December 2011 Outage Report:

Restoration and Communications Challenges and Root Cause Evaluation
# EXECUTIVE SUMMARY

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Southern California Edison deployed more than 1,500 crew members and contract workers to work around the clock in order to restore power.
The hurricane-force winds that began the night of Nov. 30, 2011, reached 100mph, toppling mature trees with trunks as large as cars onto power poles and houses. The more than 1,500 Southern California Edison crew members and municipal crews quickly, yet safely, cut down fallen trees and removed debris throughout the night and several days afterward to restore power.
Weather officials claimed the windstorm on Nov. 30, 2011, to be a “once in a decade storm” with hurricane-force winds that toppled hundreds of trees and power distribution poles.
Crew members from Southern California Edison were immediately deployed to the hardest hit areas and restored power for nearly 50 percent of customers within 24 hours.
During the windstorm and the restoration period, Southern California Edison crews safely replaced more than 250 distribution poles, more than 60,000 feet of wire, and 100 transformers, all without a single serious injury or death.
EXECUTIVE SUMMARY

The wind storm that swept into Southern California on November 30, 2011, was one of the strongest and most damaging in memory. Hurricane-force winds of 80 to 100 miles per hour, with gusts possibly exceeding 100, knocked down thousands of trees and caused widespread interruptions in electric power. Hardest hit was the San Gabriel Valley area, most of which lies within Southern California Edison's service area.

Approximately 440,000 SCE customers across its service area experienced either momentary or extended service interruptions. SCE crews worked around the clock to restore power, and most customers had power restored within a day or two. However, in one particularly hard hit area in the San Gabriel Valley, some customers were without power for as long as seven days.

As a standard practice, SCE conducts formal post-storm critiques to identify lessons learned and opportunities for improvement. When necessary, changes are made in policies and procedures as part of SCE's normal continuous improvement practices.

Due to the uniqueness and severity of the November 30 wind storm, SCE did not meet its typical restoration target of 72 hours. In addition, the accuracy of predicted restoration times and public communications did not meet the expectations of our customers or key stakeholders. As a result, the company augmented its normal post-storm critique process by: 1) performing an intensive Root Cause Evaluation using external and internal experts; 2) identifying relevant best practices from American Electric Power and Alabama Power, companies experienced in restoration following hurricane-force winds; and 3) commissioning an independent third-party review by Davies Consulting LLC, an industry leader in emergency preparedness and response. The Davies report will be released simultaneously with this report.

Based on the judgments of SCE storm managers and experts from American Electric Power and Alabama Power, with full hindsight review SCE’s restoration time might have been shortened from seven days to six. But this storm would still have resulted in an extended outage. SCE’s biggest opportunity for improvement is in setting accurate restoration time estimates and communicating those to customers. As a result of this review, SCE will commit to improve in all aspects of its restoration and customer communications.

These are the key findings of this report:

1. **SCE was slow to grasp the magnitude of damage from the storm.** Sources of system data were available to SCE that could have provided an indication of the magnitude of the outage sooner. With earlier use of available data, teams could have been mobilized to assess the damage quickly. *Lesson learned: SCE should develop a better method of collecting and evaluating data from computerized systems and from field personnel to gauge the magnitude of storms sooner.*
2. Some of SCE’s policies and procedures conflicted with each other during the November 30 storm and created delays in service restoration. For example, policies designed to protect the safety of the public, crews and contractors from electrocution from downed wires were implemented in a way that diverted personnel away from power restoration and damage assessment efforts. This delayed system recovery and prevented SCE from getting a complete picture of the extent of the damage in a timely fashion. Lesson learned: SCE should establish an approach that ensures that, before a policy is implemented, its impact on the restoration effort is well understood, the impact is mitigated to the extent possible, and that the restoration effort is adjusted if necessary to compensate for that impact.

3. SCE’s estimates of restoration times proved to be inaccurate, and its communications with customers and the news media caused frustration. For example, some estimates relied on a trend in the recent restoration rate to predict the future restoration rate, which did not produce an accurate result. SCE’s communications with customers and the news media created expectations for service restoration that could not be met and did not adequately keep customers informed. Call centers were overwhelmed by the volume of customer calls, and many customers were routed to automated system responses, or they gave up trying to get through. The automated estimates of service restoration that were provided for individual customers were often inaccurate. Lessons learned: SCE should develop better methods for estimating restoration time in major outages. In addition, early in the recovery phase SCE should avoid giving estimates for individual customers and instead give more conservative overall area-level estimates for service restoration. SCE also should expand its use of social media for rapid and interactive communication with customers.

4. SCE’s storm and emergency response plan, known as the Event Response and Recovery Protocol, does not account for an event of the magnitude and geographic concentration of the November 30 wind storm. The Protocol should be updated to include lessons learned from the recent storm. For example, geographically concentrated damage may require a different restoration approach to provide the most effective and timely response. Also, concentrated damage has the capability to overload the normal work control procedures such as issuance of work clearances and switching orders. Lesson learned: SCE should revisit its emergency response plan to allow for appropriate modifications during a major event.

5. SCE was unable to reliably compare actual restoration rates to predicted rates in order to gauge whether publicly-stated restoration targets would be met, and, as a result, did not update its restoration predictions with more accurate information in a timely fashion. Lesson learned: SCE should take steps to ensure that, once it has established an estimated time of service restoration, it continues to monitor the actual restoration rate, and promptly adjust its estimates and communicate the changes to the public.

A more detailed explanation of these findings can be found in the section titled Root Cause Evaluation. In addition, SCE is exploring other improvements to its storm response and communications procedures based on feedback from public agencies and other stakeholders; these are summarized in the section call Additional Areas for Improvement.
About This Report

This report describes the events, restoration activities and communications associated with the November 30 storm, as well as the primary challenges, root causes and corrective actions identified through SCE’s internal review. The report addresses only SCE’s response to the storm and does not examine the condition, prior to the event, of SCE’s power distribution system or equipment, including whether poles were overloaded. SCE is preparing a separate analysis of the estimated attachment loading of each pole that failed during the storm, along with an assessment of whether that loading may have been a contributing factor in the failure in addition to wind, condition of the wood and the effect of trees falling into wires attached to the pole. SCE will make this analysis public when it is complete.

This report does not attempt to determine whether the decisions made by individual SCE employees during the event were reasonable or prudent based on information available to them at the time. Indeed, the internal investigation found that, aside from the unprecedented level of damage from the storm, gaps in available information were a major factor in the extended restoration time and inaccurate public communications. Therefore the main focus of this report is not second guessing individual decisions after the fact, rather it is how SCE can adjust its policies and procedures to make more complete information available in a timely manner and improve its overall response to future storms of this magnitude.

This report contains many references to numbers of personnel, customers, material and equipment as of particular dates and times. The authors and reviewers have made significant efforts to ensure that these numbers are as accurate as possible. All such numbers are necessarily estimates that are subject to revision based on receipt and analysis of further information. However, SCE believes that the data herein are sufficiently accurate to support the report’s conclusions and recommendations.

BACKGROUND

The Company

Southern California Edison is one of the largest electric utilities in the country and is California’s second largest investor-owned electric utility. SCE provides power for 14 million people, 180 cities, 5,000 large businesses, and 280,000 small businesses in Central and Southern California. The company’s service area covers 50,000 square miles and its network consists of 16 utility interconnections, 4,990 transmission and distribution circuits, 888 substations, 11,605 circuit breakers and 1.5 million poles.

The service area is organized in the following way:

- Two distribution construction and maintenance divisions (Northwest, Southeast), which include seven regions (North Coast, San Joaquin, Metro West, Metro East, Desert, San Jacinto, Orange) and 35 districts.
- Four system operating zones (Northern, Western, Southern, Eastern), which include 18 sectors.

See Appendix B for service area maps.
Three of SCE’s business units are directly involved in storm response: Transmission & Distribution, Customer Service and External Relations.

The Transmission & Distribution Business Unit (TDBU or T&D) maintains and manages the network through one of its organizations, Power Delivery. Within Power Delivery, Grid Operations, Distribution Construction & Maintenance, and Transmission are the most active in storm situations. Grid Operations manages the Troubemen, Substation Operations (including switching centers) and Distribution Operations Centers. Distribution Construction & Maintenance and Transmission manage the internal and contract line construction and line clearing crews.

The Customer Service Business Unit (CSBU) manages interactions with customers. Within CSBU, the Customer Communications Organization manages inbound and outbound communications through the Call Center and company website. The Meter Services Organization manages the Field Service Representatives, who interact with customers at their homes and businesses.

Within the External Relations, Corporate Communications manages public, media and internal communications and Local Public Affairs manages communications with local governments.

**The Electrical Distribution System**

The distribution system begins where the primary circuit leaves the distribution substation and ends where the electric service enters the customer’s meter socket. Distribution circuits serve many customers. The distribution voltages used by SCE vary from 2,400 to 33,000 volts, depending on the distance covered and the number of customers served. Distribution circuits are fed from a transformer located in a substation, where the voltage is reduced from the high values used for power transmission to a lower level used for distribution. Conductors, or wires, for distribution may be carried on overhead pole lines or buried underground. Most SCE customers are connected to a transformer, which reduces the distribution voltage to the relatively low voltage used by lighting and interior wiring systems. The transformer may be pole-mounted or set on the ground in a protective enclosure. Each customer has an “electrical service” or “service drop” connection and a meter for measuring power consumption.
Storm Procedures and Roles

Southern California Edison’s storm and emergency response is guided by its Event Response and Recovery Protocol. The purpose of the Protocol is to ensure the orderly and timely restoration of the transmission and distribution systems during storms and other catastrophic events. The Protocol has evolved over the 15 years since it was created and has proven to be effective in prior events. In addition to an annual review, the Protocol may also be updated based on the critiques SCE conducts after certain storm events. Overall accountability for storm recovery efforts rests with the Director of Grid Operations who, for the purpose of the Event Response and Recovery Protocol, is referred to as the Storm Recovery Manager.

Three categories of storms exist to aid Transmission & Distribution in responding to the event to ensure that adequate staffing and resources are deployed throughout the restoration effort. Those storm categories are described in the chart below:

### Storm Activation Criteria

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<th>CATEGORY</th>
<th>DESCRIPTION</th>
<th>CRITERIA</th>
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| Category 1 (least severe)    | Localized to a geographic area and resources at the zone level are sufficient to manage response and recovery activities | • Five or more circuit interruptions, area outs, or combination thereof, in any one regional sector in the same zone within a two-hour period or at the direction of the Storm Center Manager (distribution), or;  
• Sufficient Design, Construction & Maintenance area resources can be deployed to provide assistance |
| Category 2                    | The event is escalating and a second zone is involved. Situation requires additional resources because the storm is escalating or there is widespread power outage from a transmission disturbance. | • Multiple zones are affected and requirements for additional resources needs to be coordinated at a global level to ensure efficiency  
• Resources are deployed by the closest region regardless of division boundaries |
| Category 3 (most severe)     | Emergency/event involves multiple regions; resources are fully committed, restoration will most likely exceed 72 hours, and additional assistance, such as mutual assistance, is requested. Corporate Emergency Operations Center will most likely be activated. | • Service restoration cannot be completed within 72 hours with available SCE resources due to the extent of damage to the transmission and/or distribution system. If T&D determines that assistance is needed, it will be requested. However, assistance will not be requested if it would not substantially expedite restoration of electric service. |

Source: Event Response and Recovery Protocol
As the storm category escalates, T&D expands its restoration strategy. Actions taken during normal operations are dispersed to members of the Storm Management Organization, who are trained to perform roles that focus on a specific function of the storm process. These actions may include:

- Activation of the T&D Storm Management Organization;
- Mobilization of equipment and personnel, including contractors;
- Activation of the Business Unit Storm Support;
- Activation of the Mobile Command Center;
- Activation of Mutual Assistance from neighboring utilities;
- Increased communications to the public and media.

The restoration goals of T&D:

- During Category 1 and 2 storms, no customer shall be without service for more than 24 hours.
- Communication of outage status information to the Customer Communications Centers (Call Centers) will be made within 10 minutes of a known interruption affecting three or more customers. Updates will be provided every hour until a restoration time has been established.
- Major, essential and critical customers are contacted proactively with outage status information.
- During a Category 3 storm, every effort will be made to have no customers without service for more than 72 hours.
- Storm categories are escalated in a timely manner to ensure adequate staffing levels, expedite damage assessment and minimize the length of outages.

T&D's restoration priorities:

1. Protect public safety and ensure that utilities and public agencies have electricity.
2. Repair any facilities that have sustained damage.
3. Repair transmission lines.
4. Ensure substations and circuits are energized.
5. Repair distribution lines to restore service to large numbers of customers.
6. Repair tap lines to restore service to smaller numbers of customers.
7. Repair individual customers’ “service drops.”

The following functions perform important roles during storm events.

**Storm Recovery Manager** – The Storm Recovery Manager has total accountability for transmission and distribution recovery efforts. The Storm Recovery Manager ensures compliance with the established Event Response and Recovery Protocol, and that all areas of responsibility are providing a high level of customer satisfaction. The primary responsibilities are:

- Oversees the T&D response and recovery activities;
- Determines the magnitude of the event and is responsible for timely assessment and declaration of Category 1, 2, or 3 and catastrophic events;
- Strategizes to increase overall response and recovery efforts;
- Conducts post-event critique with organizational managers to determine opportunities for improvement;
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- Uses the storm preparation process to expedite responsiveness to emergency conditions;
- Acts as a company spokesperson.

**Storm Management Center** – The objective of the Storm Management Center is to ensure an orderly and timely restoration of the transmission and distribution systems within its zone, and provide needed communications during storms. Each Storm Management Center has the responsibility and authority to conduct operations within its jurisdiction and to coordinate system matters with the appropriate switching centers.

**Officer-In-Charge** – The Officer-In-Charge has the responsibility of assessing the overall impact of an emergency event on the company and determining the appropriate corporate response. The primary responsibilities are:
- Lead initial recovery efforts from a corporate perspective.
- Determine the need to activate the Emergency Operations Center.
- As appropriate to the event, assign an ongoing executive in charge of recovery, who will direct all company activities and resources associated with the recovery.
- Coordinate assets.
- Facilitate communications and maintain common messages.
- Establish and maintain priorities and objectives.

**Emergency Operations Center** – The purpose of the Emergency Operations Center is to act as a central point for gathering and disseminating emergency-related information when Category 3 storm events warrant. At the request of the Officer-In-Charge, the T&D Storm Recovery Manager will designate one or more individuals to report to the Emergency Operations Center. This person(s) will act as the communications liaison between the Storm Management Center and the Emergency Operations Center. The primary responsibilities are:
- Maintain strategic overview, or “big picture,” of the disaster.
- Collect, gather and analyze data.
- Make decisions that protect life and property, maintain continuity of the organization and disseminate those decisions to all concerned agencies and individuals.

**Customer Communication Organization** – The Customer Communication Organization (CCO) staffs and operates two call centers, one in Rancho Cucamonga and one in Long Beach, that respond to customer requests 24 hours a day, seven days a week in seven different languages. Additionally, SCE augments its staff through the use of a third party supplier in Texas that is available seven days a week to handle customer requests. The CCO also performs crisis coordination during significant events such as earthquakes or storms. The staff and infrastructure can handle up to 1,002 customer calls at one time. When calls exceed that number, callers are automatically routed to SCE’s overflow vendor in Nebraska for outage information and broadcast messaging provided by an interactive voice response system. CCO representatives use the information in the Outage Management System, described below, to provide customers with estimated restoration times. During times of significant events, like storms, CCO management assesses the staffing level against call volume to determine whether additional staff or mandatory overtime is required. If call volumes exceed staffing capabilities, calls will be routed to SCE’s overflow vendor or placed on hold until the next call specialist is available.
Business Unit Storm Support – Business Unit Storm Support is activated when needed by the Storm Recovery Manager for Category 2 and Category 3 storms and serves as a central location where designated personnel assemble to coordinate department recovery efforts. The Santa Ana Storm Management Center is the primary location for T&D. The primary responsibilities are:

- Resource deployment and tracking;
- Material logistics;
- Coordination of communications between field reports and Corporate Communications;
- Providing lodging for traveling field crew members.

Mutual Assistance – SCE has established Mutual Assistance agreements with other utilities to provide for or receive assistance in restoring electric service. Mutual assistance need not be requested if it would not substantially expedite restoration of electric service. The need for mutual assistance is evaluated by the Storm Recovery Manager, in consultation with TDBU senior leadership. The threshold for requesting assistance is when a Category 3 storm has been declared and service restoration cannot be completed within 72 hours with available SCE resources and additional resources would significantly diminish the restoration time.

Mobile Command Center – The Mobile Command Center is a 40-foot, self-contained vehicle that can be directed to areas of devastation. It gives SCE a presence in the areas hardest hit by natural disasters and catastrophic events and is used as a communications command post. The Mobile Command Center can also be used as a corporate command center if the company’s facilities are affected by a disaster or emergency event.

Outage Management System – The Outage Management System receives trouble orders as they come into the Customer Call Center and inputs them into the mainframe Customer Service System. The Outage Management System then associates each order with the distribution circuit and equipment that provides electrical service to the customers who initiated the order. That enables orders to be logically grouped and facilitates field troubleshooting and restoration by providing a prediction of the common distribution circuit device that affects the associated trouble calls.

Switching Centers – There are 13 Switching Centers located throughout the SCE service area. Each center has jurisdiction over a portion of the SCE electrical distribution system and is responsible for directing the reconfiguration of that system, which requires opening and closing electrical switches and circuit breakers in the field. The Centers are staffed 24 hours a day with operators who work rotating shifts. Each Switching Center has onsite supervision that oversees the personnel and operations of each of the Centers. Primary responsibilities are:

- Monitor and control of the electric system under their jurisdiction.
- Respond to emergency and unplanned outages.
- Direct any switching of electrical equipment in their jurisdiction.
- Develop switching procedures.
Roles by Storm Category

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Storm Breadth and Impact

On Wednesday, November 30, hurricane-force winds of 80 to 100 miles per hour at times, and possibly higher for very brief periods, entered SCE’s service area from the north and northeast directions. The winds uprooted and toppled more than 2,500 trees with trunk diameters of 30 to 40 inches, many of which damaged power lines or other components of the utility infrastructure. As a result, there was considerable damage to SCE’s distribution and sub-transmission power grid, power lines, poles, and equipment in a localized area. Approximately 440,000 customers experienced an interruption in electric service due to the storm. Despite the widespread damage, there were no serious injuries to customers or SCE field personnel working on the restoration effort.

Six storm centers, in the Ridgecrest, El Nido, Vista, Lighthipe, Mesa and Mira Loma sectors, were opened. The highest density of damage was experienced in the San Gabriel Valley area. For the purposes of this report, the San Gabriel Valley area is defined by the geographic area in which SCE’s system experienced significant damage resulting in a high number of momentary (less than 5 minutes) and sustained (more than 5 minutes) distribution circuit interruptions as indicated by the red border in the illustration below.
Wind Storm Outage Pattern
The customer outage pattern experienced as a result of this storm event was significantly different than outage patterns in prior wind storm experiences. Specifically, nearly all of the damage and associated outages occurred within a matter of hours, resulting in a much higher maximum number of customers without service at the peak. However, the duration of the event and the total number of customers who experienced an outage at some point is similar to these past events.
Equipment Damage

The storm resulted in damage that required replacement of approximately 1,064 wire spans, 248 poles and 175 transformers within the SCE service area. The Mesa Storm Center, where response to the damage in San Gabriel Valley area was managed, accounted for the vast majority of damage. Across all six sectors involved in storm restoration activities, the repair work performed in the Mesa Sector accounts for approximately 65 percent of the overall spans of wire that were replaced and approximately 80 percent of the poles and transformers that were replaced due to the storm.

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<td>13</td>
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* Assets replaced at other locations due to storm conditions, however, those locations did not meet the criteria for opening a storm center (i.e., 5 or more circuit interruptions, area outs, or combination thereof, in any one regional sector in the same zone within a 2-hour period)

Customer and Circuit Impact

In addition, the SCE Call Center received a total of approximately 4,200 reports of downed wires, with the Mesa Storm Center accounting for 76 percent, or approximately 3,200 of the total wire-down calls received. This represents an unprecedented amount of damage associated with a single storm center.

The Mesa Storm Center was in operation for 259 hours before returning to normal operations, compared to an average of 57 hours for the remaining five storm centers. As it was not predicted that the San Gabriel Valley area would experience such high winds, the normal staffing levels were available initially. After an initial assessment of circuit disruptions and damage, additional Troublemens, Damage Assessment Teams, repair crews and tree trimming crews were dispatched to the Mesa area from surrounding areas to assist with recovery efforts.

Approximately 64 percent of customers in the Mesa Sector experienced an outage, far exceeding the next highest percentage of 20 percent in the Ridgecrest Sectors. Within the Mesa Sector, 76 percent of customers in the San Gabriel Valley area experienced an interruption of service. The San Gabriel Valley area is primarily within the Mesa sector and consists primarily of the Monrovia and Montebello districts as well as a small portion of Covina district. This area represents the area in which damage was highly concentrated.
Storm Restoration Times

Given the degree of damage in the Mesa Sector, the average circuit restoration took approximately 78 hours, more than 58 hours longer than circuit restoration in the Mira Loma Sector, which was the next longest restoration time of the six storm centers opened. The average restoration time of the storm centers involved in this storm, excluding Mesa, was 13.9 hours, which is below the comparable historic average shown on the graph below by the green dashed line.

The duration of the average restoration time in Mesa was approximately four times the comparable historic average time of restoration of 17.6 hours, indicating that the damage in the Mesa area was measurably different than previous storms. The comparable historic average is made up of the restoration average for seven of the past storms that hit the SCE area and most closely matched the profile of the November 30, 2011, wind storm.
Resource Deployment

Approximately 1,928 SCE and contract field personnel were involved in storm response in the San Gabriel Valley area, including 80 Troublemens, 131 vegetation management crews, 259 repair crews, and additional 88 Damage Assessment Teams. Crews worked extended hours with rotations for rest breaks, but restoration activities continued around the clock.

For the full eight days following the storm, more than 2,400 field personnel were actively involved in restoration of electricity to customers. SCE deployed approximately 3,300 people overall to support the storm effort. This level of support is the highest level of resources deployed to a storm that has been recorded. The next highest resource level was the 2003 wind and heat storm that affected approximately 930,000 customers, in which SCE deployed 2,550 personnel.
CHRONOLOGY OF EVENTS

Day One – Wednesday, November 30, 2011
At 5:05 a.m. on Wednesday, November 30, a special weather statement was issued indicating strong winds were expected from Wednesday through Friday in Los Angeles, San Bernardino, Riverside, Orange and Ventura counties, including in the mountains, passes and canyons. In anticipation of the storm, SCE conducted a pre-event conference call at 7:43 a.m. to discuss preparatory activities for the incoming wind storm. As it was anticipated that a typical storm event would ensue, the pre-event conference call was operational in nature and representatives from some support organizations, such as the Call Center, were not invited to participate.

Corporate Communications issued a press release raising awareness of possible service interruptions, downed power line safety and additional safety tips to customers. The press release was distributed to local general and ethnic television stations, radio, targeted newspaper outlets and the Edison Twitter channel.

At 4:59 p.m. a Category 1 storm was opened in the Ridgecrest district, and approximately one hour later, at 5:58 p.m., a second storm was opened in the El Nido sector, which elevated the storm to Category 2. The company’s Emergency Response and Recovery Protocol was activated and SCE personnel assumed their event response roles. At 9:45 p.m. on November 30, SCE management activated the Business Unit Storm Support to create a centralized command post and begin assessing resource and material needs and availability.

Call Center management was aware of the impending storm given the weather data they had received, but made no significant changes in staffing given historical weather patterns. The Call Center began experiencing an increase in customer calls at approximately 8:00 p.m. on November 30, and staff were kept on overtime to cover incoming call volume. Because the storm volume began during the traditional “swing” shift, staffing was limited. At around 11:00 p.m., approximately 200 customers were holding, with an average response time of 84 seconds.

Additional personnel were requested based on alerts from Energy Management System, Outage Management System, and calls from customers and public agencies.

Day Two – Thursday, December 1, 2011
Storm damage continued to accumulate throughout the day of December 1. However, the majority of the damage to SCE’s infrastructure was sustained by 2:00 p.m. Although many parts of Edison’s service area experienced notable wind and outages during the early morning hours, the storm’s full force was felt in a 114-square-mile area of the San Gabriel Valley consisting largely of residential customers.

Trouble orders were created in the Outage Management System at the Distribution Operations Centers and prioritized first based on public safety and then grouped in order to restore service to as many customers as possible. During the early stages of the event, the Storm Recovery Manager determined that resource needs could be fulfilled through the use of SCE and contract personnel from outlying areas both within and outside the SCE service
area. The resource strategy included re-deploying SCE and contract personnel from non-affected areas to the trouble area and bringing on additional contract personnel not currently working on SCE property. To facilitate re-deployment, SCE cancelled about 50 percent of all planned work in its entire system by 5:30 a.m. December 1.

By 4:00 a.m., the average number of Call Center customers on hold was between 200 and 400, with a corresponding increase in hold times. By 7:00 a.m., staff at SCE’s third party supplier in Texas began reporting for scheduled shifts and handling some of the normal day-to-day call volume as well as some of the outage-related call volume. Once call volumes exceeded SCE’s and the third party supplier’s capacity, calls were rerouted to a SCE’s overflow vendor, which provides interactive voice response services. This call volume and overflow routing continued throughout the day. When call volumes were peaking, some customers were on hold for more than 25 minutes and many were abandoning calls. Call Center management drew upon 18 former Call Center employees now in the Revenue Services Organization and approximately 100 other trained support staff to assist with customer call volume.

Trouble order information in the Outage Management System was not kept up to date, leading to incomplete and inaccurate Outage Alert Notes.

By 7:00 a.m., the Business Unit Storm Support operations were increased to include the staffing of the communications responsibilities. Information was gathered in preparation for internal and external communication.

During this storm event, conference calls were scheduled several times each day to provide status updates, including any safety concerns, the current state of the distribution system, work volumes, resource allocation, media activity, estimated restoration times and other pertinent information. The first of these status calls was conducted at 8:00 a.m. December 1 and continued to be held three times each day for the duration of the event. As a result of this first call, seven additional transmission crews were deployed from other areas to support the storm work in the San Gabriel Valley area due to transmission facility damage.

At 10:00 a.m., Corporate Communications issued a press release indicating that crews had worked throughout the night to quickly and safely restore service and that 211,469 customers were still without service at that time. This and all subsequent press releases also included a list of the most affected communities and emphasized public safety messages.

A command center was established at the Santa Anita race track by 1:00 p.m. While augmenting the operation at SCE’s Monrovia Service Center, this site was established to manage the restoration effort in the San Gabriel Valley area, including dispatching damage assessment teams and field repair crews and providing key storm management personnel access to SCE’s telecommunication network and systems. This site was also used as a staging area to provide ready access to the materials necessary for repairs because SCE’s Monrovia facility was not large enough to hold the anticipated large number of crews and materials required.
SCE issued three press releases in the afternoon of December 1. The 2:00 p.m. release indicated that repair efforts were hampered by debris, and reported what would ultimately represent the peak number of customers without service, a total of 226,053. The 4:00 p.m. and 7:00 p.m. press releases indicated that there were 215,086 and 205,321 customers without service, respectively, and that customers should be prepared to be without service overnight or longer.

By the afternoon of December 1, it was determined that the company’s “wire down” policy, implemented November 1 to protect the public from potentially energized downed wires, was delaying the restoration effort. Field crews were being diverted from restoration efforts to respond to reports of downed wires. At approximately 5:00 p.m., priorities were modified and dual efforts were undertaken to patrol for safety and re-energize the system according to a prioritized list of circuits. This policy modification also resulted in dispatching damage assessment personnel based upon the same priorities.

This change in policy specifically affected the use of Field Service Representatives, who are trained to handle and complete wire-down calls. These personnel were scheduled on a 24-hour basis by Distribution Operations Center and Meter Services Organization supervisors throughout the restoration event. Thirty-two Field Service Representatives were deployed in the San Gabriel Valley area on December 1.

Given the high volume of switching activity and clearance requests made to Mesa Switching Center staff, the issuance of work clearances needed by transmission crews to begin restoration work was not received until approximately 9:00 p.m. that evening, delaying that activity by approximately 15 hours.

Day Three – Friday, December 2, 2011
On December 2, weather conditions had returned to near normal but call volumes were still well above normal, at approximately 95,000, about twice the typical daily volume. Customers were seeking updates both from automated systems and from live agents. At two points during the day, call volume exceeded capacity, and approximately 200 calls were sent to SCE’s overflow vendor for outage updates via the interactive voice response system. Customers were asking for very specific information regarding their electric service, but many Estimated Restoration Time updates were either inaccurate or incomplete. Call Center management instructed front line employees to use the best information available if there were no updates to the estimates. Many front line employees chose to rely on information contained in press releases.

At 6:26 a.m. on December 2, the Lighthipe and Mira Loma switching centers were activated to take over jurisdiction for some of the circuit restoration activities typically handled by the Mesa switching center. This increased the number of qualified personnel available to issue switching orders and work clearances.

A second mobile command center arrived on Friday morning, expanding support for crews, equipment and material, as well as Local Public Affairs, Corporate Communications, Operations Support and other organizations assisting with the event.
At 8:30 a.m., a press release was issued stating that approximately 140,000 customers were still without power and that restoration efforts were continuing. This was the first significant decrease in the number of customers without power from the over 200,000 reported previously.

As a result of the change in the restoration approach during the prior day, at around 2:00 p.m. SCE resumed its normal damage assessment approach. This meant that Damage Assessment Teams were now being dispatched to assess damage in the field and create repair work orders instead of responding to wire down calls. On this day, 23 Field Service Representatives assisted with wire down calls.

By 4:34 p.m., the three storm centers outside of the Eastern Zone—Ridgecrest, El Nido, and Lighthipe—closed, and storm management re-categorized the storm as a Category 1, meaning that SCE had resumed normal operations in those areas. Mesa, Mira Loma and Vista were the only storm centers that remained in operation.

At 6:00 p.m., SCE issued a press release announcing that power had been restored to approximately 65 percent of the customers who had experienced an outage and predicted that 99 percent of the customers who had experienced an outage would be restored by 8:00 p.m. on December 4. This Estimated Restoration Time was calculated based on the rate of customer recovery at that point, extrapolated forward and adjusted to account for known major repair sites that had been identified, adding a small contingency to account for unique problems that often exist.

A conference call was held the evening of December 2 with key SCE organizations associated with disaster outreach to initiate community outreach activities.

Day Four – Saturday, December 3, 2011
On December 3, restoration efforts continued in the Mesa, Mira Loma and Vista sectors. Also, Mesa switching center’s jurisdiction was further subdivided to allow El Nido switching center personnel to issue switching orders and work clearances on behalf of the staff at Mesa.

A press release was issued indicating that SCE would continue to provide basic supplies such as flashlights, water and ice to customers.

On this day, 15 Field Service Representatives assisted with wire down calls, and a similar number assisted through December 6.

Customer Care distribution sites were up and running at 8:00 a.m. on December 3 and continued to remain active, as necessary, through December 7. There were seven distribution sites located in Temple City (2), Arcadia, San Gabriel, Altadena, Sierra Madre and La Canada-Flintridge. Meter Readers assisted with community outreach.

Call Center volume remained elevated during the weekend, with extra staff brought in Saturday and Sunday to handle incoming calls. At this point, customers were becoming frustrated with changing updates to the Estimated Restoration Time and/or reported
restoration targets passing without update. Several calls were elevated to both supervisors and managers for resolution during this period.

Day Five – Sunday, December 4, 2011
Electric service restoration work continued around the clock, with as many as 259 SCE and contract crews, typically four-man crews, along with support personnel focused on restoring service to San Gabriel Valley area residents still without electricity.

Previously, on Friday, December 2, a projection had been made that power for 99 percent of all customers that had experienced interruptions would be restored by 8:00 p.m. on December 4. At 3:00 p.m., a press release was issued indicating that 42,131 customers remained without power. The 99 percent restoration prediction from two days prior was replaced by a prediction of 95 percent restoration.

Day Six – Monday, December 5, 2011
Electric service restoration work in the San Gabriel Valley continued around the clock.

A press advisory was released reminding the public that SCE would once again open five distribution centers for customers affected by the widespread wind-related outages. The centers, where customers could pick up basic supplies, including flashlights, water and ice, would be open from 10:00 a.m. to 4:00 p.m.

At 6:00 p.m., SCE’s systems indicated that 27,872 customers were still without electric service. There were 19 Field Service Representatives responding to wire down reports.

Day Seven – Tuesday, December 6, 2011
Service restoration to the remaining 12,000 customers without electricity continued as crews conducted a street-by-street sweep, repairing damaged lines and transformers in the backyards of customers’ homes.

A press release was issued at 5:00 p.m. indicating that SCE missed some restoration targets in the hardest hit areas due to the extent of the damage and increasingly challenging weather conditions. The press release included a message from Ron Litzinger, SCE President, assuring customers that SCE crews would continue to work around the clock until full restoration to all customers was achieved.

At 5:00 a.m. on December 6, restoration efforts resulted in 99 percent of SCE’s affected customers having their power restored.

Day Eight – Wednesday, December 7, 2011
SCE issued three more press releases at various times during the day. At 5:30 p.m., a press release was issued stating that 1,003 customers were still without electricity, and that SCE would fully cooperate with the CPUC investigation into the outages caused by the storm.

Day Nine – Thursday, December 8, 2011
At 6:21 a.m. on December 8, SCE issued a press release announcing that the system had returned to normal operation.
PROBLEM AREAS IDENTIFIED

An initial review of the events of November 30 to December 8 revealed that the following areas of the storm response appeared to be factors in SCE not meeting expectations in restoration and communication.

Restoration Methods
There was a steep escalation in the rate of power interruptions through the evening of November 30 and into the early morning hours. The total number of customers without power continued to increase until the early afternoon of December 1. During this time, there was limited circuit restoration activity occurring as personnel critical to service restoration were occupied by response to reports of downed wires.

It was not until approximately 2:00 p.m. on December 1 that the restoration approach was modified by inspecting and then energizing circuit sections in a radial fashion, which enabled the restoration of power to progress rapidly.

Later that same evening, the Mesa switching center received more requests for switching orders and work clearances than could be accommodated without causing delays. It was not until 12 hours later, at approximately 6:30 a.m. on December 2, that a procedure enabling Mesa switching center’s jurisdiction to be split was developed and implemented. This resulted in two other switching centers being available, thereby reducing the demands on Mesa switching center resources and avoiding delays in repair and restoration activities.

Modifying SCE’s approach from responding to downed wires to radial circuit restoration at the outset could have shortened restoration activities by as much as 17 hours. In addition, splitting the Mesa switching jurisdiction in advance of the storm could have shortened restoration by another six to eight hours. Taken together, these two actions could have shortened the storm recovery by one day, from seven days to six.

Both of these actions – to modify the restoration approach and split the switching center jurisdiction – were taken in response to the circumstances that existed at the time because they are not included in the Event Response and Recovery Protocol. Had they been included in the plan, they could have been implemented sooner and rapid progress in power restoration could have started hours earlier.
**Outage Alert Notes**

Outage Alert Notes are key to SCE’s ability to communicate with its customers. These notes are generated in the Outage Management System and made available to Customer Service representatives at the call centers so they can communicate outage status and estimated restoration times to customers who call. This same information is made available to the customers via SCE’s interactive voice response system and for those customers who view outage maps on SCE’s internet site.

On December 1, at the peak of customers without power, the Estimated Restoration Times on Outage Alert Notes averaged 12 hours. On December 2, the average increased to 27 hours. The information contained within the Outage Alert Notes did not provide an accurate prediction of service restoration. In fact, the average restoration times given during the storm underestimated the duration of the outage by 21 hours. Additionally, on average, 37 percent of the time the Estimated Restoration Times given had expired. This meant that the message customers would receive would be “no estimate at this time.”

As the number of Outage Alert Notes increased for customers in a given zip code, customers experienced difficulty determining which of the Outage Alert Notes pertained to the specific outage they were experiencing. Also, because of the long list of Notes, many customers hung up after listening to three Outage Alert Notes.
Public Messages
As the restoration efforts continued, press releases were issued indicating, among other things, how many customers remained without service and communities that were most severely affected. Two such press releases established customer and public expectations by providing estimated restoration times. These estimations were not for specific customers or communities that would be restored, but rather were for a percentage of all of the customers who were without service at the peak of interruptions.

At 6:00 p.m. on December 2, SCE communicated that the company expected that 99 percent of 440,148 customers who had experienced an outage would have service restored by 8:00 p.m. on December 4. In the afternoon of December 4, the restoration forecast for 8:00 p.m. that evening was changed from 99 percent to 95 percent. While our current analysis of the data suggests that power was restored to 96 percent of affected customers by this time and date, SCE missed its original prediction of 99 percent.

In addition, SCE forecast that 99.9 percent of affected customers would have service restored by 8:00 p.m., December 5. It was not until December 7 that this restoration target was achieved.

Two primary factors contributed to inaccurate restoration predictions in the press releases. Relying on a trend in the recently experienced restoration rate to predict the future restoration rate did not produce an accurate result. Also, predicted restoration milestones were made before the extent of the damage was well understood.

Call Center
During the November 30 storm the Customer Communications Organization’s call center experienced daily call volumes—over 160,000 at peak—that were approximately three times higher than normal. And when compared to daily peak volumes experienced during previous comparable storms, the peak call volume of this storm was approximately 20 percent higher. As the graph below shows, the hourly call volume peaked at just under 15,000 calls at around 9:00 a.m. on December 1. After that, call volume began to taper off throughout the storm period as restoration efforts began to return service to customers.
The graph below shows the SCE staff used to support the November 30 wind storm compared to normal staffing levels. The approximately 420 call center phone specialists work three different shifts to ensure coverage around the clock. This means that the average peak number of SCE phone specialists scheduled for a given hour is about 200. SCE deployed approximately 270 phone specialists on December 1 to support the call volume. In addition, about 117 additional personnel from the Revenue Services Organization and Customer Communications Organization support staff assisted in handling the excessively high call volume on that day. Beyond that, SCE’s third party supplier provided additional peak staffing of approximately 110 phone specialists.
As call volume began increasing rapidly the morning of December 1, average response times (the time a customer waits to speak to a representative) peaked at more than 20 minutes. As the average response time peaked, so did the number of abandoned calls. Both happened at the same time call volumes peaked.
Resource Deployment

Field Service Representatives and others are trained as Policy/Fire Liaisons and were used during the November 30 storm response. Between 11 and 32 Representatives were deployed each day to respond to the wire down calls. However, at the time of this storm event, a total of 263 SCE employees were trained and available to perform this function. Deploying more of these people may have allowed SCE to more quickly reduce the number of wire down calls pending.

Additionally, during recovery efforts following the storm, the Storm Recovery Manager, in consultation with business line storm leadership, determined that declaring a Category 3 storm and requesting mutual assistance support from other utilities would not substantially expedite restoration of electric service.

The ongoing assessment of the storm damage in the San Gabriel Valley area identified significant access issues due to the large number of trees down in the streets and backyards, which would limit the number of crews that could reasonably be assigned to a particular location. This information, in addition to the availability of SCE crews and contract crews, and the typical deployment times for mutual assistance crews (normally 48 to 72 hours) and the need to dedicate substantial resources to assimilating those crews, supported the decision not to request mutual assistance.
It should be noted that SCE did inquire regarding Pacific Gas & Electric’s ability to provide mutual assistance on Thursday, December 1. At that time, PG&E was also under storm conditions (albeit less severe than those encountered by SCE) and was unable to commit to any mutual assistance crews. Throughout the storm recovery efforts, SCE continually reevaluated the potential use of mutual assistance. Each time, SCE management confirmed its prior decision to not request it.

Although requesting mutual assistance would not have materially affected SCE’s storm response, there are opportunities to make mutual assistance more effective. Those are discussed in the section titled Additional Areas for Improvement.

**Human Performance**

The concentration of damage experienced during this event was unique in SCE’s historical storm experiences. However, there was a delay in the recognition that the circumstances that existed in the San Gabriel Valley area were unprecedented. In addition, there were missed opportunities to adjust service restoration and customer communication procedures.

For example, downgrading the storm from a Category 2 to Category 1 at approximately 4:30 p.m. on December 2 appears, in hindsight, at odds with the actual conditions on the ground. This decision was made based on storm categorization criteria that are vaguely written and subject to interpretation. Category 3 is indicated when it is anticipated that service restoration cannot be completed within 72 hours with available SCE resources. Category 1 is indicated when the storm response is limited to one geographic zone. In this case, both criteria were met once the storm centers in other geographic areas were closed. The downgrading of the storm categories may have signaled that the restoration requirements were well understood and return to normal operations was within view, which in hindsight was not the case.

The first storm center opened on November 30 at 4:59 p.m. SCE declared the storm a Category 2 because the storm affected multiple areas. SCE did not declare the storm a Category 3, implying that it expected service restoration by 5:00 p.m. on December 3, within the 72-hour target. Both of these decisions: a) not to declare Category 3 and b) downgrade from Category 2 to Category 1, did not correlate with the actual restoration times achieved.

These decisions regarding storm categories were not determined to be root or contributing causes of SCE’s performance not meeting expectations. However, there are opportunities to clarify the categories and when they should be declared, which are discussed in the Additional Areas for Improvement section.

**ROOT CAUSE EVALUATION**

**Introduction**

The purpose of this evaluation is to identify causes and recommend changes in those areas where SCE’s performance during and after the November 30 storm did not meet expectations.
The evaluation was commissioned by SCE executive management to ensure a full understanding of the problems, knowing that a Root Cause Evaluation will follow standardized methodologies. The evaluation was led by an independent, contracted, industry-recognized cause evaluator, assisted by a San Onofre Nuclear Generating Station employee who is also qualified to perform Root Cause Evaluations. Multiple personnel within SCE supported the data gathering and analysis functions.

This evaluation examines the conditions that led to the failure to meet expectations and the causes of those conditions. Much of the information considered in this evaluation was not available to the organizations, management or individual personnel at the time decisions were made. Root Cause Evaluations are intended to assure that conditions that contributed to the performance issues are promptly identified and alternative measures are suggested to improve performance. (A more detailed explanation of Root Cause Evaluations can be found in Appendix C.)

This evaluation does not attempt to determine if any of the actions or decisions of management, vendors, internal organizations or individual personnel during the event were reasonable or prudent based on the information available at the time. This is an important distinction, and it should be clear to outside reviewers that this evaluation is not a “reasonableness” or “prudence” review, to prevent statements and conclusions included herein from being taken out of context.

**Problem Statement**

SCE has an expectation that all power typically will be restored within 72 hours of a Category 1 or Category 2 storm declaration, and that SCE customers be provided reliable power restoration estimates. In the November 30 wind storm, SCE's initial expectations were that power would be restored within 72 hours; however, power restoration was not achieved until December 8, approximately 177 hours after the Category 2 declaration. Additionally, SCE provided customers with inaccurate power restoration projections several times during the storm period. As a result, SCE opened itself to increased stakeholder criticism and a potential loss of customer confidence.

**Analysis Method**

This analysis involved a critical review of SCE performance, based on the problem statement, using industry-recognized systematic processes. A Cause and Effect Analysis began by stating the problem and sequentially asking what circumstances existed or were necessary to cause the performance issue in question. This process was followed until reaching an underlying cause, which if corrected, would improve performance.

The analysis started with failure to meet management expectations in two major areas: actual time of restoration of service, and internal and external communication of estimated restoration times.
As a starting point, analysis of the failure to meet restoration expectations was based on three initial observations:

- The magnitude of the storm damage was not recognized early in the event.
- There was a failure to effectively use internal corporate resources, such as not opening the Corporate Emergency Operations Center.
- There was a failure to effectively use SCE and contractor field resources, such as Field Service Representatives on wire down calls and additional non-source SCE contractors.

Analysis of the failure to meet communication expectations was based on two initial observations:

- Internal pre-storm communication was ineffective.
- Restoration phase communication was ineffective.

The results of the analysis produced two root causes and three contributing causes.

**Root Causes, Contributing Causes and Corrective Actions**

This section provides the detailed basis for the root and contributing causes. It also includes recommended corrective actions and interim actions to improve performance. Although explained individually, the causes are interrelated.

**Root Cause 1: SCE’s methods for collecting and analyzing storm damage information are not sufficient for events of this magnitude, limiting its ability to make accurate and timely damage assessments and estimated restoration times.**

**Basis:** During this event, some storm response managers were not aware that 117 circuit breakers—a considerably higher number than normally experienced—associated with the Mesa Sector were open until Friday, December 2. Had that information been readily available, management would have recognized the significance of the damage and recommended escalation of the storm category.

Early in the event, the Outage Management System provided indications that a large number of people had called in reports of downed wires. The Outage Management System also had indication that a significant number of breakers were open. What was not recognized was that the number of breakers open could have been considered in relation to the number of downed wire calls and “no-lights” calls to establish that there was such widespread damage that restoring power to a large number of people would not occur simply with a few breaker closures.

Because of all the factors previously discussed, the normal damage assessment method could not provide an accurate early damage and restoration estimate. This storm was sufficiently different from other storms that it required a different damage assessment methodology. In reviewing the Event Response and Recovery Protocol, it provides no direction on how to deal with situations where the normal damage assessment cannot be performed.

In addition to the damage assessment problem, there are also issues with development of Estimated Restoration Times. The current system relies on individual estimates based on
reports from Troubemen or Damage Assessment Teams. There is no requirement in the Event Response and Recovery Protocol to compare the estimated man-hours of repair to available resources to determine an overall Estimated Restoration Time. The initial estimate developed for publication, which proved to be inaccurate, was based on review of the customer return-to-service rate trend at the time and review of a limited number of major restoration projects. Personnel developing this Estimated Restoration Time were using what they believed was the best method at the time.

In hindsight, there was sufficient information available to make an early assessment of damage. Doing so would have required integration of all available information from the Outage Management System, Energy Management System, Damage Assessment Teams and area survey reports. The Outage Management System reflected approximately 6,200 incidents. Within that 6,200 were indications that 117 breakers were open. That system was not set up to automatically integrate this information to make clear at a glance the number of breakers that were open. (This is not to say that the information could not have been sorted to provide it, but there was no direction to do so.)

The Event Response and Recovery Protocol is not written to deal with situations where on-the-ground damage assessment cannot be performed or performed in a timely manner. In situations where there is high concentration damage and damage assessment cannot be performed as expected, an initial damage assessment must rely on integration of available information.

**Relevant Best Practices:** Both American Electric Power and Alabama Power use a number of data sources for the purpose of understanding the magnitude of an event in its early stages. Their primary data sources are call volume in their Outage Management Systems, the circuit related activity available via their Supervisory Control and Data Acquisition (SCADA) systems, and their very early and intentionally cursory field assessment.

With regard to the field assessment, both utilities dispatch a number of qualified individuals to the hardest-hit areas, as identified by Outage Management System and SCADA, to perform a cursory field assessment of circuits known to be interrupted. A simple document is produced providing the number of poles, wire spans or transformers affected. The time allocated to this early assessment is limited to four hours, and no switching, repair work or detailed damage assessment documentation is performed.

The results of the field assessment are extrapolated to estimate the extent of damage, resources required and restoration projections based on available resources. The assessments also can result in a request for mutual assistance from other Southeastern Electrical Exchange members or non-members as well as contract crews.

**Corrective Action 1:** Develop an improved damage assessment method that integrates information from the Outage Management System, Energy Management System, Damage Assessment Teams, Troubemen and Call Centers. The final damage restoration projections should establish a conservative estimated restoration time based on initial damage assessment, plus extra time for contingencies. Integrate the output of this methodology with formal communications to the appropriate SCE storm and senior leadership team.
Interim Action 1: Develop a tool for assessing damage and estimating restoration time, to be used by the Storm Recovery Manager, that includes the following:

- Information to determine the magnitude of the damage, such as circuit breaker positions (open vs. closed), wire down calls, quick field assessment reports, analysis of circuit problems and potential causes;
- Standard wire down, pole down, transformer down and damage restoration estimates;
- Equations that use standard travel times, parts acquisition, crew deployments and restoration estimates to determine overall restoration time;
- Contingency times to be added based on incomplete information;
- A roster for storm response that includes personnel in the organization capable of implementing this damage assessment tool.

Root Cause 2: SCE policies, such as those regarding safety around downed wires, can delay damage estimates and restoration efforts in major storms, but the company’s Event Response and Recovery Protocol does not take those effects into account, preventing it from adjusting its response to compensate for those delays.

Basis: Three policies affected the November 30 storm event: 1) the wire down policy; 2) System Operating Bulletin 322 (Operation of Distribution Lines in Fire Hazard Areas); and 3) the grounding to support tree trimming policy. The wire down policy was implemented on November 1 and was a full time policy. Therefore, it would have a definite impact on restoration efforts. SOB 322 is implemented only when red flag conditions are declared, indicating a high fire hazard. Therefore, it only impacts restoration efforts when in effect and only in designated fire hazard areas. The grounding to support tree trimming policy was part of the contract with the tree trimming contractor but had not been invoked previously. Therefore, SCE did not have a policy to address it and had not previously reviewed its potential impact on restoration efforts.

The wire down policy was one of the primary contributors to extended damage assessment and restoration times. This policy established a downed wire as a priority requiring an immediate response. It was implemented to ensure public safety, and under most conditions does not adversely affect power restoration times. Under normal conditions, there is typically a small number of wire down calls and there are a sufficient number of personnel to respond. During the November 30 storm, the Mesa area received 3,275 wire down calls. Immediate response to these calls required Troubemen and Damage Assessment Team personnel to secure the area. Troubemen typically identify issues, and if possible, restore power. Because of the high number of calls, Troubemen were diverted from the power restoration efforts normally performed. Damage Assessment Teams typically evaluate damage and generate documents necessary to create work orders to allow power restoration. Because the high number of wire down calls exceeded the capability of the Troubemen, Damage Assessment Teams were required to assist with those calls and could neither assess damage nor generate the documents necessary to create the work orders. The delay in the assessment of damage resulted in storm management personnel not having a clear picture of the magnitude of the damage early in the event.
Another aspect of the wire down guideline that increased workload is the fact that a customer's wire down call to SCE does not distinguish between a power wire and a cable television or telephone wire. This creates a situation where SCE personnel were responding to what in some cases were non-SCE problems. The problems caused by this policy were recognized relatively early in the event and the restoration approach was modified within 24 hours, but this was not widely recognized by field personnel until much later.

System Operating Bulletin 322 is a policy that is implemented when there are weather conditions that create an elevated fire hazard. During this storm, red flag conditions were in effect in Los Angeles County from 9:00 p.m., November 29, to 6:00 p.m., December 2. The intent of the policy is to minimize the probability of starting a fire by energizing a line that is faulted, which may result in sparks. During normal system operations, a momentary fault, such as a palm frond blowing across a wire, would result in a circuit breaker opening (stopping the flow of electricity) and after 30 seconds automatically reclosing (resuming electricity in the line). If the breaker remains closed, that is an indication the fault is cleared and power has been restored. When SOB 322 is in effect, however, the automatic re-closing function is disabled to minimize the possibility of sparks that could occur if the fault still exists when the system attempts to reclose the breaker. Therefore, the breaker remains open even if the fault has cleared. With SOB 322, a breaker trip must be followed by a visual inspection of the line to ensure the line is clear and that it is safe to re-energize it. During this storm, some breakers were in the normal automatic mode and some were in automatic re-closure blocked mode. As a result, when 117 circuit breakers were identified as tripped, it was not clear which ones were open due to a fault that did not clear (open-close-open cycle) and which ones were open due to SOB 322 being in effect (open only). Regardless of which breakers were which, storm response management decided to treat all breakers as meeting SOB 322 requirements and requested an inspection of each line before it would be energized. This approach to restoration preserved public safety, but it also slowed the overall pace of restoration.

SCE uses a contractor for tree trimming services. The contract with the service, established five years ago, contains a provision for tree removal that involves downed wires. The provision stated that trees with wires in them would require grounding on either side of the tree prior to the start of work. This provision had not been implemented prior to the November 30 storm. During this storm, because of the extensive amount of damage, the contractor believed it was necessary to implement this provision to protect its workers. SCE, not having dealt with this provision previously, was not fully aware of the provision prior to the storm. As a result, tree trimming crews were dispatched to remove trees and arrived at the sites before the wires had been grounded. In some cases, the storm center would be notified to send someone to ground the wire, and the tree removal crew would leave, to return only after grounding was applied. This caused additional delays in service restoration.

During this evaluation, the team did not try to determine whether these policy implementations were correct. Each was implemented for a specific safety reason. However, the policies did affect the power restoration and damage assessment efforts. Had they been evaluated before the storm for their impact on restoration, some basic choices could have been made, including:
• Leave the policy in effect and adjust the storm response plan to account for the additional required resources. (For example, call in a large number of Field Service Representatives to assist Troubemen and respond to all wire down calls.)

• Create the policy such that it could be suspended under storm restoration conditions. (For example, during storm response, respond only to those wire down calls in which downed lines are associated with closed circuit breakers.)

**Relevant Best Practices:** The Vice President of Power Delivery Distribution at Alabama Power indicates that no policy is published or implemented without his review and authorization. His organization employs a wire-down protocol similar to SCE’s policy, however, the approach is modified during storm events.

**Corrective Action 2:** Assess the impact of any new or changed T&D policies against the ability of the organization to restore power following a storm or major event. This assessment should include part time requirements, such as SOB 322, and what provisions need to be adjusted in order to facilitate timely restoration of power. The intent is to ensure any changes that affect the ability to restore power are evaluated against the response plan protocol, so the protocol can be adjusted to compensate for those effects.

**Interim Action 2:** Revise the “Troubleman Trouble Call Response Guidelines” to improve restoration time without compromising public safety. Review the new policy against impacts and risks associated with the Event Response and Recovery Protocol. This new policy would be analyzed for its impact to storm restoration and then reviewed and approved by the appropriate senior leadership before implementation. Consideration should be taken for use of other resources, such as Field Service Representatives, to maintain safety to the public and allow first responders to focus on service restoration.

**Contributing Cause 1: SCE’s Event Response and Recovery Protocol is not sufficient for responding to extensive, high concentration storm damage.**

**Basis:** The Event Response and Recovery Protocol is designed to be expandable to cover a growing number of storm centers, but it does not provide specific direction on how to deal with overloads at individual storm centers. In situations normally experienced by SCE, the Protocol has functioned well to activate storm centers and mobilize personnel. The key difference in this storm was the high concentration of damage, which required a significantly higher volume of work to be processed through a single work control center. (“Work control center” is a term that encompasses switching, clearances, work order processing and assignment of work, and is not a physical location).

SCE initially attempted to manage the high workload using the normally established practices. As the response continued, storm management recognized this was not working and made adjustments to alleviate the bottlenecks. One example of this adjustment was “split jurisdiction” for clearances. This process splits responsibility for switching and clearances normally assigned to one work center between two or more work centers. This allows parallel processing of clearances while maintaining safety. This process could similarly be applied to other aspects of getting work done.
Work status reporting ("damage assessment complete" and "restoration work complete") became an issue during this storm, in that failure to complete damage assessments (along with associated Estimated Restoration Times) resulted in incomplete or incorrect information in the Outage Management System. This incorrect or incomplete information was provided to customers through the interactive voice response call center and outage map. Failure to update work status also hindered the organization’s ability to accurately track completion of work. The impact was twofold: it limited management’s ability to track actual status and predict future progress, and it resulted in increased frustration on the part of customers based on receiving multiple inaccurate Estimated Restoration Times.

Relevant Best Practices: Whereas SCE dispatched teams to begin switching and restoration by circuit or substation, the jurisdictional control was maintained at one or more switching centers. In similar events, Alabama Power also divides the restoration activities into smaller geographic areas. However, the jurisdictional control is transferred to an individual who is effectively a member of the restoration team. This enables Alabama Power to avoid any delays in the issuance of switching orders or work clearances.

Corrective Action 3: Revise the Event Response and Recovery Protocol to address the following:

- Develop clear guidelines for activation of the Corporate Emergency Operations Center.
- Assign damage assessment responsibilities to minimize overlapping damage reporting.
- Deploy work crews with the appropriate personnel assigned when work group coordination is required. (For example: Deploying grounding personnel with line clearing crew when grounding requirement is in effect.)
- Implement split jurisdictional control for switching, clearance and assignment of work for events involving extensive, high concentration damage where clearance and switching requests exceed switching center capability.
- Provide additional resources to track and input work status in Outage Management System.

The desired outcome of Corrective Action 3 is to: 1) ensure that regardless of the geographic size of the problem, cases involving large numbers of customers where power cannot be quickly restored are promptly elevated to ensure that company leadership is engaged in problem resolution; 2) recognize that high density damage may require deployment of crews with significantly different makeup than normal to provide the most effective response; and 3) recognize that high density damage has the capability to overload the normal work control capacities, such as issuance of work clearances and switching orders, and establish a protocol that facilitates timely division of responsibilities.

Interim Action 3: Develop a method to split jurisdictional responsibility and temporarily assign switching restoration activities to operators at adjacent switching centers.

Periodically, workload on Switching Center employees exceeds their ability to comprehensively manage the affected area. A typical symptom of this is a delay in issuing switching orders or line and equipment clearances. When these delays significantly affect the restoration times, jurisdiction can be transferred to an adjacent Switching Center to assist in managing the restoration effort.
Contributing Cause 2: SCE’s storm response communication plan is not sufficient for setting realistic expectations for service restoration during major events.

Basis: During the November 30 storm response, there was a high degree of frustration on the part of customers and media in obtaining accurate information. Although pre-storm announcements were made, they were not made with an expected amount of damage in mind based on the prediction. There was not a pre-storm communication strategy that monitored the actual weather related conditions and location. SCE failed to use historical data to estimate the damage and required communication response, and failed to have a strategy to recognize that things were not going as expected and make adjustments. This induced the organization to rely on normal communication methods that, although acceptable for typical storms, did not work in this case.

The storm started on November 30, and with the phone system overloaded and the online outage maps inaccurate, the first public Estimated Restoration Time was not issued until December 2. It provided a specific date and time by which a certain percentage of customers would have service restored. Those targets were not met. Two days later, a second estimate was provided, and those targets also were not met.

Another example of the problems encountered is associated with the call center. The high concentration damage resulted in a large number of area-specific Estimated Restoration Times available on the phone system. The phone estimates are based on the information in the Outage Management System. If that system is incorrect, phone messages (both system generated and from phone responders) will be incorrect, too. Because of delays in getting data into the Outage Management System regarding work status and restoration estimates, the system would use default numbers which were typically four hours. In addition, customers were required to wade through long lists of areas to obtain the one that applied to them, and in many cases that message provided inaccurate information. Another phone issue arose when callers were required to go through a high number of menu selections to obtain a person to talk to.

Relevant Best Practices: In terms of customer communications at call centers, American Electric Power employs an approach that minimizes the likelihood of giving inaccurate information to specific customers who call for outage status information. This approach also reduces call center staffing requirements and demand on the call center telecommunications infrastructure.

Where damage is excessive and highly concentrated geographically, American Electric Power provides an event-level message that describes, in general, the circumstances of the event and an indication that restoration will be ongoing during the upcoming days. This message is intended for all customers affected by an outage in a broad geographic area and is consistent with early press releases.

Once damage assessment is largely complete and repair work packages are produced, American Electric Power transitions to a more granular level message indicating when repair crews are expected to be dispatched. This message is intended for all customers affected by
a particular circuit outage. Once dispatched, the repair crew makes updates to the outage information indicating the date and time that repairs will be complete and service restored to particular customers.

Corrective Action 4: Establish a communication strategy that includes:

- Protocol for keeping SCE employees informed in affected areas;
- Use of standard numbers for current response status and projections, including the source of the numbers and the person responsible for them;
- Use of historical storm data to predict call volume based on weather predictions;
- Use of SCE area-specific weather predictions to refine National Weather Service predictions;
- Monitoring the storm as it occurs to detect consequential differences between its predicted severity and area of impact versus the actual;
- Changing the automated voice messages to report that damage is different than expected, particularly for high concentration damage;
- Crafting message content to manage public expectations.

Contributing Cause 3: SCE does not have a method to reliably compare actual restoration rates relative to predicted rates in order to gauge whether Estimated Restoration Times will be met.

Basis: During this storm response, SCE provided the news media two Estimated Restoration Times that were not met. Restoration progress was monitored during the storm, but expected service restoration rates were not formally established for the purpose of comparing actual results to predicted restoration assumptions. As such, there were no reliable early indications that the overall restoration estimates would not be met.

Relevant Best Practices: Alabama Power monitors its restoration rate and progress toward meeting predicted restoration milestones, and it generally expects to see the number of customers experiencing an outage reduced by half every 24 hours. This approach accounts for normal restoration experiences in which large numbers of customers have service restored relatively quickly by operating switches to reconfigure the distribution system. The remaining repairs are generally prioritized based upon the number of customers without service in each area. As a result, the rate at which customer restoration occurs decreases during the normal course of the restoration while repair activity remains constant. Based upon its historical data, Alabama Power indicates that once the number of customers without service drops below 20,000, complete restoration will be within 24 hours.

Corrective Action 5: Revise the Event Response and Recovery Protocol to include the following:

- Requirement to monitor restoration rate with clearly defined roles and responsibilities;
- Method used for monitoring restoration rate;
- Actions to take when projections will not be met.
Additional Areas for Improvement

Since beginning this Root Cause Evaluation, SCE has engaged with various stakeholders and received feedback and additional suggestions for improving restoration, communication with customers, and cooperation with agencies and communities. SCE has also received and reviewed the February 1, 2012, report prepared by the Consumer Protection and Safety Division of the California Public Utilities Commission.

SCE participated in the CPUC’s January 26, 2012, public participation hearing held in Temple City. SCE also engaged with policymakers in an additional hearing on February 3, 2012. SCE met with the city managers and other stakeholders representing fifteen affected cities, and with other city mayors and local officials, to gather their input. SCE has worked with first responders to discuss how to best coordinate resources in a major event such as the November 30 windstorm. Finally, SCE has worked with its own employees to discuss how to better provide service and communications during major incidents.

As a result of these activities, SCE has identified additional opportunities for improving SCE’s Event Response and Recovery Protocol:

Storm Categorization: Revise the storm categorization criteria to ensure their appropriateness and clarity, including the efficacy of maintaining the highest category declared until normal operations are resumed.

Mutual Assistance: Revise the mutual assistance component of the Protocol to ensure the use of Mutual Assistance is more proactively encouraged and initiated when conditions warrant it. Identify ways to improve integration of mutual assistance crews by reducing their mobilization time and increasing their self-sufficiency.

Incident Command System: Review SCE’s Incident Command System, used for emergency management, to identify opportunities for integration and cohesion between the ICS and the Emergency Operations Center. Implement those improvement opportunities where appropriate.

Event Recovery Manager: Review the Event Recovery Manager role to add clarity to the position as it relates to storms, including triggers that warrant the staffing of this role and a determination of the appropriate span of control. This should factor into how to perform jurisdictional split as discussed in Corrective Action 3.

Staffing: Review the description of organizational response for each storm classification and clarify the methodologies used to establish minimum staffing requirements and develop storm organization charts and rosters.

Outage Management System: Assess system performance during major storm events when levels of outage data surge. Also review and improve the algorithms that the OMS uses to predict the extent of outages to enhance the accuracy of these predictions.
**Smart Meters:** Evaluate both interim and permanent solutions involving the use of Smart Meter data in damage assessment and restoration activities. This includes using the data for the early assessment of customer outages to help determine the magnitude of system damage and to determine the number of customers still remaining without power during the restoration activities.

**Work Flow:** Assess the performance of the repair work initiation capability of the field crews’ mobile devices, as well as the effectiveness of the process from the point at which repair orders are created, materials are ordered and filled, work is scheduled and crews are dispatched. Identify opportunities to improve performance and implement those that provide the most benefit and are also the most feasible.

**Call Center Capacity:** Review the Call Center infrastructure, processes, technology and staffing capacity requirements during events where information updates are provided to discrete groups of customers affected by an outage, versus those occasions when community-wide or event-level messaging is appropriate. Identify opportunities to improve performance and implement those that provide the most benefit and are also the most feasible.

**Stakeholder Coordination and Communication:** Identify and implement improvements in emergency communications with public agencies and elected officials.

**Medical Baseline Customers:** Identify and implement opportunities to identify and communicate more effectively with Medical Baseline customers during an outage. In addition to SCE’s current communication methods (SMS text, phone, email, or TTY), SCE will now attempt to contact all affected Medical Baseline customers via telephone if SCE determines that an unplanned outage will exceed 12 hours to let them know of the extended outage and encourage them to prepare their back-up plan. If a Medical Baseline customer cannot be reached by telephone, field personnel will be dispatched to the customer’s home to give the customer this information in person. If the customer is not at home at that time, then a door hanger will be left providing outage and safety information. Reports that track contact with Medical Baseline customers will be developed and used to ensure that all customers are contacted. Additionally, Regional Centers with reverse 911 capabilities will be used to notify these customers about the extended outage as well as provide status updates.

**Information Access:** Review and implement, as appropriate, text messaging, e-mail, webinars and conference calls to update elected officials, first responders, Community Emergency Response Teams (CERTs), CERT leaders and other community-based organizations. Also, consider use of reverse 911 capabilities.

**Education:** Conduct training for Community Emergency Response Teams on basic electrical safety. Invite CERT instructors to SCE for more detailed training on our system.

**Volunteers:** SCE will encourage its employees to join Community Emergency Response Teams (CERT) in their communities. Specifically, SCE is contacting members of the employee resource group SAFE 24/7 and SCE’s Red Cross-trained Disaster Shelter Team to encourage employees to volunteer for CERT.
**Pole-Loading:** Assess available pole-loading calculation software and select optimum program(s) to provide accuracy, ease of training and use, and compatibility with other SCE information systems. Work with all joint pole stakeholders and CPUC staff to improve and clarify responsibilities for assuring that in-service poles with new attachments will continue to meet GO 95 safety factors.
## Appendix A

### Cause to Corrective Action Matrix

<table>
<thead>
<tr>
<th>Root Cause Addressed</th>
<th>Corrective Actions</th>
<th>Interim Actions</th>
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<tbody>
<tr>
<td><strong>Root Cause 1</strong></td>
<td><strong>Corrective Action 1</strong></td>
<td><strong>Interim Action 1</strong></td>
</tr>
</tbody>
</table>
| SCE’s methods for collecting and analyzing storm damage information are not sufficient for events of this magnitude, limiting its ability to make accurate and timely damage assessments and estimated restoration times. | Develop an improved damage assessment method that integrates information from the Outage Management System, Energy Management System, Damage Assessment Teams, Troubemen and Call Centers. The final damage restoration projections should establish a conservative estimated restoration time based on initial damage assessment, plus extra time for contingencies. Integrate the output of this methodology with formal communications to the appropriate SCE storm and senior leadership team. | Develop a tool for assessing damage assessment and estimating restoration time, to be used by the Storm Recovery Manager that includes the following:  
- Information to determine the magnitude of the damage such as: circuit breaker positions (open vs. closed), wire down calls, quick field assessment reports, analysis of circuit problems and potential causes;  
- Standard wire down, pole down, transformer down and damage restoration estimates;  
- Equations that use standard travel times, parts acquisition, crew deployments and restoration estimates to determine overall restoration time;  
- Contingency times to be added based on incomplete information;  
- A roster for storm response that includes personnel in the organization capable of implementing this damage assessment tool. |
### Root Cause 2
SCE policies, such as those regarding safety around downed wires, can delay damage estimates and restoration efforts in major storms, but the company's Event Response and Recovery Protocol does not take those effects into account, preventing it from adjusting its response to compensate for those delays.

### Corrective Action 2
Assess the impact of any new or changed T&D policies against the ability of the organization to restore power following a storm or major event.

This assessment should include part time requirements, such as System Operating Bulletin 322, and what provisions need to be adjusted in order to facilitate timely restoration of power.

### Interim Action 2
Revise the “Troubleman Trouble Call Response Guidelines” to improve restoration time without compromising public safety. Review the new policy against impacts and risks associated with the Event Response and Recovery Protocol. This new policy would be analyzed for its impact to storm restoration and then reviewed and approved by the appropriate senior leadership before implementation. Consideration should be taken for use of other resources, such as Field Service Representatives, to maintain safety to the public and allow first responders to focus on service restoration.
<table>
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<th>Contributing Cause Addressed</th>
<th>Corrective Actions</th>
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</table>
| **Contributing Cause 1**    | **Corrective Action 3**  
SCE’s Event Response and Recovery Protocol is not sufficient for responding to extensive, high concentration storm damage.  

- Revise the Event Response and Recovery Protocol to address the following:
  - Develop clear guidelines for activation of the Corporate Emergency Operations Center.
  - Assign damage assessment responsibilities to minimize overlapping damage reporting.
  - Deploy work crews with the appropriate personnel assigned when work group coordination is required. (For example: Deploying grounding personnel with line clearing crew when grounding requirement is in effect.)
  - Implement split jurisdictional control for switching, clearance and assignment of work for events involving extensive, high concentration damage where clearance and switching requests exceed switching center capability.
  - Provide additional resources to track and input work status in Outage Management System.  
| **Interim Action 3**         | Develop a method to split jurisdictional responsibility and temporarily assign switching restoration activities to operators at adjacent switching centers.  
Periodically, workload on Switching Center employees exceeds their ability to comprehensively manage the affected area. A typical symptom of this is a delay in issuing switching orders or line and equipment clearances. When these delays significantly affect the restoration times, jurisdiction can be transferred to an adjacent Switching Center to assist in managing the restoration effort. |
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<tr>
<th>Contributing Cause 2</th>
<th>Corrective Action 4</th>
<th>Interim Actions</th>
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| SCE’s storm response communication plan is not sufficient for setting realistic expectations for service restoration during major events. | Establish a communication strategy that includes:  
- Protocol for keeping SCE employees informed in affected areas  
- Use of standard numbers for current response status and projections, including the source of the numbers and the person responsible for them;  
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- Monitoring the storm as it occurs to detect consequential differences between its predicted severity and area of impact versus the actual;  
- Changing the automated voice messages to reflect damage being different than expected, particularly for high concentration damage;  
- Crafting message content to manage public expectations. | None |
Contributing Cause 3
SCE does not have a method to reliably compare actual restoration rates relative to predicted rates in order to gauge whether Estimated Restoration Times will be met.

Corrective Action 5
Revise the Event Response and Recovery Protocol to include the following:
• Requirement to monitor restoration rate with clearly defined roles and responsibilities;
• Method used for monitoring restoration rate;
• Actions to take when projections will not be met.

Interim Actions
None

Additional Opportunities for Improvement
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Appendix B
Attachment 1
SCE Service Area Map
Attachment 2
Detail Map of Area Affected by November 30, 2011, Wind Storm
Appendix C

Root Cause Evaluation Description

Root Cause Evaluation is a standardized methodology used to ensure that, when analyzing the causes of an event, evaluators look beyond the obvious explanations and address the underlying “root causes” that may not be as apparent but were the key factors in the event. This methodology is based on the belief that addressing obvious symptoms serves only as a short-term solution and may not prevent the problems from occurring again.

Root Cause Evaluations use a variety of problem-solving methods to identify and correct the causes of an event, especially the root causes. All of these methods are designed to identify and analyze the factors that affected a particular outcome, including problems with procedures, management, methods, materials, machines and equipment, environment or human error.

Root Cause Evaluations have been applied across many industry sectors and disciplines. The process involves defining the problem, investigating through gathering evidence, identifying root causes, proposing corrective actions, implementing solutions and, finally, monitoring those solutions to ensure they continue to prevent the original problem from recurring. Developing solutions includes a review of internal and external best practices.

At its most basic, the process asks three questions, which together provide the framework of a Root Cause Evaluation investigation: 1. What was the problem? 2. What were the causes of the problem? 3. What actions should be taken to prevent the problem from occurring again?

Some commonly used terms:

Root Cause – An underlying reason for an event or problem that, if addressed, could prevent recurrence.

Contributing Cause – A condition or event that increases the frequency or severity of a problem.

Corrective Action – Actions identified as part of the Root Cause Evaluation, which once implemented, would eliminate the causes of the problem or event and prevent recurrence.

Interim Action – Actions taken before the Corrective Actions are fully implemented such that, if the same sequence of events occurred again, the problems could be prevented or at least minimized.