Unitil's Response to the 2008 Ice Storm

Self-Assessment Report

March 25, 2009

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EXECUTIVE SUMMARY

This Self-Assessment Report ("Report") reviews Unitil's performance in restoring power to approximately 69,000 customers after the December 11-12, 2008, ice storm ("2008 Ice Storm") to identify "lessons learned" and to prepare a set of specific recommendations that, when implemented, will improve Unitil's ability to withstand and respond to a future major storm or other emergency of comparable magnitude to the 2008 Ice Storm. The Report includes a review of actions taken leading up to the 2008 Ice Storm, throughout the restoration period, and subsequent to restoration of all storm-related outages in order to provide a context for lessons learned and recommended changes.

The 2008 Ice Storm was extraordinary as measured by its impact on customers, the physical damage to electric facilities, and the amount of work required to restore power. Unitil was not the only utility that experienced extreme outages as a result of the 2008 Ice Storm, as utilities across the state and region reported more than one million customers out of power at the peak.

The table on the following page tells the story of the 2008 Ice Storm "by the numbers" and includes quantities of materials and supplies used during the restoration process. By any measure, Unitil's Fitchburg division experienced the most extensive damage, followed by the Seacoast division. The more extensive damage reflected in the Fitchburg territory is consistent with the damage reported in neighboring communities in Massachusetts and New Hampshire that are served by other utilities.

Unitil restored power to its last customer on December 25, almost two weeks after the storm hit.[1] This was accomplished through the efforts of Unitil's employees with the assistance of additional crews that had traveled from as far away as Tennessee to help restore power. Many of these men and women worked 16-hour shifts for the entire stretch. The crews, in

[1] It is difficult to determine precisely when the last customer affected by the 2008 Ice Storm was restored because high winds caused additional outages on December 25. Unitil believes that there were very few customers remaining without power when the last trucks returned after midnight on December 24.

particular, worked under very difficult conditions, including seven consecutive days of sub-freezing temperatures and two substantial snowstorms.

2008 Ice Storm By the Numbers

	Fitchburg	Seacoast	Capitol	Total
Customers Without Power				
Total Number of Customers	28,496	44,230	28,844	101,570
Customers without Power at Peak	28,496	29,250	10,746	69,041
Percent of Customers without Power	100%	66%	37%	68%
Restoration Date	Dec 25	Dec 23	Dec 20	
Weather Conditions				
Freezing Rain (inches)	2.1	2.0	2.2	
Average Storm Temperature (ºF)	32	31	30	
Average Restoration Temperature (ºF)	27	27	25	
Crews				
Maximum	299	64	20	328
Average	100	29	7	135
Call Center (Dec 11 – 25)				
Received by the IVR	**Not Available by Division**			164,136
Answered by a Representative				32,327
Trouble Tickets	9,433	9,195	3,389	22,017
Materials and Supplies				
Feet of Primary Wire Replaced	146,226	53,482	8,590	208,298
Feet of Secondary and Service Wire Replaced	46,503	28,042	2,898	77,443
New Poles Set (Unitil Only)	212	52	15	279
Crossarms	281	210	29	520
Transformers	170	50	21	241
Fuse Links	2,000	1,100	600	3,700
Splices	6,000	4,000	4,000	14,000

The Report identifies the following 28 recommendations that will improve Unitil's ability to prepare for and respond to future outages. They cover every aspect of responding to a major storm, including preparations for an impending storm, damage assessment, power restoration activities, logistics support, public and customer communications, maintenance

activities that improve the ability of facilities to withstand a storm, and planning efforts that prepare the organization to respond to a storm.

Recommendation 1: Recruitment of Crews

Develop a strategy to obtain crews that anticipates a future storm or other outage event of the magnitude of the 2008 Ice Storm and Unitil's specific circumstances. The evaluation to develop such a strategy should:

a. Evaluate the merits of joining EEI's Restore Power web-based service;

b. Identify qualified local tree trimming contractors;

c. Consider the benefits and costs of securing standby services in the event of an impending storm and on a longer-term contractual basis; and

d. Consider pursuing all options simultaneously, and not relying primarily on the mutual aid process.

Recommendation 2: Storm Rooms

Modify the Fitchburg facility to incorporate an enclosed dedicated storm room, equipped with communications capabilities and other storm restoration management equipment required to manage a large outage and numerous outside crews.

Recommendation 3: Damage Assessment Staffing and Training

Identify and train additional personnel to perform damage assessment, including Northern Utilities personnel. It takes approximately one-half day to train a damage assessor. Conduct annual refresher courses. Explore the availability and viability of using third-party contractors to perform damage assessment.

Recommendation 4: Damage Assessment Forms and Compilation

Improve damage assessment forms based on Unitil's circumstances and experience during the 2008 Ice Storm. Develop a spreadsheet or similar decision-support tool to tally damage assessments by circuit in order to more accurately determine the number of crews and estimated times required to restore power to a segment or a broader section of the system. Revise estimates of time required for each type of repair based on experiences during the 2008 Ice Storm and other utility experience in this and prior storms.

Recommendation 5: Storm Room Staffing

Develop an outage staffing policy that governs work and rest times. Reflect the need to offload many tasks from storm room managers and supervisors in the revised ERP.

Recommendation 6: Restoration Processes and Reporting

Review all processes and data reporting requirements and develop an information system plan to automate processes that are subject to system-based efficiency improvements, reducing reliance on paper-based information flows.

Recommendation 7: Field Communications

Evaluate options to improve the reliability of field communications in the event of a sustained power outage.

Recommendation 8: OMS Acquisition, Development and Staffing

Proceed to acquire and integrate an OMS. Designate a staff member to oversee the operation and maintenance of the OMS system and train supplemental resources to maintain the OMS during significant outages.

Recommendation 9: Crew Logistics Support

Develop an approach that will enable Unitil to manage the number of crews that were required to respond to the 2008 Ice Storm, including all crew logistics activities.

Recommendation 10: Inventory Management and Stock Rooms

Join MEMS (www.mems.org), a service that allows all its utility members to have access to each other's stock lists so that they can buy from each other when materials are needed on short notice. Identify and train staff that can serve in second jobs as stock room clerks and stock delivery personnel. Include training on types of materials that will be used during restoration. Connect stock rooms to back-up generation.

Recommendation 11: Call Center Management Communications and Coordination

Conduct twice-daily (or more frequent as circumstance dictate) conference calls among operations, public communications and the call center and pass intelligence on immediately to CSRs.

Recommendation 12: Call Center Training and Staffing

Improve training of CSRs and train Hampton staff members serving in second jobs on restoration processes and priorities. Train a contingent of corporate staff to answer calls and establish telecommunications links to allow them to receive calls in Hampton.

Recommendation 13: Call Center Facility

Evaluate modifications to the call center facility that would improve the ability of CSRs to perform during a major outage. For example, it may be possible to use existing LCD screens to provide information or add whiteboards to keep track of updated restoration information.

Recommendation 14: IVR Capabilities

Streamline the IVR storm mode selections to shorten the time required for customers to report an outage. Include community-specific information based on the customer address with customer calls routed automatically when they are received. Use the IVR callback feature for proactive communication with customers about restoration progress being made in their area.

Recommendation 15: Call Center Capacity and Reliability

Install additional planned lines as soon as possible. Study the potential value (and cost) of overflow IVR and call center operations and compare to an expansion of the existing IVR capacity. Redirect overflow calls to virtual CSRs. Pursue a service with Siemens to be informed that trunk lines are experiencing an outage. Determine if an economical solution exists to the risk that Unitil loses the "final mile" connection.

Recommendation 16: Estimated Bills

Reflect customer needs and expectations after an extended outage in any decision to issue estimated bills.

Recommendation 17: Reliable, Consistent Communications

Establish a process and policies to ensure that all personnel that communicate with the public are basing these communications on a common source of reliable information, including accurate data and supplemental briefings from operations personnel. Provide communications training to personnel that are expected to have frequent contact with the media and public officials.

Recommendation 18: Communications Protocols

Communicate applicable protocols for communications with Unitil to each constituency at the outset of a major storm. Conduct scheduled conference calls with public safety officials, elected officials and members of the media. Provide a private phone number for Unitil's EIC to media and elected officials.

Recommendation 19: Emergency Information Center

Obtain input from elected officials, local officials and members of the media on Unitil's EIC approach. Provide EIC personnel with reliable information necessary to perform these duties, and include participation on internal restoration status conference calls.

Recommendation 20: Web and Non-Traditional Public Communications

Develop an "emergency response" web page that is highlighted on the Unitil website home page that supports the information needs of customers and other constituencies, including a section for the media. Include a Frequently Asked Questions or "FAQ" section, and provide descriptions of the outage damage, restoration progress, and the process of restoring power. Develop a specific outage reporting form to supplement the generic "contact the company" form.

Leverage current technology to enhance communications between Unitil and its customers. This could include communications with customers over the web, videos, podcasts, "twittering," emails, text messages and other emerging avenues. Distribute fliers with status reports and estimated restoration time to locations where people gather during an outage, including shelters.

Recommendation 21: Customer Education on the Restoration Process

Develop customer education materials that describe the protocols and procedures by which Unitil restores power after a major outage and distribute to customers along with any other follow-up to the 2008 Ice Storm.

Recommendation 22: Communications Roles in the ERP

Revise the ERP to incorporate the recommendations in this section:

- Clarify the roles and responsibilities of all personnel having communications responsibilities;
- Establish the process by which coordination among these personnel and other restoration personnel will be maintained while responding to an outage; and
- Ensure that the communications function has adequate and trained staff, including staff serving in "second jobs."

Recommendation 23: Emergency Response Planning – Leadership and Organization

Designate a senior individual with emergency restoration experience to assume responsibility for emergency planning. Communicate the critical importance of emergency response planning throughout the organization.

Recommendation 24: ERP Adequacy

Revise its ERP in the following respects:

- Replace division ERPs with a single electric operations ERP;
- Provide additional storm outage detail to reduce reliance on institutional knowledge;
- Clarify roles and responsibilities;
- Distinguish between centralized support and management services, including retention and allocation of outside crews, and local or decentralized operations to enable the EOCs to focus primarily on restoring power and coordination with local safety officials;
- Incorporate flexibility to allow adjustments to accommodate storms of varying impact as well as deviations from the plan to respond to issues as they arise during a storm event;
- Provide information that is directly useful to Unitil and city and town officials;
- Revise the communications section to incorporate the EIC;
- Specify storm preparedness activities in greater detail; and
- Significantly expand the logistics section to provide clear direction to non-operations employees that are serving in support roles.

Recommendation 25: ERP Updates

Review and modify the ERP each year and following every significant outage:

- Revise the ERP to respond to new regulatory directives;
- Update the ERP based on input from internal resources and external stakeholders, as directed by a member of senior management;
- Review and revise contact numbers on at least a quarterly basis and before each impending significant storm; and
- Incorporate learning from other major storm restoration efforts in the Northeast.

Recommendation 26: Mock Drills & Preparedness Conference Calls

Conduct a mock drill to test the execution of the ERP each year, and conduct pre-storm season meetings and/or conference calls to review the ERP with city and town officials and public safety officials.

Recommendation 27: Staffing and Training

Formalize the "second job" process by identifying all second jobs and training individuals to serve in these roles.

Recommendation 28: Tree-Trimming Policies

Revisit trimming cycles to ensure they are in line with industry standards and regulatory directives. Communicate policies to communities and customers.

I. INTRODUCTION

This Report reviews Unitil's performance in restoring power to approximately 69,000 customers after the 2008 Ice Storm, to identify "lessons learned" and to prepare a set of specific recommendations that, when implemented, will improve Unitil's ability to withstand and respond to a future storm or other emergency of lesser or comparable magnitude.[2] This report:

1) Provides a factual review of ice storm events from the first indications that an ice storm was heading to the Northeastern United States, to the communications with customers and public officials in the weeks following the storm;

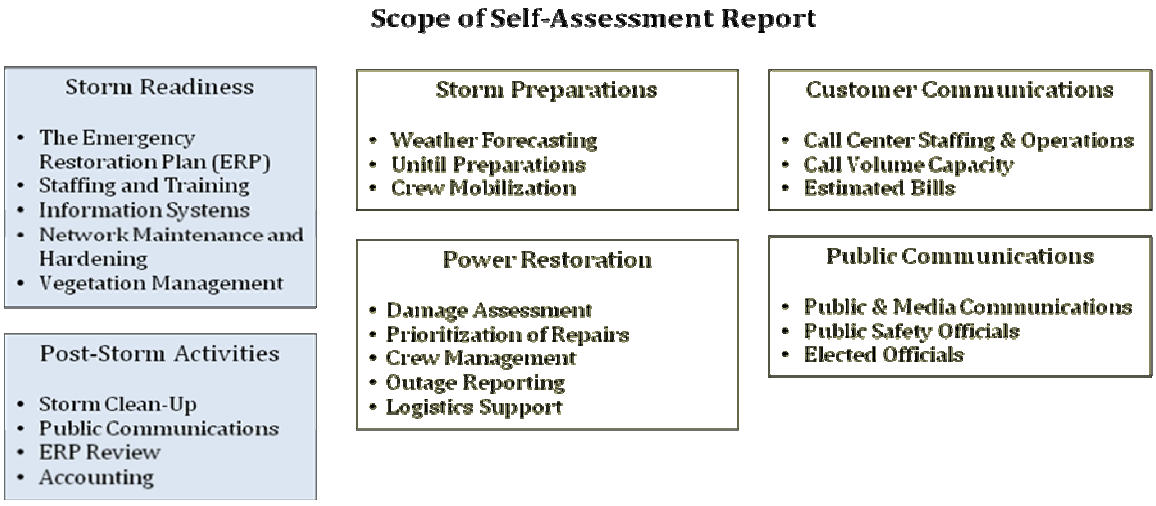
2) Provides the basis for improvements in the way Unitil prepares for and restores power after major incidents, including ice storms and hurricanes; and

3) Makes specific recommendations for improvement.

The process of restoring power begins before the storm arrives, as resources are mobilized to respond to a significant outage. However, the ability to restore power also depends on actions that take place before a storm is forecasted, including development of the Emergency Restoration Plan (ERP) and the design and maintenance of electric facilities. Efforts to restore power begin as soon as the first outage report is received, a "trouble ticket" is generated, and a crew is dispatched. Over time, the restoration effort is guided by preliminary and more detailed assessments of damage reported by customers, public safety officials, and employees assigned to inspect electric transmission and distribution (T&D) facilities. The restoration continues until power is restored to the last customer. These activities are addressed in this Report, as shown in Figure 1.

[2] The principal author of this report is Robert C. Yardley, Jr., former Chairman of the DPU and a consultant to the energy industry for over 25 years. Mr. Yardley was contacted by Robert Schoenberger, CEO of Unitil, on December 19, 2008, and asked to lead a broad assessment of the Company's response to the 2008 Ice Storm consisting of: (1) performing an objective review of Unitil's performance, (2) identifying lessons learned, and (3) providing specific recommendations to improve Unitil's ability to respond to a storm or other emergency of comparable magnitude.

Figure 1: Scope of Self-Assessment Report



The Report begins with background information on the 2008 Ice Storm and its impact on Unitil's electric facilities in order to provide a context for the self-assessment that follows. Section III reviews Unitil's preparation for the 2008 Ice Storm including monitoring of weather forecasts and mobilization of crews. Sections IV through VII describe Unitil's efforts to restore power, including damage assessment, restoration activities, outage tracking, and logistics support. Sections VIII and IX describe Unitil's communications with customers and with the public. Section X describes activities that have been conducted by Unitil since power was restored to all customers.

The Report concludes with an assessment of Unitil's state of readiness to withstand and respond to storms or other emergencies, including those of the magnitude of the 2008 Ice Storm. This section addresses the adequacy of Unitil's ERPs, vegetation management policies and expenditures, and maintenance of its T&D facilities.

There are also 3 Appendices:

- Appendix A presents a summary of the lessons learned and recommendations that appear throughout this report;
- Appendix B presents a Glossary of Acronyms; and
- Appendix C presents a list of references.

II. THE 2008 ICE STORM AND ITS IMPACT ON UNITIL'S ELECTRIC FACILITIES

As described in this section, the 2008 Ice Storm was extraordinary as measured by its impact on customers, the physical damage to electric facilities, and the amount of work required to restore power.[3] Before turning to the description of the 2008 Ice Storm and its impact on Unitil's facilities, it is necessary to briefly describe these facilities.

A. Description of Unitil's Electric Service Areas and Facilities

Unitil serves over 100,000 electric customers in three service areas, or "Distribution Operating Centers" (DOCs), which are shown in Figure 2.[4] Fitchburg Gas and Electric Light Company (FG&E) provides electric service to approximately 28,500 customers located in four Massachusetts towns: Fitchburg, Lunenberg, Townsend, and Ashby. FG&E was organized in 1852 and became a part of Unitil in 1992. The two New Hampshire divisions, Seacoast and Capitol, serve approximately 44,000 and 29,000 customers, respectively, in 31 towns. The New Hampshire divisions operate under the corporate name, Unitil Energy Systems (UES).[5] The electric distribution companies that comprise Unitil have had common management and shared services dating back to the beginning of the twentieth century.

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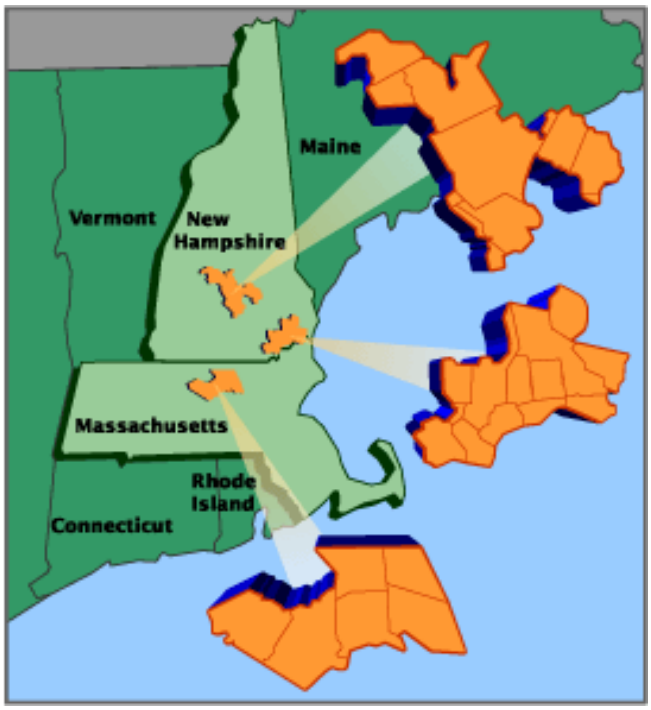
[3] The next largest storm event was a December 1996 storm that left a combined 23 inches of heavy wet snow in FG&E's service territory. As measured by the effort required to restore power, the 2008 Ice Storm was several orders of magnitude more severe than the December 1996 storm. For example, the 1996 storm required 151 crew days to restore power in Fitchburg whereas the 2008 Ice Storm required 1,401 crew days. See "Storm Report" submitted to the Massachusetts Department of Public Utilities on January 15, 1997, p. 6. The December 1996 storm also resulted in power outages to approximately 36,000 New Hampshire customers, but power was restored within 48 hours.

[4] Unitil also provides natural gas distribution service to over 69,000 customers in Massachusetts, New Hampshire and Maine.

[5] Unitil recently acquired Northern Utilities, which supplies natural gas to customers in New Hampshire and Maine.

Figure 2: Unitil Service Areas



In Massachusetts, the FG&E system is supplied from the National Grid 115-kV transmission system that connects with FG&E's system at a single point – the Flagg Pond Substation.[6] Four National Grid 115-kV transmission lines terminate at the Flagg Pond 115-kV ring bus from two different sources (two lines from Pratts Junction and two lines from Bellows Falls). Both pairs of lines are double-circuited on common towers. The Flagg Pond Substation is designed with a high degree of redundancy. FG&E's 115-kV ring bus provides a substantial improvement in reliability and operating flexibility compared to a straight bus configuration.[7]

FG&E has 15 distribution substations (including two mobile substations) and approximately 60 miles of subtransmission lines and 680 miles of distribution lines for a total of 740 miles of lines. This consists of approximately 180 miles underground and 560 miles of overhead lines located on 41 circuits. FG&E operates its distribution circuits at 13.8 kV and 4 kV.

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[6] Unitil has considered whether it is possible to establish a second connection to the regional grid, particularly to back-feed the system, but there are no nearby transmission lines of sufficient capacity to make this feasible.

[7] A transmission bus is an array of switches used to route power into a substation.

In New Hampshire, the Seacoast electric power system is supplied from Public Service of New Hampshire's (NU-PSNH's) 345-kV and 115-kV transmission systems. Service is taken from NU-PSNH at the Timber Swamp, Kingston, and Great Bay Substations. The Timber Swamp Substation, located in northwest Hampton, serves 53% of the Seacoast load along the eastern half of the system. The Kingston Substation serves 23% of the system load in the southwest corner of the system. The Great Bay Substation serves 24% of the system load in the Exeter area of the system. There are approximately 76 miles of 34.5-kV subtransmission lines serving 13 distribution substations in the Seacoast. UES Seacoast operates 21 – 34.5-kV, 10 – 13.8-kV and 9 – 4-kV distribution circuits totaling approximately 812 miles of overhead and 198 miles of underground lines.

The UES Capitol electric power system is presently supplied from NU-PSNH's 115-kV transmission system. Service is taken from NU-PSNH at the Garvins, Oak Hill and Hollis Substations. The NU-PSNH Garvins Substation located in Bow, NH, serves approximately 49% of the system load on the southern half of the system. The NU-PSNH Oak Hill Substation located in Concord, NH, serves 27% of the system load on the northern portion of the system. UES Capitol's Hollis Substation serves 24% of the system load on the easterly portion of the system. There are approximately 35 miles of 34.5-kV subtransmission lines serving 16 distribution substations. UES Capitol operates 12 – 34.5-kV, 14 – 13.8-kV, and 23 – 4-kV distribution circuits totaling approximately 692 miles of overhead and 161 miles of underground lines.

Unitil's subtransmission facilities are located in rights-of-way that are not accessible by road. The switches necessary to re-route power from a subtransmission line that has experienced a fault to an adjacent line are manually operated and can be difficult to access during wintry conditions.

The FG&E and UES Capitol service areas have many circuit ties on their distribution systems, which improves reliability because when there is an outage on any individual circuit, the power flow can be manually switched to another circuit. Most switching on the distribution system is completed manually via pole-mounted switches that are generally accessible along

the traveled way. Unitil's SCADA system[8] is used to manage flows at the substation level. Unitil's reliance on manual switching is effective in responding to the vast majority of outages.[9] The extent of the damage that resulted from the 2008 Ice Storm, however, was such that switching between circuits would not have been an effective measure early in the restoration period because so many of the circuits were either down or faulted. Distribution cirucuit ties were used later in the restoration effort to switch load away from areas of greatest damage.

B. Ice Storms and Their Impact On Electric Facilities

Ice storms are among the most dangerous types of winter storms for electric utilities, because they cover everything with a coating of ice that can vary from one-quarter inch to over an inch. The damage caused by an ice storm ranges from hazardous driving conditions associated with minimal ice glazing to widespread damage and threats to public safety from ice accretions of one-half inch or more. They are usually caused by freezing rain combined with a temperature inversion, *i.e.*, air temperatures that are warmer at high altitudes, cooler at lower altitudes and sub-freezing at ground level. Under these conditions, freezing rain will turn into an ice glaze when it reaches the ground.

The term "ice storm" is officially applied by the National Weather Service (NWS) when ice accumulations are one-quarter inch or greater. This is a sufficient amount of ice to cause problems for tree limbs and power lines due to the weight of the ice. A quarter-inch of ice can add 500 pounds to a power line segment, enough to cause power lines to fall, even without tree limbs falling across the line. The ability of a power line to withstand ice loadings depends on the length of the span, the level of ice accretion and the presence of wind. However, Unitil's lines are designed to withstand large levels of ice accretion. Thus, the damage from the 2008

[8] SCADA is short for "Supervisory Control and Data Acquisition" and is a computer system used to monitor and control power flows.

[9] There are sophisticated, and expensive, automated distribution switching technologies that may assist in responding to a storm of this magnitude but they have not yet proven to be cost-effective. Manual switching remains a standard utility practice.

Ice Storm was primarily caused by large ice-laden tree limbs falling on power lines, causing lines and the connected poles to snap.[10]

Meteorologists have become much better at forecasting ice storms, but it is still difficult to predict precisely where an ice storm will hit and the amount of ice accretion. They typically occur along relatively narrow (30 miles) sections, and a relatively small shift in an ice storm's path can be the difference between freezing rain and a severely damaging ice storm in a particular area.[11]

An overview of the impact of ice storms on trees and utility property is presented in Figure 3. It shows the spectrum of damage from an ice storm ranging from slippery roads to communications tower failures and widespread electricity outages. The 2008 Ice Storm covered the full range of impact and more, with entire trees snapped in half or uprooted by the storm.

The impact of ice on wires and trees has been described by Dr. Keith C. Heidorn, a meteorologist for over 30 years:

> Hanging wire cables collect ice until the cable breaks or the rain stops. Diameters of these ice-coated cylindrical cables may reach five centimeters, adding a weight of 15 to 30 kilograms per meter (10-20 pounds per foot) to the wire. Lines not broken directly under the ice's weight may succumb to the combined forces of ice and wind, or by trees and branches falling across them. Even days after the storm has abated, lines may break when they react to the sudden change in their load as the ice falls from them. Vibrations, often violent, may also occur as the ice falls, snapping weak points in the line under the added strain.[12]

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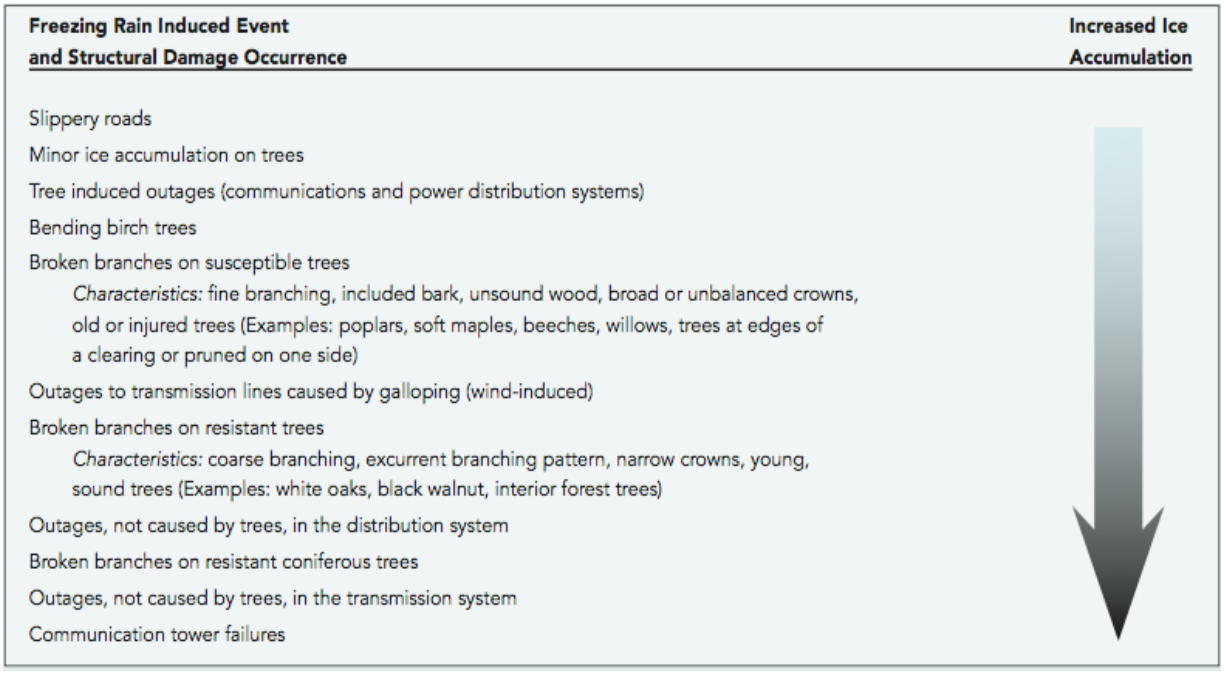
[10] Unitil designs its lines to meet "NESC Heavy Conditions" defined as ½ inch of radial ice, 40 mph winds with an additional 0.3 lbs per foot of conductor weight and other safety factors.

[11] Ice Storms: Hazardous Beauty, Dr. Keith C. Heirdorn, 1998.

[12] Ice Storms: Hazardous Beauty, Dr. Keith C. Heirdorn, 1998.

Figure 3: Types of Structural Damage Associated with Increased Ice Accumulation[13]



C. The 2008 Ice Storm and Subsequent Weather Conditions

The 2008 Ice Storm hit the Northeast during the late afternoon hours of December 11 and continued throughout the night. The potential for a significant icing event in the Northeast appeared in weather forecasts in the day or two leading up to the storm. For example, on December 10, the NWS in Taunton, MA, issued a winter weather message indicating considerable power outages and ice accumulations "between one half and one inch…with dangerously higher amounts possible."[14]

On the afternoon of December 11, NWS advisories were in effect for Massachusetts and New Hampshire as indicated in Figure 4.

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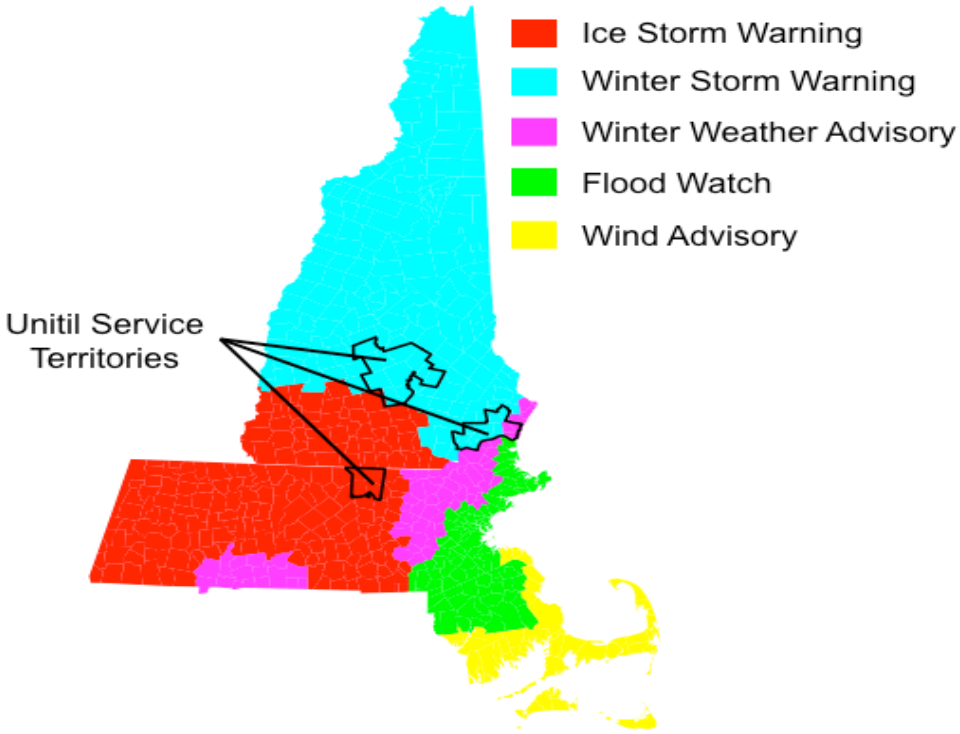
[13] Richard J. Hauer, Jeffrey O. Dawson, and Les P. Werner. 2006. *Trees and Ice Storms: The Development of Ice Storm-Resistant Urban Tree Populations*, Second Edition. Joint Publication 06-1, College of Natural Resources, University of Wisconsin-Stevens Point, and the Department of Natural Resources and Environmental Sciences and the Office of Continuing Education, University of Illinois at Urbana-Champaign.

[14] National Weather Service, Taunton, Massachusetts Office, issued December 10, 2008, at 4:10 p.m.

Figure 4: December 11 National Weather Service Weather Advisories[15]



As shown on this figure, the difference between an ice storm and a much less significant "Winter Weather Advisory" can be measured in tens of miles. This figure also shows the relatively wide area across central and western Massachusetts and the southwestern portion of New Hampshire that were subject to an Ice Storm Warning.

When it arrived, the 2008 Ice Storm was highly unusual in the breadth and extent of its damage, with freezing rain conditions reported from at least as far south and north as Luzerne County, PA, and Penobscot County, ME.[16] Weather stations in Fitchburg, MA, Concord, NH, and Portsmouth, NH, reported freezing rain over a period of several hours, starting throughout the

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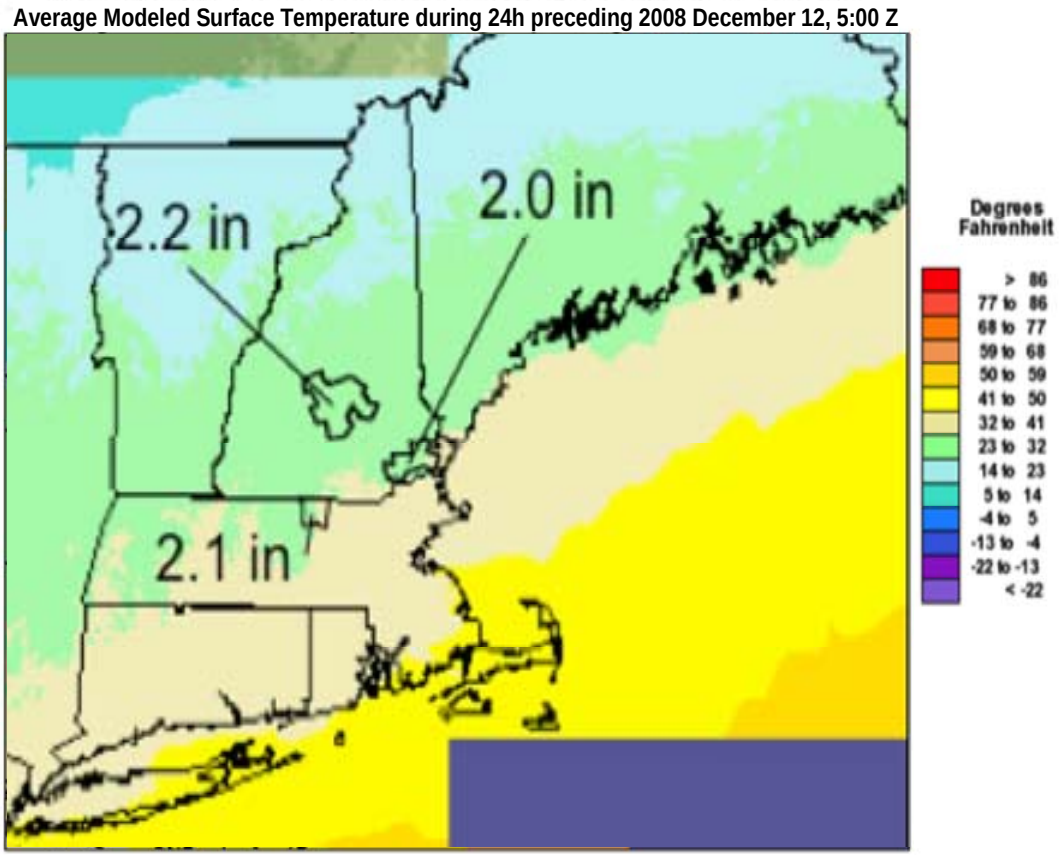
[15] National Weather Service. A Winter Storm Warning indicates heavy snow or significant ice accumulations. A Winter Weather Advisory indicates a combination of winter weather (snow, freezing rain, sleet, *etc.*) that presents a hazard, but does not meet warning criteria.

[16] As reported by airport (METAR) weather stations. Not all locations reporting freezing rain necessarily experienced surface icing, due to temperature variations.

day on Thursday, December 11, and continuing into the early hours of Friday morning.[17] Surface air temperature throughout the region, the other essential ingredient for formation of ice from freezing rain, is shown in Figure 5. Unitil's three divisions are outlined in black, with their respective observed freezing rain precipitations.

Figure 5: Surface Temperatures and Freezing Rain Amounts – December 12 at 6 a.m.[18]



As shown in Figure 5, Unitil's service areas had both high amounts of liquid precipitation and freezing temperatures in the danger zone of 23 to 32 degrees Fahrenheit.

In a Public Information Statement issued following the storm on December 13, the NWS reported ice accumulations of half an inch in towns as far apart as Ashfield, MA, and Hudson, NH, with three-quarters of an inch reported in Townsend, MA. The Windblown ski area in New

[17] Portsmouth, NH, is used as a proxy for Unitil's Seacoast division because it is the closest METAR station. Freezing rain was first reported in Concord and Portsmouth at 8:00 a.m. and in Fitchburg at 6:00 p.m.

[18] National Weather Service.

Ipswich, NH, the town just north of Ashby, reported seeing an inch and a half of ice accumulation.[19] Regional news sources reported significant icing for the entire Northeast. The Boston Globe, for example, described "a massive winter storm that encrusted the region in an inch-thick sheet of ice."[20]

For Unitil, this was easily the worst storm it had ever experienced and many times more damaging than the December 1996 storm. Unitil was not the only utility that experienced extreme outages as a result of the 2008 Ice Storm, as utilities across the state and region reported more than one million customers out at the peak.[21] NU-PSNH spokesman Matt Chagnon spoke with Plymouth State University professor of meteorology Dr. Eric Hoffman about how the storm affected New Hampshire.[22] Dr. Hoffman described the storm as follows:

> First, this storm was typical of a winter storm that causes damage to the electric grid in NH from our studies. But what made it atypical was two things: one was the amount of precipitation was very, very large and a good chunk of the precipitation fell in the freezing rain category. Often with the storms we see a narrow band where there's freezing rain and more often some wet snow and sleet but in this case there was more of a large area of freezing rain and in addition to that we got a lot of precipitation much more than we would normally get from a winter storm.[23]

When asked if he had ever seen a storm with this set of conditions before, Dr. Hoffman replied:

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19 Windblown Winter Weekly, December 12, 2008. http://www.windblownxc.com/Pages/conditions.html. In comparison, the NWS reported seeing as much as an inch of ice on surfaces in Kentucky following the late-January 2009 storm that resulted in extended outages.

20 "Nearly 1 million Remain Without Power After Ice Storm," http://www.boston.com/news/local/breaking_news/2008/12/ice_storm_leave.html, December 12, 2008.

21 Including customers in Massachusetts, New Hampshire, Vermont, Connecticut, Maine, New York and Pennsylvania.

22 http://64.140.220.121/psnhnews2/images/file/Eric_Hoffman_Interview-final.mp3

23 PSNH further explains in their report on the 2008 Ice Storm that the narrow geographical bands described by Dr. Hoffman tend to be on the order of 10 to 20 miles wide. Source: *New Hampshire Ice Storm 2008: Record Outage Record Recovery*, Public Service of New Hampshire, p. 5.

> No, not in my lifetime. There certainly have been storms with large amounts of freezing rain. So these freezing rain events certainly occur. No, I have not personally experienced this in my lifetime. I have not been in the WRONG place at the RIGHT time.

Early damage reports from the 2008 Ice Storm's aftermath described general devastation, with downed whole trees and impassable roads throughout central Massachusetts and New Hampshire.

Massachusetts Governor Deval Patrick declared a State of Emergency on the morning of Friday, December 12, which remained in effect until December 29. In his Request for a Major Disaster Declaration addressed to President Bush and dated December 23, 2008, the Governor said:

> At the height of this disaster, more than 350,000 households were without power and over 100 shelters were open. Major roads were deemed impassable. Many communities had 100% of their roads blocked and were unable to provide emergency services to their residents.

New Hampshire Governor John Lynch also declared a State of Emergency on December 12. The damage was severe enough that President Bush signed Emergency Declarations for nine counties in Massachusetts and ten counties in New Hampshire on December 13, paving the way for municipalities to receive federal assistance.[24] On a more local level, 88 communities in Massachusetts made local emergency declarations.[25]

Following the storm, Governor Patrick called in the Massachusetts National Guard, which initially mobilized about 500 members to help with road clearing and cutting limbs and debris, according to a statement from Maj. Gen. Joseph Carter.[26] The National Guard was brought into Ashby approximately three days after the storm to clear roads so that utility crews arriving from other states to assist in Unitil's restoration effort could reach the town, which was hit especially hard. The National Guard Bureau reported on December 16 that additional

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[24] FEMA National Situation Update for December 14. http://www.fema.gov/emergency/reports/2008/nat121408.shtm

[25] http://www.eagletribune.com/punews/local_story_350005713.html

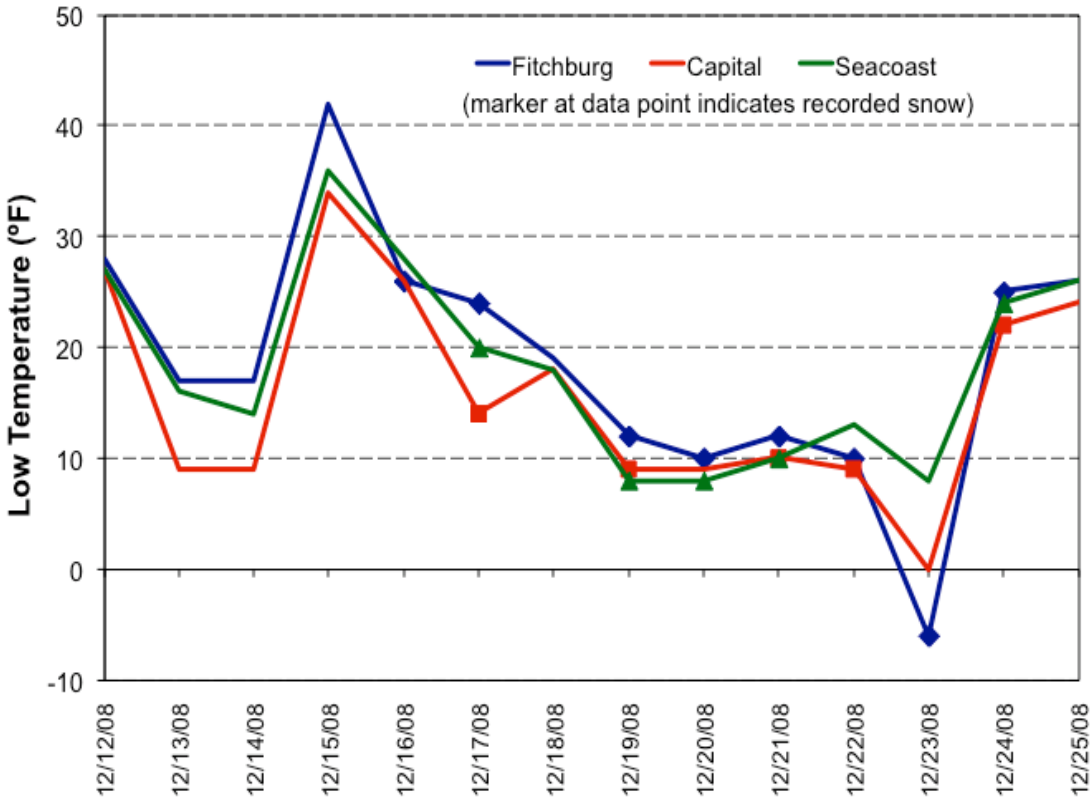
[26] http://www.thebostonchannel.com/cnn-news/18257352/detail.html

personnel were called up to bring the total to around 1,500.[27] In response to a request for assistance from Massachusetts, the Connecticut National Guard deployed a specialized unit consisting of 23 personnel with chainsaws and mobile excavation equipment. The New Hampshire National Guard was deployed as well, to assist with storm cleanup in New Hampshire starting on December 12.[28]

The restoration effort was accomplished while National Guard personnel and utility crews in the field faced several challenges, due to both the nature of the damage and weather conditions. The roads in many places were impassable following the storm due to fallen trees and branches and downed wires, and damage was still occurring a day or two after the storm as trees continued to fall from the weight of the ice. As shown in Figure 6, it was unusually cold in all three Unitil divisions during the two weeks following the storm, with two substantial snowstorms that each dropped approximately one foot of snow across parts of Unitil's service area moving through the region on the second weekend. This was followed, finally, by heavy rain on Christmas Eve and high winds that passed through on Christmas morning, resulting in additional outages. These wintry conditions made life difficult for both residents and crews throughout the restoration period.

[27] http://www.ngb.army.mil/news/archives/2008/12/121508-Guard_responds.aspx
[28] http://www.governor.nh.gov/news/2008/122208.html

Figure 6: Weather Conditions During Restoration Period[29]



D. Impact of the 2008 Ice Storm on Unitil's Electric Facilities

Across Unitil's three service areas, approximately 69,000 customers, or 68% of Unitil's electric customers, were without power at some point following the storm.[30] Figure 7 shows the peak percentage of customer outages in each town in which Unitil serves more than 50 customers.

At the peak of the storm, 100 percent of customers served by FG&E were offline due to the loss of power from the regional transmission grid into the Flagg Pond Substation.[31] Even

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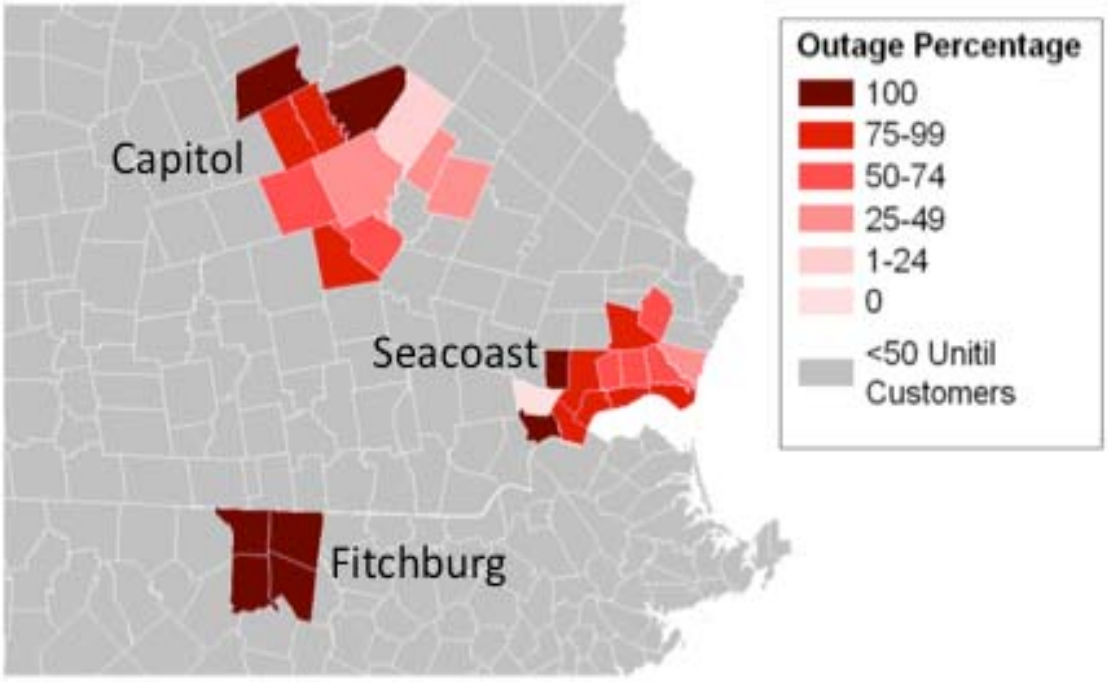
[29] Source: Weather Underground and airport weather stations

[30] Unitil's three divisions did not experience peak outages simultaneously, due to the progression of the storm.

[31] Power from the grid to the Flagg Pond Substation was interrupted on December 12 at 1:09 a.m. after multiple problems on the transmission system culminated in tree contact on the National Grid transmission line from Bellows Falls to Flagg Road, causing the entire FG&E service area to lose power.

after power began to flow again from the grid in the early morning hours of December 12, approximately 22,500 FG&E customers remained without power due to damage to Unitil's T&D facilities. The number of customers without power rose to 25,610 by the end of the day.

Figure 7: Percent of Unitil Customers Without Power



The level of damage throughout Unitil's three divisions, and the need to rebuild entire sections of the distribution network, contributed significantly to the extended restoration period.[32] Table 1 tells the story "by the numbers" and includes materials and supplies used during the restoration process.

By any measure, FG&E experienced the most extensive damage of Unitil's three divisions, followed by the Seacoast division. The more extensive damage reflected in the Fitchburg territory is consistent with the damage reported in neighboring communities in Massachusetts and New Hampshire that are served by other utilities. For example, in the neighboring town of New Ipswich, NH, NU-PSNH reported that at least 200 utility poles were

[32] In the town of Ashby, MA, for example, virtually all the distribution lines in the town were down and the system had to be rebuilt section by section.

either broken or damaged, requiring replacement, and stated that the entire town needed to be rewired because of the numerous breaks in electrical cables.[33]

Table 1: 2008 Ice Storm By the Numbers

	Fitchburg	Seacoast	Capitol	Total
Customers Without Power				
Total Number of Customers	28,496	44,230	28,844	101,570
Customers without Power at Peak	28,496	29,250	10,746	69,041
Percent of Customers without Power	100%	66%	37%	68%
Restoration Date	Dec 25	Dec 23	Dec 20	
Weather Conditions				
Freezing Rain (inches)	2.1	2.0	2.2	
Average Storm Temperature (ºF)	32	31	30	
Average Restoration Temperature (ºF)	27	27	25	
Crews				
Maximum	299	64	20	328
Average	100	29	7	135
Call Center (Dec 11 – 25)				
Received by the IVR	**Not Available by Division**			164,136
Answered by a Representative				32,327
Trouble Tickets	9,433	9,195	3,389	22,017
Materials and Supplies				
Feet of Primary Wire Replaced	146,226	53,482	8,590	208,298
Feet of Secondary and Service Wire Replaced	46,503	28,042	2,898	77,443
New Poles Set (Unitil Only)	212	52	15	279
Crossarms	281	210	29	520
Transformers	170	50	21	241
Fuse Links	2,000	1,100	600	3,700
Splices	6,000	4,000	4,000	14,000

To put these numbers in perspective, in the course of a normal year, FG&E installs 39,655 feet of primary wire, 47,769 feet of secondary wire, 170 poles, and 272 crossarms. Thus, FG&E installed almost four years worth of primary wire in two weeks. Unitil replaced approximately four months worth of primary and secondary wire in the Seacoast division during this two-week period.

[33] "Saturday's New Hampshire ice storm blog: Power won't be back soon; more shelters open," Manchester Union Leader, 12/13/08.

III. STORM PREPARATIONS AND CREW MOBILIZATION

This section of the Report describes the actions taken by Unitil to prepare for the 2008 Ice Storm, beginning with monitoring regional weather forecasts and including efforts to obtain crews to assist with the restoration effort.

A. Weather Forecasting

Unitil's storm preparations began in earnest on December 10 in response to the forecast of a potential ice storm. Unitil's Director of Electric Operations scheduled the first of three pre-storm conference calls with the three division managers to review the forecasts.

Unitil has subscribed to a professional weather service for over twenty years. The current provider is DTN Meteorlogix (DTN) out of Minneapolis.[34] The dispatch groups in each of Unitil's three divisions monitor the forecast using DTN's on-line service. Unitil supplements forecast information provided by DTN by monitoring the public forecasts produced by Weather Underground.[35] Dispatch will circulate an email to necessary personnel, including the Director of Electric Operations, when the weather forecast services indicate that the NWS has issued a weather advisory or warning or if there are other areas of concern in the forecast.

The weather forecasts leading up to the 2008 Ice Storm indicated that that the Northeast was likely to experience freezing rain and freezing temperatures, the necessary ingredients for an ice storm. Moreover, there were indications that a relatively wide area in the region could experience ice accretions. As shown in Table 2, the forecasts indicated that all three divisions could be affected by the storm, although FG&E appeared likely to be hardest hit. The potential impact on Unitil's Seacoast division was considerably more uncertain.

[34] www.dtnmeteorlogix.com
[35] www.wunderground.com

Table 2: Weather Forecasts Leading up to the 2008 Ice Storm[36]

Date	FG&E	Capitol and Seacoast
Dec 10 p.m.	4:19 p.m. – Ice Storm Warning for central and western Massachusetts in effect from 4 a.m. on Dec 11 to 7 a.m. on Dec 12; elevations above 500 feet will potentially suffer from considerable power outages late on Dec 11 as ice accumulates between one-half and one inch with dangerously higher amounts possible	3:11 p.m. – Winter Storm Watch in effect from Dec 11 (afternoon) through Dec 12 (afternoon); potential exists for significant icing in interior coastal counties; some sleet and freezing rain on the coast; the exact track of this coastal storm remains uncertain
Dec 11 a.m.	6:37 a.m. – Ice Storm Warning remains in effect until 7 a.m. on Dec 12; a glaze of one-half to one inch of ice is forecast; ice accretion should result in downed tree limbs and power lines	6:04 a.m. – Winter Storm Warning for freezing rain with some snow and sleet in effect from noon until 1 p.m. on Dec 12; heavy freezing rain will occur with between one-half and one inch accumulation
Dec 11 p.m.	4:20 p.m. – elevation ice storm with glaze accumulations ranging from one-half to one inch overnight. The heaviest amounts of glaze expected across the northern two-thirds of Worcester County and extreme northwest Middlesex County near Ashby; long duration power outages may develop tonight	3:39 p.m. – Expect sleet and freezing rain to change to rain overnight. Pockets of freezing rain may persist away from the coast into Friday morning. One-quarter to one-half inch ice accretion expected
Dec 11 p.m.	10:01 p.m. – Rain heavy tonight and into Fri a.m. where 2-3" of rainfall is expected; ice storm continues for central/west MA and south VT/NH; some areas could see another 1" of solid ice across interior New England	

B. Unitil Preparations

Based on these weather forecasts, Unitil began to make plans by placing its operations personnel on notice on the morning of December 11 that they may have to report to work later that evening when the storm was projected to arrive. Unitil activated the division Emergency Operations Centers (EOCs) and set up storm rooms at each division. The storm rooms contain communications equipment, white boards, system maps and computers that will be needed to

[36] UES data request response to New Hampshire Public Utilities Commission Staff 1-7, February 27, 2009.

dispatch resources. Unitil also alerted its contractor crews that their services would likely be needed to help clear trees and restore power.[37] [38] When combined with Unitil's 14 bucket crews, this brought the total number of "inside" bucket crews to 25, comprised of 12 in the Seacoast division, 7 in Capitol division, and 6 in FG&E. Unitil also had six tree crews working on the system, two in each division.[39]

Engineering and operations staff reported to duty on the evening of December 11 and worked through the night as the initial wave of outages was being reported. The engineering group prepares all switching orders that change the way that power flows in order to isolate circuits to perform necessary repairs. As discussed further below, this task was anything but routine during the first week of the restoration effort due to the extensive damage across Unitil's subtransmission and distribution networks.

Unitil also undertook other preparations including stocking of vehicles and trucks with materials and gear and the performance of maintenance on and fueling of vehicles. The efforts related to materials and supplies are described in Section VII.

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[37] If a contactor crew is working on Unitil's system, and a storm or other emergency is anticipated that could cause damage to the electrical system, Unitil has the right of first refusal for the services of that contractor. In other words, if a contractor is currently engaged by Unitil in Unitil's territory and its services are requested by another utility, the contractor is obligated to complete the work required on Unitil's system until "released" by Unitil to the other entity. Utilities routinely use contractors to perform work on their systems because it is economical to do so and it ensures that adequate company crews are always available for stand-by shifts and to respond to emergencies. Many of Unitil's contractors have worked on its system for several years and have demonstrated efficient, effective and safe work practices.

[38] For example, Unitil's existing tree trimming contracts require the contractor to double their resources within 4 hours if called upon to respond to a storm.

[39] A tree crew typically includes a bucket truck, with up to a 75-foot reach, a brush chipper, and hand-operated power equipment.

C. Mutual Aid

Mutual aid is one avenue available to electric utilities to secure crews to assist with power restoration efforts.[40] At 8:30 a.m. on December 11, the Northeast Mutual Assistance Group (NEMAG) held their first conference call to discuss the forecast and the potential need for mutual aid crews among members. NEMAG was formed in 2007 by a group of New England and Canadian electric utilities to facilitate the ability of its members to aid one another to respond to emergencies. [41] NEMAG filled a needed gap in emergency preparedness because there was no regional emergency coordinator or agency with responsibility for allocating resources among electric utilities in this region. The first priority of every NEMAG member is to restore service to its own customers before releasing crews to other utilities.[42] Prior to the formation of NEMAG, any utility seeking aid would have to rely on contacts with their operations counterparts at neighboring utilities. For example, Unitil has a long history of working closely with NU-PSNH to respond to outages across both systems. These arrangements were primarily relationship-driven and relied upon the ability and willingness of the counterparts at each company to work together to restore outages across each other's systems. The purpose of NEMAG was to supplement this cooperation with a formal process to facilitate a coordinated system-wide response to regional emergency situations that impact all utilities in the Northeastern United States and Canada.

On this initial conference call, NEMAG members discussed the weather forecasts, crew availability, and other items according to the protocols and procedures set forth in the NEMAG

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[40] Other avenues include direct contacts with contractors and other utilities outside of the Mutual Aid process, an approach used by Unitil shortly after the Mutual Aid process. Some utilities also enter into agreements with contractors for emergency services. Unitil has not used this approach to date.

[41] The charter members of NEMAG are Bangor Hydro, Central Vermont Public Service Company, Green Mountain Power, Hydro One, Hydro-Quebec, National Grid, New Brunswick Power, Northeast Utilities, NStar, South Norwalk Gas & Electric, United Illuminating Company and Unitil. The NEMAG documents are in draft form at the present time.

[42] This can also lead to regional crews returning home in time to respond to potential issues on their own systems.

Agreement. It was evident that all of the New England utilities anticipated that the pending storm would impact their service territories. Accordingly, crew shortages were likely. Because the storm had not yet materialized over New England, but was expected to move across the region during the afternoon hours and into the evening of December 11, another conference call was established for 6:00 a.m. the following day.

As the damage reports came in during the early morning hours of December 12, it became apparent that Unitil would require an unprecedented amount of assistance from outside crews. Unitil's operational resources, comprised of its in-house line worker crews and its list of outside contractors, though sufficient to handle past outages which have lasted in the range of one to three-days, would clearly not be sufficient for this storm based on the early damage reports.

On the 6:00 a.m. NEMAG conference call on December 12, participants began with a summary of their individual damage assessments, crew availability and/or requirements. The participating utilities reported ice accretions up to one-half inch with forecasted levels of one inch in some areas. Even if no further ice accretion occurred, it was clear to all participants that they were likely to experience substantial damage and widespread customer outages. It was also apparent that the storm had impacted a significant portion of New England, as the initial crew requests made by participants (those over and above their own crews and committed third-party contractor crews) greatly exceeded the number of available resources among the members.

Unitil reported approximately 69,000 customers without power system-wide, including all of its 28,496 Massachusetts customers, due to a loss of power supply from the grid at the Flagg Pond Substation. Unitil made an initial mutual aid request for 30 bucket crews. No crews were made available on this call. Another conference call was established for 12:00 noon that would include the New York Mutual Assistance Group and the Mid-Atlantic Mutual Assistance Group.

During the noon call, Unitil requested an additional 10 crews, bringing the total amount requested to 40 mutual aid crews. Table 3 indicates the mutual aid resources that Unitil secured during the noon NEMAG conference call on December 12. At this point, the NEMAG process has achieved its purpose and no further calls were scheduled.

Table 3: Mutual Aid Crews Committed to Unitil at Noon on December 12

Exelon/Philadelphia Electric Co (PECo)	10 crews and support personnel
Henkels & McCoy (a line contractor released by PECo)	10 crews and support personnel
Davis H. Elliot (a line contractor released by Dayton Power & Light (DP&L))	14 crews and support personnel
Serco (a line contractor released by DP&L)	6 crews

At 2:00 p.m. on December 12, Unitil also secured six crews from O'Donnell Line Construction Company located in Nashua, NH, outside of the mutual aid process. This brought the total number of crews committed to Unitil at this time to 71.

However, Unitil suffered a major setback when informed later that day that the 14 crews from Davis H. Eliiot would not be coming from Ohio because they were not able to secure the necessary resources to man the trucks. The consequences were particularly damaging because the 14 Davis H. Elliot crews represented a much larger resource contingent as each crew was comprised of two bucket trucks, a digger truck, and a general foreman in a pick-up truck. In total, this would have provided Unitil with 42 additional crews (28 bucket trucks and 14 digger trucks) bringing the total number of committed crews to 99.

The loss of 42 Davis H. Elliot crews “cost” Unitil 420 crew days (assuming these crews would have stayed for 10 days), out of the total 1,915 crew days ultimately required to restore service to Unitil’s customers.

After being informed that these crews would not be coming, the Director of Electric Operations emailed members of NEMAG requesting additional crews. No crews were available. Unitil was informed that other NEMAG members also lost previously committed crews.

D. Subsequent Efforts to Obtain Crews

Unitil's efforts to obtain additional crews continued over the next several days. On December 14, Unitil contacted Service Electric, a contractor based in Tennessee, and was able to secure 26 bucket trucks, 13 digger trucks, and other support personnel. These crews were delayed by weather but arrived to restore power to the Seacoast division on December 16. In general, it can be difficult to secure crews that require more than a day of travel, because utilities are reluctant to release crews that may need to return quickly for an event on their own system.

Unitil requested crews from NStar on December 16 and was informed that their crews were being called back from assisting National Grid due to reports of a second, potentially severe storm. Unitil also received a call from National Grid indicating that they may be in a position to send crews to assist, but National Grid subsequently informed Unitil that they were unable to do so at that time, due in part to their loss of the NStar crews.

Finally, on December 19, Unitil was contacted by National Grid indicating that they expected to release contractor crews to other utilities as their restoration neared completion, and offered crews to Unitil. Unitil requested 40 bucket crews, which was the maximum it could accommodate at the time with available support staff. Unitil was supporting all crews in the FG&E area out of the Fitchburg DOC and did not believe that it could handle more than 40 additional crews due to limits on available space and other support resources. Later that evening, Unitil received confirmation that National Grid was indeed releasing approximately 40 crews to Unitil, from three different contractors (Midwest, Carr & Duff, Energy Group). These crews reported to Fitchburg for work on Saturday, December 20.

Unitil was also able to secure crews from the New Hampshire Electric Cooperative on December 21 that reported to the Seacoast division to work on restoring power to individual services.

On December 20, representatives from the Commonwealth of Massachusetts (including the Undersecretary of Public Safety and a representative of the Massachusetts Emergency

Management Agency (MEMA)) arrived in Fitchburg and met with Unitil management to assess the situation in Unitil's Massachusetts territory. At that time, Unitil had restored power to 85 percent of its Massachusetts customers, but the remaining work to restore the last 4,000 customers was expected to be more time-intensive work on secondary lines and individual service issues. Based on this discussion, a list of needs was discussed, and a conference call was established for later that afternoon. This conference call included the Governor and Lieutenant Governor of Massachusetts, the Chairman of the Department of Public Utilities (DPU), the Undersecretary of Public Safety, representatives of MEMA, other public officials and Unitil management. As a result of the call, the Chairman of the DPU contacted each of the other Massachusetts utilities and asked them to call Unitil as quickly as possible to determine if they could provide needed support.

Senior representatives of each of the other Massachusetts electric utilities contacted Unitil within a short time following the conference call. National Grid offered to provide crews as well as a complete set of logistical support services, including the ability to stage crews at a new site. Later that day, representatives from National Grid arrived in Fitchburg to coordinate with Unitil's storm management team. They identified a staging area in Lunenburg and made arrangements to have it up and running on the following morning (December 21). National Grid arrived in Lunenburg the next morning with approximately 50 crews and support resources, including 28 damage assessors and field supervisors. Based on the extent of damage still remaining and the results of detailed damage assessments, National Grid committed to securing an additional 80 crews, as well as additional field supervision, to increase restoration resources on December 22. A second staging area in Fitchburg was established on the morning of December 22. Unitil was also able to redirect 28 crews from its Seacoast division to FG&E after power had been restored in that area.

Finally, on December 23 and 24, Unitil secured six bucket crews from NStar, and National Grid added 21 crews to cover the out-of-state crews that left to return home for the holiday. The number of crews working to restore power throughout the restoration period is presented in Table 4. This includes both tree crews and bucket or line crews.

Table 4: Crews Working on Unitil's System

Date	FG&E	Seacoast	Capitol	Total
Dec 11	6	13	6	25
Dec 12	18	10	6	34
Dec 13	47	13	6	66
Dec 14	47	13	6	66
Dec 15	47	13	6	66
Dec 16	48	34	20	102
Dec 17	51	34	20	105
Dec 18	59	50	6	115
Dec 19	59	50	6	115
Dec 20	143	58	5	206
Dec 21	192	64	3	259
Dec 22	299	27	2	328
Dec 23	297	13	2	312
Dec 24	59	12	2	73
Dec 25	29	12	2	43
Crew Days	**1,401**	**416**	**98**	**1,915**

Since multiple locations were engaged in restoration during the 2008 Ice Storm, resources were allocated based upon the extent of the damage and estimated restoration times in each division.

E. Assessment, Lessons Learned, and Recommendations

The 2008 Ice Storm was the first storm in which Unitil relied on the NEMAG mutual aid process to obtain outside crews. Although this process was instrumental in providing Unitil with crews during the 2008 Ice Storm, the extent of damage across the Northeast made it difficult to secure enough crews, even when the calls were expanded to include the New York and Mid-Atlantic Mutual Assistance Groups. Unitil also did not appreciate the magnitude of the damage to its system at the time that the NEMAG calls took place. If it had known the extent of the damage, it would have requested more crews on these calls. Moreover, crew pledges do not always result in crew commitments, as Unitil learned with the Davis H. Elliot crews. In retrospect, Unitil understands that resource commitments obtained on mutual aid calls still need to be confirmed.

It is certainly possible that the challenges of obtaining crews in the 2008 Ice Storm may be present in a future event, including the potential that there are no available crews in the Northeast at the same time that all three Unitil divisions are experiencing significant outages and Unitil must prepare for this potential.

There are approaches taken by other utilities that should be considered by Unitil. The Edison Electric Institute (EEI) provides a service for utilities to efficiently acquire restoration resources through its "Restore Power" website. EEI has also developed an agreement that guides the process by which mutual assistance is arranged and paid for. National Grid, Northeast Utilities and NStar are signatories to this agreement. This on-line service provides access to resources without having to make individual contacts to several utilities, and does not require pre-existing relationships among operations personnel.[43] The EEI Restore Power resource was used by National Grid during the 2008 Ice Storm.[44]

A second approach to securing crews is to enter into an agreement that requires contractors to devote crews to serve as "standby"or "on-call" resources to be used to respond to emergencies. Such an agreement could be entered in advance of an impending storm o,r more reliably, on a more permanent basis.

While Unitil should explore the feasibility of implementing either or both of these alternatives for securing crews, the Company should do so in the context of an overall crew strategy that reflects its particular circumstances in order to be prepared for another event of this magnitude.

After a storm of this magnitude, utilities and communities both try to secure available tree crews. There may be local qualified tree contractors that are not large enough to bid on Unitil's tree trimming work, but could help out in an emergency. These firms should be identified and contacted. Ideally, there could be some form of coordination with communities

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[43] Unitil is not currently a member of EEI.

[44] Massachusetts Electric Company d/b/a National Grid, D.P.U. 09-01-B Winter Storm 2008 Report - Page 10 of 65

around tree trimming, but this may be difficult to accomplish as Unitil and communities are addressing their respective public safety obligations.

It is also necessary to address Unitil's ability to host and manage a large contingent of outside crews. Crews require several support services, including assignment of work to be performed, stocking of materials, fueling of vehicles, lodging, and food. There are limits to the number of crews that can be managed out of each of Unitil's three division facilities. Moving beyond this limitation would require the establishment of a second (or additional) staging area(s). This issue is discussed in Section VII, Logistics Support.

The division "storm room" is an essential component of the response to a major outage. It must be designed to provide storm management with ready access to information and include whiteboards and maps to plan work and track progress. The Fitchburg storm room had the necessary information and tools, but was located in an open area and secured only by partitions. Unitil should evaluate establishing an enclosed, walled room as the storm room.

The mobilization of Unitil resources as the storm approached was primarily limited to the corporate engineering group and operations personnel in each of the three divisions. It wasn't until later in the restoration period that resources from other parts of Unitil were asked to assist by serving in support roles. The ability to assign responsibilities to additional resources within the company is discussed in Section XI, Storm Readiness.

A summary of "lessons learned" from the preparations and crew mobilization efforts is as follows:

- Mutual assistance is an essential means to quickly obtain the services of outside crews, but should serve as only one element in a broader strategy.
- The definition of a "crew" varies throughout the industry; it is necessary to verify the composition of resources that are being committed and to request any needed support resources, including supervisors.
- A commitment for contract crews made by a releasing mutual aid utility must be confirmed with the contractor before relying on these resources.

- There are limits to the number of crews that can be staged out of the three division locations. (Recommendation in Section VII)

- Many company personnel wanted to help respond to the storm, but needed to be organized (and in some cases, trained) in order to do so. (Recommendation in Section XI)

RECOMMENDATIONS

Recommendation 1: Recruitment of Crews

Develop a strategy to obtain crews that anticipates a future storm or other outage event of the magnitude of the 2008 Ice Storm and Unitil's specific circumstances. The evaluation to develop such a strategy should:

a. Evaluate the merits of joining EEI's Restore Power web-based service;

b. Identify qualified local tree trimming contractors;

c. Consider the benefits and costs of securing standby services in the event of an impending storm and on a longer-term contractual basis; and

d. Consider pursuing all options simultaneously, and not relying primarily on the mutual aid process.

Recommendation 2: Storm Rooms

Modify the Fitchburg facility to incorporate an enclosed dedicated storm room, equipped with communications capabilities and other storm restoration management equipment required to manage a large outage and numerous outside crews.

IV. DAMAGE ASSESSMENT

Damage assessment is performed: (1) to identify the scope of the damage for purposes of determining the number of crews that will be required (the initial phase); and (2) to guide the restoration process, including the prioritization of repairs, preparation of packages for crews, and stocking of materials and supplies (the detailed phase).

Trained damage assessors are required to perform the damage assessments, although the necessary training can be accomplished in a day or so for individuals with a technical background. The information collected by damage assessors is supplemented by other sources of damage-related information, including reports from customers, local public safety officials, and state officials. Damage assessment information is compiled, organized and assessed to assist in identification of crew types that are needed (*e.g.*, bucket crews and tree crews) and the dispatch of crews to restore power.

A. Initial And Detailed Damage Assessment

The initial damage assessment was performed over the first four days of the storm and focused on Unitil's subtransmission facilities and primary distribution circuits. More detailed damage assessment was performed by crew guides throughout the restoration period, in advance of the work by crews along a primary or secondary circuit. A detailed damage assessment was also performed in FG&E's service territory by National Grid on December 21 and 22 to support the efforts of National Grid crews to restore power in this division. The overall damage assessment process was complicated by the fact that new damage continued to appear after the storm had passed as ice-laden trees and limbs continued to crack and fall. The fact that many public roadways were impassable for up to three days after the storm also delayed the initial damage assessment.

The initial damage assessment was performed by approximately 60 Unitil staff and contractors, including system engineers, field supervisors, meter mechanics, other staff with knowledge of electric systems, gas workers, and individuals that were capable of conducting field inspections and marking issues on circuit maps distributed for these purposes. This initial

damage assessment facilitated the critically important decision-making process in terms of the allocation of resources and the organization of crew assignments.

The initial damage assessment was prioritized to focus on primary distribution lines because, quite simply, the extent of the damage was so severe to large parts of the FG&E and Seacoast divisions that it would have taken too long and diverted too many resources from the power restoration effort to attempt a detailed damage assessment. Thus, the initial damage assessment entailed a survey that began at each substation and focused only on the three-phase primary system. Under normal circumstances, it takes several hours to perform damage assessment on each circuit. However, it took almost four days to complete the initial assessment of damage to the main lines due to the extent of the damage, the need to respond to downed wire calls, and the difficulty of maneuvering through debris-strewn streets.

Detailed damage assessment consists of much more detailed evaluation circuit-by-circuit, pole-by-pole, and customer-by-customer. This was not performed until the second week in FG&E's service area because the damage to the electrical system was so extensive that virtually every portion of the overhead system sustained severe damage. This had the effect of changing the restoration protocol from more normal circumstances that arise after smaller storms. Instead of prioritizing and dispatching crews to individual trouble locations as would normally occur during a one-to-three day storm outage, restoration proceeded in order of priority starting with the transmission system, then substations, then the mainline of circuits, and so on until finally reaching the level of services to individual homes. Thus, damage assessment initially focused only on obtaining critical information, and organizing this information to ensure efficient dispatch of repair crews in order of priority.

Field notes were captured by damage assessors by marking up circuit maps and collecting critical information such as broken poles, damaged equipment and downed wires. Damage assessors also provided handwritten notes to supplement their report and to provide other information to assist repair crews. The notes from this damage assessment were reviewed and organized in the nighttime hours when most repair crews were resting. Office staff organized the damage assessment and developed estimated repair times. This

information was then combined to develop the total estimated time to complete repairs to the three-phase primary distribution system (in crew hours). Work was prioritized by comparing the ratio of the number of customers without power per circuit to the estimated number of crew hours of repair time. Crew assignments were prioritized to address the circuits with the highest ratio (*i.e.* the largest number of customers restored for the least amount of repair time).

The damage assessment was used to develop crew packages, which included marked-up maps and other information needed to effectively dispatch repair crews. Crew assignments were prepared during the overnight hours each night and were ready each morning when crews reported for the day's work. Storm room operations were a 24-hour operation throughout the restoration period. This process was repeated throughout the restoration in an attempt to remain focused on restoring the largest amounts of customers in the least amount of time. Many of the damage assessors later served as "bird dogs" that guided outside crews on the same circuits that they had assessed, increasing the efficiency of restoration work.

Table 5 is an example of the use of damage assessment reports in FG&E to prioritize (or rank) circuits to restore the greatest number of customers. As shown in this table, rankings are based on the ratio of customers without power to crew hours required to restore power.

A detailed damage assessment process for the remaining restoration effort in FG&E was begun by National Grid damage assessors on December 21 and completed on December 22. National Grid brought in 28 damage assessors, who were paired into teams and sent out to drive circuits prioritized for reassessment based on the estimated number of customers still without power.

This detailed damage assessment included a full survey of the system identifying all repairs that were needed including primary, secondary and service repairs. Consistent with Unitil's approach, the damage assessment teams once again began at the substation and surveyed the entire circuit for all repairs that were needed in order to fully restore power. This proved to be a valuable approach as many new repairs were identified on the three-phase

primary system from branches and limbs that had fallen after the initial damage assessment. As the damage assessment teams completed their survey, the completed damage assessment forms were returned to the office where they were summarized on a spreadsheet to calculate the number of crew hours required to complete the repairs. The completed packages were then ready for assignment as described in the next section. These packages were again prioritized based upon the largest quantity of customers still without power. At the end of each day, crews returned the completed packages or partially completed packages. During the evening hours while most crews were resting, crew assignments would again be created for the following morning.

Table 5: Sample Circuit Priorities

Circuit	Town	Circuit Customer Count	Customers Out	Estiamted Crew Hour Remaining	#Cust/Crew Hour	Rank
11W11	F	2835	4	8	0.5	12
39W18	T	2023	1	240	0.0	21
22W1	F	2133	36	15	2.4	5
40W40	F	1689	159	10	15.9	3
15W16	T	1451	78	48	1.6	7
31H34	F	1400	0	6	0.0	22
30W31	L	1198	2	68	0.0	20
39W19	A	1377	292	450	0.6	10
30W30	L	1153	22	64	0.3	16
31W37	L	1135	1	30	0.0	19
31W38	L	1016	34	48	0.7	9
20H22	F	1052	413	22	18.8	1
25W27	F	569	9	16	0.5	12
11H10	F	672	0	0	0.0	22
50W51	F	625	177	87	2.0	6
21W36	F	601	154	50	3.1	4
25W28	F	569	0	58	0.0	22
11H11	F	478	0	0	0.0	22
40W39	F	433	0	0	0.0	22
20H24	F	315	0	24	0.0	22
35H35	F	233	0	5	0.0	22
50W56	F	145	1	12	0.1	18
50W55	F	135	1	0	0.0	22
15W17	T	345	9	15	0.6	11
40W38	F	1	1	8	0.1	17
21F41	F	0	0	12	0.0	22
1W2	F	2313	407	25	16.3	2
1W4	F	2475	4	9	0.5	14
1W6	F	64	10	10	1.0	8
1W1	F	28	9	20	0.4	15
20W42	F	4	0	0	0.0	22
	Total	28470	**1824**	1360	**2.9**	

B. Assessment, Lessons Learned And Recommendations

Unitil was able to perform initial and more detailed damage assessments for the subtransmission and main circuits. However, the ability to perform damage assessments on more segments of the system was impeded by the number of trained damage assessors

required for that undertaking and the limited number of assessors actually available because they were focused on higher priority work. Moreover, damage to the FG&E system and parts of the Seacoast system was so extensive that almost all damage assessment and restoration efforts were focused on the primary system for the first week. While a more accurate and timely damage assessment will lead to a more efficient mobilization of resources and more accurate system restoration times, Unitil responded appropriately to the magnitude of the 2008 Ice Storm by remaining focused on power restoration efforts, even if these efforts detracted from more detailed damage assessment efforts.

Given the magnitude of the 2008 Ice Storm, the substantial damage to facilities in all three divisions, the difficulty in navigating roads, and the location of subtransmission lines distant from roads, Unitil would have been well served to conduct a helicopter fly-over of its subtransmission and primary distribution facilities as soon as conditions allowed. This could have provided Unitil with an earlier sense of the extent of the damage to its system and a more accurate estimate of the number of crew days that would be needed to restore power. It would also have contributed to more accurate communications to the public and to customers regarding the extent of the damage and the time that might be required to restore power (see Sections VIII and IX).

In some cases, resources capable of performing damage assessment were also capable of serving other roles to support the restoration effort. Unitil appropriately assigned these individuals where they provided the greatest value. However, there are other Unitil employees capable of being trained as damage assessors, particularly given the relatively modest training requirements, who could be employed during a major outage. Under these circumstances, Unitil should also determine if there are any third-party contractors that can efficiently provide damage assessment services on short notice.

The process of converting damage reports into crew orders is largely paper-based, which works fine during smaller outages. However, this process resulted in substantial overnight efforts to compile results, prioritize repairs, and prepare crew packages for the following day. Further efficiencies can be gained in this area to reduce the time required and

generate better information to support crew dispatch decisions. To the extent that paper forms continue to be used, these forms should also be reviewed to ensure that they contain the most relevant information and are easy to fill out.

Finally, Unitil's estimates of time required to repair damage were not long enough and did not account for difficult weather and travel conditions. This calculation is a key element of estimated restoration times.

A summary of "lessons learned" from the damage assessment efforts is as follows:

- A helicopter "fly-over" of major facilities as soon as weather permitted would have been an effective way of obtaining an early assessment of damage that is difficult to perform because of impassable roads.
- More trained damage assessors are required for a major outage like the 2008 Ice Storm.
- The process of performing damage assessment and compiling the results relies extensively on paper, making it difficult to expediently gain necessary information for a major outage.
- The estimates of time required to perform repairs were not long enough.

RECOMMENDATIONS

Recommendation 3: Damage Assessment Staffing and Training

Identify and train additional personnel to perform damage assessment, including Northern Utilities personnel. It takes approximately one-half day to train a damage assessor. Conduct annual refresher courses. Explore the availability and viability of using third-party contractors to perform damage assessment.

Recommendation 4: Damage Assessment Forms and Compilation

Improve damage assessment forms based on Unitil's circumstances and experience during the 2008 Ice Storm. Develop a spreadsheet or similar decision-support tool to tally damage assessments by circuit in order to more accurately determine the number of crews and estimated times required to restore power to a segment or a broader section of the system. Revise estimates of time required for each type of repair based on experiences during the 2008 Ice Storm and other utility experience in this and prior storms.

V. POWER RESTORATION

The restoration effort was led by the Director of Electric Operations with the DOC managers each serving in the capacity of Restoration Coordinator or Manager in their respective divisions. The DOC managers assumed responsibility for the day-to-day conduct of damage assessment, prioritization of repair work, and dispatch of Unitil and outside crews in the restoration effort. They are also responsible for clean-up activities that have taken place over the past three months, as discussed in Section X. Given the extent of the damage and number of outages in all three divisions, the Chief Operating Officer was also directly and actively involved in the day-to-day management of the restoration effort.

A. The Time Required to Restore Power

The objective of power restoration is to restore electrical service to critical facilities and to the largest number of customers in the shortest period of time, consistent with public safety. Field supervisors working under the direction of the Restoration Coordinators oversaw the physical restoration of the system. These supervisors assigned work to crews based on the restoration priorities discussed below. Field supervisors communicated with division dispatch centers, keeping them apprised of crews assigned to perform work and their current location.

Crews were assigned to perform three basic functions:

1. Subtransmission Line Repairs – The repairs to the subtransmission system were performed by a combination of bucket trucks and off-road equipment. These repairs generally consisted of replacing down conductors, removing large trees, and completing switching operations.

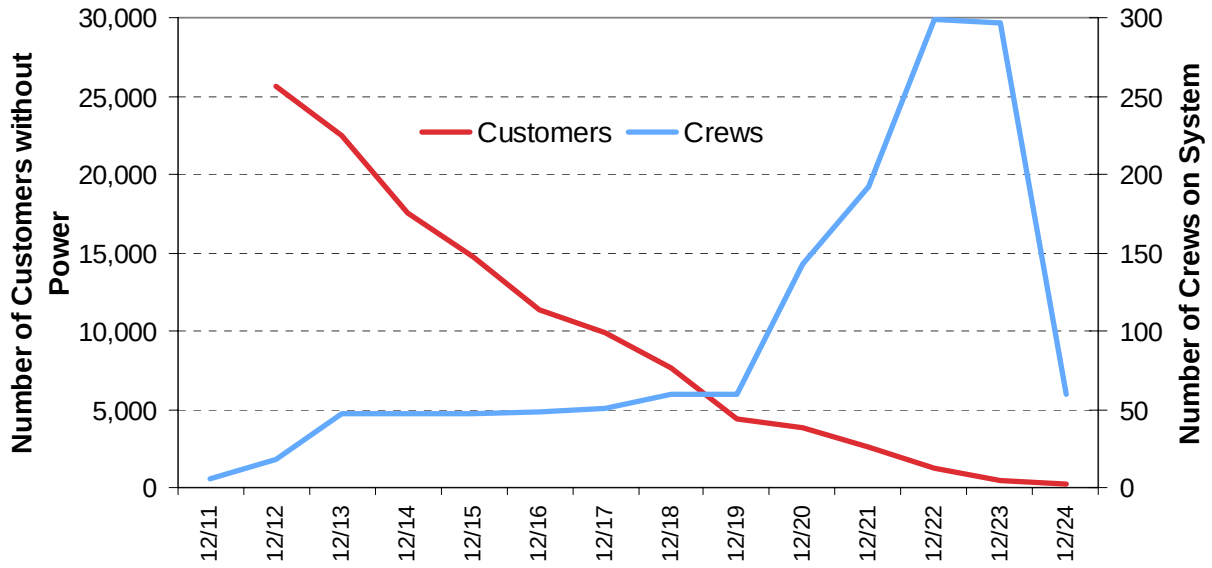
2. Overhead Line Repairs – Overhead line repairs were generally performed by line crews in bucket trucks, line crews with digger trucks or by climbing poles. Overhead line repairs consisted of: emergency response to medical and critical customers, pole replacements, pole transfers, replacement of downed conductors, replacement of broken crossarms, replacement of failed transformers, repairs to service conductors, and distribution switching.

3. Tree Trimming – Tree crews were assigned to remove trees and branches working in areas ahead of the line crews assigned to perform overhead line repairs. However,

the line crews completing overhead line repairs were also equipped to be able to remove small to moderate size limbs that required a minimal amount of trimming.

The single most important factor in the time required to restore power is the number of crews that are applied to the task. Total damage repair days depend on the extent of the damage and the productivity of crews while restoring damage. Weather conditions and crew rest are factors that affect crew productivity. A crew day is 16 hours, or two normal work shifts. This is an oversimplification as other factors contribute to the restoration time required for a given level of system damage, but these are the most important factors. The following figures depict the relationship between the number of crews working in each of Unitil's three divisions and the impact on the number of customers without power.

Figure 8: Power Restoration – FG&E



As shown in these three figures, the counts of customers without power were declining slowly almost a week into the storm as progress in the field was slower than anticipated due to the extent of the damage and the shift in focus from backbone subtransmission and distribution lines to efforts to repair secondary lines and restore power to individual residences and businesses. Typically, restoration of a subtransmission and main distribution line are the initial focus of restoration efforts and bring back large numbers of customers after they are repaired. However, at least in Fitchburg and in parts of the Seacoast division, there was extensive

damage to every segment of the system and many customers remained without power after these main lines were repaired. As shown above, a large number of crews dedicated to secondary lines and individual service repairs was required to complete the restoration effort.

Figure 9: Power Restoration – Seacoast

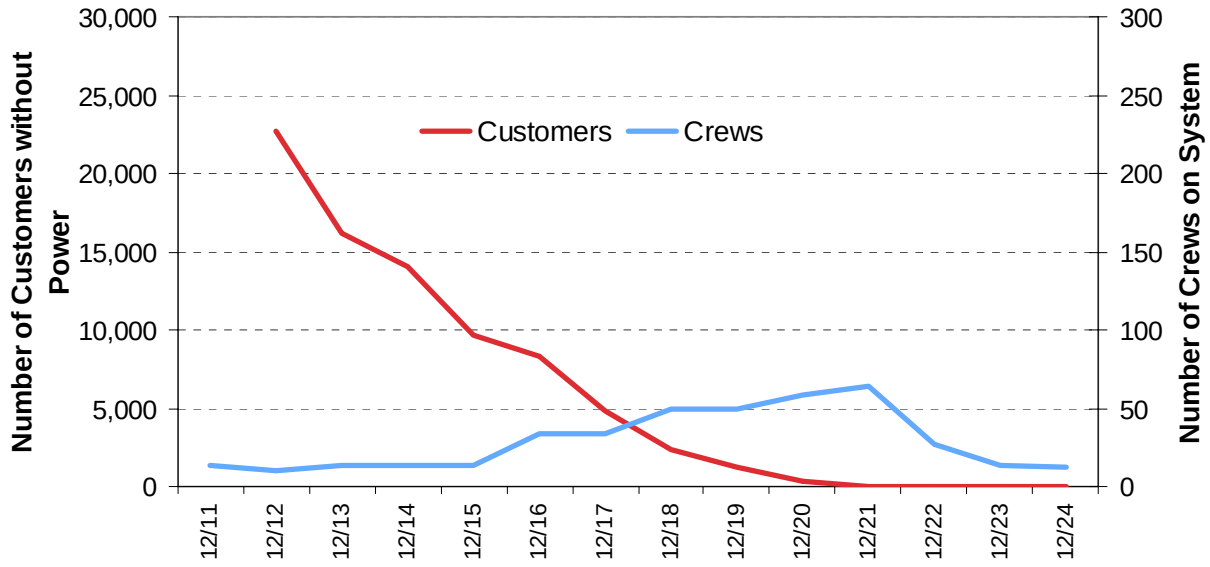
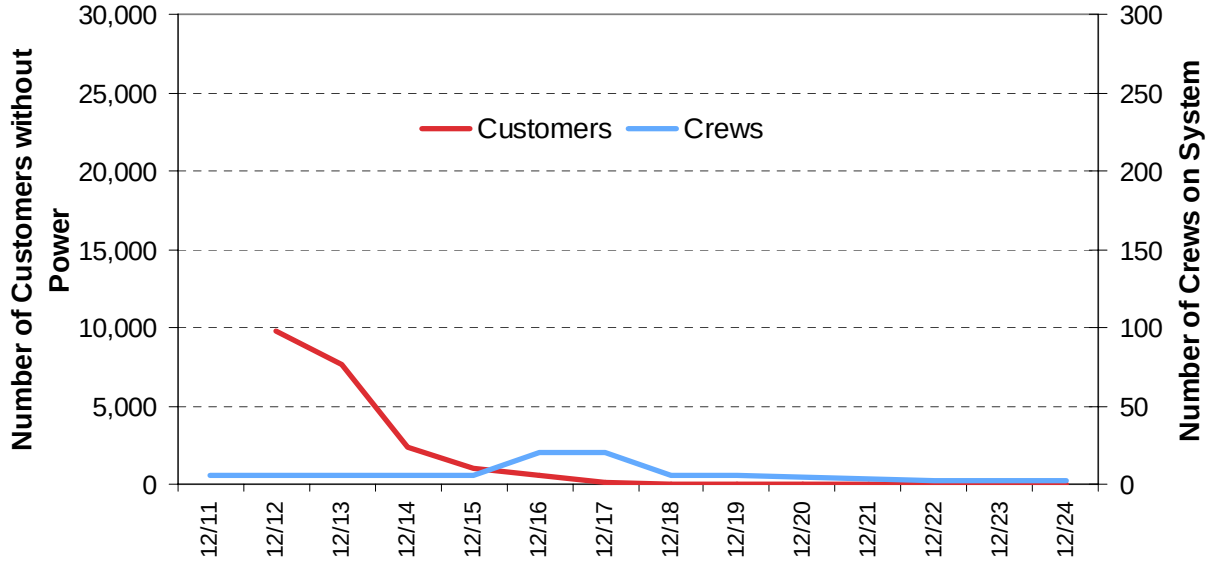


Figure 10: Power Restoration – Capitol



The last customer was restored in the Capitol division on December 20, in the Seacoast division on December 23, and in FG&E on December 25.[45] [46]

B. Prioritization of Repairs

The challenges to restoration in the FG&E and Seacoast divisions were driven by the massive destruction of Unitil's electric facilities. In the FG&E division virtually the entire system was a trouble location. There were no portions of the FG&E system, other than the underground portions, that were not extensively damaged. Virtually every circuit, fuse, mainline, side tap, and lateral was extensively damaged, as were thousands of individual customer service lines. Hundreds of broken poles and crossarms, hundreds of miles of line, and thousands of individual service lines lay in a jumble of broken and fallen trees and limbs on the ground. Unitil conservatively estimates that approximately 150 to 200 miles of its 500 miles of primary circuitry in FG&E were downed as a result of broken and falling trees.

As set forth in the ERPs, hazardous downed wires and any other public safety issues are considered highest priority work, and are responded to prior to restoration work.[47] Restoration efforts to address public safety concerns such as downed wires are performed at the same time or within hours of an initial damage assessment because of these high priority needs. Damage assessors will stay with an energized downed wire until someone else or a crew arrives.

Once restoration work has commenced, service is restored based on the prioritization categories set forth in the respective ERPs, in the following general order:

1. Transmission lines and transmission substations;
2. Distribution substations;

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[45] There were a limited number of outages reported after customers had returned from holiday travel.

[46] However, high winds caused further outages in FG&E and the Seacoast division on December 25 that were restored on the same day.

[47] There were so many downed wires during the storm that not all reports could be dealt with in this way. However, all reports of live wires or downed wires creating hazards were responded to immediately.

3. Critical facilities, including hospitals, EOCs, telecommunications facilities, central water and sewer pumping facilities, life-support customers, fire, police, Emergency Management Agency Headquarters, nursing homes, and elderly residence facilities;
4. Main circuits;
5. Largest block of customers;
6. Individual services to identified Life Support Customers; and
7. Remaining individual services.

After restoration of backbone systems and service to critical customers, Unitil made repairs that would result in the restoration of service to the largest number of customers in the shortest time. Finally, service lines were restored for critical and non-critical individual customers based upon trouble tickets and crew inspections of damaged service lines.

Unitil followed the prioritization scheme established in the ERPs when restoring power following the 2008 Ice Storm. While there were some minor variations from the prioritization scheme, they were initiated in the field in order to foster efficiencies. For example, if crews were repairing a circuit and a critical police station was located nearby, and service could be quickly restored to the station, the crew might make the necessary repairs then, rather than move on to the next circuit and have to make a separate trip back to the police station at a later time. Additionally, due to the scope and duration of the storm, Unitil augmented its critical facilities list by adding emergency shelters and other emergency-related organizations that did not have a source of backup generation. Later in the process, as it became evident that more hotel rooms were needed to house crews, these also received priority status.

While Unitil adhered to the restoration priorities set forth in the ERPs, progress working down the priority list was considerably slower than in a typical outage due to the massive scope of the damage. Instead of prioritizing and dispatching crews to individual trouble locations, as would typically occur in most outages, restoration proceeded from the very top of the priority list, with the transmission system, then proceeded to the substations, then individual circuits, and so on, until crews were finally restoring individual services to customers. Thus, crews started at substations and began working downstream, repairing the main circuits first.[48] To

[48] The mainline of a circuit is generally defined as the three-phase "backbone" portion of a circuit emanating from the substation, from which the remainder of the circuitry is fed.

the extent possible, tree crews proceeded in advance of bucket crews. The repairs to circuits required clearing and isolating all sidetaps, laterals and downstream circuitry until the mainline portions of circuits were energized. Crews then began the process of restoring increasingly smaller portions of circuits. There were instances where it was necessary to rebuild miles of line and run miles of new wire in order to restore only a handful of customers. This became increasingly typical in the final days of the restoration effort, slowing restoration efforts dramatically.

Unitil spent much of the first week repairing the subtransmission facilities and primary distribution lines that are the backbone of the system. Several subtransmission lines lost power due to falling static wire.[49] The repairs to the subtransmission system and primary distribution system proceeded in parallel. This made it possible to re-energize primary distribution lines as soon as possible after the subtransmission system was restored and power was restored to substations that serve the distribution system. A review of selected restoration activities in each of Unitil's three divisions is presented in Table 6.

The enormity of the task of restoring power created the need for a 24-hour storm room operation with management and staff performing roles that varied from day-to-day and hour-to-hour. Among the activities that had to be performed in the storm rooms were:

- Planning: planning the approach to restoration when the entire system is down and organizing necessary resources;
- Scheduling: all Unitil and outside contractor resources had to be scheduled to provide 24-hour coverage and provide for adequate handoffs for continuing responsibilities;
- Switching Orders: countless switching orders were written, authorized, and coordinated in order to de-energize and re-energize facilities for repair and safety purposes;

[49] Static lines are the top transmission wire but do not carry power; they protect against lightning strikes, but when they come down they fall across the energized transmission lines.

- Crews: compiling damage assessments and trouble tickets to develop work packages, preparation of circuit maps to guide restoration efforts, dispatching crews, arranging for bird dogs, coordination of tree trimming;

- Reporting: considerable effort was devoted to developing estimates of the number of customers without power by community, including efforts to gather restoration updates from crews and update the outage reporting system before posting these updates to the Unitil website;

- Logistics: arranging food and lodging for crews, stocking crews, and maintaining adequate storm inventory, coordination of deliveries to field crews;

- Communications: countless communications with police and fire officials, regulators, elected officials, Unitil management and public communications staff;

- Coordination: planning for the arrival of additional National Grid crews and providing necessary support services; and

- Administrative Support: accounting activities, execution of purchase orders, time sheet processing

Each of these activities must be staffed and managed. Moreover, these roles were performed under adverse conditions with a remarkable degree of safety.

Table 6: Selected Restoration Activities

Date	Fitchburg	Seacoast	Capitol
Dec 11	Supervisors and engineers called in to work. Lost power at Flagg Station; several subtransmission lines lose power	Set up storm room; called in crews and EOC supervisors when outages began at approximately 9 p.m.	Outage calls started around 10 p.m. Supervisors reported to the office to begin damage assessment and call crews in to work
Dec 12	Total system blackout at 1:09 a.m.; lost SCADA and radio communications; power restored at Flagg Station; re-energized Summer St, Canton St, and Sawyer Passway substations; four subtransmission lines and at least six substations are out; assigned crews to critical customers	Several subtransmission lines out of service; evaluation of subtransmission system faults; switching orders to restore main lines of several circuits; some subtransmission restored; simultaneously addressed mainline distribution systems	Lost and picked up several subtransmission lines; the number of customers without power doubled during the day, reaching 10,000; crew rotations established; damage assessment began
Dec 13	Focus on repairing primary system; Live wire checks and damage assessment; switching orders for 08 and 09 lines	Address and restore subtransmission line outages while simultaneously restoring mainline distribution; response to critical fire and police matters and critical care facilities.	Picked up subtransmission line and several side taps as customers out declined to 7,500
Dec 14	Walking survey of 69-kV system and execution of switching order to restore this backbone system	Focus shifted primarily to response to distribution outages, fire and police requests and critical care facilities	Significant progress overnight with mainlines and large side taps energized
Dec 15	Switching orders for restoring 69-kV system; compilation of results from damage assessments; most of transmission system back up	Focus continued with response to distribution outages, fire and police requests, and critical care facilities; preparations for Tennessee crews	Failure of the Iron Works transformer; lost and reenergized subtransmission line; restoration of main primary lines and side taps
Dec 16	Switching orders for restoring 69-kV system; switching orders for distribution circuit ties; damage assessment completed	Focus continued as on prior two days; began to evaluate the repairs necessary to the backup subtransmission systems that were switched out of service to restore power; Tennessee crews arrive	Restoration of primary side taps and services; mainline restoration complete

Date	Fitchburg	Seacoast	Capitol
Dec 17	Walking survey of 69-kV system; switching orders for 69-kV system and distribution circuit ties	Continued to restore distribution system outages and address critical public safety matters; continued repairs to backup subtransmission system	Restoration of services and single-customer side taps
Dec 18	Walking survey of 69-kV system; switching orders for 69-kV system and distribution circuit ties; started energizing laterals off mainline	Continued to restore distribution system outages and address critical public safety matters; repairs to backup subtransmission system	Restoration of services
Dec 19	Walking survey of 69-kV system; switching orders for 69-kV system and distribution circuit ties	Restoration of distribution lines; completion of subtransmission system repairs	Restoration of services
Dec 20	87% of primary system complete; preparations for arrival of National Grid crews	Restoration of distribution lines and replacement of individual transformers	Restoration complete
Dec 21	National Grid crews arrive; transmission crews work on 01 and 03 line static wires, the Flagg Station breaker, and the 01/02 Beech Street Line Tap	Restoration of services and individual transformers	
Dec 22	Detailed damage assessment completed; 110 Unitil and National Grid crews arrive; abandoned priorities to correct all problems on circuits	Restoration of services and individual transformers	
Dec 23	Repair efforts continue	Restoration complete	
Dec 24	Repair efforts continue	New outages due to snow and wind conditions	
Dec 25	Wind storm creates new outages	Transmission line tripped due to snow and wind conditions	

C. Crew Management, Field Communications, and Crew Safety

Each day, crews were given their assignment to work on a circuit – or a portion of a heavily damaged or particularly lengthy circuit – at the same time that their trucks were being restocked with necessary materials and supplies. The packets were initially given to the crews' supervisor to review, and then the supervisor assigned the crews to individual problems as they moved down the circuit.

Crews worked in the field for 16-hour shifts. Supervisors would call in throughout the day with updates that addressed energizing specific areas and streets in order to ensure that crews were working in a safe environment. The crews returned at the end of each day with marked up maps indicating the repairs that had been made.

Toward the end of the restoration effort, when the focus was on restoring individual services, crews would be assigned a map grid and given a packet with a list of service outages ("paper trouble tickets") to verify and restore power if possible. Crews would report back to the storm room if an issue arose that required the services of an electrician (*e.g.*, a meter off the house). That information would be fed into the customer information system and Unitil would contact the customer to explain that they needed to hire an electrician to restore their power. Line crews would generally also talk to the customer or a neighbor about what type of electrical work needed to be done.

Outside crews were assigned crew guides to travel with the crews to help them work more efficiently. Crew guides traveled ahead of their crews to assess what the next job looked like and made any necessary preparations.

Several outside crews (utilities and contractors) brought their own field supervisors with them who oversaw a number of crews. Unitil worked directly with these supervisors to help keep the crews productively engaged. A primary role of the these field supervisors was to protect the safety of the crews and to limit their direct interaction with Unitil, so that if an issue arose the crew could go to their supervisor who worked with Unitil to resolve the issue. Crew

supervision also consisted of making sure the crew(s) had enough resources (materials and tools), directing them, performing damage assessment, developing the work that needed to be done, and managing the work as it was performed.

The biggest challenge for Unitil during the restoration process was making sure that adequate contact was maintained with field supervisors or with crew guides for crews that did not have a supervisor. Communication was required for Unitil to shift crews to another area if a change in circumstances required immediate attention. Communication proved to be challenging in some cases because a single supervisor was often assigned 10-12 crews instead of the usual complement of 4-5 crews during normal operations. Unitil was also trying to obtain and compile information about restoration progress to report to the public, but understandably, field supervisors had other important tasks to attend to.

The primary communication system used during field restoration efforts was a two-way voice radio system. The Capitol and Seacoast DOCs use two different radio frequencies. Each vehicle is equipped with a radio capable of utilizing either frequency. A secondary communication system used during the restoration effort was cellular phones and/or landline phone systems. These systems were used when longer conversations were required with field personnel or if the primary radio system had priority communication (*i.e.*, switching orders) or an increase in radio traffic. There were field communications issues that arose due to power failures that affected radio towers. All radio towers have backup uninterruptible power supply systems that last about 24 hours, but they do not have generators.[50] Cellular communications were also affected by outages because they also rum off uninterruptible power supply systems and were lost as a result of power outages.

There was only one safety accident during the entire restoration period. A tree crew worker attempted to unsnag a low hanging telephone wire that snared his truck. The released wire tension threw the worker off the truck. A major safety concern at the start of the storm was that crews were already out working while damage was still occurring, and trees were

[50] Unitil installed a generator at the primary radio tower to maintain communications.

falling on trucks and around crews. There were reports of some near misses and linemen were concerned about beginning the restoration effort while trees and lines were continuing to fall.

There were no electrical-related accidents during the storm. Generally, contractors follow their own safety policies when working on restoration. Unitil's responsibility is to ensure that lines are not energized if there are any workers still working on the circuit. In fact, Unitil places extra emphasis on the grounding process during storms, because of the increased number of crews working on the system at the same time. In addition to grounding policies, enhanced safety measures include additional tagging / signage hanging on poles, the ground-to-ground rule and rubber glove / sleeve usage.

D. Assessment, Lessons Learned, and Recommendations

Restoring power after the 2008 Ice Storm consumed Unitil's entire operations staff for almost two weeks, working with little rest. Although it is not advisable to work at such a demanding pace for a sustained period, no major mistakes or technical glitches occurred as the teams worked through the restoration priorities in a methodical manner in each division. However, there are several enhancements that should be made to improve the restoration work environment, improve communications with crews in the field, and track restoration activities and progress. These improvements will result from better tools and improved organization of the overall effort.

First, with respect to staffing of the storm rooms, the teams started out as if the restoration effort were a sprint, and not a two-week effort. Several staff members worked incredibly long hours the first few days of the storm, recognizing that backbone systems needed to be restored before it would be possible to restore power to smaller circuits and individual services. This source of stress and fatigue can be addressed by involving more people in support roles and freeing up key managers and supervisors to focus on the most important planning and management tasks. Establishing a staff schedule based on a longer expected outage period would also have been helpful. This schedule should provide for adequate rest, but also allow for the adequate transfer of knowledge and intelligence when activities are being

handed off to the next shift. These handoffs will be smoother to the extent that as much information as possible regarding current restoration efforts can be kept in database systems, spreadsheets, whiteboards, and other tools.

Another area with room for improvement is communications with crews in the field regarding work that has been completed. While crews and their supervisors are focused on restoration and reluctant to take time to report progress back to the storm room during the workday, there may be ways to automate and thereby streamline this process. This will reduce the time required to review marked up maps that were returned to the storm room at the end of the day (*i.e.*, 11:00 p.m. or later). It will also ensure the storm room team has more time to validate progress reports and prepare crew packages for the following day.

There were also technical issues related to communication technologies that depended on electricity. Communication with the field was affected by outages to radio and cell towers. It is worth reviewing these issues to determine if there are more reliable primary or backup solutions.

Individual services are the lowest priority as repairs may only bring one or a few customers on line. The prioritization of restoration activities creates customer confusion, however, as crews may be in an area restoring a main distribution line and then leave before individual services are repaired. This issue can be addressed either by more effective communications with customers on this issue, or modifying the restoration prioritization. The restoration priorities were changed late in the storm to repair individual services while working on a circuit. This approach should be considered depending upon the nature and extent of the damage in future significant outages. The crews, who have direct contact with customers while they are working in the field, seem to prefer this approach.

An additional and potentially confusing issue in many outages is the fact that the utility is not responsible for damage that occurs beyond the end of its facilities. While this is communicated to customers, the division of responsibility is not always clear to many customers. There is anecdotal evidence that suggests that electricians were hard to come by

during the 2008 Ice Storm and that they were charging premium rates. There may be an intermediary role that Unitil can serve to make the process of hiring an electrician less complicated for customers.

A summary of "lessons learned" from the power restoration efforts is as follows:

- Storm managers had too many responsibilities for a storm of this magnitude and duration.
- More restoration processes and data tracking efforts should be automated, if possible.
- A more flexible approach to restoration priorities may be appropriate.
- The consequences of a widespread electricity outage on restoration communications should be reflected in the ERP.

RECOMMENDATIONS

Recommendation 5: Storm Room Staffing

Develop an outage staffing policy that governs work and rest times. Reflect the need to offload many tasks from storm room managers and supervisors in the revised ERP.

Recommendation 6: Restoration Processes and Reporting

Review all processes and data reporting requirements and develop an information system plan to automate processes that are subject to system-based efficiency improvements, reducing reliance on paper-based information flows.

Recommendation 7: Field Communications

Evaluate options to improve the reliability of field communications in the event of a sustained power outage.

VI. OUTAGE REPORTING

A. Unitil's Outage Reporting System

Perhaps the most requested type of information during the restoration period was estimates of the number of customers without power by community. State and local officials relied on this information to determine the progress being made by Unitil to restore power. Unitil has developed a reporting tool/database (the "Outage Reporting System") accessible to employees through the Company's intranet and to state agencies that compiles information that is provided by each of the three storm rooms.

The Outage Reporting System depends on data manipulation and analysis performed by storm room personnel. The process used to calculate the number of customers affected by an outage relies on the connected kVA of a circuit. The total connected kVA of a section experiencing outages is divided by an average kVA per customer to estimate the number of customers without power. As portions of the system are restored, this process is performed again to update the estimate. These estimates are then compiled by town and used to update the Outage Reporting System. There was enormous focus on these estimates and their validity from a communications perspective during the restoration period. As discussed in Section C below, this estimation methodology can be largely automated and thereby eliminated if there is an Outage Management System (OMS) in place.

B. Customer and IVR Outage Reporting

Unitil's Interactive Voice Response (IVR) system has a module called the "Porche" system that is one means by which customer outages are typically reported and tracked. The Porche system can identify the customer and his or her location either by using a Caller ID function or by requesting entry of the customer's account number. This information is used to generate a "trouble ticket" which indicates the time of the call, the customer's location, the relevant circuit number, and any comments entered by the customer into the IVR through the options menu. Once trouble tickets are generated in the Porsche system, they are forwarded

to personnel in the relevant operating division where they are used during normal operations to direct crews to customer locations.

Under normal operating conditions, customer outages occur as a result of separate and distinct problems that are easily identifiable and can be organized and prioritized for repair. For example, a fallen tree may result in a downed wire or broken pole, thereby causing an outage to a group of customers. Restoring these customers entails removing the tree and repairing damage to electrical equipment (a process that typically takes a couple of hours).

Given the scale of the 2008 Ice Storm, the IVR system played a much more limited role in directing resources to repair facilities. After the 2008 Ice Storm hit, virtually the entire FG&E division and large segments of the Seacoast division were, in effect, a trouble location. There were very few portions of the Unitil system in these areas that were not extensively damaged. In some areas, every circuit, fuse, mainline, side tap, and lateral were extensively damaged, as were thousands of individual customer service lines. Hundreds of broken poles and crossarms, hundreds of miles of line, and thousands of individual service lines lay in a jumble of broken and fallen trees and limbs on the ground. Under these circumstances, the IVR / trouble ticket system was of little value. However, the IVR trouble tickets provided information to help assess the extent of an outage and the areas of the system that appeared to be hardest hit. Outages by circuit were used during the 2008 Ice Storm to prioritize circuit repairs in accordance with the restoration approach to bring as many customers back on line as fast as possible. Trouble tickets became more useful toward the end of the restoration effort when repairs focused on individual services, after primary and secondary lines had been repaired.

In addition to notification by customers, outages were tracked by other means. Damage assessors and crew guides called in to the Restoration Coordinator by radio or cell phone to report outages. Unitil's SCADA system alerted operating personnel when breakers opened or closed at substations, which also assisted with locating outages. Additionally, municipal officers called Unitil to report outages in their communities.

C. Outage Management Systems

An OMS is an information system used by electric utilities to estimate the number of customers without power and to identify the protective device(s) that operate to clear the problem. An OMS, therefore, has two potential purposes: (1) assist with prioritization of repairs to restore the greatest number of customers in the shortest amount of time, and (2) report to the public on the number of outages in communities. In essence, an OMS is used to identify all known "trouble" locations and estimate the number of customers impacted by these trouble locations. It has similar objectives to Unitil's existing Outage Reporting System but is automated and performs much faster while producing more accurate information.

An OMS supplements the much more detailed information provided by damage assessment and is helpful when communicating with customers and the public regarding the extent and location of customer outages on a real-time basis. This data can be provided through a web portal. The primary source of data input is customers reporting outages through the IVR system. The OMS then incorporates Geographic Information Systems (GIS) data to interpolate additional customer outages and to tie those outages to a specific piece of equipment, *e.g.*, a fuse or breaker that has opened upon failure. When combined with an automated customer callback process, it can identify additional equipment that may be causing an outage after initial repairs are made on a circuit. It can also be integrated with the SCADA system to report on the operation of circuit breakers.

An OMS helps with the restoration prioritization process by identifying those repairs likely to restore power to the largest number of customers, information that helps electric utilities dispatch and manage crews. It is particularly useful for relatively large and complex outages as it compiles large amounts of information quickly and automatically, without the extensive human interaction required by the Outage Reporting System. It provides reliable outage data that is desired by customers, the general public, and public safety and elected officials. It can be useful in estimating restoration times, but there are many other factors that must also be reflected. The OMS also allows the input of estimated restoration times based on crew reports.

As noted above, Unitil currently relies on the "Porche" IVR product distributed by Milsoft, Inc. The Porche system tracks those outages that have been reported, but does not have the ability to either interpolate the results or connect reported outages to specific equipment requiring repair.

Unitil has investigated OMS systems within the past two years, issued an RFP in 2006, and subsequently interviewed three vendors that are already working with Unitil in some capacity. The OMS must be integrated with other Unitil systems, including the IVR, GIS, and SCADA systems, a development process that takes several months. Having a vendor that can efficiently integrate with other products is an advantage. For example, Unitil's customers need to be associated with facilities tracked by the GIS. Unitil's GIS and SCADA systems are very good, which should accelerate the integration process and lower the implementation costs. Unitil is currently updating its GIS data to reflect repairs made in response to the 2008 Ice Storm. The OMS will also need to be maintained during major outages, requiring staff dedicated to this purpose.

D. Assessment, Lessons Learned and Recommendations

Unitil's existing Outage Reporting System depends on extensive manipulation and analysis of data and is therefore time-consuming when large amounts of outages are being reported and analyzed. It also relies on an estimation methodology that provides a sense of the number of outages in parts of the system, but these estimates are less reliable for reporting purposes, particularly if reporting the number of outages in smaller communities.

The current Porche system serves a different purpose. It is used to direct resources to repair reported "troubles." It has been adequate and will continue to be adequate in most outages. However, it is not relied upon, nor should it be relied upon to direct resources when large segments of the T&D networks are on the ground, as was the case with the 2008 Ice Storm. It became more useful toward the end of the restoration period when Unitil was focused on restoring power to a manageable number of individual customers.

An OMS would provide automated and more accurate reports of the number of customers without power, and the number of individual "troubles." As it has the ability to assimilate large amounts of outage information and compile that information automatically, it would have helped with the prioritization of repairs in the Seacoast and Capitol divisions. Ironically, the damage to the FG&E division was so extensive that an OMS would not have necessarily changed Unitil's approach to rebuilding this system. However, it would have resulted in more accurate outage reporting data in all three divisions.

While the OMS serves a valuable role in developing estimates of customer outages for communicating with customers and improving the overall efficiency of communications during the restoration process, it may not result in a significant reduction of the overall restoration time, which is primarily dependent on the number of crews available to perform restoration work as discussed in Section V.

A summary of "lessons learned" from the outage reporting efforts is as follows:

- The current outage reporting system is too time consuming and cannot keep up with the need for timely outage reporting data in a major storm, nor will it produce sufficiently accurate estimates for Unitil's smaller communities.
- The IVR reporting system is most useful and can be relied upon to direct resources only when the number of reported outages is manageable.

RECOMMENDATIONS

Recommendation 8: OMS Acquisition, Development and Staffing

Proceed to acquire and integrate an OMS. Designate a staff member to oversee the operation and maintenance of the OMS system and train supplemental resources to maintain the OMS during significant outages.

VII. LOGISTICS SUPPORT

Logistics support refers to activities required to allow crews to focus on restoring power to customers. These activities include housing and feeding crews, fueling and maintaining vehicles, acquiring and storing materials and supplies (or "inventory management"), and restocking crew trucks with needed materials and supplies. For large outages, logistics also includes establishing supplemental staging areas to handle large numbers of crews. Logistics can also refer to bird-dogging and crew supervision although this task is discussed in Section V.

A. Inventory Management

Each DOC has a stock room that is staffed by an inventory manager and stock room clerks. Unitil has a Procurement and Supply Chain Manager who oversees the materials and supplies function for all three divisions. Centralization of this function contributed to better inventory management during the storm.[51] The clerks record materials as they leave the stock room, and also account for any materials that are returned to the stock room. The stock room inventory managers keep the Procurement and Supply Chain Manager apprised of stock levels, so that he can arrange for replenishment and delivery of supplies where they are needed.

As the storm approached, Unitil's Procurement and Supply Chain Manager contacted its alliance vendor, Graybar Electric Company, Inc. (Graybar), a major supplier of materials and supplies to electric utilities throughout the country. Graybar representatives visit Unitil's DOCs on a semi-weekly basis to replenish materials during normal operating conditions. Unitil has also outsourced its centralized warehouse to Graybar to provide for a more efficient and cost-effective means of maintaining inventory that can serve all three divisions. As provided for by contract, Graybar is required to maintain restoration material, and Graybar has contracts with manufacturers to supply these materials on short notice. The Procurement and Supply Chain Manager asked Graybar to check their supplies of restoration materials and maintain restoration materials to support the restoration effort. Unitil also called to ensure that it would not be disadvantaged relative to other utilities seeking supplies from the same vendor. On

[51] The Procurement and Supply Chain Manager began working at Unitil on December 1 and Unitil's procurement process was centralized at that time.

December 11, the Inventory Manager reviewed material replacement protocols and placed an order for additional restoration materials and supplies, as well as poles for the Seacoast DOC.

The types of materials and supplies needed for storm restoration depend on the type of damage and area of the system that is affected. For example, Unitil had to replace 241 transformers and 420 crossarms due to extensive damage caused by downed trees. The FG&E service area has not experienced as much growth as the Seacoast division and therefore has relatively more miles of copper wire that are still in service, requiring more copper wire and copper wire splices for restoration.

On December 12, Unitil informed Graybar that the damage to its system was extensive and that restoration supplies would be required over an extended period. Unitil's ability to maintain adequate stock levels throughout the restoration period was greatly aided by its alliance with Graybar. Graybar follows the industry practice of prioritizing all restoration work ahead of requests to support normal operations.

Set conference calls were held every day to go through material needs and updates with Unitil's inventory team. However, while Graybar was very responsive during the storm, it had difficulty anticipating what restoration material to stock. Although the agreement calls for Unitil to purchase certain materials and supplies exclusively from Graybar, this restriction was waived during the restoration period as Graybar began having difficultly replenishing certain restoration materials given the widespread regional impact of the 2008 Ice Storm. Graybar also has contracts with National Grid, NU-PSNH and the New Hampshire Electric Cooperative so they too were stretched by the storm.

Unfortunately, some non-Graybar vendors did not have vehicles available to transport materials and supplies to Unitil. Unitil employees with pick-up trucks traveled throughout Massachusetts and New Hampshire to pick up materials and delivered them to the DOC stock rooms.

Unitil's Procurement and Supply Chain Manager oversaw stocking levels throughout the storm to make sure they remained adequate to support growing demands as Unitil succeeded

in retaining additional crews. He also ensured that the vendor supply chain was meeting the needs of each of the three divisions in a timely manner. Many materials were transported during the evening hours to prepare for the following day's work. Unitil also arranged for transportation of some materials, particularly transformers, among its DOC stock rooms.

The FG&E stock room was supplying materials and supplies to more than 100 crews (not including National Grid crews) at the height of the storm. It is the standard industry practice for the host utility to supply all materials to outside crews. The number of crews being served out of this stock room stretched the ability of stock room clerks to perform their duties.

Contractor crews in Fitchburg stocked their trucks each morning between 6:30 a.m. and 8:00 a.m. The Fitchburg stock room was reorganized during the restoration effort in order to make it easier for crews to locate materials and for the stock room clerks to control distribution of materials that were in highest demand. Unitil made every effort to supply crews with all the materials that they would need for the day but there were instances in which stock room and gas operations staff were used to distribute requested materials to crews in the field. Safety materials were provided to external crews if they requested it, but in general, most outside crews brought and returned with their own safety materials (*e.g.*, hardhats).

In the Seacoast DOC, stockers built "storm kits" to streamline the stocking process. A storm kit is a prepackaged set of materials and supplies that are needed to restore power. As crews arrived in Kensington each morning, the stock room employees worked with the supervisors and operations people to understand what kind of work they would be doing in order to most effectively stock the trucks. Because the stock rooms are mostly open, a crew could come in and take a lot of materials, but the goal was to make sure they were getting the right material for the particular restoration work they would be doing on a given day.

There was a lot of material issued out of the stock rooms during the restoration period. Unitil has completed a thorough inventory at all three stock rooms in order to confirm materials that were used during the storm. It was also difficult to maintain normal procurement procedures during the restoration period, requiring Unitil's Accounts Payable and Construction

Accounting staff to catch up after the storm. The material charged out by crews was recorded on paper records brought in by the crews at the end of each day. These crew records show materials and supplies usage levels that are consistent with the actual inventory.

For accounting purposes, Unitil distinguishes between "capital items" and "exempt items" in its stock room. Capital items are more expensive items that are charged to specific projects for accounting purposes. Exempt items are much smaller items such as nuts and bolts, frequently acquired in large quantities, and are not assigned to specific construction budgets. Within the capital items category, certain materials and supplies used in large construction projects require longer lead times to supply, including poles and transformers. However, most restoration items have shorter lead times, including hand coils of copper wire, service hooks, dead-end taps, cross-arm braces and fuses.

B. Food and Lodging

It is the responsibility of the host utility to find lodging for outside crews. Fortunately, the two weeks before Christmas is not a particularly busy period for hotels in Unitil's service area. Nonetheless, Unitil faced challenges due to the number of outside crews, the loss of some or all power by some hotels, and the fact some residents that had lost power were also looking for hotel rooms. Many restaurants were also without power.

In a few cases, the logistics support staff did not have adequate advance notice of newly arriving crews. Ideally, the crews should be housed as close as possible to their staging area to minimize travel time. However, this was not always possible due to the demand for hotel rooms during the restoration period relative to the number of hotels in central Massachusetts. Unitil encountered little to no difficulties in New Hampshire with respect to obtaining hotel rooms. The New Hampshire Department of Homeland Security (NH DHS) made some rooms available to Unitil at their facility to house crews working in the Capitol division.

A second challenge was managing and tracking crew charges at restaurants and hotels. In most cases, crews were paying these charges that are then included in the lengthy bills in the month or two after the storm.

In New Hampshire, the restaurants that were open were very busy. Unitil therefore obtained and delivered boxed lunches in the field. In addition, other hot meals were provided by catering services and served at the company's DOCs. At the onset of the storm, boxed lunches were made available for all onsite/assigned crews and field personnel. As more outside resources began to arrive, breakfast was provided at the local DOC to allow crews to begin work immediately after being assigned to the field. Several local restaurants also provided hot meals (primarily dinners) for crews and were utilized by the local field supervisors at their discretion based on working conditions and requirements. Unitil also attempted to coordinate crew arrival times with various restaurants to ensure quick seating where possible.

C. Crews Logistics Support

Unitil staged all crews out of their DOC locations until December 21, when National Grid established a separate staging area to handle its crews. There are limits to the number of crews that can be staged in each division, and the FG&E DOC was already operating at maximum capability. National Grid used their network of third-party suppliers to set up a staging area quickly.

The staging area concept provides a centralized area for overnight refueling, repairs, re-stocking, and also snow blowing, when needed. A materials tent can be established at the staging area to facilitate stocking. Crews then take buses to their hotel(s). National Grid and Northeast Utilities utilize Base Logistics LLC to provide staging areas services.

D. Assessment, Lessons Learned and Recommendations

Unitil's ability to provide logistics support services was severely tested during the 2008 Ice Storm. In most respects, Unitil performed well in this area even as resources were stretched to the maximum. Inventory management was a particular area of strength although additional staff should be dedicated to this effort. Arrangements also need to be made to license additional truck drivers or arrange for third-party transportation services to move stock among stock rooms and to crews in the field.

Most importantly, the number of crews working on the system should not be limited by the ability of Unitil to manage these crews, including the establishment of separate staging areas if the division DOC locations are at or near operating capacity. Unitil has not had this need prior to the 2008 Ice Storm and benefited from National Grid's prior experience and capabilities in this area. However, Unitil may not be able to rely on this same level of support in the future and should make plans to assume this responsibility for future storms. There are many elements that should be considered as part of the solution including redeploying storm jobs to free up resources that are most productively applied to managing outside crews and working with local communities to identify potential storm response staging areas.

The management of the lodging and food logistics functions was handled at the local division level. This works well for relatively small storms. However, for larger storms that affect all three Unitil divisions, these functions can be handled more efficiently on a centralized basis, leaving division personnel more time to focus on other restoration support activities. Unitil should arrange more direct billing in the future to simplify the billing and payment processes. Unitil should work with local hotels to determine if they can provide a cafeteria-style meal service as well as boxed lunches and direct bill for these services. As there will undoubtedly be numerous sundry purchases, including dinners, it is also appropriate to arrange a corporate credit card with a large credit limit. Tracking the location of crews by hotel room was not managed very well given the unprecedented number of crews involved in this restoration effort. This can be addressed through software tools that have been designed to help utilities manage restoration logistics.

A summary of "lessons learned" from logistics support is as follows:

- More staff is required to manage stock rooms during significant outages that affect more than one division. More fork lift and licensed commercial truck drivers are needed.
- Not all stock rooms are served by on-site back up generation.
- The number of crews that can be managed out of each division's stock room may be less than the number required to expediently restore power.

- Securing hotels and calling restaurants is an assignment that can easily be delegated to someone to fill as a "second job" to free division resources to focus on storm restoration.

RECOMMENDATIONS

Recommendation 9: Crew Logistics Support

Develop an approach that will enable Unitil to manage the number of crews that were required to respond to the 2008 Ice Storm, including all crew logistics activities.

Recommendation 10: Inventory Management and Stock Rooms

Join MEMS (www.mems.org), a service that allows all its utility members to have access to each other's stock lists so that they can buy from each other when materials are needed on short notice. Identify and train staff that can serve in second jobs as stock room clerks and stock delivery personnel. Include training on types of materials that will be used during restoration. Connect stock rooms to back-up generation.

VIII. CUSTOMER COMMUNICATIONS

This section of the report reviews the communications with customers that occurred through the call center by customers speaking directly to a customer service representative (CSR) and/or interacting with Unitil's IVR system. It also addresses the telephone capacity of the call center and its ability to handle the volume of calls received by Unitil over the restoration period.

A. Call Center Staffing and Operations

Customers' primary point of contact with Unitil during the 2008 Ice Storm was through the Call Center located in Concord, New Hampshire. There are approximately 30 CSRs whose schedules are arranged in normal periods to ensure that there are approximately 15 CSRs available to handle non-emergency calls that occur between 5:00 a.m. and 11:00 p.m. Unitil recently added nine CSRs to accommodate its acquisition of Northern Utilities.

On December 11, Unitil increased the Call Center staffing levels to prepare for "storm mode" operations. For the duration of the storm and until December 25, the Call Center remained open for 24 hours a day. On the morning of December 12, Call Center staffing was further expanded by directing representatives that are normally dedicated to credit issues to assume CSR duties, bringing the total number of trained CSRs to 23. These six credit representatives are trained to serve as CSRs and most of them had started out in this role and were familiar with the Call Center protocols.

On December 16, the Call Center received back-up resources from employees that work in Unitil's corporate office in Hampton, New Hampshire. While these personnel are not trained to use Call Center computer screens, they were located adjacent to CSRs and were able to relay and verify certain critical information relating the status of the restoration efforts. The additional staff also satisfied the desire of many customers to speak to a "live person" and to empathize with customers' predicaments.

Unitil's CSRs, supervisors and managers worked under stressful conditions during the 2008 Ice Storm, working 12-hour shifts from December 12 through December 24 in an effort to ensure that customers received the most current information about the restoration effort, to record customer outage and trouble reports, and, in many cases, to provide a sympathetic ear and offer safety-related information and other practical advice to assist customers in what was an extremely trying and difficult situation.

B. Customer Outage Reporting

As soon as customers started experiencing outages during the 2008 Ice Storm, they began contacting the Call Center to report an outage, and to describe the damage to Unitil's system and to their individual service (*i.e.*, wires down, broken and leaning poles, burning limbs on the wires and transformers or other equipment down from the poles). Customers with service-related issues reported instances where their lines from the street were either down or hanging low, or where trees were leaning on the service wires and or where services were physically removed from their home.

Customers were connected to the IVR and could indicate that they wanted to speak to a CSR. As discussed in Section VI.B, the IVR has the capability to generate a "trouble ticket" without the customer speaking directly to a representative. The IVR can identify the customer and customer's location either by using a Caller ID function, having the customer enter a telephone number, or by requesting entry of the customer's account number. The trouble ticket indicates the time of the call, customer location including circuit number, and any comments entered by the customer into the IVR through the options menu regarding the type of trouble being reported (*e.g.*, broken pole, "heard loud bang", trees on the lines, downed wire, no power, *etc.*). The trouble ticket also indicates whether the customer is flagged as a critical "life support" customer. Once trouble tickets are generated in the IVR, they are immediately printed and made available to DOC personnel in the appropriate operating division where they are used to direct crews to customer locations during normal outage events.

The operation of the IVR can be modified when the Call Center is placed in "storm mode" in order to provide tailored messaging about the outage and to speed up call processing time.[52] This changes the content of messages and the options that customers hear when they call in. This capability was used extensively throughout the restoration period. In addition to information about restoration efforts, the IVR communicated safety messages and informed customers of the types of issues that would require an electrician.

Customers can also report an outage via an on-line form on Unitil's website if they have access to the internet. As currently designed, this on-line form is a generic "contact the company" option which does not automatically link to the IVR system so those reported outages were manually entered into the outage reporting system by a CSR.

Unitil's computer system designates its customers who are critical / life support status. Registration of critical status can occur at the time a customer initially signs up for service. Existing customers can also notify CSRs that they have developed a need for electrical medical equipment in their home and require critical status. Further, the Credit Department can designate customers as critical / life support. If a customer is designated as "life support," and documents his or her condition with a doctor's note or other records, then the appropriate coding is made in Unitil's computer system. The life support designation is subsequently printed out on all trouble tickets and work orders, informing staff that these customers should receive priority treatment.

In addition, if the company receives reports of medical emergencies during the course of the outage, these will be noted on the trouble tickets that are generated. During the restoration process the company did receive many reports of priority situations from local public officials that were handled in this manner. As main lines were restored and the company began to address local restoration, these reported issues were prioritized for response.

[52] The storm mode option in place during the 2008 Ice Storm did not allow customers to report an outage or listen to the updated storm message and then request to speak with a CSR, creating a potential source of frustration for customers.

C. Guidance Provided to Customer Service Representatives by Management

Unitil's CSRs have access from their desktop computers to routine information for each customer, including address, account number, usage, billing, and payment histories. During outages, the CSRs also rely upon information on the extent of the damage incurred in each service area in order to effectively communicate with customers.

A customer's need for information changes radically over the course of an outage, from initially reporting the outage to seeking more specific information regarding when their power will be restored. The Call Center management team is responsible for gathering as much information as possible on restoration efforts and communicating that information to the CSRs. This information includes the cause of the outage, efforts to respond to the outage, and estimated restoration times. The most important information relates to estimated restoration times for their division, individual communities, and individual customers. During the 2008 Ice Storm, the Call Center relied on information shared with the public through Public Service Announcements (PSAs) and also on conversations with between Call Center management and operations personnel. Briefings with the Call Center representatives were held each day in an effort to coordinate the type of information being provided to customers by the PSAs, CSRs, IVR messages and on the Unitil web-site.

In addition to specific information regarding the status of the restoration efforts, CSRs provided safety-related advice concerning the safe use of generators, such as their placement in relation to the house to avoid fumes, how to handle wires down on a customer's property, and the location of community shelters. When CSRs could not provide an accurate estimate of the time that service would be restored to a customer location, they provided other information that they had been given by management including a description of the number and location of crews in the particular location, and an explanation of Unitil's prioritization of repairs, *i.e.*, "Unitil is working on the parts of the system that would restore the greatest number of customers first."

On the morning of December 11, when the weather forecast was still uncertain, all operations personnel were informed that this could be an "all-hands-on-deck" situation, and that all three divisions could experience outages. This assessment was relayed to the CSRs, who were instructed to expect outage reports to begin around midnight.[53] [54]

The first 2008 Ice Storm PSA was issued at 1:15 p.m. This PSA indicated that:

> Severe weather conditions may occur later tonight and into tomorrow. These conditions may interrupt electric service in some areas. Most electrical outages are expected to be for relatively short periods of time, only. However, severe weather conditions can create substantial damage to the electrical system, and restoration can take an extended period of time.[55]

A subsequent communication from the Director of Electric Operations was issued at 4:25 p.m. and forwarded to CSRs indicating that the forecast had not changed significantly, but that road conditions were expected to be slick and that downed poles were a possibility during the evening commute.

CSRs were provided with updated information to pass on to customers throughout the restoration period. On December 12, as the early reports of damage were starting to come in, it was clear that this was a major outage affecting all three divisions. The PSA issued that evening indicated for the first time that:

> Unitil anticipates that it will take days to restore power to all customers and recommends that customers plan accordingly.

On Saturday, December 13, the PSA indicated that 59,000 customers were without power, with the most severe damage in the Seacoast and Fitchburg areas, and that restoration efforts were initially focused on sub-transmission facilities that feed large numbers of customers. The PSA repeated the message that restoration could take days. The PSA also referred customers needing shelter to contact local emergency personnel. Consistent with the

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[53] This information was relayed to the CSRs by forwarding a 9:45 a.m. email on December 11 from the Director of Electric Operations.

[54] A summary of PSA communications is provided in Table 8, in Section IX.

[55] Unitil Issues Electric System Advisory to Customers, December 11, 2008.

advisory, on the morning of December 13, CSRs were informed that all Unitil crews were working and that more crews were on the way from Ohio and Pennsylvania and expected to be working the next day. Based upon information available at that time, and Unitil's prior experience in major storms, the CSRs were instructed that many, if not most customers could be restored by the end of the day on December 14. The CSRs were informed that other utilities were also reporting large numbers of outages.

At mid-day on December 13, CSRs were informed that they should continue to inform customers that restoring power to all customers would take several more days, likely lasting through the week. The IVR message was updated to inform customers that 550,000 customers remained without power in Massachusetts and New Hampshire and that the Governors of both states had declared states of emergency. Customers were further informed that crews had arrived to help Unitil from outside New England. The message stated that, "[w]e anticipate that it will take days to restore power to all customers so we recommend that all customers plan accordingly."

Shortly after, CSRs were informed that damage in the Fitchburg division was going to take longer to restore than previously anticipated and would extend into the following week. Restoration efforts were proceeding in Fitchburg but the number of customers restored per "trouble" was declining. CSRs were also provided with a list of shelters to offer to customers. Later that day, on December 13, based upon continuous updates from the field, CSRs were instructed to advise customers that power may not be restored until December 17 or 18.

On Sunday, December 14, CSRs were informed that progress was very slow as some parts of the Fitchburg electric system needed to be completely rebuilt and that they should no longer convey estimated restoration times to FG&E customers due to the severity of the damage. They were informed that more crews would be coming to the Seacoast and Capitol regions that should speed the restoration process with a goal of restoring 90% of New Hampshire customers by the evening of December 17. The CSRs were provided with the Massachusetts and New Hampshire 2-1-1 telephone numbers for customers requiring assistance from health and human services organizations.

On Monday, December 15, the IVR message was updated during the afternoon to indicate that most New Hampshire customers should have their power restored by December 17 but that "restoration may not be completed in Fitchburg until this coming weekend," *i.e.,* December 20-21. It was updated again at 6:00 p.m. to convey the fact that crews from as far away as Pennsylvania, Ohio and Tennessee were working around the clock to restore customers in the Fitchburg area, with restoration not expected to be completed until the weekend. The message indicated that:

> Outage counts are coming down but the damage is extensive – in some areas virtually every single circuit, fuse, side tap and lateral has been impacted. We are prioritizing our response efforts to achieve maximum customer restorations in the shortest amount of time.
>
> Because of the damage, our customer service staff is still unable to provide estimated restoration times for specific areas. We realize that for many of our customers, that to go without electricity for now 4 days is a unique and yet extremely frustrating event. We appreciate your patience during this very difficult period.

On December 16, the PSAs indicated that service to customers in New Hampshire was expected to be "essentially" complete in the Capitol division on the following day, with restoration of service to the Seacoast in the subsequent overnight hours, "with the exception of individual service issues" subject to a potential delay due to weather.

Unitil issued a PSA at 5:00 p.m. on Wednesday, December 17 indicating that the estimated restoration times for Massachusetts customers with "[r]estoration of all *primary circuits*" was expected on Thursday in Fitchburg, on Friday in Townsend and Lunenburg, and on the weekend in Ashby, subject to weather." This PSA also indicated that restoration for the Capitol and Seacoast operations was expected to be essentially complete that evening for all but roughly 1,000 Seacoast customers, "with the exception of individual service issues."

On December 18, an evening PSA indicated that restoration efforts were continuing in New Hampshire and expected to be completed "with the exception of individual service issues" the following morning.

Early in the day on December 19, CSRs were provided with more specific talking points. The CSRs were also instructed to clarify that rumors circulating that Unitil was running out of supplies were false and unfounded. On Sunday, December 21, the CSRs were informed that National Grid had arrived to help restore power in the Fitchburg division. The PSA issued at 8:30 p.m. that evening reported that 135 crews were working across Unitil's service area and that the total would increase to 184 crews the following day, due to the release by National Grid of 47 crews to assist Unitil. However, it was unclear when power would be restored to individual customers as the communication indicated that "major lines" would be in service in the Seacoast division and Fitchburg by the next morning, with restoration of major lines in harder hit areas of Townsend, Lunenburg and Ashby to follow one day later.

At noon on Monday, December 22, CSRs were informed that a transmission outage had caused outages to 6,000 customers in Fitchburg and that there would be an outage of between 1-4 hours duration. On December 24, CSRs were instructed to tell customers that significant progress has been made in Ashby and that customers would be restored either that day or the next, December 25. A PSA issued at 8:15 a.m. indicated that:

> Restoration is expected to be substantially completed today, with the possible exception of one circuit in southwest Ashby which sustained extreme damage.
>
> The Call Center remained on storm alert through December 24.

D. Call Volumes

Nearly 165,000 calls were received by Unitil's Call Center in Concord, NH, during the period from December 11 to December 25. On a normal day, the Call Center receives between 800 and 1,000 calls, or an average of 22,000 calls per month. Call volume became heavy during the evening hours of December 11 around 8:00 p.m. The number of calls received by the Call Center representatives initially peaked at 300 calls during both the 11:00 p.m. to midnight and midnight to 1:00 a.m. hours. Call volume slowed overnight but the rate increased on the morning of December 12, as 369 calls were received between 6:00 a.m. and 7:00 a.m. During the first 48 hours of the 2008 Ice Storm, Unitil received over 40,000 calls from customers, either through the IVR system, or by speaking directly with a Unitil CSR.

After the initial calls to report outages, subsequent waves of calls over the next several days addressed a variety of matters, including reports of extraordinary hardships, requests for estimated restoration times, information regarding Unitil's restoration priorities, and location of crews in their community. Through the IVR, customers have the option to provide information regarding the cause of the outage, or the type of damage observed.

As the following table illustrates, the total volume of calls received during the first two days was approximately twice the monthly average.

Table 7: Call Center Statistics

Date	Calls Received by the IVR	One-Hour Periods over 100% Utilization	# Calls Answered by Representatives	Avg. Wait Time	Avg. Call Handle Time
Dec 11	4,092	1	977	05:37	04:59
Dec 12	24,880	13	3,855	07:03	03:32
Dec 13	16,475	4	2,125	03:18	04:44
Dec 14	15,789	4	1,827	03:30	05:18
Dec 15	16,689	10	2,748	03:49	05:15
Dec 16	14,487	11	3,487	05:54	05:00
Dec 17	11,638	13	3,277	12:09	05:23
Dec 18	10,744	9	3,747	13:04	06:20
Dec 19	9,406	5	2,583	05:49	08:06
Dec 20	7,314	1	931	09:07	08:15
Dec 21	6,748	1	1,187	08:40	06:32
Dec 22	6,819	0	2,092	03:27	06:16
Dec 23	3,712	0	1,160	05:05	05:55
Dec 24	1,995	0	852	05:13	05:44
Dec 25	13,348	3	1,479	06:13	03:43
Total	**164,136**	**75**	**32,327**		

As shown in Table 7, there were 75 hours during the two week restoration period when the capacity of the Call Center phone lines could not handle the number of calls due to a confluence of factors. Many customers expressed a desire to speak to a representative and the duration of calls was increasing. Customers waiting to speak to representatives filled up the available Call Center telephone lines, and as a result many customers received busy signals. The latest outage update from the IVR was provided to customers, but because the IVR did not provide customer- or community-specific details, many customers stayed on the line for an

opportunity to speak to a representative, or left a message requesting a callback by a CSR or a supervisor. Unitil's Call Center managers and supervisors returned all customer requests for a call back, in many cases using their cell phones to keep the Call Center telephone lines free for in-coming calls. Due to the volume of calls, it was not possible to return every call immediately.

Customers that received busy signals at the Call Center also called other Unitil telephone numbers, including the corporate offices in Hampton, NH. Customers also called town EOCs and were connected to Unitil employees embedded at the EOCs. Although non-CSR employees receiving these calls may not have had access to the same detailed information as the CSRs, they provided a sympathetic ear and a "live person" to listen to customer concerns.

At the time of the 2008 Ice Storm, Unitil had 72 lines on three 24-channel T-1 circuits, of which four channels were reserved for system connectivity, leaving 68 available for incoming calls. At any given moment, under normal operating conditions, approximately 10 lines will be in use.[56] The number of hours in which the capacity of the Call Center could not handle the number of calls is attributable to the overwhelming volume of calls, the number of customers that were waiting to speak to a CSR and the length of calls once a customer was connected to a CSR. In addition, on December 17, one of the three T-1 circuits (representing 24 lines) overloaded and went out of service, leaving only 46 lines to handle calls for approximately 24 hours until Siemens, Unitil's phone vendor, could reset the trunk card. There were also times when the overwhelming volume of calls from customers led to issues on the Verizon and FairPoint infrastructure external to Unitil's systems.[57] Unitil does not have a record of how many of these calls failed to get through.[58]

Unitil has recently added two 24-channel T-1 circuits containing 48 additional telephone lines as a cushion to account for the addition of Northern Utilities. Unitil now has 120 lines, far

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[56] Calls received between 11:00 p.m. and 5:00 a.m. are routed to the Fitchburg dispatch center, a 24-hour operation.

[57] This is one possible reason, in addition to the overflow on the IVR, that customers were hearing different busy signals or recordings such as "all circuits are busy" when trying to contact the Call Center.

[58] PAETEC cannot track these calls because they never reached PAETEC's system.

in excess of the 24 lines that is anticipated to be needed for normal operations. Unitil is also planning to add an additional T-1 circuit with 24 more lines this summer. Unitil is also reviewing several call overflow options offered by third-party vendors for both the IVR system and the calls to CSRs. Unitil is actively reviewing a proposal from its existing telephone and IVR vendors which would create a duplicate outage responding option that could be activated when call volumes to the Call Center would otherwise result in a busy signal.

One concern that did not arise during the 2008 Ice Storm is the contingency plan to address any service issues associated with the "final mile" connection between the Call Center operations and FairPoint. The call center is fully backed up by on-site generating capacity, but there is no backup for the hard connection to FairPoint's telecommunications network. In this storm, the poles serving the call center didn't go down, but it is conceivable that it could happen. One possible contingency is to establish a back-up call center in the corporate office.

E. Estimated Bills

Unitil relies on an AMI system to read meters. The meter reads are transmitted over power lines, so when the lines are down or cut the AMI cannot communicate between the meters and the reading system. Most utilities use an estimation model based on average use in a prior period to send out bills when they cannot read meters or read meters less frequently than monthly. In December, Unitil issued approximately 10,000 estimated bills in New Hampshire and 4,300 in Massachusetts. Estimated bills are based on usage during a comparable three-month period in the prior year "trued-up" when the meter is read in a subsequent period. Thus, customers ultimately pay only for electricity they use.

Estimated bills can cause customer confusion under normal circumstances. The estimated bills covered a longer-than-normal billing period (up to 34 days, compared to an average of 30 days) where many of these customers had experienced outages lasting several days. Although Unitil was operating within regulatory rules, customers were angry and did not understand why Unitil had issued bills based on estimates for a full billing cycle rather than making an adjustment to reflect the number of days that they were without power. Customers

were expecting to receive bills with much lower charges than the bills that they normally receive. Unitil decided not to implement an option to cancel estimated bills and issue new bills based on actual data due to the time and resources required to do so and the potential for exacerbating any customer confusion. Customers were reassured that the consumption would be reconciled to actual in the next billing period as actual meter readings were recorded. While this resolved most concerns, the Company did provide some additional flexibility relative to timing of customer payments in order to help address customer frustation. Delinquency notices and late fees were canceled.

F. Assessment, Lessons Learned, and Recommendations

By the end of the first week, the long hours worked by call center CSRs, the high volume of calls and the taxing nature of calls was taking a severe toll. Many customers screamed at CSRs and called them liars when they were simply passing along the information that was made available to them. The lack of clarity on division-wide restoration times that impacted the Public Communications function (see Section VII) contributed to the customer frustration directed to the CSRs.

Although assistance from the corporate office in Hampton arrived on December 16 with additional resources on December 18, it is appropriate to be able to call on these resources at the beginning of a major outage and incorporate their availability into call center staffing plans. They should receive training on how to handle outage calls. Since the 2008 Ice Storm, Unitil has made arrangements to transfer calls from the Call Center to this surplus staff while they remain at their normal office locations.

As currently structured, the IVR is not designed to provide messages that are either customer- or community-specific. As a result, many customers stayed on the line until they were able to speak to a representative or leave a message requesting a callback. The ability to provide greater detail based on customer location likely would decrease the number of customers waiting in the queue for several minutes to speak to a CSR, which would have also freed up phone line capacity.

CSRs can also perform their duties more effectively if they have more detailed – and more accurate – information on the extent of the damage and restoration efforts in each community. This intelligence comes from several sources, including outage calls to the customer service center, feedback from damage assessors and crews working in the field, and news reports. An OMS, as referenced in **Recommendation 8**, should provide more relevant information to pass along to customers.

As frustration grew with expectations that were not met, customers began to question the information provided by CSRs. They believed that they had been misled by estimated restoration times reported by CSRs or the media based on the PSAs. Many customers wanted to know if there were crews in their town, and some had driven around town looking for them. Customers also questioned why a truck they had seen in their neighborhood had left before their service was restored. They did not accept the explanation that main lines were being restored first and crews would be returning to restore power to individual customers.

It is reasonable to conclude that customer frustration reached a peak on December 17 and remained high for the remainder of the restoration period. In all likelihood, the volume of calls experienced during this time, and the number of customers seeking to speak to a representative reflects a sense of frustration by customers and a sense that expected restoration times were not being met.

Customers that received busy signals began calling any Unitil number they could find, including the main offices. Customers called town EOCs and were connected to Unitil employees if they were present in the EOC. Employees receiving these calls were not located in the call center and did not have any reliable information to pass along, but they did serve as a "live person" for customers to speak to. In certain cases, Unitil employees attempted to forward calls to the call center but they also received a busy signal. Customers also began showing up in person at all Unitil locations but these locations did not have the call center capabilities necessary to log customer service contacts. Police officers were subsequently stationed at Unitil's Fitchburg and Kensington (Seacoast) DOCs.

There are several alternatives that are being considered to address these issues. As a result of the acquisition of Northern Utilities, Unitil had already contracted to add 48 additional lines to the call center, and is looking into adding an additional 24. The first 48 additional lines are installed and were activated on February 20, 2009.

In addition to this increased capacity, there are also overflow options offered by third parties for both IVR and CSRs. Unitil has discussed one possibility with its existing phone and IVR vendors, which would create a duplicate offsite IVR that could be activated when call volumes into the call center would otherwise result in customers getting busy signals. One downside to the overflow IVR is that there is no way for customers to bounce out and speak to a CSR but they would at least be able to contact Unitil to report an outage.

Finally, it is appropriate for Unitil's management to determine how the estimated bill issue will be addressed in future prolonged outages. Eventually, customers may understand and accept that they have only paid for electricity that they used over this winter period. However, the public relations damage could not have come at a worse time for Unitil. These public relations considerations should be incorporated when making billing decisions after a extended outage, should Unitil be faced with these circumstances again.

A summary of "lessons learned" from customer communications is as follows:

- Coordination among Operations, Public Communications and the Call Center will help ensure consistent messaging based on a common set of data.
- More accurate and town-specific restoration information will reduce the number and length of calls to CSRs.
- The IVR performed a valuable function during the initial two days when customers were reporting outages, but was unable to provide more detailed information that customers required during the restoration period.
- The call center did not have adequate capacity at all times to handle the number of calls that were received.
- The issuance of estimated bills, based on a 34-day billing cycle, compounded customer relations issues.

RECOMMENDATIONS

Recommendation 11: Call Center Management Communications and Coordination

Conduct twice-daily (or more frequent as circumstance dictate) conference calls among operations, public communications and the call center and pass intelligence on immediately to CSRs.

Recommendation 12: Call Center Training and Staffing

Improve training of CSRs and train Hampton staff members serving in second jobs on restoration processes and priorities. Train a contingent of corporate staff to answer calls and establish telecommunications links to allow them to receive calls in Hampton.

Recommendation 13: Call Center Facility

Evaluate modifications to the call center facility that would improve the ability of CSRs to perform during a major outage. For example, it may be possible to use existing LCD screens to provide information or add whiteboards to keep track of updated restoration information.

Recommendation 14: IVR Capabilities

Streamline the IVR storm mode selections to shorten the time required for customers to report an outage. Include community-specific information based on the customer address with customer calls routed automatically when they are received. Use the IVR callback feature for proactive communication with customers about restoration progress being made in their area.

Recommendation 15: Call Center Capacity and Reliability

Install additional planned lines as soon as possible. Study the potential value (and cost) of overflow IVR and call center operations and compare to an expansion of the existing IVR capacity. Redirect overflow calls to virtual CSRs. Pursue a service with Siemens to be informed that trunk lines are experiencing an outage. Determine if an economical solution exists to the risk that Unitil loses the “final mile” connection.

Recommendation 16: Estimated Bills

Reflect customer needs and expectations after an extended outage in any decision to issue estimated bills.

IX. PUBLIC COMMUNICATIONS

Public communication is necessary to provide public officials and customers with reliable information about an impending storm, the means by which customers can remain safe, damage incurred to electric facilities, and progress being made to restore power. Unitil communicated throughout the restoration period with Massachusetts Governor Deval Patrick and New Hampshire Governor John Lynch and their staffs, the MA DPU and NHPUC, MEMA and the New Hampshire Office of Emergency Management (NHOEM), local public safety officials (*e.g.*, police and fire), municipal officials, and elected officials. These public officials mobilized resources to help the public, including the establishment of emergency shelters and engagement of the National Guard to help clear roads and debris. They also served as an important channel of information to customers and the general public. Public officials relied in part on information provided by Unitil to communicate with their constituents using the media and other means. Unitil issued regular media updates and responded to numerous media inquiries during the restoration period.

A. Public Service Announcements and Media Communications

Prior to and during the storm, Unitil issued PSAs to provide ongoing information on the storm and restoration efforts to all constituencies. These announcements supplement articles that are placed in Unitil's customer newsletter that include information to help customers prepare for storm-related outages.[59]

The first ice storm PSA was distributed to company employees, media and emergency and elected officials in Massachusetts and New Hampshire, and posted on the Unitil website, on December 11 at 1:15 p.m. This PSA served three purposes: (1) to provide toll-free numbers for Unitil, (2) to advise customers of supplies that would help them withstand a power outage, and (3) to provide an update on anticipated weather conditions.

[59] Feature articles on storm preparations appeared in the February and June 2008 customer newsletters.

Subsequent PSAs were issued one to five times per day and contained information on the number of customers still without power. Many PSAs also contained an indication of expected restoration times. These PSA messages are summarized in Table 8. The data used to prepare the PSAs was based on the Outage Reporting System maintained by the division EOCs and supplemental phone calls with EOC personnel.

All PSAs were posted on Unitil's web site in addition to being distributed to the media and public officials. The contact list for PSA distribution was updated and expanded throughout the restoration process to include city and town officials.

Unitil communicated the number of customers without power by division, the number of crews working across the system, an update on estimated restoration times, and information that provided a context for these data. As the restoration continued, Unitil provided additional information on the number of crews and the allocation of crews by division. The customer outage data was based on estimates reported in Unitil's Outage Reporting System, discussed in Section VI.A. They provide a reasonable estimate of the number of customers without power for a Unitil division, but are less valid for an individual community. State and local officials wanted the town-by-town information but the data was not always accurate, leading to customer confusion and questions about Unitil's reports of the progress that was being made.

The estimated restoration times became more specific throughout the restoration period. For example, the early PSAs indicated that "Unitil anticipates that it will take days to restore power to all customers." Toward the end of the restoration period, after power had been restored to New Hampshire customers, Unitil provided estimated restoration times by town for FG&E. In hindsight, it is apparent that Unitil's estimated restoration times were overly optimistic because they: (1) underestimated the extent of the damage and repairs that would be required, and (2) underestimated the time required to perform these types of repairs.

Table 8: Summary of PSA Messages

Date	# of PSAs	Outages			Crews	Messages Regarding Estimated Restoration Times	Other Messages
		FG&E	Seacoast	Capitol			
Dec 11	1					Severe weather conditions can create substantial damage to the electrical system, and restoration can take an extended period of time.	Severe weather conditions may occur later tonight and into tomorrow. These conditions may interrupt electric service in some areas.
Dec 12 8:30 p.m.	3	23,000	29,000	9,800		Unitil anticipates that it will take days to restore power to all customers and recommends that customers plan accordingly.	A key focus in the NH Seacoast and North Central Massachusetts is the repair and restoration of major sub-transmission lines which feed power to large parts of the system.
Dec 13 8:30 p.m.	3	23,000	17,000	10,000	61	Unitil anticipates that it will take days to restore power to all customers and recommends that customers plan accordingly.	Extensive and sustained power outages continue across Massachusetts and New Hampshire as result of the damaging ice storm which began Thursday night.
Dec 14 9:00 p.m.	4	17,700	14,040	2,544	92	Unitil cannot provide specific estimated restoration times but anticipates that restoration efforts will continue for several days in hard hit areas.	Repair and restoration efforts have moved into secondary roadways where local damage from ice and trees is extensive. Some circuits are having to be completely rebuilt, requiring extended periods of time to restore electric service to customers in the most severely affected areas.
Dec 15 9:30 p.m.	5	15,100	9,693	1,061		Unitil cannot provide specific estimated restoration times but anticipates that restoration efforts will continue for several days in hard hit areas.	Storm restoration efforts are continuing in all of Unitil's services areas, as they are in many areas throughout New England.
Dec 16 10:10 p.m.	4	11,814	8,290	517	131	Service restoration for Unitil's New Hampshire operations is expected to be essentially complete in the Capitol area on Wednesday and in the Seacoast area in the subsequent overnight hours, with the exception of individual service issues and subject to potential delay due to weather.	Unitil personnel are directing crews to priority areas based on restoring service to the maximum number of customers in the shortest period of time. All crews have ample materials and supplies for repair work.

Date	# of PSAs	Outages			Crews	Messages Regarding Estimated Restoration Times	Other Messages
		FG&E	Seacoast	Capitol			
Dec 17 9:30 p.m.	4	9,842	4,855	97	131	Service restoration for Unitil's New Hampshire Capitol and Seacoast operations is expected to be essentially complete Wednesday evening for all but roughly 1,000 Seacoast customers, and with the exception of individual service issues. Restoration of all primary circuits in Massachusetts is expected on Thursday in Fitchburg, Friday in Townsend and Lunenburg and on the weekend in Ashby, subject to weather.	Unitil personnel are directing crews to priority areas based on restoring service to the maximum number of customers in the shortest period of time.
Dec 18 6:30 p.m.	1	8,537	3,170	6	134	Restoration efforts are continuing in the Seacoast region of New Hampshire and are expected to be completed, with the exception of individual service issues, in the morning. Restoration efforts will be continuing overnight and into Friday for the City of Fitchburg and into the weekend in Townsend, Lunenburg and Ashby, with continuing work as required to address individual service issues.	The recovery process has been extraordinarily difficult for all affected utilities due to the intensity and scale of the damage on the utility system. This has required extensive rebuilding of circuits and components to a degree our crews have never seen before. They are working incredibly hard in very difficult conditions and they have earned our utmost respect for their dedication to the public.
Dec 19 8:30 p.m.	2	4,829	1,250		137	The company currently expects all major lines in the Seacoast area and in Fitchburg to be in service by tomorrow morning, leaving small pockets and individual services remaining to be addressed. Townsend, Lunenburg and Ashby, the hardest hit areas, are expected to reach a similar point in the restoration one day later.	The company will continue to work through the storm as long as visibility permits
Dec 20 7:00 p.m.	2	3,849	325		177	Not specifically addressed	With the addition of new crews being deployed to the devastated portions of Unitil's service territories in New Hampshire and Massachusetts, progress continued in the companies' efforts to restore service to customers.

Date	# of PSAs	Outages			Crews	Messages Regarding Estimated Restoration Times	Other Messages
		FG&E	Seacoast	Capitol			
Dec 21 10:00 p.m.	2	2,538	36		261	Not specifically addressed	
Dec 22 10:00 a.m.	1	No Update			320	Unitil expects to be substantially complete with the restoration tomorrow, except for scattered individual issues and potentially some cleanup work in Ashby.	Since Friday, Unitil has more than doubled the personnel and crew resources being deployed in its Massachusetts service area in Fitchburg, Lunenburg, Ashby and Townsend.
Dec 23 8:15 a.m.	1	1,173			320	Restoration is expected to be substantially complete today, with the possible exception of one circuit in southwest Ashby which sustained extreme damage.	
Dec 24	1					Restoration of electric service in Unitil's service territory in Massachusetts is substantially complete, with the exception of individual service problems which are being addressed by crews today.	Crews will be available and on call throughout the week and into the weekend to address any new electric service problems that may arise.

NOTE: The number of crews reported at the time in the PSAs differ from those reported in Table 4. The crew numbers in Table 4 have been verified based on contractor invoices submitted in January and February, 2009.

B. Communications with State Officials

Unitil had regular contact with NHPUC Chairman Thomas Getz and daily contact with the Commission Staff. In addition, Unitil had contacts with NHOEM and NH DHS. Governor Lynch convened a series of conference calls and meetings with the NHOEM to review efforts to restore power in the state. On December 15, the head of NH DHS offered barracks to Unitil for housing out-of-state crews in the Capitol division.

In Massachusetts, Unitil communicated regularly with the DPU and MEMA regarding outage reporting by town and other public safety matters. MEMA also requested that Unitil follow up with elected officials that had placed calls into MEMA during the outage. On December 19, two DPU staff members visited the Fitchburg DOC and met with storm managers. From that day forward, Unitil provided updates 3 or 4 times per day to review restoration goals and progress. It is Unitil's understanding that these briefings were relayed to DPU Chairman Paul Hibbard. Unitil executives communicated directly with Chairman Hibbard as well.

As discussed in Section III.D with respect to efforts to retain additional crews, the Undersecretary of Public Safety and a representative of MEMA met with Unitil management in the Fitchburg office to assess the situation in Unitil's Massachusetts territory. Based on this discussion, a list of needs was discussed, and a conference call was established for later that afternoon. This conference call included the Governor and Lieutenant Governor of Massachusetts, the Chairman of the DPU, the Undersecretary of Public Safety, representatives of MEMA, other public officials and Unitil management. As a result of the call, the Chairman of the DPU contacted each of the other Massachusetts utilities and asked them to call Unitil as quickly as possible to determine if they could provide needed support. Daily conference calls were held for each of the remaining days of restoration to review the progress being made.

C. Communications with Local Public Safety Officials

Frequent communications with local public safety officials, including police and fire officials, is necessary in to restore power safely and expediently. Information flows in both directions: police and fire officials report unsafe conditions, including downed wires that

appear to be energized and Unitil informs public safety officials of the areas that they will be working in.

These communications benefit from established relationships as management from each of Unitil's three divisions meets with local public safety officials during the year to address emergency planning, and other activities including tree trimming and maintenance plans. Local public safety officials have regular contact with Unitil throughout the year regarding utility work on public roads. The ERPs include contact numbers for key officials.

With respect to the 2008 Ice Storm, public safety officials were provided with a dedicated phone line that rang directly into the local Unitil EOC.[60] Emergency officials used this line to reach operations personnel and to report public safety priorities or emergencies involving downed wires and other safety concerns.

In New Hampshire, as restoration efforts lengthened beyond the first few days, the number of calls to the EOC reached a level that was difficult for storm managers to keep up with. An increasing number of calls were also being made to the EOC by local officials other than public safety officials. At the suggestion of a Chief of Police in one of the New Hampshire communities, members of Unitil management met with the Chiefs of Police of the thirteen Seacoast communities on December 18 to discuss opportunities to improve communication. Unitil was also concerned with the safety and welfare of line crews and field workers and sought assistance from local police to ensure their safety. As a result of the meeting and based on feedback from participants, Unitil implemented twice-daily conference calls with the Seacoast police chiefs beginning the following day. The morning briefing was intended to update local officials on the plan for the day, including restoration objectives and locations where crews were expected to be working. The end-of-day briefing was initiated to review the day's progress and discuss priorities for the next day. The briefings also provided an opportunity for emergency officials to relay other critical information back to Unitil. This

[60] During the event, the numbers for two of the three division lines in New Hampshire and Massachusetts were released to the public and became compromised. Alternative dedicated lines were then established.

process worked well for the remainder of the ice storm and has been subsequently implemented at each of Unitil's distribution operations centers for major storm events.

In Massachusetts, Unitil EOC personnel were in regular contact with the community EOCs. Unitil representatives attended many, but not all, Fitchburg town EOC briefings and the Mayor of Fitchburg's daily press conference. Toward the end of the restoration period, as the demand for communication escalated, business services personnel were assigned to coordinate with the company EOC and to serve as liaison to the four communities. Individuals were embedded in both the Fitchburg and Lunenburg EOCs and direct phone and email contact was provided to municipal officials. All personnel worked extended hours.

A particular challenge for embedded personnel was to obtain reliable information from their remote location on a real-time basis and to communicate in a manner consistent with public communications and CSRs with respect to overall storm restoration progress.

In advance of the January 7 storm, new communication protocols were put into effect, including regular conference calls for emergency first responders (EFRs) who wanted to participate to receive updates, forecasts and information about where crews would be working. A bank of phones was also set up in Unitil's Hampton, NH, office for town/state officials to call in.

D. Communications with Elected Officials

Unitil received numerous calls from state and local elected officials seeking a wide range of information from progress on the restoration effort to more specific questions regarding the location of crews and estimated restoration times for customers. This key constituency can be a valuable provider of information to customers if they have accurate information to pass along. Some state and local elected officials were on the PSA distribution list at the outset of the storm; others, including, for example, town administrators in the Seacoast division, were added during the restoration period as they were identified.

As Unitil's EOCs and its communication group became overwhelmed with the demand for information from all sources (see Section VIII.E., below) it became increasingly difficult to respond to each request in a timely manner. Elected officials were also placing calls into the EOCs seeking access to operations personnel who were focused on restoring power. Over time, the incoming calls from elected officials increased dramatically, placing additional strain on EOC resources charged with managing the restoration effort. In many cases, Unitil did not have the type of information that elected officials were looking for, including the location of crews within a community and restoration times for particular streets.

Residents rely on elected officials to help them find information when they need it. Elected officials became justifiably frustrated and news reports of their frustration with Unitil appeared in the press. Eventually, even those public officials that recognized the extent of the damage started questioning Unitil's efforts to restore power, including the prioritization process, the deployment of crews across the service area, and the stocking of crews with necessary materials and supplies.

E. Efforts to Dispel Rumors

Over time, an information gap developed, with stakeholders seeking more detailed information than Unitil was able to provide. Regrettably, this information gap was occasionally filled by a series of rumors that took on an air of truth. Fortunately, Unitil was afforded an opportunity to comment before the most serious of these were reported in news media.

For example, on December 16, a rumor surfaced that Unitil had declined crews from National Grid. Unitil was aggressively seeking more crews at this time and National Grid did not make crews available to Unitil until December 20, yet this rumor touched a raw nerve for many customers and public officials. As discussed further in Section III.D, Unitil was in regular contact with National Grid regarding the availability of crews throughout the storm. An agreement to secure crews released by National Grid was reached on the afternoon of December 19.

There were other damaging rumors as well. One such rumor was that Unitil was going bankrupt and would not be able to complete the restoration effort. Unitil first heard of this

rumor on December 19 when DPU staff notified it that the Massachusetts social services hotline ("Mass 2-1-1") was being flooded with phone calls from concerned citizens.

Another rumor had Unitil sending crews home after an 8-hour work shift because it did not want to pay overtime. Another rumor had Unitil stopping the restoration effort because it had run out of supplies. Still another rumor suggested that Unitil's union line workers were preventing outside crews from working the storm.[61] There was also a theme that emerged that if you complained loudly enough or had someone important complain on your behalf, that your service issue would be moved up in the queue. However, to the extent that Unitil adjusted its restoration priorities as the restoration period continued, these adjustments were made for operational reasons and not in response to such complaints.

F. Staffing of the Communications Function

During the course of the restoration effort, Unitil personnel received hundreds of calls and messages from public officials and from the media, and made significant efforts to respond to every one as quickly as possible and with the best information available. Given the overwhelming impact of the storm and the challenges of the restoration efforts, there were some delays in responding to calls and requests for information.

The responsibilities for communications coordination were initially split between communications staff (issuing PSAs and responding to media inquiries), and operations personnel (maintaining communications with community officials). As the event continued, communication and business services staff took an increasing role in community liaison activities. Outreach included regular issuance of PSAs, appearing at the Mayor of Fitchburg's press conferences, radio and television interviews, and returning calls and messages. All incoming media inquiries were responded to throughout the event. All personnel involved worked extended hours.

[61] It should be noted that Unitil's crews worked 16-hour shifts for and performed in an exemplary manner throughout the restoration period, working side-by-side with outside crews. Further, they acted professionally under very difficult circumstances as customers began accosting line workers in trucks bearing the Unitil name.

As the event continued, demand for communications escalated and additional company personnel were brought in to assist with this function.

Although the storm restoration effort affected Unitil's entire system, Unitil only had two full-time staff members devoted to media communications and web updates. They were assisted by eight staff from the Business Services group who were re-deployed from normal duties to assist operations and communications personnel with public communications, including serving in community EOCs. Various operations personnel also assisted with public communications in addition to their power restoration duties, including staffing of a walk-in customer service area in the corporate offices.

G. Assessment, Lessons Learned, and Recommendations

Public communications has been cited by many stakeholders as a function that must be improved upon. At various points during and after the restoration period, many constituents expressed frustration with the frequency and content of Unitil's communication efforts. These concerns have been evident in comments provided by elected officials and Unitil's customers during public hearings that were held in Massachusetts on January 27 and February 3, 2009.

Unitil agrees that it must make changes in how it communicates with the general public, and elected and other public officials, including how it uses the media to do so. The quality of information that is relied upon in these public communications must also be enhanced. In at least one respect, by establishing an Emergency Information Center (EIC), changes have already been implemented during the preparations for two storms in January 2009. The EIC is described further below.

Unitil faced many communications challenges during the restoration period. These include:

- The communication messages were compromised by the inability to provide accurate estimated restoration times. As the restoration proceeded and repairs proved to be more extensive and time-consuming than originally expected, estimated restoration times were increased. This led to customer confusion, anxiety and a loss of confidence in the information being provided by Unitil.

- The public communications function did not have sufficiently reliable information regarding estimated restoration times by area, the number of outages by community, and the location of crews working to restore power.

- Unitil's communication function would have benefited from having additional staff to allow it to respond promptly to the hundreds of requests from elected officials and the media.

- As incoming calls for restoration information increased, the public communications function became much more reactive than proactive.

- News reports became increasingly negative towards Unitil as the restoration period continued.

- The "information gap" contributed to a disconnect that developed between the damage caused by the 2008 Ice Storm and the expectations of elected officials and customers, as reported in the media.

- Unitil did not have enough personnel to staff the community EOCs as often as the communities would have preferred. Nor could these staff satisfactorily respond to the requests for information from community EOCs because they did not have the information the towns were looking for regarding specific restoration efforts.

- Communications efforts were sidetracked by the need to quickly dispel false rumors about the restoration effort.

There are a number of actions that can be taken by Unitil to avoid a similar set of circumstances from recurring. These actions involve (1) the quality of information available to the public communications function, and (2) the public communications process.

First, with respect to the quality of information, the most important step is to acquire an OMS and integrate this system with other Unitil systems, including the IVR, GIS, and SCADA systems. As discussed in Section VI.B, the OMS will provide more information regarding the number of outages by community at any point in time, one of the most important questions that were raised by customers, the general public, and public safety and elected officials. It can also be useful in estimating restoration times, but there are many other factors that must also be reflected, including the input of estimated restoration times based on crew input.

Armed with the information that can be provided by an OMS, combined with input from field personnel, Unitil would be able to communicate more accurate information to customers

that they can then use to make decisions. This should ease call volumes and pressure placed on the Call Center (see Section VIII). This same information will help meet the needs of state and local public safety officials, elected officials and the media. Elected officials can be a valuable source of information to customers if they have accurate information to pass along.

Lacking this information, Unitil's PSAs included discussions of restoration times that in some cases could not be met. With the benefit of hindsight, Unitil underestimated the restoration process when setting expectations with customers. The effort required to restore single customers is partially responsible for the slowing of restoration times toward the end of a restoration effort but this factor should be reflected in estimates. The language used to describe estimated restoration times was not always clear. For example, the use of the qualifying phrase that power will be restored in an area "with the exception of individual service issues" was probably ambiguous to customers. Finally, most communications did not emphasize the extent of the damage incurred.

The current Fitchburg ERP calls for Unitil to "embed" personnel in the city and town EOCs. The Seacoast and Capitol ERPs do not have this requirement and it would be very difficult to accomplish due to the number of communities served by Unitil in New Hampshire. One significant advantage to having embedded personnel is that it provides the community EOC with a single point of contact to obtain information on Unitil's restoration effort. Although Unitil maintained contact with the community EOCs, it did not embed personnel in the four Massachusetts communities until the second week of the restoration period. Unfortunately, these individuals were not as effective as they were expected to be for several reasons. First, individuals rotated through this position as noted above. Second, the lack of information to provide to the town EOCs regarding the location of crews and where restoration efforts were focused on a particular day was a source of frustration for both Unitil and town officials. In many cases, rather than serving as a liaison to the community EOC, the Unitil representatives were performing customer service work as customers were visiting the EOCs.

In addition, Unitil staff members that were embedded in the community EOCs were placed in a very difficult position as they were placed on the "front lines" of public

communication without sufficiently reliable information. The lack of information to provide to the town EOCs on matters such as where restoration efforts were focused on a particular day became a source of frustration for both Unitil and town officials.

In addition, the OMS will provide data and intelligence that create a foundation for public communications and customer communications, but it must be supplemented by frequent communications among key leaders working on various aspects of the restoration effort. It is through these communications that the public communication team can get a more in depth understanding of activities in the field in order to present data in a context that provides value to stakeholders. This can be accomplished by conference calls among these leaders two to three times daily. While many conversations occurred among operations, public communications, and call center management personnel, it would be more efficient and effective to invite this group to participate on conference calls at pre-established times. It should be noted that PSAs were a primary basis of communications with customers via the IVR and by CSRs, providing consistency between messages provided to customers through these two functions.

Turning to the second area, the effectiveness and efficiency of the public communications process, there are several steps that can be taken, in addition to the conference calls noted in the previous paragraph. Many of these steps serve to implement and maintain a proactive approach to communications. They include:

- Clear delineation of responsibilities within the ERP, including a clear demarcation between the operations and public communications functions;
- Protocols for communications with Unitil by various stakeholder groups that are established at the outset of a significant outage event (*e.g.*, scheduled conference calls);
- More effective use of both traditional (television, radio and print) media as well as less traditional media (*e.g.*, podcasts and "twittering").[62] Unitil can make better use of the

[62] For example, PSNH used Twitter to send and receive information via the internet and cell phones. PSNH also produced six videos and a podcast to describe the process of restoring power and why the storm had caused so much damage. "New Hampshire Ice Storm 2008: Record Outage, Record Recovery," page 19.

news media to communicate with customers by placing public service advertisements on the radio and in local newspapers.

- More effective use of web communications for customers that are able to access the internet at work or from another location. A set of "frequently asked questions" could address commonly asked questions (and rumors) more efficiently. A web page devoted to media could provide the type of information that the media needs to perform their public service function.

- More efficient communications with the media and elected officials through established conference calls at least once and perhaps twice daily.

- More efficient communications with local public safety officials through established conference calls to address public safety issues that are of interest to all officials in a particular division.

- An improved approach to accomplish the objectives of embedding personnel in community EOCs that does not depend on physical location of Unitil personnel in community EOCs but does provide more consistent points of contact for each community.

- The ability to expand staffing of the public communications function to respond to the demands of stakeholders during a significant outage.

- Media training for all personnel that will have frequent contact with the media.

- Increased focus on explaining the extent of the damage at the outset of a significant outage and the likely impact on the restoration effort.

Unitil has taken an important step to improve the communications process for elected officials and the media. In advance of a storm on January 7, 2009 – and in response to communications issues during the 2008 Ice Storm – Unitil established an EIC housed in its Hampton, NH, offices. In this and future outage events, elected officials and the media are provided a toll-free phone number to access EIC staff. The EIC at Unitil's corporate office includes a direct (IVR free) conduit for media and state and local officials to report health and safety concerns and priority issues to EIC personnel, who will provide Unitil's emergency response information based on information from the division EOCs. The EIC will be activated by the Director of Business Services upon notification by the Senior Vice President of Customer Service and Communications. The Director of Business Services will contact the EIC personnel, who will report to their designated locations and perform a "second job."

The revised communications model has two components: (1) daily Operations contact with EFRs and (2) an EIC for elected officials and the media to get updates on storms. The EIC will have personnel in the EOC storm rooms reporting to the central location, which will have toll-free numbers for elected officials to call. The staff embedded in the storm rooms would interface with Operations and relay information to the EIC, and the EIC will also have access to the OMS, once it is in place.

Unitil continues to develop this EIC concept and will consult with elected officials and members of the media to obtain their input.

A summary of "lessons learned" from public communications is as follows:

- A proactive communications approach is necessary to more efficiently and effectively disseminate information to all stakeholder groups, including local elected officials.
- Effective public communications depends critically on reliable data regarding outages by community, supplemented by estimated restoration times that are based on activity in the field. The public needs better intelligence regarding the manner in which power is restored and a greater understanding of the restoration priorities that are followed.
- Appropriate expectation setting depends on an accurate portrayal of the damage that has been incurred and the effort that will be required to restore power.
- Additional resources, including staff serving in "second jobs," must be assigned to the public communications function to meet the varying demands of multiple stakeholders.

RECOMMENDATIONS

Recommendation 17: Reliable, Consistent Communications

Establish a process and policies to ensure that all personnel that communicate with the public are basing these communications on a common source of reliable information, including accurate data and supplemental briefings from operations personnel. Provide communications training to personnel that are expected to have frequent contact with the media and public officials.

Recommendation 18: Communications Protocols

Communicate applicable protocols for communications with Unitil to each constituency at the outset of a major storm. Conduct scheduled conference calls with public safety

officials, elected officials and members of the media. Provide a private phone number for Unitil's EIC to media and elected officials.

Recommendation 19: Emergency Information Center

Obtain input from elected officials, local officials and members of the media on Unitil's EIC approach. Provide EIC personnel with reliable information necessary to perform these duties, and include participation on internal restoration status conference calls.

Recommendation 20: Web and Non-Traditional Public Communications

Develop an "emergency response" web page that is highlighted on the Unitil website home page that supports the information needs of customers and other constituencies, including a section for the media. Include a Frequently Asked Questions or "FAQ" section, and provide descriptions of the outage damage, restoration progress, and the process of restoring power. Develop a specific outage reporting form to supplement the generic "contact the company" form.

Leverage current technology to enhance communications between Unitil and its customers. This could include communications with customers over the web, videos, podcasts, "twittering." emails, text messages and other emerging avenues. Distribute fliers with status reports and estimated restoration time to locations where people gather during an outage, including shelters.

Recommendation 21: Customer Education on the Restoration Process

Develop customer education materials that describe the protocols and procedures by which Unitil restores power after a major outage and distribute to customers along with any other follow-up to the 2008 Ice Storm.

Recommendation 22: Communications Roles in the ERP

Revise the ERP to incorporate the recommendations in this section:

- Clarify the roles and responsibilities of all personnel having communications responsibilities;
- Establish the process by which coordination among these personnel and other restoration personnel will be maintained while responding to an outage; and
- Ensure that the communications function has adequate and trained staff, including staff serving in "second jobs."

X. POST-STORM ACTIVITIES

Unitil has been actively engaged in post-storm activities, beginning on December 29, the first Monday after the Christmas holiday and four days after power was restored to the last customer. The development of a self-assessment and lessons learned that is the subject of this report began in earnest on this date. Unitil has also been actively engaged in regulatory proceedings to examine the 2008 Ice Storm in both Massachusetts and New Hampshire. As noted in the Recommendation sections of this Report, Unitil has made progress on several recommendations over the past three months.

Unitil's management team has held numerous meetings in 2009 with city and town officials, elected officials, and other stakeholders in an effort to rebuild relationships that were strained by the end of the restoration period.

After restoring services during the storm, Unitil communicated with customers that needed to retain the services of an electrician in order to resume power delivery. Unitil has been following up with customers since the storm as necessary, although most of these issues were resolved while restoration was still taking place.

Unitil has been performing numerous "clean up" activities in 2009 related to service to individual customers and maintenance of its electric facilities. Starting soon after the storm ended, line crews and supervisory personnel began a patrol of distribution circuits, using damage assessment forms, in order to identify any line- or tree-related issues that needed to be attended to. The line crews made immediate repairs if they were able to do so and removed any trees or tree limbs that threatened service. These efforts included replacement of broken poles and removal of wire, parts of broken poles, damaged transformers and other materials from the ground. There are no fallen utility poles that have not been replaced. Unitil continues to perform permanent repairs and is nearing the conclusion of this effort. These repairs include re-attaching services that required a more permanent repair. Some of the clean-up work could not be completed until snow melted.

Unitil conducted a "fly over" of its sub-transmission system on January 23 in order to identify immediate or long-term issues relative to line construction or tree-related matters needing attention. There were no public safety concerns or any emergency conditions affecting the integrity of the system. Unitil has addressed all immediate concerns that were identified and the remaining issues will be addressed when access to the right of ways has improved by snow melting. Unitil intends to retain an external engineering firm to conduct a condition assessment on the subtransmission system. The condition assessment will focus on the age, condition and application of the existing equipment, maintenance of the equipment and maintenance of the right-of-way.

Unitil's FG&E distribution system is under review and a complete patrol of the facilities has been completed. The purpose of the patrol was to identify public safety issues, temporary repairs, abnormal conditions, and any other items requiring attention. Unitil identified approximately 1,700 hours of repair work that needed to be completed. This work has been completed.

Unitil has had two storms since the 2008 Ice Storm and implemented a new EIC to provide direct incoming and outgoing communication with public officials in communities affected by a major storm event. Access is provided through dedicated toll-free phone lines. The EIC was activated for the first time for the January 7 storm. Unitil also established a daily conference call with local fire and police officals with this storm.

The process of accounting for materials and supplies as well as processing invoices for outside crews is also a significant effort. Unitil has completed a thorough inventory of stock levels in each of its three division stock rooms in order to identify the quantities and value of materials used during the restoration period. Since the storm, the Inventory Manager has held meetings with Graybar and other vendors in order to prepare scorecards for storm performance.

A thorough review of mutual aid and other outside crew invoices has also been completed. Unitil has been working with FairPoint and Verizon to exchange information

regarding pole replacements in their respective maintenance areas. Both Unitil and the telephone providers replaced poles as they were identified without regard to these maintenance areas during the restoration period.

XI. STORM READINESS

Storm readiness sets the stage for the ability of a utility to respond expediently to a significant customer outage. Storm readiness includes the development, maintenance, and application of an ERP that directs internal and external resources in the effort to restore power and communicate with customers, public safety officials and government representatives. Storm readiness includes efforts to "harden" the system by making it more resistant to storms including tree trimming, vegetation management,[63] investments in T&D facilities, maintenance of T&D facilities, and selective undergrounding of facilities.

Storm readiness also includes assigning non-operations personnel to storm support functions and providing training as needed to prepare them to serve in this capacity. Finally, it includes investments in information systems, databases, and other tools that improve the ability to respond to storms.

A. The Emergency Restoration Plan

Each of Unitil's three divisions has its own ERP, with local contact information for public officials and logistics support incorporated in the ERP document. They present an overview of the restoration process and priorities, define the organizational and functional responsibilities, identify communications protocols, and describe, in some detail, the framework required to restore power in the event of a major storm or other emergency event. The ERPs are structured in slightly different ways but contain similar information including:

- Activation of the ERP;
- Functional charts and descriptions of storm-related responsibilities (often staffed as "second jobs");
- Pre-storm planning;
- Weather monitoring;

[63] Vegetation management includes planning what types of trees to plant near transmission lines to minimize tree-related outages.

- All aspects of the restoration process including damage assessment, crew mobilization, prioritization, and outage tracking;
- Post-storm activities;
- Communications;
- Forms to be used by storm staff; and
- Contact lists for public officials and logistics support (*e.g.*, contract crews, hotels, and restaurants).

The ERP may be officially activated before the storm hits or after the extent of the damage is known to be of sufficient magnitude to require emergency response procedures. Unitil activated ERPs in each of its three divisions on the morning of December 12 although many pre-storm planning activities began on December 10 and 11.

The ERPs establish a response and restoration framework designed to be adaptable and flexible depending on the nature and extent of a specific emergency. They do not present a rigid set of guidelines. The plans build off of Unitil's normal operating procedures and do not require an entirely new organizational structure or specialized workforce to be implemented. In fact, it is preferable if operating procedures reflect normal operations to the extent possible because personnel are already familiar with these policies, procedures, and practices.

Unitil's ERPs have proven to be adequate for prior, smaller outages (*e.g.*, three days or less) where limited coordination of resources is required among the three divisions. As the divisions have each had many such outages, the approach to restoration is ingrained in division management and most staff. This certainly aided the response to the 2008 Ice Storm in each division. The respective ERPs were also a useful source of key contacts and hotels and restaurants.

Substantial degrees of coordination among divisions took place throughout the restoration period as necessary to respond appropriately to the 2008 Ice Storm. For example, retention of outside crews, certain logistical support functions, and system-wide management

of the restoration process were handled at the corporate level in order to operate more efficiently.

B. Staffing and Training

Responding to a major storm requires an extraordinary effort by internal and external resources. The actual restoration of T&D lines and distribution services requires highly trained line workers and the utility must supplement its existing crews with outside crews. However, there are many supporting roles that can be and were served by staff performing "second jobs" during the storm. These second jobs supplement existing staff resources that are under enormous strain during a major storm (*e.g.*, CSRs), and perform jobs that are only required during storms (*e.g.*, logistics support and damage assessment).

There was certainly enormous strain on many employees during the restoration period. Call center representatives worked 12 hours per day on average and supervisors worked 12 to 14 hours per day. Employees in the division offices that were providing logistical support to crews worked up to 16 hours per day in shifts that covered the entire 24-hour day. With the exception of call center and communications functions, requests for additional resources were left to the discretion of the division EOCs, with direction provided from senior management. As expected, they looked first to their own division employees for supplemental resources, before requesting support from the Hampton office.

Over 200 Unitil employees performed second jobs during the 2008 Ice Storm. These included 127 that worked directly on restoration activities, 66 that assisted in the call center or with other communications activities, and 29 that provided logistical support. These employees served an essential role during extraordinarily difficult circumstances.

The workload increased as the restoration effort progressed and the inquiries from customers, town officials, and elected officials escalated, with many calls being directed to operations personnel charged with managing the restoration effort.

C. Systems, Databases and Decision-Support Tools

Unitil employed a variety of tools to track outages, assign work to crews, dispatch crews, measure progress, and account for expenditures. Many of these tools involve management of large volumes of paper and tracking of progress on large system maps and storm room whiteboards. These processes should be reviewed after each major event to determine if there are any investments in new tools and systems, or in the organization of storm rooms, that would improve the effectiveness and efficiency of the restoration process.

D. System Inspections

Unitil has several different inspection cycles for categories of system components, as summarized in Table 9.

Table 9: Unitil's Distribution System Inspection Cycles

Category	Description
Annual Inspection	Visual inspection of streetlight poles
Two-Year Inspection	Visual inspection of manhole system (MA ONLY)
Five-Year Public Safety Inspection	Tests performed on above-grade components of underground distribution system
Ten-Year Public Safety Inspection	Visual inspection of overhead distribution facilities
Ten-Year Pole Test	Visual inspection and testing of wood distribution poles

Unitil relies on its inspection programs to determine whether facilities need to be replaced or whether continued maintenance of existing facilities is warranted.

As discussed in more detail below, vegetation management and tree trimming are one type of maintenance activity that helps maintain reliability. Pole inspection, maintenance and replacement are also discussed in more detail below.

E. Vegetation Management and Tree-Trimming

Vegetation management includes the trimming of trees near electric lines and the prevention of new growth within utility rights-of-way. It also refers to efforts of customers and towns to encourage new plantings of trees that are more resistant to impeding electric lines under both normal and storm conditions. Tree trimming improves the reliability of service by

decreasing the probability that tree limbs will interfere with electric wires if they become entangled, or cause outages when they break.

Unitil's tree trimming policies are designed to trim branches back to a set distance from wires, with the desired clearance distances depending on the voltage of the line, the degree of control over the right-of-way, and the length of the tree trimming cycle. Unitil's transmission and subtransmission lines are subject to the most aggressive vegetation clearing practices (generally, cutting down aging trees entirely) because the impact of a fallen tree could affect thousands of customers. Unitil also has explicit trimming rights within its right-of-way which allows trimming as much as necessary to ensure the integrity of the line, as compared to distribution lines which are usually located in the public right-of-way and where the company's trimming rights are much more circumscribed due to state or local law or individual property rights. In many cases, tree trimming (along with pole maintenance) is a shared responsibility between the electric and telephone utility companies.

Unitil’s tree trimming policy is designed to address tree and branch movement within the normal range of movement caused by wind, but not breakage. For example, the standard calls for trimming branches located less than 15 feet above the line, but if higher-up branches break they will still damage or even take down the line.

Consistent with this policy, Unitil’s practice is to perform aggressive tree trimming within its rights of way by side-cutting and ground-cutting, effectively trimming as if the property contains transmission lines, regardless of the actual voltage. Unitil will contact property owners if there are adjacent dead trees that are large enough to cause damage should they fall on Unitil’s right-of-way.

Each year Unitil prepares a plan for tree trimming and schedules the work to be done through the year. Unitil contracts with companies that specialize in this work and have tree crews and trucks just for this purpose. These are specialized jobs – not something utility line trucks are equipped to do, although line workers will do limited trimming work in the process of restoring service after an outage.

Unitil established a team to review and revise its tree-trimming practices in 2006 as part of a broader initiative designed to examine operations that can affect reliability. The trimming plan, and the clearances that are sought in the trimming process, are intended to keep new growth from interfering with the lines, at least until the next planned trimming cycle. In older growth areas, tree trimming will not significantly affect the tree canopy, which is well above the lines, unless there are clearly identified problem or "danger" trees, such as any that are dead or dying.

This team conducted an empirical analysis to determine if there was any correlation between outages and vegetation control practices for different kinds of lines and roads. The team determined that more trimming is needed on 3-phase line than 1-phase lines as 1-phase lines serve fewer customers. The team also recommended that ground cutting should receive greater emphasis because it reduces future trimming needs. The resulting tree-trimming cycles are presented in Table 10.

Table 10: Tree Trimming Cycles

Line Type	Cycle
Transmission	5 years
Distribution	
3 Phase	
34.5 kV	4 years
13.8 kV	5 years
4 kV	8 years
1 Phase	
34.5 kV	5 years
13.8 kV	7 years
4 kV	10 years

Unitil follows standard utility industry practice in tree trimming, which calls for tree trimming to be performed in cycles over a period of years – meaning every circuit on the system is assessed and trimmed within a certain number of years. The cycle varies between four and ten years depending on the voltage of the line (higher voltages serve more customers) and whether it is a three-phase (more capacity) or single-phase circuit. Each year Unitil prepares a plan for tree trimming and schedules the work to be done through the year.

FG&E's expenditures for tree trimming have averaged approximately $350,000 annually in recent years. The 2009 budget, which was established before the 2008 Ice Storm, is $390,000, an increase of approximately 10% over 2008.[64] [65] Trimming costs go up every year, due to both increasing operational costs and the increasing amount of line as the system expands. The vegetation management budget for Unitil's Capitol and Seacoast divisions includes $800,000 for distribution and $100,000 for transmission. These budgets are based on costs approved in the most recent Massachusetts and New Hampshire rate cases, but costs generally increase every year, due to both increasing operational costs and the increasing amount of line as the system expands.

Scheduling tree trimming requires advance notification of towns and permission from abutting landowners. Once the annual plan has been developed, Unitil meets with the tree wardens in each town to go through the list of which streets will be trimmed and the trimming specifications they plan to use. Certain roads may be designated by the cities and towns as "scenic roads" with more stringent tree trimming restrictions that Unitil must comply with.

Permission "door cards" are distributed to residents in advance of tree crews coming through with three options: trim, do not trim, and remove selectively. In some cases Unitil cannot get needed permissions and is unable to do a complete trim.[66] If permission is not granted, the crews are restricted in their ability to trim. Restrictive tree trimming can have long-term consequences because it is much less expensive to more completely trim a tree in anticipation of returning on the normal cycle than to only partially trim more frequently.

There are occasions in which Unitil receives specific requests from a customer regarding a problem with a tree or a limb on or near a line. Unitil investigates all calls and trims selectively if the tree or branch poses an immediate threat to electric equipment. If the issue

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64 Approximately 30% of the tree-trimming budget is used to compensate police details.

65 This funding level excludes tree trimming associated with capital projects.

66 State laws in both Massachusetts and New Hampshire provide property owners with the right to require utilities to seek permission for tree trimming that occurs in front of their property – for example between a sidewalk and the street.

involves telephone or cable company equipment, Unitil will notify the appropriate service provider of the location and the problem.

While it may be possible to reach generalized conclusions regarding the impact of distribution line tree trimming policies on the damage caused by a storm, it is much more challenging, if not impossible, to perform a true after-the-fact diagnostic that quantifies this impact. This is particularly true for severe ice storms due to the degree of ice loading on trees. Expansion of the trim zone may help improve day-in/day-out reliability, but would not be sufficient to prevent the type of damages where whole trees are snapped in two or uprooted as occurred during the 2008 Ice Storm. The only way to avoid damage in these circumstances would be to replicate for the distribution lines the clearing practices applied to the transmission lines, where entire trees are cut and limitations on vegetation growth are more severe. Yet even the more significant transmission line trim zone did not prevent damage to transmission lines from falling trees and limbs from outside of that zone. Moreover, large falling trees and branches will sometimes cause the electric lines to snap, leaving the pole intact, but when they fall against the thicker cable and telephones lines which do not break as readily, more significant damage may occur to the pole.

The impact of tree trimming as a preventative measure during an ice storm depends significantly on the amount of ice that collects on trees because at a certain level of ice buildup, a tree branch or entire tree will fall with or without more aggressive tree trimming practices. The 2008 Ice Storm had extraordinary levels of ice buildup on trees, resulting in the collapse of thousands of trees onto electric facilities. More aggressive tree-trimming practices would not have prevented most of the damage incurred by trees during and after the 2008 Ice Storm. For example, in all likelihood, it would not have prevented trees from bringing down utility poles.

As noted by David Graves, a spokesman for National Grid, “[t]his was a devastating and unprecedented storm. The ice accumulation on the trees could not have been prevented by trimming. It's impossible to speculate as to what trees might have, could have and didn't come

down because they were trimmed."[67] This article cited comments along the same lines by Tom Frantz, Director of the New Hampshire Public Utilities Commission Electric Utilities Division:

> Pruning more trees would not have prevented the widespread power outages in this ice storm, said Tom Frantz, director of the electric utility division for the state Public Utilities Commission. That's because most of the trees that took down lines grew outside the trim zone, he said. Only 20 percent to 25 percent of the trees that caused the outages were inside the area where utility companies would normally cut trees or branches. "Unless you moved through the rights-of-way and took out a huge amount of trees," Frantz said, the damage could not have been prevented. "New Hampshire's a heavily forested state." Tree trimming works to improve reliability in normal circumstances, and utility companies and the Public Utilities Commission have taken steps to improve tree maintenance programs, he said.

In the 2008 Ice Storm, trees outside of relatively wide transmission right-of-ways caused damage. Healthy trees that had up to an inch and a half of ice were uprooted and fell on power lines, causing poles to snap. Unitil had to replace nearly 300 poles across its three divisions in order to restore power.[68] Fortunately, the 2008 Ice Storm had relatively modest winds or the damage would have been much more significant.

F. Utility Poles

Transmission poles are inspected and poles and insulators are replaced as part of Unitil's annual pole maintenance program. Most distribution utility poles installed for electric supply and communication lines are jointly owned by the electric company and the incumbent local exchange carrier (Verizon or FairPoint), though they may be occupied by other parties as well including cable TV, competitive local exchange carriers and municipals. Unitil jointly owns virtually all poles in its franchise territory in combination with Verizon (Fitchburg) and FairPoint (Capitol and Seacoast). The division of ownership between Unitil and Verizon / FairPoint is accomplished by means of "Joint Ownership Agreements" through which the parties own a part ("half") interest in every pole in shared franchise areas. Responsibility for the installation,

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[67] "New Hampshire Utilities Blame Weather, Not Tree-Trimming For Outages," Eagle Tribune article authored by Margo Sullivan, December 17, 2008.

[68] This number of poles set in does not include poles replaced by Verizon and FairPoint.

removal and maintenance of jointly owned poles is divided between the owners into specific geographic areas referred to as "maintenance areas." These areas divide responsibility for custodianship and maintenance of jointly owned poles between the owners in a manner intended to equalize the number of poles each party is responsible for.

For each maintenance area, the custodian (Unitil or Verizon / FairPoint) is responsible for maintaining all poles and anchors in its custody in safe and serviceable condition, and for replacing poles that become defective or are of insufficient size or strength for existing or proposed Appendices. Under the agreements, it is expected that each joint owner is responsible for placing and removing all jointly owned poles within its designated maintenance areas. In other words, Unitil, Verizon and FairPoint each install all the poles within their designated maintenance areas.[69]

However, because of the severity of the 2008 Ice Storm and the sheer quantity of broken poles, these Joint Ownership Agreements were mutually and temporarily suspended in order to expedite the restoration process. In other words, the company that could set the pole the quickest did so regardless of maintenance areas.

During the 2008 Ice Storm, as new poles were set, the broken pole and wood debris was either removed immediately, or was removed from the traveled way in order to make the area safe. Due to the volume of downed and damaged poles, Unitil employed the services of a contractor to assist in the collection of broken poles and pole debris (pieces of various lengths of poles). Unitil continues to remove old poles and pole debris as they are identified; however it is possible that as the snow banks begin to melt along the roadways, additional pole debris will become visible. As this occurs, Unitil will remove these poles as they are discovered or as Unitil is notified.

[69] Additional information on this topic can be found in NH PUC Docket No. DM 05-172, Investigation Into Utility Poles. Docket files are listed online at: http://www.puc.state.nh.us/Regulatory/Docketbk/2005/05-172.htm. The final work product on Joint Ownership Responsibilities issued on 8/29/07 may be of particular interest.

G. Storm-Hardening Investments

Many utilities that have experienced ice storms are asked by regulators and other stakeholders to consider "storm-hardening" investments including the undergrounding of lines. Other examples of storm hardening include more aggressive tree-trimming and pole replacement programs, and breakaway service connectors.[70] It is also possible to upgrade older facilities to the same standards that are in place for new construction or to build in excess of that required by standards.

The assessment of program options requires an analysis of the tradeoffs between limiting the damage from a significant storm and the costs required to achieve this end. In general, most storm hardening activities are hard to justify economically based solely on utility expenditures and savings.[71] Undergrounding of facilities, for example, may be economical in densely populated areas but does not make sense in rural areas. It is also more costly to relocate existing facilities underground than to build a new system underground. Undergrounding also results in higher maintenance costs as facilities are harder to reach and can be much more costly and difficult to restore if there is a failure in an underground piece of equipment.

In the past, Unitil has been asked to consider undergrounding in a couple of its New Hampshire communities. The Town of Hampton, for example, wanted to put part of the beach system underground, which was estimated to cost $20 to $25 million for less than a square mile of service territory, and customers would have to individually bear the significant cost of converting to underground service.

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[70] A relatively new technology that enables the service line to disconnect from the pole and avoid damage cased by service wires either to the pole or to the customer's meter set.

[71] Windstorm of December 14-15, 2006. Puget Sound Energy Restoration and Readiness Review, KEMA, July 2, 2007, p. 7.

H. Assessment, Lessons Learned, and Recommendations

There are many actions that can be taken to improve Unitil's readiness in advance of future storms. The most important of these is a comprehensive revision of the ERP, and consolidation of the ERP to eliminate the divisional ERPs.

The ERPs guide internal and external resources in their coordinated efforts to quickly and efficiently restore power and communicate with customers, public safety officials and government representatives. The ERPs have been adequate to respond to the relatively few significant outages that have occurred subsequent to the December 1996 storm. However, the nature and extent of damage to Unitil's system caused by the 2008 Ice Storm far exceeded the damage from the 1996 storm or any storm experienced by Unitil. As a result, although the ERPs provided a basis for restoration and supporting activities, they are not adequate to respond to a storm that inflicts widespread damage across a broad geographic region and results in a loss of power to almost two-thirds of Unitil's customers, such as the 2008 Ice Storm. In fact, the 2008 Ice Storm was of such magnitude that certain functions that were more efficiently provided by a centralized corporate group were not contemplated by the individual plans. The ERPs should be modified to anticipate another major storm affecting a broad geographic region.

On a going-forward basis, it is appropriate to identify all functions that should be centralized for efficiency purposes for significant outages affecting two or more divisions. In order to facilitate the division of responsibilities between a central organization and divisional responsibilities, it is appropriate to establish a common ERP that applies to all divisions. Division-specific contact numbers can be included in division-specific Appendices.

It is also necessary to modify the plan to explicitly accommodate a major region-wide storm, in order to ensure that Unitil is able to obtain the necessary outside crew complement on a timely basis. Finally, effort should be taken to make it as workable and detailed as possible, while retaining the flexibility needed to respond to the unique circumstances associated with each major outage. Other utility ERPs should be reviewed to assess how they

strike the balance between providing definitive instructions and providing flexibility that is needed to respond to events that each have their own unique attributes.

Several changes in Unitil's approach were already implemented during the January 7, 2009, storm and the threatened January 24, 2009, storm. These include a more efficient approach to communications with public officials and the media through the establishment of an EIC, early mobilization of outside crews, and a revised damage assessment forms.

It is also necessary to develop a more extensive and formalized approach to second jobs. This would include defining all potential second jobs, assigning individuals to receive training in one or more jobs based on a skills assessment, and then scheduling resources during a major outage. Second jobs can address operational needs such as damage assessment, crew work assignments, and bird-dogging. They can also address call center support and many elements of logistics support, including stock room operations. A decision to activate second jobs would be made by senior management based on the extent of damage incurred, the need for assistance from outside crews, and estimated time required to restore power.

As noted above, Unitil should review its existing restoration processes, systems, and tools to identify cost-effective enhancements that will improve the efficiency of the damage assessment, power restoration, logistics support, communications, and outage reporting functions. There are other recommendations in this report that address the need for new or modified tools that apply to respective areas of responsibility.

Unitil believes that its capital and maintenance expenditures, including the more specific tree-trimming and pole maintenance/replacement policies, are adequate and that the devastating impact of the storm was not related to any deficiency in equipment or system maintenance. However, the company has indicated that it will review these practices with the MA DPU and NHPUC and local communities to determine if any improvements can be made.

Finally, Unitil has examined storm-hardening opportunities on an individual basis, usually in response to a community request. It may be appropriate to examine the costs and

benefits of a broader range of storm hardening activities, although it may be costly to engage in such an effort.

A summary of "lessons learned" from storm readiness activities is as follows:

- The existing ERP is not adequate to respond to a major regional storm that affects two or more of Unitil's three divisions.
- There are improvements that can be made to several processes, systems and tools to provide better information in a more useful format and improve the efficiency of the restoration process.
- Unitil's tree-trimming practices should be shared with a wider group of community members.

RECOMMENDATIONS

Recommendation 23: Emergency Response Planning – Leadership and Organization

Designate a senior individual with emergency restoration experience to assume responsibility for emergency planning. Communicate the critical importance of emergency response planning throughout the organization.

Recommendation 24: ERP Adequacy

Revise its ERP in the following respects:

- Replace division ERPs with a single electric operations ERP;
- Provide additional storm outage detail to reduce reliance on institutional knowledge;
- Clarify roles and responsibilities;
- Distinguish between centralized support and management services, including retention and allocation of outside crews, and local or decentralized operations to enable the EOCs to focus primarily on restoring power and coordination with local safety officials;
- Incorporate flexibility to allow adjustments to accommodate storms of varying impact as well as deviations from the plan to respond to issues as they arise during a storm event;
- Provide information that is directly useful to Unitil and city and town officials;

- Revise the communications section to incorporate the EIC;
- Specify storm preparedness activities in greater detail; and
- Significantly expand the logistics section to provide clear direction to non-operations employees that are serving in support roles.

Recommendation 25: ERP Updates

Review and modify the ERP each year and following every significant outage:

- Revise the ERP to respond to new regulatory directives;
- Update the ERP based on input from internal resources and external stakeholders, as directed by a member of senior management;
- Review and revise contact numbers on at least a quarterly basis and before each impending significant storm; and
- Incorporate learning from other major storm restoration efforts in the Northeast.

Recommendation 26: Mock Drills & Preparedness Conference Calls

Conduct a mock drill to test the execution of the ERP each year, and conduct pre-storm season meetings and/or conference calls to review the ERP with city and town officials and public safety officials.

Recommendation 27: Staffing and Training

Formalize the "second job" process by identifying all second jobs and training individuals to serve in these roles.

Recommendation 28: Tree-Trimming Policies

Revisit trimming cycles to ensure they are in line with industry standards and regulatory directives. Communicate policies to communities and customers.

APPENDIX A: LESSONS LEARNED AND RECOMMENDATIONS

SECTION III: PREPARATIONS AND CREW MOBILIZATION

Lessons Learned:

- Mutual assistance is an essential means to quickly obtain the services of outside crews, but should serve as only one element in a broader strategy.
- The definition of a "crew" varies throughout the industry; it is necessary to verify the composition of resources that are being committed and to request any needed support resources, including supervisors.
- A commitment for contract crews made by a releasing mutual aid utility must be confirmed with the contractor before relying on these resources.
- There are limits to the number of crews that can be staged out of the three division locations. (Recommendation in Section VII)
- Many company personnel wanted to help respond to the storm, but needed to be organized (and in some cases, trained) in order to do so. (Recommendation in Section XI)

Recommendation 1: Recruitment of Crews

Develop a strategy to obtain crews that anticipates a future storm or other outage event of the magnitude of the 2008 Ice Storm and Unitil's specific circumstances. The evaluation to develop such a strategy should:

a. Evaluate the merits of joining EEI's Restore Power web-based service;

b. Identify qualified local tree trimming contractors;

c. Consider the benefits and costs of securing standby services in the event of an impending storm and on a longer-term contractual basis; and

d. Consider pursuing all options simultaneously, and not relying primarily on the mutual aid process.

Recommendation 2: Storm Rooms

Modify the Fitchburg facility to incorporate an enclosed dedicated storm room, equipped with communications capabilities and other storm restoration management equipment required to manage a large outage and numerous outside crews.

SECTION IV: DAMAGE ASSESSMENT

Lessons Learned:

- A helicopter "fly-over" of major facilities as soon as weather permitted would have been an effective way of obtaining an early assessment of damage that is difficult to perform because of impassable roads.
- More trained damage assessors are required for a major outage like the 2008 Ice Storm.
- The process of performing damage assessment and compiling the results relies extensively on paper, making it difficult to expediently gain necessary information for a major outage.
- The estimates of time required to perform repairs were not long enough.

Recommendation 3: Damage Assessment Staffing and Training

Identify and train additional personnel to perform damage assessment, including Northern Utilities personnel. It takes approximately one-half day to train a damage assessor. Conduct annual refresher courses. Explore the availability and viability of using third-party contractors to perform damage assessment.

Recommendation 4: Damage Assessment Forms and Compilation

Improve damage assessment forms based on Unitil's circumstances and experience during the 2008 Ice Storm. Develop a spreadsheet or similar decision-support tool to tally damage assessments by circuit in order to more accurately determine the number of crews and estimated times required to restore power to a segment or a broader section of the system. Revise estimates of time required for each type of repair based on experiences during the 2008 Ice Storm and other utility experience in this and prior storms.

SECTION V: POWER RESTORATION

Lessons Learned:

- Storm managers had too many responsibilities for a storm of this magnitude and duration.
- More restoration processes and data tracking efforts should be automated, if possible.
- A more flexible approach to restoration priorities may be appropriate.
- The consequences of a widespread electricity outage on restoration communications should be reflected in the ERP.

Recommendation 5: Storm Room Staffing

Develop an outage staffing policy that governs work and rest times. Reflect the need to offload many tasks from storm room managers and supervisors in the revised ERP.

Recommendation 6: Restoration Processes and Reporting

Review all processes and data reporting requirements and develop an information system plan to automate processes that are subject to system-based efficiency improvements, reducing reliance on paper-based information flows.

Recommendation 7: Field Communications

Evaluate options to improve the reliability of field communications in the event of a sustained power outage.

SECTION VI: OUTAGE TRACKING

Lessons Learned:

- The current outage reporting system is too time consuming and cannot keep up with the need for timely outage reporting data in a major storm, nor will it produce sufficiently accurate estimates for Unitil's smaller communities.

- The IVR reporting system is most useful and can be relied upon to direct resources only when the number of reported outages is manageable.

Recommendation 8: OMS Acquisition, Development and Staffing

Proceed to acquire and integrate an OMS. Designate a staff member to oversee the operation and maintenance of the OMS system and train supplemental resources to maintain the OMS during significant outages.

SECTION VII: LOGISTICS SUPPORT

Lessons Learned:

- More staff is required to manage stock rooms during significant outages that affect more than one division. More fork lift and licensed commercial truck drivers are needed.

- Not all stock rooms are served by on-site back up generation.

- The number of crews that can be managed out of each division's stock room may be less than the number required to expediently restore power.

- Securing hotels and calling restaurants is an assignment that can easily be delegated to someone to fill as a "second job" to free division resources to focus on storm restoration.

Recommendation 9: Crew Logistics Support

Develop an approach that will enable Unitil to manage the number of crews that were required to respond to the 2008 Ice Storm, including all crew logistics activities.

Recommendation 10: Inventory Management and Stock Rooms

Join MEMS (www.mems.org), a service that allows all its utility members to have access to each other's stock lists so that they can buy from each other when materials are needed on short notice. Identify and train staff that can serve in second jobs as stock room clerks and stock delivery personnel. Include training on types of materials that will be used during restoration. Connect stock rooms to back-up generation.

SECTION VII: CUSTOMER COMMUNICATIONS

Lessons Learned:

- Coordination among Operations, Public Communications and the Call Center will help ensure consistent messaging based on a common set of data.

- More accurate and town-specific restoration information will reduce the number and length of calls to CSRs.

- The IVR performed a valuable function during the initial two days when customers were reporting outages, but was unable to provide more detailed information that customers required during the restoration period.

- The call center did not have adequate capacity at all times to handle the number of calls that were received.

- The issuance of estimated bills, based on a 34-day billing cycle, compounded customer relations issues.

Recommendation 11: Call Center Management Communications and Coordination

Conduct twice-daily (or more frequent as circumstance dictate) conference calls among operations, public communications and the call center and pass intelligence on immediately to CSRs.

Recommendation 12: Call Center Training and Staffing

Improve training of CSRs and train Hampton staff members serving in second jobs on restoration processes and priorities. Train a contingent of corporate staff to answer calls and establish telecommunications links to allow them to receive calls in Hampton.

Recommendation 13: Call Center Facility

Evaluate modifications to the call center facility that would improve the ability of CSRs to perform during a major outage. For example, it may be possible to use existing LCD screens to provide information or add whiteboards to keep track of updated restoration information.

Recommendation 14: IVR Capabilities

Streamline the IVR storm mode selections to shorten the time required for customers to report an outage. Include community-specific information based on the customer address with customer calls routed automatically when they are received. Use the IVR callback feature for proactive communication with customers about restoration progress being made in their area.

Recommendation 15: Call Center Capacity and Reliability

Install additional planned lines as soon as possible. Study the potential value (and cost) of overflow IVR and call center operations and compare to an expansion of the existing IVR capacity. Redirect overflow calls to virtual CSRs. Pursue a service with Siemens to be informed that trunk lines are experiencing an outage. Determine if an economical solution exists to the risk that Unitil loses the "final mile" connection.

Recommendation 16: Estimated Bills

Reflect customer needs and expectations after an extended outage in any decision to issue estimated bills.

SECTION IX: PUBLIC COMMUNICATIONS

Lessons Learned:

- A proactive communications approach is necessary to more efficiently and effectively disseminate information to all stakeholder groups, including local elected officials.

- Effective public communications depends critically on reliable data regarding outages by community, supplemented by estimated restoration times that are based on activity in the field. The public needs better intelligence regarding the manner in which power is restored and a greater understanding of the restoration priorities that are followed.

- Appropriate expectation setting depends on an accurate portrayal of the damage that has been incurred and the effort that will be required to restore power.

- Additional resources, including staff serving in "second jobs", must be assigned to the public communications function to meet the varying demands of multiple stakeholders.

Recommendation 17: Reliable, Consistent Communications

Establish a process and policies to ensure that all personnel that communicate with the public are basing these communications on a common source of reliable information, including accurate data and supplemental briefings from operations personnel. Provide communications training to personnel that are expected to have frequent contact with the media and public officials.

Recommendation 18: Communications Protocols

Communicate applicable protocols for communications with Unitil to each constituency at the outset of a major storm. Conduct scheduled conference calls with public safety officials, elected officials and members of the media. Provide a private phone number for Unitil's EIC to media and elected officials.

Recommendation 19: Emergency Information Center

Obtain input from elected officials, local officials and members of the media on Unitil's EIC approach. Provide EIC personnel with reliable information necessary to perform these duties, and include participation on internal restoration status conference calls.

Recommendation 20: Web and Non-Traditional Public Communications

Develop an "emergency response" web page that is highlighted on the Unitil website home page that supports the information needs of customers and other constituencies, including a section for the media. Include a Frequently Asked Questions or "FAQ" section, and provide descriptions of the outage damage, restoration progress, and the process of restoring power. Develop a specific outage reporting form to supplement the generic "contact the company" form.

Leverage current technology to enhance communications between Unitil and its customers. This could include communications with customers over the web, videos, podcasts, "twittering," emails, text messages and other emerging avenues. Distribute fliers with status reports and estimated restoration time to locations where people gather during an outage, including shelters.

Recommendation 21: Customer Education on the Restoration Process

Develop customer education materials that describe the protocols and procedures by which Unitil restores power after a major outage and distribute to customers along with any other follow-up to the 2008 Ice Storm.

Recommendation 22: Communications Roles in the ERP

Revise the ERP to incorporate the recommendations in this section:

- Clarify the roles and responsibilities of all personnel having communications responsibilities;
- Establish the process by which coordination among these personnel and other restoration personnel will be maintained while responding to an outage; and
- Ensure that the communications function has adequate and trained staff, including staff serving in "second jobs."

SECTION XI: STORM READINESS

Lessons Learned:

- The existing ERP is not adequate to respond to a major regional storm that affects two or more of Unitil's three divisions.
- There are improvements that can be made to several processes, systems and tools to provide better information in a more useful format and improve the efficiency of the restoration process.
- Unitil's tree-trimming practices should be shared with a wider group of community members.

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Recommendation 28: Tree-Trimming Policies

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APPENDIX B: GLOSSARY OF ACRONYMS

CSR	Customer Service Representative
DOC	Distribution Operating Center
DPU	Massachusetts Department of Public Utilities
DTN	DTN Meteorlogix
EEI	Edison Electric Institute
EIC	Emergency Information Center
EFR	Emergency First Responder
EOC	Emergency Operations Center
ERP	Emergency Restoration Plan
FG&E	Fitchburg Gas & Electric
GIS	Geographic Information System
IVR	Interactive Voice Response
MEMA	Massachusetts Emergency Management Agency
NEMAG	Northeast Mutual Assistance Group
NH DHS	New Hampshire Department of Homeland Security
NHOEM	New Hampshire Office of Emergency Management
NU-PSNH	Public Service of New Hampshire, a subsidiary of Northeast Utilities
NWS	National Weather Service
OMS	Outage Management System
PSA	Public Service Announcement
SCADA	Supervisory Control and Data Acquisition – a computer system used to monitor and control power flows
T&D	Transmission and Distribution
UES	Unitil Energy Systems

APPENDIX C: REFERENCES

1. "Storm Report December 6 & 7, 1996" submitted to the Massachusetts Department of Public Utilities on January 15, 1997.
2. Ice Storms: Hazardous Beauty, Dr. Keith C. Heirdorn, 1998.
3. Richard J. Hauer, Jeffrey O. Dawson, and Les P. Werner. 2006. *Trees and Ice Storms: The Development of Ice Storm-Resistant Urban Tree Populations*, Second Edition. Joint Publication 06-1, College of Natural Resources, University of Wisconsin-Stevens Point, and the Department of Natural Resources and Environmental Sciences and the Office of Continuing Education, University of Illinois at Urbana-Champaign.
4. *New Hampshire Ice Storm 2008: Record Outage Record Recovery*, Public Service of New Hampshire.
5. Cost-Benefit Analysis of the Deployment of Utility Infrastructure Upgrades and Storm Hardening Programs, Quanta Technology, submitted to the Public Utility Commission of Texas, March 4, 2009.
6. Windstorm of December 14-15, 2006. Puget Sound Energy Restoration and Readiness Review, KEMA, July 2, 2007.
7. "Best Practices in Utility Restoration", Daniel P. O'Neill, presented at the International Construction and Utility Equipment Exposition, October 17, 2007.