure that customers have power while infrastructure is compromised. In Texas, the PUC has recommended all telecommunications utilities’ central offices in hurricane-prone areas be capable of full operation without interruption for at least 72 hours after loss of electric utility power.\(^f\) On the residential side, customers typically purchase, install and operate portable generation. The utility gets no credit for “hardening” the system unless they somehow encourage and facilitate the activity. Widespread use of backup and standby generators is not without issues. There are safety concerns, particularly with regard to utility workers, and social equity issues. Finally, expansion of whole house backup to a micro-grid neighborhood concept has been discussed as a remedial action for widespread electric infrastructure damage. However, if distribution infrastructure damaged, it is difficult to see how a micro-grid would be effective.


\(^f\) PUC Project No. 32182, PUC Investigation of Methods to Improve Electric and Telecommunications Infrastructure to Minimize Long Term Outages and Restoration Costs Associated with Gulf Coast Hurricanes, August 2006
2.2 Preparation and Training

Before everything else, getting ready is the secret to success.

~ Henry Ford

Apart from hardening the system to withstand the impact of a storm, the next most effective activity is preparing and training for storm restoration. This includes all activities that enable utility mobilization and power restoration as soon as possible after a storm, and to ensure continuity of business operations.

2.2.1 Emergency Response Plans

It is standard practice in the industry to develop and maintain a storm plan, to guide response during major events. Storm plans are typically reviewed on an annual basis and may or may not be exercised periodically. Following the terrorist attack on September 11, 2001 awareness of the vulnerability of critical infrastructure, like the electric grid, to physical and cyber attacks has increased. On December 17, 2003 the President signed Homeland Security Presidential Directive-7 (HSPD-7), “Critical Infrastructure Identification, Prioritization, and Protection.”

This directive established a national policy for Federal departments and agencies to identify and prioritize United States critical infrastructure and key resources and to protect them from terrorist attacks. Additionally, Federal department and sector-specific Agencies were directed to collaborate with the private sector ... to identify, prioritize and coordinate the protection of critical infrastructure and key resources; and to facilitate sharing of information about physical and cyber threats, vulnerabilities, incidents, potential protective measures, and best practices.\(^g\)

This federal policy, in combination with several very active and devastating storm seasons early this decade, has created a groundswell of awareness regarding utility emergency planning. Several states now require regulated utilities to create and maintain comprehensive Emergency Response Plans (ERP), and file an updated ERP with the utility commission each year. In the DSTAR Program 11 member survey (see Appendix), three IOUs, South Carolina Electric and Gas, Wisconsin Public Service and Progress Energy Florida, reported that they are required to file an emergency response plan with the state regulatory commission.\(^h\) For Florida utilities in particular, PSC Order No. PSC-06-0351-PAA-E1, which mandates (among other things) that regulated utilities develop a comprehensive Natural Disaster Preparedness and Recovery Program, was in direct response to the major hurricanes of 2004 and 2005.

In the case of the cooperatives, the Rural Utilities Service (RUS) is requiring that borrowers create or expand the ERP to detail how the borrower will restore its system in the event of a system-wide outage resulting from a major natural or manmade disaster, or other causes. Regulations state that the ERP shall include preventative measures and procedures for emergency recovery from physical or cyber attacks to the borrower’s electric systems and core businesses, and shall also address Homeland Security concerns.

The ERP is substantially different from the “ole storm plan” in that it is more comprehensive and wider in scope. The storm plan can be considered an element of the ERP. Essentially, the ERP is a living document that provides a uniform, corporate-wide approach for managing an emergency, defining roles, responsibilities and accountability, documenting recovery procedures and providing a business continuity plan (BCP) to maintain or re-establish business operations following a disruptive event. Three approaches to the ERP (PSC mandated, internally developed, and customized for co-ops) are presented below.


\(^h\) Note that responses were not available from Program 11 members Duke and Ameren
New York State ERP Directives

The New York State requirement for utility Emergency Response Plans, outlined in NYCRR 16 Part 105, is a good example of an industry best practice. The PSC requires regulated utilities in New York State to file an ERP that addresses storms, as well as other causes of electrical emergencies with storm-like characteristics, on or before April 1st each year, (or another date that the commission may prescribe). The mandated contents of the ERP include the following:

- **Emergency classifications** – criteria and guidelines for determining storm severity, including geographical scope, estimated restoration time, expected damage and projected resources
- **Emergency response training** – program to provide emergency training for storm duty personnel, and persons responsible for managing and evaluating effectiveness, procedures for drills and simulation and provisions for advance notice and drill critique
- **Advance planning and preparation** – ongoing actions to plan and prepare for emergencies and procedures to update (at least annually) contact information for:
  - Utility personnel with storm responsibilities (updated at least semi-annually)
  - Mutual aid companies and contractors
  - Life support and other special needs customers
  - Human service agencies
  - Print and broadcast media
  - Lodging and dining facilities
  - State and local elected officials, law enforcement, emergency management and response personnel
  - Medical facilities
  - Vendors
- **Emergency anticipation** – preparatory measures implemented within hours or days of a storm, criteria for notifying response personnel and special precautions to take
- **Service restoration procedures** – mobilizing personnel, materials and equipment for damage surveys and developing an action plan. Procedures and criteria include:
  - Identifying restoration priorities
  - Determining when centralized versus decentralized control is appropriate
  - Making rapid (within 24 hours) and detailed (within 48 hours) damage assessments
  - Integrating field damage reports with other damage indicators, like call-ins
  - Deploying, monitoring, reassigning and releasing company and mutual aid crews
  - Communicating with damage-assessment and service-restoration crews
  - Coordinating restoration efforts with other utilities, state and local emergency management and public works agencies
- **Personnel responsibilities** – Description and chart of emergency organization, personnel operational assignments, areas of management, responsibilities and functions; procedures for contacting and managing all assigned personnel at corporate and operating division level

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- **Customer contacts** – procedures and facilities for handling call volume, contacting and responding to the special needs customers and estimating, obtaining and distributing dry ice
- **Communications** – procedures and facilities for communicating damage and restoration progress with customers, human service agencies, the media, Department of Public Service, State Emergency Management Office, other state agencies, county and local governments, emergency response organizations and law enforcement
- **Outside aid** – Policy, criteria and procedures for requesting service restoration aid from other utilities, contractors, government agencies or others
- **Support services** – actions to take and personnel responsible for sustaining and supporting restoration crew activities, including vehicle management, foreign crew accommodations and distribution of supplies

**Ameren ERP Elements**

Ameren received plenty of attention for widespread outages from severe storms in 2006 and early 2007 that resulted in electric outages for more than 1.5 million customers in Missouri and Illinois. The aftermath has increased focus on alternatives for improving reliability during severe storms. The utility, which prides itself on having a “well-developed” planning process, identifies the major elements of its corporate ERP as:

- **Emergency operations center** – description of EOC activation/storm levels, organization and operations, resource procurement and release procedures, restoration updates
- **Job duties/responsibilities** – org chart and description of storm duty personnel/roles, including:
  - EOC personnel
  - Distribution dispatch offices
  - Division storm center
  - Construction field jobs
  - Service crew work
  - Damage assessment roles
  - Division support
- **Damage assessment** – procedures for information review, initial (high-level) assessment, detailed assessment and heavy localized damage assessment
- **Restoration update conference calls** – procedures for call timing, call setup, call content and call documentation
- **Division electric emergency restoration plans** – provide templates, critical logistics information and review annually
- **Division supply list** – update with new items that may benefit a Division during restoration and provide contingency plan for local offices
- **Logistics planning** – major component of a successful plan/restoration effort that must anticipate various situations and leverage prior relationships; includes provisions for:
  - Meals, lodging, laundry
  - Ice and water/sports drinks
  - Parking and transportation
- Security
- Selected sites and upfront contracts
- Sample layouts and staffing for sites
- Storm trailers and mobile command centers

- **Procedures for sending internal crews (providing mutual assistance) and receiving/handling outside crews** – use of checkpoints, a checkpoint coordinator, an Ameren liaison, a safety coordinator, squad leaders, crew guides, etc.

- **Use of technology to aid restoration** – phones, mapping, SCADA, weather tools, web pages, resource tracking, etc. and contingency planning for loss of critical systems and facilities

### NRECA/CRN Emergency Restoration Planning Guide

In accordance with RUS Bulletin 1730B-2, the Cooperative Research Network (CRN) of the National Rural Electric Cooperative Association (NRECA) produced an Emergency Restoration Planning Guide for its members. The guide is designed to provide cooperatives with an easy-to-follow, step-by-step process for creating, publishing and maintaining emergency restoration plans. Use of the forms helps ensure that in an emergency the right information is on hand for key users at coops. The guide is designed so that business operations (“inside operations”) and electric service (“outside operations”) sections of the ERP meet RUS requirements.

The Planning Guide is available as a downloadable file or as a CD-ROM with linked acrobat files that include: checklists, fillable forms, a reference manual, example sets, a copy of the Vulnerability and Risk Assessment Analyses project, and a copy of the IT Recovery Plan project. The figure that follows shows the ERP map, a ten-step checklist linked to relevant forms and templates for each step.

### ERP PLAN FORMS IN STEPS

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<td>Step 10 Exercise Documentation Form</td>
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Steps 8.6 through 8.10 are more tactical than strategic. They probably cannot be completed in advance.

### NRECA Cooperative Research Network ERP/BCP Checklist

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2.2.2 Training and Drills

Training for emergency response personnel is typically delivered in a variety of forms, such as hardcopy handouts, audio-visual presentations, online tutorials, classroom lectures, tabletop and field exercises and district, regional or company-wide simulations. The type and amount of training varies with roles and responsibilities, personnel experience and company exposure, but the majority of utilities provide some form of training to emergency response personnel. Some best practices regarding training of storm personnel are discussed below.

Provide flexible training options, sub-annually, on demand, at orientation and on role changes – Data from the DSTAR utilities survey suggest that most utilities provide training (at least) annually to personnel assigned storm roles. Training is typically completed prior to the start of the storm season (if it is definable). A best practice among leading utilities is to provide flexible training options for employees. Progress Energy, for example, has a robust training program that provides training when new employees are hired or existing employees change storm roles; the program offers refresher training each spring for storm center personnel, and offers a class each quarter for anyone needing the training. It provides individual training to Operation Centers at the Operations Manager’s request, and provides regular refresher training for damage assessment personnel. At Exelon, training is conducted every 6 months, but a new training program is being developed to target storm roles that will require more extensive training because of the nature or severity of the task. More flexible options will ensure the emergency response capability is expanded throughout the company, to as many personnel as possible.

Budget and track training costs and evaluate training effectiveness by testing and measuring – A leading practice among utilities with effective training programs is to capture and track training costs in the budgeting and accounting process, and not just assign training cost to overhead. This elevates the importance of the training program and holds developers or implementers accountable for performance and results. After Puget Sound Energy (PSE) experienced over 700,000 customer outages in December of 2006, they bought in a consultant to review their storm preparation and response performance. One recommendation was to add training evaluation to improve training effectiveness, measure and analyze participation and test the skills acquired and/or maintained.

Select knowledgeable personnel and provide damage assessor training just before storm season – One key training area is damage assessment, a critical (sometimes bottleneck) function of the storm restoration process. If assessors are not properly trained to quickly and adequately describe and report damage, time and resources may be squandered, and the restoration timeline may be compromised. A leading practice among utilities is to select damage assessors based on their knowledge of the system and geography, and put them through an extensive training program just before the storm season. At PSE, a four-hour damage assessor training – for individuals with a reasonable understanding of the system – covers the following:

- Establishing the scope of a storm (short-lived or multi-day event) during the first 6 to 12 hours
- Setting an initial target of 24 hours for a complete assessment
- Defining the overall electric emergency event organization
- Setting work and environmental expectations for the assessors
- Defining proper damage assessment, practices and procedures
- Explaining the use of the damage assessment form
- Reviewing use and terminology of overhead circuit maps

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- Using the storm damage tag
- Reviewing potential safety issues and how to deal with them in the field
- Handling customer inquiries, and
- Reviewing general types of T&D equipment and structures

As with any training, it is recommended that damage assessment training be budgeted and tracked, and that assessment skills be tested and measured during storm drills or simulation exercises.

**Conduct annual storm drills to exercise and refine all phases of the emergency response plan**

A storm drill is a training exercise held by electric utilities, that tests the adequacy and effectiveness of storm-duty personnel (especially personnel performing job functions outside of their normal areas of responsibility) in implementing the utilities’ service restoration procedures. To be truly effective, the drill must simulate the timeline and impact of an actual storm-type and test the planning, tracking, pre-storm ramp-up, mobilization and deployment capability, damage assessment and restoration activities, internal and external communications, and post storm tactics. This exercise requires careful planning and extensive coordination within the utility, and externally with the media, local and state officials, and sometimes, other emergency response organizations. Some state commissions mandate that utilities conduct storm drills as part of their annual emergency planning, but other states leave the decision to the utility. For example, the New York State PSC clearly outlines purpose, definition, and extent of storm drills in NYCRR16 Part 105, but gives the option to certify that all requirements of the definition are met in the ERP, in lieu of an actual drill.

Regardless of a PSC mandate, a best practice among utilities is an annual exercise of emergency response capability via a simulated storm scenario involving contacts with outside agencies, local governments and others who are typically involved with service restoration responses. Among DSTAR utilities responding to the storm survey, 70% conduct storm drills on an annual or semi-annual basis, but only Exelon reports that state and local emergency responders are invited to participate in the drills.

History and location typically determine the type and timing of drills conducted. Across the Northeast and Midwest, it is common to conduct winter storm drills in late fall. Baltimore Gas and Electric, for example, conducts a Winter Storm drill in November, incorporating personnel across Central Maryland, the Operations Center, Customer Communications Center, regional command centers and staging areas. Most large utilities in the South and Southeast (Duke, Progress, Southern, etc.) and some mutual aid organizations, like the Southeastern Electric Exchange conduct storm drills before the hurricane season, in late spring. One leading practitioner is Florida Power and Light (FPL). In a press release, FPL vice president of distribution Geisha Williams commented, “every year we train our employees and practice different scenarios because we know that every hurricane is different and each brings with it its own set of problems. We practice our dry run as if it was a real storm. We countdown from 72 hours until the hurricane makes landfall and follow through with the storm event post-landfall to study what significant problems we might encounter. The lessons we learn are captured and incorporated into a preparedness plan.”¹ The May 2007 mock exercise, Hurricane Max, was originally a category 5 moving across the Atlantic, weakened to a category 3 as it it moved onshore in North Palm Beach, crossing the state, and exiting as a category 1 storm through Charlotte Harbor on Florida’s West Coast. The extended realistic simulation allows FPL storm response personnel to become familiar with their roles in advance of a real emergency.

Use outside consultants or advisors to observe storm drills and make recommendations – Oftentimes, company personnel are so close to their own procedures, or so familiar with them, that it becomes difficult to recognize deficiencies, think outside the box, or be innovative. A good industry practice is to have knowledgeable outside observers at the storm drills to provide constructive feedback. Entergy has extensive storm response experience, having won either the Edison Electric Institute’s Emergency Response Award or its Emergency Assistance Award for seven consecutive years. At their annual spring storm drills, an outside consultant watches and makes recommendations for improvements.

2.2.3 The Final Word on Preparation

Although it certainly helps, no amount of planning, preparation or drilling can recreate the real thing. In Entergy’s April 2005 drill scenario, a Category 4 hurricane impacted New Orleans with 20 feet of flooding. Following meetings with local officials and media in May, planned action items included:

- Upgrading the evacuation process
- Launching an internal “IE StormNet”
- Upgrading the external website
- Improving outage mapping applications
- Incorporating lessons of 2004 Florida storms

In August of 2005, Hurricane Katrina made landfall along the US Gulf Coast. The levee system in New Orleans failed catastrophically, and Entergy’s worst-case scenario, as it played out in the drill, was exceeded several-fold. Early reports estimated that 123,000 would be unable to accept service for an extended period. After the storm, outages peaked at more than one million customers in Louisiana and Mississippi, and damage exceeded anything Entergy had ever experienced. Peers, officials, and even the media hailed Entergy’s post-Katrina restoration performance as heroic (see cartoon below from a local paper). Among the key success factors identified in the post-mortem were (1) a clear command structure, (2) plan for “worst case scenarios” and (3) practice – formal drills. Enough said.
2.3 Early Warning and Tracking

The argument for early warning and tracking is easy to make. The value of advanced knowledge in the pre-storm buildup has been well recognized and demonstrated both by its absence and presence in major storm experiences across the country over the last decade. Three illustrative cases are described below:

Case 1: AmerenUE August 2005 Thunderstorm

On Saturday afternoon August 13, 2005 at approximately 4:00 p.m., a series of thunderstorms developed over central and eastern Missouri, moved into the St. Louis metro area and passed into western Illinois. By 5:00 p.m. AmerenUE reported 151,000 customers out, and before the event was over, approximately 217,000 customers lost power. However, for hours after the storm passed through AmerenUE’s service territory, AmerenUE did not know the extent of the damage; the National Oceanic and Atmospheric Administration (NOAA) had not yet reported any information regarding the downbursts.

NOAA later informed AmerenUE that the thunderstorm had contained downbursts – straight-line winds of at least 75 mph – that were sustained for as long as five minutes. When AmerenUE overlaid the map of downbursts on the outage map at the height of the outages, areas with the highest number of outages were where the downbursts occurred (ovals on map to the right). While this is excellent information to explain the damage and would have helped AmerenUE know where the most damage was, so that it could have more efficiently directed its resources, NOAA could not furnish this information on a real time basis.

Case 2: Utah Power 2003 Holiday Storm

A severe winter storm hit the Wasatch Front late in the evening, on December 25, 2003. The storm gathered strength in the early hours of December 26 and continued unabated until December 31. The heavy – and continuous – snow brought down power lines and damaged essential electrical equipment, leaving about 80,000 customers without power at the height of the storm, 190,000 customers without power at some point during the storm, and about 2700 customers out for several days following the storm’s initial impact.

The magnitude of the storm was unexpected. Neither local meteorologists nor the National Weather Service had forecasted such severe storm conditions. Because of the extent of damage and the severity of weather conditions, it quickly became apparent that the company was inadequately staffed to immediately respond to the storm, because of lack of advanced warning, and the number of employees on vacation.

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m Staff Report on AmerenUE’s Storm Restoration Efforts Following the August 13, 2005 Severe Storm, http://www.psc.mo.gov/electric/UE_Storm_Rest_Report_2005.pdf
Case 3: BGE September 2003 Hurricane Isabel

Baltimore Gas and Electric Company (BGE) began monitoring Hurricane Isabel on September 6th, 2003 as a tropical depression off the Southern Cape Verde islands (almost two weeks before landfall). On September 8th a Mid-Atlantic Mutual Assistance (MAMA) conference call was held. By Thursday, September 11th, Hurricane Isabel was classified as an extremely dangerous category-5 storm, with sustained winds of over 160 mph; another conference call was held.

Based upon Hurricane Isabel’s intensity and forecasted track, on Monday September 15th, BGE initiated its Severe Impact Storm (SIS) procedures. After contacting the MAMA, the Southeastern Electric Exchange (SEE) and Edison Electric Institute (EEI), BGE premobilized 300 external, overhead construction crews and 85 external tree crews. Throughout the week, as the storm weakened and shifted, BGE continued to monitor the progress and increase crew commitment.

On Thursday, September 18th, Isabel made landfall as a category-2 hurricane on the Outer Banks of North Carolina with sustained winds of 100 mph. The size of the hurricane stretched more than 300 miles in diameter. By late Friday, September 19th, almost 2 million customers were without electricity including more than 790,000 in BGE territory. Because of preemptive action and advanced warning, BGE was able to mobilize the largest workforce in its 200-year history, and restored power to the last customer who was able to receive power on Friday, September 26th, only one week after the storm.

2.3.1 Storm Predictability

One key point that the three cases illustrate is the inherent difficulty in predicting and forecasting certain storm events. Some storms have very short lead-times, while other events afford greater latitude for planning and mobilizing. In a survey, DSTAR members were asked to provide their average advance warning time (in hours) for various types of storms. The results are summarized on the chart to the right.

* Baltimore Gas and Electric Company Major Storm Report: Hurricane Isabel
By a wide margin, DSTAR utilities have a much longer lead-time for hurricanes than they do for any other type of storm. Typically a utility has 3 to 5 days of advanced warning that a hurricane is headed its way. The National Hurricane Center’s (NHC) standard lead-time for hurricanes is 5 days, but it could be more for a well-developed storm coming from the Atlantic. The lead time could also be a lot less for a depression that develops quickly into a hurricane, such as Ophelia in 2005, or a hurricane that makes a sudden sharp turn, as Charley did in August 2004. Within minutes of the Florida coast on a Friday afternoon, Hurricane Charley, baffled scientists by suddenly strengthening and making a last-minute swerve to the right (see chart) striking 70 miles south of where it was predicted to hit, flattening the Florida town of Punta Gorda in Lee County, killing several people and injuring many others. A large number of residences and businesses in Lee County lost power during the storm, some remaining without for as long as a week. Bill Swank, Florida Power & Light spokesman commented, "I don’t know that we expected (the hurricane) coming down there and being the category that it was."^n^p

Tornadoes, on the other hand, predictably, have the shortest lead-time reported by any utility. Advanced warning may be several hours during an active spell, severe thunderstorms or other conditions that spawn tornadoes, or much less than an hour for sudden outbreaks. Across the US, tornadoes are most common in the Midwest and Southeast, and a few areas in Northeast. Overall, Oklahoma has a higher tornado density than any other state. Fortunately, tornado damage tends to be confined along a relatively narrow path; consequently, power outages and infrastructure damage is more contained than during most other types of storms.

Winter storms (ice storms and snowstorms) are more frequent in the Northeast and Midwest, but are often very devastating when they occur in other parts of the country like the Southeast because utilities in these areas have less experience preparing for and dealing with winter storms. Also systems may not be engineered for unusual levels of ice loading. DTAR utilities report typical lead times of ½ a day to 2 days for snowstorms and ½ a day to 1 day for ice storms. In general, conditions for ice storms are much less predictable than snowstorms because the mechanics that lead to icing are less well understood than those of snow and rain. Utility workers also report that ice storms are some of the most difficult storm conditions to work with, even more so than hurricanes. Consider the excerpt below from a 2001 T&D World Magazine article.^q^q

Workers say ice storms are more harrowing than hurricanes because, although hurricanes pack an enormous punch and can create incredible damage, they generally clear out after a short burst. Aside from the dangers associated with flooding, crews say work can proceed apace in the aftermath of a hurricane. Ice storms, however, present a different challenge, with conditions usually remaining treacherous for days after a storm has passed, particularly in a northern climate where the temperatures may not rise high enough to melt snow and ice for weeks or months.


Craig Ivey, vice president of distribution operations for Dominion Virginia, says ice storms also are
tougher because they are harder to track or predict. “We can usually see a hurricane coming for days in
advance and have some ability to prepare for it,” he says, adding that, however, “Many ice storms in the
South are predicted to be an all-rain event. So you don't know until you are in it how bad it is going to
be.”

Windstorms, thunderstorms and lightning are all related to similar meteorological
conditions and often occur together. In
addition, thunderstorm conditions spawn
tornadoes and influence hurricane strength
and direction. Lead times reported by
DSTAR members are better than for
tornadoes, but a lot less than hurricanes.
Thunderstorm conditions may be predicted
a day or 2 in advance, but typical lead
times are 6 to 15 hours. Lightning in
particular tends to be less predictable than
thunderstorms or windstorms, with a
minimum lead time of a few minutes, in
some cases. The frequency of lightning incidents varies significantly across the country, with the highest
dodaknatic levels seen along Gulf coasts of Florida, Georgia, Alabama, and Mississippi, and pockets of the
Midwest (see chart on right). Utilities can procure lightning visualization/alert information from a number
of vendors who use either the National Lightning Detection Network (NLDN) or the United States
Precision Lightning Network (USPLN) to map and track lightning strikes within a utility’s territory.

Heat storms or heat waves are extended
periods of extremely hot weather that
cause demand to increase dramatically
(due primarily to air conditioning loads)
and can lead to extensive equipment
overloads, failures and subsequent
outages. Heat waves are associated with
powerful thunderstorms known as
derechos, with high winds that can
severely damage electrical infrastructure.
The great North American heat wave of
July 2006 (see chart on right) created a
series of severe wind events across a wide
swath of the country including the middle
Mississippi River Valley, particularly St.
Louis, which was hit twice by powerful derechos. Nearly 950,000 Ameren customers in Illinois and
Missouri (over 3,000,000 people across the region) lost power, some more than once, and many did not
have their power restored for weeks. Meteorologists predicted the heat wave several days in advance, but
the associated derechos that caused the majority of outages were less predictable. Typical lead times
reported by DSTAR members for heat waves is 1 to 2 days, but experience has shown that warning time
could be as much as five days. Meteorologists predicted the great Chicago heat wave of 1995 that killed
about 600 people at least a week in advance, but reports indicate that the city was slow to react to the
emergency.
2.3.2 Weather Prediction and Advanced Warning Measures

There is no single company that has cornered the market on weather prediction. Because it is an inexact science, distribution utilities tend to gather large amounts of overlapping information from several credible sources, and then distill, interpret, and project (based on history and experience) what it means for their service territory. Sources for weather data include public sources like the National Weather Service (NWS), media sources and their Websites, and private/commercial meteorological services. The NWS maintains a database of Industrial Meteorology that has websites and contact information for private sector organizations, including consultants and information service companies, which provide weather data, services and products (http://www.nws.noaa.gov/im/). In addition, there are several commercial applications available to filter and interpret severe weather information and assess the potential for disruption. Some of these services and products are briefly discussed in this section.

NOAA National Weather Service

According to the survey results, most DSTAR member utilities use information from the National Weather Service (NWS) for storm warnings. The NWS, run by the National Oceanic and atmospheric Association (NOAA), provides weather, hydrologic and climate forecasts and warnings for the U.S. and its territories. NWS data and products can be accessed and used by individuals, government agencies, and public and private companies, including electric utilities. The NWS also runs the National Hurricane Center (NHC), which issues warnings, forecasts and analyses of hazardous tropical weather from May 15th, in the eastern Pacific, and June 1st in the Atlantic through November 30th.

Distribution utilities and other entities have access to NWS products in a variety of ways:

- **Internet** – The NWS and NHC websites (http://www.nws.noaa.gov/, http://www.nhc.noaa.gov/) are comprehensive repositories of up-to-date and historical weather data, including alerts and long-term predictions. The websites include RSS and CAP/XML feeds of alerts and advisories.

- **Radio** – The NWS operates a nationwide network of radio stations known as the NOAA Weather Radio (NWR), which works in conjunction with the Emergency Alert System to broadcast warning information for all types of hazards and severe weather like hurricanes, tornadoes, floods, high winds, thunderstorms, tropical storms, chemical spills and fires.

- **Wire service** – The NWS operates the NOAA Weather Wire Service (NWWS), a satellite data collection and dissemination system that provides the state and Federal government, commercial users, media, and private citizens with timely information. NWWS delivers severe weather and storm warnings to users in 10 seconds or less from the time they are issued.

- **Data feeds** – The NWS also operates an Emergency Managers Weather Information Network (EMWIN), which uses radio, satellite and Internet broadcasts to disseminate a live stream of weather and other critical emergency data. Various vendors have developed products to relay EMWIN information via text messages, email and voice to pagers, cell-phones, PDAs and other devices (http://www.weather.gov/emwin/winven.htm).

Public News, Media and Internet Sources

Local radio and television stations are usually good sources for current information on events that affect a more contained area, or events that are moving across a territory, including tornadoes, thunderstorms and lightning. Often, trained storm spotters call in tornadoes, wind gusts and storm damage to local media stations. Local media websites are another excellent source of information for local multi-day forecasts, tracking information, and historical storm data.
National media websites and other public websites offer a rich source of freely available information. Some of the more popular Websites, mentioned by DSTAR utilities (and others) for national and local weather include:

- Accuweather (http://www.accuweather.com/)
- CNN Weather Center (http://weather.cnn.com/)
- Intellicast (http://www.intellicast.com/)
- USA Today (http://www.usatoday.com/weather/default.htm)
- Weather Channel (http://www.weather.com/)
- WeatherBug (http://weather.weatherbug.com/)
- Weather Underground (http://www.wunderground.com/)
- Yahoo (http://weather.yahoo.com/)

Many of the private and commercial meteorological vendors, listed in the NWS database of Industrial Meteorology (http://www.nws.noaa.gov/im/), also provide weather updates on their websites.

**Private and Commercial Meteorological Services**

The primary goal of public services, particularly the NWS, is to protect the public and prevent loss of life. As a result, they tend to err on the side of caution. Also because they are a national service, standards used at the NWS to prioritize, rate and track storms do not necessarily meet the needs of companies that protect local assets. For this reason and others, most utilities report using private meteorological services. A few have even gone so far as having a meteorologist on staff, but this is not common.

Trained meteorologists provide private meteorological services; they generate forecasts and alerts for utilities, or filter and interpret forecast information to provide customized, targeted and actionable information for making local decisions. While there is a vast amount of publicly available information on all types of storms, the volume of data and complexity of the models often require a trained individual in the loop to resolve conflicts, provide a sanity check, and translate information for local impact.

Two revealing cases in September 2007 demonstrate the value of private meteorological services.

1. Hurricane Humberto struck High Island, Texas on September 13th, 2007 with winds of over 85 mph; it intensified from a tropical depression to a hurricane faster than any storm on record. The rapid increase of 50 mph within 18 hours of landfall surprised virtually everyone, including the National Hurricane Center, which commented in discussions, “it would be nice to know…someday…why this happened.”

2. Hurricane Felix came ashore as a category-5 storm on the northeast coast of Nicaragua on September 4th and set a record for storm intensification when it strengthened from a tropical storm to a category-5 hurricane in only 51 hours. Just about every computer model, including those at the NHC, failed to predict how quickly the storm would intensify.

These two cases help explain one reason why utilities use private meteorological services to supplement nationally available information. In the case of Humberto, meteorologists at companies like Impact Weather continuously tracked progression of the weak system for interested clients and provided constant timely updates, even before the NHC rated Humberto as a “hurricane”. When Humberto rapidly

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intensified, clients in the area were not caught totally off guard. This example underscores the uncertainty inherent in even the best computer models. In the case of Felix, some meteorologists knew it was likely to become a powerful hurricane because the storm was crossing deep warm water and did not encounter upper level winds that would have impeded its development. Based on this information, private meteorologists like Dr. Keith Blackwell of the Coastal Weather Research Center of the University of South Alabama issued appropriate warnings to clients in the area. Here is yet another example of why people – trained tropical meteorologists – are needed in the forecast loop.

Impact Weather and the Coastal Weather Research Center are two services used by DSTAR utilities. Other vendors reported in the survey include WeatherBank, Accuweather and WSI Corporation, but there are many others in use at other utilities and throughout the industry. From conversations with some of these suppliers, the added value to utilities is summarized below:

- Expert human filtering of voluminous, complex, computer generated information; a second opinion
- Clear, concise presentation of complex data with graphics and discussions
- Earlier warnings, longer lead times, more frequent updates and greater specificity than public sources like the NWS
- Detailed, targeted local forecasts and storm tracking information
- Translation of information into probabilistic or risk adjusted forecasts
- Customized websites where utilities can access information pertinent to their territory
- Triggers and thresholds that utilities can set for alerts; updates as necessary
- Near real-time (5-minute) radar
- Time-stamped lightning data/visualization and prediction
- 24x7 support, on-demand consultation, conference calls during storm mode, and executive briefings
- Flexible delivery options

**Commercial Weather Forecasting Applications**

These tools provide access to local satellite data on a desktop application. They are configurable and can be customized to the utility’s needs. Examples of these tools include MxVision WeatherSentry from DTN/Meteorologix, (http://www.meteorlogix.com/products/mxvision/weathersentry/weathersentry.cfm), Energycast Alert! from WSI (http://www.wsi.com/energy/products/alert/) and Co-op Cast from NRTC (http://www.nrte.coop/sub/utilitiesolutions/coop_cast.htm).

**Lightning Detection**

Lightning detection services provide real-time lightning information to utilities in the path of a storm. Since lightning is one of the largest causes of outages on T&D systems, advanced knowledge may allow utilities to preposition crews for faster response. There are two main lightning detection networks: Vaisala’s U.S. National Lightning Detection Network (NLDN) and United States Precision Lightning Network (USPLN). Both deploy a series of ground sensors which detect and report lightning strikes back
to a central analyzer which processes information on the location, time, polarity, and amplitude of each stroke. Vaisala (http://www.vaisala.com) provides data and support for the NLDN, while WSI (http://www.wsi.com) and TOA Systems (http://www.toasystems.com) provide lightning data and services for USPLN. In addition, there are several private weather companies (resellers) that offer lightning services based on data from USPLN (http://www.uspln.com/reseller3.html). Utilities that subscribe to either service would have access to lightning stroke data within seconds on their computer terminals for tracking storms. As discussed in Section 2.3.1, lightning and thunderstorm lead time is typically on the order of a few hours, but the availability of detection data increases the lead time, enables better response, and ultimately saves the utility money.

### 2.3.3 The State of the Art

The future of weather prediction will be characterized by a trend toward more site-specific detailed forecast information. Research is ongoing at the NOAA National Severe Storms Laboratory (http://www.nssl.noaa.gov/), university centers, and commercial labs (such as IBM Research) where they are looking into ways to use modern computer technology to improve forecast accuracy and precision.

One outcome of research at the NWS is a shift away from county-based warnings to more precise warnings based on storm boundaries. Known as storm-based warnings, the new alerts will, potentially, reduce a warning area from thousands of square miles to a few hundred square miles and subject fewer people to unnecessary storm warnings (see graphic below from the NOAA). The new system will initially be limited to warnings for tornadoes, severe thunderstorms, floods and marine hazards, but will eventually be expanded to include other threats like extreme heat.

Another technology with seemingly great potential is the Deep Thunder weather service from IBM. Deep Thunder increases resolution by using a mini-supercomputer to include additional information about the local area, like the topographic layout of a metropolitan area, which can affect weather conditions. IBM

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researchers claim that Deep Thunder can predict rain, wind and temperature conditions down to a one-kilometer resolution, and in time, they should be able to nail resolution down to individual streets.\(^v\) Greater forecast specificity can potentially have a tremendous impact on utility storm operations. Consider the AmerenUE August 2005 Thunderstorm discussed at the beginning of Section 2.3. Ameren discovered, after the fact, that knowing where the downbursts (and hence most damage) were occurring would have allowed them to direct their resources more efficiently. The NWS could not furnish data at this resolution, but this is exactly the kind of information Deep Thunder is expected to provide in the future, with appropriate radar data and local knowledge.

A case in point is the January 2005 severe windstorm in Westchester County, NY. The storm caused service disruptions to thousands of customers, some waiting up to five days to be restored. In its report to the NY PSC, Con Edison stated, “the forecast called for 20-30 mph sustained winds with frequent gusts as high as 30-35 mph, but actual sustained winds were 25-30 mph, with peak wind speeds of 55-65 exceeding the forecasted gusts by 20 mph and causing extreme damage throughout Westchester County.”\(^w\) The severity of the wind gusts was surprising to the utility, but a Deep Thunder operational forecast available on an internal IBM Website, 15 hours before the event predicted sustained winds of 35-45 mph across the county for January 18 (see map at right). If Con Edison had had access to this forecast the day before the event, they may have anticipated the major wind damage, leveraged resources to respond faster and perhaps avoided some lengthy outages.

The latest Deep Thunder update from IBM Research indicates that it is running on a regular, operational basis at the IBM Research Center for several metropolitan areas in the United States including New York City, Miami-Fort Lauderdale, San Diego, Chicago, Kansas City, Atlanta, Baltimore and Washington DC.\(^x\)

Based on conversations with weather professionals, the future will see steady progression in the application of weather data. There will be a trend toward site-specific forecasts with more detail and longer lead times. There will also be improvements in the reliability and user-friendliness of computer generated information, which at times can be cryptic, confusing and contradictory. The major challenges are predicting downdraft location in real-time with Doppler radar, accurately quantifying the risk or likelihood of event occurrence, and standardizing the fractured, highly competitive weather industry.


2.4 Predicting Storm Damage

In the DSTAR member survey, 6 of 11 respondents report using some in-house tool or process for storm damage prediction. The goal of storm damage prediction is to forecast the amount of damage a storm will produce, the resources required for restoration and the approximate time to restore service; it is an essential part of the storm management process, providing triggers for levels of storm center activation and crew mobilization, as shown in the graphic below.

![Diagram of storm management process]

Storm prediction is based on accurate weather forecast of elements that can damage the electric distribution system. This could be inches of ice accumulation on trees and overhead equipment for ice storms, peak wind speed and gust durations for hurricanes, and stroke proximity and frequency for lightning. Based on the history of storm damage, operational capability, and the susceptibility of the current design, expected damage and approximate crew requirements can be predicted.

Damage prediction for a substation area or feeder might include the location and extent of the following:

- Poles broken
- Transformers damaged
- Primary conductor down (miles or spans)
- Secondary conductor down (miles or spans)
- Customers out
- Trees down/damaged

Prediction tools range from simple storm classification, based on current data and past information, to more sophisticated computer models that take into account other system variables. The former, less sophisticated approach, is more common among utilities because it uses readily available information and in-house expertise. An example is the simple but effective, and widely used storm classification matrix.

2.4.1 Storm Classification Tables

The storm classification approach, in its simplest form, attempts to match the intensity of a forecasted storm with damage caused by past storms with similar characteristics. The classification table or matrix is developed and refined over time based on operation history. A good classification system has several levels of storm intensity with clearly defined weather conditions and indicates, at least, the number of customers projected to be out and estimated restoration times.

The table below shows the storm classification matrix Con Edison used during the January 2006 Windstorm in Westchester County. An excerpt from the storm report provides an explanation of how the matrix was used in their pre-storm mobilization.

On Tuesday, January 17, Bronx / Westchester Electric Operations conducted a prestorm meeting at 7 PM to discuss the current weather forecast and event classification. Based upon the forecasted weather, a

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level 1 storm classification was declared through 7AM on Wednesday. At 7 AM on Wednesday, after review of the 5 AM weather forecast and the onset of customers outages, still less than 1,000 customers out of service, we initiated an automated notification to all key personnel and established an Incident Command Structure to coordinate the recovery effort with a 7:30 AM mobilization meeting and a declaration of a level 2A response. Based upon increased customer outages, actual wind readings and field reports regarding damage, we increased our response levels to 2C and then to 3A by 1 PM on Wednesday.

<table>
<thead>
<tr>
<th>STORM CLASSIFICATION MATRIX</th>
</tr>
</thead>
<tbody>
<tr>
<td><strong>Storm Category &amp; Plan</strong></td>
</tr>
</tbody>
</table>
| 1 - Upgraded                | 1               | - Thunderstorms, rain and moving fronts
                             |                  | - Sustained winds of 25-30 mph
                             |                  | - Frequent gusts of 35 mph +
                             |                  | - Condition is short to mid term
                             |                  | - Up to 6" Heavy, wet snow | U to 7,000                  | 8-12 Hours |
| 2A - Serious                | 2               | - Heavy thunderstorms, rain
                             |                  | - Sustained winds up to 30 mph
                             |                  | - Frequent gusts of 40 mph +
                             |                  | - Up to 8" Heavy, wet snow | Up to 9,000                  | 12-16 Hours |
| 2B - Serious                | 2               | - Heavy thunderstorms, rain
                             |                  | - Sustained winds up to 35 mph
                             |                  | - Frequent gusts of 45 mph +
                             |                  | - Up to 12" Heavy, wet snow | Up to 12,000                 | 12-20 Hours |
| 2C - Serious                | 2               | - Heavy thunderstorms, rain
                             |                  | - Sustained winds up to 40 mph
                             |                  | - Frequent gusts of 50 mph +
                             |                  | - Up to 15" Heavy, wet snow | Up to 15,000                 | 12-24 Hours |
| 3A - Full Scale             | 3               | - Severe thunderstorms, tropical storms, nor'easter type storms, heavy rains
                             |                  | - Sustained winds of 40-50 mph
                             |                  | - Frequent gusts of 60+ mph
                             |                  | - > 15" Heavy, wet snow | Up to 40,000                 | 1-2 Days |
| 3B - Full Scale             | 3               | - Tropical storms
                             |                  | - Hurricane Category 1-2
                             |                  | - Condition exists for 6-12 hours or longer | 40,000-60,000                | 2-3 Days |
                             |                  | - 60% Damage to distribution system | 60,000-80,000                | 1 week |
| Disaster Response           | 3               | - Hurricane Category 3-5
                             |                  | - Condition exists for >12 hours | >100,000                    | > 1 week |

Con Edison Storm Classification Matrix for Damage Prediction

### 2.4.2 Computerized Storm Models

An example of a more sophisticated damage prediction approach is the proprietary storm model used by Florida Power and Light. FPL developed their storm model in conjunction with on-staff meteorologists to forecast the type and extent of damage after a storm. Instead of a simple matrix or table, the model uses a damage curve to match wind speed with the estimated infrastructure damage. Progress Energy, Southern Company, Entergy and a number of other large utilities with hurricane exposure have also developed in-house models to predict storm damage. Progress Energy Carolinas has adapted their model for use in winter storms.
Computer storm models take into account additional variables that more simple approaches cannot accommodate. These can include topology, system design and layout, customer density and vegetation. Also, they draw from a more extensive history of weather conditions and storm damage. Consequently, computer storm models offer more accurate and localized estimates of damage and restoration times.

### 2.4.3 Commercial Applications

Commercially speaking there are not many applications available for storm damage prediction. Several papers discuss approaches and algorithms, and at least one methodology has been patented. But at this point, only one commercially available product has been identified through this study. The product, OutageCast™ from DTN/Meteorlogix, is built on technology developed by Kinetic Analysis Corp, ([http://www.kinanco.com/Real_time_impacts.htm](http://www.kinanco.com/Real_time_impacts.htm)). The diagram below shows the inputs and outputs.

![Diagam of Inputs and Outputs](Images/inputs_outputs.png)

**Inputs And Outputs For DTN/Meteorlogix Storm Damage Prediction Tool**

In their literature, the developers claim that OutageCast … *has the ability to compute damage along the track of any approaching storm*. The level of damage or loss to residential or commercial property and infrastructure is estimated using engineering-based damage functions. Predictions include percentage of generation plants, transmission lines, substations, and both concrete-reinforced and wood poles likely to be affected by the storm. In an interview, the vendors claimed that OutageCast is 98% accurate.

The tool was tested on FPL’s system during hurricane Wilma in 2005. The chart that follows illustrates a comparison of actual customer outages by FPL regions and outage predictions made 24 hours before Wilma’s landfall.

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**Notes:**

- **dd** Based on a conversation with Ron Baldwin, Utility Solutions, DTN
2.5 Emergency Response Organization

In November 2006 the Puget Sound Energy (PSE) service territory experienced unprecedented severe weather that caused the most extensive damage the electric transmission and distribution infrastructure had ever sustained. Severe December winds, preceded by record-setting-November rains, caused widespread damage to trees resulting in power outages throughout the territory. Over 700,000 PSE electric customers, representing nearly 70 percent of total electric customers, lost power during the storm. Within 3 days, 500,000 customers were restored, and 100% were restored within 10 days. An external consultant brought in to review PSE’s performance, concluded that one of the contributing factors to their success was a well-developed restoration organization, consistent with leading practices in the electric utility industry.

A well-designed emergency response organization (ERO) has the following elements clearly defined:

- Command structure
- Critical positions
- Master personnel roster, with backups identified
- Formal process for communicating critical restoration information
- Mobilization and demobilization triggers
- Group to develop the restoration strategy
- Group(s) to manage and direct physical restoration efforts
- Personnel assigned to managing:
  - Staging resources
  - Accommodations to rest crews
  - Feeding crews
  - Guiding foreign crews

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• Checklists for each position identified in the plan delineating responsibilities
• Personnel and support systems dedicated to providing timely information to the various stakeholders, and
• Liaisons identified to work with government agencies and other first responder organizations

The ERO should drive application and execution of the plan but be flexible enough to allow decentralized decision-making – the primary responsibility of the ERO is to implement the emergency response plan (discussed in Section 2.2.1). Therefore, application and execution of the ERP needs to be fully institutionalized within the utility. This means that the ERO should provide a framework for emergency response and coordinate activity consistent with the plan. However, the ERO should not be a bottleneck to “getting things done” in the field. During storm emergencies, decisions can generally be made locally ninety percent of the time, which results in faster restoration and improved customer satisfaction. The ERO should provide accountability for local operations without micro-managing and without excessive centralized control.

When hurricane Andrew hit southern Florida in August 1994, it was (at the time) the worst natural disaster in U.S. history. In total, more than 1.4 million customers were disrupted – 690,000 in Dade County alone – and some were out as long as 34 days. The most affected utility, FPL, instructed employees in storm leadership roles to “implement the plan and stick to it.” But managers, superintendents, crew supervisors, and coordinators of various restoration support functions were also given full authority to make decisions, creating an environment characterized by autonomy, independence, and flexibility within the restoration plan. A good example of this was the decision to divide the south storm headquarters boundaries into several smaller, more manageable areas. Dade County was divided into six areas, each with its own storm headquarters, crews, materials and supervisors, and enough support to restore service more rapidly. The FPL storm boss at the time concluded that the decision to subdivide the area proved to be, without a doubt, the reason why successful rebuilding was completed in such a timely manner.

2.5.1 Incident Command Structure

Within most utilities, there are two primary components of the storm organization, the emergency operations center (EOC) and operations bases. In various utilities, EOC may be synonymous with Central Dispatch, Central Operations, or Central Control. Operations bases may be synonymous with storm sites, storm boards, storm bases, storm centers, or regional/division service centers. The exact structure of the EOC and operations bases is different from utility to utility and can be extremely complex and convoluted for large utilities. However, there are several common, essential functions identified across the board. This section presents a generic structure, and functional descriptions of key positions.

The EOC sets the restoration strategy, makes key decisions, identifies and procures resources and directs and controls external communication. EOC personnel are responsible for interpreting the ERP and adapting it to changing circumstances. The following chart shows the generic structure of a typical EOC and the key positions. The definitions and responsibilities of the key EOC positions are also described below.

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**Essential Components of a Typical EOC**

**EOC Director/Manager** – provides strategic oversight and financial authority, and interfaces with executive management. The manager coordinates the EOC opening and closing, balances resources against system needs, oversees reporting and updates, and interfaces with other utility managers (operations, planning, engineering, substations). The manager may report to a director.

**Resource Coordinator** – ensures that all needed resources for restoration are provided, including repairs; supplies materials for staging areas. In some EOCs the resource coordinator may also be responsible for procuring external crews and contract workers.

**Logistics Coordinator** – manages the logistics of setting up and maintaining staging sites, transportation, lodging, security, meals, water and ice, laundry, etc. The logistics organization has a coordinator for each activity, who reports to the logistics coordinator.

**Crew Coordinator** – allocates foreign crews as needed, coordinates crew registration, movement and tracking; may or may not be tasked with procuring external crews, but provides status updates and identifies the need for additional crews (may be pushed down to the operations base).

**Service Area Coordinator** – supervises restoration service according to company priorities, coordinates field operations and crew placement, coordinates switching procedures and serves as a liaison for other utilities (telephone, cable, water, gas, etc.).

**Communications Coordinator** – responsible for all communication with external media and stakeholders. May also bear responsibility for the integrity of communications infrastructure. But this responsibility may be pushed down to the operations base or shared with IT management.

**IT Management** – provides resolution oversight for all mission-critical tools including SCADA/EMS, OMS, GIS, CIS, IVR, etc., computer networks, and some communications systems. This has lately become an essential component of the EOC. Actual failure resolution may be performed at the operations sites.
2.5.2 Operations Bases

The response strategy is executed at operations bases. A typical utility has several, each covering a defined territory, staffed with a storm manager and all positions necessary for restoration in the area. The following chart shows the organization of the operations bases at Puget Sound Energy. Key staff positions are also described below.

**PSE Operations Base Organization**

**Storm Manager** – directs and manages storm operations and all restoration activities in the area, assesses resource needs, prioritizes restoration activities and coordinates with EOC, damage and crew coordinators

**First Response Supervisor** – supervises and monitors local area first responders (servicemen) and dispatchers to ensure adequate response, reassigns or reallocates resources as appropriate, communicates information to EOC

**Storm Board Coordinator** – analyzes and tracks needed repairs and locations of assigned resources, receives processes and packages information from servicemen, call takers, assessors, and other field personnel, reviews and prioritizes emergencies reported via 911 agencies

**Crew Coordinator** – oversees line crews, and ensures field resources are deployed efficiently for safe, timely restoration. The contract crew coordinator may report to the crew coordinator. The contract crew coordinator leads foreign crews and ensures that they are informed of required safety, construction, and operating standards

**Damage Assessment Coordinator** – oversees and coordinates damage assessment and restoration prioritization, assigns personnel for damage assessment duty, ensures that storm board and OMS are updated and communicates status and location of assessment teams

**Communications Coordinator** – ensures that critical customer loads are identified and prioritized, monitors outage impact on key accounts, coordinates with EOC to ensure local notifications and updates are consistent with corporate communications, responds to specific inquiries from major accounts, provides information to local media and other organizations

*Wherever it makes sense, push EOC functions down to the operations bases to improve efficiency* – Every utility tailors its incident command structure to suit its own needs and particular characteristics. For
small utilities and coops, a strict division between oversight and operations functions may not be possible given resource constraints. For utilities covering a large territory, it could be more effective to move oversight functions out to the operating areas. In many cases, efficiency gains are achieved if some oversight functions are performed at the operations centers. Note that in PSE’s command structure, crew and communication coordination are operations base functions rather than EOC functions. The operations base crew coordinator oversees all aspects of the crew restoration effort. This may be accomplished more efficiently at the operations level, rather than having EOC personnel responsible for tracking crews. The operations base communication coordinator is responsible for local communications, but ensures that the message is consistent with corporate communications. This division of responsibilities moves critical oversight functions closer to where actual decisions are made.

During major incidents, it may be more efficient to subdivide operating areas into smaller units – Although it is generally more cost-effective to have fewer, larger operating territories, during major restoration projects, it is more efficient to relinquish control to smaller units. PSE’s storm organization has nine operations bases. However, during the windstorm of 2006, the damage was so widespread that it stretched the capability of operations bases. The decision was made to create smaller, more workable area coordination centers for some of the hardest hit areas. This provided more control over work in each area, and ensured that smaller communities were not forgotten.

Use the capability of modern outage management systems to command and control distributed, decentralized restoration efforts – Centralized dispatch is typically the focal point of coordination for operational practices such as restoration and switching activities. However, during major storms, high volumes of outages may require centralized dispatch centers to hand-off control to remote sites such as local line shops and districts to manage the workload. Historically, this was First Energy’s approach to managing high volume outage events. Emphasis was placed solely on ‘getting the lights on’ as quickly as possible. They would routinely divide the geographic territory into smaller, more manageable, areas and push responsibility down to the line shop level during major events. While this approach was effective in restoring service to customers, it compromised accurate and timely documentation of the outages and restoration effort, as well as the real-time feedback of information to customers and regulators.

The regulatory environment and changing expectations of customers with regard to information and access has forced FirstEnergy and many utilities to rethink their approach to storm restoration. It is no longer acceptable to turn over control of an event to the local line shop and essentially state “take care of the situation and call us when you are done or if you have a problem.” Regulators routinely scrutinize utility performance and customers, even in remote sites, demand estimated restoration times and progress information. With modern technology this informational “black hole” can be eliminated, or at least reduced. Outage management systems (OMS … discussed further in Chapter 5), allow the two-way transfer of information from the centralized dispatching office to various distant locations, enabling visibility and control over remote restoration operations.

First Energy implemented a new OMS and decentralization process in 2003 and had an opportunity to test it during a series of severe thunderstorms in May 2004. The system of thunderstorms caused over 680,000 customer outages and widespread physical damage to the distribution system, the largest in First Energy’s history at the time. However, according to reports, the new OMS coupled with the strong storm process featuring decentralization based on work type rather than geography resulted in a reduction in overall storm restoration time of 12 hours over FirstEnergy’s previous best effort for a storm of similar magnitude, saving the company over $2.2 million in man power costs by conservative estimates.99

99 Karl Fickey and Jim Tracey, ‘Divide And Conquer’ – Effectively Using an Outage Management System and Distributed Dispatching to Reduce Storm Restoration Times, DistribuTECH, January 2005
2.6 Activation and Mobilization

When a storm is imminent or storm damage occurs, management must decide the appropriate level of response for the event. Naturally, the extent to which a company should plan or mobilize resources depends on the type of storm, the warning or lead times and the expected damage. Once mobilized, resources can be staged and deployed, as illustrated in the flow chart below.

Experience has shown that the earlier the storm organization can be activated and resources mobilized, the more successful the restoration effort is. The chart below from the Southeastern Electric Exchange mutual assistance group illustrates some mobilization decisions faced by utilities during every storm.

Key mobilization questions and decisions include:

- When should the storm center be activated?
- When should crews be mobilize and external resources secured?
- How many resources are needed to reduce outages as desired?
- When should resources be increased, reduced or released?

Unfortunately, there is no textbook with definitive answers, but over the years a set of best practices and recommendations have evolved from various utility storm experiences. Some of these are discussed with pertinent examples in the next section.

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**SEE Mobilization Timeline and Key decisions**

2.6.1 Storm Center Activation

The first step in responding to a storm emergency is to activate the storm organization (discussed in Section 2.5). A best practice is to provide mobilization triggers for various stages of advanced planning.

**Develop a categorization method that prescribes levels of activation based on storm characteristics** – Categorization methods and activation levels can vary greatly from utility to utility based on factors like geographic location, size, customer base, etc. The results of the DSTAR member survey (see Appendix) illustrate the variations possible even with a small sample size. The charts below show two examples of storm activation levels, one for a large utility commonly exposed to tropical storms, ii and the other for a smaller utility more commonly exposed to winter storms.

### Example of Levels of Activation Based on Storm Severity

<table>
<thead>
<tr>
<th>Level 1</th>
</tr>
</thead>
<tbody>
<tr>
<td>- Estimated restoration time is 24 to 72 hours</td>
</tr>
<tr>
<td>- All personnel report to service centers if not on vacation</td>
</tr>
<tr>
<td>- Refer blocks of trouble to service center and refer crew work</td>
</tr>
</tbody>
</table>

<table>
<thead>
<tr>
<th>Level 2</th>
</tr>
</thead>
<tbody>
<tr>
<td>- Estimated restoration time is 3 to 7 days</td>
</tr>
<tr>
<td>- Service centers – full storm organization activation</td>
</tr>
<tr>
<td>- All storm organizational personnel contact their storm headquarters</td>
</tr>
<tr>
<td>- All personnel should report to service centers</td>
</tr>
<tr>
<td>- Possible staging site activated in needed areas</td>
</tr>
<tr>
<td>- Fully activate communication headquarters</td>
</tr>
<tr>
<td>- Fully activate phone centers</td>
</tr>
<tr>
<td>- Fully activate storerooms</td>
</tr>
</tbody>
</table>

<table>
<thead>
<tr>
<th>Level 3</th>
</tr>
</thead>
<tbody>
<tr>
<td>- Estimated restoration time is greater than 7 days</td>
</tr>
<tr>
<td>- Storm centers – full storm organization activated</td>
</tr>
<tr>
<td>- All personnel report to storm headquarters ASAP</td>
</tr>
<tr>
<td>- All trouble personnel report to work</td>
</tr>
<tr>
<td>- Staging sites fully activated</td>
</tr>
<tr>
<td>- Communications fully activated</td>
</tr>
<tr>
<td>- Phone centers fully activated</td>
</tr>
<tr>
<td>- Fully activate storerooms</td>
</tr>
</tbody>
</table>

### Wisconsin Public Service Storm Center Activation Levels

1. **Level Zero** *(normal conditions)*
   - Dispatching from Central Dispatch Center

2. **Level One** *(more than normal, less than 6 hours)*
   - Dispatching from Central Dispatch Center with added resources

3. **Level Two** *(more than 6 hours, less than 12 hours)*
   - Storm site mobilized for resource management
   - Dispatching continues from Central Dispatch Center with added resources

4. **Level Three** *(more than 12 hours, less than 24 hours)*
   - Storm site mobilized for resource management
   - Nearest Regional Dispatch Site is mobilized for dispatch of the storm site.

5. **Level Four** *(more than 24 hours)*
   - Storm site mobilized for resource management
   - Regional Dispatch site is mobilized for dispatch of the storm site or Storm Site assumes dispatching functions with resource assistance.

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2.6.2 Mobilization Timeline

Once the storm center is activated, appropriate personnel are mobilized to staff the various command functions. The level of activation also provides triggers for resources, both in terms of materials and crews. Other key decisions in the mobilization timeline are when to secure line and crew contractor commitments, when to request mutual aid support from other utilities, and when to release resources.

The example below from Baltimore Gas and Electric’s response to Hurricane Isabel illustrates a classic mobilization timeline for a major event, and offers insight into these key decisions.

**Baltimore Gas and Electric’s Hurricane Isabel Mobilization Timeline**

Hurricane Isabel struck the Southeast coast of the U.S. on September 18, 2003, causing widespread damage and flooding, and disrupting power to almost 800,000 customers in Baltimore Gas and Electric’s (BGE) territory. In response to the storm, BGE mobilized the largest workforce in its history – nearly 6400 people, including over 2800 external personnel mobilized from 27 states and Canada. The sequence of events leading up to and characterizing the mobilization (from BGE’s Hurricane Isabel Storm Report) is described below:

- September 6th, 2003 – BGE began monitoring Hurricane Isabel as a tropical depression
- September 8th, 7 a.m. – Mid-Atlantic Mutual Assistance (MAMA) conference call to discuss Hurricanes Fabian and Isabel and Tropical Depression Henri
- September 11th, 7 a.m. – Another MAMA conference call; Isabel continued to build strength and looks destined to affect the East Coast by the following week
- September 15th – Based on the hurricane track and intensity, BGE initiated its Severe Impact Storm (SIS) procedures and decided to pre-mobilize crews
- September 15th, 7 a.m. – BGE participated in a MAMA Conference Call where it formally requested the assistance of 300 external construction crews. Other MAMA utilities were also requesting aid. No commitments were received because of the threat to most of the East Coast
- September 15th, 9:30 a.m. and 5 p.m. – BGE participated in Southeastern Electric Exchange (SEE) Mutual Assistance Conference Calls and received commitments of 150 line personnel from Entergy and 107 line personnel from Southern Company
- September 15th, 6 p.m. – MAMA conference call, BGE learns that no MAMA utilities could provide assistance until after the storm had passed
- September 15th, evening – BGE began contacting Edison Electric Institute (EEI) member utilities and contractors within a 1000-mile radius of Baltimore and the leadership of contractor organizations within 500 miles to secure resources
- September 16th – BGE continued to monitor the weather and participate in daily mutual assistance calls as well as contact outside construction entities via the External Mobilization Team
- September 17th – By evening, about 150 external overhead crews were on the BGE system
- September 18th – Storm hits the East Coast; BGE continued to monitor and participate in daily mutual assistance calls
- September 19th – By early morning, an additional 134 overhead crews were pre-positioned to begin service restoration, bringing the total of pre-mobilized crews to 284 overhead and 85 tree
- September 19th – BGE received commitments for additional crews bringing the total to 308 external overhead crews and 135 external tree crews
• September 19th, 10 a.m. – It was decided to increase the number of external overhead crews to 450; commitments were secured by mid-afternoon

• September 19th, early evening – Based on the magnitude of the damage and number of customers impacted, it was decided to bring in a total of 600 external overhead crews and 190 external tree crews, and have additional crews ready to work by Monday, September 22nd at 5 a.m.

• BGE continued to participate in twice-daily Mutual Assistance Calls throughout the weekend

• September 23rd – After another storm caused another 56,000 outages overnight, the number of external overhead crews was increased by 40 and external tree crews by 10. BGE secured commitments from utilities to the north (PECO and PP&L) who were releasing contractor crews

In total, 711 total external overhead construction crews (utility and contractor) as well as 200 external tree crews were secured and deployed on the BGE system. The table below summarizes the outside assistance requested and received by BGE.

<table>
<thead>
<tr>
<th>Company</th>
<th># of Vehicles</th>
<th># of Crews</th>
<th># of Personnel</th>
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<tbody>
<tr>
<td>Ameren Utility</td>
<td>98</td>
<td>81</td>
<td>178</td>
</tr>
<tr>
<td>Asplundh</td>
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<td>446</td>
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<td>Cinergy</td>
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<tr>
<td>Davey</td>
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<td>Davis Elliott</td>
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<td>Dillard Smith Construction</td>
<td>33</td>
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<td>34</td>
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<tr>
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<tr>
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<td>5</td>
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<tr>
<td>Utility Line Construction</td>
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<tr>
<td><strong>Total</strong></td>
<td><strong>1,775</strong></td>
<td><strong>911</strong></td>
<td><strong>2,877</strong></td>
</tr>
</tbody>
</table>

Outside Aid Received by BGE During Hurricane Isabel
The preceding BGE case illustrates four good practices concerning storm mobilization:

1. **Identify and monitor the threat early on and activate the storm organization in a timely manner** – BGE began tracking Isabel 10-12 days before the storm hit using data and reports from several meteorological vendors. Even when the storm varied and shifted, BGE had enough information to make a timely decision. Early activation of the storm organization allowed BGE to begin putting resources in place long before the storm hit. Such early detection and tracking is not always possible, as some storms are more predictable than others, but technology is certainly improving (see Section 2.3). Utilities must make every effort to stay ahead of the curve.

2. **Make an early decision to pre-mobilize crews based on storm characteristics** – Three days before storm impact, BGE decided to pre-mobilize 300 external construction crews and 85 tree crews based on the storm track, and an assessment of potential damage based on storm intensity. BGE more than likely had some mechanism in place to predict storm damage. There are different ways to do this, from simple to sophisticated (see Section 2.4). But however it is accomplished, the results impact initial mobilization decisions. Even though BGE updated resource needs throughout the timeline, the initial decision on the number and types of crews provided a mobilization base that enabled eventual success.

3. **Preposition external crews and other resources based on anticipated damage** – Given that storms tend to compromise the transportation and communication infrastructure, it makes sense to place crews in or near locations where they are most likely to be needed, prior to the storm. This is of course subject to a variety of factors including geography, resources, and availability of safe-holding sites, but nevertheless, has proven to speed up restoration of critical facilities. During Hurricane Isabel, BGE not only pre-mobilized over 300 crews, but was able to pre-position crews to quickly commence restoration activities as soon as it was safe to do so.

4. **Continually review and update mobilization targets as additional information becomes available** – BGE revised the number of external crews it needed several times throughout the restoration timeline. The initial decision was to pre-mobilize 300 external construction crews. This target was updated several times in response to actual storm conditions, preliminary damage assessments, and some subsequent storm damage after the main event. Constant communication up and down the emergency organization enabled good decisions. Ultimately, BGE secured and deployed an additional 411 crews beyond the initial target.

Within eight days of Hurricane Isabel’s landfall, BGE restored service to all (non-flooded) customers who were able to receive power. By any standard, it was a successful restoration effort. The BGE storm report reveals that one key success factor was BGE’s extensive and proactive exercise of mutual assistance agreements, which were in place with several groups of utilities and contractors.

### 2.6.3 Joint Mobilization Process

A best practice among mutual assistance organizations is the use of a Joint Mobilization Process to address assistance issues. When a major storm threatens a member utility’s area, a conference call is initiated with all member utilities in the group. During these calls there is discussion of anticipated or actual damages, resource needs from affected utilities and resources available from unaffected utilities. This is a vast improvement over the days when threatened utilities would have to make dozens of calls among each other to figure out who was doing what and for whom. The graphic below shows the Joint Mobilization Process used by Southeastern Electric Exchange and other mutual assistance groups.

The joint mobilization process is illustrated in BGE’s response to hurricane Isabel. The mobilization timeline shows that BGE first participated in a MAMA conference call on September 8th during which the
participating utilities shared data on potential threats and jointly decided to continue monitoring. On another call three days later, the members decided Isabel constituted a threat. On September 15th, three days before landfall, BGE formally requested support from MAMA utilities. However, during joint mobilization discussions, other utilities in the region also requested additional crews and, understandably, could not release their own crews. The joint mobilization process allowed BGE and other MAMA utilities to quickly identify resource needs, resolve commitment issues, and make critical, timely decisions.

2.6.4 Mutual Assistance

In December 2006, a severe wind and rainstorm struck Seattle City Light (SCL) service territory, knocking out power to nearly 50% of its 375,000 customers. In the aftermath, SCL restored more than 60% of customers within 24 hours, 83% within 48 hours, and 90% within 72 hours. Although the response time for that level of disruption was comparable to other companies, SCL brought in an outside consultant to assess its response, internal processes, and technology and to provide recommendations for how it could meet industry best practices and improve future restoration efforts. Some key recommendations from the assessment concerned mutual assistance practices. This section summarizes some of the recommendations and findings from SCL’s review, BGE’s hurricane report, and other utility experiences with mutual aid.

Develop an internal mutual assistance plan that is integrated into the emergency response plan – The Emergency Response Plan (as noted in Section 2.2.1) provides a uniform, corporate-wide approach for managing an emergency. As such, an essential part of the plan is sending and receiving resources as part of mutual aid support. SCL’s consultants noted that mutual aid best practices begin with developing an internal mutual assistance plan. This should be integrated with the restoration plan and outline the specific processes and procedures for requesting mutual assistance and managing crews once they are on-scene, including making work assignments, housing, and deployment procedures. Plans generally also address the methods for requesting mutual assistance crews and the types of resources (types and size of crews) and equipment, voltage qualifications, work rules, and materials that the utility generally requires during large events. Recall that the New York State ERP directives in Section 2.2.1 required utilities to outline criteria and procedures for requesting service restoration aid from other utilities and contractors.

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Have strong mutual assistance agreements in place with groups of peer utilities and contractors – Regardless of utility size, an industry best practice is to have a written mutual aid agreement with other utilities or contractors who can provide personnel, material and logistic support during major disruptive events. There are many mutual assistance associations across the country, usually state- or region-based, serving investor-owned utilities (IOUs), municipals (munis) and cooperatives (coops). IOUs, especially those operating in multiple states, tend to belong to one or more large regional or national groups, in addition to state organizations. For example, We Energies is a member of the Wisconsin Utilities Association, the Great Lakes Mutual Assistance Group, and the Midwest Mutual Assistance Group. Southern Company is a member of the Edison Electric Institute (EEI) and the Southeast Electric Exchange (SEE).

For coops and munis, their size and location (particularly for coops) often dictates that they be more reliant on neighbors. A 2006 NRECA survey found that the majority of cooperatives (58%) indicate they have a written mutual assistance agreement with neighboring cooperatives, 21% with neighboring utilities, and 18% with their Statewide Association. Coops may also appeal for support from the NRECA, the national association that links statewide associations. For example, New Hampshire Electric Cooperative reports mutual aid agreements with Northeast Public Power, Northeast Electric Cooperatives, and the NRECA. Adams Electric Cooperative lists membership in the Pennsylvania Rural Electric Association (PREA) and the NRECA.

Maintain agreements with multiple groups and bilateral agreements with local and long-distance partners – During a major widespread event such as a hurricane, many utilities are impacted at or around the same time and securing aid can become a very competitive process. In the pre-event horizon, it may not be possible to get commitments from neighboring or regional utilities as they may be in the same predicament. A good practice is to maintain mutual assistance agreements with multiple organizations, including at least one regional or national group and to form additional bilateral agreements with local and distant utility partners. Good, solid relationships are key to obtaining commitments at a time when everyone else is vying for the same resources.

During the December 2002 major ice storm in North Carolina, 40 counties were impacted and over 2 million customer outages were reported. Two of the most severely impacted cities were Raleigh and Durham, a few miles apart, served by Progress Energy and Duke Power respectively. Although both utilities had substantial internal resources, they could not assist each other. In fact, both needed large amounts of external resources to work the storm. The diversity of their mutual assistance agreements, as well as relationships and arrangements with individual utility partners, allowed Progress and Duke to draw resources from 19 and 18 states respectively to restore their systems.

Develop and maintain relationships with mutual aid partners before and outside of storm events – During a storm event, despite the Joint Mobilization Process, the mutual aid arena becomes highly competitive. At times like this, established working relationships between utilities may be the difference between securing commitments and not … even for utilities in the same mutual assistance groups. With smaller utilities and coops, this becomes even more critical since the majority of coops depend on their neighbors for aid. A bilateral agreement is a good idea (as discussed above), but a good working relationship (at a corporate and personal level) is worth just as much – and maybe more – in crisis times.

Proactively exercise mutual assistance agreements to receive timely commitments before the storm – According to John Sherrod, Entergy’s former Storm Boss, the concept of mutual assistance is nothing...
new, but whereas it was viewed as more of a last resort practice in the past, it is now the first step in responding to a major event. This is due to the fact that utilities have reduced their own construction and repair workforces over the years, and customer expectations for prompt restoration have increased dramatically.\footnote{Brown, Steven, Mutual Assistance: Helping Hands in the Aftermath of a Storm, Utility Automation & Engineering T&D, May 2003} Under Sherrod, Entergy needed mutual assistance at least once yearly, which is fairly typical of a large utility. With so many utilities requesting mutual assistance every year, and often for the same events, utilities need to assess their needs early and be proactive in requesting support. The key is “timely” requests. Utilities don’t want to receive aid commitments too early because the situation can change, but they also need to get requests in before the resources are committed to others. A full ten days before Hurricane Isabel hit, BGE participated in an initial conference call with MAMA utilities. In the days leading up to the storm, BGE participated in many more calls with MAMA and other mutual assistance groups. Because they communicated \textit{early and often}, they were able to exercise all options to secure the commitments they needed.

\textbf{Expand mutual aid requests to include groups and utilities not threatened by the storm} – This might seem obvious, but it’s one of those things that may be overlooked until too late. When aid cannot be secured from primary partners, a well-timed decision to expand the request is necessary. However, the caveat is that too quick a decision, may lead to more expensive aid from farther away, when local aid may eventually be available. During Hurricane Isabel, BGE initially turned to MAMA utilities for aid. When the utilities in MAMA could not commit because they were holding over their crews as well as seeking aid themselves, BGE quickly turned to SEE and EEI members who were not threatened by the storm. As a result, they were able to receive the resource commitments they needed before the storm hit.

\textbf{Explore mutual aid relationships with cooperatives} – Cross segment aid between IOUs and cooperatives, is not very common, but that doesn’t have to be the case. During the July 2006 windstorms, Ameren reported that for the first time they received help from the surrounding rural electric cooperatives. Twenty-two of the cooperatives responded with 97 linemen supporting the restoration effort. After the event, the Missouri PSC recommended that Ameren “\textit{explore the structure of a mutual assistance agreement with the Association of Missouri Electric Cooperatives (AMEC) for future emergencies.}”

\textbf{Maintain contact with mutual aid groups and contractors throughout the event} – As Hurricane Isabel restoration progressed, BGE continued to participate in daily conference calls with MAMA, SEE, and EEI utilities and kept in contact with contractor organizations. When they needed extra crews after a subsequent storm caused additional outages, they were able to quickly pick up contract crews released from PECO and PP&L. BGE had no problem securing crews when it revised mobilization targets because it maintained communication with aid organizations and contractors throughout the restoration.

\textbf{Develop processes for forecasting, capturing and tracking mutual assistance costs} – During the restoration period, it becomes almost too easy to lose track of the cost of external resources and to justify additional “fire-fighting” expenses. Coordinators need to have a handle on who is onsite, where they are working, how many hours, where they are sleeping, whether they’re still needed, and countless other details that translate into cost. When this is done well, costs can be tracked and forecasted to limit post-storm “surprise” invoices. When it is not done well, companies are hit with unexpected huge invoices months after the storm for external support. It is certainly helpful to have a system in place to track and project mutual assistance costs.

Accurate tracking of personnel movement during restoration, especially external crews, is a first essential step toward controlling mutual assistance costs. One potentially useful technology is an application called Resources on Demand from Macrosoft, Inc. (http://www.macrosoftinc.com/resources_on_demand.html).
According to the vendors, the network-based, multi-user tool can manage resource requests, track personnel movements, and support logistics during a large-scale restoration event. The application features real-time integration with ARCOS, the widely used automated crew callout and roster management system. Microsoft lists several North American utilities as customers, including DSTAR members Duke and Ameren. ARCOS users include DSTAR members Southern Company, Exelon, Progress Energy and We Energies.

Another potentially applicable product was mentioned in a 2003 Utility Automation & Engineering T&D Magazine article.\textsuperscript{nn} The product, emPower from LeT Systems, was supposedly designed, in part, to help coordinate mutual aid operations. A recent search for this product, led to a workforce management product called eRespond (http://www.letsys.com/workforce.shtml), which is the likely successor. The eRespond solution includes an External Resource Management module that is “designed to help manage and administer non-company technical crews called in, for example, to assist in an emergency situation.” The product is used by several large European utilities, but Con Edison and TXU are the only U.S. utilities listed among its customers.

\textbf{Attend mutual assistance conferences and participate in post-event evaluations and benchmarking} – Several mutual assistance groups and trade organizations organize periodic conferences that allow utility members, contractors, vendors and consultants to network, exchange ideas, learn about the latest technologies and processes, and share experiences. For example, the Southeastern Electric Exchange (SEE) sponsors a three-day event in early summer called the Engineering & Operation, Accounting, Customer Billing & Finance Annual Conference & Trade Show. The Edison Electric Institute (EEI) sponsors a Mutual Assistance Conference in the late winter, in addition to its Annual Convention & Expo. There is a wealth of information available at these events to help utilities improve storm response.

It is not uncommon for mutual assistance partners to gather and analyze their collective storm response to figure out what went wrong and what went right. Lessons learned from these reviews can lead to valuable updates and revisions to internal plans, agreements, and procedures.

Benchmarking and recognition is another valuable outcome of mutual assistance conferences and performance reviews. Member utilities can get a sense of how their storm performance stacks up against their peer utilities, what separates the best-in-class from the rest, and how to close the gap. One of the larger mutual aid groups, EEI, annually hands out Emergency Recovery Awards for exceptional effort restoring power, and Emergency Assistance Awards for outstanding effort assisting in the recovery of their fellow utilities. The 2006 winners of the Emergency Assistance Award were:

- **American Electric Power** (Nineteen Events - Fourteen States - 2006)
- **Entergy** (Thunderstorms - Missouri and Illinois - July 2006)
- **FirstEnergy Corp.** ("October Surprise" Snowstorm - New York - 2006)
- **Georgia Power Company** (Hurricane Ernesto-Virginia - September 2006)
- **Indianapolis Power & Light** (Thunderstorms and Snowstorms - MI, KY, IL, & MO - 2006)

EEI also maintains a Web Portal, http://www.restorepower.com/ that facilities electrical utility power restoration needs before, during and after emergencies. Subscribers can search for information on utilities, contractors or vendors, post support requests, post resource availability and participate in discussions. Likewise, the SEE maintains a similar Web Site (http://www.theexchange.org/index.html) where members can log in to submit and receive information, request support and offer aid.

2.7 Materials Management and Logistics

Materials management and logistics form the backbone of a utility’s restoration effort. During the course of the event, the utility must ensure that personnel are properly fed, visiting crews have lodging, workers have access to materials and tools, trucks and other equipment are maintained and fueled, security is in place, transportation, water, ice and laundry and bathroom facilities are all available, and scores of other details without which work would grind to a screeching halt.

The logistics organization and the materials management (or inventory services) organization may be under one coordinator in some utilities. For example, in the Seattle City Light ICS, the logistics section also handles inventory management. In many other utilities (Florida Power and Light, for example), the sheer size and scope of the responsibilities requires that the organizations be separate, with individual coordinators who would typically have several sub-coordinators handling the various functions.

There are no distinct advantages to combining the two organizations, as opposed to keeping them separate as long as there is adequate communication and coordination up and down the chain of command, and between the coordinators. This is especially important in the staging area where there needs to be a clear delineation of duties, so that important functions (like fueling) are not compromised. The schematic below show the structure and responsibilities of a typical logistics organization (from Emergency and Disaster Planning Manual by L. Kaplan, 1996).

![Structure and Responsibilities of a Typical Logistics Organization](image)

Note that this is only an example of the responsibilities and division of labor – based on the FPL model. In practice the size of the utility and the scope of the restoration effort, ultimately determine the logistic challenge. As is evident from the schematic, logistic needs are in large part driven by the requirement to accommodate external resources.

The materials management organization is in charge of forecasting, planning, ordering, stocking, delivering, replenishing and controlling all materials, tools, fuel and other essentials needed by crews to perform restoration duties. In some utilities, selection and management of the staging site and provision
of onsite storage falls under this organization. The schematic that follows shows the structure and responsibilities of a typical materials management organization (also from Emergency and Disaster Planning Manual by L. Kaplan, 1996).

```
Inventory Services

Material
- Plan and distribute
- Material alternatives
- Identify critical material
- Coordinate delivery schedules

Staging Site
- Selection and management
- Provide storm kits and raingear
- Provide cots and beds
- MRE storage

Vendor Services
- Commitments
- Bids
- Contracts
- Auditing
- Billing

Fuel
- Prepare emergency fueling orders
- Ensure proper labeling of external crew vehicles
- Support to storerooms and staging areas

Tools
- Control and log tools
- Disburse and deliver tools to field

Reclamation
- Break apart material
- Coordinate to have material reclaimed

Salvage
- Pick up material
- Deliver to reclamation site
```

**Structure and Responsibilities of a Typical Materials Management Organization**

In general, logistical support and materials management are such key functions of the restoration effort that an industry best practice is:

*Have a formal logistic and materials management plan that is incorporated into the ERP* – The corporate emergency response plan (as discussed in Section 2.2) provides a uniform approach for managing an emergency. Several state regulatory commissions have already issued ERP directives to utilities, which include logistical planning. For example, one of the ERP directives from the NY State PSC (see Section 2.2.1), concerns support services, which are actions to be taken and personnel responsible for sustaining and supporting restoration crew activities, including vehicle management, foreign crew accommodations, and distribution of supplies. Another example is Ameren’s ERP (see Section 2.2.1), which lists the logistics planning elements that the plan incorporates. By having plans that pre-identify requirements and mechanisms for logistical support prior to an event, activities are more manageable during actual restoration. The logistic and materials management plans formalize the structure of the organizations and identify key personnel and responsibilities – based on the ICS model. Some of the best practices and lessons learned with regard to the various aspects of logistics and materials management are discussed in the sections below.

### 2.7.1 Materials and Inventory Control

Making materials available when they are needed is the key function of materials management. This encompasses an array of planning and estimation activities, as well as communication and controlling the flow of materials. Materials management receives estimates and specific requests from operating centers and must deliver materials to the appropriate sites in a timely manner. All the time, they must communicate delivery times and locations, update inventory, anticipate needs, and maintain contact with suppliers. The effectiveness of this organization has a direct impact on a successful restoration effort.
Standard industry practices for materials management include the following:

- A process for forecasting storm outage needs and assembling outage stock at operation bases or service centers before the event
- Procedures and channels to expedite materials handling and sourcing during restoration to keep pace with accelerated construction needs
- Plans to quickly replenish inventory in preparation for the next event
- Methods to monitor and track restoration costs with sufficient rigor to withstand scrutiny

These practices constitute a cycle for material management personnel, in that after every event, they need to begin anticipating and preparing for the next. Three days before the December 14th 2006 windstorm, the PSE materials management organization met to review recovery from earlier storms, and project materials needs. Materials delivery began the next day, and adjustments were made throughout the restoration timeline. An after-action review was conducted to evaluate performance, and preparation then began for the next event.

Another illustrative example is BGE’s materials procurement in preparation for Hurricane Isabel. Six days before the storm, after tracking data showed that Isabel looked destined for the East Coast, BGE reviewed stock levels for storm-critical items. Three days later, they expedited outstanding orders of critical items to ensure arrival before the storm hit, and initiated orders for additional key items. Pole and crossarm stock levels were increased substantially and arrangements were made with vendors for continuous supply. When Isabel hit on September 18th, BGE was well stocked with materials and was ready to respond.

Some industry best practices, and lessons learned from utility storm experiences include:

- **Pre-order and pre-stage materials near areas likely to be affected by the event, so that work can begin as soon as possible** – Prior to landfall of Hurricane Fran in 1996, Duke Power Company pre-staged materials and restoration crews in the northeastern portion of the service area. The result was that a concentration of available crews and materials were ready to begin restoration work immediately after Fran's passage, which aided in reducing the total storm outage time for customers in the affected regions.

- **Use inventory control applications to manage the flow between central purchasing and the field** – Most utilities utilize some sort of computer-based system to manage and track inventory. These range from homegrown spreadsheets, to sophisticated commercial applications integrated with accounting and work management systems. During a storm event, any miscoordination between the field and purchasing becomes heightened, and the consequences can have severe repercussions on the restoration effort. A properly designed, easy-to-use, flexible inventory management system allows operations centers to order and track restoration materials and expected delivery times, and allows materials management to expedite deliveries as needed.

- **Continuously monitor stock levels during the event and take prompt action on heavily-used items** – This is essentially a “no-brainer”, but still bears mentioning because it’s so fundamental to the effort. During Hurricane Isabel, BGE material management was challenged to keep enough stock to supply 5 service centers and 5 staging areas. In the height of an unprecedented event on

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their system, they managed to keep ample materials stocked at the service centers and staging areas. According to their Hurricane Isabel storm report, “this was the result of continuous stock monitoring, spot ordering and expediting to ensure prompt delivery of fast moving items. Materials Engineering Procurement and the Central Warehouse personnel were in constant communication to monitor the flow of stock. This allowed us to identify high use items before we depleted stock and adjust orders to track usage.” With an inventory control application, tracking and monitoring high-use items becomes easier as alert levels for particular items may be preset.

- Document material requirements and use documentation from prior restoration efforts to guide procurement.
- Document all processes used or created during the effort to source, procure and deliver materials on short lead-time.
- Arrange for critical materials to be stored on site as vendor stock that can be released on short notice with email confirmation to purchase.
- Pre-arrange for expedited shipping to ensure availability of transport as well as best pricing.
- Use helicopters to airlift materials to crews in difficult to reach areas or where timeliness is key.
- Prepare work packages and materials overnight so crews would be ready to move out first thing in the morning.

2.7.2 **Staging and Positioning**

Staging and positioning refers to all activities associated with setting up and locating resources (both personnel and material) near damaged areas so that work can begin as soon as possible, and proceed in an efficient manner. The staging site is a fully equipped and self-supporting service center for all logistic functions pertaining to restoration. Naturally, mobilization targets and resource plans are key factors in staging and deployment decisions.

### Criteria for Proper Selection of a Staging Area

- **Proximity to damaged areas**
- **Access to major roads, and proximity to railroads and ports**
- **Size, ability to accommodate a large number of vehicles**
- **Availability of utilities (gas, water and sewer, electric and communications)**
- **Length of availability (time of use)**
• Soil conditions (compacted, paved), terrain, grading and drainage
• Security and lighting provisions
• Whether or not the land is company-owned
• Environmental restrictions/considerations

Staging sites should be agreed on before the storm and layouts should be developed – Possible stage sites should be scouted, verified and selected long before the storm season. Once the sites are selected, agreements should be signed with owners. The availability of the sites must be verified every year before the storm season and contracts and agreements should be updated. When the storm center is activated, pre-mobilization activities should not be hampered by the details of contract negotiations for staging sites.

For all sites under agreement, a physical layout should be developed in accordance with the physical characteristics of the land. The layout should specify, at a minimum, materials storage areas, parking lots, fuel and maintenance areas, and the location of dining and bathroom facilities. The diagram below is an example of a typical staging site layout, based on a schematic from Emergency and Disaster Planning Manual by L. Kaplan, 1996. Staging area layout diagrams should be documented as part of the logistic and materials management plan in the ERP.
You can’t work more people than you can logistically house and feed – This is precisely why logistics is such a critical storm response function. More crews will almost always speed up the restoration process, but the ability to care for the crews will always be a bottleneck. During Hurricane Rita in 2005, Entergy Gulf States learned this lesson the hard way. A report by the Texas PUC stated, “EGSI learned that its logistical support was a bottleneck. Facilities to house restoration workers were either not available or very limited. Inventory levels were very low for both the utility and suppliers. EGSI also had difficulties with back-up generators for its field radio service and other communication problems. EGSI concluded that its contractor and vendor lists need to be updated each year before the hurricane season.”

PGE also experienced logistic issues during their December 2006 windstorm. During the response phase, there were numerous challenges acquiring additional resources such as flagging crews, staging areas, shuttle transportation and hotels. After the storm, the utility reported that the “consensus among operations personnel is that while additional line or tree crews could have helped restore power more quickly, no resources were available to supply, house and manage additional crews.”

Contract self-sustained mutual-assistance crews to reduce staging and logistic needs where feasible – Since the ability to care for crews will always be a bottleneck, as discussed above, some of the logistic burdens can be eased by contracting self-sufficient, autonomous work crews, where it makes sense. Many utilities are already migrating away from full command and control of every single foreign crew, so this is just another logical step. In addition to linemen and first-line supervisors, modern mutual assistance teams may also include safety patrol and damage assessment teams, logistics experts, materials coordinators, refueling teams, caterers, and security. This permits the receiving utility to increase the workforce without significant increase in management and logistic requirements.

Pre-position crews near areas where heavy damage is expected – Before the storm hits, crews that have been pre-mobilized should be positioned in areas where the greatest damage is expected. In this case, a damage prediction process that forecasts not only the expected resources needed, but also the damage location is important. After the storm passes, assessors need to be in place and an adequate number of crews should ready for the first full day of restoration. The first day can set the tone for the entire effort. If the pre-deployment strategy is flawed, this could create additional problems. During the December 2002 ice storm in North Carolina, there were accusations that Duke assigned fewer resources to the Durham area than other parts of its territory. The subsequent investigation showed that Duke incorrectly predicted the extent and timing of ice build-up in Durham, under-estimated the damage, and did not position sufficient crews in the area for the first day of restoration. On the second day resources were redeployed from other areas where the damage was less severe.

Some other industry best practices, and lessons learned from staging experiences include:

- Provide shuttles to bus crews between lodging and staging areas so that vehicles left at staging sites can be restocked, refueled and serviced; trucks should be ready to roll when crews arrive.
- Train non-line resources to perform overnight stocking of trucks and job site material delivery, to allow line resources to focus on restoration; crews should not lose time restocking trucks in the morning or exhaust themselves restocking late at night.
- Install dedicated standby generators at service centers.

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90 PUC Project No. 32182, PUC Investigation of Methods to Improve Electric and Telecommunications Infrastructure to Minimize Long Term Outages and Restoration Costs Associated with Gulf Coast Hurricanes, August 2006


98 Response of Electric Utilities to The December 2002 Ice Storm, North Carolina Utilities Commission and the Public Staff September 2003, [http://www.ncuc.commerce.state.nc.us/reports/report.htm](http://www.ncuc.commerce.state.nc.us/reports/report.htm)
• Anticipate and address traffic problems at staging areas and work sites.
• Provide necessary services to the families of internal responding crews so that they can focus on the task at hand. Some utilities have reported hiring carpenters and electricians to repair the damaged homes of their employees, who do not have the time to tend to their own needs, providing special counseling, family care centers for dependents, and even special financial assistance (cash advances and loans).

2.7.3 Lodging and Meals

For the crews, lodging and meals coordination are perhaps the most critical logistic functions. If the health and well being of the workers is not a priority, nothing will be accomplished.

The lodging coordinator is primarily responsible for assigning hotel/motel facilities, arranging back-up or alternative accommodations, and setting up laundry service.

The meals coordinator secures commitments from caterers and vendors for hot meals, meals ready to eat (MREs), beverage, water, ice, tents, chairs and all other provisions to supply and distribute meals for the duration of the effort.

Some industry best practices, and lessons learned with regard to lodging and meals include:

• Establish and maintain support procedures and relationships, including agreements and long-standing contracts with hotels, motels, other lodging facilities (tents, dormitories, and trailers) and catering services.
• Have contingency plans in place for limited hotel/motel room availability. During an event it is not unusual for local hotels and motels to be either without power or inundated with displaced local residents. The lodging coordinator should anticipate this and have backup sites/accommodations and transportation in place. During Hurricane Katrina, in 2005, Mississippi Power learned this lesson when there was limited hotel/motel space available for first responders due to the large number of displaced residents. Mississippi Power relied heavily on sleeper trailers and tent cities to accommodate crews.
• If lodging cannot be arranged in hotels/motels in the general area, crews may be bussed short distances to other areas where lodging is available.
• Secure motels and hotels with onsite restaurants or catering facilities, and large parking lots that can accommodate large line trucks and other vehicles.
• Assume that no food or water will be available on day one, immediately following the storm. Instruct all reporting personnel to bring enough food and water to last 24 hours.
• Plan on providing MREs the first day of storm restoration and hot meals within 24 to 48 hours. A vendor should be contacted to deliver MREs to a designated location 24 to 48 hours before the storm, so that MREs can be distributed on the first day of restoration. Vendor agreements should be in place for hot meal service to commence within a day or two of the disaster.
• Have four or five local caterers ready to prepare and service boxed meals in case MREs and local suppliers fail to deliver. In addition, contact local fast-food establishments to back-up or supplement food supply.
• Arrange catering services that deliver meals to crews at their work locations (in the field), to alleviate the need for crews to travel from the work site to the staging area two or three times per day.

• Pre-register crews with hotels, collect all the room keys and make room assignments as the crews arrive.

• Provide written notification of company policies with regard to expense reimbursements, incidental hotel expenses, and personal long-distance calls.

2.7.4 Security and Safety

The staging area effectively becomes company work facilities, and security and safety provisions must meet or exceed that which would be provided at the company’s normal facilities. Security at the staging area should perform the following functions:

**Provide physical security** – The first line of physical security is security fencing all around the perimeter of the staging area (if possible). This is typically a chain-link fence, several feet high, that (a) provides a physical barrier and clear line of demarcation between the utility staging area and other property, (b) discourages random, uncontrolled access to the staging area, (c) directs vehicle and pedestrian traffic to pre-designated, monitored entry and exit points. The next line of physical security is an identification system (badges or access cards) that authorizes restoration and support personnel and associated vehicles to be in the staging area. Every utility already possesses some sort of corporate identification system for access to their facilities. This system can be extended to control access to the staging site by foreign crews, vendors, caterers and other personnel. The third line of physical security is security guard personnel, typically provided by an established guard contractor at the request of the security coordinator. Their general function is to observe and report irregularities, enforce the security identification system, and control the points of access. Security personnel should be onsite around the clock, 24 hours a day until the site is closed down.

**Protect company assets and investigate all security matters** – On some sites, personal items, materials (such as copper), and even vehicles have been known to “walk away” when left unattended. Security personnel are tasked with protecting assets from theft, misappropriation, vandalism and sabotage. All incidents of this nature are reported to and investigated by security. In addition to asset protection, security also investigates all criminal incidents, (assault, drug use, threats), and non-criminal offenses such as insubordination and conflict-of-interest.

**Provide law enforcement and military liaison** – The staging area security personnel must maintain good lines of communication with law enforcement and military operations centers. Even though they may conduct investigations, the powers of staging area security are limited. When criminal matters arise, local or state police must be called in to assume the investigation and make arrests, as needed. Security liaisons may also coordinate with police and military to provide escorts for crews traveling to trouble areas, traffic direction and control, and military presence, when needed.
3. STORM RESTORATION - RESPONSE

... and having done all, to stand. Stand therefore...

~ Ephesians 6:13-14

After all the planning, preparation, training, activation, mobilization, and logistical arrangements are completed, the only thing left to do is execute the plan … meaning, restore the system. In some ways, this is the most familiar aspect of the entire operation, as it simply calls on line workers to do what they have been trained to do – construct, repair and maintain electrical infrastructure. This chapter discusses the various restoration activities that take place after a storm and draws on numerous storm experiences to highlight industry best practices and lessons learned.

3.1 Storm Restoration Priorities

Restoration activity is generally guided by the utility’s restoration priorities. This is a high-level guide to the order in which systems should be restored, based on importance and criticality. The DSTAR member survey results (see Appendix) reveal that the restoration priorities are very similar across the utilities (as expected), with a few caveats. The general order is:

1. In utilities with transmission facilities, large transmission lines receive top priority, because without power from power plants, downstream restoration efforts are pointless. However, several utilities point out that work on transmission and distribution tends to proceed in parallel, since different resources are typically required for each.

2. Substations are restored next in order of priority to provide power to the distribution system. Again, this work may be performed simultaneously with distribution restoration since different resources are typically involved.

3. On the distribution side, several utilities report that cases where public safety is an issue, such as fire, police and wire down calls, take first priority (even over substation restoration at one utility). Some utilities have specific resources assigned to safety calls, so this activity may also proceed in parallel with distribution restoration.

4. Aside from safety calls, the first distribution priority for most utilities is to restore the main or three-phase backbone feeders that route power from substations throughout the system.

5. Emergency services, priority and high profile customers are restored next. These include police, fire stations, hospitals, life support services, public works, communications, media, airports, schools, etc.

6. Single-phase lines serving large blocks of customers are restored next. The general strategy is to restore the largest number of customers in the shortest time.

7. Lines serving neighborhoods and multiple customers are next in priority.

8. Individual customers are restored last because the fewest number of customers are involved, and if they are scattered, it takes more time to restore them.

As far as possible, supervisors and field crews follow the utility’s restoration process, but in practice it is always supplemented with good judgment. In the aftermath of Hurricane Hugo in the U.S. Virgin Islands, crews from the U.S. mainland were dispatched to help the V.I. Water and Power Authority (WAPA) restore the devastated island grid. Since staging and logistic provisions were limited, the foreign crews found that it was expedient to deviate every now and then from WAPA’s process and restore an individual restaurant, auto-repair shop, or gas station, so they could have access to services they needed.
3.2 The Field Restoration Process

According to former Entergy Storm boss, John Sherrod, “Getting the ‘boots on the ground’ and optimizing their effectiveness is the ‘bread and butter’ of restoration.” Knowing where on the ground to put the boots is just as important as getting them there; which is why, a best practice in the industry is to perform damage assessment immediately after the storm – before, crews are deployed to repair the system. This section describes the essential activities leading up to and including field restoration management, and discusses leading industry practices from utility experiences.

3.2.1 Damage Assessment

The time to restore a distribution system following a major event is highly dependant on a quick and accurate assessment of system damage. In terms of the process flow, this assessment follows staging and positioning (which should already be in motion before the storm), and should precede crew deployment and the performance of actual restoration activities.

Damage assessment scouts, also called field checkers, or spotters, evaluate storm damage before line crews are dispatched. Ideally assessors are personnel specifically selected for their knowledge of the system and geography, who have been put through a training program before the storm season. The role of a damage assessor is to patrol the feeders to identify trouble spots, evaluate the extent of the damage, and develop initial estimates of resources needed for restoration. The assessment generates critical information that helps to define the scope of the work, prioritize efforts and assign resources. The typical damage assessment process is:

- Scores of damage evaluators or damage assessment teams are sent out to survey all the feeders and taps.
- Assessors record and tally the number of broken poles, spans of wire down, damaged transformers, etc., and the location of the damage.
- Upon returning to the dispatch location (usually at the end of the day) the information is passed on to someone to prioritize the trouble and dispatch crews to perform the repairs.

Most utilities report that damage assessment comprises at least two (maybe three) phases:

**Phase I** – Initial or quick assessment in 1 to 4 hours to verify circuit status, determine worst hit areas, and provide an overall assessment of resource needs and restoration time.

**Phase II** – Detailed or full assessment in 24 to 48 hours to evaluate specific restoration needs for backbone feeder system. The 20-40-40 rule is in effect: 20% is completed as soon as possible, 40% within 24 hours and 40% by the second day.

**Phase III** – Potentially, a third ongoing phase may consist of field checkers working ahead of line crews to provide pole-to-pole evaluations, and estimates for smaller outages and facilities.

Damage assessment is effectively a bottleneck in the storm restoration process. Since crews will not typically be dispatched until assessment results are analyzed, foreign and local crews are idle while waiting for their assignments. This wait time can be quite expensive, up to $200,000 per day for 100 crews by some estimates (labor/overtime cost, truck cost, board and lodging for 2-man crews). Needless
to say, the speed and accuracy of data transfer to the operations center, impacts the length and cost of the overall restoration effort. A decision error during this period carries through the entire restoration process and can have a major impact on restoration time. This consideration has given rise to the emerging best practice …

**Develop processes/technology to efficiently collect and transfer damage data to operations center** – In many utilities, the damage assessment process is still manual. The teams would normally be supplied with systems maps and would record the damage on paper. The notes and maps are hand-delivered to the dispatch center to be analyzed, and may be entered into applications such as spreadsheets and Outage Management Systems (OMS). Other utilities report that results may be called in on radios or cell phones, emailed or faxed. Regardless of the mode of delivery, a recommended practice is to …

**Use standard damage assessment forms to document the location and extent of damage** – Standardizing the assessment forms, and training assessors on how to use the forms, will improve both the accuracy of data collection, and the efficiency of data transfer and analysis in the operations center. The forms should use checkboxes as much as possible, with ample room for elaboration. Circuit maps should be used to supplement the forms, not as the main data collection vehicle. The diagram below shows a page of a standard damage assessment form used by Progress Energy crews during 2005.
Even with standardized collection, the process may still suffer from inefficiencies in data transfer. While radios, cell phones, emails and faxes are certainly faster than hand delivery, the fact that results are entered into computer applications by hand, potentially adds time, cost and error to the process. The most recent best practice in damage assessment is to …

**Use mobile communication technology to streamline field assessment collection and reporting** – Many utilities currently use a wide array of technologies in normal operations and during emergencies. These include mobile computing, Geographic Information Systems (GIS), Outage Management Systems (OMS), Automated Meter Reading (AMR) and other communication networks. These technologies can be leveraged to significantly improve a utility’s response in an emergency, especially during the damage assessment phase.

There are several commercial companies and individual utilities that have produced, or are developing, expedited damage assessment applications that run on mobile devices such as PDAs, cell phones, GPS handhelds and laptops. New generations of these devices (such as the one shown to the right) either have GPS capability, or can be outfitted with capability. The mobile devices can provide electronic forms for damage reporting, and display digital circuit maps. With GPS capability, they may even automatically tag the damage location, down to a few meters. If communication networks are intact, data can be uploaded in real-time to back office applications such as OMS and GIS databases. With loss of communication, they can be seamlessly synched with the applications in the operations center, still greatly expediting the entire process.

One example of a commercial application is Intergraph’s OneMobile, part of its mobile workforce management (MWFM) solution. The screen capture to the right is a pre-defined digital form on the application. According to a 2006 press release from Intergraph, OneMobile provides an end-to-end, real-time information link between field service technicians and the corporate back office resulting in enhanced productivity and efficiency. With OneMobile, field personnel can use one geospatial user interface (GUI) to receive multiple types of work, view and redline facility map data, share resources across departments, and communicate with back-office applications. OneMobile supports workflows including design, inspection, damage assessment, viewing, routing, and dispatching.

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*a Mobile Workforce Management - Intergraph’s InService application enables you to dispatch, schedule, and remotely manage all types of field work, whether it be planned or unplanned, short term or long term, and connect mobile users to back office IT systems to maximize productivity in the field, [http://www.intergraph.com/utilities/mwm.aspx](http://www.intergraph.com/utilities/mwm.aspx).
Another example, from a smaller company, is GSI Work’s PocketScout application. In 2005, AEP and GSI partnered to develop a mobile application for storm damage assessment to improve AEP’s storm restoration process. The application, which can run on tablets, laptops, cell phones or windows mobile devices provides field checkers with all the tools necessary to capture material damage and crew requirements. The damage assessment coordinator can assign events to assessors through a Web portal and the data is uploaded to the OMS over a wireless communication link. The PocketScout has been deployed at AEP on Trimble pocket pc devices and interfaces with their GE PowerOn OMS. GSI claims that PocketScout has saved AEP a large amount of time (and money) in their overall restoration efforts.

On the utility side, there are several good examples of utilities that have extended their GIS applications to provide field tools for electronic damage assessment. Dominion, for example produced an application called Hazard Patrol (built on ESRI’s GIS suite) to collect and report hazard locations to the office, after their experience with Hurricane Isabel. According to Dominion, the project, was implemented in just two weeks, and was a success. Over 23,000 hazard locations were identified and several hundred thousand dollars was recovered from the ability to track non-Dominion owned joint-use poles that Dominion replaced during the restoration effort. The success of the project and proof of concept initiated a project to create a more sophisticated application with Mapframe, and several other utilities in the Southeast including Duke and Dominion.

Use recent technology such as smart meters to enhance damage assessment – Even as some utilities are seeing great gains in efficiency from using mobile devices for damage assessment, other newer technological advancements are enhancing and changing the damage assessment process. Traditional AMR systems are giving way to AMI or Advanced Metering Infrastructure systems that incorporate two-way communication capability to “smart meters.” Smart meters can provide “on-off” or voltage level signals via wireless communications, power line carrier or broadband over power line that can be picked up at the control center or by mobile devices carried by crews. In the field, this data can be combined with visual inspection to increase the information available to properly assess the damage. At the same time, the data can be automatically routed back to the OMS to provide an early estimation of customer outages.

Smart meter readings may also be collected via van drive-bys or helicopter flyovers. For widespread damage, and damage in hard-to-reach areas, helicopters can pick up the readings for a larger area, reducing the number of ground crews that must be deployed (or allowing them to be deployed to other areas).

Provide assessors with specific methods to estimate resource needs and restoration times – In most utilities, there is no quantitative or documented method or guideline for assessors to estimate resource needs and customer restoration time. Crew requirements in particular can be subject to the experience and “feel” of the assessor and may vary widely from assessor to assessor for the same situation. Since these estimates are critical inputs for mobilization and deployment decisions, a more rigorous, standardized approach would be valuable. A standard approach to estimation by all assessors, even if it is not the most rigorous, would enable better manpower decisions. For restoration times, assessors often assign the time to restore a block of customers by the time to repair backbone feeder damage. Therefore, the restoration time may be grossly underestimated for some customers if there is additional damage on the laterals and

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e Damage Assessment: The Key to Quicker Outage Restoration and Storm Recovery, Damon Dougherty, Executive Consultant - Outage & Mobile Workforce Solutions, Intergraph
services feeding them. For utilities with an OMS, if field damage reports are comprehensive, algorithms can generate more accurate restoration times. The point is that damage assessment training should be enhanced with methods and examples to more accurately estimate crew requirements and restoration times. These methods should be documented and included in the assessor kit.

**Start damage assessment as early as possible after the storm** – Since early damage assessment is so mission-critical to effective and efficient restoration, it makes sense to get the assessors out as soon as possible after the storm. Work should be performed at all available times, including at night, where conditions permit, and should not be constrained by other system repairs and activities. During the February 2006 severe windstorm in New York State, the winds dissipated by early Friday evening in National Grid’s Eastern Division, but the company put off the Phase I distribution damage assessments until Saturday morning, even though they continued transmission restoration efforts through the night. At the time, National Grid’s policy was to not perform damage assessments on distribution facilities affected by transmission outages until transmission service was restored to the distribution substations. Transmission was not restored until Saturday morning, which delayed the completion of distribution damage assessments until Sunday. These decisions came under review and criticism by the NY PSC which recommended that National Grid modify its distribution assessment procedures to ensure that:

1. Night hours are used effectively when working conditions permit, and
2. Damage assessments on distribution lines … are not delayed until the restoration of transmission service is complete.

**Some other damage assessment best practices and lessons learned are:**

- Use contractors to supplement damage assessment teams if there are not enough assessors to complete assessment in the target time. During the 2006 windstorm in PGE territory, there was such a shortage of qualified personnel that assessment in North King County took *more than a week to complete*. There are several contractors such as Osmose and others who offer services to fill the damage assessment gap during the restoration effort.
- Use field checkers in advance of tree crews to determine the types of crews and equipment needed in each area. This is essentially the Phase III damage assessment described earlier.
- Place damage assessors close to assigned areas and use night hours to perform Phase I assessments *where conditions permit*.
- Assign damage assessors to particular feeders and ensure that they are intimately familiar with the feeders they are assigned to patrol.
- Pair damage assessors with a driver to allow the assessor to concentrate on evaluation and reporting.
- Following the automated callback process, use damage assessors to check on pockets of customers still without power after all reported damage has been addressed.

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3.2.2 Public Safety Process

The goal of the public safety process is to protect the public and make as many hazardous situations safe in the shortest possible time. The most common public safety hazard on overhead systems is from arcing or downed wires. Other public safety concerns include open neutrals from secondary damage, contact voltages from energized underground facilities, and flooded metering equipment.

In the storm response survey (see Appendix), DSTAR member utilities reported that public safety was a priority and briefly described their processes for dealing with public safety issues.

- Southern Company’s Alabama Power: “If energized conductors are found to be on the ground, or if other public safety issues are discovered, those areas will be guarded by company personnel until the circuits can be switched off, or the problem repaired. In some cases local law enforcement will assist in this process.”

- Progress Energy: “Assigned personnel are partnered with the governmental EOC’s to clear intersections and other safety related issues as they are reported.”

- Exelon: “Wire watchers are used for public safety in the event of a down-wire, open neutral and other public safety concerns until a crew arrives and repairs the damage.”

- Wisconsin Public Service: “Send wire down guards or damage assessors to the scene to assess the situation and make the appropriate decision.”

- Palmetto Electric Cooperative: “First we will make sure the line is dead and cleared out of the way and not a public safety concern. We will then repair when we can get back to it.”

- Adams Electric Cooperative: “We have those extraordinary situations along with reports from 911 centers handled separately in dispatch. We break resources loose from the normal repairs to handle the ones that appear to be a safety issue.”

A leading practice is to have safety functions proceed in parallel with damage assessment. This is best done in three stages (although in practice some or all stages may be combined):

**Stage I** – Public safety patrollers respond to wire down calls from customers and public safety officials to assess the threat to public safety. An initial inspection is performed to determine if the downed wire is from the electric utility or another utility (telephone, cable). Safety patrollers are primarily responsible for communicating information back to the operations center, not performing repairs.

**Stage II** – Public safety standby personnel or wire watchers are dispatched to the scene to set up barriers and monitor the situation to protect the public. They are not responsible for assessing threats or performing repairs, but should have basic safety awareness training. Since training requirements are low, standby personnel can be drawn from the wider employee pool or even contracted. In some cases local law enforcement will assist in this process. During the peak restoration period after Hurricane Isabel, BGE had approximately 375 public safety personnel standing by downed wires.

**Stage III** – Cut and clear crews are dispatched to the locations where standby personnel are guarding downed wires to make the situation safe. These crews are qualified overhead personnel assigned to the safety function. Their main goal is secure the situation by switching off, cutting and clearing energized down wire, but they may also restore power if the repair is not time-consuming. During Hurricane Isabel, this became such a priority for BGE that additional construction crews were assigned to supplement the original 12 pre-mobilized cut and clear crews.
One particularly cogent observation about the safety patrol process, from a utility’s experience is that “you have to communicate clearly when down-wires are left as-is because they are CATV or telephone wires, so customers are not anxious and angry.”

During some storms, flooding may become an issue for utilities with underground construction. When conduits, manholes and vaults become flooded, facilities that are not normally energized, such as manhole covers, service boxes, lampposts, and even concrete sidewalks, may sometimes become energized due to conductive pathways created by water ingress into areas with poor insulation. This is a particular problem for underground facilities in central business districts during winter storms. Excessive amounts of salt, used to melt ice and snow, mix with the water and create an even more conductive solution. Utilities with this problem usually have well-developed public safety processes to address contact voltage issues during and after storms. These processes have been even more closely scrutinized (and possibly improved) due publicity from a relatively recent incident at Con Edison.h

As far as practically possible, detect and eliminate open neutral conditions on secondary wires – After the December 2002 ice storm in North Carolina, one of the recommendations from the North Carolina Utilities Commission (NCUC) was that the “utilities should make an effort to detect and eliminate open neutral conditions whenever practicable during the power restoration process. In particular, the utilities should inspect primary lines for open neutral conditions as power is restored.”i

The report stated that several customers complained to the NCUC about damage to their homes and personal property resulting from excessive electric voltage after service was restored. This was due to the fact that the secondary neutral wire was somehow damaged during the storm, and the damage was not detected when the line was energized. This condition may lead to excessive voltages (as much as 170 volts) on nominal 120/240 volt circuits, which could cause significant damage to connected equipment and even fire.

The commission understood that it is not easy to detect an open neutral in triplexed secondary wire, and that such conditions are relatively uncommon (less than 0.02% of Duke’s customers affected by the ice storm suffered damage caused by open neutral conditions). However, they concluded that “the severity of the potential damage and the danger of fires merit the utilities’ efforts to detect and eliminate the problem of an open neutral whenever possible. In particular, the Commission and Public Staff recommend that the utilities inspect primary lines for open neutral conditions as a part of the restoration process.”

In another example, after the February 2003 ice storm in Kentucky, undetected open neutral situations and faulty wiring repairs were factors in four house fires in the Lexington area investigated by KPSC staff. The investigation did not find that utility practices were directly responsible for the fires. However, they recommended that the methods of re-energizing services, and communication procedures with local inspectors need to be reviewed in a timely manner in order to limit the possibility of similar incidents in the future.j

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h In 2004, a lady was electrocuted while walking her two dogs on a wet street in the East Village, after contact with a metal service plate that was unintentionally electrified. Con Edison, was forced by a settlement with state regulators to spend $9.6 million to buy and operate mobile detectors to check for stray voltage throughout its service area and $1 million for further research on ways to improve public safety. The ensuing publicity has caused all utilities with underground secondary systems to take another look at their exposure.


j The Kentucky Public Service Commission, Assessment Of Electric Utilities Response to the February 2003 Ice Storm, February 6, 2004
Inspect flooded meters and educate customers about risk associated with flooding beyond the meter –

The standard response after storm flooding includes using pumps to remove water from manholes and faults, de-energizing, inspecting and repairing damaged equipment such as switchgear, transformers and cable. However, there are significant potential hazards associated with re-energizing the system without proper inspection of customer meters that were submerged. As part of the public safety process, meters in known flooded areas and areas in proximity to bodies of water should be inspected before re-energization. During Hurricane Isabel, there was flooding throughout the downtown Baltimore area. BGE used their GIS to identify flood-risk areas and mobilized teams of residential and commercial metering specialists and local electrical inspectors to perform inspection and repair.

Beyond the meter, there can still be significant risk if appliances and wiring were submerged or exposed to storm surge. Inspection and repair of these facilities are outside the scope of the utility’s duty. But in the interest of public safety, the utility can educate the customer about these risks and possibly provide a list of licensed contractors. In parallel with meter inspections, BGE urged customers to have a licensed electricians and contractors inspect their equipment if they experienced flooding. The message was spread via personal contact, print and broadcast media, Website alerts, and door hangers.

3.2.3 Crew Deployment

Crews are dispatched to repair damage and restore service after the damage assessment data is analyzed to determine the best deployment strategy. This is not an exact science. Local personnel are typically deployed in their home regions. Mutual aid and contract personnel are deployed based on various strategies, but utilities should strive for equitable deployment, so that no region is disadvantaged to benefit another. Some factors that should go into making deployment decisions include:

- Proximity of area to incoming mutual aid crews
- Number of customers out
- Number of critical facilities damaged
- Severity or extent of damage
- Ease of repair or access to damaged areas
- Geography and customer density
- Logistical support available

Taking all these factors into consideration and making logical deployment decisions, still does not guarantee that there will be equitable restoration or that some customers will not feel that they were intentionally neglected. Two quick observations from a utility’s storm experience are discussed below.

Deploy crews in proportion to damage and not just to outages – Many times the areas with the most customer outages are the most heavily damaged, but this is also often not true. A damaged backbone feeder may disrupt a large number of customers, but may only need a single crew for repair. Conversely, dispersed damage on secondaries may disrupt less customers, but may need multiple crews for quick repair. Damage assessment data should give enough information to make this distinction. During Hurricane Isabel in September 2003, Dominion Virginia Power was able to restore service in the Northern Virginia, Shenandoah Valley, and Southside regions on the order of five days ahead of the Richmond Metro/Tri Cities, Tidewater and Gloucester/Northern Neck regions.\(^k\) Since Richmond, Tidewater and

\(^k\) Commonwealth of Virginia State Corporation Commission, Preparation for and Response to Hurricane Isabel by Virginia’s Electric utilities, September 2004
Gloucester/Northern Neck incurred the most damage, customers expressed concern that there was inequitable distribution of resources. A PSC staff investigation revealed that DVP largely deployed crews in proportion to the number of outaged customers, but the damage in the Richmond Metro/Tri Cities, Tidewater and Gloucester/Northern Neck was more severe, and in many cases facilities had to be rebuilt. This was particularly bad in Gloucester because of its geography – fingers of land jutting out into the Chesapeake Bay. Crews reported that they would work hours or even days rebuilding line without restoring a single customer – on their way to energizing a group of customers at the very end of the line.

**Continually assess needs and redeploy crews as restoration progresses** – Initial deployment decisions are based on damage assessment results, but as the restoration work progresses, the situation needs to be continually reassessed so that work in some regions do not lag too far behind others. In some cases secondary outages may occur and a region that had enough resources would need to be staffed up. In other cases, restoration may progress better than expected in some areas and resources can be moved to areas where work is progressing more slowly. This requires good communication up the line, and coordination at the operations level to make appropriate, timely decisions. In DVP’s Hurricane Isabel experience, the inequity in restoration meant that there was an opportunity for redeployment. As restoration neared completion in the less damaged northern and western portions of their territory, DVP was able to send resources south and east to speed up their progress.

### 3.2.4 Clearing, Repairing and Switching

Clearing lines, repairing damage and switching customers are core activities of the restoration process. Once damage assessment is complete, coordinators in the storm center have a fairly good idea of the size and extent of the damage and the resources required. Crews are then assigned (dispatched or deployed) to specific areas to restore the system. Best practices associated with restoration and restoration management are discussed below.

**Coordinate tree crew movements with line crews needs** – After a major storm, lines that must be repaired could be virtually inaccessible by construction crews because of downed trees and limbs in the ROW. Line clearance should be used more extensively during storm restoration work, and in support of line crews. This is an observation from Seattle City Light’s experience in their December 2006 windstorm. Line crews are capable of tree work, but are more effective when they concentrate on line work. Tree crews can effectively remove trees that impinge on overhead lines without damaging the energy delivery infrastructure. They can be dispatched to work directly with, or just ahead of, line crews when tree damage is heavy and localized. At Adams Electric Cooperative, for example, tree crews are used to effectively extend the capability of line crews. They are equipped with system maps and utility radios, and dispatched like utility employees. They are used as ground hands to clear lines more quickly, saving the line crew’s energy.\(^\text{m}\)

\(^1\) Seattle City Light December 2006 Wind Storm Report, May 2007, Prepared By Davies Consulting, Inc.

\(^\text{m}\) From DSTAR member survey, see Appendix
Use heavy machinery to help clear heavy damage in harsh conditions – Sometimes tree crews, on their own, may not be able to clear lines in heavily damaged areas, or where working conditions are difficult. Ice storms, for example, leave more widespread damage than typical summer thunderstorms. There are more downed trees and broken branches over a wider area. Harsh working conditions, like the cold and/or ice, can hamper transportation and communication. Line clearing is more challenging, and linemen may not even be able to climb poles. During the 2003 ice storm in Kentucky, bulldozers were brought in to clear ROWs, establish new ROWs and pull trucks in and out of fields. Other vehicles, like 4-wheelers and all-terrain-tracked-digger-derrick units provided assistance to crews. The units helped the restoration effort tremendously, but limited availability meant manual methods remained the standard means of clearing.

Deploy trained crew guides to work along with external crews – Crew guides or bird dogs serve several purposes: they provide guidance on utility construction and safety standards as well as operational procedures, serve as guides in unfamiliar geographic territories, distribute and manage work at the crew level and serve as a point of contact with the command center. Ideally, crew guides should be equipped with mobile data terminals containing computerized maps of the territory and engineering/construction standards. At the very least, they should have reference books and maps of territories. A database of qualified personnel with appropriate skills should be maintained and refreshed every year, and personnel should undergo training before storm season.

Subdivide areas and push responsibility down the line, where it makes sense – In some major restoration efforts, it can be more efficient to push key decision-making responsibility out of the EOC and allow people closer to the field to make decisions. However, this is situational, as the reverse can also be true, i.e. efficiencies can be realized by centralized coordination of certain activities. For example, during Ameren’s July 2006 windstorms, the Missouri PSC noted, “while centralization of Ameren’s storm restoration process brought about a number of coordination efficiencies, district managers should be provided with authority to request priority treatment of projects in their areas that require special attention.” In their Hurricane Andrew response, FPL was able to speed up activity by subdividing the south area of Dade County, Florida into six separate autonomous regions and allowing local control. Another example is the 2006 windstorms in Washington State; PSE created smaller, more workable area coordination centers for some of the hardest hit areas because the damage was so widespread that it stretched the capability of the operations bases. Some decisions must be made at the operations level, but a large percentage can be made, (and perhaps should be made), by personnel closer to the field.

As a regular practice, some utilities, like Entergy, break up districts into sub-districts and train personnel to manage responses in them, while district managers coordinate between those sub-districts. Other utilities report assigning responsibility for a substation area or feeder to personnel who manage all the

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\(^n\) The Kentucky Public Service Commission, *Assessment Of Electric Utilities Response to the February 2003 Ice Storm*, February 6, 2004

\(^\circ\) Report on AmerenUE’s Storm Outage Planning and Restoration Effort Following the Storms on July 19 and 21, 2006, Case No. EO-2007-0037 Missouri Public Service Commission Staff, November 17, 2006
resources and resource needs for responses at that level. These personnel coordinate up the line to the operations center, but serve as the point of contact and key decision-maker down the line. This division-of-labor has the potential to improve response speed and efficiency, but the procedures need to be clearly outlined and understood; communication must be good; and personnel need to be properly trained.

At Wisconsin Public Service, employees in the operations center follow a documented procedure that lets them know when to delegate dispatching functions to district offices, which can also access OMS data. When storm damage is so widespread that operations cannot handle it alone, the storm coordinator, based on specific criteria, turns dispatch over to the district offices closest to the outages.

**Coordinate switching and clearance activities to achieve best maximum efficiency** – There is a wide range of opinions as to what the proper balance is between allowing crews to work autonomously to speed up restoration, and controlling and coordinating crew activities to ensure safety and efficiency. Whenever a crew works on a circuit, they need clearance to lockout the circuit for repair, and switch it on when the repair is completed. All switching can be controlled from the operations center (centralized) or switching responsibility can be decentralized to the districts, substation areas, feeders, or even to the field crews. The manner in which clearances and switching requests are handled can have a huge impact on the overall effort.

At Puget Sound Energy, the operators in Electric System Operations issue clearances for the distribution system. The process is reasonably straightforward, requiring only open radio communication between the crew leader, and the regional operator. However, during the December 2006 windstorm the abundance and backlog of requests for clearances delayed crews in the performance of repairs. In many cases, crews routinely waited for up to two hours to obtain clearances before starting work. This meant that four to eight people were standing around until the clearance was obtained, delaying restoration, and leading customers observing the crews to believe that they were simply not working.

There is no single recommended practice to issue clearances or perform switching during emergencies. In the PSE case, the clearance procedure was not at fault, but how it was executed needed improvement. PSE should have ensured that the operations centers were sufficiently staffed to handle the volume of clearance requests. Additionally, when it became evident that clearances were a bottleneck, they might have allowed clearance requests to be handled at lower levels – but those procedures must be defined in advance.

At Entergy, experience with clearances and switching requests from major storms led the storm boss to decentralize switching procedures. Switching authority was pushed out to the field with very clear procedures. For external teams, a switchman was assigned to coordinate switching and clearance.

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**p** Gene Suchyta et al., *Automated Systems for Disaster response: Three Case Studies*, Geospatial Solutions, April 2006


**r** From interview with former Entergy Storm Boss John Sherrod, November 2006
The DSTAR utilities reported a variety of switching practices in the member survey (see Appendix). The responses are listed below:

- **Southern Company’s Alabama Power**: In general, control of feeders and associated switching is transferred to the person responsible for the restoration activities on that feeder. With this control, this person can perform switching within the area under his control. If he needs to do switching within the substation, or if he needs to do switching involving areas outside his control (i.e. tying two substations together) then he would go through the centralized control center.

- **Progress Energy**: For major hurricane damage, a de-centralized switching authority is established at the Regional Level. An individual is assigned to each affected Substation and controls all switching from this station.

- **We Energies**: Substation and mainline switching is controlled by dispatch within each of the three operating areas. Taps and service transformers are switched under the control of field personnel.

- **Exelon**: Lockout Managers are assigned at the on-set of an event and oversee the process of Energization & Switching.

- **Wisconsin Public Service**: All switching procedures are coordinated between the electrical field engineer and the system operators. Both individuals are equally responsible to verify the procedure is run correctly and safety is always taken into consideration. The electrical field engineer and/or system operator will conduct the switching with the crews.

- **Palmetto Electric Cooperative**: All substation and feeder energization is handled from our Central Dispatch Center.

- **Adams Electric Cooperative**: Energizing any switch in a substation is cleared through dispatch. Operation of line devices is done by the local crew with notification to dispatch before action is initiated but a clearance from dispatch is not required.

- **New Hampshire Electric Cooperative**: This depends on the switching situation; all line workers are trained in switching and coordinate their switching efforts with our control center.
4. COMMUNICATIONS

Our customers do not want to be in the dark literally or figuratively.

~ Tom May, CEO NSTAR

Effective communication, both internal and external, is a key component of any successful restoration effort. It goes without saying that internal communications are essential to manage and coordinate restoration activities, but external communications are equally important to create public trust and reinforce the perception of a successful effort.

Good communications makes it much easier to bolster and maintain the perception of a successful restoration effort and well run utility.

On the other hand, regardless of how statistically and logistically successful the restoration effort, poor external communications can doom it in the eyes of consumers, the media, officials, regulators and shareholders.

Source: 2004 Salt Lake Tribune Editorial Cartoon based on Utah Power (PacificCorp) Christmas 2003 Storm Event
4.1 External Communications

External communications comprises of all contact outside of the utility, with customers, government officials, community leaders, the media, public safety organizations, other utilities and emergency management organizations. Within the EOC, the Communications Coordinator is responsible for all external communications with stakeholders. External communication is important for many reasons, most importantly public safety. But poor communications can lead to unwanted attention from regulators and government officials. A review of recent regulatory audits shows that the outcome is often a function of how well the utility communicates during the event. From a purely business perspective, communications drives customer satisfaction, which in turn affects the perception of the utility; and as we all know, perception impacts the bottom line, especially for publicly traded companies.

4.1.1 Communications with Consumers/Customer Service

When the power goes out, customers typically what to know three things: Does the electric company know my power is out? When will the power be back on? What caused the outage? Failure to provide adequate information can lead to frustration, disillusionment and a dissatisfied, complaining customer. In particular, customers often express frustration when they cannot get an estimated restoration time or the time is so long as to be meaningless. Sometimes customers see neighbors or other neighborhoods with power while they are still out, and feel that they are intentionally or inadvertently left in the dark … figuratively and literally. This could be due to a lack of basic understanding about electric distribution systems and the restoration process, or a deep-seated bias against the utility.

This section discusses some of the industry leading practices, and lessons learned for ensuring effective customer communications and outstanding customer service.

Provide customers with additional information about the outage when they call to report – According to the 2007 J.D. Power and Associates Electric Utility Residential Customer Satisfaction Study, the more information customers receive about outages the more they are satisfied. As the chart below shows, among customers who called to report an outage, those who were given four or more points of information about the outage gave the utility significantly higher scores for power quality & reliability (PQ&R), than customers who were given one point of outage information. Points of information may include a message about an outage in the area, a message that the customer’s power specifically is out, information on the cause and extent of the outage, the time to restore power, instructions on what to do if power is not restored by a certain time, and other useful pieces of information.

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Plan your outage communications to run pre-event, during the event, and post-event – Customer communications should not neither begin nor end with the storm event. Effective communications should start long before the storm season with preparing and education the customer base, take on a different more urgent nature during the restoration, and persist after the event to thank customers and solicit feedback. Some basic and leading practices are summarized below.  

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<th>Basic Practices</th>
<th>Leading Practices</th>
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| **Pre-Event**    | Letters and bill inserts on storm plans  
                  | Door hangers and neighborhood signs  
                  | Individual calls to C&I customers by account rep’s | Targeted media messages on storm plans  
                  | Telephone hot lines, websites and email  
                  | IVR to pre-notify customers  
                  | Media and officials included in drills/plans |
| **During the Event** | Media updates as outlined in storm plan  
                    | Basic information given to customers when they call | VRU and IVR updated frequently  
                    | Websites updated with outage information  
                    | Coordination with local officials/EMA  
                    | Dedicated lines for priority customers |
| **Post-Event**   | Account representatives contact C&I customers  
                  | For large construction projects, media updates and ads thanking customers for their patience  
                  | Internal evaluation teams | Out-bound calling to thank customers  
                  | Targeted customer satisfaction surveys  
                  | Neighborhood meetings with cust, officials  
                  | Formal storm assessment reports |

Educate customers on how the electric system works and on the utility storm restoration process – If customers know the basics of electric distribution systems and are informed about the restoration priorities, they will have a basis to comprehend why the neighbor across the street has power and they do not. Education should be a continual process, before during and after the storm. Disseminate information about the restoration process via print and broadcast media, websites, flyers and door hangers. The latter (flyers and door hangers), can be done in concert with public safety messages and messages concerning consumer responsibilities.

Educate customers about where utility responsibility ends and where consumer responsibility begins – Many customers are unaware that the utility is not responsible for repairing broken service masts, weatherheads or meter bases. They blame the utility for their lights being still out, even though the distribution system is repaired and they are unable to receive service. To avoid these situations, some utilities perform minor repairs, maintain and provide a preferred electrical contractor list or even contract with electricians to repair severely damaged weatherheads, service masts or meter bases. In all cases, the customer is informed of the damage and his/her responsibilities. During Hurricane Isabel, DVP temporarily amended its policy to allow employees to make necessary repairs as long as they did not have to enter the home. Duke Power’s procedure is: if the service connections or the weatherhead can be repaired easily and safely, field crews will attempt to perform this work in order that the power can be restored. If the damages are extensive and cannot be easily and safely repaired, the field personnel responding to the customer outage are expected to advise the customer that a licensed electrician will be required to make appropriate repairs. The field personnel will attempt to contact the customer... and also report this information to the Duke Power office by phone, or in person at the end of the day.

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After the February 2003 ice storm in Kentucky, utilities generally allowed inspection waivers to be granted for customers who had repair work done to their services because of storm damage. Otherwise, homes would be left without service until a local inspector could check each of the repaired wiring jobs. This meant that even after the lines were repaired, some homeowners were still left waiting for electric power, creating a great deal of frustration. The Lexington area, in particular, experienced much confusion on this subject, driven by media reports, local government interaction, and a general lack of understanding about the repair process. The KPSC staff noted that the widespread nature of the storm highlighted the need for better communication and increased public awareness regarding customer responsibility.

Provide safety-related announcements to the public before and shortly after major storms – As a public service, the utility should provide information to the public concerning all aspects of preparation for, and conduct during a major storm. This should include information on stocking water and non-perishable food items; shelter and cover; avoiding and reporting downed lines; and safe handling and operation of portable generators, heaters and lamps. Information should be distributed via public announcements, press releases, calls to special-needs customers, Websites, flyers and door hangers.

Provide a dedicated call-in number for customers on life-support equipment (LSE) registry – Consumers with special needs, like customers on life support equipment (LSE), have long been afforded special considerations during emergencies. Virtually every utility maintains an LSE registry where customers on life support equipment can register to receive priority messages from the utility regarding electrical emergencies. However, if these customers call into the utility, they may have to go through the same call route as all other customers. A dedicated line for these priority customers would enable them to receive critical information in a more timely manner.

Make provision for communicating with Spanish speaking customers – If a significant portion of your customer base is Spanish-speaking, it is good practice and good sense to dedicate communications resources to them. This may apply to other languages, as well but problems have only been reported with Spanish up to this point. During the December 2002 ice storm in North Carolina, Duke and Progress Energy identified a need for improved communications with Spanish-speaking customers, who had grown by about 400% over the previous decade. After the storm, Progress included a full Spanish outage-reporting menu on its voice response unit (VRU) and identified nearly 50 Spanish-language media outlets in its service area for distribution of news releases and information. Duke established a new toll-free number for Spanish-speaking customers, widely promoting it on radio stations targeting the Hispanic community. They also employed Spanish-speaking communication specialists to provide updates to the community.

During outages change the VRU script to offer the outage reporting option first – When customers call in during a storm event, it is likely that they are calling to report an outage, so this is the first option they should be given – as opposed to billing or some other option. This may be a small thing, but it increases efficiency and avoids unnecessarily annoying the customer with references to billing at a time when he/she has no service.

Avoid providing ancillary or inaccurate information that could lead to public frustration – Customers and the media always want to know everything, but there is a fine balance between what to provide and what to conceal. While it is important to provide information about restoration goals and progress, providing inaccurate information could eventually be more damaging (to consumer relations) than providing none at all. Dominion experienced this after Hurricane Isabel in 2003. In an attempt to provide

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<sup>* The Kentucky Public Service Commission, *Assessment Of Electric Utilities Response to the February 2003 Ice Storm*, February 6, 2004</sup>
customers with more information about restoration progress, Dominion listed on its website the areas in which crews would be working each day. In practice, however, crews often didn’t showed up when and where they were expected, because they were routinely over-scheduled to prevent work lapses. Frustrated customers became increasingly skeptical of Dominion’s communications and their ability to manage the restoration. This generated more complaints to the commission than if the crew information were not provided in the first place.

**Register long-term care facilities for priority notification and possible priority restoration** – During and after every major storm, utilities and regulators routinely get complaints from consumers with special needs and nursing homes, asking to be given priority over other consumers (on par with hospitals) because they need electricity to operate life-sustaining equipment. While all nursing homes are not equivalent to hospitals, some do provide equivalent care, so this is not a totally unreasonable request. However, with the large number of special-needs customers and nursing homes dispersed across a typical utility territory, it may be logistically impossible to prioritize them in a wholesale manner. Most regulators understand this, and have only directed utilities to provide better information to such customers. Where it is feasible, it is good practice to afford some level of priority service to long-term care facilities that provide hospital-like care.

**Some other leading practices include:**

- Provide online information via thematically shaded maps, and databases where customers/media/officials can obtain information about the restoration effort and “view” restoration status. This is further discussed in Chapter 5, Technology Use.
- Distribute glow-in-the-dark magnets with outage reporting numbers.
- Distribute dry ice during prolonged outages.

### 4.1.2 Communications with the Media and Through the Media

During an emergency the press can be your best friend or your worst enemy, depending on the nature of the relationship fostered and developed with reporters and media personnel. One of the core missions of the media is to provide information to the public, and this information must come from the electric utility. In the absence of real information, it is not beyond the press to speculate and focus on the less constructive aspects of the story. The goal of the communications specialists should be two-fold: (1) provide all the necessary information to the media for public consumption, and (2) use the media to establish a favorable impression of the restoration effort. Best practices for achieving these two goals are discussed below:

**Educate the media about what happens during a storm outage** – Before a storm occurs, customers and stakeholders should have a good idea of how the utility would respond, what its priorities are, and what to expect during a storm. The utility should use the media to get the word out by educating them about its processes. This requires a carefully planned agenda using news stories, interviews, news releases, and public announcements to highlight storm planning and preparation. Many utilities widely publicize their storm drills and even invite the media and public officials to observe. AmerenUE, for example, hosts a “Storm School” before storm season in an effort to educate the media, fire, police and city and county officials about what occurs during a widespread outage.

**Be proactive in taking your story to the media, especially stories that highlight the restoration workers** – Instead of waiting for reporters to come to you, take the story to the media. Approach the press with angles and opportunities that are beneficial to you. Provide photo opportunities, joint statements, canned footage, educational text, etc. Invite them to report on preparation, pre-positioning of resources and material, mutual aid agreements, disaster plans, public safety, staging and mobilization efforts. A good
practice is to provide human-interest stories on your restoration workers highlighting their “heroic
decisions to leave their own damaged homes and distressed loved ones and selflessly devote themselves
to the public good.” Everyone loves a good human-interest story and this influences public perception by
humanizing the utility and showing that you have “skin in the game.” Make spokespersons available at all
hours of the day in the field and in the studio.

Consider giving the media controlled access to areas of activity in order to shape the story – During an
emergency, the members of the media will always be looking to tell a story – after all, that is their job. If
a story is not forthcoming, they will dig something up, and often it will not be flattering to the restoration
effort. With so many eager press personnel literally running around, it is in the best interest of the utility
to control the story, in order to shape public opinion, as much as possible. One way is to allow the media
controlled access to areas of storm activities, or allow them to be “embedded” to some extent. During the
run up to Hurricane Isabel, members of the press were invited to report on BGE public safety efforts,
actions to secure external crews and mobilize resources, and pre-positioning of equipment. During the
storm, BGE took the extraordinary step of allowing media on site in staging areas, regional command
centers, storm center and customer call center, including its twice per day conference calls. The result was
that the media had a better understanding of BGE’s planning and restoration activities and became more
of a partner than a detached or impartial observer.

Communicate restoration goals and trends through the media and update regularly – Even if a
restoration effort is long and protracted, communicating the goals (50%, 75%, 90%, 100% restoration
target dates) and the trends (% restored) significantly improves the perception. However, the goals and
trends must be accurate and updated often and regularly, or it could lead to the perception that nothing is
happening. In the aftermath of Hurricane Isabel, in September 2003, a great concern was Dominion’s
inability to provide system restoration goals and trends to the public. On September 21, three days after
the storm, the company informed the public that its goal was to restore 75 percent of affected customers
by September 25th. However, it did not provide an update to its restoration goals until four days later,
which left a lot of time for speculation and misinformation. This led to a poor perception of the progress.

Some other leading practices include:

- Record comprehensive briefings on a dedicated media phone line with detailed restoration
  progress and restoration times.
- Make information available to the media online in a dedicated area of the utility Website; provide
detailed data, maps, news releases, historical context, etc.
- Give members of the media the opportunity to sign up for personalized updates via their mobile
deVICES.

4.1.3 Communications with Officials, and Other Utilities

During an emergency, some of the loudest complaints and demands are not from consumers per se, but
from government officials and emergency management personnel who need data to distribute information
or make contingency plans. Other utilities that depend on the electric utility to perform their function also
become critical customers during the storm. All these entities may feel entitled to priority notification and
attention, so proper communication plans and processes should be in place before the storm, as part of the
ERP. Some of the best practices and lessons learned for communications with officials and other utilities
are discussed below:

Maintain a contacts database and update at least annually and after each election – Every utility
should maintain a database with the contact information, including cell phone numbers and email
addresses, of local and state emergency directors, city, county and locally elected officials, and other
personnel who are responsible for responding to emergencies and/or providing information to the public. The database should be “owned” by a liaison and updated every year (twice recommended) and after each election.

**Be consistent and proactive in providing information** – Don’t let public officials have to track you down for information or there will be complaints. Have several different avenues to provide information and updates, and dedicated resources to respond to inquiries. During the 2006 February windstorm in New York State, some officials complained to the PSC staff that it was difficult to get information from National Grid. They complained that their phone calls were not returned and that they had to get information from the local news or crews on break. This prompted the PSC to recommend that National Grid hold daily conference calls to brief public officials during a major event. 

**Designate liaisons to provide information to government and emergency management officials** – After the December 2002 ice storm in North Carolina, the Utilities Commission found that government officials in Durham were concerned that they did not receive sufficient information from Duke during the storm and the restoration process. The Commission recommended that Duke take necessary steps to ensure that elected officials in all areas of its service territory had direct access to information. From this experience, Duke initiated the practice to have specific employees serve as liaisons with particular counties and emergency operations centers to provide a direct link between the utility EOC and local emergency operations. This is certainly a best practice, but it can be a strain on resources if it is not included as part of the overall response plan. A case in point is: during the response to Hurricane Isabel in 2003, cooperatives in Virginia that depended on Dominion for bulk power requested that Dominion place a representative inside local emergency operation centers to effect better information exchange. However, Dominion claimed it did not have sufficient resources to meet the request without impacting the restoration effort.

**Provide storm center direct number to key officials** – When AmerenUE provided its storm center number to city, county and state officials, several officials reported that having this number available was extremely helpful to them. AmerenUE also reported that the calls received on this number did help it prioritize work on several critical projects. The number should be accompanied with strict instructions that it not be redistributed, as this could lead to non-critical calls that could disrupt efficiency.

**Coordinate with electric cooperatives and other resellers that rely on the utility for power** – In many states, cooperatives rely on the utility for power at the transmission or sub-transmission level to delivery points for their distribution circuits. During major outages, these coops need timely information from the utility so that they can plan and execute their restoration accordingly. Coops who rely on the utility should be included in preparation meetings and calls before the storm, and should have priority access to information when they need it. Communication plans should be routinely updated before the storm, so that information exchange during the storm is seamless. After Hurricane Isabel hit Virginia in 2003, Dominion Virginia Power discovered they did not have adequate information about their coop delivery points. Coops complained to the regulators that delivery points were not adequately prioritized because Dominion had no idea how many customers were behind each point, and so may have treated points serving hundreds of customers as a single customer. After the storm, it was agreed that the coops would provide a list of the total number of customers and critical customers served off each delivery point.

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Some other leading practices include:

- Include city and county officials in major-outage-related informational meetings prior to storm season.
- Provide collaborative planning and training (“storm schools”) between the Commission, EMAs, first responders, emergency aid workers and community leaders.

### 4.1.4 Estimated Restoration Times

During a restoration event, study after study has shown (and the DSTAR survey in the Appendix confirms) that the number one question from customers is: when will my power be back on? The importance of providing timely estimated times of restoration (ETR) couldn’t be overstated; providing accurate ETRs directly affects customers’ perception of restoration efforts. Customers need estimates to make alternative plans. Delayed and overestimated ETRs lead to frustration.

Following Hurricane Isabel, in September 2003, Dominion Virginia Power was not able to provide customers with a specific restoration time until nine days after the hurricane hit. Even then, a large percentage of customers received an ETR that was the last day of the estimated system restoration. This led many customers to be dissatisfied with the utility and complain to the regulatory commission and elected officials.

From the same Hurricane Isabel storm event in 2003, PEPCO learned the following lessons:

- Recognize that major outages are “community events”. Customers need to plan their lives and global information only goes so far in terms of planning.
- Providing accurate and timely ETR’s is critically important.
- Field operations must understand the importance of providing accurate ETR’s.
- An “estimate” of when power will be restored is acceptable but emphasis should be placed on restoring prior to the estimate.
- The flow of information from the field to the customer requires planning, drilling and change management.
- Open, honest, and frequent communications to customers before, during and after the outage event is extremely important.

Use key metrics to monitor and improve ETRs and outage performance – A fundamental truism in process improvement is “you can’t manage what you don’t measure.” A best practice for improving ETRs and outage performance in general is to define performance measures and monitor performance to identify areas of weakness and opportunities for improvement. At NSTAR, they use five measures focused on providing customers timely and accurate information:

- Percentage of Outage Jobs Analyzed within 10 minutes
- Percentage of Customers Offered ETR
- Percentage of Customers Offered Job Level ETR
- Percentage of Outages Restored before ETR
- ETR Accuracy (+/- 60 minutes)

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Since implementing the metrics, NSTAR has been able to identify “low hanging fruit” and have made several adjustments to quickly improve performance and customer service. In the year after they started tracking the metrics, the Percentage of Outage Jobs Analyzed within 10 minutes exceeded set targets at the end of the year, and improved by more than 50% over the previous year.¹

**Provide accurate, stable, and reasonable ETRs** – According to data from PEPCO, customer complaints about ETRs fall into three (3) categories:

1. Inaccurate ETRs: “…you said my power would be back on by noon…”
2. Constantly changing and revising ETRs: “…first you said I’d be back by Saturday night, then Sunday morning…”
3. Odd Time ETR’s: … 9:03 a.m., 10:17 p.m., etc.

Based on this feedback, PEPCO established the following guiding principles, which are leading practices:

- Tell our customers what we know when we know it.
- Provide customers with accurate ETRs and ensure minimal ETR changes.
- Ensure that if an ETR change is necessary, ETR changes move closer to the current time.
- Remove all references to “odd time” ETRs.

**Communicate ETRs to customers proactively via different media** – This goes not just for ETRs but outage information in general. The traditional approach has been to offer an estimate to customers who call to request one from the VRU. More recently, some utilities have made good use of the Web to make restoration information available on their storm center. However, in this era of mobile technology, customers are expecting much more proactive, instant and individualized communication from their utility. Based on extensive customer feedback, KCPL has developed a leading outage communication system that notifies customers of outages, ETRs and restoration via cell phones, email and pagers, with voice and text, and updates the messages every hour. 43% of their customers have registered to receive messages from the system.¹

**It may be better to avoid providing specific ETRs if they are not reliable** – After AmerenUE’s August 2005 windstorms, customers complained about the inaccuracy of the estimated restoration times. Approximately half of the customers indicated that if they could not receive an accurate estimate, they would prefer no estimate at all.² Consequently, the Missouri PSC suggested that AmerenUE turn off its

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² Tom Burke, Nancy McCurry, and regina Hogan, Kansas City Power & Light Outage Communication: How KCP&L keeps Everyone Up to Speed When the Lights Go Out, Distributech 2007, San Diego
estimated restoration message during a major event. AmerenUE made the decision to produce a general ETR for all customers that indicated the severity of the storm and the potential for an extended outage.

**Other leading practices with regard to estimated times of restoration include:**

- Set a global (conservative) restoration target or high-level global ETR shortly after the storm, based on historical data and damage prediction, and use field checker information to refine and localize the ETRs.
- Categorize customer outages into tiers; establish ETRs for each tier and load them into the OMS. Given damage assessment data, the OMS can automatically generate ETRs for blocks of customers. An example of the tiers used by a utility is: Tier 1 - Outages with 100 or more customers without power; Tier 2 - Outages with 25 - 99 customers without power; Tier 3 - Outages with 6 – 24 customers without power; Tier 4 - Outages with 1 – 5 customers without power.
- In the absence of an ETR, (or a reliable one) use particular VRU scripts to provide as much information as possible to help ease customer concerns.

### 4.2 Internal Communications

Internal communications is communications within the utility enterprise needed to manage and coordinate the storm response – one of those things that’s often taken for granted and critically missed when it’s gone. Poor or no internal communications can potentially hobble the entire effort. During a storm, many modes of communication are used to report emergencies, keep families and off-duty personnel up-to-date, maintain contact with customers and suppliers, and coordinate response actions. These systems include cell phones, beepers/pagers, radios, telephones and faxes and computer networks. The DSTAR member survey (see Appendix) shows that the primary means of communication with crews and other responders are by two-way radios, cell phones, remote data terminals, and in some cases satellite phones. Not surprisingly, there is more reliance on private networks than on public or commercial services during emergencies, because experience has shown that private networks are more reliable during major storms.

A study by UTC Research examined the reliability of internal communication networks during the 2005 hurricane season. According to the report, storms Katrina, Rita and Wilma pointed out the weaknesses in many ... critical infrastructures, including telecommunications networks, some of which [were] still recovering months after the storms. However, in sharp contrast to many commercial wireless, landline telephone and other telecommunications networks, the private, internal networks (radio, microwave and fiber) of electric, gas and water utilities for the most part continued to function throughout and immediately after the storms. In some cases, it was utility communications networks that provided the only reliable communications among emergency responders and other officials during the first few days after the storms.¹

**Overall findings and recommendations from the UTC report:**

- 86% of impacted CII entities responding reported that their communications networks generally survived the hurricanes and continued to operate well throughout restoration efforts.

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² Critical Infrastructure Industries (CII) are defined by the FCC in Section 90.7 of its Rules (47 CFR § 90.7), and include electric utilities, petroleum and oil pipeline companies, railroads and others.
• Private land mobile radio (LMR) networks provided critical communications among crews; however, a huge number of responding entities from around the country taxed capacity or could not operate on local systems, pointing up the need for CII interoperability.

• Utility fiber and microwave systems survived and generally continued to function; however, this was due in part to built-in redundancies, robustness and recovery mechanisms that would be cost-prohibitive for a for-profit network designed to serve the general public. Therefore, CII entities will continue to require private networks to meet mission-critical needs in the foreseeable future, along with the ability to expand, as needed, to meet system growth requirements.

• Unfortunately, there was little or no formal coordination with state or local agencies or public safety organizations during or after the storms. Given the opportunities for improved response communications offered by robust CII systems, and the presence of CII personnel “on the ground” in nearly every disaster scenario, this lack of coordination emphasizes that CII must be included in emergency response planning at the Federal level.

Control critical-to-mission communication systems – In many cases, utilities do not own or operate the communication network, but may lease capacity or contract service from a third party. During a major storm, when demand is high, not only from the utility but from the general population as well, and supply is low due to infrastructure damage, it is critical that the utility has control over vital communication networks, especially those used to coordinate the restoration. During Hurricane Andrew, FPL learned, if you want to depend on a system, be sure it is a system that your personnel can restore to service. They discovered that the communication systems owned by the utility performed well while systems they did not control were unreliable or unavailable. One DSTAR member, Southern Company, has reported that the company-owned wireless communications network, SouthernLINC, plays a major role in their restoration effort. In fact, during Hurricane Katrina in 2005, the only viable communication channel Mississippi Power had available, to coordinate over 10,000 external personnel and 30 staging sites, was the SouthernLINC system!

Coordinate communications among utilities and with public safety entities – With the large number of foreign crews typically bought in to assist with major events, there are often problems with interoperability of communications. Most utilities use LMR systems because they provide excellent mobility and quality. However, a major shortcoming is that responding utilities operate on several different frequency bands, which affects the ability to coordinate foreign crews. In some situations radio networks may be compatible, but often they are not, requiring a crew guide with a local radio to accompany foreign crews and coordinate with central dispatch.

During the 2005 hurricane season, utilities that depended on commercial cell phone service suffered serious communication difficulties. Overall, smaller cooperatives and municipal authorities had the most communication difficulties. Since IOUs assist other IOUs and coops help other coops, there tends to be limited assistance between utility segments. Sharing resources in emergency situations improves interoperability among utilities, and is a best practice that aids overall restoration efforts.

The UTC report found that, while utility communications systems fared well during the hurricanes, there was little or no coordination with state or local public safety organizations, aside from some informal sharing of resources. Since utility networks are generally more resilient, responding utilities should be included in any State- or Federally-developed coordination process. This is currently, most often, not the case.

Deploy backup communication systems – Even though utilities’ private communication systems tend to be more resilient than commercial systems, it is good practice to have backup systems should the in-place network become inoperable. During the 2005 hurricanes, there were some incidents of tower damage and outages that compromised utilities’ fixed communications systems. As a backup in these types of situations, some utilities deploy mobile towers and satellite communications trailers that can be easily transported to remote sites for first response communications deployment. A Southern Company communications trailer is shown in the image to the right. This particular trailer includes a satellite communications package: iDirect modem and Automatic Vehicle Location (AVL) control panel, wireless access, Voice Over IP, VPN functionality, and other customized solutions. It also includes a radio system that works through the satellite system to communicate between the trailers and the storm center. The trailer is powered with a diesel genset, and is light enough to be pulled behind a heavy-duty pick-up truck, like a Ford F-250.°

Pay attention to employee and family communications – A large part of internal communications is communicating with employees who are not in the field, or on duty, and their families who also need updated information on a regular basis. Traditionally, a hotline is provided for employees and their families. Entergy, for example, has a toll-free information line that allows family members and employees to check teams’ status daily. Team leaders send reports to Entergy’s “Storm Boss,” who then posts them on the information line. The line also allows families to leave messages in an emergency message center for crew members and check the progress of specific teams. A useful suggestion that expands on this concept is to create an “employee info” section on the external Web site where offsite employees and their families can access specific information, receive instructions or notices, post messages, and get contact information.

Other best practices and lessons learned regarding internal communications are:

- Include IT personnel when command center is activated.
- Install and maintain permanent backup generation at service centers and communication facilities.

° Specifications provided courtesy of Southern Company, Alabama Power.
5. TECHNOLOGY USE

_Technology makes it possible for people to gain control over everything, except over technology_  
~ John Tudor

As discussed in the previous chapter, communication technologies, including telephone, radio, microwave, and fiber networks, are critical to the core utility mission. There are many other applications and networks, built on, and enabled by these core communication layers that have also become indispensable tools in outage response. Some of these have already been discussed in the context of damage assessment and system restoration, but there is a wide array of many other useful technologies available to utilities. As utilities realize their potential to improve efficiency and reduce cost, various applications are becoming a more common part of the storm restoration process. The scope of all available technologies is too wide to cover here, but some of the more common ones, mentioned by DSTAR members are highlighted in this chapter.

5.1 Interactive Voice Response Units

A best practice among utilities is using interactive voice response (IVR) technology to queue, prioritize and route calls. A good practice is to coordinate the IVR with the customer information system (CIS) so that it can associate a caller with a billing account. If a customer calls from his/her home phone, the system recognizes the customer and can prioritize the call, such as for registered medical equipment users. Good IVR applications also provide estimated wait times and offer customers an automated alternative to waiting for a representative. The IVR should be integrated with the outage management system (OMS) so calls show up in the OMS as soon as the caller is identified by the IVR. To close the loop, agents in the call center should also have access to the OMS and CIS data, to give the customer relevant information.

- **Ensure that an adequate number of phone lines and queue capacity are in place to manage call volume imposed by major storms** – On most systems the number of customers is steadily increasing, so assumptions based on the last major storm may not be applicable. Nothing is more frustrating to customers than being without power, and not being able to reach the utility to communicate their issues. A good practice is to contract with a private company to provide additional capacity in these situations. For example, at AmerenUE, if the number of calls going to their VRU (voice response unit, same as IVR) reaches its maximum volume, additional trunk lines are automatically accessed from NNC (the private company that provides trunk line service).

- **Make first IVR option, “report an outage,” not billing or some other option.** Most customers during a storm are calling to report lights out or downed wires, and these calls should be prioritized above all others.

- **Include a clear message regarding billing issues such as “non-pay disconnects” so these customers do not continue calling.** During the 2006 windstorm in Missouri, customers complained that they could not contact AmerenUE regarding billing questions. Most of these were customers who had delinquent accounts scheduled for non-pay disconnection and were confused about whether their service would be shut off during this time, so they continued trying to reach a call center representative. A clear message addressing this issue would have freed up resources for other customers.
5.2 Outage Management Systems

In the survey of DSTAR utilities (see Appendix), all but one reported using an OMS or other similar application to manage storm response. The exception, a cooperative, reported being in the process of implementing a new OMS and IVR to help manage storm issues. An OMS is an application that locates and infers outages, tracks and monitors crews and repair status, coordinates system reconfiguration, alarms, trouble calls and dispatches crews based on its knowledge of system topology. When a customer calls to complain about an outage or an automated meter reading (AMR) system (or other sensor) sends an outage signal, the OMS pinpoints the problem location as accurately as possible based on the pattern of calls or notifications. The OMS determines the number and type of customers affected and identifies which other parts of the system could be impacted.

Not every utility uses an OMS, but those that do typically report substantial improvements in customer service and reliability measures, as well improvements in restoration efficiency and costs. During major storm events, the value of an OMS is clearly demonstrated in its ability to:

1. Keep track of what is restored and what is not
2. Run damage-assessment routines to give an assessment of the resources required
3. Prioritize restoration activities based upon needs like medical facilities and critical infrastructure like 911 centers, police, life support customers, etc
4. Supply current information about the status of the outage for customers, the media, officials, etc
5. Provide estimated restoration times based on topology, known damage and available resources

Some best practices and lessons learned with regard to OMS use during storm restoration include:

- **The OMS is part of the solution, not part of the problem** – In the past, during the frenzy of storm response, it was not uncommon to hear “disable the OMS, it’s slowing us down.” However, since the technology has gotten better, operating experience has increased, and support has improved, this is no longer a prudent course (if it ever was). Three months before Hurricane Isabel struck the East Coast, BGE had implemented a new OMS that replaced their legacy in-house system. During this first major test, they found that the OMS “performed well and significantly contributed to overall good performance.” In particular, the volume of calls handled by the OMS far exceeded the maximum that the legacy system could handle. Without the new OMS, BGE would have had to process more than 35,000 individual paper tickets with customer complaints.

- **Fully integrate the OMS into disaster planning to improve restoration and reduce cost** – The OMS is too valuable and powerful to be pushed aside during storm emergencies. Use of the technology should be integrated into the ERP, from planning and preparation through restoration and recovery. Effective use results in direct financial benefits by reducing labor costs. At DTE Energy, where OMS technology has been used to manage restoration for years, they determined that the utility saves as much as $1 million per day in outside crew costs simply because their OMS allows them to repair outages faster.

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b From interview with John Sherrod, former Entergy Storm boss, November 2006

c Baltimore gas and Electric Company Major Storm Report: Hurricane Isabel

d Gene Suchyta et al., Automated Systems for Disaster response: Three Case Studies, Geospatial Solutions, April 2006
• **Fully test the OMS before storm season and upgrade/correct as necessary** – During the January 2006 severe wind and rain storm in Westchester County, NY, Con Edison operations reported that the high volume of outages slowed down their OMS, causing transaction delays at the beginning of the event. The utility worked around the problem during restoration and made subsequent plans to enhance their OMS to accommodate larger transaction volumes. The preferred course of action would have been to anticipate the increased volumes based on customer growth and work with the vendor to upgrade the OMS in advance.

• **Assign responsibility for critical technology, such as OMS systems, to a single individual who owns/manages the operation, upgrade, and impact on upstream/downstream process** – During National Grid’s response to the 2006 windstorm in New York State, the OMS failed due to call volume, crashed several times and generally slowed down the restoration process. Post-storm analysis revealed that a major factor was the absence of a readily available expert to support the OMS across all divisions of National Grid. As a result, they began studying ways to train and deploy program experts for future storms. Today, many vendors make sure that experts who are familiar with the systems most likely to be impacted are on standby. These experts are available by phone and can sometimes be present onsite. They review preparation with the utility team, offer suggestions based on other utilities’ experience, and discuss the impact of changes and upgrades on system performance.

• **Have a clear business continuity (contingency) plan for automated technology failures (such as OMS crash and IVR saturation)** – The danger with becoming so dependent on technology is that when it fails people generally are lost. National Grid had no contingency plan for OMS failure during the January 2006 windstorm (as discussed above) and resorted to blaming their slow response on the technology. In fact they should have fully tested the system, should have had expert help available, and should have had a well-drilled process in place to deal with the fallout from the OMS crash. A case in point is Wisconsin Public Service (WPS) which in 2005 integrated their OMS with their GIS, CIS and AMR to create a powerful outage management solution. However, WPS also took the unique planning step of creating a detailed plan in case they should lose the automated IT systems during an emergency.

### 5.3 Automated Meter Reading/Advanced Metering Infrastructure

Automated Meter Reading (AMR) and Advanced Metering Systems (AMI) make near real-time metering data available to back office applications, and many utilities have found ways to incorporate this data into their storm management processes. Today’s advanced digital meters (or smart meters) continuously record and report information about the electric system, making it possible to know when power is out or on without a single call from, or to a customer. Some leading practices and benefits of advanced metering systems include:

• **Use AMR/AMI systems to improve the outage notification process** – During major outages, the OMS typically relies on customers calling in to report outages. To be effective, an OMS needs as few as 15% of affected customers to call. Most advanced meters have a “last grasp” capability, enabled by a battery or capacitor, which allows them to transmit a high priority message when

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Gene Suchyta et al., *Automated Systems for Disaster response: Three Case Studies*, Geospatial Solutions, April 2006
power is out. Information sent to an OMS this way can dramatically improve notification times –
reportedly as much as 60 minutes for one utility.\(^h\)

- **Ping meters to confirm or verify outages and restoration** – With advanced meters, an operator
can send signals and receive acknowledgements in near real-time if the meters are energized. This
ability to “ping” advanced meters is valuable in outage detection and analysis. It can save the
time and expense of sending a crew on unnecessary trouble calls. Exelon PECO was able to
cancel more than 1200 trouble calls during a 2006 thunderstorm event near Philadelphia. Pinging
meters can also help a utility confirm service restoration while the crew is onsite, and reduce or
eliminate customer callbacks. Customer service can also be improved by placing instant outage
information at customers’ fingertips.

- **Integrate with AMR/AMI OMS to reduce cost and improve efficiency and customer service** –
Studies and experience show that integrating AMR/AMI systems with the OMS results in
tangible and intangible benefits in terms of cost reduction, improved efficiency and better
customer service. In March 2005, WPS began implementation of a commercial off-the-shelf
OMS to replace their homegrown system.\(^i\) The new system included interfaces to internal systems
including IVR, CIS, GIS, as well as their recently implemented AMR system, which consisted of
over 425,000 automated smart meters. Integration of the OMS with the AMR system allowed
WPS to ping meters and confirm outages before dispatching a crew, and confirm restoration
without callbacks, saving $116,000 annually, by their conservative estimate. With the new system
in place, WPS is developing additional ways to improve customer service, like allowing
customers to ping their own meters, and proactively notifying customers of outages and
restoration.

### 5.4 Geospatial information Systems

Most utilities have adopted automated geospatial information technology for use in everyday planning
and operation functions, and in storm management. These systems include Geographical Information
Systems (GIS), OMS (previously discussed), Workforce Management Systems (WMS), computer aided
dispatch and location, and others. A key feature of these tools is the use of GIS coordinates to locate
facilities and monitor resources in the field.

GIS AM/FM Systems are invaluable tools in preparation and planning, damage assessment, restoration
coordination and even post-storm verification and cleanup. During a storm, integration of GIS with the
OMS helps facilitate storm management. DTE Energy was an early adopter of GIS technology in the
1980s. Their entire electric distribution system is represented in a GIS database, including land use and
terrain features. Periodically, the utility extracts the system and land base layers to populate the integrated
OMS for outage location and analysis, crew tracking and dispatch. Integrating OMS and GIS enabled
DTE Energy to significantly improve restoration performance and reduce costs.

There are many benefits derived from integrating GPS capability with the GIS mapping interface and the
OMS. One benefit is Mobile Workforce Management (MWFM) which automates field crew operations
with mobile workforce dispatch, scheduling and routing, remote electronic connectivity, and automatic
vehicle location (AVL). AVL in particular, allows personnel in the operations center to track, monitor,
record and report the movements and location of employees in the field and their proximity to distribution

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\(^i\) Jason E. Dettman, *AMR/OMS Integration: Improving Operational efficiencies One ping at a Time*, Electric Light & Power,
November 2007
facilities. Leading utilities have been using AVL to automate work order processes, create and calculate routes to improve dispatch, improve response time, increase productivity, and lower costs like overtime, and vehicle operating and repair. Integration of the OMS and MWFM systems allows OMS analysis results to be dispatched to field personnel, and field information, like outages and restoration times, to be sent back to the OMS electronically, and eventually passed to the CIS and IVR for customer service.

Work Management Systems (WMS) are the front end for work order processing and management, resource assignment, job status and completion tracking. Progress Energy maintains an integrated GIS/WMS design environment where up-to-date facility information from the GIS is captured on the front end of the work-order process. This ensures crews’ work orders reflect the current system and that the current system state is captured as repairs progress.

5.5 Storm Center Web Portals

At present, one of the best ways to communicate information to customers and stakeholders during a storm is via the utility’s external Website. Most utilities maintain an Internet portal that includes a storm center where customers can get information about planning for emergencies, utility preparation, the restoration process, and (in some cases) outage information and estimated restoration times. Among DSTAR utilities responding to the survey, only three reported placing real-time outage and restoration data on their Websites (see Appendix). Inclusion of a prominent storm center link on the utility home page is good practice – as opposed to burying the link where it may be more difficult to locate.

The table below compares the attributes of the DSTAR member storm center Web portals along with a sampling of cooperatives and other investor-owned utilities. Key features compared in the table include:

- **Prominent Storm Center/Outage Link** – prominence of storm center/outage reporting link on the utility homepage; is it more than twelve-point text in a long sidebar menu?
- **No. of Clicks** – the number of clicks or menu selections needed to navigate from the home page to the storm center or outage information portal
- **Report Outage Online** – capability to report outages through online form submission, without the need to login to a customer account
- **Storm Alert Sign-Up** – ability to sign up for individualized outage alerts from the storm center
- **Outage Data/Maps** – capability to view system outages in thematically shaded (interactive) map and/or data form from the portal
- **ETR** – ability to get estimated times of restoration for outages
- **Storm Prep/Safety Information** – information related to storm preparation, safety during emergencies, what to do in specific situations, proper use of generators, etc.
- **Restoration Processes & Priorities** – explanation of the utility restoration process and how outages are prioritized
- **Customer Responsibility Highlighted** – explanation of customer responsibilities for repair of service masts, weatherhead, and meter bases; what to do after a storm to ensure you can receive power
- **Spanish Language Info/Content** – existence of a Spanish language mirror website, Spanish language storm center, Spanish information page or Spanish PDF downloads, dedicated Spanish call-in number and/or other services for Spanish-speaking customers.

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## Comparison of Several Utility Storm Center Web Portals (as of June 2008)

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Best Practices for Utility Storm Response  5-6  rev date 7/21/2008
6. AFTER THE STORM – RECOVERY

After every storm the sun will smile; for every problem there is a solution, and the soul’s indefeasible duty is to be of good cheer.

~ William R. Alger

When the intense activity and frenzy of actual restoration is nearing an end, a sense of accomplishment and finality may set in. But this could be misleading, because as every utility that has been through a major storm knows, there is still a tremendous amount of work to be done, and typically with less resources than during the actual system restoration. The post-event period can be broken into three phases: ramp-down, clean-up and review.

6.1 Ramp-Down

During the ramp-down phase of post-storm recovery, resources must be demobilized in a rational, intelligent way to complete outstanding tasks and not incur unnecessary costs. It may not be economical to hold onto external resources during this period, but if they are released too soon, some outages and clean-up may be prolonged, and customer satisfaction may be affected. To illustrate this point, the graphic below shows an example of the Southeastern Electric Exchange mobilization timeline (previously discussed in Section 2.6). The chart shows that as the percent of outages nears zero, the number of resources should be stepped down accordingly. Crews that are not actively clearing or repairing lines can be dedicated to clean up and verification of the system. Obviously, this proceeds faster if more resources are available, but it is also more expensive if external resources are used. The point at which it is prudent to release foreign crews is a judgment call – very much dependent on many situational factors.

![Hour 0 Storm Timeline](See Mobilization Timeline and Key decisions)

Perform follow-up inspections to identify missed repairs or unsafe conditions – During the restoration phase, temporary repairs are sometimes made to restore service quickly, with the goal of making permanent repairs later. Follow-up inspections should be performed on these repairs during ramp-down.

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Verify and document circuit state, equipment and topology – After service is restored, and before crews are released, the state of the repaired circuits should be verified and documented. Any temporary or ad-hoc repairs should be noted, as well as non-standard construction and equipment, changes in topology and other items that may need to be eventually redressed. In the subsequent clean-up phase, all new and repaired facilities should be completely surveyed and a plan developed to bring them up to standard.

6.2 Clean-Up

Clean up is one of the more underestimated activities of storm recovery. After storms that cause widespread damage, it is not uncommon for utilities to be cleaning up downed trees, broken limbs and debris, and making facilities repairs for months after actual system restoration. The following excerpt from the Kentucky PSC report after a major ice storm in February 2003 illustrates the point. “Nearly all of the affected utilities continued to work jobs associated with the ice storm well into the summer months. Lines that were “temporarily” fixed in order to restore service had to be permanently repaired. Poles that may have been “spliced” were replaced. During restoration, lines are often cleared just enough to restore service, and vegetation management practices take a back seat to getting power back on. This speeds up repair, but it is essential that utilities document and return to areas that need further trimming. Danger trees, which are those with hanging limbs, dead sections, etc., still pose a threat to electric lines even months after the storm, especially in windy conditions.”

Besides vegetation/debris removal, there are many other clean-up and recovery concerns. Some of them (documented from FPL’s Hurricane Andrew experience) include:

- Equipment and material – for every pole, transformer and wire installed, one has to be picked up and disposed of
- Streetlights – numerous streetlights may need to be replaced and repaired after service is restored
- Underground facilities – facilities submerged by storm surge and debris need to be removed
- Demolition – facilities need to be immediately removed from homes declared uninhabitable
- Standardization – complete survey of as-repaired facilities and restoration to standard
- Rebuilding – providing temporary services and permanent connections to support construction boom after the storm

Plan debris disposal during restoration to ease the clean-up nightmare after – Following the 2003 Kentucky ice storm, debris disposal quickly became one of the crucial problems. During restoration, clearing crews, tree crews and utility crews moved limbs, brush and debris just enough to make repairs. After the storm, local and state agencies soon became over-burdened by the amount of debris that needed to be removed. The KPSC noted that future emergency plans need to address environmental issues such as streams and creeks becoming clogged, hazardous material disposal, and brush burning areas.
Clean-up rights-of-way and work sites that may have been neglected during restoration – During the restoration phase, clearing ROWs and work sites is understandably a lesser priority than getting the lights back on. However, after restoration, the utility should go back clean up work sites. This includes removing brush from ROWs, cleaning up public property, and disposing of damaged hardware. Proper removal and attention to damaged facilities prevents hazardous conditions and ensures safe conditions. This will also reduce public complaints following restoration, and improve the perception of the utility.

Perform an extensive survey of repaired system and implement a standardization plan – Because of the urgency to quickly repair the system, the customary standards cross-checking is often bypassed. To address this, a complete survey of the facilities is needed to identify non-standard configurations and develop a plan to bring them up to standard. This is one of the most important post-event tasks, affecting the ongoing operation of the system. To give an idea of the scope, after Hurricane Andrew, FPL utilized 1700 additional personnel for three months after restoration to survey, document and correct non-standard construction.

Use GIS and GPS-enabled technology to aid post-storm facilities survey – The same mobile technology that is useful for locating and logging damage during damage assessment can be used in the post-storm survey to locate and document new equipment and configurations and upload data to a central database. After Hurricane Isabel, Dominion developed an application called Hazard Patrol (built on ESRI’s GIS suite) to collect and report hazard locations to the office. The application was successfully used in their post-storm survey/inspection to identify over 23,000 hazard locations, and even helped them recover several hundred thousand dollars from the ability to track non-Dominion owned joint-use poles that they replaced during restoration. There are a number of vendors that supply commercial applications and equipment that aid in the collection of field asset data, and integrate data into a GIS database. There also several companies that provide mapping and data collection services to utilities.

6.3 Review

Every storm is unique and there are important lessons to be learned from each experience. The post-event phase provides the perfect opportunity for self-assessment, peer review and sharing of lessons-learned. Shortly after the storm, findings need to be assembled and documented for the benefit of future storm responses, for response to regulatory requests, and for public dissemination. Some industry practices that are helpful in post-storm review are:

Survey mutual-aid utility personnel and off-system contractors – It is good practice to obtain formal feedback from external workers by surveying them after their departure. More useful insight into a company’s storm-response performance, especially in the areas of management, coordination and logistics, is often obtained from external participants than from internal utility personnel. After Hurricane Isabel, Dominion sent a survey to all external crews asking them to rate Dominion in the areas of safety, communications, organization and coordination, and accommodations and meals. There was an average of 750 responses to each survey question and an additional 175 responses to an online survey. The utility also solicited comments from the 21 mutual aid utilities that provided assistance, regarding safety, communications, organization, work assignments, map directions, accommodations, meals, training, efficiency, resources, and attitudes. Responses from seven utilities were generally positive, and did not reflect any systemic problems. Concerns expressed by crews and mutual aid utilities include:

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d Commonwealth of Virginia State Corporation Commission, [Preparation for and Response to Hurricane Isabel by Virginia’s Electric utilities], September 2004
• Insufficient grounding conductors for tree trimming crews
• Insufficient 35kV materials supplies
• Insufficient fuel for trucks
• Insufficient ice and water supplies due to local boil advisories
• Lack of diversity in the food supply
• Insufficient laundry services
• Existence of some old/brittle copper conductor on the system
• Shortage of guides for mutual assistance crews
• Lack of work for some crews
• Shortage of maps and electrical network plans
• Excessive safety meetings
• Failure of trying to feed everyone at a central location
• Remoteness of some staging areas
• Shortage of restrooms and dumpsters at staging areas
• Inefficient distribution of security badges

From this feedback, Dominion was able to “review and enhance its logistics to improve productivity and comfort of restoration personnel.”

Conduct Town-hall meetings in various locations and survey customers on their storm experience – Communicating with customers is not only essential during the storm, but before and after as well. A best practice for post-storm communications is to hold neighborhood town-hall meetings where affected customers can appear in person and air their views on how a storm response impacted them, and their opinion of the utility. Although, such discussions are potentially humbling, utilities receive primary-source information that directly impacts public perception. Utilities who have done this, discovered one of the greatest source of complaints is communication during the restoration, especially with estimated restoration times. If nothing else, sending a high-profile individual to listen to customers’ complaints is cathartic and may in itself improve perception and customer relations in the long run.

Another useful way to obtain customer feedback is to survey customers on their experience within a reasonable time period after the storm. The survey should solicit brutally honest feedback on what the utility did and did not do well, the types of communications and services customers require, and how the utility can do a better job serving the community in the future. It should be distributed in every way possible: bill inserts (although this may not elicit the most objective reaction), telephone calls, Website redirects, and direct mail. In most cases, it is best to have professionals develop and perform the survey.

Prepare or commission a comprehensive assessment report on every major event with issues and recommendations – After a major storm, some regulated utilities are required to file a storm report with the state regulatory commission (see the DSTAR member survey in the Appendix). Writing a storm report forces a utility to take stock of their response and critically analyze performance. In many cases, the commission staff will respond to the utility’s report and make recommendations for improvement. Whether or not a storm report is mandated, it is a good practice to prepare an internal storm report that documents the response timeline, performance, and lessons learned from the experience. The main problem with self-assessment is that it is extremely difficult to criticize one’s self and so there are bound to be built-in biases. A preferred option is to contract an outside consultant to produce an objective storm assessment report, and give him/her access to records, data and personnel that tell the real story.
7. SUMMARY – BEST PRACTICES AND LESSONS LEARNED

The lessons-learned, best practices, observations and recommendations discussed in this report are summarized as one-liners in the following section. Each item is hyperlinked to the report section where it is discussed in more detail.

Emergency Response Plans

1. Develop and maintain a comprehensive emergency response plan, to guide response during major events

Training and Drills

2. Provide flexible training options, sub-annually, on demand, at orientation and on role changes
3. Budget and track training costs and evaluate training effectiveness by testing and measuring
4. Select knowledgeable personnel and provide damage assessor training just before storm season
5. Conduct annual storm drills to exercise and refine all phases of the emergency response plan
6. Use outside consultants or advisors to observe storm drills and make recommendations

Early Warning and Damage Prediction

7. Make adjustments and accommodation for wide differences in the ability to detect and track storm types
8. Use storm detection and tracking technology/services for early warning
9. Use damage prediction methods to forecast damage severity and location and resource needs

Emergency Response Organization

10. Incorporate essential storm management elements into the emergency response organization (ERO)
11. Wherever it makes sense, push EOC functions down to the operations bases to improve efficiency
12. During major incidents, it may be more efficient to subdivide operating areas into smaller units
13. Use the capability of modern outage managements systems to command and control distributed, decentralized restoration efforts

Storm Center Activation

14. Develop a categorization method that prescribes levels of activation based on storm characteristics
15. Identify and monitor the threat early on and activate the storm organization in a timely manner

Mobilization Timeline

16. Make an early decision to pre-mobilize crews based on storm characteristics
17. Preposition external crews and other resources based on anticipated damage
18. Continually review and update mobilization targets as additional information becomes available

**Mutual Assistance**

19. Use the Joint Mobilization Process to address assistance issues
20. Develop an internal mutual assistance plan that is integrated into the emergency response plan
21. Have strong mutual assistance agreements in place with groups of peer utilities and contractors
22. Maintain agreements with multiple groups and bilateral agreements with local and long-distance partners
23. Develop and maintain relationships with mutual aid partners before and outside of storm events
24. Proactively exercise mutual assistance agreements to receive timely commitments before the storm
25. Expand mutual aid requests to include groups and utilities not threatened by the storm
26. Explore mutual aid relationships with cooperatives
27. Maintain contact with mutual aid groups and contractors throughout the event
28. Develop processes for forecasting, capturing and tracking mutual assistance costs
29. Attend mutual assistance conferences and participate in post-event evaluations and benchmarking

**Materials and Inventory Control**

30. Have a formal logistic and materials management plan that is incorporated into the ERP
31. Pre-order and pre-stage materials near areas likely to be affected by the event, so that work can begin as soon as possible
32. Use inventory control applications to manage the flow between central purchasing and the field
33. Continuously monitor stock levels during the event and take prompt action on heavily-used items
34. Document material requirements and use documentation from prior restoration efforts to guide procurement.
35. Document all processes used or created during the effort to source, procure and deliver materials on short lead-time.
36. Arrange for critical materials to be stored on site as vendor stock that can be released on short notice with email confirmation to purchase.
37. Pre-arrange for expedited shipping to ensure availability of transport as well as best pricing.
38. Use helicopters to airlift materials to crews in difficult to reach areas or where timeliness is key
39. Prepare work packages and materials overnight so crews would be ready to move out first thing in the morning

**Staging and Positioning**

40. Set up multiple staging areas to support large restoration activities
41. Agree on staging sites before the storm and develop staging layouts
42. You can’t work more people than you can logistically house and feed
43. Contract self-sustained mutual-assistance crews to reduce staging and logistic needs where feasible
44. Pre-position crews near areas where heavy damage is expected
45. Provide shuttles to bus crews between lodging and staging areas
46. Train non-line resources to perform overnight stocking of trucks and job site material delivery
47. Install dedicated standby generators at service centers
48. Anticipate and address traffic problems at staging areas and work sites
49. Provide necessary services to the families of internal responding crews so that they can focus on the task at hand

**Lodging and Meals**

50. Establish and maintain support procedures and relationships, including agreements and long-standing contracts with hotels, motels, other lodging facilities
51. Have contingency plans in place for limited hotel/motel room availability
52. Prepare to bus crews shot distances to other areas where lodging is available
53. Secure motels and hotels with onsite restaurants or catering facilities, and large parking lots
54. Assume that no food or water will be available on day one, immediately following the storm, and instruct responding personnel appropriately
55. Plan on providing MREs the first day of storm restoration and hot meals within 24 to 48 hours
56. Have four or five local caterers ready to prepare and service boxed meals in case MREs and local caterers fail to deliver
57. Arrange catering services that deliver meals to crews at their work locations
58. Pre-register crews with hotels, collect all the room keys and make room assignments as the crews arrive
59. Provide written notification of company policies with regard to expense reimbursements, incidental hotel expenses, and personal long-distance calls

**Security and Safety**

60. Provide security at the staging site for physical safety, asset protection, investigations, law enforcement and liaison
**Damage Assessment**

61. Develop processes/technology to efficiently collect and transfer damage data to operations center
62. Use standard damage assessment forms to document the location and extent of damage
63. Use mobile communication technology to streamline field assessment collection and reporting
64. Use recent technology such as smart meters to enhance damage assessment
65. Provide assessors with specific methods to estimate resource needs and restoration times
66. Start damage assessment as early as possible after the storm
67. Use contractors to supplement damage assessment teams if needed
68. Use field checkers in advance of tree crews to determine the types of crews and equipment needed in each area
69. Place damage assessors close to assigned areas and use night hours to perform phase one assessments where conditions permit
70. Assign damage assessors to particular feeders and ensure that they are intimately familiar with the area
71. Pair damage assessors with a driver to allow the assessor to concentrate on evaluation and reporting
72. Following the automated callback process, use damage assessors to check on pockets of customers still without power

**Public Safety Processes**

73. Perform safety process functions in parallel with damage assessment
74. As far as practically possible, detect and eliminate open neutral conditions on secondary wires
75. Inspect flooded meters and educate customers about risk associated with flooding beyond the meter

**Crew Deployment**

76. Deploy crews in proportion to damage and not just to outages
77. Continually assess needs and redeploy crews as restoration progresses

**Clearing, Switching and Repairing**

78. Coordinate tree crew movements with line crews needs
79. Use heavy machinery to help clear heavy damage in harsh conditions
80. Deploy trained crew guides to work along with external crews
81. Subdivide areas and push responsibility down the line, where it makes sense
82. Coordinate switching and clearance activities to achieve best maximum efficiency

**Communications with Customers**
83. Provide customers with additional information about the outage when they call to report
84. Plan your outage communications to run pre-event, during the event, and post-event
85. Educate customers on how the electric system works and on the utility storm restoration process
86. Educate customers about where utility responsibility ends and where consumer responsibility begins
87. Provide safety-related announcements to the public before and shortly after major storms
88. Provide a dedicated call-in number for customers on life-support equipment (LSE) registry
89. Make provision for communicating with Spanish speaking customers
90. During outages change the VRU script to offer the outage reporting option first
91. Avoid providing ancillary or inaccurate information that could lead to public frustration
92. Register long-term care facilities for priority notification and possible priority restoration
93. Provide online information via thematically shaded maps, and databases
94. Distribute glow-in-the-dark magnets with outage reporting numbers
95. Distribute dry ice distribution during prolonged outages

**Communications with the Media**
96. Educate the media about what happens during a storm outage
97. Be proactive in taking your story to the media, especially stories that highlight the restoration workers
98. Consider giving the media controlled access to areas of activity in order to shape the story
99. Communicate restoration goals and trends through the media and update regularly
100. Record comprehensive briefings on a dedicated media phone line with detailed restoration progress and restoration times
101. Make information available to the media online in a dedicated area of the utility Website
102. Give members of the media the opportunity to sign up for personalized updates via their mobile devices

**Communications with Officials and Other Utilities**
103. Maintain a contacts database and update at least annually and after each election
104. Be consistent and proactive in providing information
105. Designate liaisons to provide information to government and emergency management officials
106. Provide storm center direct number to key officials
107. Coordinate with electric cooperatives and other resellers that rely on the utility for power
108. Include city and county officials in major-outage-related informational meetings prior to storm season
109. Provide collaborative planning and training (“storm schools”)
Estimated Restoration Times

110. Use key metrics to monitor and improve ETRs and outage performance
111. Provide accurate, stable, and reasonable ETRs
112. Communicate ETRs to customers proactively via different media
113. It may be better to avoid providing specific ETRs if they are not reliable
114. Set a global (conservative) restoration target or high-level global ETR and use field checker information to refine and localize
115. Categorize customer outages into tiers and let OMS automatically generate ETRs for blocks of customers
116. In the absence of an ETR, (or a reliable one) use particular VRU scripts to provide as much information as possible to help ease customer concerns

Internal Communications

117. Control critical-to-mission communication systems
118. Coordinate communications among utilities and with public safety entities
119. Deploy backup communication systems
120. Pay attention to employee and family communications
121. Include IT personnel when command center is activated
122. Install and maintain permanent backup generation at service centers and communication facilities

Technology Use

123. Ensure that an adequate number of phone lines and queue capacity are in place to manage call volume imposed by major storms
124. Make first IVR option, “report an outage,” not billing or some other option
125. Include a clear message regarding billing issues such as non-pay disconnects so these customers do not continue calling
126. The OMS is part of the solution, not part of the problem
127. Fully integrate OMS into disaster planning to improve restoration and reduce cost
128. Fully test OMS before storm season and upgrade/correct as necessary
129. Assign responsibility for critical technology, such as OMS system, to a single individual who owns/manages the operation, upgrade, and impact on upstream/downstream process
130. Have a clear business continuity (contingency) plan for automated technology failures (such as OMS crash and IVR saturation)
131. Use AMR/AMI systems to improve the outage notification process
132. Ping meters to confirm or verify outages and restoration
133. Integrate AMR/AMI with OMS to reduce cost and improve efficiency and customer service
134. Use automated geospatial information technology in storm response
135. Use the Internet to provide and collect outage information via a storm center portal
136. Perform follow-up inspections to identify missed repairs or unsafe conditions
137. Verify and document circuit state, equipment and topology

**After the Storm - Recovery**

138. Plan debris disposal during restoration to ease the clean-up nightmare after
139. Clean-up rights-of-way and work sites that may have been neglected during restoration
140. Perform an extensive survey of repaired system and implement a standardization plan
141. Use GIS and GPS-enabled technology to aid post-storm facilities survey
142. Survey mutual-aid utility personnel and off-system contractors
143. Conduct Town-hall meetings in various locations and survey customers on their storm experience
144. Prepare or commission a comprehensive assessment report on every major event with issues and recommendations
8. APPENDIX – DSTAR MEMBER SURVEY
### 8.1 Questionnaire

1. Please provide information on the ten (10) most severe storms your company has experienced since 1991 (15 years).*

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<th>Time to Restore % Customers (days)</th>
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* Format based on 2003 EEI storm response survey
1 Identify storm type, i.e. hurricane, windstorm, thunderstorm, ice storm, tornado, blizzard, flood, etc.
2 Month and year of event
3 The maximum number without power at the same time during the storm, and the percentage of customers this number represents
4 Number of days to restore power to 75% and 100% of customers who lost power during the storm
5 Includes line crews working to restore damage, field support personnel, contractors, and mutual aid personnel
6 Impact of storm on utility physical infrastructure, includes poles and transformers replaced, and primary conductor replaced/rebuilt
Before the Storm

2. Please describe the range of early alert processes and technologies you use for detection, tracking, and monitoring storm systems? (e.g. NWS/NOAA, private meteorological services, on-staff meteorologists, lightning detection services, etc.)

3. *Typically* how much advance warning (hours) do you get for various storm types? (Example 72 – 90 hours or “N/A” if not applicable to your region)
   - Hurricanes
   - Ice storms
   - Windstorms
   - Thunderstorms
   - Lightning
   - Snowstorms
   - Others?

4. Please describe any processes, models or applications for forecasting storm impact i.e. physical damage predications and resource projections before storm hits? (e.g. in-house prediction models, commercial tools such as OutageCast, historical data)

5. Do you use a storm classification matrix or storm categories to initiate levels of activation? If so, please describe the classifications.

6. At what point do you commit to mobilization of external (contractor and mutual aid) resources prior to the onset of a forecasted storm?

7. Are you required to file an emergency response plan with the state regulatory commission or another oversight body?

8. How often do you conduct training for personnel with storm responsibilities?

9. How often do you conduct storm drills?
   Do you include state and local emergency response or other utility personnel (telephone water, etc.) in your drills? *Elaborate if necessary.*

10. Please list the mutual assistance organizations that you are a member of.

11. Please list the types of contractors you utilize during storms.
Storm Restoration

12. **Briefly describe your storm restoration process** (i.e. restoration priorities for transmission, substation, distribution, hospitals, police, fire and public works facilities, public safety, etc.).

13. **Is storm response centralized** (one distribution central dispatch office), **pseudo-centralized** (several regional dispatch offices) or **decentralized** (line shops responsible for response in their territory)? **Please elaborate as necessary.**

14. **Do you utilize an outage management system (OMS) or other similar application to manage storm response?** Please describe.

15. **Please list and describe other technologies that you use for more efficient storm response?** (such as GIS AM/FM, work management systems, interactive voice response, automatic vehicle locator/GPS, remote data terminals, handhelds, AMR, AMI)

16. **How is field damage assessment usually conducted?** (For instance, one utility has described a phased approach where they do a quick assessment in 1-3 hrs, use this to initially assign crews with scouts, then do a more detailed assessment on backbone feeder within 24 hrs)? **Please include details of how assessment information conveyed back to command/trouble center?** (hand delivered, called-in, uploaded, etc.).

17. **What is the process for handling down-wires, open neutrals, and other public safety concerns during the restoration process?**

18. **Who has responsibility for the coordination of substation and feeder energization and switching activities after the repairs have been completed?** (Some utilities have described a decentralized approach where responsibility is assigned to a switch manager in the field with very clearly outlined procedures. Other utilities will only allow switching from central command for various liability, safety, or logistical reasons). **Please elaborate on your practices.**

19. **What are your best practices for handling logistics of staging and crew deployment?**

20. **What is your primary means of communication with crews and other responders during a storm?**
**Do you use any alternative or non-traditional communication means of methods?** Please elaborate.

21. **What is your standard practice for communicating with media and elected officials during a storm?**
**Do you have any particularly effective communication approaches or strategies?**

22. **Do you provide restoration estimates to customers who call?** If so, **how are these derived?**

23. **Do you provide real-time outage information on-line (map or database) for customer access via the Internet?** If so, **how often is it updated?**
24. What is your customer’s number one complaint about your storm response?

25. If you could do one thing to improve your storm response capability what would that be?
   Elaborate as necessary.

After the Storm

26. Do you have any processes to compensate customers for losses from outages? (If so, do you think this influences customer perception of your response?)

27. Are you required to file storm reports to the state regulatory commission? (If so what is the threshold that triggers a report?)

28. Are you required to report reliability statistics to a regulatory commission?
   What criteria if any do you use to declare a major event?
   Are outages during major events included in reported reliability statistics?

29. Do you collect and maintain outage data from storm events?
   How is this data used (if at all) after the storm?

30. Do you have an instituted review/post-mortem process after major storms?

31. What are some of the lessons learned from recent storm restoration activities?

Please provide a contact person for follow-up, if needed.
   Name:
   Title/Position:
   Company:
   Phone:
   Email:
### 8.2 Response Summary

**Storm Data (Question 1)**

<table>
<thead>
<tr>
<th>Storm Event</th>
<th>Date</th>
<th>Peak # Customers Out (% Out)</th>
<th>Time to Restore % Customers (75% days, 100% days)</th>
<th>Peak # of Line Restoration Personnel</th>
<th>Damage Estimates</th>
</tr>
</thead>
<tbody>
<tr>
<td>Hurricane Katrina</td>
<td>August, 2005</td>
<td>635,591 (69%)</td>
<td>2.5 3</td>
<td>2658</td>
<td>1376 940 384</td>
</tr>
<tr>
<td>Hurricane Opal</td>
<td>October, 1995</td>
<td>475,829 (37%)</td>
<td>2.5 7</td>
<td>2496</td>
<td>2400 NA 498</td>
</tr>
<tr>
<td>Blizzard</td>
<td>March, 1993</td>
<td>404,206 (21%)</td>
<td>3.5 8</td>
<td>5479</td>
<td>1527 NA 189</td>
</tr>
<tr>
<td>Derecho Wind Storm</td>
<td>February, 2001</td>
<td>356,876 (27%)</td>
<td>2 4</td>
<td>3233</td>
<td>NA NA NA</td>
</tr>
<tr>
<td>Hurricane Davis</td>
<td>July, 2005</td>
<td>241,214 (19%)</td>
<td>0.5 3</td>
<td>4641</td>
<td>422 265 125</td>
</tr>
<tr>
<td>Derecho Wind Storm</td>
<td>July, 2000</td>
<td>539,974 (13%)</td>
<td>1 2</td>
<td>1608</td>
<td>NA NA NA</td>
</tr>
<tr>
<td>Hurricane Georges</td>
<td>September, 1998</td>
<td>148,000 (11%)</td>
<td>1.5 3</td>
<td>2022</td>
<td>NA NA NA</td>
</tr>
<tr>
<td>Ice Storm</td>
<td>February, 1996</td>
<td>62,025 (3%)</td>
<td>1 4</td>
<td>619</td>
<td>NA NA NA</td>
</tr>
<tr>
<td>Tornadoes</td>
<td>December, 2000</td>
<td>56,204 (4%)</td>
<td>0.5 2</td>
<td>247</td>
<td>NA NA NA</td>
</tr>
<tr>
<td>Hurricane Charlie</td>
<td>August, 2004</td>
<td>202,001 (43%)</td>
<td>6 9</td>
<td>9000</td>
<td>3100 1580 667</td>
</tr>
<tr>
<td>Hurricane Frances</td>
<td>September, 2004</td>
<td>333,000 (70%)</td>
<td>4 6</td>
<td>5000</td>
<td>2500 1300 300</td>
</tr>
<tr>
<td>Hurricane Jeanne</td>
<td>September, 2004</td>
<td>722,000 (62%)</td>
<td>3 5</td>
<td>8300</td>
<td>600 370 200</td>
</tr>
<tr>
<td>Wind Storm</td>
<td>March, 1993</td>
<td>5100</td>
<td>2 3</td>
<td>35</td>
<td>5 5 0.05</td>
</tr>
<tr>
<td>Flood</td>
<td>October, 1994</td>
<td>6800</td>
<td>1.5 2</td>
<td>30</td>
<td>0 10 0</td>
</tr>
<tr>
<td>Hurricane (storm 1)</td>
<td>September, 1998</td>
<td>9500 (75%)</td>
<td>1.5 2</td>
<td>30</td>
<td>2 0 0</td>
</tr>
<tr>
<td>Hurricane (storm 2)</td>
<td>September, 1999</td>
<td>15000 (70%)</td>
<td>1.5 2</td>
<td>30</td>
<td>5 5 1</td>
</tr>
<tr>
<td>Ice Storm</td>
<td>October, 2003</td>
<td>18000</td>
<td>2 3</td>
<td>80</td>
<td>1.0 5 2</td>
</tr>
<tr>
<td>Tropical Storm</td>
<td>January, 2002</td>
<td>5200</td>
<td>1 2</td>
<td>45</td>
<td>2 2 0.5</td>
</tr>
<tr>
<td>Hurricane Bertha</td>
<td>July, 1996</td>
<td>212,000</td>
<td>4 6</td>
<td>2000</td>
<td></td>
</tr>
<tr>
<td>Hurricane Fran</td>
<td>September, 1996</td>
<td>790,000 (6)</td>
<td>6 10</td>
<td>7200</td>
<td>5500 2800 1000</td>
</tr>
<tr>
<td>Hurricane Floyd</td>
<td>September, 1999</td>
<td>537,000 (4)</td>
<td>4 6</td>
<td>7000</td>
<td>1100 386</td>
</tr>
<tr>
<td>Ice Storm</td>
<td>December, 2002</td>
<td>480,000</td>
<td>5 7</td>
<td>3600</td>
<td>1322 2200</td>
</tr>
<tr>
<td>Hurricane Isabel</td>
<td>September-03</td>
<td>320,000</td>
<td>2 4</td>
<td>2300</td>
<td>212 307</td>
</tr>
<tr>
<td>Ice Storm</td>
<td>March-06</td>
<td>11,600 (40%)</td>
<td>1 3</td>
<td>110</td>
<td>20</td>
</tr>
<tr>
<td>Blizzard</td>
<td>March-09</td>
<td>20,105 (67%)</td>
<td>2 3</td>
<td>75</td>
<td>10</td>
</tr>
<tr>
<td>Hurricane Isabel</td>
<td>September-03</td>
<td>18,450 (60%)</td>
<td>2 3</td>
<td>65</td>
<td>25</td>
</tr>
<tr>
<td>Hurricane Ivan</td>
<td>September-04</td>
<td>5,640 (26%)</td>
<td>1 2</td>
<td>25</td>
<td>2</td>
</tr>
<tr>
<td>Ice Storm</td>
<td>December-02</td>
<td>7,438 (26%)</td>
<td>1 2</td>
<td>25</td>
<td>3</td>
</tr>
<tr>
<td>Storm Event</td>
<td>Date</td>
<td>Peak % Customers Out</td>
<td>Time to Restore % Customers</td>
<td>Peak # of Line Restoration Personnel</td>
<td>Poles Replaced</td>
</tr>
<tr>
<td>-----------------------------</td>
<td>----------------</td>
<td>----------------------</td>
<td>-----------------------------</td>
<td>-------------------------------------</td>
<td>---------------</td>
</tr>
<tr>
<td>Deserts</td>
<td>May, 1998</td>
<td>151,500 (total)</td>
<td>1</td>
<td>3</td>
<td></td>
</tr>
<tr>
<td>High Wind Event</td>
<td>November, 1998</td>
<td>133,800 (total)</td>
<td>1</td>
<td>3</td>
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</tr>
<tr>
<td>High Wind Event/Lightning</td>
<td>June, 2001</td>
<td>36,000 (total)</td>
<td>1</td>
<td>3</td>
<td></td>
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<tr>
<td>Severe Thunderstorm</td>
<td>September, 2005</td>
<td>128,000 (total)</td>
<td>1</td>
<td>4</td>
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</tr>
<tr>
<td>Ice Storm</td>
<td>March, 98</td>
<td>463,213 (14%)</td>
<td>2</td>
<td>7</td>
<td></td>
</tr>
<tr>
<td>Wind Storm</td>
<td>November, 98</td>
<td>204,962 (6%)</td>
<td>2</td>
<td>5</td>
<td></td>
</tr>
<tr>
<td>Lightning, Wind Storm</td>
<td>October, 95</td>
<td>292,174 (7%)</td>
<td>2</td>
<td>7</td>
<td></td>
</tr>
<tr>
<td>Lightning, Wind Storm</td>
<td>July, 93</td>
<td>105,070 (3%)</td>
<td>3</td>
<td>5</td>
<td></td>
</tr>
<tr>
<td>Lightning Storm</td>
<td>August, 98</td>
<td>109,093 (3%)</td>
<td>2</td>
<td>4</td>
<td></td>
</tr>
<tr>
<td>Wind Storm</td>
<td>May, 03</td>
<td>676,321 (2%)</td>
<td>1</td>
<td>3</td>
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<tr>
<td>Lightning Storm</td>
<td>May, 00</td>
<td>175,194 (2%)</td>
<td>1</td>
<td>3</td>
<td></td>
</tr>
<tr>
<td>Lightning, Wind Storm</td>
<td>July, 04</td>
<td>92,719 (3%)</td>
<td>2</td>
<td>4</td>
<td></td>
</tr>
<tr>
<td>Wind Storm</td>
<td>March, 02</td>
<td>57,274 (2%)</td>
<td>1</td>
<td>3</td>
<td></td>
</tr>
<tr>
<td>Lightning Storm</td>
<td>August, 93</td>
<td>161,493 (3%)</td>
<td>1</td>
<td>2</td>
<td></td>
</tr>
<tr>
<td>Ice Storm (Ice Breaker of 24)</td>
<td>January, 94</td>
<td>203,955</td>
<td>2</td>
<td>7</td>
<td></td>
</tr>
<tr>
<td>Hurricane Isabel</td>
<td>September, 03</td>
<td>227,981 (14%)</td>
<td>2</td>
<td>7</td>
<td></td>
</tr>
<tr>
<td>Wind/Rain/Lightning (Harrow Storm)</td>
<td>July, 96</td>
<td>285,556 (18%)</td>
<td>3</td>
<td>7</td>
<td></td>
</tr>
<tr>
<td>Hurricane Floyd</td>
<td>September, 99</td>
<td>310,461 (13%)</td>
<td>2</td>
<td>8</td>
<td></td>
</tr>
<tr>
<td>Tornado (Albany)</td>
<td>May, 99</td>
<td>214,928 (14%)</td>
<td>2</td>
<td>5</td>
<td></td>
</tr>
<tr>
<td>Severe Windsstorm</td>
<td>December, 92</td>
<td>75,392 (5%)</td>
<td>2</td>
<td>3</td>
<td></td>
</tr>
<tr>
<td>Lightning (Hot Tots)</td>
<td>June, 98</td>
<td>123,423 (9%)</td>
<td>1</td>
<td>3</td>
<td></td>
</tr>
<tr>
<td>Wind Storm</td>
<td>November, 03</td>
<td>49,498 (3%)</td>
<td>2</td>
<td>5</td>
<td></td>
</tr>
<tr>
<td>Wind/Rain/Lightning</td>
<td>September, 93</td>
<td>98,140 (7%)</td>
<td>1</td>
<td>4</td>
<td></td>
</tr>
<tr>
<td>Snow Storm</td>
<td>March, 99</td>
<td>114,774 (7%)</td>
<td>1</td>
<td>4</td>
<td></td>
</tr>
<tr>
<td>Wind/Rain Lightning</td>
<td>April, 03</td>
<td>31,514 (8%)</td>
<td>1</td>
<td>3</td>
<td></td>
</tr>
<tr>
<td>Wind/Rain Lightning</td>
<td>July, 99</td>
<td>76,811 (20%)</td>
<td>1</td>
<td>4</td>
<td></td>
</tr>
<tr>
<td>Wind/Rain Lightning</td>
<td>April, 04</td>
<td>11,123 (3%)</td>
<td>1</td>
<td>3</td>
<td></td>
</tr>
<tr>
<td>Wind/Rain Lightning</td>
<td>August, 92</td>
<td>8,591 (2%)</td>
<td>1</td>
<td>1</td>
<td></td>
</tr>
<tr>
<td>Wind/Rain Lightning</td>
<td>July, 02</td>
<td>23,401 (6%)</td>
<td>1</td>
<td>2</td>
<td></td>
</tr>
<tr>
<td>Wind/Rain Lightning</td>
<td>June, 01</td>
<td>68,979 (17%)</td>
<td>1</td>
<td>4</td>
<td></td>
</tr>
<tr>
<td>Wind/Rain Lightning</td>
<td>May, 01</td>
<td>70,224 (21%)</td>
<td>1</td>
<td>4</td>
<td></td>
</tr>
<tr>
<td>Steel Snow disaster</td>
<td>April, 02</td>
<td>23,006 (6%)</td>
<td>1</td>
<td>3</td>
<td></td>
</tr>
<tr>
<td>Steel Snow disaster</td>
<td>November, 05</td>
<td>49,213 (12%)</td>
<td>1</td>
<td>2</td>
<td></td>
</tr>
<tr>
<td>Steel Snow disaster</td>
<td>November, 06</td>
<td>36,382 (10%)</td>
<td>1</td>
<td>4</td>
<td></td>
</tr>
</tbody>
</table>
Before the Storm (Questions 2 – 11)

<table>
<thead>
<tr>
<th>2. Early alert processes and technologies</th>
<th>3. Advance Warning (Hrs)</th>
<th>4. Processes, models, applications for forecasting storm impact</th>
<th>5. Storm classification matrix or storm categories to initiate levels of activation?</th>
</tr>
</thead>
<tbody>
<tr>
<td><strong>Southern ALP</strong></td>
<td><strong>National Weather Service, National Hurricane Center, Impact Weather, Dr. Blackwell in Mobile, AL.</strong></td>
<td>Hurricanes 72-96, Ice storms 48-72, Winds 6-24, Thunderstorms 24-48, Lightning 0, Snowstorms 48-72.</td>
<td>For hurricanes, we use in-house prediction models based on past storms. No.</td>
</tr>
<tr>
<td><strong>Progress Florida</strong></td>
<td><strong>Private Meteorological service</strong></td>
<td>Hurricanes 130, Ice storms N/A, Winds 24, Thunderstorms 3, Lightning 3, Snowstorms N/A.</td>
<td>For major storms we have an internal prediction model based on wind speed and duration. 1. Personnel within a local affected area are able to restore without assistance in a timely manner. 2. Personnel within an Operations area are able to restore without outside assistance in a timely manner. 3. Personnel within a Regional area are able to restore without outside assistance in a timely manner. 4. Personnel within affected Regions are not able to restore power in a timely manner without outside assistance.</td>
</tr>
<tr>
<td><strong>PE Carolinas</strong></td>
<td><strong>We monitor all web available weather services, such as NOAA and Accuweather, but also contract with a private meteorological service.</strong></td>
<td>Hurricanes 120, Ice storms 48, Winds 24, Thunderstorms 3, Lightning 3, Snowstorms 48.</td>
<td>For tropical storms and hurricanes we have an internal prediction model based on wind speed and duration. 1. Personnel within a local affected area are able to restore without assistance in a timely manner. 2. Personnel within an Operations area are able to restore without outside assistance in a timely manner. 3. Personnel within a Regional area are able to restore without outside assistance in a timely manner. 4. Personnel within affected Regions are not able to restore power in a timely manner without outside assistance.</td>
</tr>
<tr>
<td><strong>WE Energies</strong></td>
<td><strong>We use a private meteorological service which includes a lightning detection service. We also utilize NWS/NWSI reports.</strong></td>
<td>Hurricanes N/A, Ice storms 24-48, Winds 12-24, Thunderstorms 2-12, Lightning 2-12, Snowstorms 24-48, Heat 24-48.</td>
<td>Outage Predictor – an in-house prediction model estimates the number of customer outages. No, storms are grouped into 3 general classifications (small, medium and large) based on the number of customer outages. Storm classification is also influenced by the geographic area and type of event (wind, lightning). Small &lt;10,000, Medium &lt;20,000, Large &gt;20,000.</td>
</tr>
<tr>
<td><strong>SC&amp;G</strong></td>
<td><strong>NWS and Commercial lightning detection service</strong></td>
<td>Hurricanes 72/90, Ice storms 12-24, Winds 8-6, Thunderstorms 0.4, Lightning 0.4, Snowstorms 12-24.</td>
<td>None. 4 - damage possible w/ 72 hrs, 3 - damage possible w/ 48 hrs, 2 - damage possible w/ 24 hrs, 1 – damage is imminent.</td>
</tr>
<tr>
<td>State</td>
<td>Early Alert Processes and Technologies</td>
<td>Advance Warning (hrs)</td>
<td>Processes, Models, Applications for Forecasting Storm Impact</td>
</tr>
<tr>
<td>--------</td>
<td>---------------------------------------</td>
<td>-----------------------</td>
<td>-----------------------------------------------------------</td>
</tr>
<tr>
<td>Exelon (ComEd, PECO)</td>
<td>WSI Corporation's ENERGYcast, private meteorological services</td>
<td>Ice storms 4-6 hours, Windstorms 4-8 hours, Thunderstorms 12-24 hours, Lightning 12-24 hours, Snowstorms 12-24 hours</td>
<td>EED Storm Assessment Tool (in house)</td>
</tr>
<tr>
<td>Wisconsin Public Service</td>
<td>Weatherbank, Lightning Detection</td>
<td>Hurricanes N/A, Ice storms 12-24, Windstorms 12-24, Thunderstorms 12-24, Lightning 12-24, Snowstorms 12-24</td>
<td>None</td>
</tr>
<tr>
<td>Palmetto EC</td>
<td>NWS/NOAA, Satellite Weather System Subscriber, University of South Alabama Storm Center, NRCC, County Emergency Management Center, The Weather Channel</td>
<td>Hurricanes 72-120, Ice storms 14, Windstorms 2, Thunderstorms 12, Lightning 12, Snowstorms N/A</td>
<td>Historical Data and Damages experienced by other Utilities</td>
</tr>
<tr>
<td>Adams EC</td>
<td>We use satellite based weather, and two other local weather services including Accuweather, we also fine access to lightning detection info</td>
<td>Hurricanes 12-72, Ice storms 4-12, Windstorms 12-24, Thunderstorms 6-24, Lightning 0-24, Snowstorms 12-48</td>
<td>None</td>
</tr>
<tr>
<td>NIH EC</td>
<td>CNN, weather channel, local TV station, internet weather websites, looking out the window</td>
<td>Hurricanes 96-6, Ice storms 96-6, Windstorms 24-6, Thunderstorms 24-2, Lightning 24-2, Snowstorms 48-4</td>
<td>None at this time</td>
</tr>
<tr>
<td>---</td>
<td>---</td>
<td>---</td>
<td>---</td>
</tr>
<tr>
<td>Southern ALP</td>
<td>Views based on type of store, storm severity, and location of available resources</td>
<td>Southern ALP</td>
<td>No</td>
</tr>
<tr>
<td>Progress Florida</td>
<td>Hurricanes – 3 days</td>
<td>Progress Florida</td>
<td>Yes – Florida Public Service Commission</td>
</tr>
<tr>
<td>PE Caroline</td>
<td>Hurricanes – 3 days</td>
<td>PE Caroline</td>
<td>No</td>
</tr>
<tr>
<td>WE Energies</td>
<td>Ongoing; contacts may be held over for up to 3 hours. Offshore, mutual resources are requested when an actual need has been determined</td>
<td>WE Energies</td>
<td>No</td>
</tr>
<tr>
<td>SCE &amp; G</td>
<td>24 hrs</td>
<td>SCE &amp; G</td>
<td>Yes</td>
</tr>
<tr>
<td>---</td>
<td>---</td>
<td>---</td>
<td>---</td>
</tr>
<tr>
<td>ConEd (ConEd, PECO)</td>
<td>Typically there is no mobilization of outside resources prior to a storm, but due to the anticipation of extensive damage, a call is conducted with neighboring utilities (MOA) to discuss availability. This call occurs more during the winter months when the damage has been assessed and on land resources are exhausted.</td>
<td>ConEd (ConEd, PECO)</td>
<td>No, but the Public utility commission is notified during an event. The PECO event center is opened if the number of extreme weather storms and conditions exceed the annual average.</td>
</tr>
<tr>
<td>Wisconsin Public Service</td>
<td>No prior commitments made</td>
<td>Wisconsin Public Service</td>
<td>Yes, State Public Service Commission</td>
</tr>
<tr>
<td>Palmetto ECP</td>
<td>OECO/CMS 1 in 1</td>
<td>Palmetto ECP</td>
<td>No</td>
</tr>
<tr>
<td>Adams ECP</td>
<td>After assessment of damage</td>
<td>Adams ECP</td>
<td>No</td>
</tr>
<tr>
<td>MEC</td>
<td>Contractors are assigned to standby status when forecasted storms are headed by our service territory, and then committed to project sites. Contractors will be contacted via telephone, and we will maintain our communication.</td>
<td>MEC</td>
<td>No</td>
</tr>
</tbody>
</table>

## Storm Restoration (Questions 12 – 24)

<table>
<thead>
<tr>
<th>12. Storm restoration process</th>
<th>13. Storm response centralized, pseudo-centralized or decentralized</th>
<th>14. OMS or another similar application to manage storm response</th>
</tr>
</thead>
<tbody>
<tr>
<td><strong>Southern ALP</strong></td>
<td>Transmission and substations restoration have priority and are typically worked on simultaneously with distribution restoration. If different resources are working on each facet, the emphasis is on restoring the main feeders first and then branches and taps. Where possible, priority is given to restoration for hospitals and critical infrastructure agencies.</td>
<td>Depends on the severity of the storm. During minor storms, we would be pseudo-centralized with several regional dispatch offices handling the restoration. For major storms, additional operations centers are established at staging areas throughout the storm impact area. The more severe the storm, the more operations centers would be set up.</td>
</tr>
</tbody>
</table>

**Progress Florida**

Transmission & Distribution are restored with parallel efforts.

Distribution Priorities:
1. Feeders, Lines & Services to Nuclear Plant sites, hospitals, water treatment, shippers
2. Feeders, Lines & Services to Law Enforcement, Fire/Rescue, Food distribution
3. All other Feeder, Lines & Services

For major storms, centralized Dispatch handles feeder level switching while the Operations Centers are responsible for tap lines.

Yes – We have an internal OMS system that tracks customer calls, mapped equipment and electronically monitored equipment, etc. to track outages and number of customers out.

**PE Carolinas**

Transmission & Distribution are restored with parallel efforts.

Distribution Priorities:
1. Feeders, Lines & Services to Nuclear Plant sites, hospitals, water treatment, shippers
2. Feeders, Lines & Services to Law Enforcement, Fire/Rescue, Food distribution
3. All other Feeders, Lines & Services

For major storms, we de-centralize dispatch functions to Operations Centers, but Distribution Control Center is still manned and available to assist.

Yes – We have an OMS system that tracks customer calls, mapped equipment and electronically monitored equipment, etc. to track outages and number of customers out.

**WE Energies**

Public safety issues (Fire and police calls) and other wire down calls first, followed by substations, feeder faults, critical customers, primary outages, secondary. We do not own transmission facilities.

During normal operation we are pseudo-centralized with distribution dispatch offices in each of our three geographic operating areas (southwest Wisconsin, Appleton, WI and Iron Mountain, MI). Following medium and large storms, we decentralize to stabilized service centers in the affected areas.

We use ABB Network Manager (CADOPE) DMS.

**SCE&G**

Handed at local level, but generally focus is on getting most customers on as quickly as possible and thus priority customers like hospitals, police, etc.

OMS
<table>
<thead>
<tr>
<th>12. Storm restoration process</th>
<th>13. Storm response centralized, pseudo-centralized or decentralized</th>
<th>14. OMS or other similar application to manage storm response</th>
</tr>
</thead>
<tbody>
<tr>
<td>Exelon (ComEd, PECO)</td>
<td>High profile &amp; priority distribution customers that are without service (i.e. locked out) due to an interruption (i.e. feeder lockout) that are listed and receive restoration priority by escalating via Emergency Response Director. Examples of these customers include but are not limited to: hospitals, airports, schools, radio stations, 911 centers, nuclear plants, life safety accounts &amp; politically sensitive accounts. When the priority customers are restored their restoration efforts focus on large customer count jobs working backwards to the lesser amount. Depending on the type of storm, non-outage events with涉及 wires down would take precedence using a cut &amp; run strategy to ensure public safety.</td>
<td>Pseudo-centralized</td>
</tr>
</tbody>
</table>

Wisconsin Public Service | Distribution: substation lockouts, feeder lockouts, structure fires, hospitals, locations of police or fire standing by, wire down locations, pole gaps, fuse blown, transformers, services, gas leaks, bright and dim, flickers, power net out events | Integraph’s InService OMS |

Palmetto EC | Substations, Main Feeders, Hospitals, Police, Fire, Public Works (Water & Sewer) and Safety Facilities, Communications, Fused Taps | In minor storms, outages are dispatched from our Central Dispatch Center - Moderate to heavy storms, outages are dispatched from our decentralized district operating centers. |

Adams EC | We do not have responsibility for transmission. We restore the substations first, and continue restoring the most customers as quickly as possible. That normally means main three phase lines first and single phase sections later. We try to pass badly damaged single phase sections that will take a long time to repair. | We have UA's Outage Management System. It takes outage calls from our Contact Center and/or IVR system, it then groups and analyzes the calls and predicts the protective device that is open. |

NH EC | Outage calls are first received by our member solutions department then an outage ticket is generated and sent to our control centers. The center then dispatches lines crews depending on the utility affected and the severity of the report. Conditions with wires down take precedence over others. Then hospitals, police, communications, etc are dealt with. | For routine and extended outages dispatching is centralized, where the classification goes to major same districts are staffed and dispatch locally and decentralized. |
<table>
<thead>
<tr>
<th>15. Other technologies for more efficient storm response</th>
<th>16. Field damage assessment process</th>
<th>17. Handling down-wires, open neutrals, and other public safety concerns</th>
</tr>
</thead>
</table>
| **Southern ALP**  
Southern Link 2-way radio and cell phone communications system. Also use GIS system to determine concentrations of customer outages. | **Our damage assessment is conducted as described with a quick assessment followed up by a detailed evaluation. At present, information is recorded on paper maps and hand delivered back to the operations center. Looking using GPS or other means for recording and reporting this information.** | **If energized conductors are found to be on the ground, or if other public safety issues are discovered, these areas will be guarded by company personnel until the circuits can be switched off, or the problem repaired. In some cases local law enforcement will assist in this process.** |
| **Progress Florida**  
1) Resource Storm Volunteer Program – internal software that mobilizes and tracks Progress Energy Employees  
2) ResourceLink – an internal software that mobilizes and tracks contact line and tree resources  
3) SCADA – Internal electronic tracking and operation of automated equipment  
4) GIS – new system that is able to track storm vehicles  
5) FRAMWE – Internal mapping of all lines & equipment  
6) UDO Mobile – communications  
7) CSS – Internal software for tracking customer issues (low hanging lines, voltage compliances, etc.)  
8) YRU – Automated messaging for updated outage restoration information | **1) Perform a statistical survey (initial 1-3 hours) to verify open/failed switches and gauges accuracy of predictive model**  
**2) Electrical Sweep (1-2 days) – Determine restoration of backbone feeders and customer outage counts**  
**3) Perform Full Assessment (ongoing) – Call to PC and report 4 times per day to Oฯ Center (all DA information is inputted electronically for tracking and assisting in establishing EIR’s or estimated time of repair)** | **Assigned personnel are partnered with the governmental EDC’s to clear intersections and other safety related issues as they are reported.** |
| **PE Carolinas**  
1) Resource Storm Volunteer Program – internal software that mobilizes and tracks Progress Energy Employees  
2) ResourceLink – an internal software that mobilizes and tracks contact line and tree resources  
3) SCADA – Internal system for Supervisory Control of most feeder breakers and some end point devices  
4) GFS – new system that is able to track storm vehicles  
5) FRAMWE – Internal mapping of all lines & equipment  
6) UDO Mobile – communications  
7) CSS – Internal software for tracking customer issues (low hanging lines, voltage compliances, etc.)  
8) YRU – Automated messaging for updated outage restoration information  
9) Damage Assessment Tool – An internally developed database to collect and data and help estimate times of restoration | **1) Perform a statistical survey (initial 1-3 hours) to verify open/failed switches and gauges accuracy of predictive model**  
**2) Electrical Sweep (1-2 days) – Determine restoration of backbone feeders and customer outage counts**  
**3) Perform Full Assessment (ongoing) – Call to PC and report 4 times per day to Oฯ Center (all DA information is inputted electronically for tracking and assisting in establishing EIR’s or estimated time of repair)** | **Assigned personnel are partnered with the governmental EDC’s to clear intersections and other safety related issues as they are reported.** |
| **WE Energies**  
GIS AM/FM, interactive voice response, automatic vehicle locator/GPS, remote data terminals, automated crew callout  
| **Initially, Troubleshooters do patrols beginning with the largest outages. They make permanent or temporary repairs where possible and report their finding via radio or cell phone. In large storms, design and supervision personnel will take patrol and report via cell phone.**  
| **Hazards are cut clear, repaired, or guarded pending resolution.** |
| **SCE&G**  
GIS, OMS, IVR  
| **Quick assess to determine how much assistance required. Then detailed assess & restoration begins. Info hand delivered and then put in spreadsheet to summarize.**  
<p>| <strong>Central dispatch coordinates this</strong> |</p>
<table>
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</thead>
<tbody>
<tr>
<td><strong>Exelon (ComEd, PECO)</strong></td>
<td>Quick field assessments in 1-4 hours by assigned patrols which provide Damage Assessment Coordinators with details of material &amp; manpower needed to restore service.</td>
<td>Wire watchers are used for public safety. In the event of a down-wire, open neutral and other public safety concerns until a crew arrives and repairs the damage.</td>
</tr>
<tr>
<td>GPS on trucks; GIS (OMS); Remote data terminals, AMR meters involving a Pinging Process to eliminate unnecessary field trips</td>
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<tr>
<td><strong>Wisconsin Public Service</strong></td>
<td>3 waves of Damage Assessment: 1. Vehicle patrol of main lines; 2. Vehicle foot patrol of break-offs; 3. Work with or just ahead of a crew. All of the damage assessment information is reported back to a Damage Assessment Coordinator via cell phone to add the information into the OMS.</td>
<td>Send wire down guards or damage assessors to the scene to assess the situation and make the appropriate decision.</td>
</tr>
<tr>
<td>DWM/SAMMS (WMS Work Management Information System), IVR at the call center, AMR Future tools (next year or 2). GPS and mobile computing</td>
<td></td>
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<tr>
<td><strong>Palmetto EC</strong></td>
<td>Currently our damage assessments will be done by spreadsheets in a laptop. The information will be emailed, faxed, or called in to central command and to each operating center.</td>
<td>First we will make sure the line is dead and cleared out of the way and not a public safety concern. We will then repair when we can get back to it.</td>
</tr>
<tr>
<td>We have used IVR system to assist us. Also, we are in the process of integrating our AMR System with our OMS. This will allow us to ping meters that have been identified by our OMS to verify whether a circuit is truly out. This is especially valuable after the restoration of power to verify that everyone in that area that the power actually has been restored. Also, we are in the process of installing an AVL system to improve crew management during a storm.</td>
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<tr>
<td><strong>Adams EC</strong></td>
<td>We always work 3-man crews with one of the 3 being a scout running ahead of the working crew. If damage is more massive, larger crews may be needed. We will break the scout base to do more detailed assessment. Based on these assessments, we make a decision to bring in outside crews.</td>
<td>We have these extra ordinary situations along with reports from 911 centers handle separately in dispatch. We break resources loose from the normal repair to handle the ones that appear to be a safety issue.</td>
</tr>
<tr>
<td>We use an IVR that feeds all calls received into our OMS which uses that info along with field calls received to predict outages. The dispatcher running the OMS software uses input from SCADA to adjust the predictions. We use AMR to ping meters in areas where we can not be sure of the level of outage.</td>
<td></td>
<td></td>
</tr>
<tr>
<td><strong>NH EC</strong></td>
<td>This depends on when the storm damage occurred and the availability of trained personnel. Assessment for large outages is immediate and smaller outages go by location and number of members served again depending on available personnel.</td>
<td>Down wires are a first priority.</td>
</tr>
<tr>
<td>DDI's unfortunately this technology will not be supported much longer. ACE, SCADA system</td>
<td></td>
<td></td>
</tr>
<tr>
<td>18. Coordination of substation and feeder energization and switching activities</td>
<td>19. Best practices for handling logistics of staging and crew deployment</td>
<td>20. Primary communication link with crews and other responders</td>
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<tr>
<td><strong>Southern ALP</strong></td>
<td>- Pre-identify staging areas that are suitable for parking large numbers of trucks, and also with enough room to set up feeding tents. &lt;br&gt; - Line up catering to feed all crews assigned to the staging area breakfast and dinner. Typically box lunches will be eaten at the work site. &lt;br&gt; - Line up tankers to refuel trucks at night. Trucks must be parked to allow this. &lt;br&gt; - Buses are used to transport crews to and from the staging areas to their lodging areas. &lt;br&gt; - If lodging cannot be arranged in hotels in the general area, crews may be bussed short distances to other areas where lodging is available. Also, tent cities may be set up to accommodate lodging, showers, toilets, etc. &lt;br&gt; - For hotel lodging, we will have personnel at the hotel to collect all the room keys and to make room assignments as the crews arrive.</td>
<td>- Southern Line - Radios and cell phones &lt;br&gt; - Some satellite phones</td>
</tr>
<tr>
<td><strong>Progress Florida</strong></td>
<td>- We activate a Staging &amp; Logistics storm organization with trained personnel. This storm organization is controlled at the system level, with a top-down hierarchy. Staging sites are identified and any contractual issues resolved annually before storm season. Outside vendors, such as fuel, catering, mobile housing, etc., are contracted. Outside personnel must attend an orientation at a muster/ staging site before being released for storm duty.</td>
<td>- Radios &amp; Cell phones &lt;br&gt; - If required, satellite phones can be rented</td>
</tr>
<tr>
<td><strong>PE Carolina</strong></td>
<td>- We activate a Staging &amp; Logistics storm organization with trained personnel. This storm organization is controlled at the system level, with a top-down hierarchy. Staging sites are identified and any contractual issues resolved annually before storm season. Outside vendors, such as fuel, catering, mobile housing, etc., are contracted. Outside personnel must attend an orientation at a muster/ staging site before being released for storm duty.</td>
<td>- Radios &amp; Cell phones &lt;br&gt; - Satellite phones have been used but these have not been very reliable.</td>
</tr>
<tr>
<td><strong>WE Energies</strong></td>
<td>- Substation and mainline switching is controlled by dispatch within each of the three operating areas. Taps and service transformers are switched under the control of field personnel. &lt;br&gt; - Crews are staged from local service centers. In the event of numerous long-term outages in a specific area, materials may be staged in a temporary area set up on an ad hoc basis.</td>
<td>- Radio, remote data terminals, and cell phones.</td>
</tr>
<tr>
<td><strong>SCE&amp;G</strong></td>
<td>- Handled by central dispatch</td>
<td>- Radio and cell phone</td>
</tr>
</tbody>
</table>
| Exelon (ComEd, PECO) | Staging centers are set in storm-devastated areas. Crews report to their assigned staging center for deployment. There is a management individual assigned to the staging center for logistics acting as a SPCC or Incident Commander depending on the extent of the damage. Also crew movement from region to region. | 2 way radio
Cell phone, UCAD & Text Messaging system. |
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<tbody>
<tr>
<td>Wisconsin Public Service</td>
<td>All switching procedures are coordinated between the electrical field engineer and the system operators. Both individuals are equally responsible to verify the procedure is run correctly and safety is always taken into consideration. The electrical field engineer and/or system operator will conduct the switching with the crews.</td>
<td>Each one of the district offices has pre-assigned staging areas for materials and crews.</td>
</tr>
<tr>
<td>Palmetto EC</td>
<td>All substation and feeder energization is handled from our Central Dispatch Center.</td>
<td>Have a well thought out plan on how and where you can set up a base camp for housing, feeding, and showering hundreds or thousands of line workers.</td>
</tr>
<tr>
<td>Adams EC</td>
<td>Energizing any switch in a substation is cleared through dispatch. Operation of line devices is done by the local crew with notification to dispatch before action is initiated but a clearance from dispatch is not required.</td>
<td>One thing that we do that is very effective is to dispatch our tree crews (they have our radios) and use them as ground hands and to of course to cut trees. This gets the trees cut more quickly and saves the energy of our crews. These tree crews carry our maps and can be dispatched like our own employees.</td>
</tr>
<tr>
<td>NII EC</td>
<td>This depends on the switching situation, all line workers are trained in switching and coordinate their switching efforts with our control center.</td>
<td>Keep the assisting crews away from district offices, utilize utility guides (bird dogs) to communicate company practices and extent of damages and general storm information, take crews to work locations, feed the crews, provide necessary stock, and show them to hotels.</td>
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<tr>
<td><strong>Southern ALP</strong></td>
<td>Telephone, live interviews. Get word out early that the company is preparing for the event. Best to over-estimate the damage and outage times.</td>
<td>Generally, we do not provide specific estimates. We may know that certain areas are expected to have &quot;most&quot; customers restored by a certain time, but allow for &quot;stragglers.&quot; From estimates provided by the various operations centers.</td>
</tr>
<tr>
<td><strong>Progress Florida</strong></td>
<td>A specific storm organization is activated and assigns personnel to each EOC. Updates to county and state agencies are shared 3-4 times daily. Face to face communications are most effective. Having personnel staged at each EOC works well as this establishes a partnership with the EOC's and promotes a high level of confidence.</td>
<td>Yes. Either our automated voice system or customer service rep identifies the customer calling and offers updates based on the latest ETTR update.</td>
</tr>
<tr>
<td><strong>PE Cardinals</strong></td>
<td>A specific storm organization is activated and assigns personnel to each EOC. Updates to county and state agencies are shared 3-4 times daily. Face to face communications are most effective. Having personnel staged at each EOC works well as this establishes a partnership with the EOC's and promotes a high level of confidence.</td>
<td>Yes. Either our automated voice system or customer service rep identifies the customer calling and offers updates based on the latest ETTR (estimated time of restore) update.</td>
</tr>
<tr>
<td><strong>WE Energies</strong></td>
<td>Central communications group coordinates all media communication. Account managers at customer representatives also communicate with community officials.</td>
<td>Yes. For extensive outages, a global ETOR is provided based upon the estimated hours of restoration work required in the area and the available crew commitment. Restoration estimates for individual outages are based on crew dispatch times and ETORs shown in OMS.</td>
</tr>
<tr>
<td><strong>SCE&amp;G</strong></td>
<td>Through our Corporate Communications group.</td>
<td>Yes. Formulas based on past experiences, type of trouble.</td>
</tr>
<tr>
<td>Exelon (ComEd, PECO)</td>
<td>Wisconsin Public Service</td>
<td>Palmetto EC</td>
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<tr>
<td>There are constant media updates and press releases every 4-6 hours throughout the duration of the storm. Direct phone calls to the news station production directors and the use of internet information on outages and duration.</td>
<td>Yes, until the storm escalates to major storm (Level 4), then we will no longer provide ERTs to customers. ERTs are derived from historical data based on the customers and the feeder. ERTs also adjust as the storm levels change with the escalation of the storm.</td>
<td>We indicate to the customers whether we are working in their area or not. We will give them a general estimate if possible. Estimates made by engineering and operations personnel.</td>
</tr>
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</table>

**Adams EC** We provide our media specialists with updates of outage levels, they respond to media inquiries. We will provide an escorted tour of heavily damaged areas showing our crews working. This seems very effective. Sometimes from dispatch supervisors. | No | Why didn’t I get on more quickly? | Have more 4 wheel drive bucket trucks or tracked vehicles. |

**NHEC** We have a public relations department which continually updates the media of outage restoration activities. Only when we are sure of the message and outcome. This generally does not happen until crews are responding to the last reported outages. | Not at this time | We can not tell them with any degree of accuracy of when they will have their power restored. | Mandate staff involvement as a requirement of employment. At times employees do not want to work the outages and some younger employees do not have the same work ethic/commitment as older employees. |
# After the Storm (Questions 26 – 31)

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<tbody>
<tr>
<td>Southern ALP</td>
<td>No</td>
<td>??</td>
<td>Yes 5% of customers out</td>
</tr>
<tr>
<td>Progress Florida</td>
<td>We have Claims Department that investigates each reported claim.</td>
<td>Yes, when submitting cost recovery requests.</td>
<td>Yes When outside assistance is required.</td>
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<tr>
<td></td>
<td>No, responses generally are associated with time of restoration rather than financial issues.</td>
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</tr>
<tr>
<td>PE Carolinas</td>
<td>We have a Claims Department that investigates each reported claim.</td>
<td>Yes, when submitting cost recovery requests.</td>
<td>Yes When outside assistance is required. For reliability reporting purposes, we follow IEEE Standard 1366-2003 which utilizes a statistical approach known as 2.5 Beta Method. All outages that are identified as a Major Event, as defined by IEEE Standard 1366-2003, are excluded from reported reliability numbers.</td>
</tr>
<tr>
<td>WE Energies</td>
<td>No</td>
<td>Not specific to storms, but we must report feeder outages of more than one hour duration</td>
<td>Yes 100,000 customers out. Yes, reliability statistics are reported both with and without major events</td>
</tr>
<tr>
<td>SCE&amp;G</td>
<td>No</td>
<td>??</td>
<td>No % of customers out</td>
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**Best Practices for Utility Storm Response**

8-20

**rev date: 7/21/2008**
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<tbody>
<tr>
<td>Southern ALP</td>
<td>No</td>
<td>???</td>
<td>Yes 6% of customers cut No</td>
<td></td>
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<tr>
<td>Progress Florida</td>
<td>We have a Claims Department that investigates each reported claim. No responses generally are associated with time of restoration rather than financial issues.</td>
<td>Yes, when submitting cost recovery requests.</td>
<td>Yes When outside assistance is required No</td>
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<td>Yes 100,000 customers cut Yes, reliability statistics are reported both with and without major events.</td>
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</tr>
<tr>
<td>SCE&amp;G</td>
<td>No</td>
<td>???</td>
<td>No % of customers cut No</td>
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</tbody>
</table>
| Exelon           | Yes, the customer calls the Customer Service number and requests a claim form. Once the claim form is completed, it is forwarded to the Claims Dept, which investigates the claim. | Yes. The threshold is of the following:  
- Form GIE-417 must be submitted to the DOE (Department of Energy) Operations Center within one hour if one of the following apply:  
  - Complete operational failure or shut-down of the transmission and/or distribution  
  - Electrical system (EED responsible if Distribution, PJM responsible if Transmission)  
  - Uncontrolled loss of 300 Megawatts (MW) or more of firm system loads for more than 15 minutes from a single incident (EED responsible if Distribution, PJM responsible if Transmission)  
  - Load shedding of 100 MW or more implemented under emergency operational policy (EED responsible if Distribution, PJM responsible if PJM Initiated)  
- Form GIE-417 must be submitted to the DOE Operations Center within six hours if one of the following apply:  
  - Less of electric service to more than 50,000 customers for 1 hour or more (EED responsible if Distribution, PJM responsible if Transmission) | Yes 10% of an operating area being affected within a 24-hour period |                                                                   |
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<tbody>
<tr>
<td>Wisconsin Public Service</td>
<td>For Michigan customers only and they seem quite satisfied with our response times.</td>
<td>No, only for feeder lockouts that last longer than 1 hour.</td>
<td>Yes 3 step criteria: 1. Extensive Mechanical Damage to the system. 2. Outages involving more than 10% of the customers served by a district. 3. More than 1% of customers served have not been restored in 24 hours. Yes, we report to the Public Service Commission with and without major storms.</td>
</tr>
<tr>
<td>Palmetto EC</td>
<td>No</td>
<td>No</td>
<td>No We plan on going to the new IEEE methodology. But, previously we have used the scenario if we had an event that lasted for 24 hours and affected more than 10% of our customers it was considered a major event. Yes, under the Major Event Category</td>
</tr>
<tr>
<td>Adams EC</td>
<td>No</td>
<td>No</td>
<td>No The magnitude of the storm and IEEE 1366 Yes</td>
</tr>
<tr>
<td>NIE EC</td>
<td>No</td>
<td>No</td>
<td>No we are not regulated; however, we generally participate so we can measure ourselves against the other companies. We do update and communicate with the Office of Emergency Management to keep them informed of our restoration activities. No we are not regulated; however, we generally participate so we can measure ourselves against the other companies. 76 different outages being experienced and 3600 members without power. Yes</td>
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</tr>
<tr>
<td>Southern ALP</td>
<td>Yes, For predicting outages for future storms and for determining resource (manpower) needs.</td>
<td>Yes</td>
<td></td>
</tr>
<tr>
<td>Progress Florida</td>
<td>Yes, after each major event a detail lessons learned is initiated.</td>
<td>Storm Plan needed to: 1) Identify key sub-processes 2) Identify key interfaces 3) Develop a tighter linkage between all storm orgs and their individual storm plans</td>
<td></td>
</tr>
<tr>
<td>PE Carolinas</td>
<td>Yes, after each major event a detail lessons learned is initiated.</td>
<td>Storm Plan needed to: 1) Identify key sub-processes 2) Identify key interfaces 3) Develop a tighter linkage between all storm orgs and their individual storm plans 4) Need to get estimated times of restoration at a lower level, Currently working on feeder level estimates but would like to get down to the district level so customers could access information via the VRV or Internet.</td>
<td></td>
</tr>
<tr>
<td>WE Energies</td>
<td>Yes, It is used for regulatory and internal reports, system studies and benchmarking analysis.</td>
<td>Instituted more proactive approach to prepare for possible weather events (i.e., weekly stand-up meetings with operations, engineering and construction groups to communicate and identify potential weather events, unusual system configuration, personnel availability and logistics issues).</td>
<td></td>
</tr>
<tr>
<td>SCF&amp;G</td>
<td>Yes, ?</td>
<td>Partial cars can be a problem. Use more talk groups (with fewer people) to improve radio communications. Non-operations storm responders need additional, annual training. Anticipate and address traffic problems at staging areas and work sites.</td>
<td></td>
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<td>Exelon (ComEd, PECO)</td>
<td>Yes, It is used to determine corrective actions and identify trending of any sort. It is also used to analyze field productivity as well as determining if execution was effective during an event.</td>
<td>Yes! Lessons learned are held in face-to-face meetings and / or conference calls with key individuals who were directly involved with an event. Post Lessons Learned meetings, action items are then provided to the responsible parties and tracked to affective completion. During damage assessment, each patroller needs to be assigned a feeder to patrol for assessment. Update list of potential staging areas Coordination of supply delivery to working crews in the field Provide kits for patrollers that include: feeder maps, large flashlights, flags</td>
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<td><strong>Wisconsin Public Service</strong></td>
<td><strong>29. Collect and maintain outage data? How used?</strong></td>
<td><strong>30. Instituted review/post-mortem process</strong></td>
<td><strong>31. Recent lessons learned</strong></td>
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<td>Yes. Not used at this time, but will be used in the future to recreate a storm with our OMS.</td>
<td>After each storm we send out storm questionnaires to affected crews and storm leaders. The questionnaires are collected and there is a storm critique meeting with the storm leaders (storm coordinators, field coordinators, Dispatch Center leader, call center leader, War Room leader, storm team members) to discuss the positive and negative aspects of the storm. Form this meeting goals are set to make improvements before the next storm.</td>
<td>- Need to get more damage assessment completed in the field. - Need to provide more training to the dispatchers that do not use the OMS as frequent. - Need to provide our customers with more outage information. One way is to enhance the IVR system, another is to provide more information on the company website. - Need to increase the number of phone lines coming into the call center to handle the large call volume.</td>
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<td><strong>Palmetto EC</strong></td>
<td>Yes; For historical data collection reasons.</td>
<td>No</td>
<td>We can never be too prepared!</td>
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<td><strong>Adams EC</strong></td>
<td>Yes; Only to gauge the size of the storm</td>
<td>Yes</td>
<td>Pre positioning of crews is very effective before the storm hits, using daylight to its max effectiveness is crucial, give employees a rest, use free crews to extend the capability of your own employees, use your own folks to guide outside crews but the guides must be trained in advance.</td>
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<td><strong>NH EC</strong></td>
<td>Only when we have discovered something new to utilize in the overall restoration process or for filing FEMA claims. For identifying better/safer ways to correct outages</td>
<td>Yes, normally at one district and we have ten districts to deal with</td>
<td>Alerting staff of forecasted storms and potential of damages to our distribution system. Dispatching staff to accomplish line assessment right away. Training utility guides and providing them with a reference book. Communicating with other companies who could provide support prior to any outages. Establishing response rosters prior to the event.</td>
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