STRATEGIES FOR COMPLEX ORGANIZATIONS

Seattle City Light

December 2006 Wind Storm Report

May 31, 2007

Prepared For:

SEATTLE CITY LIGHT
SECOND CENTURY
OF SERVICE

1905 2005

Prepared By:

davies consulting inc.

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Executive Summary

In December 2006, a severe wind and rain storm struck the Seattle City Light (City Light) service territory. After the record-breaking winds abated, City Light faced restoring power to nearly 50% of its customers. The utility met this daunting challenge remarkably well and re-established more than 60% of customers within 24 hours. Working at a breakneck pace, crews restored 83% of customers within 48 hours, 90% within 72 hours, and 94% within 96 hours. The effort continued for another five days, as the remaining 6% of outages were complicated. City Light's response time was generally in-line with benchmarks of companies suffering outages to 50% of its customers. Despite its relatively swift restoration effort and adequate customer satisfaction, City Light sought an experienced 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.

Shortly after the storm, City Light hired CH2M Hill to conduct a series of high-level interviews. The Denver-based environmental engineering firm gathered information to gauge internal reaction to the storm effort and perform a cursory analysis of the utility's response. In March 2007, City Light then engaged Davies Consulting, Inc. (DCI) to evaluate the utility's response effectiveness and provide recommendations on how to improve performance – from both an emergency response and utility operations perspective. DCI based the evaluation approach on its Storm Restoration Framework, which is founded on the premise that in order to fully and effectively analyze a utility's event performance, four critical components must be evaluated and considered:

- Event restoration performance data;
- Breadth and depth of the planning effort;
- Restoration and Customer Relationship Management (CRM) Plan execution from the planning, resource management, operations, and customer service perspectives; and
- Delivery system management and preparedness.

The high-level tasks that DCI undertook include:

- Performing an initial review and analysis; and
- Organizing and facilitating an expert review panel.

DCI then evaluated best practices that would have positively affected City Light's restoration response if they had been implemented before December 2006. Using the gathered information, DCI performed a gap analysis, an

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assessment that enables a utility to compare its actual performance with its potential performance. Finally, DCI developed this final report, which includes recommendations for improving City Light's storm restoration process and its response-related IT infrastructure.

Based on the findings from the initial review and expert panel, the best practices, gap analysis, and recommendations focused on the following topics:

- Emergency Response and Restoration planning – prior to the storm, City Light recognized the importance of having and was in the midst of developing a response plan. Subsequent to the storm, City Light has continued development of the plan and should place priority on its completion. City Light also needs to develop a restoration plan that is scalable – from small events such as localized thunderstorms to major events such as earthquakes or a pandemic event. Development of these scalable plans will provide City Light with the structure and process to effect a well implemented restoration process;
- DOC and Trouble Center – construct a permanent trouble center as soon as possible to coordinate the restoration from an appropriate facility. Currently, the DOC and trouble center operations are located in a conference room in the Seattle Municipal Tower. On an interim basis, DCI recommends that the Trouble Center be located at the System Control Center (SCC) since that is where all of the trouble ticket dispatching is done and where the Incident Commander will be. The DOC, most likely, will remain at the Seattle Municipal Tower. All of these restoration functions should be in the same location since there are the corner stones of the restoration process. Completion of the new facility will bring these key functions to one location.
- Damage assessment—The damage assessment currently in place at City Light is haphazard and lacks a process to distinguish between line crews and damage assessors. As a result, crews' assessment work has been redundant and customers haven't historically received estimated times of restoration (ETRs);
- Mutual assistance – City Light failed to develop strong relationships with regional mutual assistance groups and establish agreements to guarantee that it has additional resources available if needed;
- Logistics – best-in-class utilities generally have a logistics plan that is integrated with their corporate response and restoration plans and outlines procedures, policies, and processes prior to and during emergency

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events. These utilities also have pre-existing relationships and agreements with vendors, such as caterers, lodging suppliers, and logistics companies that can provide support during emergencies. At the time of the December storm, City Light did not have a logistics plan in place;

- Communications – effective communications during an emergency are based on developing a plan that is incorporated in the emergency response and restoration plans through the Incident Command System (ICS). In December 2006, City Light did not have a communications plan that addressed policies and procedures for internal and external communications;
- Vegetation management – City Light should implement an effective vegetation management program that maintains or improves customer reliability and customer service related to vegetation outages while, at the same time, optimizing vegetation trim cycles to reduce overall costs;
- Coordination between City Light and other City departments – by designating a liaison to the Emergency Operations Center who can work within the ICS organization, City Light will enhance its ability to coordinate with the city; and
- Infrastructure – City Light's current infrastructure limits the utility's ability to respond to events as a best-in-class utility. In order to improve their capability, City Light should install an Outage Management System (OMS), consider the purchase of an Automated Meter Infrastructure (AMI), replace the existing Interactive Voice Response (IVR) system to improve inbound and outbound communications, and upgrade the existing Geographic Information System (GIS). Each of these systems is integrated with the OMS to provide complete restoration processes that maximize the use of technology while minimizing restoration time, regardless of event size. These systems and the associated processes will also enable City Light to provide better estimated times of restoration.

This report addresses each of these topics in detail. City Light has a dedicated staff that not only shows concern for its customer base, but also works for its best interest in all events. There is, however, a limited amount that this staff can accomplish considering that they are using processes and technology that are years behind best-in-class utilities. In order to regain best-in-class status, City Light has several months, and even years, of challenging work ahead of it. City Light's dedication to improving its performance will be impressive. Indeed, the utility already has established

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lofty goals and aggressive timelines for implementing numerous recommendations. This pro-activity is a first step toward being, again, at the top of the utility ladder.

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1. Introduction

1.1. Purpose and Scope

Seattle City Light (City Light) was founded over 100 years ago as a municipal electric utility. The utility serves approximately 375,000 residential, commercial, industrial, and governmental customers located predominantly in the City of Seattle. Over the course of its history, City Light has consistently delivered reliable electric service at low cost to its customers and has been recognized as a leader in the municipal electric utility industry.

On December 14, 2006, a devastating wind and rain storm hit Seattle and knocked out power to 180,000 of City Light's customers. Although the utility restored 110,000 customers within 24 hours, the restoration lasted an additional eight days. As a result of the large number of outages and extended response time, City Light hired Davies Consulting, Inc. (DCI) to evaluate the effectiveness of its response to the event and to provide recommendations on how to improve performance – from both an emergency response and utility operations perspective. The purpose of this evaluation and report is to identify the processes, technologies, and metrics that will improve future City Light restoration efforts.

To achieve its objective, DCI developed an integrated plan that includes the following tasks, which are discussed in subsequent sections. Each of the tasks serves as a building block in the overall analysis of the restoration performance.

- Task 1: Mobilize project and identify areas of interest;
- Task 2: Review existing response data and preliminary findings;
- Task 3: Prepare assessment of City Light's performance;
- Task 4: Compare City Light response plan to industry best practice;
- Task 5: Evaluate internal and external communication;
- Task 6: Utilize DCI's Storm Restoration Framework and benchmark database;
- Task 7: Organize expert panel review;
- Task 8: Facilitate expert panel review;
- Task 9: Prepare the final report; and
- Task 10: Write the executive summary.

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1.2. Background

Before the December 2006 storm, several events occurred over a period of years that affected City Light's ability to cope with a major power outage. Following divestiture of some of its generation assets, the utility was forced to buy energy, increase rates, and reduce maintenance budgets. The efforts on the part of the utility to improve restoration process have created some change management issues that must be resolved.. Following is a brief discussion of these issues and how each might have ultimately lengthened City Light's restoration effort.

1.2.1. Energy Crisis

Throughout its history, City Light has enjoyed a diverse generation base, producing both hydro and coal-fired energy. Traditionally, the utility has offered low rates, which were expected to continue into the future. But when coal generation plants fell into disfavor, a decision was made to divest City Light of its coal generating plant. This left the utility's generation capacity deficient. With prices rising and with City Light unable to serve its load with its remaining hydro generation, the utility entered the market to purchase a significant amount of energy. The resulting purchases, which totaled $600 million dollars, forced City Light to simultaneously adjust rates and significantly curtail operating budgets to counter rising costs.

1.2.2. Maintenance Reductions

The cost containment measures imposed during the budget crises focused on reducing maintenance budgets, including pole inspection programs, vegetation management programs, and other system maintenance activities. These were either eliminated completely or severely reduced. At the time City Light imposed these cost-saving measures, its system was in proper operating condition and could withstand several years of reduced maintenance. But over time, the system has aged and moved closer to the end of its useful life. With normal maintenance programs in place, the facilities would have been replaced with new equipment to reduce the likelihood of future failures. Funding robust maintenance programs and processes not only improves performance today, but it also reduces the costs of replacing neglected assets in the future. Since 2003, City Light senior staff has placed increasing emphasis on funding its maintenance programs.

1.2.3. Senior Staff Replacements

Senior staff makes decisions that affect all aspects of a utility's operations. When changes in leadership occur new ideas and direction that are introduced take time to implement and often require a structured change management process to gain acceptance in the overall organization. As is often the case, prior to the time change is identified and implemented, an

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event occurs that highlights the differences between existing processes and newer processes that would improve operations. That is exactly the case in this event. The majority of senior staff has worked at the utility for less than 18 months. Comments provided to Davies during the interview step indicated that some operating staff felt that senior staff lacked the experience to offer constructive instructions on the restoration process. DCI does not concur with these statements. Given that the new senior staff inherited old utility work processes and inadequate technology systems, they did the best they could. From our observations the new senior staff was well versed on current utility industry best practice restoration processes.

1.2.4. Labor Management Relations

Labor management relations at City Light are strained from a cultural perspective. In past years, a culture developed that defined the current restoration process. In large part, these practices were formed in the late 70s and early 80s when technology was not available to assist personnel in restoration efforts. In order to be effective in today's environment, however, new process and technologies must be adopted by staff and used during the restoration effort to keep customers informed and reduce the length of the outage. Gone are the days when a utility could simply point crews toward the door and let them start the restoration without regard to an overall process. This conflict between processes and the old method of conducting restorations has created much of the tension that exists today. One example of culture conflict occurred early in the restoration when line crews did not follow the storm boss' orders to break work at 11 p.m. The storm boss correctly identified that total restoration would take longer than originally estimated and asked crews to stop work and move to a 17/7 schedule (17 hours on, 7 hours off). This decision was misunderstood by some operating personnel and created additional tension between labor and management.

In interviews, both labor and management expressed a strong interest in providing quality service to the utility's customers, which is just one example of their common objectives. Using their commonalities as a starting point, labor and management must be willing to resolve their difference through a change process that will encourage an adjustment of current City Light practices to best practices and technologies.

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2. History of Event

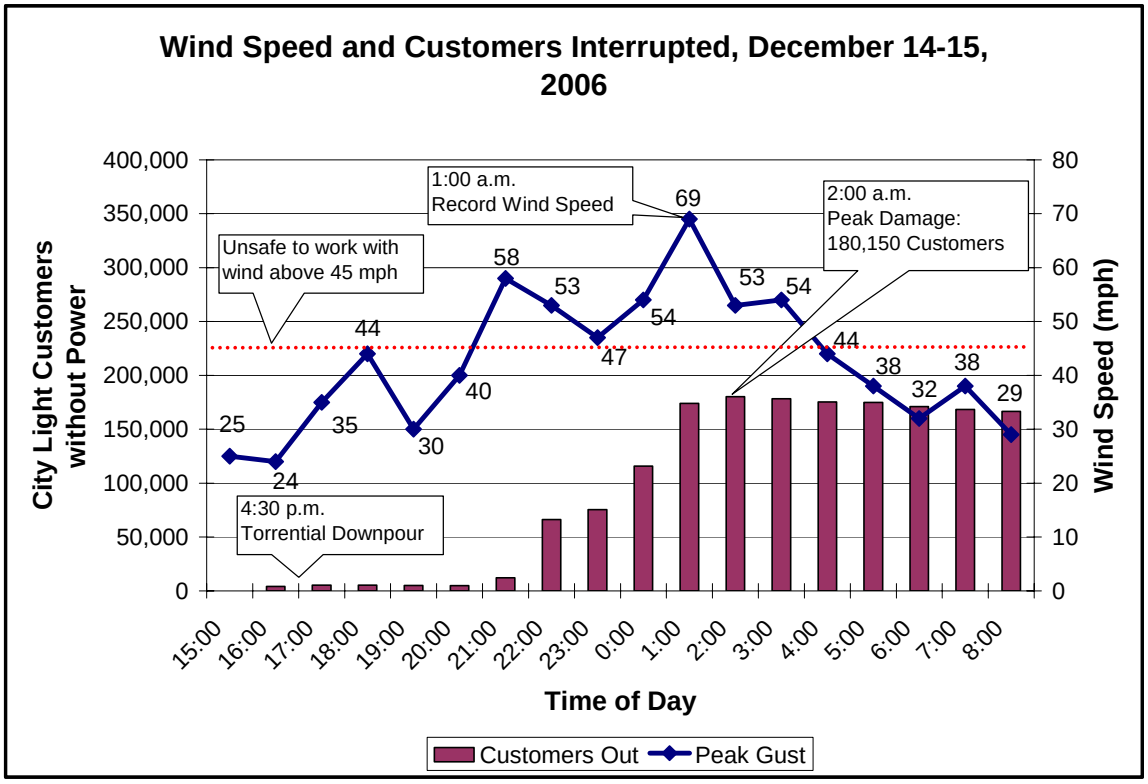
2.1. Event Description

On the evening of Thursday, December 14, 2006, a severe storm struck the City of Seattle and surrounding areas. Its gale-force gusts set speed records and knocked out power to 180,000 City Light and 700,000 Puget Sound Energy customers.

2.2. Event Timeline

The winds, forecast for a week, were preceded by an unexpected downpour and high-wind gusts. The storm released an inch of rain and wind gusts up to 35 mph on the city between 4:30 p.m. and 5:30 p.m. wind gusts in the 30 to 45 mph range continued through early evening, and then rose in intensity to 47 to 54 mph (58 mph at 9 p.m.) for the next three hours, before peaking at a record-setting 69 mph at SEATAC airport at 1 a.m. The winds subsided during the night and dropped below 40 mph by 5 a.m. They petered out completely by 9 a.m.

Figure 1: Wind Speed and Interrupted Customers



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During the initial downpour, the City Light electrical system sustained minor damage, losing just over 4,000 customers. Although some repairs were carried out, minor outages continued to accumulate over the next few hours. At 9 p.m. the wind intensity increased dramatically. By 2 a.m., following the record-setting 69 mph wind, damage reached its peak, with just over 180,000 of City Light's 375,000 customers losing service. A total of 65 of City Light's 169 feeders were totally out of service. The winds continued to blow through the morning, and then dropped to safe levels by 4 a.m.

2.3. Response Description

City Light prioritized its response with the guidelines most utilities follow: it started with the areas where the most customers could be restored in the least amount of time and continued to prioritize this way until all customers had power. It took less than a day to restore the first 90,000 customers (50% of those who lost power) and 162,000 (90%) were restored within three days – but it took just over a day to restore the next 9,000 (5%) and almost another five days to restore the final 9,000. This is despite the fact that an additional 63 to 75 line workers from other utilities helped during the final four days

City Light's response involved several centers of activity, each with specific roles to play:

Table 1: Group/Facility Roles and Responsibilities

Group	Roles & Responsibilities
Trouble Center	➢ Home to the damage assessment; and ➢ Responsible for coordinating damage assessment (sending scouts to inspect feeders and report damage), coordinating with other city departments, communicating to the public through the media, arranging for field assistance from contractors and other utilities, and securing logistical support for all resources involved in the restoration effort.
Call Center	➢ The public's conduit to City Light; and ➢ Responsible for registering outage tickets based on customer calls, relaying progress updates to callers as available, and fielding customer complaints.
Control Center	➢ Location of storm boss; ➢ Operational headquarters for the restoration; ➢ Responsible for restoration oversight; and ➢ Responsible for prioritizing field work based on trouble ticket and damage assessment information,

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Group	Roles & Responsibilities
	dispatching crews to repair feeders, coordinating switching to ensure crews are not in close proximity to wires when they are energized, and confirming power has been restored after repairs are complete.
Service Centers with Fleet and Material Support	➢ Home base for line crews from City Light and assisting utilities; and ➢ Responsible for provisioning materials, delivering certain materials to work sites, fueling and maintaining vehicles, and briefing crews on the daily status.
Field Resources	➢ The most visible group, consisting of damage assessment scouts, vegetation management workers, and line workers operating in the field to identify and quantify the damage, clear large trees from wires, and repair the electrical system recovering power to customers.
SDOT Vegetation Management	➢ Additional vegetation management crews who are not certified to work in the vicinity of live power lines; and ➢ These crews support the restoration by clearing trees out of roadways and performing job site cleanups, removing and chipping the wood from fallen trees
Information Technology	➢ Working behind the scenes to ensure that the systems other groups rely on are prepared before the event and continue to work throughout the event; and ➢ These systems include the various information systems needed by the Trouble, Control, Call, and Service Centers, along with the necessary communications systems such as the Call Center trunk lines and interactive voice response system, the general telephone system, and the radio system used in the field.

Although City Light is an active participant in the majority of these groups, it works alongside a number of other city departments, including Fleet and Facilities, Seattle Department of Transportation (SDOT), Seattle Public Utilities (SPU), the Department of Information Technology (DOIT), and the City's Emergency Operations Center (EOC).

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2.4. Response Timeline

The damage to City Light's infrastructure was the result of a one-hour rainstorm and five hours of high winds. From the peak of the damage, it took eight days and seventeen hours to restore all customers. City Light's response, however, began in advance of the event when the weather forecasters were predicting the impending storm.

2.4.1. December 7–13, 2006

Several parts of the organization mobilized to prepare for the storm.

- Store managers checked inventory levels for material typically needed during restoration efforts and alerted suppliers that City Light might need assistance if large transformers or other structures were damaged or lost during the storm;
- The Trouble Center was opened and staffed at 4 a.m. on the first day of the event;
- External communications early in the event to provide information to SCL customers;
- The Control Center set up its timetable for the restoration, along with extra workstations for dispatch and a sorting area for trouble tickets. One of the dispatchers even parked his RV at the Control Center to make sure he was available to assist with the restoration; and
- Crews ensured their line trucks were stocked up for the upcoming restoration.

2.4.2. Thursday, December 14, 2006

On the day of the event, City Light field resources worked their regular shift, which finishes mid-afternoon. Seattle was playing host to San Francisco in a nationally televised NFL game, so a limited number of crews were held back to ensure the stadium experienced no major outage. The remaining crews were sent home to rest, with instructions to return at 4 a.m. the following morning. This directive was met with some resistance – many field workers felt that with the storm on its way, they should stay on the job, ready to deploy the moment the storm was over.

With the winds not expected until the evening and projected to blow through the early morning, City Light management thought it best to have crews rest at home for the upcoming restoration work. The storm would not be complete for 10 to 11 hours after the end of the shift and a damage assessment would be required before restoration work could begin.

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The unexpected deluge of rain between 4:30 p.m. and 5:30 p.m. caused a number of outages, making it necessary for management to call back a small number of crews only a few hours after being sent home. This triggered additional discontent among some field resources, reinforcing their belief that management did not know what they were doing. This frustration may well have been exacerbated by the transportation delays caused by routes flooded by the heavy rain.

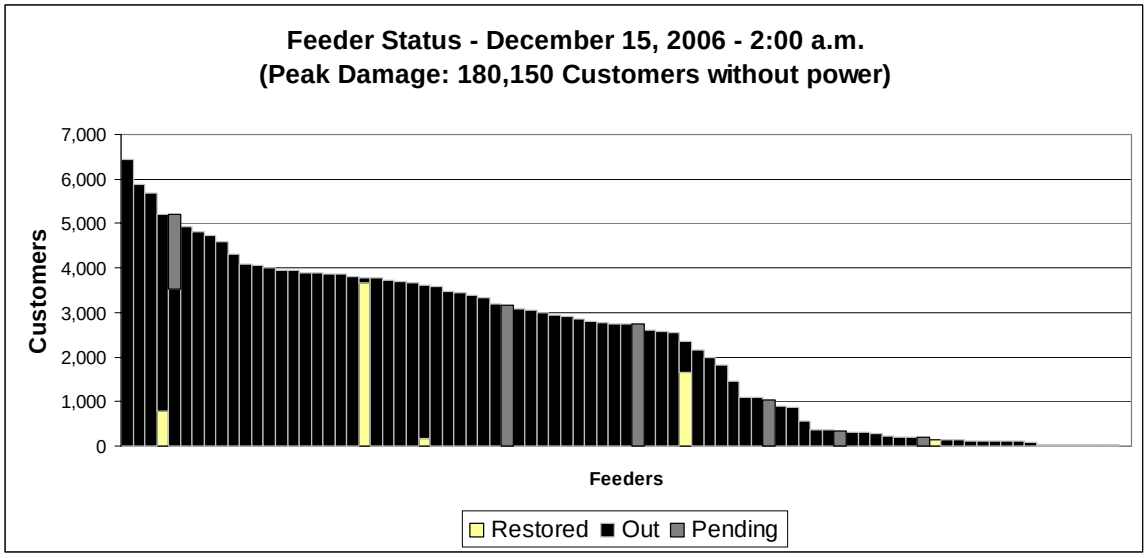
The crews called back performed some repairs and restored most customers before the winds rose to levels too high to work safely. The winds rose above safe levels at about 9 p.m. and continued to blow above those levels through to the next day.

2.4.3. Friday, December 15, 2006

The winds reached record levels at around 1 a.m. And gusts above 45 mph continued until 4 a.m. The damage to the system reached its peak at 2 a.m. on Friday, December 15, with total outages on 65 feeders and minor outages on another 15.

The following diagram depicts the damage levels on all feeders experiencing outages between December 14 and 23. This snapshot is taken at 2 a.m. on December 15:

Figure 2: Feeder Status 12/15/2006



Each bar in this diagram represents an affected feeder. The height of the bar represents the highest number of customers interrupted simultaneously on the feeder in the 10-day period. The black region in each bar represents the number of customers without power at the time of the snapshot. The light

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yellow region represents customers already restored and gray regions show outages that have not yet occurred as of the time displayed in the chart title.

Note that two feeders remain gray through December 21. These feeders were not implicated during the original storm, but did experience an outage during the afternoon on December 21, while the restoration was underway. Because they did need to be repaired during the restoration period, they are included in the chart.

As of 2 a.m. on December 15, 180,150 customers were out of service. A number of the customers who had experienced outages due to the deluge were restored between 6 p.m. and 9 p.m. on December 14, and are represented by the yellow bars, above.

The System Control Center went into its normal restoration status by calling additional dispatchers in and setting up two temporary dispatch tables. Many dispatchers came on without notification because of their belief, which was correct, that the system had suffered major damage. The Trouble Center activated at the Municipal Tower and a total of 16 damage assessment teams, comprised of one engineer and one meter technician, were assembled. When the winds subsided, these crews were asked to begin the damage assessment process by patrolling feeders. The city's Emergency Operations Center opened, but closed shortly thereafter when it was determined that only the electrical system had suffered damage. Vegetation management crews from SDOT and 10 crews from City Light's contractor, Asplundh Tree Expert Company (ATE), deployed immediately to remove fallen trees from major roadways. The Call Center was fully staffed and ready to take outage calls. Customer service representatives from the billing inquiries department staffed available phones for the Call Center. As instructed, crew members began to arrive at the North and South Service Centers around 4 a.m.

At the South Service Center, crews were held for several hours pending the influx of damage assessment data. At the North Service Center, crews were sent out immediately to find trouble spots and begin restoration work. By 10 a.m., all available crews, both North and South, were on the system performing restorations. This activity continued non-stop into the night.

2.4.4. Saturday, December 16, 2006

Working continuously, crews made significant progress in the first 24 hours. As illustrated below, City Light restored almost 110,000 customers in the first 24 hours, leaving 71,556 without power. Efforts continued through the day.

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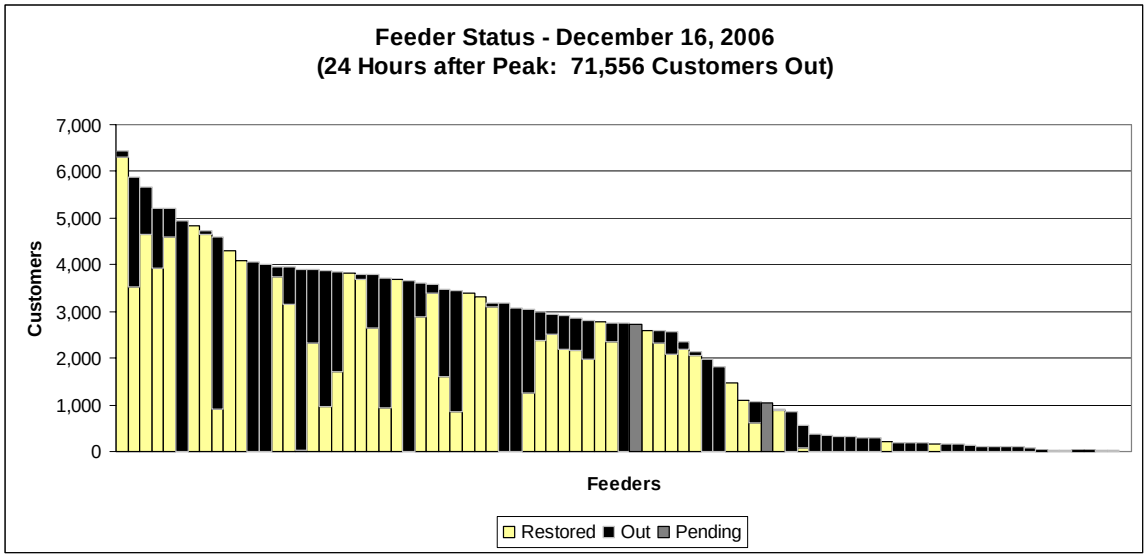
Figure 3: Feeder Status 12/16/2006



Recognizing that the restoration effort would extend for several days and that safety issues would begin to arise as crews worked extended hours without rest, management decided to call a work break and ordered all crews to return from the field at 11 p.m. Crews would then continue work the following morning at 6 a.m. To ensure proper compensation for hard work, management decided crews should work 17-hour days and take seven hours of rest between every shift. According to rules in the bargaining agreement, this schedule would allow line resources to collect overtime premiums for every hour worked until the end of the storm.

Now over 36 hours into the restoration effort, the crews continued work through the day and into the night and took short breaks along the way as required.

2.4.5. Sunday, December 17, 2006

By 2 a.m. on Sunday, 48 hours from the start of the restoration, City Light had restored nearly 150,000 of the original 180,150, with 32,633 customers still in the dark.

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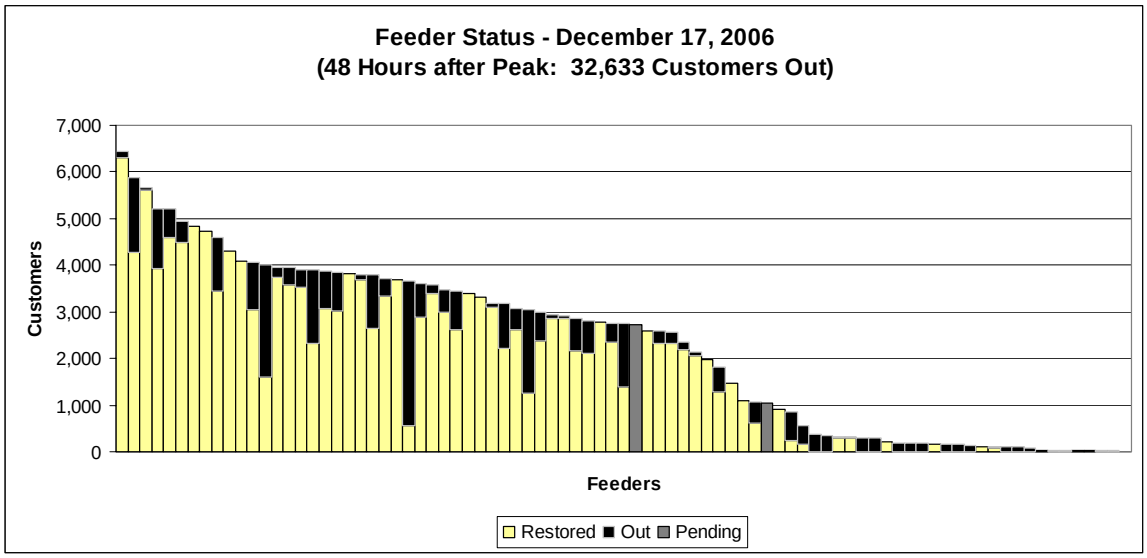
Figure 4: Feeder Status 12/17/2006



Storm management was troubled to learn that many crew members ignored the directive to stop work at 11 p.m. the previous night and return at 6 a.m. the next morning. Some crews worked through the night and returned from the field mid-morning for rest. This presented difficulties for a number of reasons:

- Crews were sleeping through the most productive hours of the day; it is far easier to restore power in daylight than at night;
- Because crews were running around the clock, the Control Center never experienced a lull in the schedule to re-group, re-organize, and re-prioritize the work for the field;
- Maintenance and logistics were unable to work with predictable timeframes for their activities; and
- With crews failing to respond to the requests of Storm Management, they were not following a monitored schedule that preserved safety and maximized productivity.

Restoration work continued through the day, with crews breaking and returning to work according to their individual patterns. Prior to the end of the day, Storm Management issued a “hard stop” order, whereby all crews had to return to their respective service centers by 11 p.m., or face disciplinary action.

This action triggered considerable tension, particularly in those crews that had worked the latest through the morning of December 17, returning from their rest in the afternoon and only working six to 10 hours before having to come

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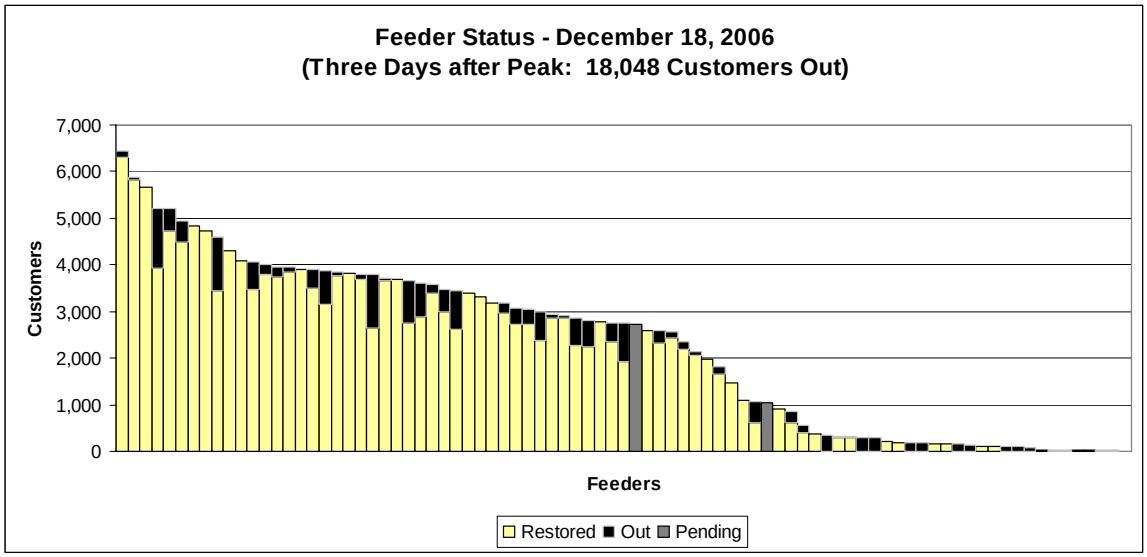
back off the job. These crews were particularly upset and some individuals expressed their frustrations on local radio shows, complaining that Storm Management had taken them off the job while they were still fresh and capable of restoring customers through the night.

2.4.6. Monday, December 18, 2006

By 2 a.m. on Monday, close to 90% of the interrupted customers had power restored.

Figure 5: Feeder Status 12/18/2006



With the "17 hours on and 7 hours off" policy now firmly in place, certain patterns began to establish themselves:

- The control center staff, working in twin 14-hour shifts with a one-hour overlap on each shift, took advantage of the overnight pause to update their record keeping, sort trouble tickets, and plan switching for the day ahead;
- At the service centers, line trucks were fuelled and maintained overnight; and
- Line crews arrived at 6 a.m. to return to work in the field. They performed their work during the daylight hours and continued to 11 p.m.

2.4.7. Tuesday, December 19, 2006

By early morning on December 19, four days after the peak of damage and the start of the restoration, City Light had restored over 170,000 of the original customers, with only 9,436 customers remaining without power. The final 5%

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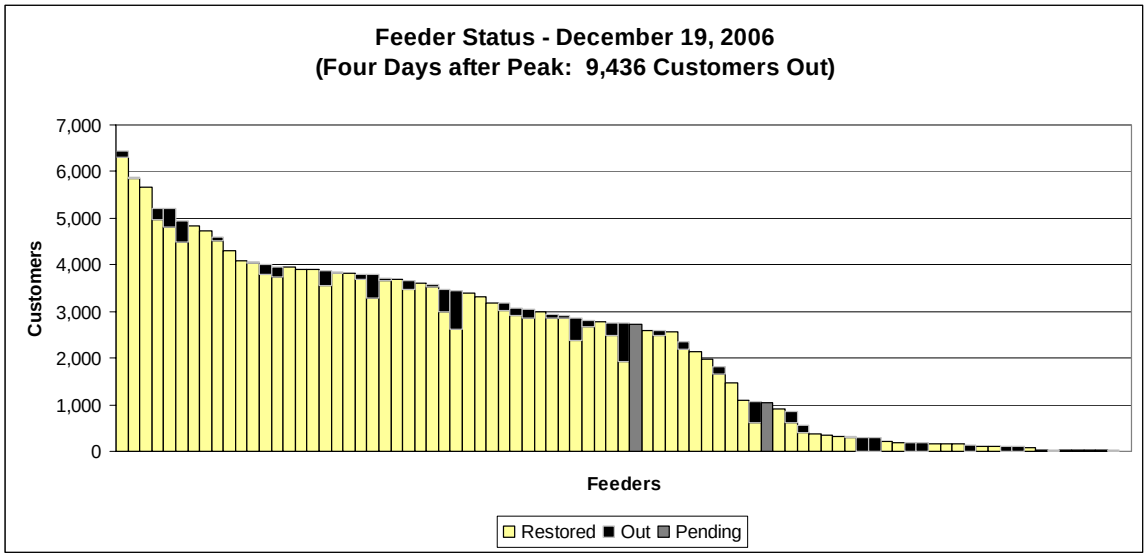
of the interruptions would take longer to restore than the first 95% because of their increasing complexity.

Figure 6: Feeder Status 12/19/2006



December 19 was also the last day that City Light's crew of 105 line resources would have to work on their own. Storm Management succeeded in securing 53 resources coming off duty from PacifiCorp, along with another 12 from Benton. These resources arrived on the evening of December 19 and then rested through the night to begin work on the morning of December 20.

2.4.8. Wednesday, December 20, 2006

By 2 a.m. on December 20, 5,823 customers were still without power.

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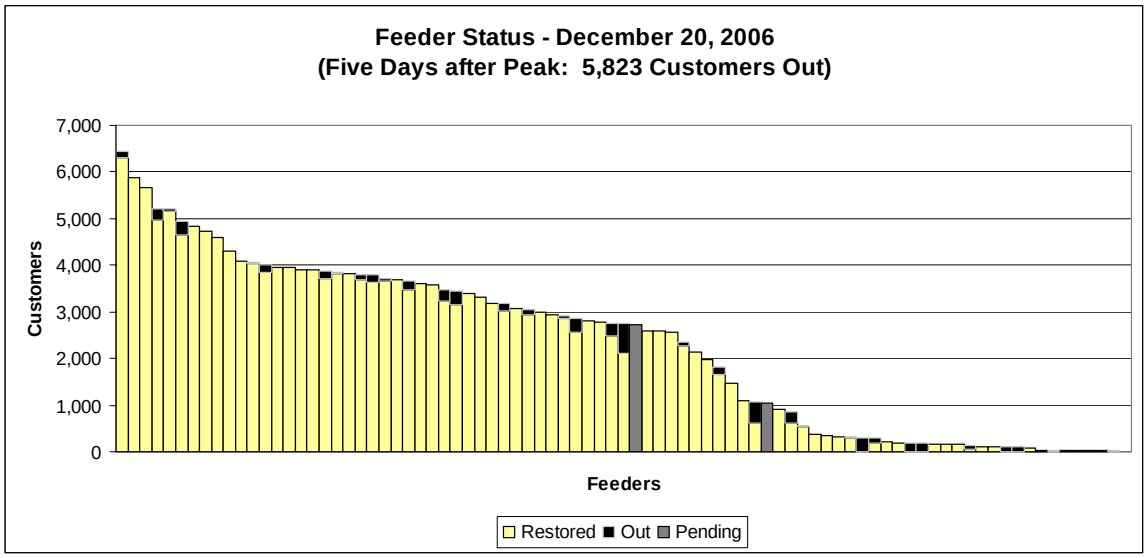
Figure 7: Feeder Status 12/20/2006

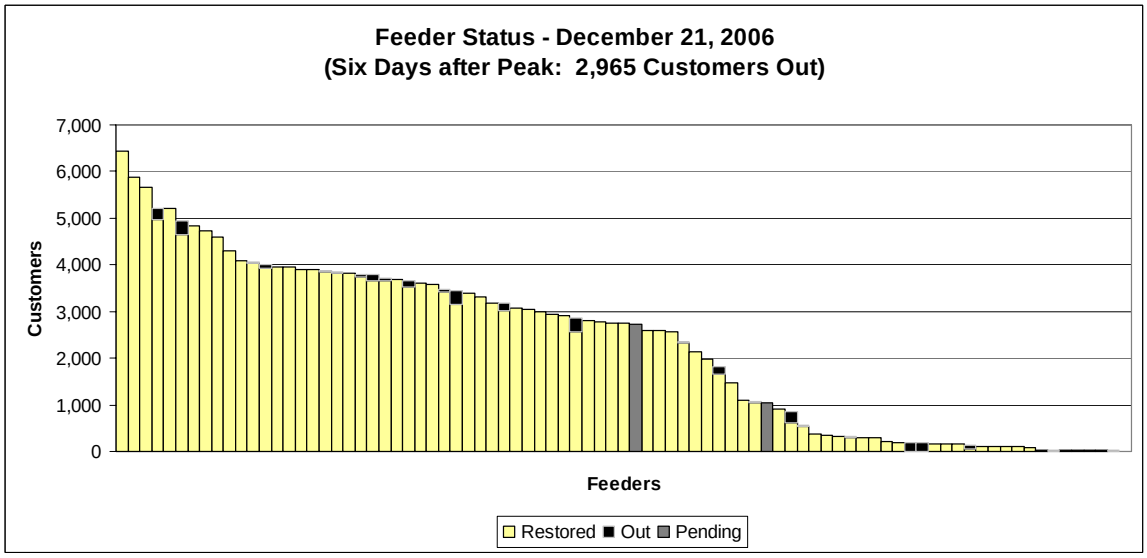


With support from the additional 65 resources from PacifiCorp and Benton, City Light's line resources returned to the field to perform restorations. By now, many of the outstanding outages were "nested" or "hidden" outages, meaning each restoration activity, which would take a few hours, would return only one to 12 customers to service. Unable to predict the location of every outage, City Light invited those still without power to call in.

2.4.9. Thursday, December 21, 2006

By 2 a.m. on December 21, 2,965 customers remained without power.

Figure 8: Feeder Status 12/21/2006



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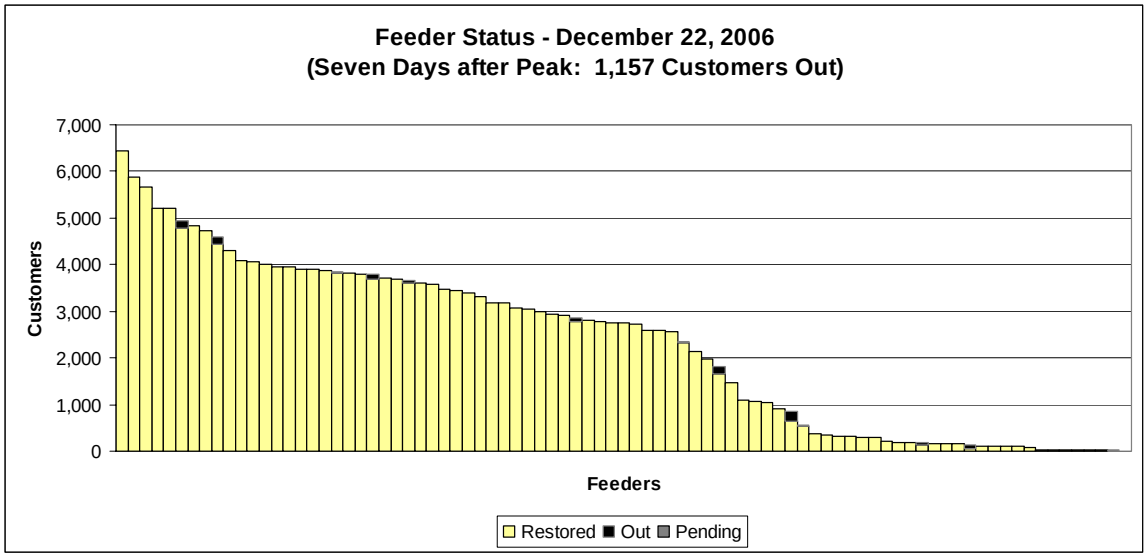
In the early evening, three new outages occurred, putting approximately 7,000 customers in the dark. These outages were of a sort that could be quickly remedied. In keeping with the prioritization methodology of bringing the maximum number of customers on the most quickly, these outages were resolved within four hours. The restoration effort continued until 11 p.m.

2.4.10. December 22, 2006

By 2 a.m. on December 22, a full week after the storm, 1,157 customers remained without power.

Figure 9: Feeder Status 12/22/2006



An additional 10 resources from Snohomish PUD arrived and Storm Management immediately sent them to work on the system, bringing the number of line resources working on the system to 180. The majority of crews had now split up into smaller groups of two, performing restorations on lower voltage secondary lines (240 volts and below) and customer hookups (services). Again, work continued until 11 p.m.

2.4.11. December 23, 2006

At 2 a.m. on December 23, 157 customers remained without power.

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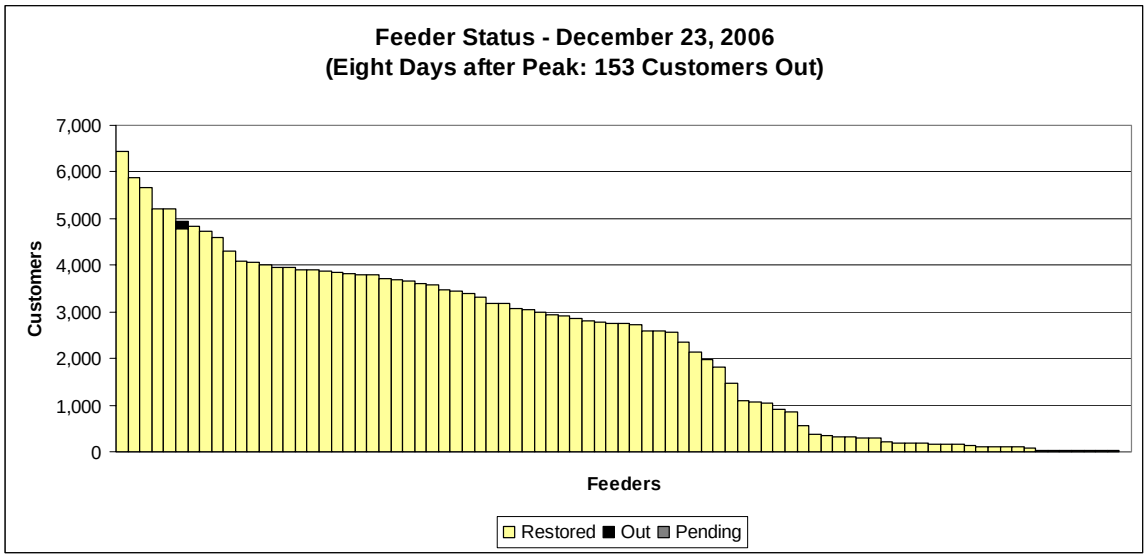
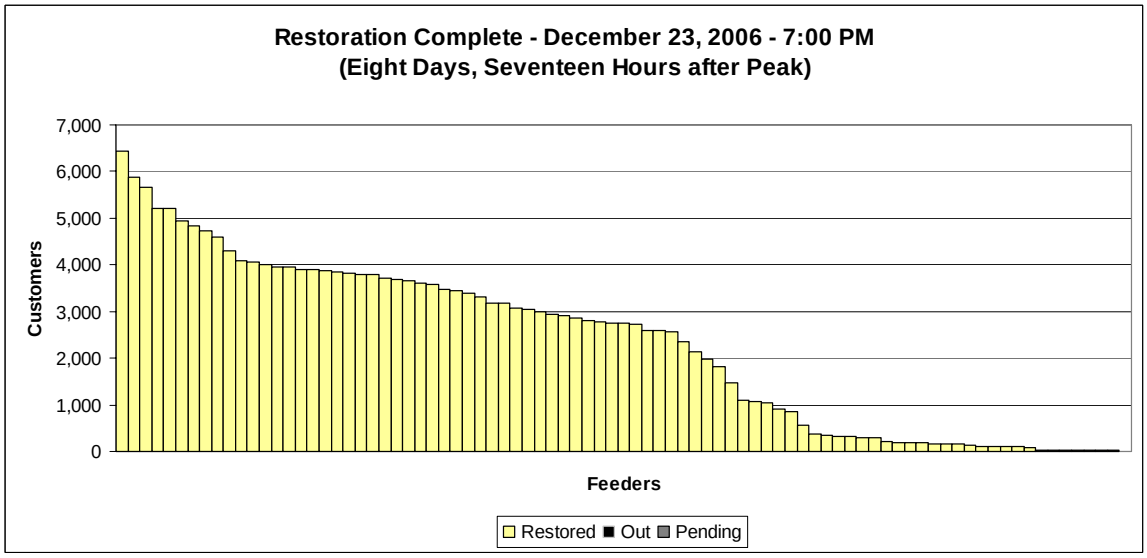
Figure 10: Feeder Status 12/23/2006



The crews from Benton were released and the remaining 168 resources worked from 6 a.m. to 7 p.m. to complete the restoration.

Figure 11: Feeder Status 12/23/2006 7 PM



At 7 p.m. on December 23, eight days and seventeen hours after the start of the restoration, all customers were returned to service. The PacifiCorp and Snohomish crews rested overnight before driving home on December 24.

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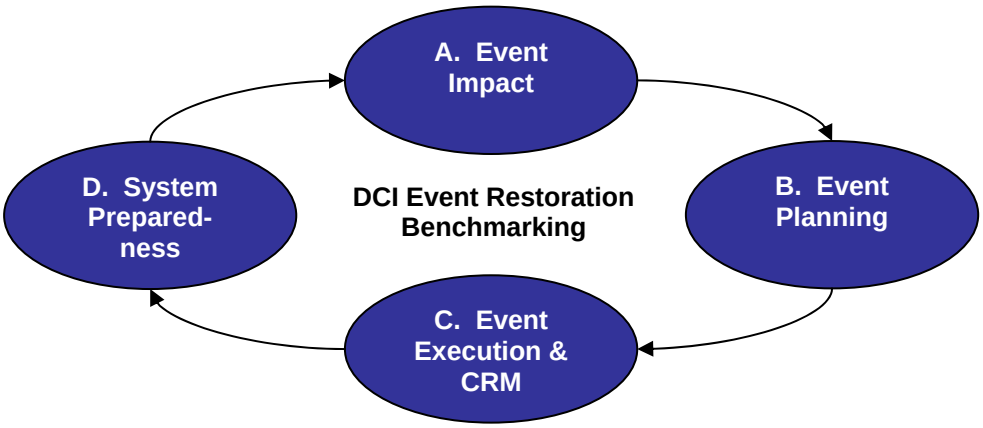
3. Restoration Review Approach

Reconstructing a restoration effort several months after the event requires the use of a structured process that identifies the sequence of events and the actions taken at critical points. Through numerous engagements with other utilities, DCI developed the Storm Restoration Framework, which forms the basis of the approach utilized by DCI in reviewing City Light's response to the December 2006 storm.

Figure 12: DCI's Storm Restoration Framework



The framework depicted above is based on the premise that in order to fully and effectively analyze utility event performance, four critical components must be evaluated and considered:

- Event restoration performance data;
- Breadth and depth of the planning effort;
- Restoration and Customer Relationship Management (CRM) Plan execution from the planning, resource management, operations, and customer service perspectives; and
- Delivery system management and preparedness.

Using the above framework and our experience in helping utilities assess storm restoration performance, we customized a layered approach to review and provide recommendations on the December 2006 storm for City Light. At a high level, DCI's approach included the following tasks:

- Perform initial review and analysis;
- Organize and facilitate expert review panel; and
- Produce report and recommendations.

Following is a detailed description of DCI's approach.

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Task 1: Mobilize project and identify areas of interest

The purpose of this task was to: (1) re-confirm the objectives of the effort related to the City Light request for proposal (RFP) and agree on a detailed engagement plan; (2) coordinate and liaise with City Light leaders and resources; (3) identify and agree on the data elements required to evaluate City Light's restoration effort; (4) determine the areas for which data and findings already existed; (5) issue additional data requests; and (6) agree on the project management structure and communication plan.

Task 2: Review existing response data and preliminary findings

The purpose of this task was to gain full understanding on the scope of the storm and City Light's restoration using available information, including the work conducted by CH2M Hill. Immediately after the event, City Light hired CH2M Hill to conduct an in-depth data-gathering effort, which included structured interviews with many members of City Light's staff. CH2M Hill compiled its data into a report that was made available to DCI. DCI gained a significant amount of background information through this source and, where warranted, DCI used the information from CH2M Hill's interviews to enhance its integrated project plan. In addition to the CH2M Hill report, we used the following documents:

- City Light's Red Book (Emergency Operations Manual);
- Internal documents describing the level of effort and coordination;
- Preliminary findings from internal reviews; and
- Detailed key statistics related to the level of damage, speed of restoration, number of customers out of service, resource deployments, and customer communications.

Task 3: Prepare assessment of City Light's performance

The purpose of this step was to understand the magnitude of the windstorm's impact on the utility and the effectiveness of City Light's restoration effort. DCI conducted a series of interviews with individuals who managed the storm response in the following areas: Storm Management, Logistics, Mutual Aid, Corporate Communications, Call Center, Field Operations, and Operations Center.

Task 4: Compare City Light response plan to industry best practice

The purpose of this step was to evaluate emergency plans, organizations, roles, procedures, and training, and to identify immediate and long-term areas of improvement based on DCI's experience and best practice database. DCI used the findings from the previous step to focus on specific areas of

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concern. When DCI identified such an area, we delved deeper into the emergency restoration process used by City Light. As a starting point in the analysis, DCI looked at three primary emergency plans (or their equivalents) that City Light used in its restoration effort:

- Operation emergency restoration plan (including command structure/governance, pre-storm preparedness, mobilization, damage assessment, restoration and post-restoration analysis) for operations, logistics, staging/satellite management, supply chain, resource management, and planning and analysis;
- Customer care emergency restoration plan (including Call Center operations, call overflow IVR/VRU plans, and Call Center statistics); and
- Customer relationship management emergency restoration plan (including estimated times of restoration (ETRs) and coping information; use of various types of media, including radio, print, TV, and Web; special needs customers requirements; restoration priorities; partnerships with communities; and emergency management centers).

City Light provided a copy of its Red Book as the only document available at the time of the event that addressed organization and restoration. Although a review of the Red Book revealed a partial ICS-based response plan, none of the restoration plans that would guide the restoration process were included.

Task 5: Evaluate internal and external communications

In this step, DCI evaluated the execution of the communications plans. DCI used the findings from the previous steps to help focus on specific areas, such as the adequacy of Call Center staffing. DCI examined the utility's accountability structure with local officials and, through interviews, the adequacy of the knowledge of assigned City Light staff. Some of the questions DCI tried to answer in this step include:

- How well were the planning and communications structure and process implemented to facilitate effective communication to customers and public officials?
- How well were the planning and communications structure and process implemented to facilitate effective communication to internal City Light stakeholders?
- Was Call Center response time adequate for events of this magnitude?
- Was the internal communication process consistent with ICS/NIMS guidelines?

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Task 6: Utilize DCI's Storm Restoration Framework and benchmark database

Over the last four years, DCI has developed a comprehensive knowledge base of emergency restoration best practices and created a comparative database of the scope of restorations associated with recent major events throughout the United States. The database pulls information from a comprehensive survey including more than 100 questions structured according to our Storm Restoration Framework. DCI used this extensive database, which includes information gathered from 19 utilities and 34 different events (including hurricanes, snowstorms, ice storms, and windstorms), to compare City Light's response to similar storms at other utilities. In developing the database, DCI worked directly with staff at each utility to benchmark restoration performance. The benchmark data offers information on how a utility performs compared to other companies in a given metric. Because of variables (type of utility, geography, system characteristics, etc.) included in each benchmark, the information should not be taken as an absolute measure of performance. Rather, the data serves as an indicator of performance that DCI then uses to determine which elements of the restoration process may require further investigation.

The entire benchmark analysis can be found in Addendum F, a separate attachment to this document.

Task 7: Organize expert panel review

Many utilities have experience restoring service after devastating events such as hurricanes, tornados, windstorms, ice storms, and earthquakes. The expertise gained by these utilities can be used to gauge the effectiveness of the process used by City Light.

DCI recommended five utilities as candidates to serve on the expert panel to review City Light's restoration performance. Each of the selected utilities had to meet the following criteria:

- Experienced events similar to the City Light December windstorm;
- Viewed as industry leaders in emergency response;
- Comparable to City Light's size, system characteristics, or geography; and
- Willing to participate on the panel.

The five utilities that met or exceeded these criteria were:

- Southern California Edison (SCE);
- Los Angles Department of Water & Power (LADWP);
- Orlando Utilities Commission (OUC);

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- Nashville Electric Service (NES); and
- Toronto Hydro Electric Service, Ltd.

Task 8: Facilitate expert panel review

The purpose of the panel was to provide feedback on DCI's initial findings and recommendations based on City Light's response to the windstorm. To stimulate the analysis, DCI asked the panel to respond to a set of hypotheses based on its initial review of City Light's performance. Further, DCI developed a detailed agenda and facilitation guide to ensure that City Light received maximum value from the panel review. Section 6 of this report contains a summary of key recommendations from panel members.

Task 9: Prepare the final report

DCI wrote this report to provide a detailed description of findings and recommendations, including those developed by the review panel. We structured it according to our Storm Restoration Framework, and each section discusses and describes our evaluation criteria, findings and conclusions, and recommendations.

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4. Interview Summary

The CH2M Hill report provided DCI with detailed interviews from a significant cross section of the City Light organization. DCI used the report as a foundation of information on the restoration and also to determine if any additional interviews would be necessary. DCI did decide to conduct more interviews and selected a cross section of job functions to gain additional information and to verify CH2M Hill's data. Although each interview was scheduled for one hour, in several cases they went on longer. In a few cases, follow-up interviews were conducted and supporting documentation was collected for analysis. The following table provides a summary of the additional interviews conducted by DCI staff in the data-gathering period of the project.

Table 2: Interview Table

Interview Table			
Position/Function	**Date**	**Position/Function**	**Date**
Dir. Security and Emergency Management	3/5	Chief of Staff	3/5
Superintendent	3/5	Communications Director	3/5
Customer Care & Energy Delivery Officer	3/5	Director, Energy Delivery	3/7
Vegetation Management	3/7	Call Center	3/13
Community Coordination and Deployment of Call Center Resources	3/8	Restoration work prioritization Call Center	3/13
Mutual Aid & Crew Utilization	3/13	Logistics Discussion	3/14
Information Systems	3/13	Lineman Interview, South SVC	3/20
Vegetation Management Discussion	3/14	Lineman interview, North SVC	3/21
Major Accounts	3/26		

The results of these interviews and the analysis of the data collected is included in Section 5.

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5. Restoration Performance Review

Common themes emerge when examining restoration efforts, be they responses to hurricanes, ice storms, or in the case of City Light, windstorms. DCI examined City Light's performance along these themes:

- Response and Restoration Emergency Planning
- Damage Assessment
- Community Coordination
- Internal Communications
- External Communications
- Mutual Aid
- Logistics
- Vegetation Management
- Measuring Customer Satisfaction
- Systems

5.1. Response and Restoration Emergency Planning

Outage events are defining moments for utilities. The consequences of decisions made during an outage have an immediate and long-lasting effect in shaping customer opinion and satisfaction. As such, utilities view emergency planning as a top priority. They have robust, unambiguous all-hazard response plans suited to a wide variety of possible events.

5.1.1. Response Plan

In best practice utilities, these all-hazard plans, which form the umbrella over all other plans (storm, pandemic flu, oil spill, nuclear event, etc.), accomplish the following:

- Adopt the Incident Command System (ICS) as the utility-wide response organization;
- Provide an event classification methodology;
- Establish training standards and expectations;
- Provide pre-event notification procedures;
- Establish a central emergency planning and preparedness utility unit; and
- Create a post-event review process.

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The umbrella response plan functions as the "all-hazard" hub of an interconnected wheel of emergency plans. This hub and spoke methodology ensures consistency both in plan development and in response organizational structure. The advantages associated with using a centralized response plan and emergency planning and preparedness process include:

- Meeting local, state, and federal emergency planning expectations;
- Providing emergency response structures and approaches that are consistent across emergency responder organizations;
- Meeting best practices; and
- Establishing common understanding of emergency planning and preparedness to ensure both internal and external coordination.

Generally, a centralized emergency planning and preparedness unit is responsible for the following: overseeing an annual update of the umbrella response plan; working with business groups to ensure that other sub-plans (restoration, etc.) are up-to-date and revised annually; training event responders on the utility-wide response organization; ensuring compliance of plans with local, state, and federal expectations or mandates; and attending emergency planning and preparedness conferences and workshops.

5.1.2. Restoration Plan

Restoration plans provide the operational guidelines for restoring power during an event. In addition, they may contain overall performance goals and priorities, clear roles linked to the goals, required competencies to succeed in the roles, decision-making authorities, details on use of information systems, contingency plans, resource and logistics plans, and measures of success. Oversight of the development of the restoration plan, training of people on restoration-specific roles, and certification of restoration processes should be managed at a high level in the organization.

Observations

At the time of the windstorm, City Light did not have either a comprehensive restoration plan, response plan emergency response training plan in place. Its existing Emergency Operations Manual, which the utility refers to as the Red Book, does not sufficiently outline the actions required to prepare and respond to a storm emergency. At the time of the storm, however, a Continuity of Operations Plan (COOP), which is City Light's response plan, was drafted but not yet implemented. City Light should use the COOP as a foundation for a complete, viable, effective, integrated, and robust emergency plan. Because of its significant gaps and a lack of adoption among City Light staff, the Red Book should be retired from service.

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- At the time of the storm, City Light did not have an integrated emergency preparedness response plan or restoration plan and also lacked the following:
  - An organization-wide response plan or structure, other than as provided in the Continuity of Operations Plan (COOP);
  - Organization-wide pre-incident planning, such as event risk analysis, classification methodology, and emergency declaration protocols, etc.;
  - A declaration for how individual roles shift to support the restoration (except what exists at the highest levels);
  - Organization-wide training programs on emergency preparedness and response;
  - A “lessons learned” mechanism;
  - A formal process for updating the emergency operations manual;
  - Mutual assistance management processes; and
  - Formal plans for coordination with local, state, and federal agencies and entities.
- The COOP revision will require that key stakeholders are involved in developing the emergency planning process, revising existing response plans, and developing and implementing training programs; and
- City Light leadership recognizes that the demands placed on utilities to develop robust and consistent emergency preparedness and response plans are significant. The next step must be to develop and implement these plans. This need is evidenced by the 9/11 terrorist attacks, Hurricane Katrina, earthquakes and the potential for an avian flu pandemic, and the December storm.

5.2. Damage Assessment

In major events, utilities use damage assessment teams (spotters) to evaluate damage before a line crew is dispatched to perform repairs. Damage assessors patrol feeders while identifying trouble locations, evaluating the extent of the damage, and developing initial estimates of the labor and materials required to perform the restoration. This assessment generates the information required to more effectively identify the volume of work, prioritize restoration efforts, and assign resources. This function is typically handled by line resources or “trouble crews” during day-to-day operations or minor events, but when major events occur, trouble crews should focus exclusively on repairing the electrical plant and restoring power. Second jobs, established in a restoration plan, should clearly identify the

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other resources (meter technicians, engineers, and other qualified and trained individuals) that should perform damage assessment.

At the beginning of the restoration, the damage assessment teams work just ahead of the crews, relaying assessment information to the Control Center. This information can then be used to prepare the job site, arrange all appropriate switching, and obtain required material. As the assessment teams outpace the line crews, they continue to provide information on problems on the lines, which the Trouble Center uses to prioritize crew work and develop ETRs. Most utilities complete their damage assessment within two to three days of an event that takes seven to ten days to restore. The actual number of days to complete damage assessment should be scalable to the amount of damage and total time to restore. Given the tight geographical borders of the City Light service territory, the utility should have been able to complete the damage assessment for this event within two or three days.

Observations

- City Light's Red Book contains limited direction and detail with respect to managing operational efforts.
- City Light neither follows a standard process nor has a system owner for damage assessment.
- The Trouble Center and damage assessment processes do not scale well to different size events.
- There is little structure available to the damage assessment teams who have not received:
  - Copies of the Red Book;
  - A manual for damage assessment;
  - A checklist, field guide, or reference; and
  - A standard form, format, or template for recording and reporting damage.
- An inadequate number of individuals are trained for damage assessment duty and the training is not sufficiently extensive:
  - City Light was able to field approximately 20 damage assessment teams on each day of the storm, consisting of:
    - One engineer; and
    - One qualified electrical worker, typically a meter technician or other craftsperson, but not necessarily an overhead line technician.

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- City Light's lack of a damage assessment plan for large events hampered its efforts on the first day because many crews had to wait for assignments.
- The System Control Center had little confidence in the data from the damage assessment teams and chose to have line crews do their own redundant scouting in many instances.
- The composition of damage assessment teams is not determined in advance and, in fact, disputes arose at the time of the event that generally revolved around:
  - How to pair off engineers and non-engineers; and
  - How to pair off experienced damage assessors and newer resources.
- There is no evidence that the damage assessment teams were dispatched according to any priority sequence.
- Reports from the damage assessment teams were sometimes incomplete or inaccurate in the first day and a half of the restoration.
- By the third day of the restoration, the System Control Center was saturated with data and requested a halt to incoming information. The damage assessment function was scaled back.
- At the System Control Center's request, the damage assessment teams were redeployed to confirm repairs later in the storm.
- Circuit maps were not readily available for use by damage assessors or off system crews. Additionally, many of the maps were inaccurate as some system reconfiguration information had not been transferred to the electronic database from which the maps are printed.

5.3. Community Coordination

In the wake of major events, City Light and other services within the city are positioned to help each other in ways that none of the parties could accomplish on their own. Through its knowledge of the electric system as well as information provided by damage assessment teams, line crews, and the Call Center, City Light may become aware of public safety issues unknown to the city's emergency services. Conversely, by virtue of their presence in the community and channels of communication into the community, emergency services may well know of outage or safety issues that would be priority items for City Light. In order to take full advantage of this symbiotic relationship, clearly defined lines of communication between City Light and the other city services must exist, along with a commitment to support each other through the duration of the event.

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Observations

- The Red Book does not define partnerships with other local emergency management departments that might play a role in a major event:
  - City Light's role at the city EOC and the city's role in a City Light emergency must be clearly defined; and
  - The city EOC stood down while City Light continued to be in an emergency restoration mode.
- The City Light Trouble Center lacks a dedicated phone line for police, fire, and other emergency services.
- City Light does not have a process to confirm that the emergency services have power to operate facilities.
- City Light had only one delegate at the city EOC. This would not have allowed for 24-hour representation had the EOC remained open.
- City Light assumed responsibility for a number of public safety issues, which distracted from the restoration effort:
  - Opening and coordinating emergency shelters to accommodate people without a safe source of heating after the city EOC stepped down;
  - Issuing cold weather warnings for citizens who might find themselves without safe heat sources;
  - Warning the public of carbon monoxide risks;
  - Notifying the public on safety hazards; and
  - Delivering public safety flyers translated into multiple languages.

5.4. Internal Communications

The occurrence of a major event requires a utility not only to mobilize en masse to restore service in a safe and timely manner, but also to keep customers apprised of their progress. To succeed in each of these tasks, the utility must do more than simply work faster than they would during normal operations. Roles shift, the complexity of the operation increases, and the need for structured internal communications increases dramatically. The Incident Command System (ICS), which is described more fully in Section 7.1, provides responders with a means to effectively communicate through common terminology, decreased spans of control (the number of direct reports that any supervisor has), and identification of common incident objectives. ICS fits into the National Incident Management System (NIMS), which allows City Light to coordinate its activities with local, state, and federal agencies and first responders.

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Despite the beginnings of a NIMS/ICS plan at City Light (the Red Book), internal communications were established on an ad-hoc basis, using existing personal and business connections. This resulted in breakdowns in communications that hindered the overall restoration effort.

Observations

- An integrated emergency communications plan does not exist:
  - Protocols for communications in an emergency either do not exist or were not used;
  - Staff receives little or no training in emergency communications;
  - Significant gaps exist in the internal communications processes; and
  - The communications function was not integrated into the overall emergency response effort and as a result did not receive timely restoration information from the field.
- Some communication with the field was conducted by cell phone instead of radio:
  - It is standard practice to use radios in the field so that key information is broadcast to all parties and communications can be recorded; and
  - Some attempts to communicate were unsuccessful, as cell phones were connecting either via an overloaded infrastructure (the phone system) or not at all when cell service was entirely down.
- Operating and restoration information was not shared in a timely manner:
  - Operations, the Call Center, and the communications functions operated in silos. If these elements had been better integrated, the internal information flow during the restoration response would have been more effective and efficient, as other functions would have been better able to carry out their responsibilities;
  - The Call Center and communications center was not included in daily situation report conference calls, depriving them of information they could relay to customers;
  - At the end of each day, Operations generated an internal report that summarized the progress to date and the planned work for the next day. This information would have been extremely helpful to the Call Center and communications functions, but there was not a process in place to share it;
  - Operations did not provide enough timely information to support call center and communications needs, particularly related to estimated times of restoration;

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- The Call Center did not have enough information that could be provided to customers who inquired about status; and
- There was no integration of communications between the Communications Center, Call Center and Operations to better assess the status of customer outages. Although the Call Center received a fair amount of information from communications, the lack of a process for dissemination of information form the call center to operations resulted in Operations not obtaining and/or using it.

5.5. External Communications

In order to meet customer expectations and maintain satisfaction during major power outages, a utility must:

- Demonstrate that it knows the customer is without power;
- Convey a sense of urgency about restoring power; and
- Provide the customer with reasonable time estimates for restoration.

Due to its existing processes and technologies, City Light fell short in the first and third items listed above. They did, however, convey a sense of urgency and an earnest desire to get customers restored quickly. As a result, City Light emerged with a reasonable level of customer satisfaction. If another storm were to arrive in the near future, however, customers would likely be less patient because of their fresh memory of the last event.

Call Center agents perform two principal functions during a major restoration: 1) fielding lights-out calls to create trouble tickets and 2) providing ETRs. Ideally, an agent receives a call from a customer, pulls the customer and outage information up on their screen, and gives the customer some confidence that the utility is on the job. It is unlikely that an agent can provide an ETR early in an event, but as restoration progresses agents should be able to do so with increasing accuracy.

The utility should designate a single individual who is responsible for communicating with the media and public, leaving the rest of the utility free to focus on the restoration. The content of the messages delivered during the restoration should be confined to helping customers understand the prioritization and restoration process, issuing safety advisories, delivering progress updates, and providing ETRs. Introducing additional voices during a major restoration effort can lead to inconsistencies in information. This creates confusion that must be addressed, and ultimately draws resources away from the restoration effort.

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Observations

- City Light succeeded in educating and preparing the public for the 2006 storms:
  - In November, City Light provided press releases on anticipated storms. The press releases included:
    - The anticipated level of damage; and
    - Tips on how to prepare for the storm.
  - In November/December, the utility also produced a front-page article in its newsletter What You Can Do During a Power Outage; and
  - In the days leading up to the Hanukah Eve storm, City Light's Director of Communications appeared on local news programs to warn that a larger windstorm was approaching and how customers could be prepared. This was accompanied by a press release to the same effect.
- Communications during and after the storm were strong on providing tips for dealing with outages, explaining what restoration work had already been completed, and broadcasting safety bulletins. They were weak on ETRs – the information customers and media really wanted to know:
  - Early press releases optimistically estimated that total restoration would be complete in three or four days. These negatively affected City Light's credibility when later releases reported significantly longer restoration times;
  - City Light was proactive in approaching the media to ask what they needed; and
  - City Light's performance with respect to ETRs was visibly weak.
- The early system-wide projection for completion of restoration was significantly low and was replaced with a higher estimate a few days into the event.
- The second projection was correct, but could not be incorporated into regional, circuit, or individual ETRs as time progressed.
- The Electrical System Status (ESS) proved ineffective in keeping stakeholders (customers, Call Center, Communications Center, Trouble Center) up-to-date:
  - There were too many outages on the feeders to display properly in the ESS output tables;
  - The graphical interface to ESS only showed feeders (for large groups of customers) as 100% off or 100% on; it lacked the ability to pinpoint

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individual customers or isolated clusters of customers (i.e., laterals) without service;

- The system continued to be used but with feeder number limitations it was ineffective; and
- Efforts are underway to improve the ESS based on the December experience.

- The communications group worked hard to keep the public informed and called the media hourly. The group, however, lacked the information the public needed and at times used too many voices, resulting in inconsistent messages.
- The Call Center performed admirably under difficult circumstances, but would benefit from better infrastructure and access to the information customers seek. Specific issues confronted during the event include:
  - Call volumes often exceeded the capacity of the Call Center;
  - The Outage Hotline was unplugged on Monday, which forced calls directly to the Call Center; and
  - Customers were unhappy with information provided during calls.
- Media releases were overly technical and contained utility-specific verbiage (i.e., feeders, laterals, etc.), which was frustrating for customers who just wanted to know their ETRs.
- Integrating communications functions into the utility EOC/DOC would enhance consistent information flow for all communications activities.

5.6. Mutual Aid

Utilities are typically staffed with adequate line resources to maintain, upgrade, expand, and troubleshoot the system under normal conditions. These staffing levels are sufficient to handle restorations after moderate storms, but are inadequate for major events. It would, however, be financially unsound to employ a workforce large enough to perform major restorations year-round, so the practice of seeking assistance from outside resources, through the mutual assistance process, has evolved over the last half century. In 1952, the Edison Electric Institute (EEI), an association of shareholder-owned electric companies, established a mutual aid program through the development of a library of contact names and telephone numbers of utilities willing to participate in mutual aid efforts. Now, most, if not all, major utilities participate in mutual aid programs that pledge help to neighboring utilities in exchange for the right to call on those utilities when they are in need of help.

While entering into mutual aid agreements is a positive first step for a utility, it must do more. The utility must actively foster relationships with members of

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regional mutual aid groups, along with contractors, so when the damage hits and the available help is being divided among utilities, there is some incentive for crews to come to your utility.

Observations

- City Light is accustomed to contending with issues on its own and has historically placed little emphasis on mutual aid:
  - Mutual aid is not addressed in City Light's emergency planning;
  - It has been decades since the utility last needed to bring in outside crews;
  - City Light has only provided mutual aid crews twice in recent history;
  - Any mutual assistance agreements previously made were lapsed at the time of the storm; and
  - There is no formal organization or team in place with a clear mission and accountability for triggering and managing the use of mutual assistance resources at any particular level of emergency response, whether predicted or actual.
- Given the projected severity of the storm, mutual aid crews should have been procured earlier:
  - Senior managers at City Light with experience in mutual aid recognized the need to bring in crews; and
  - City Light found it was unable to secure crews as agreements and relationships did not exist. They were forced to use only internal resources, with the exception of five additional tree removal crews.
- City Light secured additional crews several days into the restoration and used them to its advantage:
  - City Light management leveraged connections at PacifiCorp to secure crews as they were released from other mutual aid assignments;
  - The PacifiCorp and Benton County PUD resources arrived the evening of December 19 and were deployed to help with the restoration on December 20;
  - Mutual aid resources were paired with a City Light representative who could guide them to outage locations and liaise with City Light dispatch;

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- Mutual aid crews reported from the same service centers and benefited from the same logistical support as City Light crews;
- The mutual aid workday was offset from City Light by an hour to avoid congestion at the service center; and
- Additional crews from Snohomish PUD arrived toward the end of the restoration.

- City Light recognizes that mutual aid resources can provide an important contingency in responding to major events in the future:
  - Over the course of the restoration, City Light developed relationships with mutual aid resources, and gained direct experience in the efficient utilization and management of outside resources.

5.7. Logistics

During a major restoration, a utility must address several logistical concerns. It needs to ensure that crews have access to material, equipment is maintained and fueled, personnel have access to food, and visiting crews have a place to sleep. The logistical support provided to City Light's operations crews was adequate and generally did not constrain restoration efforts.

Observations

- The restoration effort was not hampered by lack of materials:
  - City Light maintains a larger inventory of materials than most utilities;
  - The utility's inventory does not vary seasonally, even during the storm season. This is not an issue because the unusually high inventory levels cover seasonal fluctuations in material needs; and
  - City Light line trucks are generally well stocked with the most commonly used materials such as conductors, splices, fuses, and insulators.
- It should be noted that City Light Operations (not the warehouse) operates a pole yard, with dedicated pole delivery and pole setting services.
- During the restoration effort, stores staff operated continuously (24/7). Trucks, however, were not restocked overnight and pick lists of materials needed for specific repair jobs identified through damage assessments were not communicated to materials management. City Light Crew Chiefs would determine material requirements while on the job site and send a crew member or other supporting field personnel (such as City Light's civil crew personnel) to the warehouse to pick up the necessary materials and

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deliver them to the job site. City Light restoration crews would also draw materials for the day's work in the morning at the beginning of their 17-hour shift.

- City Light has relatively uniform overhead energy delivery infrastructure utilizing standardized components.
- Fleet maintenance and fueling operated smoothly for the majority of field resources:
  - The Fleet and Facilities group within the City of Seattle Executive Services Department provides vehicles, equipment, and mechanical repairs to City Light;
  - The city's Fleet and Facilities group fueled City Light and mutual assistance vehicles overnight during the seven-hour break;
  - The contract vegetation management group, Asplundh Tree Experts (ATE), did not have access to the Fleet and Facilities fuel tanker and lost time refueling at busy gas stations; and
  - Vehicle repair support was good, with mechanics available to make repairs in the field and service and repair operations continuing overnight during the seven-hour break.
- City Light's Operations Department did not encounter any significant equipment-related limitations while responding to the event. For example, sufficient aerial equipment and tools were available for use by redeployed underground distribution system line crews. There was, however, limited availability of light vehicles such as pick-up trucks. City Light's Red Book addresses the potential need for lease and rental vehicles.
- The North and South Service Centers both lack dedicated stand-by emergency generation.
- Approval required by a director for relativity low cost purchases of consumable supplies, materials, and food was an initial constraint.
- City Light offered lodging to crews after the fixed seven-hour rest period was established, but the utility lacked pre-existing agreements with hotels and local hotels were filled by people without power, so there was inadequate capacity the first night the lodging was offered. However, as customers' service was restored, sufficient hotel rooms opened up and the situation was remedied. Subsequently, later in the restoration effort, the utility made lodging arrangements for the mutual assistance crews prior to their arrival.

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5.8. Vegetation Management

Most utilities can directly link interruption frequency to the effectiveness of their vegetation management programs. Vegetation management programs must provide adequate clearance to minimize incidental tree contacts from overgrown foliage or dead tress, which cause power interruptions during strong winds. If an effective vegetation management program is not in place, strong storms will significantly damage the utility's infrastructure. City Light increased funding on its vegetation management program after several years of decreases. While the majority of significant damage was caused by downed trees, a more aggressive preventive vegetation management program would have had a minimal impact on damage to SCL facilities but would have reduced the number of outages during this event.

Line clearance tree crews provided by Asplundh Tree Expert Company (ATE) can provide an elevated level of service in support of City Light's overhead line crews during storm restoration work.

Observations

- City Light's overhead line crews performed a significant amount of tree clearance work during the restoration effort.
- City Light's civil crew personnel supported line crews doing tree work and site cleanup.
- Requests for tree crews came through several channels, many of which were informal and based on pre-existing relationships. Some of the City Light line crews did not know they could or chose not to request tree crew support.
- Chapter 296-45 of the Washington Administrative Code (http://apps.leg.wa.gov/WAC) , which sets out safety standards for electrical workers, allows tree crews to do more work clearing trees from lines than City Light crews and personnel appear to believe.
- ATE tree crews did some of their own line patrolling, looking for restoration-related tree work.
- ATE tree crews supported other city departments during the early days of the storm response effort.
- ATE tree crews provided support in clearing the most difficult tree-related situations.
- Much of the tree work assigned to ATE was completed quickly: five of ten ATE crews were released to assist other regional utilities on day three.

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- City Light contracts for line clearance tree work with ATE. This relationship has been in place for 20 years and was extended for an additional five-year term in 2006. The contract specifications do not include any specific provision for emergency response services.
- Although the City Light vegetation management budget has been increased each of the last four years, prior to 2003, the budget was subject to significant constraints. City Light's vegetation management objective is to achieve a four-year preventive maintenance cycle, defined as completing one fourth of the feeders with tree work each year. Currently ten three-person line clearance tree crews work on the City Light system under steady state conditions. ATE also provides City Light with two full-time staff who visit locations to verify that the work requested by customers really needs to be done. City Light also has two in-house crews that maintain vegetation on the transmission system, managing the transmission rights-of-way.
    - There are no formal written plans or manuals for vegetation management work under day-to-day or emergency response conditions. There are, however, general references found in the Emergency Operations Procedures Manual that suggest City Light restoration staff should consider the use of tree crews during outage restoration work
    - Trouble Center Manual (10/6/06):
        - Line Clearing Crews are generally needed when trees are lying on a pole or wires and are larger than 20-inch diameter or when branches on the system are larger than six inches. They will also be needed for tree fires or arcing; and
        - The only tree removals that should be done during storms are those needed to clear the line and restore service.
- The City Light Line Clearance Coordinator took requests for tree crews and directly dispatched ATE crews and ATE's General Foreman provided support to crews in the field. Restoration priorities were not consistently communicated to the vegetation management group during the storm response.
- Requests for tree crew support originated from a variety of sources:
    - Directly from the Call Center – many of these requests ultimately did not involve City Light primary lines;
    - General public – City Light has a Tree Request Hotline, operated by the City, which quickly became overloaded;

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- Crew Coordinators in Operations (primarily from the North Service Center)
- Direct requests from City Light Crew Chiefs (primarily from South Service Center)
- System Operators/System Control Center
- Requests from spotter crews (damage assessors) – some of which were discovered not to be restoration-related. On occasion, spotters also made commitments to customers that were inconsistent with City Light's vegetation management practices; and
- From the tree crews themselves as they encountered work.

➢ City Light management believes that routing all requests through the Line Clearance Coordinator was very effective. This belief is based on the fact that the current Line Clearance Coordinator has good existing relationships with many of the line crew chiefs. In subsequent conversations with other City Light Operations personnel, it became apparent to DCI that this informal process tended to serve some better than others. For those personnel familiar with the process, it worked well, but for those unfamiliar with the process or disconnected from the relationships, the informality of the process was a limitation

➢ City Light's Line Clearance Coordinator dispatched tree crews to specific locations. The tree work was typically completed well before (in many cases more than a day before) an OH line crew would actually arrive on site to make repairs. ATE line clearance tree crews generally did not work directly with or in close association with City Light's OH line crews.

➢ The work that was completed by the ATE line clearance tree crews included work with large trees and difficult removals. In addition, tree crews patrolled lines identifying work locations for themselves, as well as performing some preventive maintenance work. Tree crews also provided support for other city departments such as Seattle Public Utilities (SPU) and Seattle Department of Transportation (SDOT).

➢ City Light did not request additional tree crews either prior to or in response to this windstorm. After three days, the majority of requests for heavy tree work were complete, and City Light released five ATE crews for redeployment at Puget Sound Energy (PSE) and Snohomish County Public Utility District (PUD).

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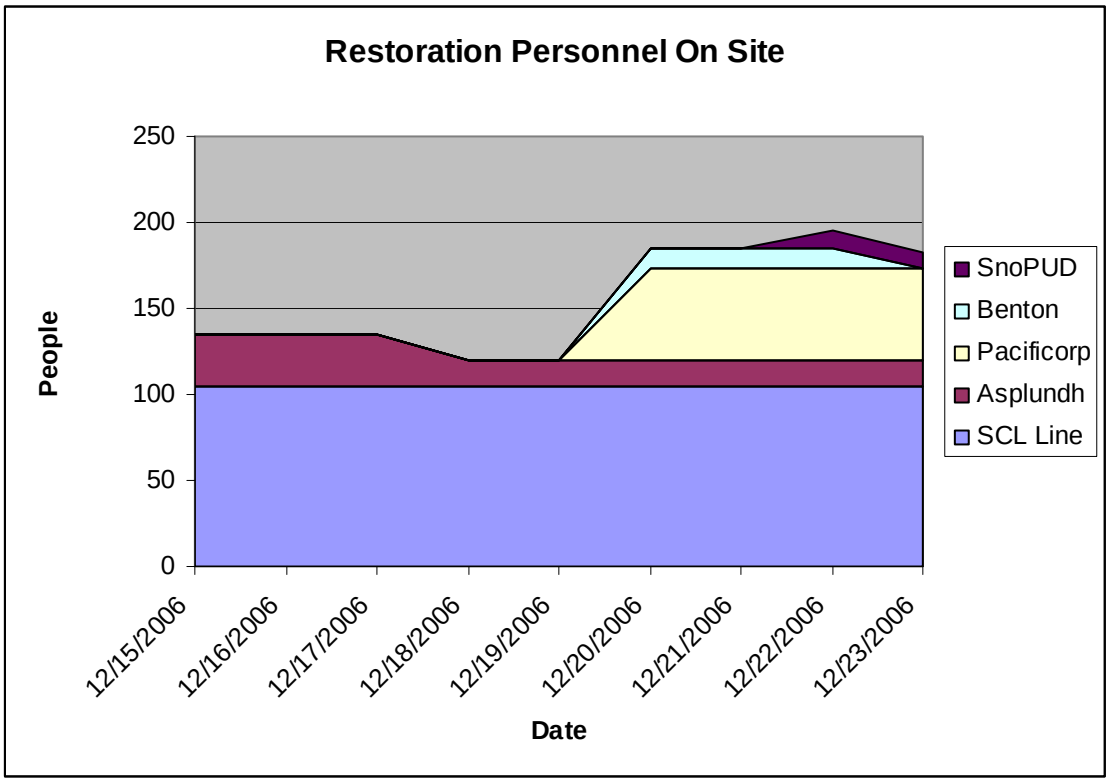
Figure 13: City Light and ATE Personnel



- City Light vegetation management staff and line crews have a strong tradition of safety and believe that grounds must be in place before a tree crew can start. This focus on safety might account for the fact that line crews are performing their own tree work, believing it is simpler to perform the work than coordinating with and taking a clearance for a tree crew. For whatever reason, City Light appears to make less use of line clearance crews than is commonly seen in the industry. The Washington Administrative Code explicitly states that tree crews can remove trees and limbs from energized lines or non-grounded lines provided that they use insulated tools and maintain minimum approach distance.
- Tree work related to the windstorm, such as clearing hazards, continued well into 2007 (six to eight weeks post-event). City Light vegetation management continues to respond to post-storm "trouble calls" from customers and only began to resume scheduled preventive maintenance in March 2007. City Light did not keep a list of sites found during the restoration period that may have been deferred and completed later – if there was tree work to do, City Light did it.
- During interviews, vegetation management staff indicated that they did not believe that there was any correlation between the damage they observed

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and prior preventative maintenance clearance work. Damage was observed on circuits where vegetation maintenance had recently been completed. In addition, much of the damage was due to the failure of large "healthy" trees, which were located a significant distance from damaged overhead lines and weren't considered hazards. City Light does not conduct a post-event follow-up investigation of tree-caused faults.

- Given the somewhat limited exposure tree crews had to the actual field conditions and damage that line crews were repairing, DCI sought the experience of the Operations organization in considering the impact trees had in this event. Anecdotal evidence suggests that:
  - 60% of the tree-caused faults resulting in interruptions were due to failures of limbs and branches; and
  - 40% of the tree-caused faults resulting in interruptions were due to entire trees falling.

This data describes damage to trees rather than the damage caused by the trees. Obviously, the greatest damage to City Light's system was due to larger trees falling into feeders and breaking poles. Because City Light's standard feeder conductor is quite large and strong, when trees fell, rather than the conductor parting, poles often broke. The number of pole failures may also have been high because of the extensive use of large-diameter telecommunications attachments in the joint use space on City Light's poles.

DCI concurs with the consensus opinion of the Operations and Engineering Departments that the deferral of scheduled vegetation maintenance in the past resulted in a higher level of outages during this severe wind event. It is important to note that while vegetation management programs can improve reliability, they will not completely eliminate the risk of tree failures. City Light simply has too much exposure (hundreds of thousands of trees and thousands of miles of overhead line) to successfully identify all high-risk sites and the prediction of tree hazard is not an absolute science. DCI believes, however, that a well-established and well-maintained vegetation management program is an effective means to achieve some hardening of City Light's overhead system. In addition to reducing the risk of tree failure, an effective vegetation management program assists in maintaining the system, which can be restored more quickly because damage assessment and repair work is less impeded by heavy vegetation.

5.9. Measuring Customer Satisfaction

Given the dramatic effect major outages have on the general public, it's important to measure the influence a utility's performance has had on customer satisfaction. Since the timing of major events cannot be predicted, utilities should conduct regular surveys to develop a baseline against which

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post-storm results can be measured. Customer satisfaction surveys are a lagging indicator and earning good numbers in one instance does not guarantee that a utility will achieve the same levels of satisfaction in response to the next event. Regardless of the results following the Hanukkah Eve storm, the citizens of Seattle will have higher expectations of City Light in future events.

Observations

- While the proportion of customers rating themselves as "very satisfied" and "satisfied" held constant, approximately one fifth of the customers who had originally indicated "very satisfied" moved down to "satisfied" after the storm. City Light must recognize this as warning sign and work to recover its formerly "very satisfied" customers.
- City Light had completed a customer satisfaction survey not long before the event. They should be credited for taking the risk of doing a follow-up survey shortly after the restoration was completed.

5.10. Systems

System preparedness is a key component for withstanding damage to facilities during a storm. More and more regulators are requiring utilities to review their reliability standards, sectionalizing capabilities, vegetation management practices, pole test programs, and class of construction to ensure that the system can both withstand storm events and lessen restoration time. As part of this evaluation, DCI reviewed system preparedness metrics to determine if City Light should consider implementing any specific measures.

Observations

- The vegetation management program has been recently refunded and City light is trying to establish a four-year trim cycle. The most significant damage to the distribution system was caused by falling trees. There were some outages caused by falling tree limbs but the damage caused to the lines was minimal.
- City Light has neither a pole test nor a pole replacement program. As with most utilities, City Light distribution assets are aging over time and at some point they may want to consider some form of life cycle analysis and replacement program. Despite the lack of programs, the age and/or condition of the assets was not a significant cause of outages in this event, but could be a major factor in the next event.

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- The protective devices installed by City Light seemed to function as they were designed to. Breakers and fuses opened according to design.
- City Light has made excellent use of feeder tie and sectionalizing switches to minimize the impact of outages to its customers. Its feeder-loading pattern allows it to transfer load from one feeder to another and sectionalize around faults to restore service to the largest number of customers.
- City Light's ruling span, or the distance between poles, is on average 150 feet. The average ruling span for most utilities is 200 to 250 feet. The short spans strengthen or "harden" a system against outages. Shortening the distance between poles similar to the ruling span at City Light is one of the measures that a utility uses to harden its system.

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6. Expert Panel

6.1. Purpose

After every major event, questions arise about not only how well the restoration process worked, but also how the restoration period might have been shortened through more effective response processes, including general response pre-planning and preparedness, damage assessment, mutual assistance, and communications. In order to answer these questions, a utility should either benchmark its response performance against those of other utilities or directly approach utilities for advice and constructive criticism on which processes might or might not work.

As part of the review of the December 2006 storm response, DCI worked with City Light to assemble a panel of experts from other utilities to review restoration processes and procedures. Five utilities (four municipals and one investor owned) from across the United States and Canada were selected and agreed to participate on the panel. DCI sought utilities with diverse sets of experience that would address different storm types, restoration planning, and technology use. The panel convened for a period of two and a half days.

The panel first conducted a series of fact finding interviews with a wide range of City Light staff from the following groups: Management, Facilities, Operations, Field Crews, Logistics, and Information Technology. The panel members next completed a brief tour of City Light's facilities to see construction types and the condition of facilities. They reviewed and discussed the information collected and used it to reconstruct the restoration process, including infrastructure. They then compared these processes with their own experiences.

The panel developed observations and a list of recommendations for City Light to consider. The recommendations appear in Section 9 and also in a Power Point presentation in Addendum B, a separate document attached to this report.

6.2. Company Backgrounds

As noted previously, the companies that DCI selected had to meet specific criteria:

- Experienced events similar in nature to the December windstorm;
- Viewed as industry leaders in emergency response;
- Comparable to City Light in size, system characteristics, and geography; and
- Willing to participate on the panel.

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DCI selected diverse companies with substantial restoration experience. We also wanted utilities that were willing to share experiences. Following is a brief background on each company that participated in the review panel. The five utilities that participated are:

- Southern California Edison (SCE) – the only Investor Owned Utility (IOU) on the panel. It brought extensive experience in restoration practices for a diverse set of restoration efforts including windstorms and earthquakes.
- Los Angles Department of Water & Power (LADWP) – the largest municipal utilities in the country with experience in restoring systems after major events, including earthquakes.
- Orlando Utilities Commission (OUC) – a municipal utility in the same size range as City Light with extensive restoration experience. Located in Florida, OUC has frequently faced hurricanes and severe storm damage.
- Nashville Electric Service (NES) – also a municipal electric utility of about the same size as City Light. NES has recently completed a revision of its emergency response plan and has experienced several major storm events, including a tornado that went through the center of Nashville.
- Toronto Hydro (THESL) – a large municipal utility, which was formed from an amalgamation of six municipal utilities that served the Toronto area. THESL recently installed an Outage Management System (OMS) and could provide insight into the process, such as time required to install and integrate it. THESL is also one of the few utilities that have implemented its response plan for a pandemic event.

6.3. Participants

Each of the review panel participants provided both extensive knowledge on the theory of restoration and practical experience in responses to events. Following are the panel participants and a brief synopsis of their backgrounds.

- *Mr. Eddie Andrews, NES VP of Operations*: Mr. Andrews is responsible for emergency planning as well as the restoration plan and implementation of it. Andrews recently completed a revision of the restoration plan, including training and storm exercises. Mr. Andrews also serves as the “storm boss” during major events, including the recent storms that struck Nashville.
- *Mr. Frank Farwell, SCE Grid Operations Manager*: Mr. Farwell leads the SCE mutual aid program and he also oversaw mutual aid teams at large scale restorations for Florida Power and Light (FPL), Pacific Gas and

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Electric (PGE), and Puget Sound Energy (PSE) between 2004 and 2006. In 2006, Mr. Farwell authored changes to the SCE Mutual Assistance Plan. Finally, Mr. Farwell has occupied the following positions for SCE: Storm Recovery Manager, Storm Center Manager, and Mutual Assistance Manager.

- *Mr. Benny LaPianta, THESL VP Distribution Grid Management*: Mr. LaPianta oversees the monitoring and control of the electric distribution system, emergency response, power restoration, and the company's Emergency Preparedness Planning.
- *Mr. David Grant, Manager, THESL Outage Management System*: Mr. Grant is the OMS manager and responsible for the operations of the recently installed outage management system. He brought OMS installation and operations experience to the panel.
- *Mr. Brad Chase, OUC Director, Systems*: Mr. Chase has extensive experience in restoration planning and implementation and establishing and communicating ETRs to customers during major events. He led the planning and restoration process at Orlando Utilities through several hurricanes in 2004 and 2005.
- *Mr. Roy Pyros, LADWP District Superintendent*: Mr. Pyros brought his extensive restoration experience to the panel, including the knowledge he gained through leading the LADWP restoration following the last earthquake. His experience with earthquakes brought insights to the panel and contributed greatly to developing best practice analysis in this area.

6.4. Review Panel Summary

The panel met for two and a half days at City Light to review the restoration plan, processes, and effort following the windstorm. The panel heard presentations from City Light staff in management, Operations, and IT, who focused on their roles and their decisions during the restoration. The panelists then asked the presenters questions to gain a better understanding of the steps that were taken to restore service. After performing an analysis of the reconstruction, the panelists provided observations and insights and developed recommendations for addressing identified gaps. Following are the observations, recommendations, and conclusions presented by the panel.

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Observations – Technology

Technology plays a key role in any restoration effort. The panel questioned the types of systems that were available at City Light at the time of the event. Here are their observations:

- Absence of enabling technologies necessitated intensive manual processes and resulted in productivity losses, duplicated efforts, and elongated restoration times:
  - Excessive focus in Control Center on sorting trouble tickets;
  - Control Center was inundated and could not process all tickets; and
  - Lack of ETR process.
- Absence of Mobile Workforce Management technologies that would enhance City Light's emergency response performance. Those technologies include:
  - Mobile data terminals (work order dispatch);
  - GPS/Onboard Navigation System;
  - Automatic Vehicle Location System; and
  - Digital circuit maps.
- Existing integration between the Interactive Voice Response (IVR) and the Customer System is inadequate to support effective storm response:
  - Phone number recognition was low;
  - The system is not user-friendly and, as a result, many attempts to report outages via the IVR were abandoned; and
  - Scripted prompts and questions are not sufficiently defined to effectively categorize the nature of the outage.
- Distribution automation capabilities are insufficient to support effective grid restoration:
  - Not all substation circuit breakers are Supervisory Control and Data Acquisition (SCADA) supervised; and
  - Absence of SCADA-controlled switches in the field.
- Performance of the radio system is in question:
  - Due to comfort, system congestion, personal preference, and/or system inadequacies, cell phone communication was chosen over radio in several instances.

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Recommendation – Technology

Based on their observations, the panelists developed a series of recommendations that were provided to City Light.

- Implement Outage Management System (OMS), or leverage/extend existing systems to sort and group tickets;
- Acquire Mobile Workforce Management technologies;
- Improve IVR scripts and algorithms;
- Automate 100% of substation breakers;
- Investigate SCADA controlled switches and other Distribution Automation capabilities;
- Conduct a study on the adequacy of the radio system; and
- Conduct critical communications over recorded radio systems.

Observations – People

It takes a significant amount of coordination between all of the staff to perform an effective restoration following a major event. The panel asked several questions in this area to determine the level of support and cooperation. Their observations are listed below.

- There is clear animosity and distrust between labor and management:
  - Prolonged contract negotiations;
  - Publicly aired disputes between labor and management during restoration process; and
  - Absence of an agreement on how to conduct restorations.
- Workforce constraints due to attrition.
- Lack of mutual assistance agreements in advance of emergency.

Recommendations – People

Based on the above observations, the panel recommended that City Light:

- Build trust through more informal communications and sharing of plans and strategies with union leadership and workers;
- Use the City Light's Joint Labor Management (JLM) process to fuller advantage. This process encourages the participants (City Light and representatives from the unions) to discuss issues that may arise and come to consensus on their resolution;

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- Engage the union to accept contractors to bolster workforce numbers and reduce unnecessary overtime, increase safety, and improve customer service; and
- Develop mutual aid agreements (both local and long distance), an assimilation plan, and a training philosophy.

Observations – Process

Having the best technology available does not necessarily ensure that it will be used effectively when needed. In many cases where processes are not in place to support the use of the technology, its benefits are limited. Following are the process observations noted by the panel:

- Bottlenecks in information and work flow:
  - Confusion about roles and responsibilities.
- Frustration with scheduling rotation:
  - Confusion around the hard work stop; and
  - A working schedule that was prudent yet misaligned with expectations developed based on past practices.
- Underutilization of all trade personnel during the storm response.
- Incomplete and incorrect information occasionally gathered by call takers.
- Poor access to updated system maps for many field personnel.

Recommendations – Process

Based on their observations, the panel made the following recommendations:

- Establish formal communications protocols (too many communications backdoors).
- Create emergency event response and recovery plan:
  - Benchmark recovery plans from other best practice utilities;
  - Identify roles and responsibilities (management control, receiving customer calls, damage assessment, trouble analysis, dispatching, etc.);
  - Design process to support delivery of ETRs; and
  - Implement “second job” or “storm assignment” practices.
- Design and deliver emergency response training and conduct annual storm drills.

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Observations – Strategy

The panel asked a series of questions to determine the strategies used to integrate the various restoration metrics into a storm response. Following are their observations:

- Absence of an enterprise-wide IT strategy:
  - IT funding decisions are made piecemeal and do not fit a coherent long-term plan;
  - Enabling IT systems are outdated or non-existent;
  - Absence of consolidated modernization strategy;
  - Lack of electric infrastructure investment (CapEx, O&M); and
  - Facilities are inadequate and not geographically optimized (i.e., Service Center).
- Absence of long-term people strategy:
  - Rejuvenation of trades and modernization of skills;
  - Labor relations; and
  - Workforce development.
- Stakeholder expectations may be misaligned:
  - Council management;
  - Customer relationship management; and
  - Media management was good despite the environment.
- The effect of reduced vegetation management was hidden in this storm by the volume of uprooted trees, but this could be a bigger factor in future storms.

Implementation – Strategy

The panel made the following recommendations to City Light:

- Develop an integrated long-term IT strategy;*
- Develop a modernization strategy;*
- Develop people strategy;*
- Develop a strategy to ensure alignment of stakeholder expectations; and *

* Implementation of these strategies is process-intensive and will require large-scale change management initiatives.

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- Review the adequacy of the vegetation management program (four-year cycle vs. Reliability-driven).

Observations – Creating a Comprehensive Emergency Preparedness Plan

The final metric explored by the panel was the availability of a comprehensive emergency restoration or preparedness plan that tied into an ICS-structured response plan. City Light indicated to the panel that they were working on the ICS plan and had actually scheduled a drill when the storm hit. Based on that information, the panel had the following observations:

- Every plan should identify categories, levels, or degrees of events:
  - Increasing event levels will imply a greater extent of damage or risk and carry suitably escalated protocols
- The restoration plan for each event type is generally the same, although each event type (e.g., earthquake, pandemic, hurricane, windstorm, etc.) will carry its own special constraints.

Observations – Beyond Storm Restoration

Finally, the panel focused on the steps that City Light could take to continue planning for the future and meeting utility best practices. While the recommendations below focus on day-to-day operations, their implementation would positively affect restoration efforts through improved processes, methodologies, and infrastructure. More specifically:

- City Light would benefit from the installation of the following systems:
  - Enterprise Resource Planning;
  - Work Management; and
  - Crew Location Tracking.
- City Light would benefit from the adoption of an asset management methodology; and
- While City Light is interested in acquiring Automated Meter Infrastructure (AMI) technologies, they will only realize improvements, limited improvements at that, in the storm restoration process if AMI is implemented in conjunction with an OMS or other trouble call system.

DCI would like to thank each of the panel companies for agreeing to participate. And in particular we would like to thank the panel participants for taking time from their busy schedules to review the processes used by City Light to recover from the 2006 storm. The observations and

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recommendations they made have provided significant insight into the preparation of this report.

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7. Best Practices

If certain best practices had been implemented by City Light during the December 2006 storm, the overall restoration would likely have been smoother and customer satisfaction would have been higher. This section summarizes the best practices that would have assisted City Light's response. More specifically, the best practices addressed in this section include:

- Emergency planning through development of effective response and restoration plans;
- Event pre-planning through reliance on accurate forecasts to develop damage prediction modeling;
- Event response and restoration practices such as:
  - Effective damage assessment;
  - Vegetation management;
  - Communications processes; and
  - Post-event analysis, including implementing a lessons-learned mechanism.
- Technological innovations, such as use of OMS and other IT solutions.

7.1. Emergency Planning

7.1.1. Response Plan

Best practice utilities generally have a single all-hazards response plan that provides the utility with a consistent emergency response organization, capable of being activated for any event, regardless of size or type. This response plan forms an umbrella over all other plans (e.g., restoration, pandemic, business continuity, etc.) and establishes consistent terminology, updating procedures for plans, training standards, and, perhaps most importantly, the utility's emergency response organization. In best practice utilities, this response organization is developed out of the Incident Command System (ICS). A best practice response plan includes:

- Procedures for updating and disseminating the plan;
- Explanation of ICS, including roles and responsibilities of ICS staff;
- The utility's emergency response organization;
- Internal and external communications procedures, including coordination and communication protocols with other city departments and external

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agencies such as government(s), regulator(s), and other emergency service providers;

- Event classification methodology; and
- Training on an annual basis and certification requirements.

As a result of the focus on ICS, the next four pages provide a high-level overview of the system.

Incident Command System

ICS was first developed as a result of a series of devastating wildfires in California in 1970 that destroyed 700 structures, caused the deaths of 16 people, and cost an estimated $18 million dollars per day. During the fires, local and state fire services found themselves ill-prepared to manage a response to a large multi-jurisdictional incident, particularly with regard to coordinating fire departments, police, forest and land agencies, hospitals, rescue teams, and electric and other utilities. The varied response organizations, communications, and terminology used by the agencies caused deficient communications, coordination, and management. As a result of the property and life losses, Congress asked the U.S. Forest Service to develop a system that could standardize incident response. In collaboration with the Forest Service, California's Firefighting Resources of California Organized for Potential Emergencies task force (FIRESCOPE) developed ICS. Following the attacks on September 11, 2001, the U.S. Department of Homeland Security (DHS) issued guidelines for two systems: the National Incident Management System (NIMS), incorporating ICS, and the National Response Plan (NRP).

ICS is a standardized, on-scene, all-hazard incident management concept, which allows responders to adopt an integrated organizational structure to match the complexities and demands of single or multiple incidents without being hindered by jurisdictional boundaries. ICS is designed to:

- Meet the needs of incidents of any kind or size;
- Allow personnel from a variety of agencies to meld rapidly into a common management structure;
- Provide logistical and administrative support to operational staff; and
- Be cost-effective by avoiding duplication of efforts.

Through the use of span-of-control management (generally one supervisor to between three and seven reports) and a top-down organizational structure, ICS helps ensure full utilization of all incident resources, decreases confusion, and improves communication. ICS places emphasis on the development and

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use of Incident Action Plans (IAPs) to identify and communicate incident objectives to response personnel.

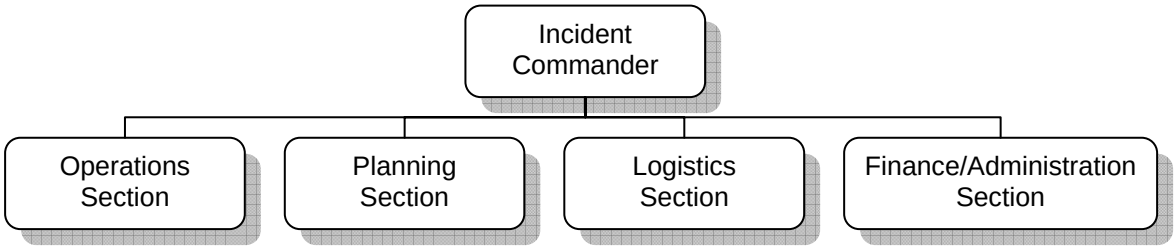
In 2003, President Bush drafted and released Homeland Security Presidential Directive 5, "Management of Domestic Incidents," which ordered DHS to develop a standardized approach to national incident management. Using best practices from fire/rescue services, law enforcement, government agencies, and the private sector, DHS developed NIMS (a standard national approach for response to and management of domestic emergencies that adopted ICS) and the NRP (designed to ensure coordination of activities and responding agencies). To ensure readiness, NIMS guides agencies to adopt a preparedness cycle that involves ongoing planning, training, equipping, exercising, evaluating, and correcting. NIMS also standardizes resource management at the Emergency Operations Center, the physical structure where representatives from the community and responding agencies can meet and discuss response plans. To achieve such standardization, the identification, acquisition, allocation, classification, certification, and tracking of resources must be consistent and done in advance.

In December 2004, DHS published the NRP, an operational plan in which on-scene incident management is coordinated with federal departments and agencies. The NRP also clarifies responses to incidents by outlining responsibilities for federal, state, local, and tribal agencies, elected and appointed officials, non-governmental and volunteer organizations, and the private sector, including utilities.

General Staff

ICS organization uses five functions as the foundation for emergency response management. These functions include:

Figure 14: The ICS General Staff



- Incident Command: Sets the incident objectives, strategies, and priorities and has overall responsibility at the incident or event.
- Operations: Conducts tactical operations to carry out the plan. Develops the tactical objectives and organization, and directs all tactical resources.

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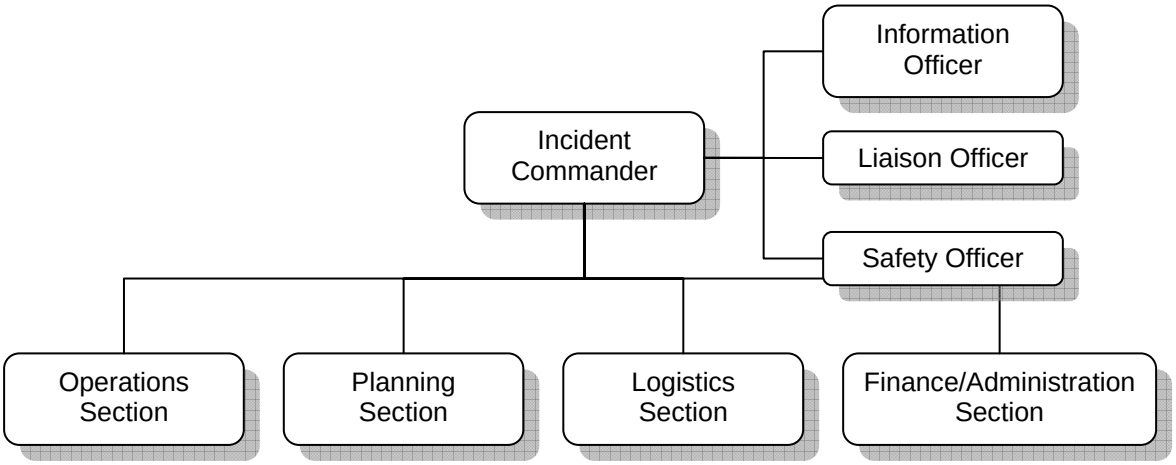
- Planning: Prepares and documents the IAP to accomplish the objectives, collects and evaluates information, maintains resource status, and maintains documentation for incident records.
- Logistics: Provides support, resources, and all other services needed to meet the operational objectives.
- Finance/Administration: Monitors costs related to the incident. Provides accounting, procurement, time recording, and cost analyses.

The number of sections established will actually depend on the complexity of the situation. For example, a wire down might only require a single crew. The crew boss would act as the Incident Command (IC), and, depending on the number of people on the crew, another member might be the Operations Section. On the other hand, a single person may manage all of the components as the IC. In all likelihood, a simple call for a wire down would not require the activation/formation of the Planning, Logistics, or Finance/Administration Sections. In the event that an event expands, the basic ICS structure incorporates a command staff of an information officer, safety officer, and liaison officer – in addition to the IC and the four sections. As an incident grows, ICS can be further expanded, as each section can be further divided into divisions (to denote a geographical division), groups (to denote a functional division), or branches (which can denote either geographical or functional divisions).

Command Staff

As an incident grows, the incident commander may delegate authority to perform or oversee certain tasks to a Command staff. The Command staff consists of an Information Officer, a Safety Officer, and a Liaison Officer.

Figure 15: The ICS Command Staff



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- Information: Responsible for developing and releasing information about the incident to the news media, to incident personnel, and to other appropriate agencies and organizations.
- Liaison: Responsible for coordinating with other agencies, jurisdictions, or companies. In general, an incident only has a single Liaison Officer with assistants, as required. In the case of a utility, the Liaison Officer will have responsibility for coordinating with local, state, and federal officials and other first responders, including other utilities (water, gas, etc.) and fire/police departments.
- Safety: Responsible for developing and recommending measures for assuring personnel safety, and to monitor and/or anticipate hazardous and unsafe situations.

Divisions, Branches, and Groups

A division is an organizational level with responsibility for operations within a specific defined geographical area. A branch is an organizational level with either functional or geographic responsibility for major parts of incident operations. For example, an IC may establish a geographic branch to resolve a span of control issue (where too many responders are reporting to a single supervisor) or a functional branch to manage a specific function, such as utility restoration. A group is an organizational function with responsibility for a specified functional assignment (such as evacuation). The ICS organization can be further divided into strike teams and task forces.

Unified and Area Command

A Unified Command allows multiple agencies with incident responsibilities to manage an incident using common objectives and strategies. This concept ensures that each agency contributes to the command process by:

- Determining objectives;
- Jointly planning for operational activities; and
- Maximizing the use of all resources.

Unified Command is useful for incidents affecting more than one political jurisdiction, multiple agencies (i.e., police, fire, and utilities) within a jurisdiction, or both multiple geographic areas and agencies within those areas. Unified Command is a structure created at the time of an incident to bring together the ICs from each major organization involved in the response operations. These organizations may include a lead local agency (i.e., police or fire), appropriate state agencies, and a federal agency.

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An Area Command, which does not have operational authority, is established where multiple incidents are occurring simultaneously in the same area and are of the same type (i.e., multiple oil spills). An Area Command is designed to reduce the stress on resources, as the incidents will require the same resources in a limited area. The Area Command will have responsibility for:

- Setting overall agency incident-related priorities;
- Allocating critical resources according to the established priorities;
- Ensuring that incidents are properly managed;
- Ensuring effective communications;
- Ensuring that incident management objectives are met and do not conflict with each other or with agency policies;
- Identifying critical resource needs and reporting them to the interagency coordination system (generally EOCs);
- Ensuring that short-term "emergency" recovery is coordinated to assist in the transition to full-recovery operations; and
- Providing for personnel accountability and a safe-operating environment.

When incidents under an Area Command actually span multiple jurisdictions, a Unified Command will be established with each jurisdiction represented in the Area Command. Area Commands are particularly appropriate for public health, biological, chemical, radiological, and nuclear emergencies – as each of these events requires a coordinated government and non-government response.

7.1.2. The Restoration Plan

A best practice restoration plan should be fully integrated with the response plan to mitigate, prepare for, respond to, and recover from emergencies. The restoration response must have the objective of protecting the health and safety of the public and workers while simultaneously minimizing the loss of property and services. A best practice restoration plan includes:

- Adoption of the emergency response organization included in the response plan;
- An operational response organization;
- Roles and responsibilities for each organization participant;
- Identification of and assignment of storm roles for all employees (second jobs);
- Risk assessment and event classification processes;

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- Operating strategies and procedures, including those for activation, communication, response, resource mobilization, and restoration; and
- Checklists for event response and second jobs.

Some best practice plans also include a disaster recovery plan that goes beyond the base plan and covers events that cause structural damage to the electricity system and surrounding infrastructure (streets, buildings, etc.), require significant rebuilding to parts of the system, and involve extended outages.

7.2. Event Preparation and Response

7.2.1. Weather Analysis

In order to effectively plan ahead for severe weather, utilities generally have robust mechanisms for tracking and analyzing weather data. Good meteorology processes require that a utility have either at least one full-time trained meteorologist or 24/7 access to a weather service. The weather service must have the capability to predict lightning, wind, rain, snow, and ice accumulation in specific geographical areas, and, perhaps most importantly, be accurate. Otherwise, operations crews will not trust the forecasts and might use their own weather instincts, which may be vastly different from another individual's instincts – leading to inconsistent pre-event planning and preparedness.

Best practice utilities have also developed (or use) damage prediction models to pre-plan for restoration events. These models translate weather forecasts into outage predictions. From the outage predictions, a utility can then forecast the broad types of events that are likely to occur (such as lines down and fuses blown). Finally, using a combination of the weather forecasts, the outage predictions, and the type projections, the utility can estimate the number of restoration resources that will be required for the event.

7.2.2. Damage Assessment

While lights-out calls from customers are good indicators that damage exists and also provide utilities with a feedback mechanism to tell whether trouble remains on the system, a complete and thorough damage assessment gives a utility the best chance of properly planning and executing the restoration. The planning function, by extension, allows the utility to provide accurate and specific ETRs as the effort progresses. Damage assessment is performed by qualified and trained individuals acting in their storm role, or second job, ensuring line resources remain available to perform restoration work. As with weather predictions, damage assessors must develop credibility or resources in the field will be reluctant to rely on the information provided.

The best practices for damage assessment include:

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- Using second job resources to perform the damage assessment;
- Making damage assessors intimately familiar with the feeders for which they have responsibility before any event occurs;
- Training and testing damage assessors;
- Performing full assessments, circuit by circuit, noting damage and trouble locations and details on the Primary voltage feeders, Secondary lines, and Services connections;
- Providing standard forms with which to capture damage information;
- Estimating the major materials required for the restoration work; and
- Reporting damage assessments to the Trouble Center staff, who prioritize the work and generate time estimates.

An adjunct to the damage assessment process is the automated call-back process, in which the utility calls customers with open trouble tickets at the time they believe they have restored power to the customer. If pockets of customers remain without power, and all reported damage has been addressed, the assessors may be redeployed to investigate and submit supplemental damage reports to the Trouble Center.

7.2.3. Mutual Aid

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. The next step in mutual assistance best practices is to coordinate with regional utilities through participation in regional mutual assistance groups, if available, and to attend mutual assistance conferences. Finally, many utilities perform post-event evaluations with their mutual assistance partners to analyze the restoration effort and determine what went right and wrong. Lessons learned from these reviews can then be addressed through plan updates and revisions.

7.2.4. Communications

Communications under emergency circumstances are governed by the management structure provided under ICS and a robust plan addressing both internal and external communications. Best practice plans:

- Establish information flow processes;

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- Identify specific lines of communication;
- Establish the timing and procedures for communications;
- Provide specific processes for information release; and
- Establish, under the ICS structure, a Command Staff Communications Officer.

In order to provide stakeholders with a clear, consistent message, a utility must communicate through the media with a single voice. Every additional person placed in front of the media risks delivering a contradictory message, causing confusion that could distract from the restoration effort. One individual – or possibly two – should be responsible for all communications.

Before the storm strikes the service territory, an effective communications plan requires that the media and emergency management agencies be educated regarding:

- How much damage is predicted;
- How the restoration process will work;
- Whether the utility expects to bring in mutual aid resources; and
- How many resources will be working on the restoration?

These educational efforts can be accomplished through:

- Pre-event development of a full-page advertisement (bilingual in communities with large immigrant or non-native English speakers) that advises customers on how to respond to predicted power outages;
- Press releases and statements regarding the predicted event and potential impact on the utility and its customers; and
- Prior to events, including media representatives in drills and educational sessions.

During the restoration, it is critical to provide consistent communications and information releases that will be viewed in as positive a light as possible in the event of a post-storm audit. Best practices for information dissemination include:

- Providing media outlets with photos, footage, and educational materials;
- Using the Internet to update customers on outages, ETRs, and restoration progress; and
- Embedding media representatives in the restoration process if it is safe and will place the utility in a positive light.

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Like customers, external stakeholders in the community and affected governments expect to be kept apprised of the restoration effort. Best practice utilities generally incorporate a specific role into the emergency response organization, with responsibility for liaising with community and/or government officials. In larger scale events, liaising with local, state, and federal officials would require a complete separation of roles from the community relations. More specifically, in large-scale events (or during any event necessitating activation of the local and/or state Emergency Operations Center), a utility response and/or restoration plan must establish a role with responsibility for representing the utility at the EOC. This representative is the communications conduit between the EOC and the utility, ensuring that the utility responds to EOC requests and that the EOC understands and is responsive to utility needs.

7.2.5. Logistics

Logistical support is a key element of the storm restoration effort and the current best practice is to have the logistics plan incorporated into the response and restoration plans and base the organizational structure of the logistics function on ICS. These plans pre-identify logistical requirements and provide mechanisms to use existing contacts at applicable vendors and hotels (sometimes through executed contracts). By having logistical plans in place prior to the event, operations and restoration staff are relieved of logistical duties, such as the following: acquisition of material; establishment of staging areas where vehicles are repaired overnight; obtaining tanker trucks to refuel vehicles in the field; organizing the transportation, housing, and feeding of resources, including mutual assistance crews; working extended shifts; and operating mobile storerooms that bring replacement parts and reconstruction materials to devastated areas.

7.2.6. Vegetation Management

Vegetation management best practices include development of a vegetation plan that maintains or improves customer reliability and customer service related to vegetation outages while, simultaneously optimizing vegetation-trim cycles to reduce overall costs. In addition to developing a plan, best-in-class utilities generally have an internal vegetation management group responsible for the vegetation management program and maintaining rights of way and easements for the transmission and distribution systems. This work includes maintenance trimming on all transmission and distribution primary and secondary overhead circuits as well as internal and external vegetation request. In most cases, contractors working for fixed-price or project-specific fees perform the majority of the vegetation work on the system. Many utilities calculate a vegetation system average interruption frequency index (VSAIFI) as a key element in their circuit trimming selection process. This index helps ensure that the right circuits are being trimmed at the right time.

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Best-in-class utilities also use educational outreach to improve customer understanding of vegetation management programs, including tree-trimming practices and schedules. Generally, these educational programs also include recommendations for reducing the likelihood of outages caused by trees outside of the rights-of-way easements.

7.2.7. Call Center

During restoration events, utilities experience a large change in the volume of calls received by the Call Center. Scalable technology is essential to address these changes in volume, which during large events can be in the neighborhood of between 100 to 1,000 times the normal call volume. A system designed solely to respond effectively during normal operations will necessarily perform inadequately during events with such incredibly increased call volumes. Best practice utilities provide mechanisms to address the volumes by accomplishing the following:

- Developing a Call Center plan for restoration events or other emergencies;
- Changing outage analysis algorithms;
- Using Call Center overload vendors and systems (i.e., 21st Century);
- Effectively using an Interactive Voice Response (IVR) System;
- Using a Dialed Number Identification Service (DNIS);
- Tracking the reasons for a call by individual caller, which enables management to review caller histories and identify service problems and potential service options; and
- Developing storm- or event-specific scripts for call takers.

Integrated Voice Response Technology

Best in practice utilities use an IVR to segment calls into different queues. These utilities then set different service levels based upon the type of call. For example, a “wire down” call would receive a higher priority than a “partial outage” call. In order to manage the different types of calls, utilities have structured their training programs to mirror the call queue structure. Best in class IVR systems provide estimated wait times and offer the option of automated service to accomplish transactions and eliminate the wait for an agent. Many utilities have also contracted with outside firms to provide a answering service or automated attendants to handle a high volume of calls.

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7.3. Post-event

When the last customer is restored and the mutual assistance crews are on their way home, a utility needs to take stock and maximize the learning opportunity afforded by the intensive restoration effort.

7.3.1. Customer Satisfaction

It is a best practice to ask customers for feedback on the restoration. Utilities need to understand the public perception, which may contrast from their own. Satisfaction surveys may reveal that small changes to the approach will yield large gains in public perception.

7.3.2. Lessons Learned

Utilities also turn inward to evaluate what went well and what went poorly. Lessons learned sessions are conducted at many levels and disseminated through to senior management and the emergency planners so that key changes can be written into new policy and response plans.

7.4. Systems

7.4.1. Information Technology Systems

Utilities use a number of information technology (IT) systems to support their restoration efforts. The following are best practices:

- Telephony
  - The IVR is coordinated with the Customer Information System (CIS) so it can easily associate a caller with a billing account and generate a trouble ticket without intervention of a Call Center agent;
  - Call Center workstations have access to OMS and CIS information so the Call Center agent knows whom they are speaking with and can inform the customer on the current status of the outage;
  - The utility possesses automated call-out technology that can deliver recorded messages to customers;
  - Sufficient phone lines and system capacity are available to answer all calls, or the utility uses a third-party Call Center to handle any overflow, so no customer gets a busy signal.
- Supervisory Control and Data Acquisition (SCADA)
  - While it is not advisable to perform remote switching during a major restoration, SCADA switches and breakers provide valuable information back to the Control Center, which can see the current status (open/closed) of all SCADA switches, without deploying a resource to check the switch and report back.

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- Outage Management System
  - Owning and operating an OMS is fundamental to most utilities' restoration efforts;
  - The OMS automatically accepts trouble tickets from the Call Center;
  - The device prediction component of OMS is disabled for major events, as the algorithms are valid only for regular operations;
  - OMS allows multiple dispatchers to stay abreast of each other's work and see what activities are underway in areas adjacent to their territory;
  - Various internal stakeholders, including Incident Command, communications, Call Center, and key customer representatives access reports out of OMS to stay abreast of the restoration; and
  - OMS has the ability to initiate automated customer callbacks, in conjunction with the utility's telephony.
- Mobile Data Technology
  - Damage assessors can utilize handheld units with updated feeder maps, GPS capabilities to pinpoint damage locations, and forms for capturing the damage reports. With these devices, reports can flow up to the Trouble Center without interrupting the damage assessors' activities; and
  - Mobile data units in line trucks can deliver maps to the trouble locations along with the damage assessment data.
- Damage Prediction and Resource Models
  - Some utilities have sufficient data from past storm experiences to create a model predicting instances of trouble based on the anticipated severity of the storm; and
  - Predicted damage levels are used to generate overall labor estimates that can be combined with restoration goals to determine the resource levels and mutual assistance requirements ahead of the storm's arrival.

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8. Gap Analysis

A gap analysis is a resource assessment tool that enables a utility to compare its actual performance with its potential performance. If a utility is underutilizing resources it currently has or is foregoing investment in capital or technology, it may be performing at a level below its potential. The objective of the analysis is to identify the gaps between best practices and the current level of performance. This provides the utility with insight into areas with room for improvement.

Overall, and based on the benchmark comparison explained in greater detail in Section 3, City Light's restoration performance was in-line with utilities suffering comparable system damage. In the areas of media relations, customer satisfaction, length of restoration, and customer communication, City Light was generally within benchmark range with other utilities. Based on the analysis of the City Light restoration performance and the best practices discussed in Section 7, DCI has identified the following gaps in City Light processes and systems.

8.1. Emergency Planning

Restoration and Response Plans

- The response plan (Red Book) did not contain a complete response and restoration plan, which resulted in a fragmented restoration with little coordination across the utility.

8.2. Event Preparation and Response

Damage assessment and prioritization process

- Pre-established damage assessment process or training did not exist, leading to problems with chain-of-command and resource coordination; and
- Damage assessment was not completed thoroughly and in a timely manor. A thorough plan was not in place to identify the ownership of distribution circuits or substations.

Mutual Assistance and Support Agreements

- Mutual assistance agreements had expired, which resulted in a delay in getting off-system line crews to support the restoration effort; and

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- Contracts with hotels and caterers were not firm enough to guarantee rooms and service, which resulted in a shortage of hotel rooms for crews at the beginning of the restoration.

Logistics

- Procurement of small material items and meals during the first three days of the restoration required senior-level management approval. A lack of credit cards for the field crews and the high-level approval requirement caused a delay in purchases of some minor material items and meals for crews; and
- North and South Service Centers lost power but did not have emergency generators in place to supply backup power

Availability and utilization of field resource

- City Light had 50 journeymen positions open at the time of the storm. These open positions plus the inability to secure mutual assistance crews reduced the ability to restore service early in the event.
- Crew assignments were not optimized and maximum use of journeymen, apprentices, and underground personnel in all cases was not made.

Communications

- City Light's radio system was congested during the restoration. For field crews, the preferred mode of communication was cell phone. The use of cell phones to perform switching and clearance operations, however, creates a safety hazard. When cell phones are used to communicate switching instructions, crews which are not a part of the conversation and may be working on the same feeder as the crew communicating with the Control Central. Therefore, crews may not be able to hear the conversation and are not aware that conditions on the feeder might be about to change, which could result in an injury. Utilizing the radio system would allow all the crews to listen to the conversation and react accordingly.
- Callbacks are not part of City Light's standard storm procedure. Unsuccessful attempts were made to establish a manual callback process. A fully automated IVR integrated with an OMS would provide an automated 100% callback capability.

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- Inconsistent messages were delivered to customers and employees due to the lack of a coordinated internal communication process.

Vegetation Management

- A formal vegetation management program or plan does not exist. Vegetation crews were not coordinated well with the line crews as part of the restoration effort.

Coordination with other City Agencies

- The city EOC closed shortly after the storm passed leaving City Light to perform functions unrelated to restoration; and
- City Light does not have a private communication capability for other city first responders.

Customer Satisfaction

- City Light does not have a process to deliver ETRs to customers. The lack of ETR information was the largest complaint from customers participating in focus groups following the storm.

8.3. Post-event

Labor and Management Issues

- A relatively new management team who had never worked with operations on a major event, new processes, and guidelines have created a level of distrust. This situation caused some difficulties early in the restoration process.

8.4. Systems

Infrastructure

- City Light has fallen behind top-performing utilities in the technology area. The utility has an acceptable Customer Information System (CIS) but its GIS and IVR systems are inadequate.
- City Light does not have an Outage Management System (OMS), which has become a standard requirement for utilities.
- Without technology, City Light is forced to use a paper trouble ticket system that completely overwhelmed the System Control Center.

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9. Recommendations

The recommendations for performance improvement include the process, technologies, facilities, and applications required to bring the City Light storm response to a level at or near best practice as outlined in Section 7 and bridge the gaps identified in Section 8.

9.1. Recommendation Methodology

9.1.1. Identification of Recommendations

DCI drew upon three main sources to compile the master list of recommendations:

- Findings from the restoration review;
- Gaps from the best practice analysis; and
- Expert panel review recommendations.

9.1.2. Classification of Recommendations—Process, Technology and Facilities

Two major classes of recommendations emerged: 1) those entailing processes, policies, and training, and 2) those requiring investments in infrastructure. The process recommendations were further subdivided by theme area, while the infrastructure recommendations were subdivided by their implementation time.

- Process
  - Emergency Planning
  - Damage Assessment
  - Mutual Assistance
  - Logistics
  - Vegetation Management
  - Communications
  - Coordination with City
- Technology and Facilities
  - Short-Term
    - Systems whose implementation time can be measured in months.
  - Long-Term
    - Systems whose implementation will take at least one year.

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9.1.3. Prioritization Methodology

DCI took a pragmatic approach to prioritization, in alignment with City Light's goal to be ready for the next storm season. Recommendations were prioritized into three tiers.

- For all process recommendations and short-term technology and facilities recommendations, the tiers were defined as such:
  - Tier 1: Restoration goals cannot be achieved without these items, which should be fully implemented by October 31, 2007.
  - Tier 2: Restoration would be significantly enhanced by these items, which should have a target completion between October 31, 2007, and February 29, 2008.
  - Tier 3: Execute as time and resources permit.
- For the long-term technology and facilities, recognizing that no item could be complete in time for the upcoming storm season, the tiers are altered:
  - Tier 1: Initiate by July 1, 2007.
  - Tier 2: Initiate by July 1, 2008.
  - Tier 3: Execute as time and resources permit.

9.2. Process Recommendations

The main process recommendations, which revolve around emergency planning, damage assessment, mutual assistance, logistics, vegetation management, communications, and coordination with government entities, include:

- Completing the ICS/NIMS compliant response plan and developing a corresponding restoration plan, including establishment of second jobs;
- Providing ETRs of increasing specificity as the restoration progresses;
- Instituting a "substation" or "feeder owner" process for damage assessment;
- Maximizing the mutual benefits of coordinating with City departments;
- Positioning City Light to have better access to mutual assistance resources, contract resources, and logistical support;
- Provide training to all staff and operations personnel;
- Enhancing the entire communications process; and
- Designing and implementing restoration processes that will free line crews to perform restoration activities.

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9.2.1. Emergency Planning

In order to meet best practices, City Light must develop both an all-hazards response plan and a restoration plan. Following development of these critical plans, City Light should begin developing plans including, but not limited to, business continuity and pandemic flu. The following sections on the Response Plan and Restoration Plan address additional and more specific recommendations in greater detail.

Response Plan

Table 3: Recommendations—Emergency Response Plan

Item	Emergency Response Plan (EP)	Duration
EP-1.1	Complete the ICS/NIMS-compliant emergency plan. Fill all positions, train and practice the plan	3-5 months
EP-1.2	On an interim basis locate the Incident Commander, ICS staff, and Trouble Tower at the System Control Center until the permanent Trouble Center facility is complete	NA
EP-1.3	Develop process for assigning City Light personnel to 'Second Jobs' and provide Second Job training	2-3 months
EP-1.4	Incorporate employee contact information for all roles within the plan. Plan should consider travel time from home location when making second job assignments	1-2 months
EP-1.5	Incorporate activation instructions for EOC, DOC, mutual assistance, Call Center, etc. in the plan	NA
EP-1.6	Structure plan to scale with magnitude of event damage	NA
EP-1.7	Perform at least one drill of the emergency response plan per year	1-2 months

EP-1.1 Complete the ICS/NIMS-compliant emergency response plan. Fill all positions, train and practice the plan

- City Light has started this process through the COOP. The utility has an ICS structure that defines the Incident Commander and support staff. City Light staff has been assigned these positions as second jobs, and one tabletop exercise was conducted by an outside consultant. The importance of emergency drills must be emphasized to staff, however, as only about half of the staff that were required to attend did so.

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- The response plan needs to contain a deeper organization to ensure that all critical roles and tasks are included in the organization chart and staff assignments are made and exercised before the next storm season.

EP-1.2 Locate the Incident Commander, ICS staff, and Trouble Center at the System Control Center until the permanent Trouble Center facility is complete

- City Light is in the process of requesting funding to construct a Department Operations Center (DOC) and Trouble Center in a facility it owns. Until that facility is funded, designed, and constructed, a room in the Municipal Center building has been designated as the DOC and Trouble Center. The Incident Commander, or storm boss, should be located where they can have an overview of what is going on and be in a position to make timely decisions based on that information. Damage assessment is a critical part of the restoration prioritization effort and it needs to be located at the hub of the restoration effort. To maximize the effectiveness of the Incident Commander and staff, the utility should locate the Incident Command Post at the System Control Center (SCC) until the new facility is completed. If desired, the remaining elements of the DOC organization could be located at the Municipal Center building if space at the SCC is an issue, but that decision would be suboptimal.

EP-1.3 Develop process for assigning City Light personnel to "second jobs" and provide second job training

- In order to maximize the restoration effort and fully utilize all staff during a storm event, everyone in the utility should have a second job assignment. If the event primarily affects overhead equipment, underground crews can restore service drops or do other make-ready functions to assist overhead crews. City Light should develop a second job requirement matrix, identify staff qualified to perform each function on the matrix, assign staff to those functions, and train the staff. Second job assignments maximize the full capability of staff and often allow line crews to do more restoration work.

EP-1.4 Incorporate employee contact information for all roles within the plan. Plan should consider travel time from home locations when making second job assignments

- All staff assigned to the Incident Command System must be identified in the plan, along with all contact information to allow speedy contact during an emergency. Known barriers, such as extended travel time, should be

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considered in job assignments. Emergency restoration requires quick response for many of the functions to be effective, and long travel times to the DOC or Trouble Center may hamper start-up operations.

EP-1.5 Incorporate activation instructions for EOC, DOC, mutual assistance, Call Center, etc., in the plan

- Storm-related events are uncommon. With infrequent events, it is difficult for staff to remember every detail of the restoration process. To compensate, a detailed set of instructions, data record forms, and instructions must be developed. This detailed information should be designed for each position in the Incident Command Organization and each person assigned to a position must be familiar with the start-up and documentation requirements for the task. These processes and procedures are exercised as part of an annual drill.

EP-1.6 Structure plan to scale with magnitude of event damage

- Plan development should be scalable to meet the size and type of the event; and
- Scalability means the plan should be used for every outage event but adjusted to the level of need.

EP-1.7 Perform at least one drill of the emergency plan per year

- One drill per year is a minimum requirement to refresh staff on their roles and responsibilities. If possible, additional drills should be planned throughout the year. If only one drill is possible, it should be conducted just before the start of the storm season

Restoration Plan

Table 4: Recommendations—Restoration Plan

Item	Restoration Plan (RP)	Duration
RP-1.1	Develop a comprehensive response and restoration plan that includes best practices outlined in the report	4-6 Months
RP-1.2	After identification of damage level and initial push, institute a 16/8 work hour policy. The objective is to make maximum use of daylight hours after the initial push for events that require longer restoration	NA
RP-1.3	Develop an estimated times of restoration process suited to the available technology. The ETOR	2-3

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Item	Restoration Plan (RP)	Duration
	process should be modified as technology changes	Months
RP-1.4	Assign responsibility for interpreting trouble tickets, damage assessment, prioritizing work and providing estimated times of restoration to the Trouble Center	NA
RP-1.5	Set goals for delivering estimated times of restoration for the System (24-36 hours), Substation / Neighborhood (3-4 days), Individual customers (5-6 days). Hours/days to deliver ETOR information should be scaled for event	2-3 months
RP-1.6	Include documentation of procedures in the restoration plan	2-3 months
RP-1.7	Perform at least one drill of the restoration plan per year	1 Month

RP-1.1: Develop a comprehensive response and restoration plan that includes the best practices outlined here

- City Light would like to establish and train staff on its plan in advance of the 2007 storm season, which begins in November;
- Given the current state of the plan and the importance of achieving buy-in on the plan, this will be a significant challenge for City Light;
- Ensure that roles and responsibilities are clearly defined with respect to all the plan stakeholders and participants;
- Consider the development of a disaster recovery plan that covers events beyond “normal” emergencies;
- A well-crafted emergency plan will identify thresholds of damage, each of which will imply the activation of particular emergency management activities—i.e., contacting mutual aid, appointing an incident commander at a particular level, etc.; and
- The plan is a living document and subject to frequent change. City Light should understand the significant risk in producing and widely distributing a large document requiring frequent updates. As soon as a printed document is released into the utility, it is at risk of falling out-of-date but still being relied upon. To mitigate the risk, the utility should make the document available in modular electronic form, perhaps as a Web site, which distributes and updates targeted documents that pertain to specific audience’s roles and responsibilities.

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RP-1.2: Institute a 16/8-work hour policy

- There is a strong desire on the part of field resources and management to bring customers back into service as soon as possible during a major outage. While this is a laudable goal, factors of safety and productivity must be taken into account, and firm guidelines should be imposed that set the number of consecutive hours crews can work and the amount of rest they get;
- After identification of damage level and initial push, institute a 16/8 hour work policy. In other words, field resources can work up to 16 hours in each 24-hour period, with a minimum of eight hours rest. The 16/8 shifts should be timed so every crew makes the maximum possible use of available daylight hours;
- Once into the 16/8 rotation, not all crews need to start and stop at the same time. By staggering schedules, City Light can reduce congestion at the service centers as Crew Chiefs collect their starting assignments from the supervisors. As long as all crews are making the maximum use of daylight hours, staggering starts is to their advantage; and
- The overnight stop gives some of the back-end processes the chance to catch up with the day's progress. Staggering crews reduces the number of hours in which this can occur.

RP-1.3: Develop an ETR process suited to the available technology

- City Light should implement a revised ETR process to:
  - Provide ETR information to customers over the duration of outage restoration.
- City Light should enhance the feedback process between the Control Center, the Trouble Center, the Service Centers and the Call Center to ensure that if an ETR is missed, the customer receives an explanation for the reasons that the ETR was incorrect.

RP-1.4: Assign responsibility for interpreting trouble tickets, damage assessment, prioritizing work, and providing ETRs to the Trouble Center

- These activities should be moved close to the Incident Commander so that he/she can be apprised of the current situation. Some of the knowledge-base for these activities currently resides with Control Center personnel; and

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- It may be necessary to move a small number of these individuals to the Trouble Center during a major restoration.

RP-1.5: Set goals for delivering ETRs for the System

- Build a progressive set of goals and processes around establishing and refining ETRs into the current restoration plan. Enable City Light employees to take pride not only in keeping customers informed during a restoration, but also in restoring customers quickly; and
- Goals should start at the system level and work their way down to the individual customer level. For example:
  - First 36 hours post the event – system-wide ETR, providing an estimate as to when every customer will be restored;
  - 37–60 hours post-event – ETRs for Communities or geographic areas
  - 61–96 hours post-event – ETRs for Feeders;
  - 96 plus – ETRs for Customers; and
  - In situations where a circuit or customer-specific ETR becomes available earlier, the updated ETR information will be provided to the customer.
- The absence of some IT systems at City Light may be perceived as a barrier to implementing a comprehensive ETR policy. While this shortfall increases the challenge of processing incoming trouble tickets, it is, for the most part, tangential to the task of producing ETRs. ETRs are the product of a timely and thorough damage assessment, coupled with reasonable time estimates to address trouble tickets under the heightened circumstances of a major restoration. City Light's ability to do this can be established right away, with the addition of supporting IT systems.

RP-1.6: Create documentation of procedures to include in plan

- While the ICS-based emergency plan clearly lays out the paths of command and communication, it does not establish the norms and procedures for actually restoring power. Operational procedures for executing damage assessment, restoring power, generating ETRs and the like must be agreed to and documented; and
- In order to succeed, these procedures must have some grassroots acceptance and support.

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RP-1.7: Perform at least one drill of the restoration plan per year

- Ensure the plan is exercised at least once annually;
- While ICS and NIMS are national standards for emergency management, they are not immediately understood by those brought up in corporate environments, and therefore must be practiced to ensure their successful implementation during an emergency; and
- Attendance to such sessions must improve from current levels.

9.2.2. Damage Assessment

To meet best practices, City Light should develop a damage assessment process and create a plan that accomplishes the following: explicitly divides the role of damage assessor from that of line crew; establishes a damage assessment management process; provides the policies and procedures for assessing damage following a storm; guarantees that, through the damage assessment process, ETRs are communicated to customers; and, generally, provides structure for the damage assessment process. This damage assessment plan should ultimately provide City Light staff, particularly frontline resources, with clarity and direction. It should also be fully integrated with the restoration plan. Additional and more detailed recommendations appear below.

Table 5: Recommendations—Damage Assessment

Item	Damage Assessment (DA)	Duration
DA-1.1	Institute Feeder Owner process for damage assessment	2-3 Months
DA-1.2	Develop damage assessment workforce using second job resources	2-3 Months
DA-1.3	Provide comprehensive training and testing for damage assessment resources	1 Month
DA-1.4	Create standard damage assessment forms to be used by damage assessors to communicate location and extent of damage to the trouble center	1 Month
DA-1.5	Perform damage assessment on a feeder by feeder basis	NA
DA-1.6	Channel all damage assessment data through the Trouble Center	2-3 Months

DA-1.1 Institute feeder owner process for damage assessment

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- Designate a single individual for each overhead circuit in the system. This person is responsible for leading the damage assessment on that circuit during a major event; and
- Develop a strategy for the circuit owners who have more than one circuit but cannot perform a damage assessment on all of them in an emergency. It is acceptable for a given circuit owner to own more than one circuit, although a balance must be struck. If somebody owns five circuits, it may take an unacceptable amount of time for the damage assessment to be performed. Is a substitute "second job" individual put on the task, or should line personnel be deployed to the circuit to perform the evaluation before launching into restoration work?

DA-1.2 Develop damage assessment workforce using second job resources

- There are sufficient qualified resources working desk jobs at City Light to form a storm damage assessment team, which will allow the line resources to focus on line repair thereby accelerating the restoration instead of losing time assessing damage.

DA-1.3 Perform damage assessment on a feeder-by-feeder basis

- Damage assessment should be done on entire feeders. City Light must resist the temptation to jump from feeder to feeder on damage assessment as it will be difficult, if not impossible, to come up with overall assessments and expected restoration times if they come in piecemeal.

DA-1.4 Create standard damage assessment forms to be used by damage assessors to communicate location and extent of damage to the Trouble Center

- Create standard damage assessment forms in conjunction with damage assessment training; and
- City Light must develop a strategy to ensure the forms are readily available when the damage assessors need them.

DA-1.5 Provide comprehensive training and testing for damage assessment resources

- Create and deliver a training program for all damage assessors – primary and second job alike; and

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- City Light has a great number of personnel who could perform damage assessment as a second job, but their contribution will be of limited value if their work is not trusted by those who must depend on it. Those who perform damage assessment on a day-to-day basis, and who depend on accurate information should be involved in the design and delivery of the training, so they can develop confidence in those who will step up during a storm.

DA-1.6 Channel all damage assessment data through the Trouble Center

- In the December storm, damage assessors were reporting to the Trouble Center, and then line resources were performing a separate and parallel damage assessment for the Control Center. All damage assessment should run through the Trouble Center, so the Control Center can focus on dispatching the work and providing clearances.

9.2.3. Mutual Assistance

As noted in Section 7.2.3, mutual assistance best practices require that a utility have a plan that provides the policies and procedures for requesting mutual assistance and establishes a specific role for managing resources once available. In addition, best practices require that utilities become actively involved in their regional mutual assistance groups and develop relationships that can be called upon during large events. To meet these best practices, City Light must:

- Integrate a mutual assistance plan into the utility's restoration plan;
- Use an event classification system, as established in the response and restoration plans, in combination with weather forecasting, to predict resource requirements. These can be used to plan for mutual assistance prior to, or in the early stages of, an event.
- Develop a formal mutual assistance management and response process, including through creation of mutual assistance teams;
- Initiate discussions with potential mutual assistance partners;
- Actively participate in regional and other mutual assistance groups and conferences; and
- Develop the capacity to use personnel other then experienced linemen as bird dogs for mutual assistance crews.

Details on each of these recommendations are included in this section.

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Table 6: Recommendations - Mutual Assistance

Item	Mutual Assistance (MA)	Duration
MA-1.1	Integrate a mutual assistance position into the City Light ICS organization. Position should be on the Incident Commander staff	1 month
MA-1.2	Form additional bilateral mutual assistance agreements with local and long-distance partner utilities	3-4 months
MA-1.3	Consider pre-positioning mutual assistance, vegetation management, and contractor resources prior to storm based on anticipated damage	NA
MA-1.4	Actively participate in regional mutual assistance associations	NA
MA-2.1	Use contractors on a routine basis and secure commitments for emergency assistance	NA
MA-2.2	Develop working relationships with mutual assistance partners	ongoing
MA-2.3	Identify and train 'Second Job' mutual assistance scouts on duties, the service area, and radio protocols	4-6 Months
MA-3.1	Execute the Edison Electric Institute's mutual assistance Short Form Agreement	NA
MA-3.2	Develop process for capturing mutual assistance costs	1-2 Months

MA-1.1 Integrate a mutual assistance position into the City Light Incident Command System

- There should be an individual within City Light maintaining the relationships with members of mutual assistance companies, line contractors, and vegetation management resources year-round. Leading up to and during major events, this individual is responsible for securing resources and keeping track of who is onsite.

MA-1.2 Form additional bilateral mutual assistance agreements with local and long-distance partner utilities

- In addition to being a member of various organizations, develop relationships and agreements with partners, both local and long-distance, as another contingency for securing assistance for a major restoration.

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MA-1.3 Consider pre-positioning mutual assistance, vegetation management, and contractor resources prior to storm based on anticipated damage

- Given the tendency for storms to impinge on transportation infrastructure, it may make sense given particular forecasts to preposition resources throughout the service territory to ensure that key infrastructure elements can be scouted and/or restored early on; and
- The need to pre-position crews at City Light may be mitigated by the relatively small size of its service territory. Pre-positioning crews is acceptable if safe-holding sites are located before deploying.

MA-1.4 Actively participate in regional mutual assistance associations

- In addition to entering the agreements, City Light should develop a clear and realistic understanding of their entitlements; and
- These agreements must be kept up-to-date.

MA-2.1 Use contractors on a routine basis and secure commitments for emergency assistance

- Engage a limited number of contractors to perform line work in the day-to-day operations. This will reduce the unfair demand for excessive overtime on City Light line personnel and increase its ability to secure contractors during major restorations; and
- City Light culture is highly resistant to the use of contract labor.

MA-2.2 Develop working relationships with mutual assistance partners

- When the event arrives, the mutual assistance arena can be a competitive environment. Be sure to have relationships with partners ahead of time to help with securing resources.

MA-2.3 Identify and train "second job" mutual assistance scouts on duties, the service area, and radio protocols

- Mutual assistance crews require a liaison to the Control Center. Ensure there are resources trained and available to travel with these crews and act as their go-between.

MA-3.1 Execute the Edison Electric Institute's mutual assistance Short-Form Agreement

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- The Edison Electric Institute (EEI) has developed a successful program that has organized each of the regional mutual aid groups into a single body that is addressing many of the roadblocks to securing and moving crews from one state to another. EEI is also working with state highway agencies and departments within the federal government to make mutual aid between jurisdictions less complex. Through EEI, it is also easier to contact utilities outside of the regional group to secure mutual aid agreements with utilities that are distant.

MA-3.2 Develop process for capturing mutual assistance costs

- In the heightened activity surrounding a major restoration, it is easy to lose track of who is onsite, where they are working, where they are sleeping, their hours, their contact information, and many other details. It is helpful to have a system in place that can track all of this information, so that there are no unpleasant surprises when the invoice arrives.

9.2.4. Logistics

Like many of the other best practices highlighted in Section 7, logistics best practices revolve around the development of a logistics plan that clearly establishes policies and procedures for pre-planning of logistical needs and implementing a logistics function during an event. To meet these best practices, City Light should:

- Establish logistical support processes, procedures, and relationships, including agreements with hotels, motels, other lodging facilities (tents), and catering services;
- Establish joint emergency operations procedures and Service Level Agreements (SLAs) with the fleet services group within the City of Seattle Executive Services Department;
- Increase the level of direct engagement of materials management personnel in providing restoration materials;
- Review inventory management practices; and
- Install dedicated standby generators at both service centers.

These and other recommendations are explained in greater detail below.

Table 7: Recommendation—Logistics

Item	Logistics (LG)	Duration
LG-1.1	Establish contracts containing service level agreements with providers of logistical support (e.g.,	1-2 Months

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	lodging, meals, etc.)	
LG-2.1	Streamline process to allow first line supervisors to purchase miscellaneous materials and meals without Director level approval	1-2 months
LG-2.2	Take advantage of overnight crew rest periods to restock make minor repairs & refuel trucks	ongoing
LG-2.3	As required, identify and train non-line resources to perform overnight stocking of trucks and job site material delivery, allowing line resources to focus on the restoration	3-5 Months

LG-1.1 Establish contracts containing firm service level agreements with providers of logistical support (e.g., lodging, meals, etc.)

- Ensure contracts with these providers have sufficient commitments to guarantee access to the necessary services despite competing interests.

LG-2.1 Streamline process to allow first line supervisors to purchase miscellaneous materials and meals without director-level approval

- Ensure simple matters like buying meals are not tied up in red tape, so productivity does not suffer.

LG-2.2 Take advantage of overnight crew rest periods to restock, make minor repairs, and refuel trucks

- Make sure the trucks are ready to roll when the crews arrive, in an effort to support their productivity.

LG-2.3 As required, identify and train non-line resources to perform overnight stocking of trucks and job site material delivery, allowing line resources to focus on the restoration

- To increase line crew productivity, City Light should make sure crews do not lose time restocking their own trucks in the morning or returning from the job site for materials.

9.2.5. Vegetation Management

Best practices highlighted in Section 7 revolve around developing a vegetation management plan that maintains or improves customer reliability and customer service related to vegetation outages while simultaneously optimizing vegetation trim cycles to reduce overall costs. City Light needs a

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formal vegetation management program and plan. In addition, it should provide a mechanism for tracking and investigating tree-caused outages after an event.

Table 8: Recommendations—Vegetation Management

Item	Vegetation Management (VM)	Duration
VM-1.1	Form agreements containing service level commitments for storm assistance with vegetation management vendors	1-2 Months
VM-1.2	Coordinate vegetation management crew movements with the needs of line crews	NA
VM-2.1	Estimate the number of vegetation crew requirements in advance of storm	NA
VM-3.1	Consider certifying a number of SDOT crews for work around electric lines as an additional potential source of VM crews during restorations	2-3 month

VM-1.1 Form agreements containing service level commitments for storm assistance with vegetation management vendors

- City Light should engage Asplundh Tree Experts (ATE) more completely to help with the restoration efforts. ATE has extensive experience and a deep bench of resources.
- Establish a formal process for requesting and using tree crews

VM-1.2 Coordinate vegetation management crew movements with the needs of line crews

- Line clearance should be used more extensively during storm restoration work, and in support of line crews. Line crews are certainly capable of tree work, but the overall restoration progresses more efficiently with line crews working on line work.
  - Tree crews can be particularly cost-effective in removing trees from lines when the trees in conflict with overhead conductors have not damaged the energy delivery infrastructure; and
  - Tree crews can work directly with line crews when tree damage is both heavy and localized.
- Keep the activities of the vegetation management crews focused on the needs of the line crews to minimize delays in restoration.

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- There are not sufficient vegetation management crews to match with line crews on a one-to-one basis, so there will, on occasion, be delays. Split the vegetation management crews between the North and South dispatch, and allow them to move the crews as they see fit.

VM-2.1 Estimate the number of vegetation management crew requirements in advance of storm

- Examine past events, deriving relationships between weather severity and damage in order to come up with a predictive algorithm linking the intensity of the event to the anticipated damage.

VM-3.1 Consider certifying a number of SDOT crews for work around electric lines as an additional potential source of vegetation management crews during restorations

- Trimming near high-voltage wiring requires specialized training. Offering this training to a limited number of Seattle Department of Transportation (SDOT) personnel would give City Light additional operational flexibility during a storm, subject to the cooperation of SDOT.
- In addition to the training, agreements and policies would need to be in place to ensure that SDOT could release crews in times of need.

9.2.6. Internal Communications

In order to meet best practices in communications, City Light must develop a communications policy and plan, which is integrated into the response and restoration plans. This plan should contain templates for internal communications releases and ensure that policies are adopted and implemented by City Light personnel. As part of the annual drills on the restoration and response plans, the communications plan (along with all other emergency response plans) should be tested and drilled. Additional recommendations follow.

Table 9: Recommendations—Internal Communications

Item	Internal Communications (IC)	Duration
IC-1.1	Commit to conducting internal communications via the Incident Command System	NA
IC-1.2	Ensure all dispatch and switching clearance communications are conducted via recorded radio communication	ongoing
IC-1.3	Establish schedule for internal updates to get key	1 Month

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	information to internal stakeholders	
IC-1.4	Use different radio channels for North and South to reduce congestion	NA
IC-1.5	Refresh training on radio use & protocol, and practice throughout year	3 Months
IC-2.1	Provide a means of communication for Incident Command Staff that will eliminate customer calls	3 Months

IC-1.1 Commit to conducting internal communications via the Incident Command System

- Develop an emergency communications plan that is integrated into the overall emergency preparedness plan. This ensures that communications becomes an integral part of the emergency planning and restoration activities. This also facilities knowledge transfer that is critical to continuity of emergency preparedness, especially given the frequent changes in roles played by individuals.
- Ensure that roles and responsibilities are clearly defined with respect to communications representatives and that representatives are present in the EOCs/DOCs. Integrating communications functions into the utility EOC/DOC would enhance consistent information flow for all communications activities whether they are internal or external.

IC-1.2 Ensure all dispatch and switching clearance communications are conducted via recorded radio communication

- This is an absolute requirement for reasons of safety. All actions in which high-voltage circuits are to be energized must be broadcast by radio to ensure all parties can take necessary precautions.

IC-1.3 Establish schedule for internal updates to get key information to internal stakeholders

- Identify the times and participants for each level of meeting. There will likely be meetings with varying breadths of participant.

IC-1.4 Use different radio channels/frequencies for North Service Center and South Service Center to reduce radio congestion

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- Make the most of the available radio infrastructure to avoid having communications overflow onto non-approved means, such as mobile phones.

IC-1.5 Refresh training on radio use and protocol—and practice throughout the year

- To enforce good habits, refresher training on the radio systems should be provided for the Control Center, service centers, and line resources, and radio use should be practiced year-round, not just used during emergency restorations

IC-2.1 Provide a means of communication for Incident Command staff that will eliminate customer interference

- Whether they be radios or cell phones with unpublished numbers, the officers of Incident Command must have a way to communicate that does not expose them to public interference. Because a complete staff directory is available online, officers' telephones were jammed by unconstructive calls from the general public, hindering their ability to focus on the restoration.

9.2.7. External Communications

Like best practices for internal communications, effective external communications requires, first and foremost, development of a communications plan and process. Indeed, this plan should address both external and internal communications procedures. More specific efforts include:

- Ensuring that communications becomes an integral part of the emergency planning and restoration activities;
- Creating communications roles through the ICS structure and ensuring that communications personnel are present not only in the City Light command post but, during large events, also at local or state EOCs; and
- Preparing templates for external communications in emergencies.

In addition, the communications plan should address mechanisms for educating customers prior to and during events and for following up with customers to obtain feedback on performance after a restoration effort, possibly through an effective Customer Relationship Management (CRM) process.

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Table 10: Recommendations - External Communications

Item	External Communications (EC)	Duration
EC-1.1	Create an outbound callback process, suited to the currently available technology, for verifying power restoration	1-2 Months
EC-1.2	Position the individual responsible for media communications in the Trouble Center	NA
EC-2.1	Use a single voice to release data to the media	NA
EC-2.2	Improve the Call Center scripts to collect better trouble data from customers	1 Month
EC-3.1	Make fuller use of web technology to communicate updates to the general public	3-4 Months

EC-1.1 Create an outbound callback process, suited to the currently available technology, for verifying power restoration

- Use the callback process to identify nested outages – this will enhance customers' confidence that City Light is on top of the situation.

EC-1.2 Position the individual responsible for media communications in the Trouble Center

- With the activities carried out at the Trouble Center, this should be the best place to stay abreast of the overall progress of the event, and to develop the message in concert with other members of the ICS.

EC-2.1 Use a single voice to release information to the media

- During the restoration, quotes from one members of senior management who were not part of the communications group negatively affected City Light. This created an additional layer of issues to address, distracting from the restoration effort. City Light should release information to the press and public via the ICS Communications Officer, which will likely be staffed by two individuals to cover the 24-hour clock.
- City Light runs the risk of appearing guarded or non-responsive by adopting this strategy, particularly in a culture where individuals outside the command structure are comfortable going to the press with their impressions of the effort.

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EC-2.2 Improve the Call Center scripts to collect better trouble data from customers

- The Call Center needs a script (or a better one) to interrogate customers and gather important information for accurate damage assessment.

EC-3.1 Make fuller use of Web technology to communicate updates to the general public

- While a customer without power cannot look information up on the Internet, that customer likely knows somebody with power or can get access from work, a relative, or a friend living outside of the affected area. The Internet can efficiently deliver personalized information to many individuals.

9.2.8. Coordination with City Departments

Implementation of ICS at City Light will necessarily result in improved coordination between the utility and local, state, and federal agencies that it might interact with during an event. In addition to implementing ICS, and in order to meet best practices, City Light should:

- Ensure that community and/or government relations is addressed in the response and restoration plans; and
- Initiate discussions with the city to ensure that City Light is an integral player at the city EOC and that agreements/plans are in place for each to support the other in the event of an emergency. Each entity should also be aware of and possibly participate in the other's training and exercises.

Table 11: Recommendations - Coordination with City

Item	Coordination with other City Departments (CD)	Duration
CD-1.1	Integrate plans and co-ordinate responsibilities with other City Departments	2-3 Months
CD-1.2	Develop list of critical customers connected to City Light lines. Integrate critical customer restoration plans with other City Departments	4-5 Months
CD-1.3	Designate a primary and backup liaison to the City EOC around the clock to coordinate all restoration activities	1-2 months
CD-1.4	Provide a dedicated phone number and phone lines to communicate with other City first responders	3 Months
CD-2.1	Develop table top exercises that will include other city	3-5

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Item	Coordination with other City Departments (CD)	Duration
	first responders and participate in City exercises.	Months

CD-1.1 Integrate plans and coordinate responsibilities with other city departments

- It is unusual for an electric utility to focus its resources on matters outside of making the electric system safe, restoring the power, keeping the general public informed of its progress, and providing ETRs. While City Light's efforts to inform the public on the dangers of carbon monoxide poisoning and to establish shelters for city residents left in the cold were laudable, they distracted from its primary responsibilities. City Light should ensure that in a major event, the city EOC remains open and manages public safety and well-being issues; and
- City Light needs to continue discussions with other city departments to delineate its responsibilities versus those of the remainder of city services.

CD-1.2 Develop list of critical customers connected to City Light lines. Integrate critical customer restoration plans with other city departments

- City Light should make sure emergency services are aware of critical care customers and are prepared to act in whatever capacity is appropriate upon notification.

CD-1.3 Designate a primary and backup liaison to the city EOC around the clock to coordinate all restoration activities

- If City Light maintains a physical presence in the city EOC, the quality of the utility's interactions with other city departments will improve.

CD-1.4 Provide a dedicated phone number and phone lines to communicate with other city first responders

- Analysis shows that the main Call Center infrastructure was saturated during the storm, leaving no alternate avenue for police, fire, and other emergency services to call with priority access; and
- Distributing this number requires a continuously updated list of stations and contact names with whom to verify connections.

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CD-2.1 Develop tabletop exercises that will include other city first responders. Participate in City-sponsored exercises

- Enhance City Light's ability to work with and benefit from other city departments by conceptualizing and hosting exercises that include these parties as well as participate in exercises sponsored by other city first responders. Tabletop exercises use pre-developed storm scenarios to walk through the process for preparing and responding to the storm. The members of all critical response functions are represented in the exercise and provide input on the steps that their function will take during the response.

9.3. Technology and Facilities Recommendations

- Optimize the use and usability of existing information systems until such time as they can be supplanted by comprehensive enterprise systems.
- Increase the ability to monitor the system electronically.
- Ensure key systems and facilities have available power and backup generation.
- Find a way to ensure customers calling in do not encounter busy signals.
- Expedite the construction of a permanent Trouble Center to coordinate the restoration from an appropriate facility.
- Acquire technologies to improve the information flow to improve decision making in City Light's response:
  - Purchase OMS and evaluate AMI; and
  - IVR and GIS upgrades

9.3.1. Short Term Technology and Facilities Improvements

Table 12: Recommendations—Short Term Technology and Facilities

Item	Short Term Technology and Facilities (ST)	Cost	Dur.
ST-1.1	Extend the SOARS application to permit 'Virtual Trouble Ticket Sorting'	$25K - $40K	2-4 Months
ST-1.2	Install & maintain permanent backup generation at the service centers and communications infrastructure facilities	$75K Install.	4-6 Months
ST-1.3	Continue with updates to the Electrical System Status (ESS) application to bridge the gap until an enterprise OMS comes	$200K - $250K	4-6 Months

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Item	Short Term Technology and Facilities (ST)	Cost	Dur.
	online		
ST-2.1	Evaluate & select an alternative for increasing call center capacity ensuring customers do not get busy signals when trying to call	NA	2-3 Months

ST-1.1 Extend the SOARS application to permit "virtual trouble ticket sorting"

- Eliminate the unwieldy paper-sorting process by leveraging existing data systems to create virtual "stacks." This is not a substitute for the full functionality of an OMS, but it will decrease the mundane and unproductive task of sorting paper-based trouble tickets.
- Help staff develop trust in such an application. The efficacy of this system will have to be demonstrated using trouble tickets from past events to validate the analysis of outages and gain confidence by the prospective users

ST-1.2 Install and maintain permanent backup generation at the service centers and communications infrastructure facilities

- Having the communications infrastructure up and running is of paramount importance. Because it may be difficult to transport generators to these critical facilities during an event, the facilities should have dedicated generation, or at the very least the generators should be stored at the facilities.
- These generators must be frequently exercised so they will function correctly when called upon.

ST-1.3 Continue with updates to the Electrical System Status (ESS) application to bridge the gap until an enterprise OMS comes online

- One of the largest avoidable bottlenecks in City Light's current practice is the requirement to print and sort thousands of trouble tickets in order to identify and prioritize work. In addition to being laborious, it relies heavily on Control Center resources, whose time could be used to greater advantage if they did not have this responsibility. Current ESS should be expanded to allow City Light to capture, sort, analyze, and report on

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outages electronically. This would eliminate manual analysis from the process and clear the way for implementation of an ETR process.

ST-2.1 Evaluate and select an alternative for increasing Call Center capacity ensuring customers do not get busy signals when trying to call

- During the restoration event, the volume of inbound calls frequently reached the capacity of the Seattle Public Utility (SPU) Call Center and that call volume persisted for several hours. This means that customers were getting busy signals when trying to connect with City Light. SPU must either increase its capacity to handle calls (i.e., more phone lines and attendants) or employ an overflow service to accept the calls that would otherwise have resulted in busy signals.
- Increasing day-to-day capacity to handle the glut of calls during a major event is costly. Ideally, the staffing levels and Call Center capacity should be tuned so the Call Center can meet its performance targets (hold time, call handling time, abandoned calls, etc.) on day-to-day operations and in small-scale events. It would be practical to increase the technological capacity of the Call Center (i.e., more phone lines) and ramp up staffing with "second job" workers during a major event. Using an overflow service is another economical way to handle major events, but the challenge is providing the overflow service with the information, data, and forms they need to handle the calls.

9.3.2. Long Term Technology and Facilities Improvements

Table 13: Recommendations—Long Term Technology and Facilities

Item	Long Term Technology and Facilities (LT)	Cost	Dur.
LT-1.1	Acquire & implement Outage Management System (OMS)	$3.5M - $4.5M	2-3 Years
LT-1.2	Upgrade Geographic Information System (GIS) to ARC-FM	$1.5M - $2M	6-12 Months
LT-1.3	Reprogram the existing or replacement Interactive Voice Response (IVR) system to improve the ease with which customers can auto-register lights out reports	$200K - $300K	6-9 Months
LT-1.4	Expand SCADA coverage to enable remote control of all substation breakers	$300K -	6-9 Months

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Item	Long Term Technology and Facilities (LT)	Cost	Dur.
		$400K	
LT-1.5	Expedite construction of the Trouble Center	$6M - $7M	6-9 Months
LT-2.1	Enable outbound calls and automated call-back through integration of OMS and Customer Notification System (CNS) or similar outbound calling mechanism (eg Upgraded IVR)	$450K - $550K	3-6 Months
LT-2.2	Evaluate the need for additional SCADA monitoring on feeder devices	N/A	1-2 Months
LT-3.1	Acquire & Implement Automated Meter Infrastructure (AMI)	$55M - $65M	3-7 Years

LT-1.1 Acquire and implement Outage Management System (OMS)

- Implementing an OMS has several advantages, both for day-to-day operations and during a major restoration. The benefits during the restoration include: integrated update of published restoration updates (e.g., ESS); improved ability to dispatch accurately; fewer redundant job assignments; improvement of communications between the SCC, the service centers, the Trouble Center, etc.; an improved legacy of historical data for future analysis; the ability to run callbacks to confirm restorations and identify “nested outages;” future integration with advanced technologies such as Automatic Meter Infrastructure (AMI) to further improve City Light’s ability to “see” outages through its IT systems; and elimination of the paper-sorting process.
- A key step in any OMS implementation is to verify the integrity of Geographic Information Systems (GIS) data. City Light maintains GIS in an established software platform and has plans to upgrade it in the short-term. Implementing OMS is a multiple-year process and will likely result in an increase in reported reliability performance metrics (i.e., SAIFI/SAIDI), despite the fact that actual reliability has not changed. This is a result of the new system’s ability to capture more timely and higher quality information.

LT-1.2 Upgrade Geographic Information System (GIS) to ARC-FM

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- This upgrade, when tied to the new OMS, will improve the restoration process. Trouble locations and sectionalizing device identification will be enhanced when these systems are operational.

LT-1.3 Reprogram the existing or replacement Interactive Voice Response (IVR) system so customers can easily auto-register lights-out reports

- Customer anecdotes revealed that the task of reporting a lights-out situation via the IVR is cumbersome. Customers abandoned attempts to do so, and instead used a Call Center operator's time to report the outage. This is a suboptimal use of the technology and should be revisited; and
- There are two principal mechanisms to examine: 1) the "tree" of prompts itself, and 2) the underlying data connection to Banner, the Customer Information System. Part of the difficulty with the IVR system is that it struggled to recognize the customer—i.e., it did not identify the phone numbers customers were calling from or those they entered as the phone number associated with the account. This aspect of the algorithm, in particular, should be examined.

LT-1.4 Expand Supervisory Control and Data Acquisition (SCADA) coverage to enable remote control of all substation breakers

- Automated control of substation breakers can significantly improve restoration times and efficiency. Automated control also provides a great degree of operations flexibility that can improve both restoration efforts and routine operations.
- The current SCADA scheme provides City Light with the ability to monitor 100% of all station breakers. However, the current SCADA does not include the 4kV distribution system, and provides only a partial coverage for remote switching at the breakers. SCADA control and coverage should be expanded to include 100% remote control ability at all station breakers on the system.

LT-1.5 Expedite construction of the Trouble Center

- The current conference room designated as a temporary Trouble Center is not ideally suited to the task. When the property becomes available, City Light should move quickly to create a permanent facility.

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LT-2.1 Enable outbound calls and automated callback through integration of OMS and Customer Notification System (CNS) or similar outbound calling mechanism

- Frequently in the course of a restoration, the damage causing outages for individual customers or small pockets of customers ("nested outages") is not initially visible to an electric utility because their effects are masked by a wider-scale outage. Many utilities use automated outbound call capabilities to check back with customers after a restoration to confirm that the lights are back on, and to further identify nested outages in cases where the lights have not yet come back on;
- SPU does not at this point have any outbound calling capabilities, automated or otherwise. This may require upgrades to the current IVR system; and
- Enabling a fully automated call system typically requires input from an OMS system, so this may not be fully realized until OMS is installed.

LT-2.2 Evaluate the need for additional SCADA monitoring on feeder devices

- City Light has a network of feeder tie and sectionalizing switches that it can use to transfer load as well as sectionalize around faults to quickly restore service to as many customers as possible. It is not always practical or cost-effective to either automate the switch to a read-only or full-remote control but City Light should evaluate these switches for SCADA upgrade. Feeders with highly sensitive load or high-rated critical customers may merit the installation of automation controls.

LT-3.1 Acquire and implement Automated Meter Infrastructure (AMI)

- Once the OMS is installed, AMI will help provide real time information on specific customer service outages. This will not significantly influence the bulk of major restorations, which are damage-assessment driven, but can help with the identification of smaller outages or nested outages among the major outages in a large- or small-scale restoration. AMI has the benefit of improving productivity and operational flexibility in areas outside of restoration as well. For example, AMI can be used for remotely connecting or disconnecting supply, remote meter reading, load control, and implementing demand side management programs.

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10. Conclusion

City Light's response to the December 2006 storm was relatively effective: More than 94% of the customers who were without power immediately following the storm were restored within 96 hours of the start of the event. Even though the length of City Light's restoration was in-line with other utilities suffering extensive damage to their systems, gaps existed in City Light's effort – both in the utility's preparedness for and response to the event. As a result of the utility's self-awareness and a desire to ensure successful future response, City Light engaged DCI to evaluate the effectiveness of the utility's response to the December 2006 storm and to provide recommendations on how the utility might improve its performance – both from an emergency response and utility operations perspective. What DCI discovered was in-line with City Light's perceptions: in terms of restoration capability, City Light technology and processes are years behind best-in-class utilities. There are areas where improvements could be made that would positively affect both future responses and, ultimately, customer satisfaction.

Following an extensive review of City Light's response and system preparedness, best practices, and information provided by an expert panel, the recommendations for improving City Light's response capabilities include:

- Emergency Response and Restoration planning – prior to the storm, City Light recognized the importance of having and was in the midst of developing a response plan. Subsequent to the storm, City Light has continued development of the plan and should place priority on its completion. City Light also needs to develop a restoration plan that is scalable – from small events such as localized thunderstorms to major events such as earthquakes or a pandemic event. Development of these scalable plans will provide City Light with the structure and process to effect a well implemented restoration process;
- DOC and Trouble Center – construct a permanent trouble center as soon as possible to coordinate the restoration from an appropriate facility. Currently, the DOC and trouble center operations are located in a conference room in the Seattle Municipal Tower. On an interim basis, DCI recommends that the Trouble Center be located at the System Control Center (SCC) since that is where all of the trouble ticket dispatching is done and where the Incident Commander will be. The DOC, most likely, will remain at the Seattle Municipal Tower. All of these restoration functions should be in the same location since there are the corner stones of the restoration process. Completion of the new facility will bring these key functions to one location.

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- Damage assessment – A damage assessment process, integrated with the restoration plan and capable of ensuring prompt delivery of ETRs, must be developed and implemented;
- Mutual assistance – City Light needs to develop relationships with regional mutual assistance groups and ensure that agreements are in place to guarantee that it has mutual assistance resources available if needed;
- Logistics – The utility needs to develop a logistics plan that is integrated with the corporate response and restoration plans and outlines procedures, policies, and processes prior to and during emergency events. Furthermore, City Light must develop relationships and execute pre-existing agreements with vendors, such as caterers, lodging suppliers, and logistics companies, who will be expected to provide support during emergencies;
- Communications – City Light must develop a communications plan with a management structure based on the Incident Command System (ICS) and integrated with the overall storm response organization and plan;
- Vegetation management – City Light needs to implement an effective vegetation management program that maintains or improves customer reliability and customer service related to vegetation outages while, at the same time, optimizing vegetation trim cycles to reduce overall costs;
- Coordination between City Light and other City departments – Through use of ICS and designation of a liaison with the Emergency Operations Center, City Light will enhance its ability to coordinate with the city, state and other governmental agencies; and
- Infrastructure – City Light's current infrastructure limits the utility's ability to respond to events as a best-in-class utility. In order to improve their capability, City Light needs to install an Outage Management System (OMS), consider the purchase of an Automated Meter Infrastructure (AMI), replace the existing Interactive Voice Response (IVR) system to improve inbound and outbound communications, and upgrade the existing Geographic Information System (GIS). Each of these systems is integrated with the OMS to provide complete restoration processes that maximize the use of technology while minimizing restoration time, regardless of event size. These systems and the associated processes will also enable City Light to provide better estimated times of restoration.

DCI has also recommended an installation timeframe for the process, technology, and infrastructure recommendations contained in this report.

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- Process :
  - Tier 1 recommendations should be implemented by October 31, 2007;
  - Tier 2 recommendations should be completed between October 31, 2007 and February 29, 2008; and
  - Tier 3 recommendations should be executed as time and resources permit.
- Short-term technology and infrastructure:
  - Tier 1 recommendations should be implemented by October 31, 2007;
  - Tier 2 recommendations should be completed between October 31, 2007 and February 29, 2008; and
  - Tier 3 recommendations should be executed as time and resources permit.
- All long term technology and infrastructure:
  - Tier 1 recommendations should be initiated by July 1, 2007;
  - Tier 2 recommendations should be initiated by July 1, 2008; and
  - Tier 3 recommendations should be executed as time and resources permit.

The process, technology, and infrastructure recommendations made in this report are directly related to the restoration effort after the December windstorm. A complete lack of, or a lack of funding of, maintenance programs can, over time, also contribute to the amount of damage suffered as the result of a storm. DCI looked at the maintenance programs in place at City Light to determine whether maintenance was a contributing factor to the level of damage. It is clear that some outages were the result of a lack of maintenance, but it did not appear that system maintenance had a major impact on the number or duration of outages. If the lack of maintenance programs continues into the future, however, there likely will be a detrimental effect on the number and duration of outages in the next event. Some maintenance programs have been refunded, some are not funded, and others are pending approval. Following are some of the maintenance programs that will have an impact on the ability of the City Light system to withstand future emergency events.

- Vegetation management
- Aging asset evaluation and replacement strategy
- Pole inspection and replacement

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- System hardening evaluation
- Asset management evaluation

City Light has a dedicated staff that not only shows concern for its customer base, but also works for its best interest in all events. There is, however, a limited amount that this staff can accomplish considering that they are using processes and technology that are years behind best-in-class utilities. In order to regain best-in-class status, City Light has several months, and even years, of challenging work ahead of it. City Light's dedication to improving its performance will be impressive. Indeed, the utility has already established lofty goals and aggressive timelines for implementing numerous recommendations. This pro-activity is a first step toward being, again, at the top of the utility ladder.

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11. Glossary

Acronyms and Abbreviations

AMI	Automated Meter Infrastructure
COOP	Continuity of Operations Plan
CIS	Customer Information System
CNS	Customer Notification System
CRM	Customer Relationship Management
DHS	U.S. Department of Homeland Security
DNIS	Dialed Number Identification Service
DOC	Department Operations Center
EEI	Edison Electric Institute
EMA	Emergency Management Agency
EOC	Emergency Operations Center
EOP	emergency operating procedure
ESF	Emergency Support Function
ESS	Electrical System Status
ETR	Estimated Time of Restoration
FEMA	Federal Emergency Management Agency
FERC	Federal Energy Regulatory Commission
GIS	geographic information system
HSPD	Homeland Security Presidential Directive
IAP	Incident Action Plans
IOU	Investor Owned Utility
ICS	Incident Command System
IVR	Interactive Voice Response
JLM	Joint Labor Management
MHz	megahertz
mph	miles per hour
NERC	North American Electric Reliability Council
NIMS	National Incident Management System

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NRP	National Response Plan
OMS	Outage Management System
PSE	Puget Sound Energy
PUD	Public Utility District
Red Book	*Seattle City Light Emergency Response and Procedures Manual*, August 8, 2006, and revisions
SCADA	Supervisory Control and Data Acquisition
SCC	Systems Control Center
SCL	Seattle City Light
SDOT	Seattle Department of Transportation
SLG	FEMA State and Local Guide
SODO	South Downtown (Seattle)
SOARS	Service Order Analysis and Retrieval System
SOP	standard operating procedure
SPU	Seattle Public Utilities
VRU	Voice Recognition Unit
WAC	Washington Administrative Code

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