CHAPTER II

Storm Restoration Performance

Chapter Structure

This chapter provides an overview and assessment of the respective responses to the December 2008 ice storm of the following four New Hampshire electric utilities:

- Public Service Company of New Hampshire (PSNH)
- Unitil Energy Systems (Unitil)
- Granite State Electric Company (d/b/a National Grid)
- New Hampshire Electric Cooperative, Inc. (NHEC)

The conclusions were based upon the review of numerous utility procedures with regard to the storm, beginning with the identification of the threat to the electric transmission and distribution system, and ending with the evaluation of the companies' efforts to develop improved plans for responding to similar incidents in the future. The review included (1) an examination of the organizational relationships within and among the departments responsible for responding to the storm; (2) the processes and practices employed; and (3) the measures used to evaluate each company's performance in restoring power. Particular attention was given to evaluating communications with customers, government officials, and emergency agencies regarding power restoration schedules and efforts. NEI also reviewed the ways in which each utility handled calls from customers when reporting outages, as well as their ability to provide timely and accurate information related to estimated restoration times (ETRs).

A. BACKGROUND

The Storm

The National Climatic Data Center (NCDC) Storm Event Database reported the following description of the December 2008 ice storm in New Hampshire:

> ***11 December 2008, 4 am to 12 December 2008, 10 am*** *– A cold frontal boundary dropped south of New England on the evening of the 10th. Low pressure developed along the frontal boundary across the southeastern states late on the night of the 10th into the 11th. The low then tracked rapidly to the northeast, spreading a significant amount of precipitation into New England. A deep layer of warm air aloft and sub-freezing air at the surface resulted in a major ice storm across interior Massachusetts and southern New Hampshire as well as much of northern New England. The hardest hit areas in southern New England were the Monadnock region of southwest New Hampshire, the Worcester Hills in central Massachusetts, and the east slopes of the Berkshires in western Massachusetts. Anywhere from half an inch to an inch of ice accreted on many exposed surfaces. Especially when combined with breezy conditions, the ice downed numerous trees, branches, and power lines which resulted in widespread power outages* [1]

One of the best indicators of the severity of a storm is the peak number of customers who simultaneously lose power as a result. Figure II-1 shows the effects of the storm on New Hampshire's four largest electric power companies as reflected by the number of customers experiencing power outages by date for each utility.

[1] National Climatic Data Center. "Storm Events – New Hampshire." http://www4.ncdc.noaa.gov/cgi-win/wwcgi.dll?wwevent~ShowEvent~744812 (Accessed May 27, 2009).

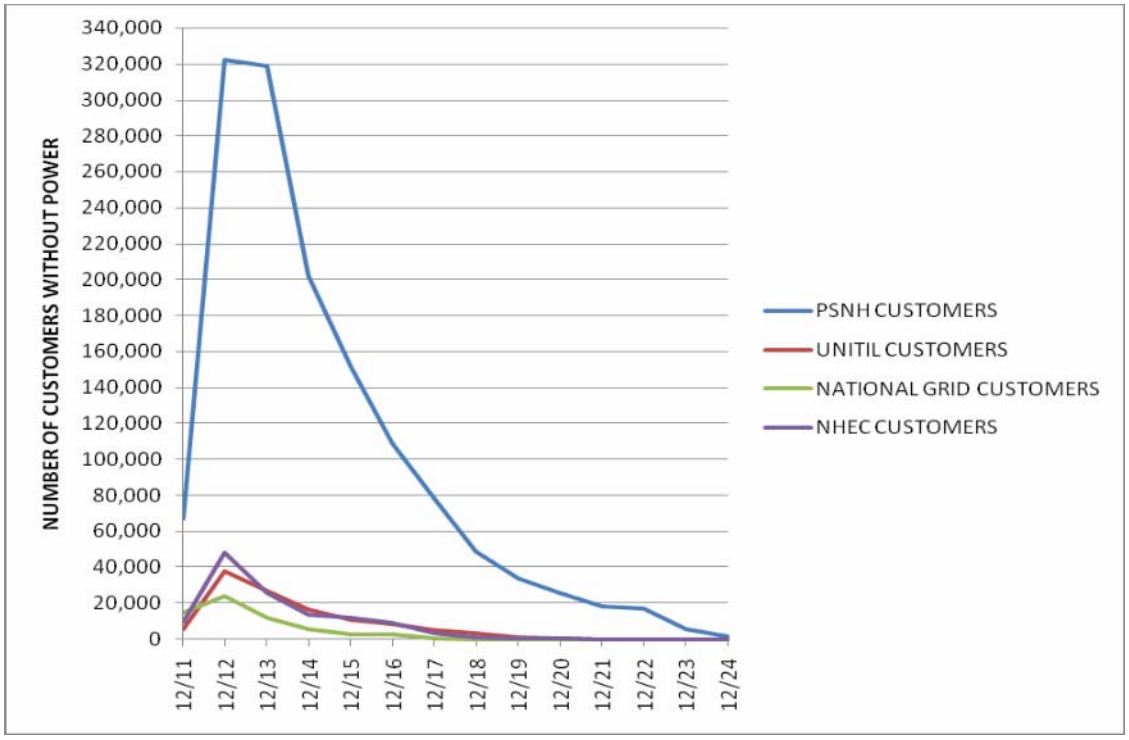

Figure II-1 – The total customers without power for each utility during the ice storm.[2] [3] [4] [5]

As shown in Table II-1, each of the utilities had power interrupted to a large percentage of its customers during the storm. The maximum number of customers who were simultaneously without power was 432,632. Of the customers shown in Table II-1, 26,213 of NHEC's customers were without power due to sub-transmission system failures on lines owned by PSNH, and 5,401 of National Grid's customers were without power for 54 hours and 35 minutes due to a failure on a transmission line jointly owned and operated by National Grid and PSNH.

[2] Unitil. (July 9, 2009). Data Response UT0010. NEI.
[3] National Grid. (April 1, 2009). New Hampshire, 2008 Ice Storm Report, pg 10.
[4] PSNH. (June 29, 2009).Data Response PS0018.NEI.
[5] NHEC. (June 8, 2009). Data Response CO0006.NEI.

Table II-1 – The number of customers who were without power in New Hampshire, by major utility.[6] [7] [8] [9]

Utility	PSNH	Unitil	National Grid	NHEC	Totals
Total Customers as of December 2008	492,803	74,115	40,470	78,424	685,812
Maximum Number of Customers Without Power	322,438	37,800	24,164	48,230	432,632
Percent of Total Customers Without Power	65%	51%	60%	61%	63%

The Utilities' Restoration Response

To restore power to customers, repair crews were deployed by the utilities. During the outage restoration period, which began late on Thursday, December 11 (Day 1) and lasted through Wednesday, December 24 (Day 14), the utilities employed hundreds of field crews made up of line crews (a/k/a bucket crews), tree crews, and digger crews. These crews worked around the clock to clear debris, replace damaged structures, and restore service. The makeup of field crews varies somewhat between the different utilities. In general, a line crew consists of two to four people and one or two trucks, and is responsible for switching, repair of equipment and hardware, and the final energization of the line. A digger crew typically consists of two to four people and one truck and is responsible for the replacement of poles. A tree crew consists of two or three people and one truck, and is responsible for the removal and disposal of downed trees. Figure II-2 shows the number of field crews of all types, as supplemented by assistance from other utilities and contractors, that the New Hampshire electric utilities had available to respond to outages during the duration of the restoration. In addition to the personnel reflected in Figure II-2, other personnel such as trouble-men (workers dedicated to finding and repairing problems), field spotters, and various types of support personnel were vital to the restoration effort.

[6] Unitil. (July 9, 2009). Data Response UT0011.NEI.
[7] National Grid. (June 23, 2009). Data Response NG0021.NEI.
[8] PSNH. (June 29, 2009). Data Response PS0019.NEI.
[9] NHEC. (June 22, 2009). Data Response CO0007.NEI.

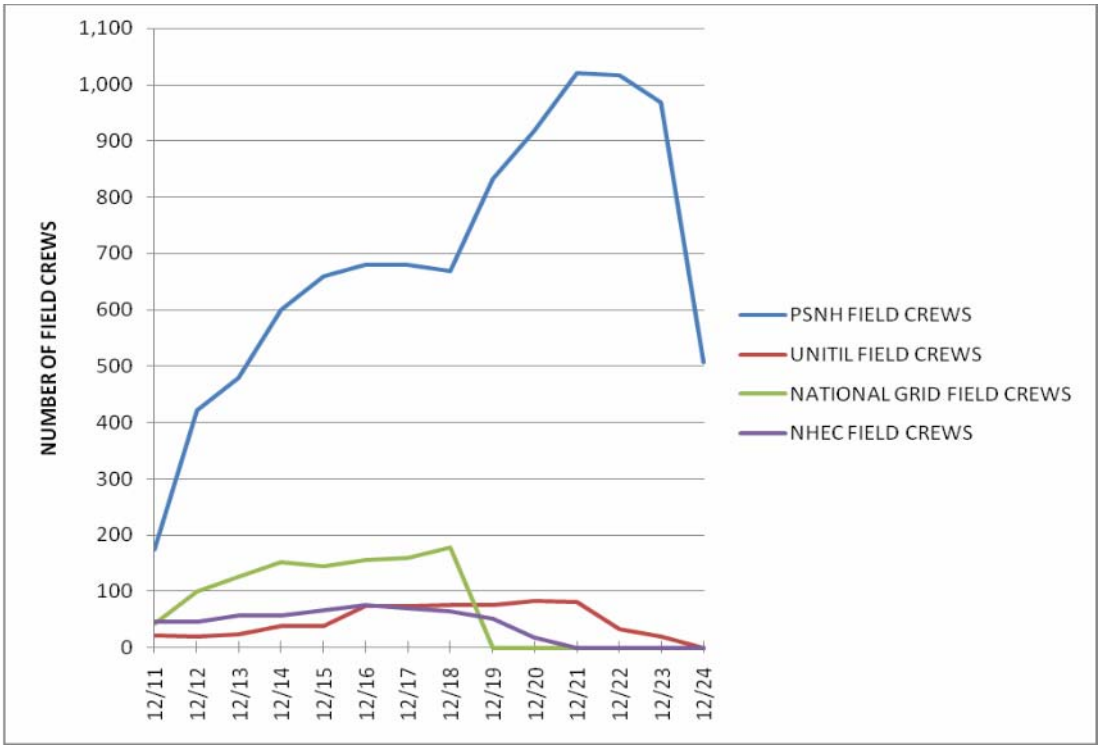

Figure II-2 – Graph showing the total number of field crews deployed by utility during the ice storm.[10] [11] [12] [13]

A comparison of the number of field crews working each day and the number of customers without power on those days is given in Figure II-3. This graph shows the total of all the utilities involved and later in this chapter the totals for each utility are given. A breakdown of the maximum number of customers without power each day and the maximum number of field crews working to restore power each day is given in Table II-2.

[10] Unitil. (February 27, 2009). Data Response STAFF 1-22. NHPUC.
[11] National Grid. (February 27, 2009). Data Response STAFF 1-22. NHPUC.
[12] PSNH. (February 2, 2009). Data Response STAFF 1-22. NHPUC.
[13] NHEC. (February 22, 2009). Data Response STAFF 1-22. NHPUC.

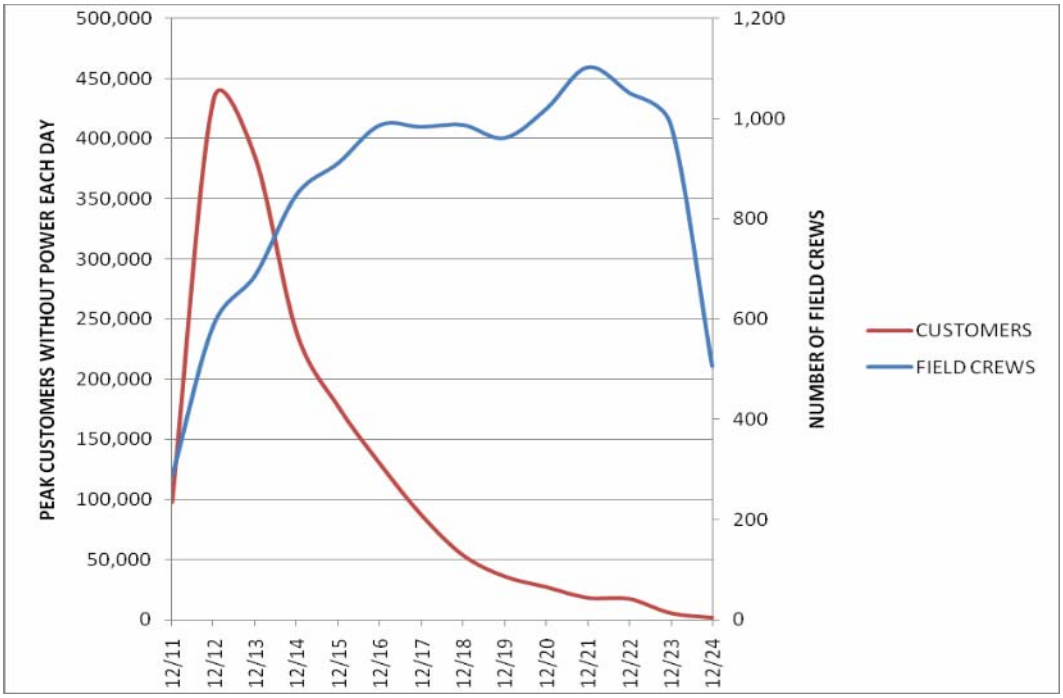

Figure II-3-Graph showing the total field number of field crews working each day compared with the total number of customers without power.

Table II-2-The total number of customers without power and number of field crews working each day.

	PSNH		Unitil		National Grid		NHEC		TOTAL	
Date	Field Crews	Customers Without Power	Field Crews	Customers Without Power	Field Crews	Customers Without Power	Field Crews	Customers Without Power	Field Crews	Customers Without Power
12/11	174	67,530	23	5,450	43	15,000	46.5	9,656	286.5	97,636
12/12	422	322,438	20	37,800	100	24,164	46.5	48,230	588.5	432,632
12/13	479	319,250	24	27,000	126	11,995	58	26,078	687	384,323
12/14	600	202,360	39	16,584	152	5,991	57.5	13,579	848.5	238,514
12/15	659	151,769	39	10,754	145	2,695	68	12,011	911	177,229
12/16	679	109,180	74	8,807	157	2,816	76.5	9,017	986.5	129,820
12/17	679	78,247	74	4,952	160	481	70	3,492	983	87,172
12/18	668	49,046	76	3,176	178.5	186	64.5	1,380	987	53,788
12/19	833	34,150	76	1,250	0	0	52	775	961	36,175
12/20	917	26,218	83	325	0	0	18.5	769	1,018.5	27,312
12/21	1,020	18,346	82	36	0	0	0	0	1,102	18,382
12/22	1,017	17,460	0	0	0	0	0	0	1,017	17,460
12/23	968	5,618	0	0	0	0	0	0	968	5,618
12/24	506	1,854	0	0	0	0	0	0	506	1,854

An examination of Figure II-1, Figure II-2, and Figure II-3 shows the rate of restoration efforts and the amount of resources committed. The slope of the graph in Figure II-1 indicates the rate at which customers were being restored. It is expected that the slope would be the steepest immediately after the storm, showing that the most rapid rate of restoration was occurring during that time. The slope should then gradually decrease as time progressed due to the decrease in the rate of restoration. This decrease would occur because more time will be required to restore power to the most heavily damaged areas of the power system, and the heavily damaged areas with few customers would likely be the last restored.

Care should be taken in interpreting these graphs, especially for the first two days following the storm. The graphs show peak values for each 24-hour period rather than the number of customers without power at the end of each period. For example, the peak number of customers without power on December 12 for PSNH was 322,438 and the peak number for December 13 was 319,250. These numbers were not recorded 24 hours apart as might be assumed; in fact, they were taken only a few hours apart. The first was taken at approximately 5:00 p.m. on December 12, and the second was taken a few hours later just after midnight December 13, since that is when the peak number of customers without power occurred on those days. After the first two days, the graphs become more representative of the speed of the restoration efforts, as the number of customers without power was more consistently measured at times shortly before midnight.

Table II-3 shows the peak number of customers who were still without power for each field crew deployed by each utility during each day of the event. It may be seen in Table II-3 that National Grid was consistently able to deploy more crews per customer without power than any of the other three utilities. This no doubt contributed to their ability to restore power to all their customers sooner than any of the other utilities.

It may also be seen that PSNH was able to deploy more crews at first than Unitil and NHEC, but on Day 3, Saturday, December 13, NHEC had fewer customers without power per crew than did PSNH. It was not until Day 6, Tuesday, December 16, that Unitil equaled PSNH in customers without power per crew deployed.

Table II-3-The number of customers without power for each field crew deployed.
(blank spaces mean all customers had power)

Date	PSNH	Unitil	National Grid	NHEC
12/11	388	237	349	208
12/12	764	1,890	242	1,037
12/13	666	1,125	95	450
12/14	337	425	39	236
12/15	230	276	19	177
12/16	161	119	18	118
12/17	115	67	3	50
12/18	73	42	1	21
12/19	41	16		15
12/20	29	4		42
12/21	18			
12/22	17			
12/23	6			
12/24	4			

Table II-4 shows the number of customers restored for each crew-day worked by each utility over the entire storm restoration period. Taking an average of all the crews of all utilities, the average crew was able to restore 36 customers per day during the whole restoration period. The National Grid number in Table II-4 was lower than the other utilities. This was due to the fact that it was able to devote more crews per outage to the restoration effort than were the other utilities. National Grid kept this relatively large number of crews deployed until all customers were restored instead of reducing the number at the end of the restoration effort. Consequently, each crew had fewer outages to restore. This resulted in National Grid completing the restoration of its customers one week before PSNH restored power to all its customers. National Grid's advantage lies in the fact that it covers a very small area in New Hampshire with relatively few customers, as well as it being a relatively large company with more resources than the other utilities.

Table II-4-The number of customers restored for each crew-day worked.

PSNH	Unitil	National Grid	NHEC
34	57	23	86

Another way to look at Table II-4 is that it shows the obstacles each utility faced and the amount of damage each utility had to repair to restore its customers. NHEC's service area experienced less damage from the storm than that of PSNH, which is one reason it was able to restore more customers for each crew-day worked.

Analysis of the Resources Deployed

It is instructive to compare Table II-3 and Table II-4 with an understanding of the nature of the storm and the sizes of each utility. It is clear that National Grid devoted more resources per outage; on average it had 96 customers restored per crew, it restored power faster to its area, and restored fewer customers for each crew-day. This all indicates that National Grid devoted more resources to the restoration effort than did the other utilities, likely because it had more resources at its disposal due to the size of the company.

PSNH averaged 204 customers restored per crew, which was far less than National Grid, but still sufficient so that each crew had to restore only 34 customers per day. PSNH is much larger and serves more customers than Unitil or NHEC and has more resources at its disposal. Its area is also larger and was heavily damaged by the storm. PSNH tried, especially at the beginning of the restoration effort, to acquire more crews. Had it been possible to acquire crews more rapidly, the total length of the outage would have been reduced.

NHEC had on average 235 customers restored per crew, nearly the same as PSNH, and it restored 86 customers for each crew day. This high restoration rate may reflect the fact that most of its service area was more lightly damaged. However, it too could have benefited from additional crews if they had been available.

Unitil had on average 440 customers restored per crew, showing its lack of available man-power. However, it had a relatively high restoration rate of 57 customers restored per crew-day. This high restoration rate may be due to Unitil's service area being more densely populated than that of the other utilities. High customer density facilitates a crew's ability to restore many customers at once since several customers may all be without power due to a single failure. This makes it possible to restore large numbers of customers with a relatively small number of repairs. The result is that power is restored to more customers with less effort than would otherwise be possible if customers were spread out and extensive repairs were needed to restore each one.

If all four utilities had been able to devote the same resources per customer without power as National Grid was able to deploy, the following estimation of potential changes can be made to the duration of the restoration effort. On average for the whole storm, there were 850 crews working per day and 121,605 customers per day without power. During the restoration, National Grid supplied, on average, one crew for every 96 outages. If the other utilities had supplied sufficient crews to equal those of National Grid, then an average of approximately 1,270 crews per day would have been supplied statewide. If the utilities restored power at the same average rate of 36 customers per crew day (as was done during the storm), 45,720 customers would have been restored each day, resulting in all 432,632 customers who were without power at the peak of the storm being restored in approximately 9 1/2 days. It is reasonable to assume that if all the utilities could have supplied resources at the same rate and quantity as National Grid, all power would have been restored to the state approximately 4 days sooner than actually occurred.

Safety during the Storm

Throughout the restoration period, safety was appropriately emphasized by all of the utilities. Each utility has a safety plan for day to day operations to meet OSHA and other requirements for safety. These plans call for a daily safety meeting with all field employees to discuss known safety issues. These issues might change from day to day depending on the type of restoration work anticipated for that day. Even though this was an emergency situation, the existing safety plans were strictly followed during the restoration work. Throughout the restoration effort, personnel and public safety was remarkable in view of the fact that thousands of linemen and right of way workers were engaged. PSNH reported a total of 38 incidents involving personnel and equipment. None of the incidents were serious injuries or resulted in lost time during the restoration effort.[14] No safety incidents were incurred by any Unitil employee, Unitil contractor, or Unitil mutual aid company during the entire restoration effort.[15] Only one safety incident involving a National Grid employee was reported for the duration of the restoration effort in New Hampshire. The incident was not serious and did not impact restoration efforts. National Grid also reported only one vehicle accident. No damage resulted and there were no injuries.[16] [17] NHEC reported that one service contractor injured his lip when struck by a falling tree limb.[18] NHEC also reported five minor vehicle incidents, but none resulted in loss of use during the storm restoration period.[19]

Material Supply

One concern that occurs with many large storms is securing adequate material in a timely manner to support the repair effort. In general, this did not appear to be an issue for this storm. All four utilities were able to secure sufficient material from suppliers in a timely manner to keep the flow sufficient so as not to hamper the repair efforts. In short, the supply chain worked efficiently. None of the utilities experienced any difficulty acquiring the large quantity of materials and tools needed to make repairs. Despite the fact that many establishments were affected by the storm and did not have power themselves, none of the utilities experienced any significant difficulties with meals or lodging for the crews.[20] [21] [22] [23]

[14] PSNH. (February 2, 2009). Data Response STAFF 1-45. NHPUC.
[15] Unitil. (February 27, 2009). Data Response STAFF 1-45. NHPUC.
[16] National Grid. (February 27, 2009). Data Response STAFF 1-45. NHPUC.
[17] National Grid. (February 27, 2009). Data Response STAFF 1-46. NHPUC.
[18] NHEC. (February 19, 2009). Data Response STAFF1-45. NHPUC.
[19] NHEC. (February 19, 2009). Data Response STAFF 1-46. NHPUC.
[20] Unitil. (February 27, 2009). Data Response STAFF 1-23, 24. NHPUC.
[21] National Grid. (February 27, 2009). Data Response STAFF 1-23, 24. NHPUC.
[22] PSNH. (February 2, 2009). Data Response STAFF 1-23, 24. NHPUC.
[23] NHEC. (February 19, 2009). Data Response STAFF 1-23, 24. NHPUC.

Economic Impact

The substantial economic impact of the December 2008 ice storm on the State of New Hampshire may never be precisely known due to the wide spread damage and loss of business and employment opportunities during the holiday shopping season. However, the financial impact reported by the local utilities, New Hampshire residents, and state and federal governments has shown this number to be in excess of $152 million. These reported losses are shown in Table II-5.

Table II-5 – The economic impact of the storm as reported for the State of New Hampshire.

Entity Reporting the Loss	Loss Value
NHEC[24]	$ 2,126,000
National Grid[25]	$ 2,565,000
PSNH[26]	$ 75,000,000
Unitil[27]	$ 3,196,665
FairPoint[28]	$ 4,788,090
TDS Communications[29]	$ 272,180
Division of Resources and Economic Development (DRED) (Private business losses) [30]	$ 11,370,000
FEMA Assistance to towns, municipal organizations, and non-profit organizations[31]	$ 17,874,000
Personal Insurance Claims[32]	$32,411,901
Commercial Insurance Claims[33]	$4,057,292
Cable TV Companies[34] [35]	$1,633,900
Total Reported Losses	**$ 155,295,028**

[24] NHEC. (July 1, 2009). Data Response GN0012. NEI.
[25] National Grid. (July 2, 2009). Data Response GN0012. NEI.
[26] PSNH. (February 2, 2009). Data Response Staff 1-49. NHPUC.
[27] Sprague, K. Director of Engineering, Unitil. Interview by Mike Joyner. May 21, 2009.
[28] FairPoint.(July 8, 2009). Data Response Staff 6-1. NHPUC.
[29] TDS. (July 10, 2009). Data Response TE0041. NEI.
[30] Avery, D. DRED. Interview by Mike Joyner. June 30, 2009.
[31] Knepper, R. NHPUC. Interview by Malmedal K. 8-14-09.
[32] Knepper, R. NHPUC. "RE: Reported Numbers by Dept. of Insurance for Table II-5." E-mail to Nelson, J. August 19, 2009.
[33] Knepper, R. NHPUC. "Re: Reported Numbers by Dept of Insurance for Table II-5 ." E-mail to Nelson, J. August 19, 2009.
[34] Barstow, J.. "RE: Ice storm costs." E-mail to Bailey, K. July 21, 2009.
[35] Hodgdon, C. Director, Legislative Affairs, Comcast.. "RE: Comcast ice storm follow-up." E-mail to Bailey, K. August 17, 2009.

Storm Timeline

To understand the response of the utilities and their use of resources, a timeline of the storm event is useful. The information below was gathered from interviews, data responses, National Weather Service reports, and news reports. As nearly as may be determined from the amount and types of information available, the sequence of events is given below:

Day minus 2, Tuesday, December 9

Weather reports indicate a winter storm is likely in Upstate New York and New England.

PSNH- No known actions are taken.

Unitil- No known actions are taken.

National Grid- Conference call is held and crews are pre-staged to Albany, N.Y.

NHEC- No known actions are taken.

Day minus 1, Wednesday, December 10

Throughout the day the various professional weather forecasting services and the National Weather Service issue Winter Weather Advisories for possible ice accumulations of up to 1" in southwestern New Hampshire.

6:00 a.m.– PSNH receives first forecast of "possible significant icing" on Thursday.

6:25 a.m.– NHEC disaster recovery executive notifies its staff via e-mail of the impending storm. Managers and supervisors respond with crew availability reports. Contractor crews on standby are activated and requests for additional crews are issued.

8:00 a.m.– PSNH receives a report from its professional weather service of a:

"*Significant icing event possible on Thursday midday through Friday morning for portions of northwestern Connecticut, southwestern Massachusetts, and southwestern New Hampshire.*"

8:47 a.m. - PSNH issues an initial Weather Advisory to alert personnel about the possibility of an impending storm.

Day minus 1, Wednesday, December 10 (continued)

8:51 a.m. - National Grid Emergency Planning notifies Electric Distributions Operations of a potential ice event on Dec 11-12.

During the day, Unitil UES Capital and UES Seacoast Emergency Operations Centers perform pre-storm planning activities.

3:00 p.m. - National Grid holds its first system-wide storm conference call. It is noted amounts of ½ inch ice accretions are causes for serious concern. and ¾ inch of ice is projected from southwest portions of NH, northeast of Laconia and south to Manchester/Nashua area.

3:11 p.m. - Unitil receives from its professional weather service a forecast for its Seacoast/Capital areas of a Winter Storm Watch for Thursday afternoon through Friday afternoon with potential for significant icing from the foothills to interior coastal counties and heavy snowfall of 6 inches or more in the mountains and foothills.

5:10 p.m.- A National Weather Service forecast is issued for heavy ice pellets or freezing rain for Thursday night. The forecast states that the potential for a major ice storm exists but the most likely locations for ice in excess of 1" on horizontal surfaces are not yet known. Significant icing and ice pellets are expected for Jaffrey, Keene, Peterborough, Nashua, Weare and Manchester, New Hampshire. An ice storm warning is issued for Massachusetts and a winter storm warning is issued for New Hampshire. Also notes indicate "*This is a potentially dangerous situation with long duration power outages possible."*

Day 1, Thursday, December 11

12:43 a.m.- The National Weather Service issues an ice storm warning, a flood watch is issued for Massachusetts, and a winter storm warning is issued for parts of Vermont.

6:00 a.m. to 9:00 a.m.- Freezing rain begins in Jaffrey, Concord, and Manchester, New Hampshire.

6:00 a.m.- National Grid receives from its professional weather service a forecast of: *"Potentially devastating ice storm… 3/4 to 1-inch likely with over an inch possible in some areas..."*

Day 1, Thursday, December 11 (continued)

7:12 a.m.- A forecast is issued for heavy accumulating ice with power outages expected for portions of Maine and New Hampshire. Freezing rain is expected to approach 1 inch over interior sections. Heavy ice accumulations are expected across portions of the coast and depending upon the weather pattern could be greater than 1/2 inch. High terrain areas (elevation 700 to 800 ft) could see "*crippling effect*"

8:30 a.m.- The Northeast Mutual Aid Group (NEMAG) conducts its first conference call, PSNH, Unitil, and National Grid attend. (NHEC is not a member of NEMAG.) The call revealed that all New England utilities anticipated the storm would impact their territories. A second call is scheduled for 6:00 a.m. on December 12.

8:34 a.m.- PSNH Customer Operations conducts a PSNH Storm Conference call and issued a Level I Emergency Planning Advisory. A weather advisory to alert customers is issued.

11:00 a.m.- New Hampshire State Emergency Operations Center (EOC) is open at Level I

New Hampshire Department of Safety, Homeland Security, and Emergency Management holds a conference call with the utilities.

11:52 a.m.- National Grid Emergency Planning contacts Field Assistant Strike Team members for mobilization assignments in Massachusetts and New Hampshire.

1:15 p.m.- Unitil issues a public service announcement (PSA) to warn employees, customers and public officials of the impending storm.

1:30 p.m.- National Grid holds second system-wide storm conference call.

In the afternoon, National Grid mobilizes ten contractor crews that are moved from Massachusetts and pre-staged to Lebanon to be ready to go to work at first light. Extra storm restoration materials are delivered to garages. Overnight crew trucks are fueled for the next day's restoration work.

During the afternoon, PSNH issues a Level II- Emergency Preparation Advisory

Day 1, Thursday, December 11 (continued)

4:28 p.m.- An ice storm warning is issued for western Massachusetts and southern New Hampshire. A winter weather advisory and flood watch are issued for eastern, northeastern, and western Massachusetts and an ice storm warning and flood watch are issued for central and eastern Massachusetts.

4:30 p.m.- New Hampshire State EOC escalates to Level II.

5:00 p.m.- Base Crews Available per Electric Utility

PSNH – 84 Line Crews, 11 Contractor Crews, 7 Digger Crews, 78 Tree Crews

Unitil – 11 Line Crews, 8 Contractor Crews, 0 Digger Crews, 4 Tree Crews

NHEC – 27.5 Line Crews, 5 Contractor Crews, 0 Digger Crews, 14 Tree Crews

National Grid – 11 Line Crews, 17 Contractor Crews, 0 Digger Crews, 6 Tree Crews

6:00 p.m.- Freezing rain begins at Lebanon, New Hampshire.

8:00 p.m.- Unitil opens its Division Emergency Operations Centers in Seacoast and Capital Districts.

9:00 p.m.- NHEC activates its EOC.

Unitil's Seacoast Division calls in crews and supervisors.

10:00 p.m.- Unitil's Capital Division calls in crews and supervisors

11:00 p.m.- PSNH issues a Level III Emergency Response Organization Activation and activates its EOC.

NHEC records 9,656 members without power.

Day 2, Friday, December 12

Midnight- National Grid opens its North Andover Division Storm Room.

PSNH records 67,530 customers without power.

Unitil records 5,450 customers without power.

National Grid records a peak of 15,000 customers without power.

Day 2, Friday, December 12 (continued)

2:00 a.m.-	National Grid opens its New England EOC in Northborough, MA
4:00 a.m.-	Key National Grid personnel told to report to EOC.
3:00 a.m. to 5:00 a.m.-	Freezing rain begins at Whitefield and Berlin, New Hampshire.
3:00 a.m. -	PSNH reports 200,000 customers with out power to NHPUC.
6:00 a.m.-	All four electric utilities begin damage assessment.
	Second NEMAG conference call, PSNH requests 250 crews, Unitil requests 30 crews, and National Grid also requests additional crews. At this time no additional crews are available from NEMAG.
	NHEC requests additional contract line crews and finds that none are available. NHEC contacts Northeast Public Power Association (NEPPA) and this call is also unsuccessful in obtaining additional crews. It gets commitments for six crews from three co-ops in New York, Vermont, and Maine. NHEC has 46.5 crews dispatched.(Alton- 4.5, Andover- 2.5, Meredith- 7, Ossipee- 4.5,
	Plymouth- 5.5, Raymond- 12, Sunapee- 10.5).
	PSNH has 205 crews dispatched (Southern Division (So.)- 79, Western/Central Division (W/C) - 68, Seacoast/North Division (S/N) - 47), Contract Crews – 11).
	National Grid has a peak of 24,164 customers without power and 59 crews are dispatched (16-Charlestown, 14.5-Lebanon, 28.5-Salem).
	Unitil records a peak of 37,800 New Hampshire customers without power and 20 crews are dispatched (8- UES Capital, 12 – UES Seacoast).
	NHPUC staff reports to State EOC.
6:50 a.m. -	Unitil reports 6,000 Capital and 29,000 Seacoast customers without power to NHPUC.
7:00 a.m.-	New Hampshire State EOC escalated to Level III.
9:00 a.m.-	NHEC records a peak of 48,230 members without power.
	Governor Lynch declares State of Emergency and activates National Guard.
10:00 a.m.-	Governor Lynch with NHPUC Chairman Getz holds conference call with senior executives of NHEC, PSNH, National Grid, Unitil, and Fairpoint.

Day 2, Friday, December 12 (continued)

11:30 a.m.- Unitil issues Advisory Notice describing the storm's impact and restoration operations are under way. Unitil continues to issue Public Service Announcements throughout the storm using media outlets, key community leaders, and using the company's Integrated Voice Response system.

12:00 p.m.- Third NEMAG conference call also included New York Mutual Assistance Group (NYMAG) and Mid-Atlantic Mutual Assistance (MAMA). PSNH again requests 250 crews, Unitil requested an additional 10 crews bringing the total requested to 40 crews, National Grid did not request additional crews.

PSNH was allocated 170 crews from the NEMAG call.

Unitil was allocated 40 crews from the NEMAG call.

2:00 p.m.- Unitil secured an additional six line crews out of Nashua, NH. Total crews committed to Unitil is 46.

3:00 p.m.- The first NHEC co-op crews requested at 6:00 a.m. arrives.

During the day National Grid begins posting news releases on its website with public service announcements.

5:00 p.m.- PSNH records a peak of 322,438 customers are without power and 422 crews have been dispatched. 217 additional crews have arrived during the day.

Unitil is informed 14 of the crews committed from NEMAG would not be available due to a resource shortage reducing committed crews to 31.

5:33 p.m.- New Hampshire Public Radio reports 24 shelters are open along with several warming stations.

11:59 p.m.- Precipitation has ended over the whole state of New Hampshire. Exact times and locations are unknown due to widespread outages interrupting power to automated recording weather stations.

Day 3, Saturday, December 13

12:00 a.m.- PSNH records 319,250 customers without power.

Unitil records 27,000 customers without power.

National Grid records 11,995 customers without power.

4:00 a.m.- NHEC records 26,078 members without power.

Day 3, Saturday, December 13 (continued)

6:00 a.m.-	PSNH has 479 crews dispatched throughout its system.
	NHEC has 58 crews dispatched on its system.
	Unitil has 24 crews dispatched on its system.
	National Grid has 126 crews dispatched on its system.
	PSNH uses contracted helicopter that was being used for transmission line repair prior to storm for damage assessment.
10:00 a.m.-	Governor Lynch holds second teleconference with senior management of NHEC, PSNH, National Grid, Unitil, and Fairpoint.
4:00 p.m.-	National Grid begins providing updates via its New England media hotline. Updates are provided each day at 6:00 a.m., 11:00 a.m., 4:00 p.m., and 9:00 p.m. Updates include the number of customers still without power.

Day 4, Sunday, December 14

12:00 a.m.-	PSNH records 202,360 customers without power.
	Unitil records 16,584 customers without power.
	National Grid records 5,991 customers without power.
1:00 a.m.-	NHEC records 13,579 members without power.
6:00 a.m.-	PSNH has 600 crews dispatched throughout its system.
	NHEC has 57.5 crews dispatched on its system.
	Unitil has 39 crews dispatched on its system.
	National Grid has 152 crews dispatched on its system.
	PSNH uses helicopter for damage assessment.
	President Bush declares State of Emergency in New Hampshire.
12:30 p.m.-	Unitil issues its first restoration update with numbers of customers out of service in each town served.

Day 5, Monday, December 15

12:00 a.m.-	PSNH records 151,769 customers without power.
	Unitil records 10,754 customers without power.
	National Grid records 2,695 customers without power.
6:00 a.m.-	PSNH has 659 crews dispatched on its system.
	NHEC has 68 crews dispatched on its system
	Unitil has 39 crews dispatched on its system.
	National Grid has 145 crews dispatched on its system.
	New England Cable News (NECN) reports 27 shelters are open in New Hampshire.
8:00 a.m.-	Governor Lynch holds meeting with senior executives of PSNH, Unitil, National Grid, NHEC, and FairPoiont.
9:36 a.m.-	Television station WMUR reports 56 shelters have been opened state wide with space for 6,000 people.
1:00 p.m.-	NHEC records 12,011 members without power.

Day 6, Tuesday, December 16

12:00 a.m.-	PSNH records 109,180 customers without power.
	Unitil records 8,807 customers without power.
	National Grid records 2,816 customers without power.
2:00 a.m.-	NHEC records 9,017 members without power.
6:00 a.m.-	PSNH has 679 crews dispatched on its system.
	NHEC has 76.5 crews dispatched on its system.
	Unitil has 74 crews dispatched on its system.
	National Grid has 157 crews dispatched on its system.
8:10 a.m.-	PSNH issues first estimated restoration time indicating when communities would be 95% restored.
9:00 a.m.-	NHEC issues first estimated restoration time for members without power.

Day 7, Wednesday, December 17

12:00 a.m.- PSNH records 78,247 customers without power.
Unitil records 4,952 customers without power.
National Grid records 481 customers without power.

6:00 a.m.- PSNH has 679 crews dispatched on its system.
NHEC has 70 crews dispatched on its system.
Unitil has 74 crews dispatched on its system.
National Grid has 59 crews dispatched on its system.

9:00 a.m.- NHEC records 3,492 members without power.

11:30 a.m.- PSNH begins posting daily estimated restoration dates on its website.
Snow showers during the day with snow totals of approximately 3 inches.

Day 8, Thursday, December 18

12:00 a.m.- PSNH records 49,046 customers without power.
Unitil records 3,176 customers without power.
National Grid records 186 customers without power.

6:00 a.m.- PSNH has 668 crews dispatched on its system.
NHEC has 64.5 crews dispatched on its system.
Unitil has 76 crews dispatched on its system.
National Grid has 179 crews dispatched on its system.

7:00 a.m.- NHEC records 1,380 members without power.

12:00 p.m.- PSNH opens satellite emergency operations center in New Ipswich.

1:00 p.m.- PSNH opens satellite emergency operations center in Peterborough, NH.

6:30 p.m.- PSNH opens satellite emergency operations center in Fitzwilliam, NH.

10:19 p.m.- National Grid records last customer power restored.

Day 9, Friday, December 19

12:00 a.m.- Unitil records 1,250 customers without power.

5:00 a.m.- PSNH records 34,150 customers without power.

6:00 a.m.- PSNH has 833 crews dispatched on its system.

NHEC has 52 crews dispatched on its system.

Unitil has 76 crews dispatched on its system.

9:00 p.m.- NHEC records 775 members without power.

Day 10, Saturday, December 20

12:00 a.m.- Unitil records 325 customers without power.

6:00 a.m.- PSNH has 917 crews dispatched on its system.

NHEC has 17.5 crews dispatched on its system.

Unitil has 83 crews dispatched on its system.

7:00 a.m.- New Hampshire State EOC escalated to Level IV.

9:00 a.m.- NHEC records 769 members without power.

4:00 p.m.- PSNH records 26,218 customers without power.

NHEC records last member power restored. Note some seasonal homes are inaccessible until Spring.

Snow storm beginning on Day 9 ends with snow totals averaging 9 inches.

Day 11, Sunday, December 21

12:00 a.m.- PSNH records 18,346 customers without power.

Unitil records 36 customers without power.

6:00 a.m.- PSNH has 1,020 crews dispatched on its system.

Unitil has 82 crews dispatched on its system.

Second snow storm in two days brings an additional 12 inches of snow to New Hampshire.

Day 12, Monday, December 22

12:00 a.m.-	PSNH records 17,460 customers without power.
6:00 a.m.-	PSNH has 1,017 crews dispatched on its system.
	Unitil has 34 crews dispatched on its system.

Day 13, Tuesday, December 23

12:00 a.m.-	PSNH records 5,618 customers without power.
6:00 a.m.-	PSNH has 968 crews dispatched on its system.
	Unitil has 20 crews dispatched on its system.
12:00 p.m.-	Unitil records last customer power restored.

Day 14, Wednesday, December 24

12:00 a.m.-	PSNH records 1,854 customers without power.
6:00 a.m.-	PSNH has 506 crews dispatched on its system.
1:00 p.m.-	New Hampshire State EOC returned to Level I.
6:00 p.m.-	PSNH records 99.9% of customer power restored. Some seasonal homes are inaccessible until Spring.

-End of Storm Response-

The following maps track the location of customers without power in New Hampshire following the storm and show the progress of the restoration effort. These maps were prepared by the NHPUC using data they recorded during the storm restoration. They are instructive because they show the general progression of the restoration patterns with the final customers being restored located at the very south-central part of the state which was the area most damaged by the storm.

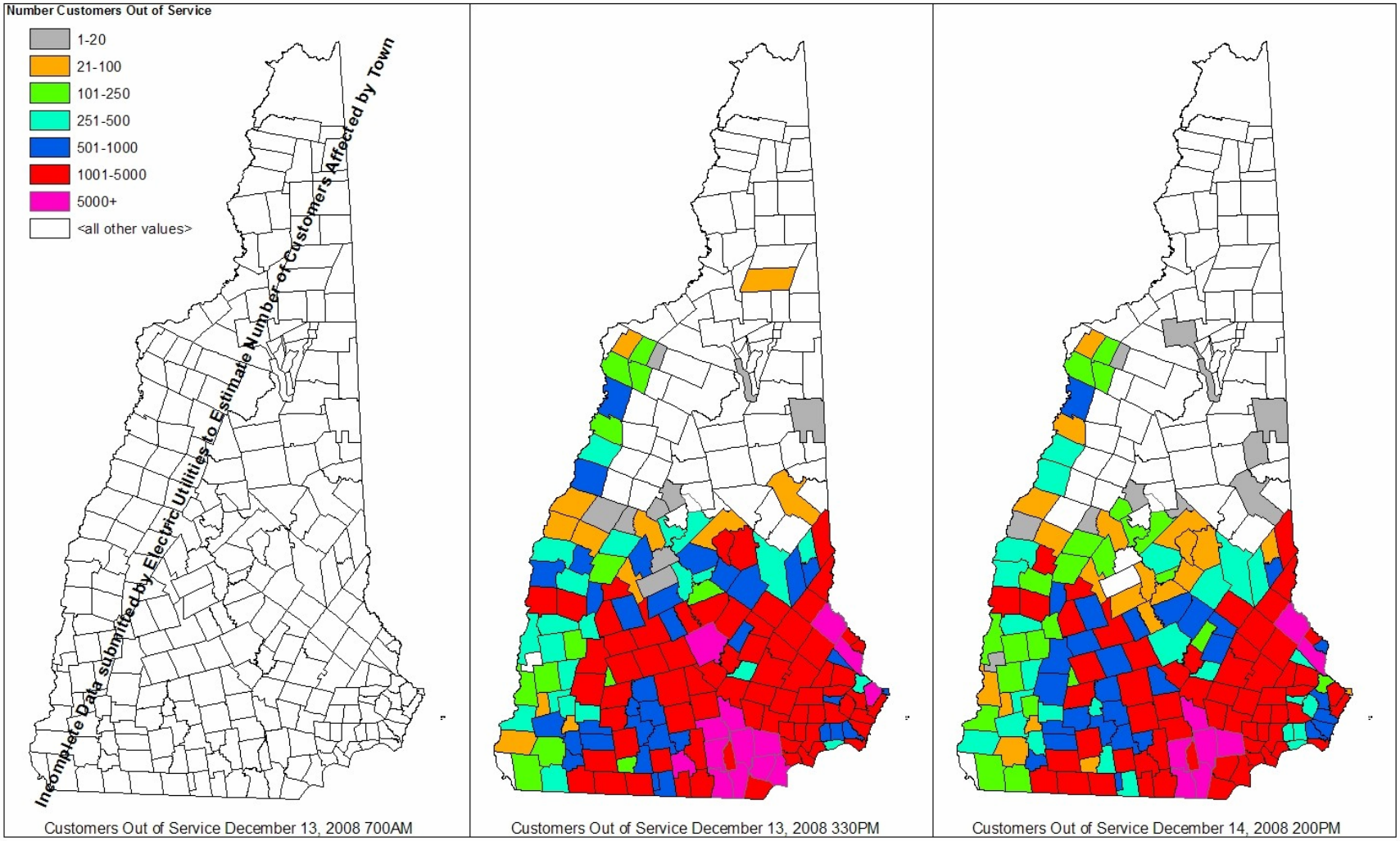

Figure II-4 – New Hampshire electric utility customers without power by municipality.

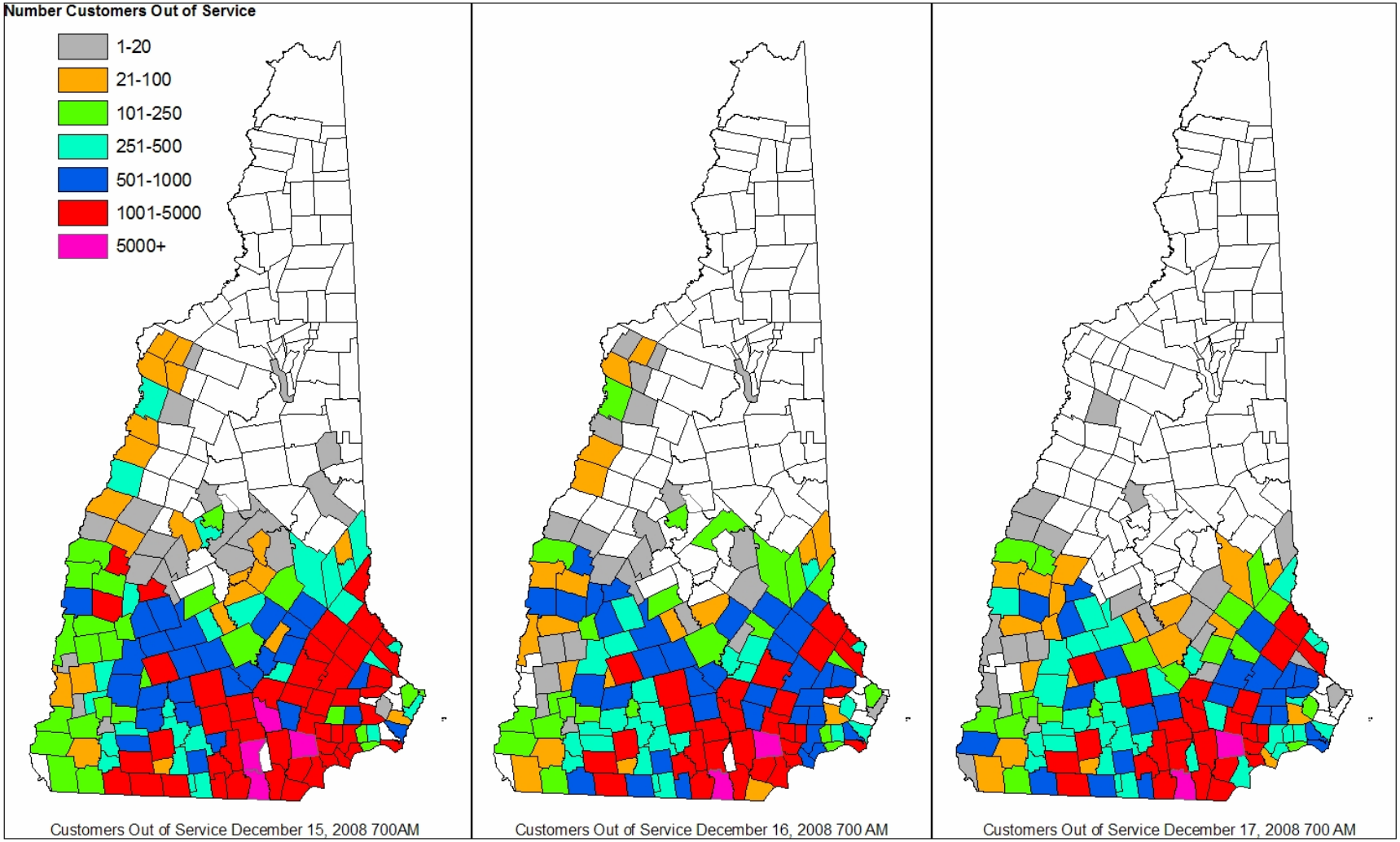

Figure II-5 – New Hampshire electric utility customers without power by municipality.

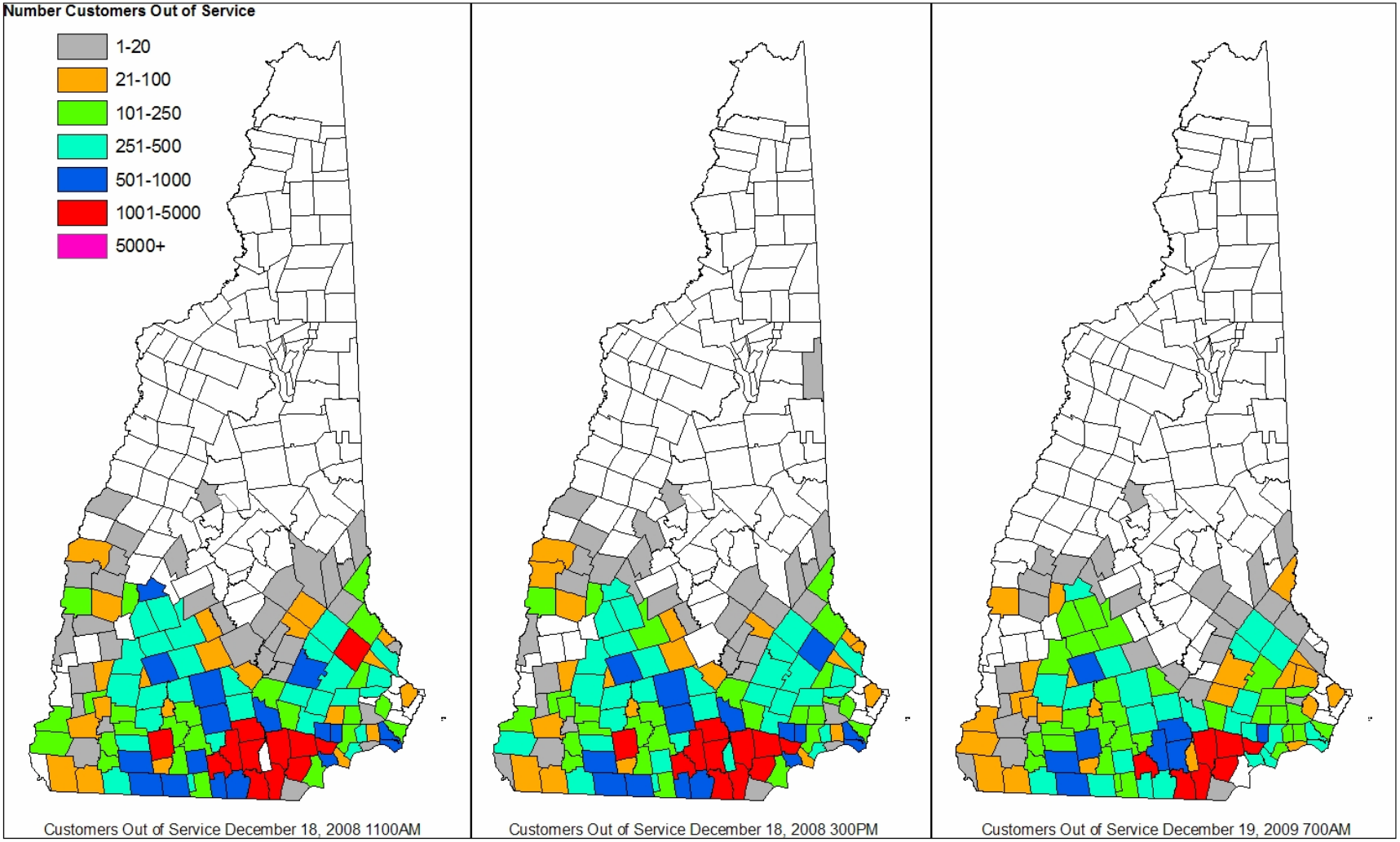

Figure II-6 – New Hampshire electric utility customers without power by municipality.

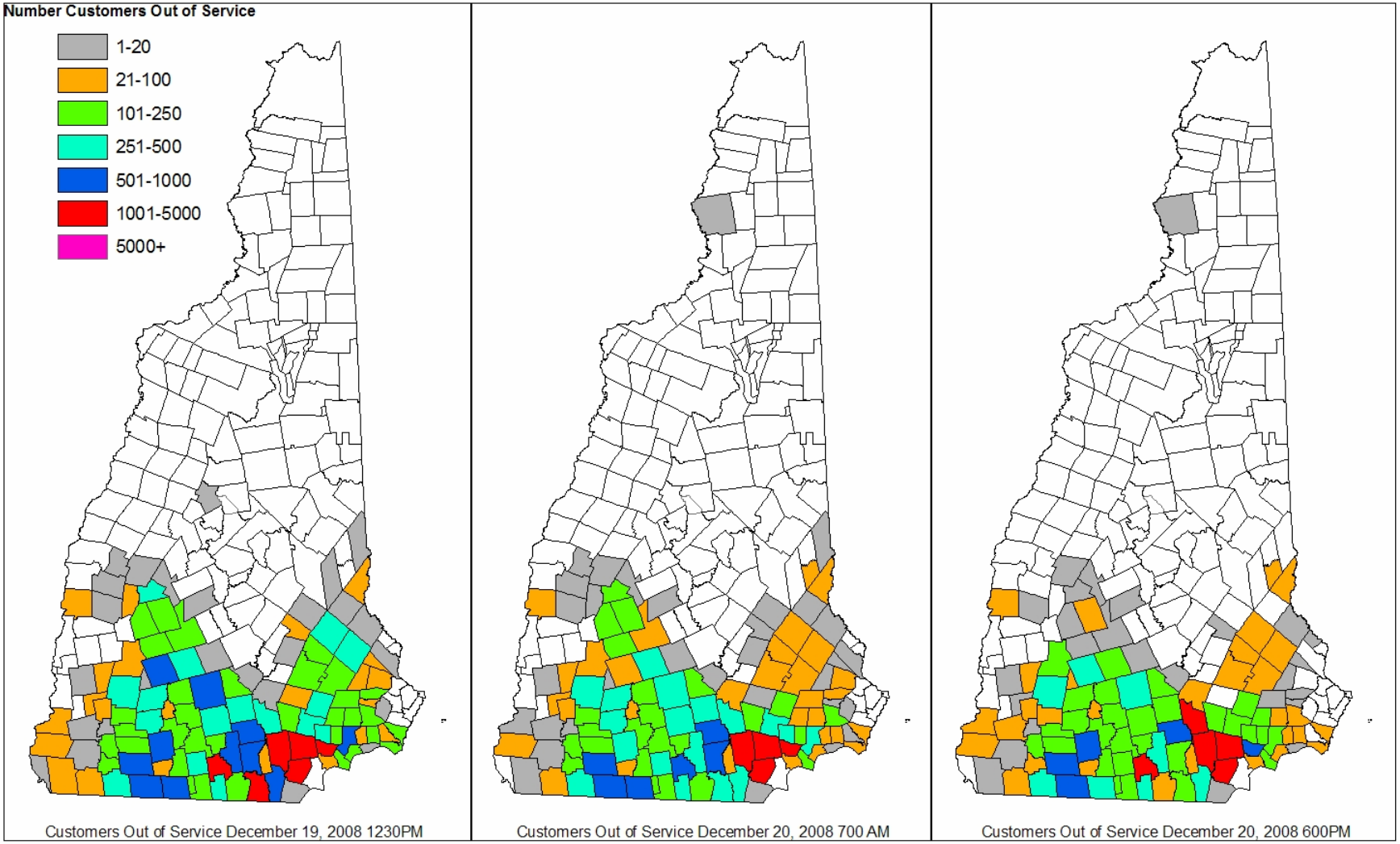

Figure II-7 – New Hampshire electric utility customers without power by municipality.

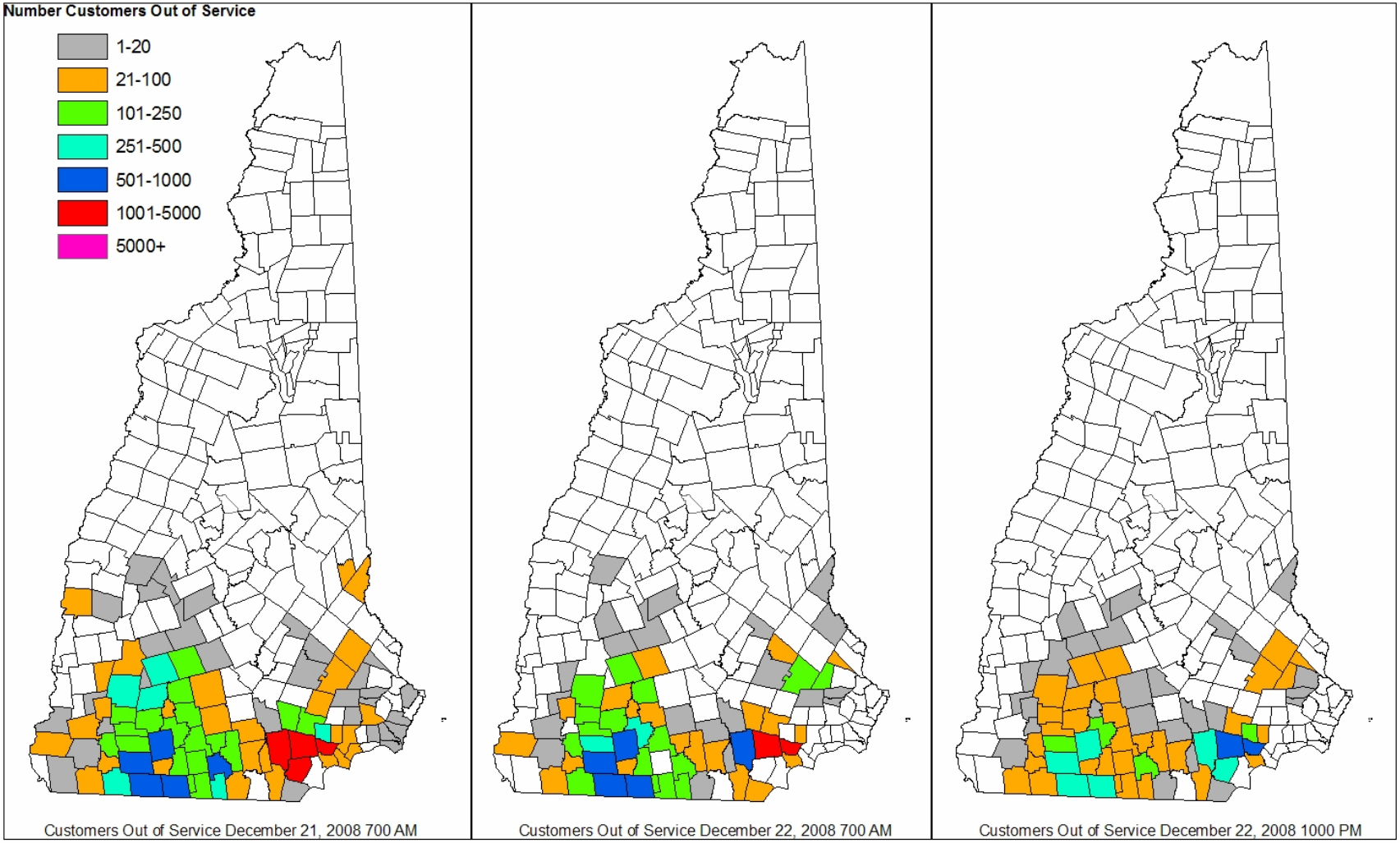

Figure II-8 – New Hampshire electric utility customers without power by municipality.

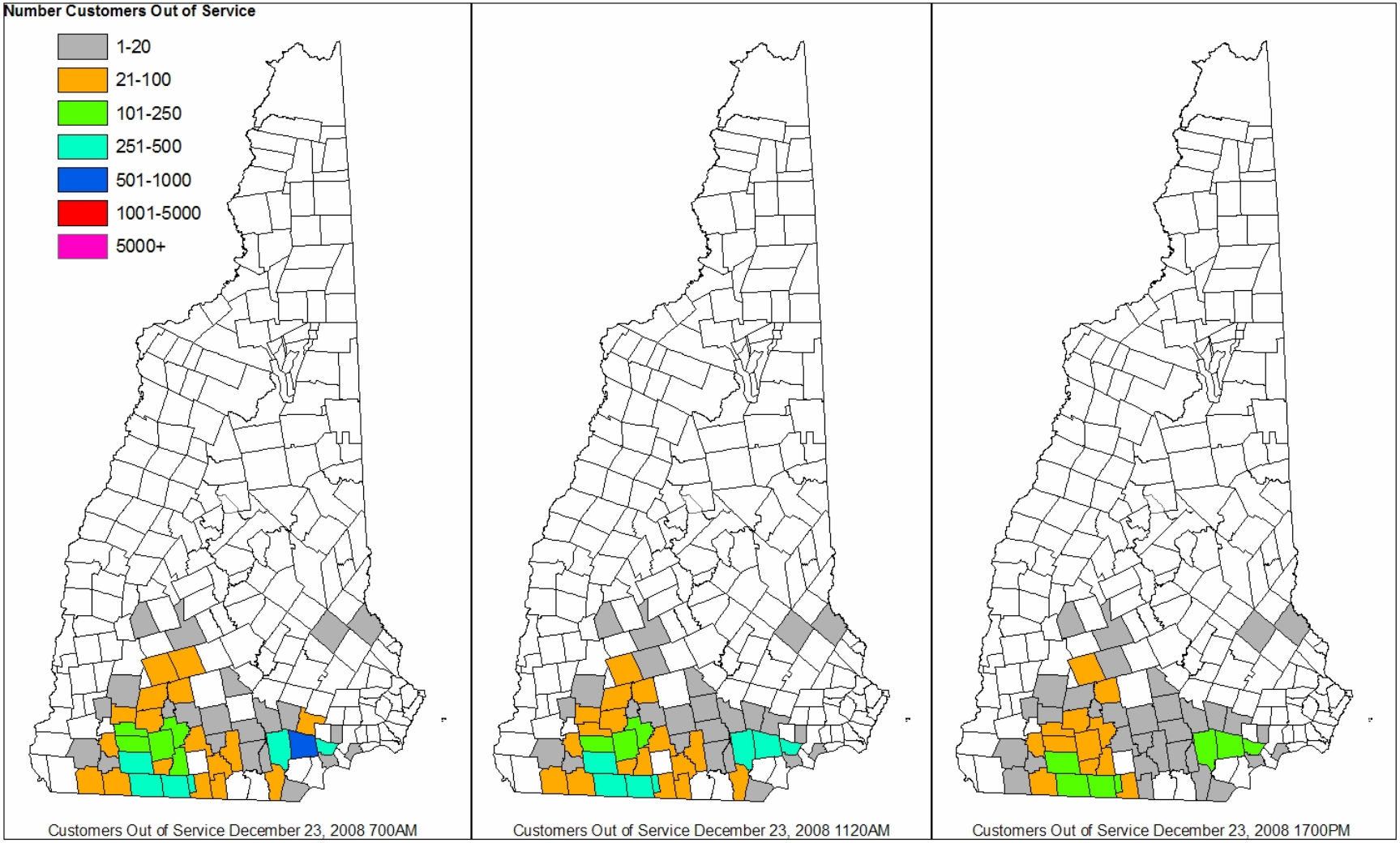

Figure II-9 – New Hampshire electric utility customers without power by municipality.

B. EVALUATIVE CRITERIA

The storm restoration efforts of each utility were evaluated using four specific criteria. These are:

1. The effectiveness of procedures for deploying resources.
2. The effectiveness of the mechanism for collecting and maintaining information on customer outages.
3. The efficiency of restoration efforts.
4. The timeliness and accuracy of external communication.

1. During storm restoration, the companies should have an effective process for deploying and managing both internal and external resources.

- Beginning with the first indication of an impending storm that is expected to cause power disruptions, each utility should immediately notify the appropriate personnel to prepare for a major storm. At minimum, the following staff should be notified:
  - Emergency operations center staff
  - Safety coordinators and training personnel
  - Work management and other information systems technicians
  - Logistics and materials managers
  - Customer call centers
- Damage assessment personnel should be pre-positioned to various locations in order to be able to provide a timely indication of storm damage.
- Customer call centers should begin ramping up staffing levels in order to prepare to handle incoming customer calls.
- Communications personnel should contact the news media, communities, and local officials following the first indication of the approaching ice storm.
- Calls to mutual assistance utilities and contractors should be made at the earliest possible moment.
- Operations managers should hold crews on location and develop restoration schedules before sending crews home.
- The utility should have effective systems and tools for developing estimates of damage and projecting outage durations and resource requirements.

2. The companies should have effective systems and tools for collecting and maintaining customer outage information.

- The information should be accurate.
- The systems should facilitate thorough collection of all available information regarding customer outages.

- The tools used by the utility should allow for regular updating and reassessment of the extent of damages and estimated restoration times.
- The information delivered should be consistent with that provided in external communications.

3. Storm restoration efforts should be efficient and effective.

- The utility should make use of all available intelligence to determine the extent of the damage and number of customers without power.
- The utility should activate its process for insuring public safety and relieving emergency personnel (police and fire) from responsibility for downed wires.
- System repairs should be made in an orderly and expeditious manner, with emphasis on restoring the largest number of customers in the least amount of time.
- Customer call centers should answer customer calls in a reasonable amount of time and call center representatives should be able to adequately respond to customer questions and inquiries. During the peak of the outage all customers may not be able to access either the integrated voice response system (IVR) or speak with a customer service representative (CSR) due to the large volume of calls, but with repeated calls every customer should be able to leave a message on the IVR system or speak with a CSR within a 3-hour period. As the restoration efforts progress the time to answer a customer's call should decrease.
- An effective process should be in place to constantly monitor, update, and eliminate old or incomplete outage information from outage management systems (OMSs).
- Orders should be closed out as work is completed in order to avoid a large decrease in remaining outages at the end of the work day.
- Record keeping should be sufficient to allow all managers and supervisors to be well apprised of the status of outages, conditions at other work centers, and local conditions in their respective areas of the system.
- Records should be sufficient to provide for a thorough reconstruction of restoration efforts and lessons learned assessment.

4. Communications with customers, local officials, state agencies, and the public should be adequate to provide timely and accurate information.

- The utility should designate a single point of contact and designate multiple backups so someone is always readily available for external communications.
- Updates should be provided to the news media on a regular basis and planned to coincide with the needs of customers and public officials.
- Executive managers should be fully cognizant of all information being provided in external communications.

- The utility should have an effective process for insuring public safety by communicating the locations of downed wires.

The following four tables indicate the extent to which each of the utilities met the criteria. These tables were not prepared to compare one utility with another. The four utilities are very different, face different problems, and experienced different amounts of damage to their systems. They were prepared to show where each utility may improve its performance in preparation for the next storm or other disaster. A further explanation for the improvements that are recommended to each of the utilities may be found in the findings and conclusions section of this report. The meanings of the symbols used in the tables are:

○ Improvement is needed as stated in the report

◐ Adequate with minor improvements suggested as stated in the report

● Effective with no improvements noted.

Table II-6 - PSNH Storm Restoration Performance Evaluation Matrix

1) EFFECTIVE PROCESS FOR RESOURCE DEPLOYMENT	
Beginning with 1st indication of impending ice storm, companies should have immediately notified appropriate personnel to prepare. Contacts should have been made.	●
Damage assessment personnel should have been pre-positioned to various locations to provide timely indication of storm damage.	○
Customer call centers should have begun ramping up staffing levels to handle incoming customer calls.	○
Communications personnel should have contacted news media, communities & local officials following 1st indication of approaching ice storm.	○
Calls to mutual assistance utilities & contractors should have been made at earliest moment.	○
Operations managers should have held crews on location & developed restoration schedules before sending crews home.	◐
Company should have had effective systems & tools for developing estimates of damage & projecting outage durations & resource requirements.	◐

2) COLLECTION MECHANISMS FOR MAINTAINING CUSTOMER OUTAGES	
Information should have been accurate.	○
Systems should have facilitated thorough collection of all available information regarding customer outages.	○
Tools should have allowed for regular update & reassessment of extent of damages & estimated restoration times.	◐
Information should have been consistent with that provided in external communications.	○

3) EFFICIENCY OF RESTORATION EFFORTS	
Company should have made use of all available intelligence to determine extent of damage & real outages.	○
Company should have a process for ensuring public safety & relieving emergency personnel (police & fire) from responsibility for downed wires.	◐
System repairs should have been made in orderly & expeditious manner, with emphasis on restoring largest number of customers in least amount of time.	◐
Customer call centers should have answered customer calls in reasonable amount of time & call center reps should have been able to respond to customer inquiries.	◐
Effective process should have been in place to constantly monitor, update & eliminate old or incomplete outage information from outage mgmt systems.	○
Orders should have been closed out as work was completed to avoid large decrease in remaining outages at end of workday.	○
Recordkeeping should have been sufficient to allow managers & supervisors to be well apprised of status of outages & local conditions in their respective areas of system.	◐
Records should have been sufficient to provide for thorough reconstruction of restoration efforts & lessons learned assessment.	○

4) TIMELINESS & ACCURACY OF EXTERNAL COMMUNICATIONS	
Companies should have designated single points of contact (with multiple backups) for external communications.	●
Updates should have been provided to news media on regular basis & planned to coincide with needs of customers & public officials.	●
Executive managers should have been fully cognizant of all information being provided in external communications.	●
Companies should have had effective process for ensuring public safety by communicating locations of downed wires.	◐

Table II-7 - Unitil Storm Restoration Performance Evaluation Matrix

1) EFFECTIVE PROCESS FOR RESOURCE DEPLOYMENT	
Beginning with 1st indication of impending ice storm, companies should have immediately notified appropriate personnel to prepare. Contacts should have been made.	●
Damage assessment personnel should have been pre-positioned to various locations to provide timely indication of storm damage.	○
Customer call centers should have begun ramping up staffing levels to handle incoming customer calls.	○
Communications personnel should have contacted news media, communities & local officials following 1st indication of approaching ice storm.	○
Calls to mutual assistance utilities & contractors should have been made at earliest moment.	○
Operations managers should have held crews on location & developed restoration schedules before sending crews home.	●
Company should have had effective systems & tools for developing estimates of damage & projecting outage durations & resource requirements.	◐

2) COLLECTION MECHANISMS FOR MAINTAINING CUSTOMER OUTAGES	
Information should have been accurate.	○
Systems should have facilitated thorough collection of all available information regarding customer outages.	○
Tools should have allowed for regular update & reassessment of extent of damages & estimated restoration times.	○
Information should have been consistent with that provided in external communications.	○

3) EFFICIENCY OF RESTORATION EFFORTS	
Company should have made use of all available intelligence to determine extent of damage & real outages.	◐
Company should have a process for ensuring public safety & relieving emergency personnel (police & fire) from responsibility for downed wires.	◐
System repairs should have been made in orderly & expeditious manner, with emphasis on restoring largest number of customers in least amount of time.	●
Customer call centers should have answered customer calls in reasonable amount of time & call center reps should have been able to respond to customer inquiries.	◐
Effective process should have been in place to constantly monitor, update & eliminate old or incomplete outage information from outage mgmt systems.	○
Orders should have been closed out as work was completed to avoid large decrease in remaining outages at end of workday.	◐
Recordkeeping should have been sufficient to allow managers & supervisors to be well apprised of status of outages & local conditions in their respective areas of system.	◐
Records should have been sufficient to provide for thorough reconstruction of restoration efforts & lessons learned assessment.	○

4) TIMELINESS & ACCURACY OF EXTERNAL COMMUNICATIONS	
Companies should have designated single points of contact (with multiple backups) for external communications.	◐
Updates should have been provided to news media on regular basis & planned to coincide with needs of customers & public officials.	◐
Executive managers should have been fully cognizant of all information being provided in external communications.	●
Companies should have had effective process for ensuring public safety by communicating locations of downed wires.	◐

Table II-8 - National Grid Storm Restoration Performance Evaluation Matrix

1) EFFECTIVE PROCESS FOR RESOURCE DEPLOYMENT	
Beginning with 1st indication of impending ice storm, companies should have immediately notified appropriate personnel to prepare. Contacts should have been made.	●
Damage assessment personnel should have been pre-positioned to various locations to provide timely indication of storm damage.	●
Customer call centers should have begun ramping up staffing levels to handle incoming customer calls.	○
Communications personnel should have contacted news media, communities & local officials following 1st indication of approaching ice storm.	○
Calls to mutual assistance utilities & contractors should have been made at earliest moment.	○
Operations managers should have held crews on location & developed restoration schedules before sending crews home.	◐
Company should have had effective systems & tools for developing estimates of damage & projecting outage durations & resource requirements.	◐

2) COLLECTION MECHANISMS FOR MAINTAINING CUSTOMER OUTAGES	
Information should have been accurate.	◐
Systems should have facilitated thorough collection of all available information regarding customer outages.	○
Tools should have allowed for regular update & reassessment of extent of damages & estimated restoration times.	◐
Information should have been consistent with that provided in external communications.	◐

3) EFFICIENCY OF RESTORATION EFFORTS	
Company should have made use of all available intelligence to determine extent of damage & real outages.	◐
Company should have a process for ensuring public safety & relieving emergency personnel (police & fire) from responsibility for downed wires.	◐
System repairs should have been made in orderly & expeditious manner, with emphasis on restoring largest number of customers in least amount of time.	◐
Customer call centers should have answered customer calls in reasonable amount of time & call center reps should have been able to respond to customer inquiries.	◐
Effective process should have been in place to constantly monitor, update & eliminate old or incomplete outage information from outage mgmt systems.	○
Orders should have been closed out as work was completed to avoid large decrease in remaining outages at end of workday.	◐
Recordkeeping should have been sufficient to allow managers & supervisors to be well apprised of status of outages & local conditions in their respective areas of system.	◐
Records should have been sufficient to provide for thorough reconstruction of restoration efforts & lessons learned assessment.	◐

4) TIMELINESS & ACCURACY OF EXTERNAL COMMUNICATIONS	
Companies should have designated single points of contact (with multiple backups) for external communications.	●
Updates should have been provided to news media on regular basis & planned to coincide with needs of customers & public officials.	◐
Executive managers should have been fully cognizant of all information being provided in external communications.	●
Companies should have had effective process for ensuring public safety by communicating locations of downed wires.	◐

Table II-9 - NHEC Storm Restoration Performance Evaluation Matrix

1) EFFECTIVE PROCESS FOR RESOURCE DEPLOYMENT	
Beginning with 1st indication of impending ice storm, companies should have immediately notified appropriate personnel to prepare. Contacts should have been made.	●
Damage assessment personnel should have been pre-positioned to various locations to provide timely indication of storm damage.	○
Customer call centers should have begun ramping up staffing levels to handle incoming customer calls.	○
Communications personnel should have contacted news media, communities & local officials following 1st indication of approaching ice storm.	○
Calls to mutual assistance utilities & contractors should have been made at earliest moment.	◐
Operations managers should have held crews on location & developed restoration schedules before sending crews home.	◐
Company should have had effective systems & tools for developing estimates of damage & projecting outage durations & resource requirements.	●

2) COLLECTION MECHANISMS FOR MAINTAINING CUSTOMER OUTAGES	
Information should have been accurate.	●
Systems should have facilitated thorough collection of all available information regarding customer outages.	○
Tools should have allowed for regular update & reassessment of extent of damages & estimated restoration times.	◐
Information should have been consistent with that provided in external communications.	◐

3) EFFICIENCY OF RESTORATION EFFORTS	
Company should have made use of all available intelligence to determine extent of damage & real outages.	◐
Company should have a process for ensuring public safety & relieving emergency personnel (police & fire) from responsibility for downed wires.	◐
System repairs should have been made in orderly & expeditious manner, with emphasis on restoring largest number of customers in least amount of time.	◐
Customer call centers should have answered customer calls in reasonable amount of time & call center reps should have been able to respond to customer inquiries.	○
Effective process should have been in place to constantly monitor, update & eliminate old or incomplete outage information from outage mgmt systems.	◐
Orders should have been closed out as work was completed to avoid large decrease in remaining outages at end of workday.	●
Recordkeeping should have been sufficient to allow managers & supervisors to be well apprised of status of outages & local conditions in their respective areas of system.	◐
Records should have been sufficient to provide for thorough reconstruction of restoration efforts & lessons learned assessment.	○

4) TIMELINESS & ACCURACY OF EXTERNAL COMMUNICATIONS	
Companies should have designated single points of contact (with multiple backups) for external communications.	◐
Updates should have been provided to news media on regular basis & planned to coincide with needs of customers & public officials.	●
Executive managers should have been fully cognizant of all information being provided in external communications.	●
Companies should have had effective process for ensuring public safety by communicating locations of downed wires.	◐

C. TASKS

In order to fully examine the storm restoration efforts of the four largest New Hampshire electric utilities, NEI conducted interviews with utility managers and reviewed documents provided by the NHPUC Staff and the utilities. Specific tasks included the following:

- Review and evaluate the adequacy of each company's emergency procedures.
- Review the storm plans at the company and local level
- Review all storm related records, beginning with the first indication of the impending ice storm through the restoration of the last customer outage.
- Develop a detailed chronology of the storm restoration efforts of each company.
- Develop and review the work-down curves and compare them to other indicators such as staffing levels, customer call volume, and the number of remaining customers without power.
- Assess all service interruption reporting systems.
- Interview appropriate utility personnel associated with the outage.
- Interview public safety and municipal officials.
- Provide an overall assessment of each company's storm restoration efforts.

D. FINDINGS AND CONCLUSIONS

Conclusion: In the field, the utilities carried out an excellent tactical response to the December 2008 ice storm generally directing resources effectively once field crews were acquired, mobilized, and put to work.

In response to major weather events such as hurricanes and ice storms, electric utilities must mobilize a tremendous volume of resources in order to quickly rebuild transmission and distribution systems that are literally torn apart. In an era in which even a momentary power outage may cause economic losses and inconvenience to customers, these restoration efforts never seem to be fast enough. Nonetheless, all four New Hampshire electric utilities responded effectively once crews were acquired, mobilized and put to work. The effectiveness may be shown by the fact that over 40% of all customers without power were restored in the first day following the storm.

PSNH

On Day 1, Thursday, December 11, an internal weather advisory was issued at PSNH in response to forecasts for a major winter storm. Using a custom designed weather modeling tool developed for PSNH by Plymouth State University in 2004, the company determined that a major power outage event was likely to occur. The information given by this tool did not appear to provide better or more accurate information than was available from the weather services at the time, and did not appear to increase PSNH's early response to the storm. It is still in development and may

at some time in the future provide useful data to predict the number of outages that may be expected from certain types of storms.

In accordance with its Emergency Response Plan, PSNH issued an Emergency Management Advisory on Day 1, Thursday, December 11 to begin preparations for the storm. Those preparations included:

- Alerting all personnel and planning for adequate staffing
- Fueling and stocking line trucks and other emergency response vehicles with necessary equipment
- Preparing for meals and lodging for field employees
- Stocking first aid equipment, road and circuit maps, flashlights, batteries, and office supplies
- Preparing reception areas and procedures for outside crews[36]

PSNH's central Emergency Operations Center (EOC) was activated at approximately 11:00 p.m. on Day 1, Thursday, December 11. At that time the typical compliment of 174 crews were already working to restore service to customers without power.

The EOC is the emergency command post, the headquarters for managing the storm and communicating with everyone inside and outside the company. It is the central location where information is gathered and from which the restoration effort is directed. The EOC would include representatives from all disciplines: operations, communications, customer service, logistics, etc.

An operating work center is a local point where a manager and whatever staff he has available work on storm restoration activities. It would include trucks, linemen, supervisors, damage assessors, and other types of crews and support personnel. The operating work centers would usually report in to the EOC. The crews actually work from work centers located in major areas of the territory served (fig I-4), and the EOC coordinates allocation of resources for the work dispatched from these centers.

By the time the EOC was activated power outages were already beginning to occur. Recognizing the magnitude of the storm, PSNH immediately requested help from other utilities and contract crews in New England. Unfortunately, because the storm was impacting the entire region, many of the contract crews in the area were already committed to helping other utilities. Those utilities were given priority under the regional Mutual Aid Agreement (agreements between utilities to aid each other in the case of emergencies) since they had sustained damage before PSNH.[37] As PSNH cast a wider net to solicit help from utilities along the East Coast, in the Midwest, and into Canada, local employees were mobilized to begin restoring power. Despite the efforts of over 400 PSNH crews working statewide by Day 2, Friday, December 12,

[36] PSNH. (March 24, 2009). New Hampshire Ice Storm 2008: Record Outage, Record Recovery, pg 10.
[37] See Conclusions No. 25, 26, and 27 in Chapter III of this report for additional information on mutual aid agreements.

the number of power outages continued to climb. By 5:00 p.m. more than 322,000 PSNH customers were without power. By Day 4, Sunday, December 14, more than 300 additional tree and line crews had arrived in New Hampshire to help restore power to PSNH customers. PSNH continued to focus its resources on clearing and repairing damaged lines that would restore the greatest number of customers in the shortest time. By nightfall on Sunday, crews had restored service to more than half of the PSNH customers who had lost power in the storm.[38]

During the next few days, crews continued to arrive from as far away as Maryland, Ohio, and Canada to augment PSNH's in-house staff of approximately 176 line and tree crews. By Day 9, Friday, December 19, more than 800 line, tree, and service crews were working for PSNH in New Hampshire. Power had been restored to more than 300,000 PSNH customers, about 89% of the customers that had been affected by the storm. By Day 10, Saturday, December 20, the last portion of restoration work had been completed in the Seacoast and northern regions of the state, and PSNH's restoration workforce had grown to more than 900 crews.[39]

PSNH is unique among electric utilities in New Hampshire in that it is responsible for service restoration up to and including the meter socket. In order to handle the large number of damages to customer premises equipment, PSNH hired more than 100 local electricians. During the first half of the restoration effort PSNH concentrated on restoring major lines and the medium voltage (above 1000V) system while also restoring services as they progressed. After many of the major lines were restored PSNH began hiring electricians on Day 7, Wednesday, December 17 to restore the low voltage services from the transformers to the customer's homes and businesses. This freed up linemen so they could continue with the major repairs to the medium voltage system while allowing the electricians to restore the low voltage services. They continued hiring additional electricians throughout the storm until the last service repair on Day 14, Wednesday, December 24.

In addition to the external electricians PSNH had service crews from multiple contractors and utilized some internal service crews. At its peak, PSNH had more than 130 service crews working to repair services. PSNH estimates that the electricians and service crews worked in excess of 11,100 crew hours and repaired more than 3,000 services. This approach kept line crews working on damaged circuits and resulted in the restoration of power significantly earlier than would have been possible if PSNH had relied exclusively upon its own line crews to perform the repairs.[40] Hiring outside electricians was a departure from PSNH's everyday operations but turned out to be an effective way to handle the responsibility PSNH has to restore the low voltage services to buildings. Moreover, the electricians were local and did not require food and lodging. While occurring relatively late during this outage, using local electricians

[38] PSNH. (June 29, 2009). Data Response PS0018. NEI.
[39] PSNH. (February 2, 2009). Data Response STAFF 1-22. NHPUC.
[40] PSNH. (February 2, 2009). Data Response STAFF 1-18. NHPUC.

during a large outage is something that should be included in PSNH's plans for response to future storms.

In the three areas where the storm damage was most severe PSNH activated additional satellite emergency operation centers to manage the efforts of the massive number of crews, support staff, and equipment. These areas were activated on Day 8, Thursday, December 18 and were located in Peterborough (operational at 1:00 p.m.), New Ipswich (operational at noon), and Fitzwilliam (operational at 6:30 p.m.), New Hampshire. These satellite EOCs were staffed by personnel from Division EOCs which were moved from the Northern/Seacoast Division of PSNH after power had been restored at those locations and there was no longer a need for the Division EOCs. Resources were also moved from areas that were already restored to areas still needing attention. In the final three days of restoration, Days 12-14, December 22-24, PSNH's workforce totaled more than 1,000 crews, who worked around the clock to restore service to nearly 20,000 PSNH customers who were still without power. These repairs were particularly time-consuming, as most of the remaining outages had been caused by damage to equipment that served just one residence or a small pocket of homes. PSNH was able to restore power to more than 99.9 percent of its customers by 6:00 p.m. on Day 14, Wednesday, December 24.[41] Figure II-10 shows the total number of crews PSNH had working on its system each day of the restoration effort compared to the peak number of customers without power. The graph indicates that the number of field crews did not reach its maximum until ten days after the storm. If more of the field crews had begun working on the system sooner, it is likely that the restoration would have been completed earlier.

[41] PSNH. (February 2, 2009). Data Response STAFF 1-25. NHPUC.

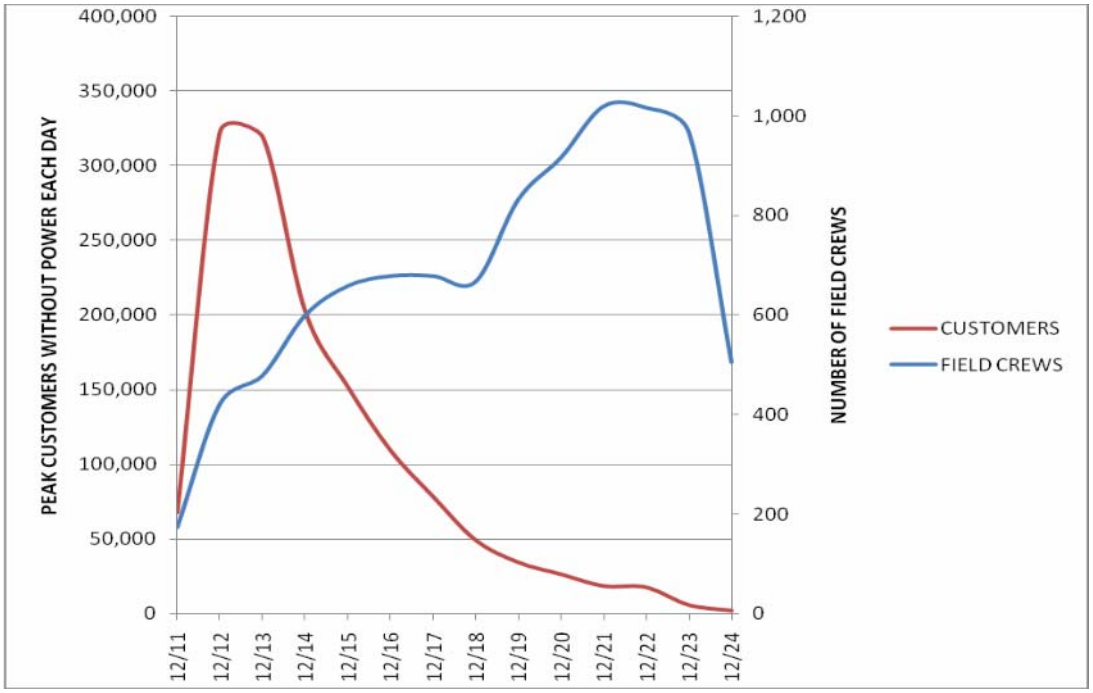

Figure II-10 – Graph showing the number of PSNH field crews and customers without power following the ice storm.[42] [43]

The slope of the customers graph in Figure II-10 indicates the rate at which customer power was being restored. Ideally, if the utility had the philosophy of restoring as many customers as possible in the shortest amount of time this graph would be the steepest right after the storm when the restoration efforts began and would gradually flatten out as fewer and fewer customers were without power and more effort was needed to restore each customer. In other words, it would normally be expected that power would be restored to the most customers immediately after the storm and the rate of restoration would gradually decrease. Ideally the utility should dedicate sufficient resources so that the customer line in Figure II-10 would be a smooth curve, and descend at the steepest rate possible allowing for the available resources.

While it is generally true that the customer curve in Figure II-10 is smooth and gradually flattens as expected, showing that PSNH deployed crews in such a way that the rate of restoration was as expected, the response on Day 2, Friday, December 12, to Day 3, Saturday, December 13, appears to be unusual. The flattening of the curve on Day 2 is merely an artifact of the way data was recorded and shown. Since the data shows the peak number of customers without power on each day, these numbers may not be taken exactly 24-hours apart, which is the case for the data on Day 2. This makes it appear that rate of restoration was much slower than it was in truth.

Another anomaly seen in the customer curve of Figure II-10 is that the slope once again changes on Day 12, Monday, December 22. This occurred at the same time that the number of crews was

[42] PSNH. (February 2, 2009). Data Response STAFF 1-22. NHPUC.
[43] PSNH. (February 2, 2009). Data Response PS0019. NEI.

decreasing. This may be an indication that PSNH began releasing crews slightly too quickly, mutual aid crews were recalled by their own company, or outside crews were leaving to be home for the holidays. PSNH could have used the additional help for another day. This effect is minor and may represent only a few hours in the time needed to restore all customers' power.

Unitil

Unitil's System Dispatchers as a standard practice review the weather hourly. When a storm front is predicted a weather advisory e-mail message is sent to key personnel within the company. Based on the content of weather advisories Unitil's Director of Electric Operations scheduled several conference calls with the electric system managers and other operating personnel to discuss the impending storm. The purpose of each of the calls was to assess the current weather forecasts and determine the potential impact to Unitil's electric system and to discuss pre-storm readiness activities including notifying all operations staff and line personnel of the potential for widespread outages.

The electric systems managers also notified Unitil's contract line crews that the company was in storm readiness mode. 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.[44] During 2008 Unitil had an average of 16 contract line and tree crews[45] working for it. At the time the storm began on Day 1, December 11, Unitil had 23 crews available both contract and employed by Unitil.

Also on December 11, e-mail communications were sent to key management personnel informing them that operations personnel would be needed to help with the storm restoration effort. Unitil then issued a pre-storm Public Service Announcement (PSA) at 1:15 p.m. on December 11 which went to an extended list of employees and managers, a list of public officials, and was posted on the Company website. This announcement stated that due to the ice storm warning Unitil had put its personnel and emergency crews on alert and that all customers were advised that the storm could cause short power outages that night and the next day. Customers were also notified that it was possible that extended outages could occur and then listed telephone numbers for customers to call if they were without power.[46]

Unitil's restoration effort was led by the Director of Electric Operations with the Distribution Operating Center (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-

[44] Unitil. (March 25, 2009). Unitil's Response to the 2008 Ice Storm, Self-Assessment Report, pg 19.
[45] Unitil. (February 27, 2009). Data Response STAFF 1-15.NHPUC.
[46] Unitil. (March 27, 2009). Data Response STAFF 2-15.NHPUC.

day conduct of damage assessment, prioritization of repair work, and dispatch of Unitil and outside crews during the restoration effort. Unitil appropriately adhered to the restoration priorities set forth in its emergency response plans, working down the priority list instead of dispatching crews to individual trouble locations as would typically occur in a smaller outage. The restoration effort proceeded from the very top of the priority list starting with the substations and then proceeding to individual circuits, until crews and electricians were finally restoring individual services to customers. Crews were first focused on substations and began working downstream, repairing the main circuits first.[47]

To the extent possible, tree crews proceeded in advance of bucket crews. Repairs to circuits usually required clearing and isolating all side taps, laterals, and downstream circuits before the mainline portions could be energized. Crews then began the process of restoring increasingly smaller portions of circuits and, similar to what was experienced by the other utilities, as the restoration progressed more effort was needed per customer to restore power.

The typical number of Unitil crews for an average day in New Hampshire is approximately 20. Unitil eventually amassed a restoration workforce composed of approximately 19 internal line and tree crews and 64 external crews that amounted to a total of 83 at its peak on Day 10, Saturday, December 20.[48] Service was restored to the last of Unitil's New Hampshire customers in the Capital Division on Day 10, Saturday, December 20 and in the Seacoast Division on Day 13, Tuesday, December 23.[49] Figure II-11 shows the total number of crews Unitil had working on its system each day of the restoration effort compared to the peak number of customers out of power on that day. The graph indicates that the peak number of crews working on Unitil's New Hampshire system did not reach its maximum until ten days after the storm began. As discussed further in the conclusions below, restoration could have been completed sooner if the additional crews had been acquired earlier. Unitil had fewer crews dispatched per outage than any of the other utilities until Day 6, Tuesday, December 16, when it finally procured enough crews to equal PSNH and NHEC. Of the four utilities Unitil could have benefited the most from additional crews.

[47] Unitil. (March 25, 2009). Unitil's Response to the 2008 Ice Storm, Self-Assessment Report, pg 39.
[48] Unitil. (February 27, 2009). Data Response STAFF 1-22.NHPUC.
[49] Unitil. (March 25, 2009). Unitil's Response to the 2008 Ice Storm, Self-Assessment Report, pg 43.

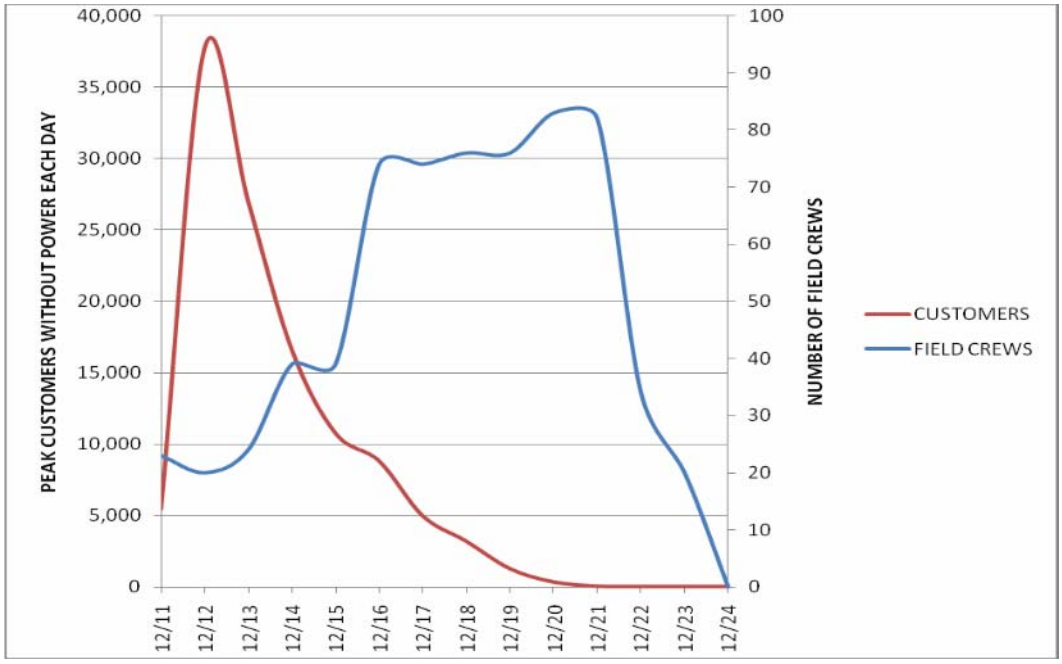

Figure II-11 – Graph showing the number of Unitil field crews and customers without power following the ice storm.[50] [51]

Figure II-11 clearly shows the difficulty that Unitil had in quickly acquiring enough crews. The field crews curve flattens out on December 16 showing they stopped acquiring additional crews even when the rate of restoration decreased as shown on the customer graph for this date. If more crews were available they should have continued acquiring them. While this hurt the speed of their restoration effort the customers graph shows that the crews that were available efficiently restored customers at a rate that would be expected until December 16 at which time the restoration rate slowed.

[50] Unitil. (February 27, 2009). Data Response Staff 1-22. NHPUC.
[51] Unitil. (July 9, 2009). Data Response UT0011. NEI.

National Grid

National Grid began preparation several days ahead of the December 2008 ice storm by alerting key personnel with advance weather warnings, holding emergency response team conference calls (the first on Wednesday, December 9) and staging company line crews in the Albany, NY, area so they would be available to the National Grid utilities as needed. All four utilities appeared to have similar warnings about the storm, but National Grid acted on these warnings sooner and began its preparation for the storm a full day before the other utilities. This preparation helped it to respond more quickly once the storm occurred and its scope became apparent. The early planning allowed it to allocate more assets per outage than any of the other utilities and the resources directed to New Hampshire caused it to be the first of the four utilities to restore power to all its customers.

By midday on Day 1, Thursday, December 11, National Grid's Customer Operations organization issued orders to pre-position crews and extra storm restoration materials throughout the northern portions of its New England service territory. A total of ten contractor line crews were transferred from its Massachusetts service area to Lebanon, New Hampshire during the afternoon of December 11, in the event that travel on the following day was hampered by the ice.[52] Key emergency restoration personnel were told at 4:00 a.m. on Day 2, Friday, December 12, by National Grid's Vice President of Customer Operations to report to the Emergency Operations Center. Damage assessment personnel were notified to be ready to begin examining the New Hampshire system at 6:00 a.m. on Day 2, Friday December 12.[53] [54]

Also on Thursday, December 11, National Grid's Materials Management organization verified an appropriate level of inventory and contacted vendors to arrange for an uninterrupted supply of stock. The Fleet Services organization fueled all trucks overnight so that line crews could begin to restore service at daybreak. National Grid's bargaining unit contract calls for linemen to work up to 18 hours per day, with the objective being to allow for 6 hours for rest. The other three utilities also had agreements with their employees to allow for similar working hours. During the restoration effort, National Grid kept two or three crews active at night, in order to maintain an around the clock presence and be prepared to clear unsafe conditions that may emerge.[53] [54]

National Grid's customer outages peaked on Day 2, Friday, December 12, at 24,164 customers. By the end of Day 3, Saturday, December 13 more than half had been restored and by the end of Day 4, Sunday, December 14, less than 6,000 customers were still without power. National Grid was the first utility to get all customers restored, with restoration officially complete at 10:19 p.m. on Day 8, Thursday, December 18.[55] While it is true that National Grid had fewer customers without power than any of the other utilities, it is also true that they allocated far more

[52] National Grid. (April 1, 2009). New Hampshire, 2008 Ice Storm Report, pg 7.
[53] Kearns, R. Director Emergency Planning, National Grid. Interview by Joyner, M. June 9, 2009.
[54] Demmer, K. Manager Electric Distribution New Hampshire, National Grid. Interview by Joyner, M. June 9, 2009.
[55] National Grid. (April 1, 2009). New Hampshire, 2008 Ice Storm Report, pg 10.

resources per outage to the restoration effort than the other utilities did. They also began planning for the storm sooner than the other utilities. This is why National Grid representatives rightly attribute the relatively early restoration of their system to heavily applying resources, having a good plan, doing early damage assessments, getting help from outside the utility, and cooperating with the municipal officials and agencies.[56] [57] To augment its internal staffing of approximately 20 line and tree crews, National Grid received all the crews it needed.[58] [59] Nonetheless, as discussed in the conclusions, if the additional crews had arrived sooner, it is likely that restoration would have been completed sooner. Figure II-12 shows the total number of crews National Grid had working on its system each day of the restoration effort compared to the peak number of customers out of power.

Figure II-12 – Graph showing the number of National Grid field crews and customers without power following the ice storm.[60] [61]

[56] Kearns, R. Director Emergency Planning, National Grid. Interview by Joyner, M. June 9, 2009.
[57] Demmer, K. Manager Electric Distribution New Hampshire, National Grid. Interview by Joyner, M. June 9, 2009.
[58] Sankowich, S. M. Manager Vegetation Management Strategy Asset Strategy & Policy, National Grid. Interview by Joyner, M. May 8, 2009.
[59] Ramsey, J. Manager Senior Arborist, National Grid. Interview by Joyner, M. May 8, 2009.
[60] National Grid. (February 27, 2009). Data Response STAFF 1-22. NHPUC.
[61] National Grid. (June 23, 2009). Data Response NG0021. NEI.

The field crew curve in Figure II-12 shows that National Grid procured field crews more quickly than did the other utilities and the slope of the curve is steeper for a longer period of time than the other utilities. The customer curve decreases at a rapid and expected rate until December 15 when the number of customers without power increased slightly. This was due to the fact that some line switching was needed which resulted in some previously restored customers being taken back out of service for a short time so additional work could be done to adjacent lines serving other customers. It was safety related switching and was unavoidable. In general National Grid received sufficient resources and put them to work effectively and quickly and this is reflected in the slope of both the customer and field crew graphs.

NHEC

Early on Day -1, Wednesday, December 10, in response to the weather forecasts, NHEC's Disaster Recovery Executive issued a statement via e-mail to ensure that all NHEC staff was aware of the impending storm. The message pointed out that the potential existed for heavy snowfall in the mountains and foothills and significant amounts of freezing rain and sleet in the southern areas of New Hampshire. A response was sent back by managers and supervisors identifying employees who were available for storm duty. Supervisors also reviewed their emergency checklists for vehicles, materials, fuel and equipment to ensure they were well supplied and ready.[62] Contract crews, which included line and tree crews, were put on notice.[63]

NHEC has a continuously staffed control center located in Plymouth, NH. The control center is responsible for notifying the Disaster Recovery Executive when weather reports or customer outage calls indicate an approaching storm. In each of NHEC's 10 operating districts, a line crew is kept on call to respond to customer outage calls. When outage calls become too numerous for one crew, additional crews are called in to work. Outage reports received during the night on Day 1, Thursday, December 11 and early morning December 12, rapidly exceeded the capability of available trouble crews in six of NHEC's districts. Based on a call from the control center during the late evening of Day 1, Thursday, December 11, the Disaster Recovery Executive activated NHEC's Emergency Operations Center (EOC) at 9:00 p.m.[64]

NHEC members without power peaked on Day 2, Friday, December 12 at 48,230 members.[65] By Day 5, Monday, December 15, NHEC had 68 crews working on its system and had reduced the number of members without power to 12,011. On Day 6, Tuesday, December 16, the NHEC storm restoration workforce peaked at 76.5 crews.[66] Late on Day 9, Friday, December 19, NHEC had completed repairs to all known major outages and reduced the number of members still out of power to 90. Later that night a tree on a wire caused another 658 members to lose

[62] NHEC. (February 19, 2009). Data Response STAFF 1-8. NHPUC.
[63] NHEC. (February 19, 2009). Data Response STAFF 1-10. NHPUC.
[64] NHEC. (June 18, 2009). Data Response CO0006. NEI.
[65] NHEC. (June 22, 2009). Data Response CO0007. NEI.
[66] NHEC. (February 19, 2009). Data Response Staff 1-22. NHPUC.
Note: NHEC crews normally consist of 2-3 line workers. Less than the full complement represents a half crew.

power. Those members were restored early morning on Day 10, Saturday, December 20, leaving only scattered outages, primarily related to individual service lines.[67]

NHEC is responsible for attaching overhead service drops to the weather head at customer premises. This presented a significant challenge to the restoration effort because a large number of service lines were damaged during the ice storm. NHEC handled more than two hundred service orders for damaged service lines and also repaired many that were found and not recorded. NHEC used in house electricians and other licensed and experienced employees to make these repairs in parallel with other efforts so the overall restoration process would not be delayed.[68] [69] [70] Customers were notified if problems existed that were not the responsibility of NHEC so that they could be corrected and power safely restored.[71] The situation where the utility is responsible for the service drop is somewhat unusual among utilities. Typically the utility is responsible for installing the medium voltage equipment (above 1000 Volts) and the transformer which steps the voltage down from medium to low voltage and the service drop to the customer's weather head/service mast. The customer is responsible for providing the connection between the service drop and the meter and an electrician the customer hires normally takes care of this connection. To be consistent with what is typically done nationally, and what is done in New Hampshire (except for PSNH) we suggest that NHEC crews in future concentrate on repairing the medium voltage distribution system and let customers privately take care of their low voltage system from the service drop to the meter.

Service was restored to the last NHEC member without power during the afternoon of Day 10, Saturday, December 20.[72] Figure II-13 shows the total number of crews NHEC had working on its system each day of the restoration effort compared to the peak number of customers out of power.

[67] NHEC. (February 19, 2009). Data Response STAFF 1-42. NHPUC.
[68] Gosney, W. Executive Vice President, NHEC. Interview by Joyner, M., June 17, 2009.
[69] Bakas, J. Vice President of Engineering and Operations, NHEC. Interview by Joyner, M. June 17, 2009.
[70] Lynch, H. Disaster Recovery Executive, NHEC. Interview by Joyner, M. June 17, 2009.
[71] NHEC. (February 19, 2009). Data Response STAFF 1-18. NHPUC.
[72] NHEC. (February 19, 2009). Data Response STAFF 1-25. NHPUC.

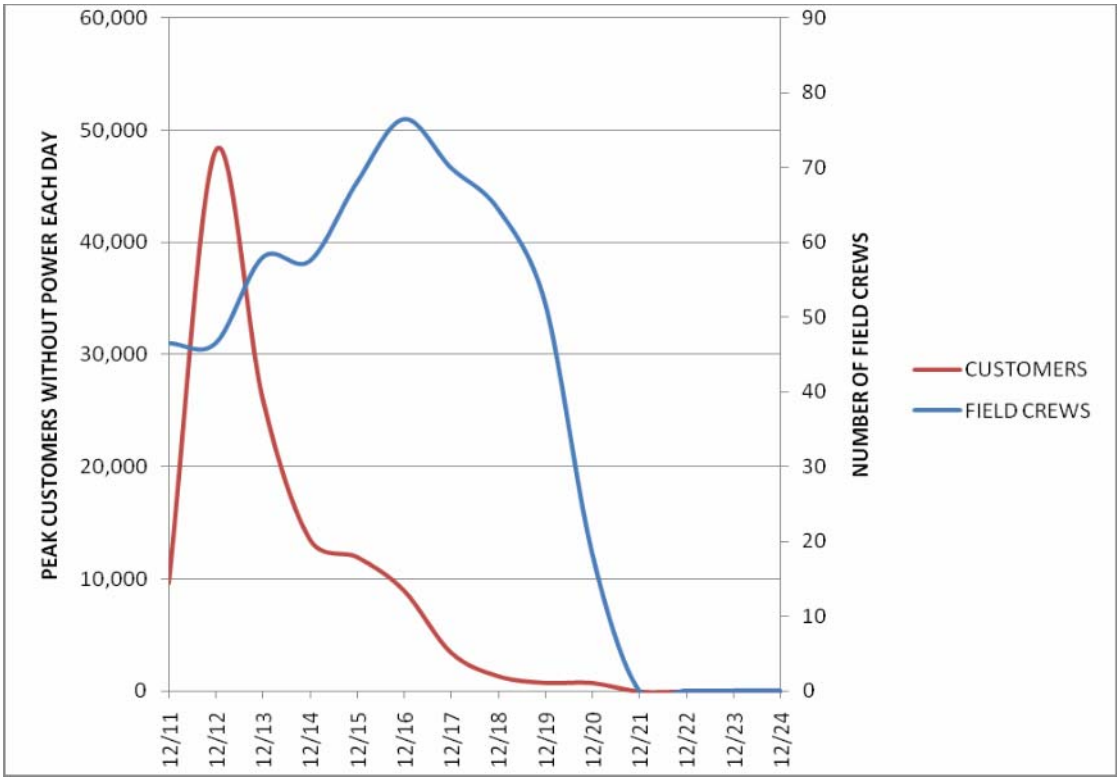

Figure II-13 – Graph showing the number of NHEC field crews and customers without power following the ice storm.[73] [74]

The curves on the above graph indicate that the maximum number of crews working on NHEC's system occurred on Day 6, December 16, four days after the peak number of customers without power. The field crew graph shows a slower than desirable rate of the ramp-up of crew numbers and this is reflected in a flattening of the customer graph after December 14, when the number of crews held steady and then began to increase again on December 15. This is an indication that NHEC would have benefitted by having more crews working after December 14 and the slow increase in the number of crews working hampered the speed of restoration. As discussed further in Conclusion 5, if the line and tree crews had been put to work sooner, it is likely that restoration could have been completed earlier.

Conclusion: At Unitil, the restoration strategy during the ice storm was inappropriate.

The restoration strategy at Unitil[75] during the December 2008 ice storm was to attempt to get all customers restored at the same time. The other three utilities try to restore customers as rapidly as possible which means that some customers who are more isolated or on systems with more damage, may wait longer for power to return. The philosophy of Unitil may impede the rate at which customers are restored. This may be an issue in making the customer curve in Figure

[73] NHEC. (June 22, 2009). Data Response CO0007. NEI.
[74] NHEC. (February 19, 2009). Data Response STAFF 1-22. NHPUC.
[75] Unitil. (February 27, 2009). Data Response STAFF 1-47. NHPUC.

II-11 shallower at the beginning of the storm than those of Figure II-12 and Figure II-13 since the rate of restoration is slower. If all customers were indeed restored at the same time the graph would be horizontal until the final day at which point it would be vertical. A philosophy of restoring the largest number of customers as quickly as possible would make the customer graphs in Figure II-11 steeper and more exponential, and Unitil's philosophy of restoring all customers at once would make this graph less steep and more horizontal.

The fact that all of the customer graphs including Unitil's show a relatively steep exponential shape indicates that the philosophy of Unitil is impractical to achieve and probably an inappropriate goal. To achieve this goal would mean that some customers who could be restored quickly with little effort may have to wait until resources have also restored more heavily damaged customers.

The de-facto result of the restoration efforts by all the utilities in this storm is that many customers were restored at the beginning of the effort. Customers receiving more damage or who were more remote and difficult to reach waited longer, which is why the customer curves in the graphs flatten out at the ends. It is clear from the graphs that Unitil's philosophy of trying to restore all customers at the same time was not carried through even though they may have tried. In reality it would be impractical to restore all customers at the same time. A true concerted effort to do so would have extended the outage for all but a handful of customers.

While this goal of trying to restore all customers at the same time may represent a means of being fair to all customers (i.e., everyone gets served at the same time), NEI believes that this strategy was inappropriate and may have led Unitil to improperly allocate its resources. As a result, its restoration effort was adversely impacted because the system area with the most damage rather than the most customers was assigned the greatest amount of resources. If any area completed restoration before others, those resources were then assigned to other locations.[76]

As shown in Table II-10, Unitil's Massachusetts territory received what appears to be an inordinate number of crews relative to the number of customers without power. Although 100% of the customers in Unitil's Massachusetts area were without power, a larger number of Unitil's customers in the New Hampshire area were without power. Since the damage in Massachusetts was known to be more severe it would be expected that restoration efforts would be more effective and more of Unitil's customers would be restored at a faster rate by assigning resources to the New Hampshire area first even though this would certainly have delayed restoring the customers in Massachusetts. This would have steepened the slope of the customer graph in Figure II-11 immediately after restoration began while flattening the tail of the graph at the end of the restoration effort. We believe that a more appropriate and effective strategy is to attempt to restore service to the largest number of customers as rapidly as possible as was done by PSNH, National Grid, and NHEC.

[76] Unitil. (March 25, 2009). Background, The December 2008 Ice Storm and Unitil's Response, pg 1.

Table II-10 – The Unitil balance sheet showing the resources deployed in MA and NH.[77]

	Massachusetts	New Hampshire
Customers Without Power At Peak	28,496	39,746
Maximum Number of Crews Assigned	299	84
Customer Outages Per Crews Assigned (Max.)	95.3	473.2
Average Daily Number of Crews Assigned	100	36
Customer Outages Per Crew Assigned (Avg.)	285	1104
Feet of Wire Replaced	192,729	93,012
Feet of Wire Replaced Per Crew Assigned (Avg.)	1927	2584
New Poles Set	212	67
New Poles Set Per Crew Assigned (Avg.)	2.12	1.86
Transformers replaced	170	71
Transformers Replaced Per Crew Assigned (Avg.)	1.70	1.97
Splices	6,000	8,000
Splices Per Crew Assigned (Avg.)	60	222.2
Estimated Storm Related Expenditures [78]	$15,298,624.00	$3,196,665.00

Recommendation No. 1: Unitil should adopt a storm restoration strategy that is based on achieving restoration for the largest number of customers in the least amount of time.

- Unitil should allocate storm restoration resources among communities or circuits within the service area or between non-contiguous parts of the service territory based upon the number of customers experiencing outages. Crews should not be assigned purely determined by the extent of the damage; rather, the restoration strategy should be targeted at restoring service to large numbers of customers as expeditiously as possible. Crews should be focused on tasks that will provide the greatest pay-off in terms of overall customers restored in the least amount of time.

[77] Unitil. (March 25, 2009). Unitil's Response to the 2008 Ice Storm, Self-Assessment Report pg 16.
Note: Although differences are not significant, some of this data does not match data supplied in information requests submitted by the NPUC Staff and NEI.
[78] Unitil. (July 21, 2009). Fitchburg Gas and Electric Company 2008 Ice Storm Costs As of July 21, 2009. Docket D.P.U. 09-Exhibit 1.

Conclusion: Initial damage assessments were slow or nonexistent and the processes used to develop and disseminate accurate estimates of service restoration dates and times were not effective.

In response to a major storm utilities normally conduct an initial assessment to determine the extent of damage to the system and to decide on the number of crews that will be required to restore service. Trained damage assessors are utilized to perform the initial damage assessment, and provide regular updates as the restoration effort proceeds. These assessors are typically in-house employees with long experience dealing with the construction methods and practices used by the utility. The information collected by damage assessors is usually combined with that from other sources, such as trouble reports from customers, data from the outage management system (if such a system exists) and reports from government officials. In addition to helping to plan and organize the restoration effort, damage assessments are also used to inform customers and communities of estimated restoration times.

In recent years it has become increasingly important for utilities to develop and communicate estimated restoration times (ETRs) following storms, because customers are no longer satisfied to simply wait until service is restored. Businesses must decide when to ask employees to report for work and families need to know if they should rent hotel or motel rooms, relocate to emergency shelters or stay with relatives until the power is back on. Municipalities and critical care facilities must plan for maintenance and refueling of emergency generators. For most utilities developing and communicating ETRs is a time-consuming and labor intensive activity that does little to actually contribute to the rate of restoration effort. Nonetheless, it is a critical part of the emergency response process since public demand for ETRs is high and is not dependent upon whether the information contributes to the restoration effort.

PSNH

On the morning of Day 2, Friday, December 12, after the storm had passed, PSNH realized it had a serious problem. Based on incoming trouble reports from customers it was apparent that damage to the system was far greater than had been anticipated. Company personnel responsible for managing the restoration effort expected that an initial damage assessment would take several days. Customer service representatives were told by customer service managers via e-mail to stop providing customers with the standard three hour restoration time and begin telling customers to plan for an extended outage and that the damage assessment had not yet been completed so exact restoration times could not be provided.[79] [80] [81] [82] PSNH also informed

[79] Hybsch, R. Director of Customer Operations, PSNH. Interview by Joyner, M. June 4, 2009.
[80] Kellerman, G. Manager-Operations Support, PSNH. Interview by Joyner, M. June 4, 2009.
[81] Comer, D. Director of Call Center Relations Experience, PSNH. Interview by Joyner, M. June 4, 2009.
[82] Fanelli, M. Manager-System Restoration and Emergency Preparedness, PSNH. Interview by Joyner, M. June 4, 2009.

customers that priority during the restoration effort was being given to hospitals, nursing homes, police and fire facilities, schools (for shelters), etc., and until those were completed, the company would not be able to restore most residential customers.[83]

At 6:00 a.m. on Day 2, Friday, December 12, PSNH initially deployed 141 in-house damage assessors to various locations throughout the state. This number increased as additional personnel became available. The company also called upon retired employees with experience who were qualified to work as damage assessors. At PSNH, during significant storm events, employees initially perform their primary storm assignments but are often moved from one position to another as the situation demands and based on the employee's skill set. Thus, the exact number of damage assessors PSNH used at any given time is difficult to determine.[84] Nonetheless, as the restoration effort continued, PSNH realized it could have used more damage assessment personnel earlier in the process.[85] [86] [87] [88]

Beginning the morning of Day 2, Friday, December 12, PSNH conducted regular damage assessments in each regional work center. As restoration work proceeded, PSNH compiled damage assessments on a daily basis and held conference calls twice daily to discuss restoration progress. At the end of each day, damage assessment documents were brought into the PSNH EOC for review. Estimated time for restoration (ETR) reports were first prepared for each community late on the Day 5, Monday, December, 15 and disseminated to customers and the media via a PSA at 8:10 a.m. on Day 6, Tuesday, December 16.[89] These reports were prepared by the EOC from reports of the field damage assessors.

After several days, PSNH began telling customers that line crews and tree crews were working to restore the main line of each circuit. Once each main line was complete, crews would then begin repairs on all of the side taps off of the main lines. Individual service lines from the street to a home that were damaged would likely be among the final problems to be corrected on any given circuit. Restoration times were not provided to customers in these situations.[90]

By Day 6, Tuesday, December 16, PSNH had introduced a system that called for developing restoration estimates by town every evening, based on information received from the field employees during the day. The intent was to estimate the day and time when 95% of each town with outages would be restored. Town lists were updated each night so that by early morning, the customer service representatives (CSRs) would have the new list. These lists were also placed on

[83] PSNH. (March 6, 2009). Data Response STAFF 2-20. NHPUC.
[84] PSNH. (February 2, 2009). Data Response STAFF 1-27. NHPUC.
[85] Hybsch, R. Director of Customer Operations, PSNH. Interview by Joyner, M. June 4, 2009.
[86] Kellerman, G. Manager-Operations Support, PSNH. Interview by Joyner, M. June 4, 2009.
[87] Comer, D. Director of Call Center Relations Experience, PSNH. Interview by Joyner, M. June 4, 2009.
[88] Fanelli, M. Manager-System Restoration and Emergency Preparedness, PSNH. Interview by Joyner, M. June 4, 2009.
[89] PSNH. (March 6, 2009). Data Response Staff 2-20. NHPUC.
[90] PSNH. (March 6, 2009). Data Response Staff 2-20. NHPUC.

the PSNH website.[91] The first such posting was made on the morning of Day 7, Wednesday, December 17, at 11:30 a.m. [92] If it was not yet known when a town would be at the 95% restoration level, customers were advised to plan on at least several more days without power.[93]

The first PSNH Storm ETR Report from Day 6, Tuesday December 16, showed that service had been restored to approximately 28% of the more than 200 towns served by the company. More than 100 towns were expected to be restored on Day 6, Tuesday, December 16, Day 7, Wednesday, December 17, or Day 8, Thursday, December 18. Restoration times were unknown for the remaining 44 towns. The ETR Report for the Day 7, Wednesday, December 17 showed that restoration was complete or had reached 95% completion in 92 towns, almost twice the number for the previous day. Even so, the projected restoration date for 14 towns had been changed to Day 9, Friday, December 19, and the number of unknown restoration dates had increased to more than fifty. On December 18, the number of unknowns had dropped to 31, but the projected restoration dates for fifteen towns had been moved to Day 10, Saturday, December 20. The ETR issued on Day 9, Friday, December 19 showed that almost three-quarters of the towns were at least 95% restored, but restoration dates for seventeen towns had been moved to Day 11, Sunday, December 21, with 34 still unknown. The ETR issued Day 10, Saturday, December 20 showed that six more towns were complete, but estimated dates for ten others had been moved to Day 12, Monday, December 22. The ETR for Day 11, Sunday, December 21 showed projected restoration dates for three towns moved to Day 13, Tuesday, December 23, with 18 towns still unknown.[94] By Day 12, Monday December 22, PSNH customers still without power were being told that the company expected all remaining restoration to be complete by midnight on Day 14, Wednesday, December 24.[95]

Unitil

Unitil's procedure which is communicated to employees in training sessions, calls for an initial damage assessment to begin at the first indication of an impending storm. Based upon the weather forecast, the Director of Electric Operations, along with the affected Electric System Managers, will estimate the potential impact to the energy delivery system. This estimate is based upon prior experience with similar weather patterns. The information is used to predict the volume of anticipated system troubles, including which areas of the system will be affected and the extent to which damage will cause service interruptions. The company will then analyze staffing levels, including both internal and external resources that may be available for restoration.[96]

[91] PSNH. (March 6, 2009). Data Response Staff 2-20. NHPUC.
[92] Knepper, R.. "Re: FW: Clarification." E-mail to Joyner, M. July 1, 2009.
[93] PSNH. (March 6, 2009). Data Response STAFF 2-20. NHPUC.
[94] PSNH. (June 19, 2009). Data Response PS0014. NEI.
[95] PSNH. (March 6, 2009). Data Response Staff 2-20. NHPUC .
[96] Unitil. (February 27, 2009). Data Response STAFF 1-9. NHPUC.

Unitil had a total of 33 in-house personnel performing damage assessment in New Hampshire during the December 2008 ice storm.[97] Efforts were initially focused on sub-transmission facilities and primary distribution circuits. The process was complicated by the fact that many public roadways were impassable and because new damage continued to occur as ice-covered trees and limbs fell onto power lines. As a result, it took about four days to complete the initial damage assessment.[98]

The principal method Unitil used for keeping customers informed during the restoration effort was through Public Service Announcements (PSAs) which were issued in advance of and during the ice storm and the restoration process. PSAs were issued to all news media as well as to community leaders. PSAs were also posted on the company website. Additional information was supplied by conversations with storm restoration personnel when Unitil prepared and updated messages in the company's Integrated Voice Response (IVR) system. All of this information was provided on a regular basis to customer service personnel.[99]

Unitil issued a total of 35 PSAs, beginning with a storm advisory to its customers on Day 1, Thursday, December 11, and ending with a statement on estimated bills on December 29. Mid-day on the Day 4, Sunday, December 14, Unitil began including in the PSAs a table that listed each town served, the number of uncorrected troubles and number of customers interrupted. Specific estimated restoration times were not included, but the PSA did say the company anticipated that restoration efforts would continue for several days.

On the morning of Day 6, Tuesday, December 16, Unitil issued its first PSA that provided an estimated time of restoration. At that time, the total number of Unitil's customers without power in New Hampshire was about 10,500, with 9,628 in the Seacoast area and 902 in Concord. Unitil said it expected to have power restored in the Capital region within 24 hours, with the exception of some service lines serving individual homes. No estimate was provided for the Seacoast region. A message entitled "Statement on Expected Service Restoration Times" was issued at 6:00 p.m. on Day 6, Tuesday, December 16, that reiterated the estimated restoration time for the Capital region and for the first time advised Unitil's customers in the Seacoast region that restoration of service was expected to be complete during the overnight hours of Day 7, Wednesday, December 17. A PSA issued late on Day 9, Friday, December19, indicated that 1,250 customers in the Seacoast region were still without power and advised that all major lines would be in service by the morning of Day 10, Saturday, December 20. On Day 12, Monday, December 22 a PSA reported that only a few dozen service outages still existed in Unitil's New Hampshire service areas. There were eight additional messages sent out, regarding emergency

[97] Unitil. (February 27, 2009). Data Response STAFF 1-27. NHPUC.
[98] Unitil. (March 25, 2009). Unitil's Response to the 2008 Ice Storm, Self-Assessment Report, pg 30.
[99] Unitil. (March 27, 2009). Data Response STAFF 2-15. NHPUC.

shelters, frequently asked questions, a statement from Unitil's Chairman and CEO, and tips for preparing for power restorations.[100]

National Grid

National Grid did not complete a comprehensive initial damage assessment, per se. Rather, the damage assessment process was fluid, and did not result in the production of a single complete list of estimated restoration times for the various parts of the system.[101] [102] With respect to the distribution system, damage assessment included a public safety phase during which available resources were initially focused on identifying the locations of downed wires, so as to de-energize the system where unsafe conditions may exist. Damage assessment was initially conducted with twelve[103] supervisors and on-duty line workers.

National Grid's mutual aid needs were based on man-hours shown in its outage management system (PowerON, by GE), combined with judgment provided by the field managers. Unfortunately, due to the widespread and extreme nature of the damage to the distribution system, the estimated time of restoration feature of PowerOn was disabled very early in the storm. As the restoration effort progressed, damage assessors and line crews were able to project more accurately the expected restoration times for individual neighborhoods and distribution circuits. As estimated restoration days and times became available, that information was added to the outage management system and the company's web site for communication to customers.[104]

National Grid also received help from municipal fire department personnel in assessing storm damage. Fire department personnel helped National Grid to understand the extent of damage in particularly bad areas. This was beneficial in safely getting the most customers back on as soon as possible.

Following the storm, National Grid's goal was to provide information to media and customers that was timely, consistent, and accurate. This was done using press releases and relaying information through their CSR. The information conveyed in these releases throughout the duration of the storm focused on safety, the magnitude of the damage, the magnitude of the restoration effort, and once available, estimated restoration dates and times.

Upon daylight on the morning of Day 2, Friday, December 12, damage assessment teams were operational and were assigned to perform a main line assessment of the circuits that had locked out as a result of the ice damage. That survey consisted of a rapid assessment of the (three-phase) main lines on the impacted feeders. National Grid issued a press release reporting that the ice storm that had swept across eastern New York, Massachusetts, Rhode Island and New

[100] Unitil. (March 27, 2009). Data Response STAFF 2-15. NHPUC.
[101] Demmer, K. Manager Electric Distribution New Hampshire, National Grid. Interview by Joyner, M. June 9, 2009.
[102] Kearns, R. Director Emergency Planning, National Grid. Interview by Joyner, M. June 9, 2009.
[103] National Grid. (February 27, 2009). Data Response STAFF 1-27. NHPUC.
[104] National Grid. (April 1, 2009). New Hampshire, 2008 Ice Storm Report, pg 9.

Hampshire the night before had left more than 500,000 of its customers without power; approximately 24,000 of those customers were in New Hampshire.[105] At peak, 24.164 customers in the company's New Hampshire service area experienced outages, which represented approximately 60% of its customers.[106] The afternoon press release on Day 2 stated that damage assessment surveys were still being conducted, but no specific estimated time of restoration was offered. The company said only that the effort would take several days and perhaps longer.

Beginning on the morning of Day 3, Saturday, December 13, damage assessment progressed to include the entire circuits. That survey consisted of a detailed analysis of all impacted infrastructure.[107] On that day National Grid reported that about 12,000 New Hampshire customers were still out of power and projected that by the night of Day 4, Monday, December 15 all major restoration efforts would be complete with remaining work focused on small pockets of significant damage.[108] Although National Grid continued to make steady progress, as of Day 6, Tuesday, December 16, the company still had more than 2,800 customers without power. No revised estimated restoration times were issued. National Grid's last customer was restored at 10:19 p.m. on Day 8, Thursday, December 18.[109]

NHEC

At NHEC, when a major storm event is being experienced, the affected districts assign trained personnel to assess damage in the field and provide reports to the respective District Supervisor. The initial damage assessment is based primarily on the information collected in the field, but also includes data from the company's outage management system (OMS). In fact, OMS data is normally used as a first good indicator of potential damage which helps to focus the initial damage assessment in the field. The years of experience of the District Supervisors and the Disaster Recovery Executive are also important in completing the assessment and determining the level of restoration resources that will be needed.[110]

NHEC had two communications goals during the December 2008 ice storm. They were to inform the general public about the progress of storm restoration and, when possible, inform members and town officials in the communities that were affected by power outages. NHEC had eight employees dedicated to the customer and community communications effort during the storm. Two of these employees were specifically assigned with contacting town managers and other local officials in the communities affected by power outages. Beginning on Day 5, Monday, December 15, phone calls were made to the Police and Fire Chiefs and Emergency Management personnel of the 17 towns in the NHEC service territory that were without power. From then on, updates were provided several times per day and concluded with the last calls

[105] National Grid. (March 27, 2009). Data Response STAFF 2-15. NHPUC.
[106] National Grid. (June 17, 2009). Data Response NG0020. NEI.
[107] National Grid. (April 1, 2009). New Hampshire, 2008 Ice Storm Report, pg 9.
[108] National Grid. (March 27, 2009). Data Response Staff 2-15. NHPUC.
[109] National Grid. (April 1, 2009). New Hampshire, 2008 Ice Storm Report, pg 10.
[110] NHEC. (February 19, 2009). Data Response STAFF 1-9. NHPUC.

being made on the morning of Day 10, Saturday, December 20. These updates informed town officials of outage street locations and estimated restoration times. In addition, officials had the opportunity on these calls to speak directly with NHEC staff to address any questions or concerns, or call back later using cell phone number that were provided.[111] NHEC also relied on its website and statewide news media to disseminate information relating to power restoration. Within two days of the storm, NHEC began providing restoration updates three times daily. These updates included information from the outage management system and from field assessments provided by the District Supervisors to the Disaster Recover Executive, a senior executive at NHEC who fulfills this role during emergencies. Many of the news media entities posted on their own websites links to outage information provided by NHEC. Local shelters were contacted and updated on power restoration efforts.[112]

When NHEC prepares estimated times of restoration (ETOR's) during outages the following elements are part of the restoration situational status updates:

- Present and forecasted weather conditions
- Line assessment reports, which provide damage and other key information for the deployment and scheduling of crews based on priorities
- Crew availability and road status (primarily road access for restoration efforts)
- Equipment requirements, focusing on equipment deployment and also equipment availability (especially off road equipment)
- Material availability
- The number of continuous days crews have worked restoring power
- The experience of the field supervision and staff in charge[113]

NHEC conducts extensive and ongoing communication with PSNH and National Grid when they experience an outage on the transmission and sub-transmission lines that serve NHEC substations or delivery points. This communication is to determine the estimated restoration times for these transmission outages.[114]

During any outage restoration event, NHEC always strives to provide its customers with the most current and accurate information available, even if that means saying, "We do not know at this time." The level of detail that is provided regarding estimated restoration times is limited by the extent of outage information that is available during the inquiry, status of the restoration effort, the number of crews dispatched, and projected time to restore the system. The information provided includes any and all of the following, if known at the time of the inquiry:

- NHEC is aware of the outage.

[111] NHEC. (July 2, 2009). Data Response CO0009. NEI.
[112] NHEC. (February 19, 2009). Data Response Staff 1-42. NHPUC.
[113] NHEC. (March 24, 2009). Data Response STAFF 2-19. NHPUC.
[114] NHEC. (March 24, 2009). Data Response STAFF 2-19. NHPUC.

- NHEC estimates we will have power restored within "x" amount of time based on the initial/current information provided from the outage management system (OMS).
- A crew or crews have been dispatched and are in route to the outage.
- Crews are at the scene.
- NHEC estimates that power will be restored by "x" time.

NHEC began its initial damage assessment at first light on Day 2, Friday, December 12. Damage assessments of each district were conducted by the District Supervisors. Coverage was focused, based on outage calls from customers. Due to the extensive damage, and the large number of roads closed because of fallen trees, the initial damage assessment took several days to complete.[115] [116] [117]

NHEC issued its first specific estimated restoration time at 9:00 a.m. on Day 6, Tuesday, December 16. By then fewer than 10,000 co-op members were still without power, down from a high of more than 48,000 on Day 2, Friday December 12. NHEC projected that all outages would be restored by the evening of Day 10, Saturday, December 20. NHEC restated that ETR the next morning, Day 7, Wednesday, December 17. At 2:30 p.m. on the Day 7, NHEC issued an update that provided a list of 16 towns with estimated restoration times for each. Service was expected to be restored in four of the towns on Day 8, Thursday, December, three towns on Day 9, Friday, December 19 and the remaining nine on the Day 10, Saturday, December 20. At 6:00 p.m. on Day 10, NHEC reported that at 4:00 p.m. a co-op line crew had restored the last member still in the dark as a result of the ice storm.[118]

Recommendation No. 2: Each electric utility should improve the systems and processes it uses to develop damage assessments and communicate ETRs to customers during storm restoration efforts.

- The electric utilities should adopt a policy requiring that estimated times of restoration following storms be prepared and disseminated to customers within 24 to 48 hours of the event. This will require the dedication of personnel who are directly responsible for the effort of gathering the required information from the field personnel and putting it into a form that can be released to the press, communicated by the utility's customer service personnel, and posted on the utility's web site.
- The electric utilities should modify emergency procedures to assign responsibility for assessing damage and estimating the number of outages expected and projecting the number of resources required for restoration.

[115] Gosney, W. Executive Vice President, NHEC. Interview by Joyner, M., June 17, 2009.
[116] Bakas, J. Vice President of Engineering and Operations, NHEC. Interview by Joyner, M. June 17, 2009.
[117] Lynch, H. Disaster Recovery Executive, NHEC. Interview by Joyner, M. June 17, 2009.
[118] NHEC. (February 19, 2009). Data Response STAFF 1-42. NHPUC.

- The electric utilities should assign damage assessment personnel to specific areas and pre-stage these resources ahead of major events.

Conclusion: All four of the electric utilities underestimated the expected impact of the storm as well as the extent of the resultant damage.

Although advance meteorological warnings provided a relatively accurate description of the approaching storm, when it arrived, the storm turned out to be highly unusual due to the breadth and extent of its damage. While most ice storms in New Hampshire occur along a fairly narrow strip, ranging between 25 and 50 miles, the December 2008 ice storm spread across a range of 75 to 100 miles. The amount of precipitation was extremely large, with much of it falling as freezing rain. Moreover, none of the utilities had ever experienced a storm that caused the total amount of state-wide damage that resulted from the December 2008 ice storm. In terms of power outages, the 2008 ice storm was more significant than PSNH's top four prior storms combined.[119] Only NHEC had experienced a storm which caused more damage to its system in terms of repair costs than the December 1998 ice storm.[120] None of the utilities anticipated the amount of damage they eventually incurred. As a result, the utilities were less than optimally prepared during the early days of the storm. National Grid appeared to begin preparation sooner than the other utilities and this was one reason they were able to restore power to their areas sooner than the other utilities. The other three utilities responded to the approach of the storm in similar ways.

Three of the four New Hampshire electric utilities (all except NHEC) subscribe to professional weather services that provided advance warning of severe weather conditions.[121] [122] [123] [124] In addition to the warnings and reports provided by those services, various weather websites were monitored prior to and during the December 2008 ice storm. PSNH also participated in the New Hampshire Department of Safety, Homeland Security and Emergency Management conference call at 3:00 p.m. on Day 1, Thursday, December 11.[125]

PSNH

As early as Day -2, Tuesday, December 9, the PSNH weather service predicted that a low pressure system would develop and be moving towards the Mid-Atlantic States on Thursday night and then over New England on Friday. A "rain/wintry mix" was expected, with parts of New Hampshire having a chance for moderate to heavy snow and sleet accumulation. Gusty winds were expected on Friday. Ice was first mentioned on Day -1, Wednesday, December 10,

[119] PSNH. (March 25, 2009). New Hampshire Ice Storm 2008: Record Outage, Record Recovery, pg 5.
[120] NHEC. (February 19, 2009). Data Response STAFF 1-49. NHPUC.
[121] Unitil. (February 27, 2009). Data Response STAFF 1-5. NHPUC.
[122] National Grid. (February 27, 2009). Data Response STAFF 1-5. NHPUC.
[123] PSNH. (February 2, 2009). Data Response STAFF 1-5. NHPUC.
[124] NHEC. (February 19, 2009). Data Response STAFF 1-5. NHPUC.
[125] PSNH. (February 2, 2009). Data Response STAFF 1-7. NHPUC.

with accretions in excess of 1/2-inch possible. The greatest threat from heavy ice was expected to be across elevated terrain between 1,000 and 2,000 feet. On the morning of Day 1, Thursday, December 11, the weather forecast summary said significant ice accumulations were possible across southwestern New Hampshire. For PSNH specifically, the forecast called for more than 1 inch of ice. On Thursday evening the forecast called for 1/2 to 1 inch of ice accretion in parts of southern New Hampshire.

Unitil

Unitil's weather service announced a winter storm watch for the utility's New Hampshire service area during the afternoon of Day -1, Wednesday, December 10, saying the potential existed for significant icing due to freezing rain and sleet. The exact track of the storm remained uncertain but would ultimately determine where the most significant icing and snowfall would occur. On Day 1, Thursday, December 11, Unitil issued an Electric System Advisory (public service announcement) to its customers saying that in response to the National Weather Service's winter storm warning and ice storm warning, Unitil personnel and emergency crews had been placed on alert. The advisory went on to say that severe weather conditions might occur later that evening, Day 1, Thursday, December 11 and into Friday, December 12. Customers were advised that the severe weather conditions might interrupt electric service in some areas. Most electrical outages were expected to be for relatively short periods of time; however, the advisory pointed out that severe weather conditions could create substantial damage to the electrical system, and restoration could take an extended period of time.[126]

On the morning of Day 1, Thursday, December 11, Unitil's weather advisory changed to a winter storm warning. Heavy freezing rain accretion was expected to occur with between 1/2 and 1 inch of accumulation. That forecast continued through Thursday afternoon. Late Thursday evening the weather service added that "some areas of Massachusetts, Vermont, and New Hampshire could see another 1 inch of solid ice." By mid-morning, Day 2, Friday, December 12, the storm had exited Unitil's New Hampshire service area, and the forecast changed to milder temperatures with gusty winds up to 25 mph.[127]

National Grid

National Grid began receiving severe weather forecasts as early as Day -3, Monday, December 8. A forecast provided by the weather service at 6:00 a.m. on Day -1, Wednesday, December 10, indicated that sleet and freezing rain might develop across portions of southern Vermont, New Hampshire, and northern Massachusetts that could produce possible significant icing. By early afternoon ice accretion of from 1/2 to 3/4 inch and possibly more was predicted as far north as Laconia, New Hampshire. Wind gusts of up to 50 mph were also mentioned as being possible. By late afternoon on the Day -1, Wednesday, December 10, the weather service had high

[126] Unitil. (March 27, 2009). Data Response STAFF 2-15. NHPUC.
[127] Unitil. (February 27, 2009). Data Response STAFF 1-7. NHPUC.

confidence that up to a 1/4 inch of ice would accumulate in National Grid's New Hampshire service area. In the early morning on Day 1, Thursday, December 11, a forecast described as "high confidence" called for more than 1 inch of ice. The early evening and midnight forecasts for ice remained high, though the amount predicted was first reduced to 1/2 to 3/4 inch and then raised to 3/4 to 1 inch. Additional ice accretion on Friday was expected to be light.[128]

NHEC

NHEC does not subscribe to any professional weather forecasting services, having found that weather information could be acquired free via the Internet and other sources such as television and radio. Weather is constantly monitored in the co-op's system control center in Plymouth. In addition to a number of online services that provide an abundance of weather data, the company collects information broadcasted by local news stations, the New England news networks, and the National Weather Service. NHEC did not record any of the weather data before or during the December 2008 ice storm.[129] [130] [131] [132]

Conclusion: The utilities relied too heavily upon local mutual aid agreements, which delayed the process of securing additional resources.

Utilities, whether investor-owned, municipal or cooperative, rarely have sufficient resources to respond to a major storm using just their own people. When major storms hit, utilities rely on a vast network of support contractors and crews from other utilities. Typically the number of restoration personnel deployed by a utility peaks a day or two after a major storm, due to the time it takes to acquire and mobilize the extra workers required to restore power. This extra workforce usually declines as progress is made in restoring outages.

Mutual aid (or assistance) is generally considered the primary means of obtaining extra line crews to assist with storm restoration efforts. Naturally, the first priority of every utility is to restore service to its own customers before releasing crews to other utilities. The Northeast Mutual Assistance Group (NEMAG) was formed in 2007 by a group of New England and Canadian electric utilities to facilitate the sharing of crews among its members in order to aid one another in response to emergencies. Prior to the formation of NEMAG, any utility seeking aid would have to rely upon its own contacts with neighboring utilities. NEMAG now serves as the regional coordinator for allocating resources among electric utilities in the northeast region during storm restorations.[133]

At 8:30 a.m. on Day 1, Thursday, December 11, NEMAG held its first conference call to discuss the forecast and the potential need for mutual aid crews among members. PSNH, Unitil and

[128] National Grid. (February 27, 2009). Data Response STAFF 1-7. NHPUC.
[129] Unitil. (February 27, 2009). Data Response STAFF 1-5,6,7. NHPUC.
[130] National Grid. (February 27, 2009). Data Response STAFF 1-5,6,7.NHPUC.
[131] PSNH. (February 2, 2009). Data Response STAFF 1-5,6,7. NHPUC.
[132] Unitil. (March 27,2009). Data Response STAFF 1-5,6,7. NHPUC.
[133] Unitil, (March 25, 2009). Unitil's Response to the 2008 Ice Storm, Self-Assessment Report, pg 20.

National Grid all participated (NHEC is not a member of NEMAG). On this initial conference call, NEMAG members discussed the weather forecasts, crew availability, and other items according to the NEMAG procedures. It was evident that all of the New England utilities were concerned with the possibility of crew shortages due to the impending storm. Because the storm had not yet materialized, but was expected to move across the region during the evening of December 11, no commitments for mutual assistance were made. National Grid recommended that the list of participants on future calls be expanded to include the New York Mutual Assistance Group and the Mid-Atlantic Mutual Assistance Group.[134] A follow-up conference call was scheduled for 6:00 a.m. on Day 2, Friday, December 12.[135]

During the 6:00 a.m. NEMAG conference call on Day 2, Friday, December 12, participants began with a summary of their individual damage assessments, crew availability, and requirements. The three participating utilities reported ice accretions of up to 1/2 inch with forecasted levels of 1 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 far exceeded the number of available resources among the member utilities since by this time many crews were already allocated to other areas.

PSNH

PSNH opened its emergency operations center at approximately 11:00 p.m. on Day 1, Thursday, December 11. At that time, massive power outages were already beginning to occur in its service area. Like the other utilities, PSNH recognized the magnitude of the storm and immediately put out requests for help from other utilities and contract crews in New England. PSNH participated in all three NEMAG conference calls, requesting 250 crews during the second and third calls.[136] Unfortunately, since the storm was impacting the entire region, many of the contract crews in the area were already committed to helping other utilities. PSNH then expanded its search and began requesting crews from utilities throughout the East Coast, the Midwest, and into Canada. To the extent they were available, PSNH secured hundreds of tree and line crews outside of the mutual aid process.

By Day 4, Sunday, December 14, PSNH had acquired more than 300 additional tree and line crews and by nightfall on Day 4, those crews had helped to restore service to more than half of the PSNH customers who had lost power in the storm. Over the next few days, crews continued to arrive from as far away as Maryland and Ohio. By the Day 8, Thursday December 18, more than 650 line, tree, and service crews were working for PSNH and power had been restored to more than 275,000 PSNH customers (about 86 percent of those affected by the storm. By Day

[134] National Grid, (April 1, 2009). New Hampshire, 2008 Ice Storm Report, pg 7.
[135] Letourneau, R. Director-Electric Operations, Unitil. Interview by Joyner, M. May 19, 2009.
[136] Desbiens, A. "RE: NEI Question-Mutual Aid Crew Request." E-mail to Joyner, M.. July 9, 2009.

11, Sunday, December 21, the last portion of restoration work had been completed in the Seacoast and northern regions of the state, and the PSNH restoration workforce had grown to over 1,000 crews.[137]

PSNH also had access to the resources of its affiliate utility, Connecticut Light and Power (CL&P). This support is recognized and relied upon as part of PSNH's emergency restoration procedures. About sixty of the crews that supplemented the PSNH workforce on Day 4, Sunday, December 14, were from CL&P.[138]

Figure II-14 and Figure II-15 show the number of additional crews requested by PSNH from mutual aid, contractors, or other sources, versus the number that eventually arrived on a daily basis and cumulatively. Ideally, the two curves in Figure II-14 would mirror each other and be slightly offset with the crews arrived curve being slightly to the right of the crews requested curve. This would indicate that all the crews requested did indeed arrive in a timely manner. The space between the curves would indicate the speed with which the crews were supplied, the smaller the space, the faster the supply of crews. If the crews had arrived on the same day they were requested, and all crews requested arrived, the two curves would lie on top of each other.

The curves in the graph in Figure II-15 would also ideally lie on top of each other if crews were requested and supplied on the same day. The space between the curves shows the time lag between request and supply and the curves would mirror each other if all the crews requested were supplied.

The graphs demonstrate that mutual aid crews that were requested were supplied in a timely manner, typically within twenty-four hours. The graphs also suggest that PSNH may have lost valuable restoration time by not ramping up restoration workforces until several days after the storm damage occurred.

[137] PSNH. (February 2, 2009). Data Response STAFF 1-19. NHPUC.
[138] PSNH. (February 2, 2009). Data Response STAFF 1-21. NHPUC.

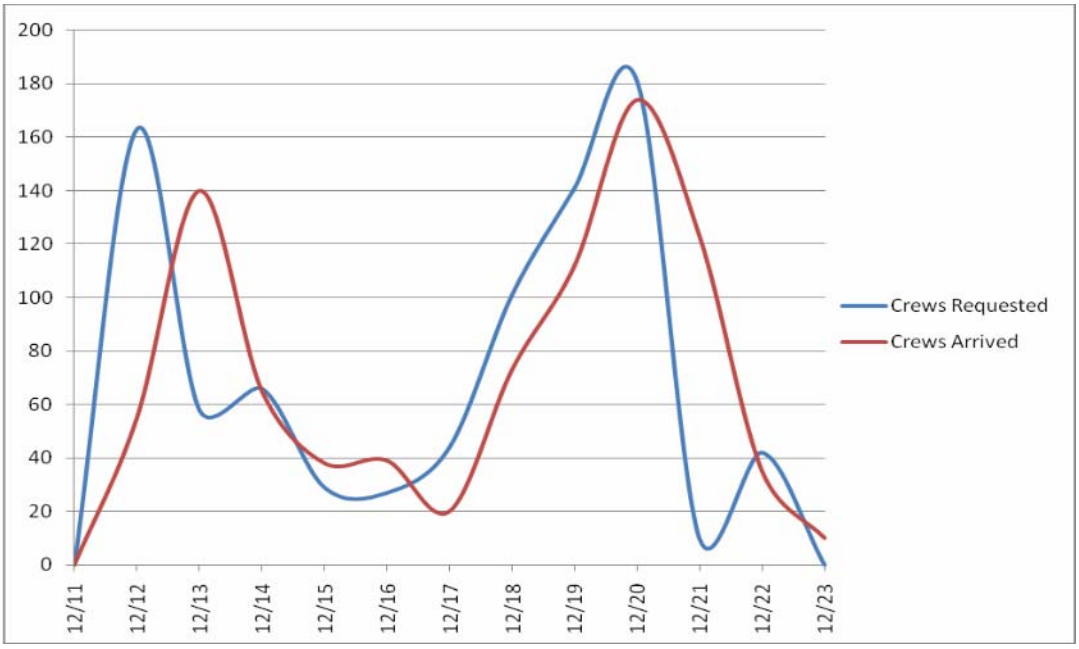

Figure II-14 – Graph showing the number of PSNH crews requested and when they arrived.

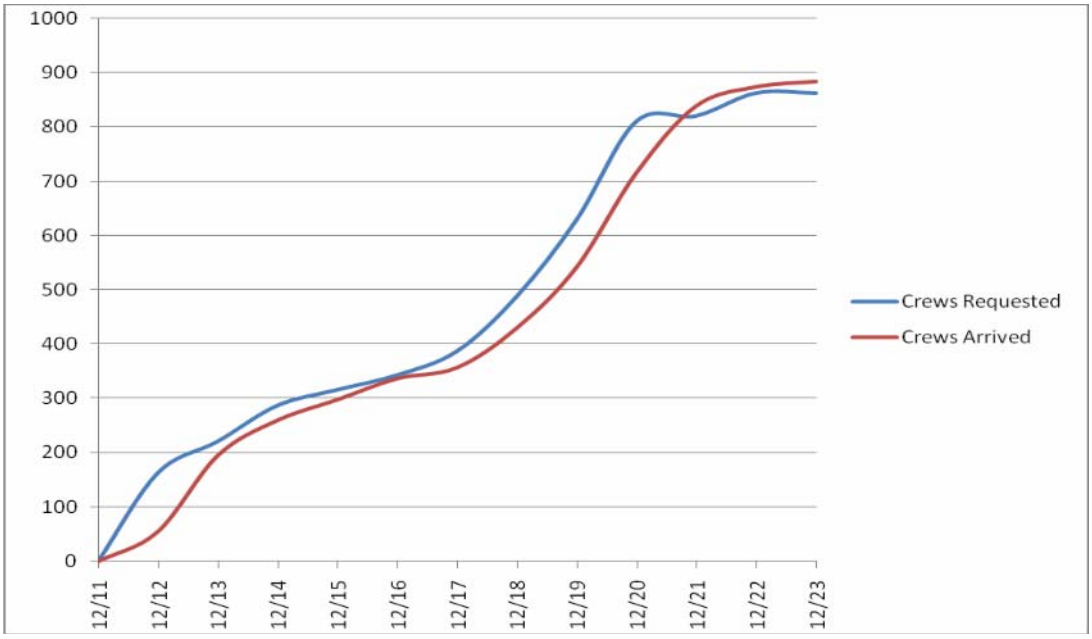

Figure II-15 – Graphs showing the cumulative number of PSNH crews requested and when they arrived.

Unitil

Based on the damage reports that came in during the early morning hours of Day 2, Friday, December 12, it became obvious that Unitil would require an unprecedented amount of assistance from outside crews. During the 6:00 a.m. call on the Day 2, Unitil reported approximately 69,000 customers without power system-wide, including about 38,000 customers

in New Hampshire and all of its Massachusetts customers. Unitil made an initial mutual aid request for 30 crews. Unfortunately, similar to the call the previous morning, no crews were made available to any of the utilities expressing needs.[139] All of the utilities indicated their crews were still needed locally.

A third NEMAG conference call was established for noon on Day 2, Friday, December 12. Unitil's storm boss hoped that the noon call might be more fruitful.[140] During this call, Unitil requested an additional 10 crews, bringing the total number requested to 40. Unitil got commitments from the Philadelphia Electric Company (PECo) for 20 of the needed crews (10 in-house and 10 from a PECo contractor) and another 20 from two contractors released by the Dayton Power and Light Company (DP&L) in Ohio.[141]

Unitil secured six crews from O'Donnell Line Construction Company located in Nashua, NH, also outside of the mutual aid process. That brought the number of additional crews committed to Unitil to 46. Combined with Unitil's 25 existing crews a total of 71 crews were available at that time to work on Unitil's system.[142]

Figure II-16 and Figure II-17 show the number of additional crews requested by Unitil versus the number that eventually arrived on a daily basis and cumulatively. Ideally, the two curves in Figure II-16 would mirror each other and be slightly offset with the crews arrived curve being slightly to the right of the crews requested curve. This would indicate that all the crews requested did indeed arrive. The space between the curves would indicate the speed with which the crews were supplied, the smaller the space, the faster the supply of crews. If the crews had arrived on the same day they were requested, and all crews requested arrived, the two curves would lie on top of each other.

The curves in the graph in Figure II-17 would also ideally lie on top of each other if crews were requested and supplied on the same day. The space between the curves shows the time lag between request and supply and the curves would mirror each other if all the crews requested were supplied.

The graphs demonstrate that in Unitil's case, the mutual aid crews that were requested were not supplied until nearly Day 6, Tuesday, December 16. The graphs also suggest that Unitil may have lost valuable restoration time by not ramping up restoration workforces until several days after the storm damage occurred.

[139] Unitil. (March 25, 2009). Unitil's Response to the 2008 Ice Storm, Self-Assessment Report, pg 21.
[140] Letourneau, R. Director-Electric Opeations, Unitil. Interview by Joyner, M. May 19, 2009.
[141] Unitil. (March 25, 2009). Unitil's Response to the 2008 Ice Storm, Self-Assessment Report, pg 21.
[142] Unitil. (March 25, 2009). Unitil's Response to the 2008 Ice Storm, Self-Assessment Report, pg 21.

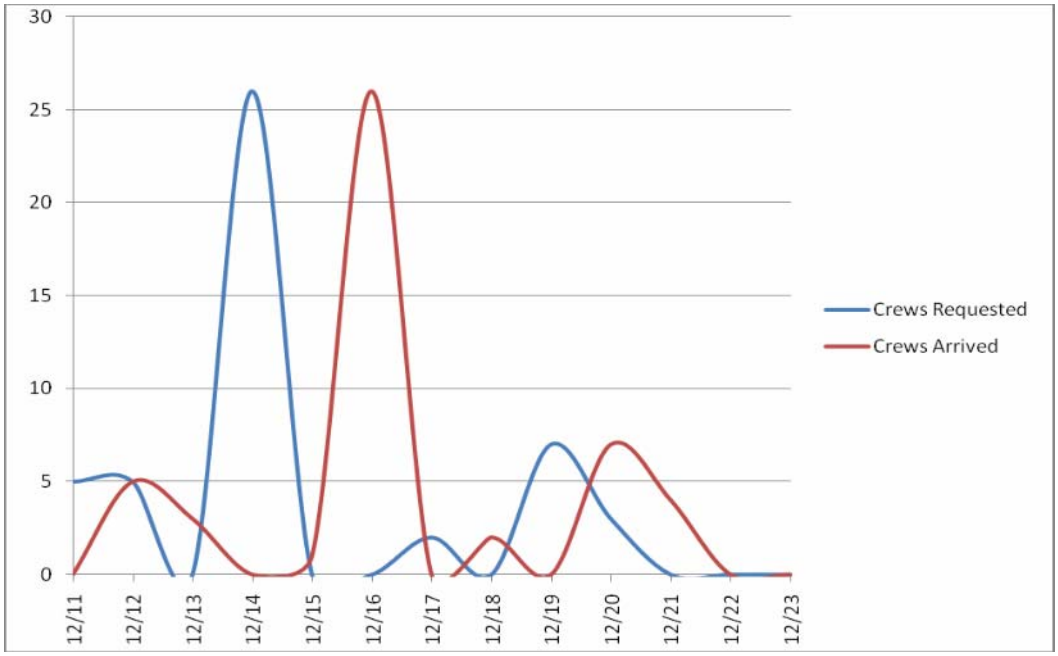

Figure II-16 – Graph showing the number of Unitil crews requested and when they arrived.

Figure II-17 – Graph showing the cumulative number of Unitil crews requested and when they arrived.

National Grid

National Grid also participated on the 6:00 a.m. call on Day 2, Friday December 12, and reported 250,000 customer outages in its New England service area and requested a large number of mutual assistance crews. Other utilities responded with estimates ranging from only a few thousand interruptions, to tens of thousands of customer interruptions. Participants on the call anticipated that these estimates would increase as the storm lingered. As a result, National Grid continued to request resources from mutual assistance utilities.[143]

National Grid reported a peak of over 500,000 customer interruptions, with more than 24,000 in New Hampshire. The mutual assistance resources National Grid acquired for its New England region via the noon call on Day 2, Friday, December 12, included crews from utilities in Ohio, Virginia, Indiana, Delaware and Maryland, all outside of NEMAG. National Grid was also promised assistance from line contractors located in Indiana, Michigan, North Carolina, Ohio, Pennsylvania, Tennessee, and Virginia.[144]

At the conclusion of the noon call the NEMAG process had achieved its purpose of supplying the requested crews and no further calls were scheduled. Although no further NEMAG calls were held once the available resources were assigned, the impacted utilities remained in contact with one another as their respective restoration efforts progressed. With this on-going communication, National Grid requested additional resources from the Mid-Atlantic Mutual Assistance Group on Day 4, Sunday, December 14. Baltimore Gas & Electric (Maryland) and Public Service Enterprise Group (New Jersey) responded to the mutual assistance request with a number of internal line crews.[145]

Figure II-18 and Figure II-19 show the number of additional crews requested by National Grid versus the number that eventually arrived on a daily basis and cumulatively. Ideally, the two curves in Figure II-18 would mirror each other and be slightly offset with the crews arrived curve being slightly to the right of the crews requested curve. This would indicate that all the crews requested did indeed arrive. The space between the curves would indicate the speed with which the crews were supplied, the smaller the space, the faster the supply of crews. If the crews had arrived on the same day they were requested, and all crews requested arrived, the two curves would lie on top of each other.

The curves in the graph in Figure II-19 would also ideally lie on top of each other if crews were requested and supplied on the same day. The space between the curves shows the time lag between request and supply and the curves would mirror each other if all the crews requested were supplied.

[143] National Grid. (February 27, 2009). Data Response STAFF 1-20. NHPUC.
[144] National Grid. (February 27, 2009). Data Response STAFF 1-20. NHPUC.
[145] National Grid. (2-27-09). Data Response Staff 1-20.NHPUC.

The graphs demonstrate that mutual aid crews that were requested were supplied in a timely manner to National Grid, typically within twenty-four hours. The graphs also suggest that National Grid requested crews more quickly than the other utilities which probably contributed to being able to restore power to its service area before the other utilities.

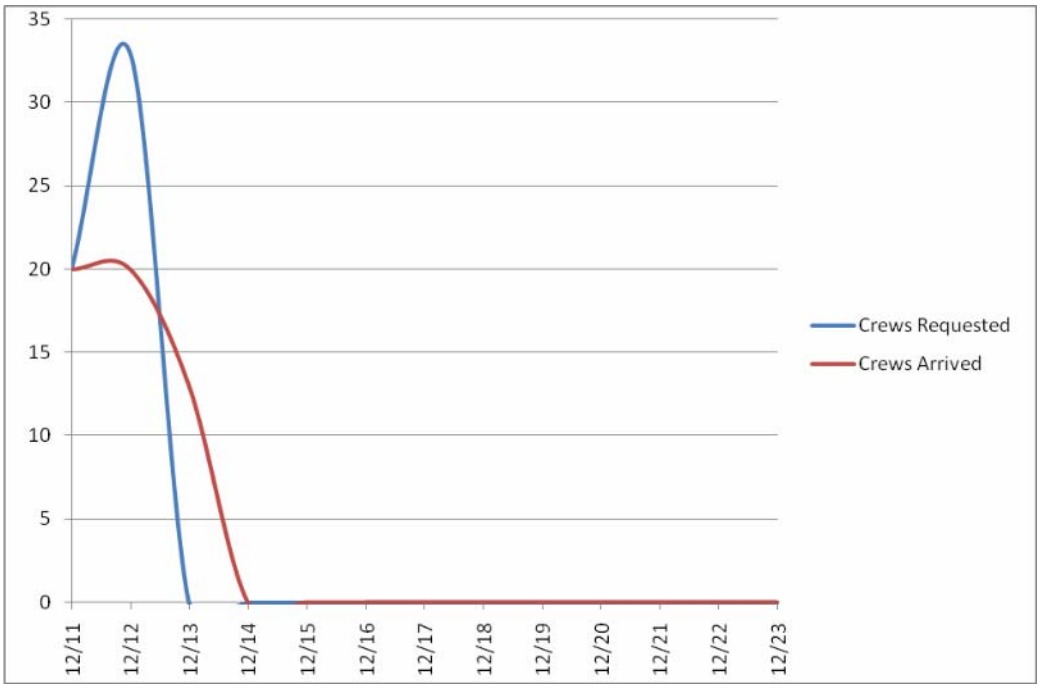

Figure II-18 – Graph showing the number of National Grid crews requested and when they arrived.

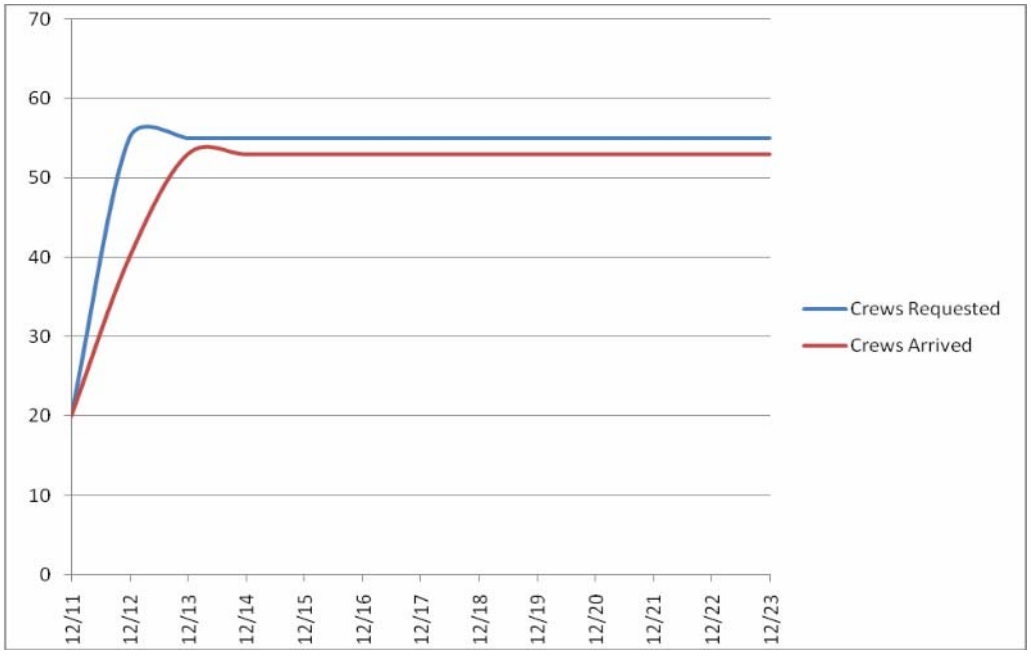

Figure II-19 – Graph showing the cumulative number of National Grid crews requested and when they arrived.

NHEC

NHEC's emergency operations center was staffed by and activated by 9:00 p.m. on Day 1, Thursday, December 11. Requests were immediately issued for extra line and tree crews from contractors working on NHEC's system. Contract line and tree crews that had been on standby were activated. On the morning of the Day 2, Friday, December 12, a request was sent to all other line contractors on NHEC's approved list; however, none were available. Additional contract tree crews were procured, but their projected arrival times varied because of the unfavorable road conditions.[146]

A call to the Northeast Public Power Association (NEPPA) for mutual aid was unsuccessful. NEPPA is an organization for electric cooperatives and municipalities that is the counterpart of NEMAG for investor owned utilities. A utility will generally belong to one or the other depending upon the type of utility, co-op, municipal, or investor owned, but usually will not belong to both organizations. NEPPA is the organization that NHEC would look to for mutual aid.

The extent of damages experienced by the companies that comprise NEPPA was such that all of their crews were needed locally. Calls for assistance continued throughout Day 2, Friday, December 12, with positive responses from three cooperatives in New York, two in Vermont and one in Maine. One of the crews from those six cooperatives arrived and began working the afternoon of Day 2, Friday, December 12. The rest started Day 3, Saturday, December 13, with the exception of one that started the afternoon of Day 4, Sunday, December 14. Nonetheless, field assessments that were being returned to the district supervisors on Friday and Saturday indicated that even more line crews would be needed to expedite the restoration process. Contact was then made with the Pennsylvania Rural Electric Association and 6 more crews started on the morning of Day 4, Sunday, December 14. All of the mutual aid crews requested by NHEC were working on the co-op's lines by the morning of Day 5, Monday, December 15.[147]

Figure II-20 and Figure II-21 show the number of additional crews requested by NHEC versus the number that eventually arrived on a daily basis and cumulatively. Ideally, the two curves in Figure II-20 would mirror each other and be slightly offset with the crews arrived curve being slightly to the right of the crews requested curve. This would indicate that all the crews requested did indeed arrive. The space between the curves would indicate the speed with which the crews were supplied, the shorter the space, the faster the supply of crews. If the crews had arrived on the same day they were requested, and all crews requested arrived, the two curves would lie on top of each other.

The curves in the graph in Figure II-21 would also ideally lie on top of each other if crews were requested and supplied on the same day. The space between the curves shows the time lag

[146] NHEC. (February 19, 2009). Data Response STAFF 1-20. NHPUC.
[147] NHEC. (February 19, 2009). Data Response STAFF 1-20. NHPUC.

between request and supply and the curves would mirror each other if all the crews requested were supplied.

The graphs demonstrate that mutual aid crews that were requested were supplied in a timely manner to NHEC, typically within twenty-four hours.

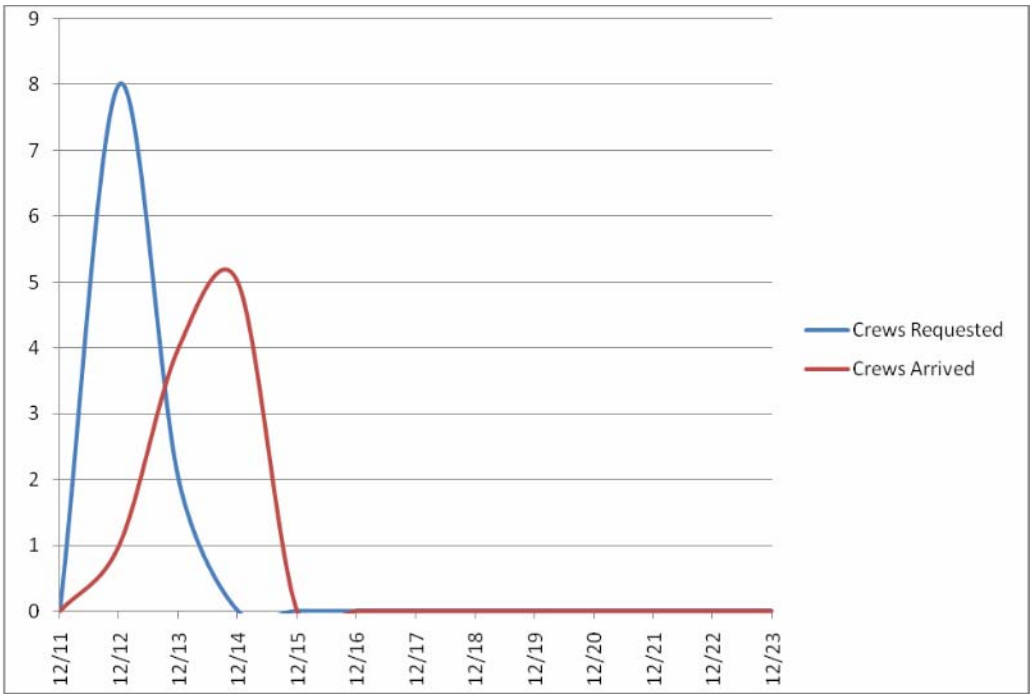

Figure II-20 – Graph showing the number of NHEC crews requested and when they arrived.

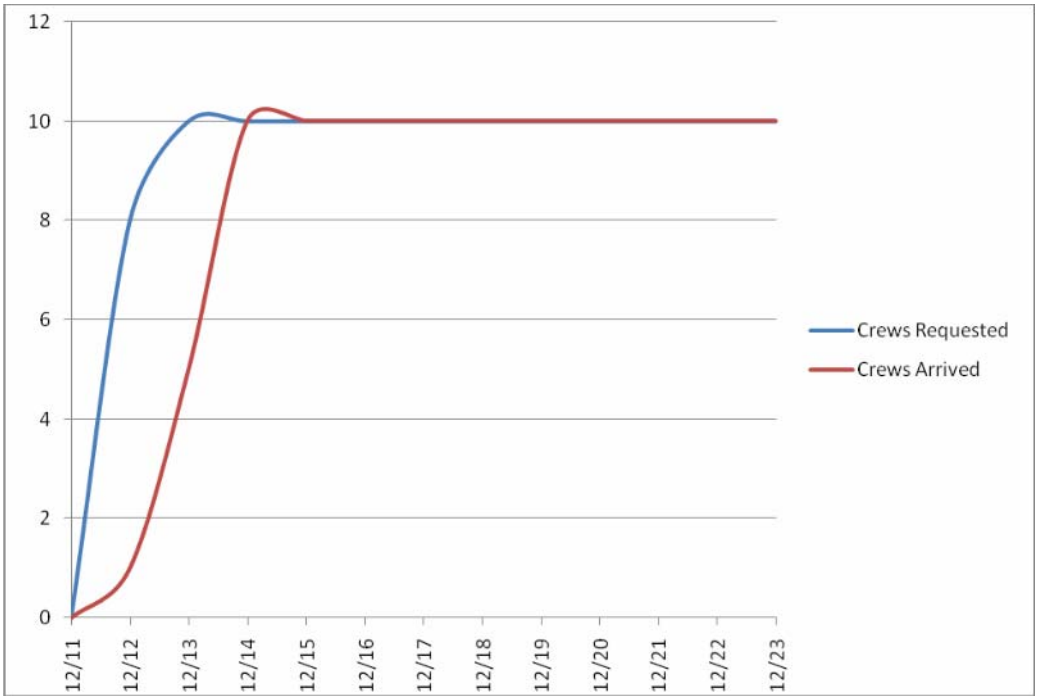

Figure II-21 – Graph showing the cumulative number of NHEC crews requested and when they arrived.

Recommendation No. 3: Each electric utility should adopt storm restoration procedures that require the process of procuring additional crews to begin at the first indication of an impending storm and include utilities and contractors beyond the local area.

- The electric utilities should continue to maintain their existing mutual aid agreements with NEMAG and NEPPA for use in future storm restoration efforts.
- The electric utilities should maintain, or expand upon, existing agreements with local line and tree contractors.
- The electric utilities should develop mutual aid agreements with utilities and contractors outside the New England region.
- The electric utilities should implement storm restoration procedures that call for expanding the search for assistance crews outside the local area at the earliest indication that a storm may potentially result in damages that exceed the capacity of restoration resources in the local area.

Conclusion: Communications with state and municipal government officials and emergency response agencies were mostly ineffective. None of the utilities provided details or responded in a timely basis when specific inquiries were made.

Any utility's response to a major storm includes more than the field work required to restore service to customers who have experienced outages. It also includes establishing and maintaining communications with the news media, government officials, emergency response agencies, and customers in the affected communities. These communications are essential in order to provide warnings of an impending storm, as well as instructions regarding safety and what the public should do during a power outage. Utilities must coordinate restoration efforts with local fire, police and public works departments in order to complete repairs safely and efficiently.

In recent years communicating estimated restoration times has become increasingly important, as customers are no longer satisfied to simply wait until service is restored. Businesses must decide when to ask employees to report for work and families need to know if they should find shelters or travel to other locations until the power is back on. The modern global business environment leaves little room for businesses to handle the impacts that power outages might have on their bottom line. Public safety officials must make important decisions regarding their emergency efforts, school closings, and shelter openings, and depend on accurate restoration times for specific locations for planning purposes and resource deployment.

PSNH

In accordance with its Emergency Response Plan, communications efforts at PSNH were coordinated by the Communications Chief. During the 13-day restoration effort, at least one of four designated Communications Chiefs was stationed in the EOC at all times. A total of 28 PSNH employees were dedicated to public communications during the storm restoration effort. Of these 28 employees, 12 were embedded in local communities in order to be better able to respond directly to municipal needs.[148]

Starting at 4:30 a.m. on Day 2, Friday, December 12, PSNH began issuing regular, proactive updates in order to keep the public as informed and safe as possible during the storm restoration effort. Updates were issued to customers and community officials through e-mail and were also posted on PSNH's website. PSNH continued issuing these updates until 5:00 p.m. on Day 14, Wednesday, December 24, the day on which its last customer was restored. These updates reflected the best information available at the time.[149]

To help facilitate communication with the State, PSNH employees were assigned to provide around-the-clock information to the Division of Homeland Security and Emergency Management and the NHPUC. PSNH officers and senior managers also participated in planning and reporting sessions with Governor Lynch, NHPUC Chairman Getz, and Safety Division Director Knepper. At the community level, PSNH employees provided regular updates to municipal officials and emergency response organizations. In the hardest-hit communities, PSNH placed employees in the municipal Emergency Operations Centers in order to meet the communities' need for more detailed, up-to-the-minute information.[150]

As soon as reliable information was confirmed from the field, PSNH began publishing restoration estimates for each town. Information for each community was gathered directly from the appropriate personnel in the field each day in order to ensure that estimates were accurate. Unfortunately, PSNH was late in implementing a process for developing restoration estimates for each town. ETRs for each community were first prepared late on Day 5, Monday, December 15 and were not disseminated to customers and the media until the morning of Day 6, Tuesday, December 16.[151]

In addition to traditional information outlets, PSNH also used a Web-based tool called "Twitter" to send and receive short bursts of information via the Internet and cell phones. Within days of the storm, the number of subscribers "following" PSNH's Twitter posts increased from 100 to about 1,900. Many subscribers found PSNH's posts especially useful since they did not have electricity, but they were able get information on their cellular telephones via Twitter.[152]

[148] PSNH. (February 2, 2009). Data Response STAFF 1-42. NHPUC.
[149] PSNH. (February 2, 20092-2-09). Data Response STAFF 1-42. NHPUC.
[150] PSNH. (February 2, 2009). Data Response STAFF 1-42. NHPUC.
[151] PSNH. (March 6, 2009). Data Response STAFF 2-20. NHPUC.
[152] PSNH. (February 2, 2009). Data Response STAFF 1-42. NHPUC.

PSNH also produced and posted on the internet a total of six videos that outlined the extent of the damage and what the company was doing. A podcast was posted to the Internet, featuring a Plymouth State University professor of meteorology explaining why the storm was so devastating and how it differed from previous storms. PSNH also provided on the Internet a means of sharing storm-related photographs by the company and customers. Throughout the restoration effort, PSNH used a secondary website, psnhnews.com, to aggregate all available information, including links to the social media sites.

Unitil

Prior to and during the 2008 ice storm, Unitil relied upon public service announcements (PSAs) to provide information about the storm and restoration efforts to its customers and community officials. The first PSA was distributed to company employees, news media, emergency response agencies, and government officials on Day 1, Thursday, December 11 at 1:15 p.m. This PSA provided toll-free numbers for Unitil, advised customers of supplies that would help them endure a power outage, and provided a forecast of anticipated weather conditions. Subsequent PSAs were issued up to five times per day and contained additional information such as the number of customers still without power.[153] Eventually PSAs also contained some indication of expected restoration times, although these were not published until the morning of Day 6, Tuesday, December 16.[154]

Unitil personnel received hundreds of calls and messages from public officials and from the media, and made efforts to respond to every one as quickly as possible and with the best information available. However, 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. Moreover, 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.[155]

On Day 8, Thursday, December 18, a full week after the storm, when customers became increasingly frustrated, Unitil met with the chiefs of police of the thirteen seacoast communities to discuss opportunities to improve communication. Unitil had become concerned with the safety and welfare of line crews and field workers and sought assistance from local police to protect them from disgruntled customers. The outcome of that meeting was that Unitil implemented twice daily conference calls with emergency officials. The first was to provide an update of the plan for the day, including restoration objectives and locations where crews were expected to be working; the second call was to review the day's progress and discuss priorities

[153] Unitil. (February 27, 2009). Data Response STAFF 1-42. NHPUC.
[154] Unitil. (March 27, 2009). Data Response STAFF 2-15. NHPUC.
[155] Unitil. (February 27, 2009). Data Response STAFF 1-42. NHPUC.

for the next day. This process worked well for the remainder of the ice storm and has become a standard operating procedure for future storms.[156]

Rumor control also proved to be a significant challenge for Unitil during the restoration process. Every effort was made to immediately dispel incorrect or misleading information. Unitil also had personnel changes and experienced delays in assigning personnel to serve as contact points for communication with public officials. As the customer call center became unable to meet the demands from customers for information due to large call volume, personnel shortages and a lack of accurate data, pressures from local public officials increased significantly. As the restoration period lengthened, customers and public officials sought very specific information about the status of restoration efforts, the locations of crews, and the length of time it would take to restore specific streets or addresses. This type of specific information was generally not available.[157]

National Grid

National Grid's Energy Solutions Services department was responsible for communicating with state and local public officials during the December 2008 ice storm. At least four people in the department were dedicated to communicating with New Hampshire officials, including the Public Utilities Commission, Governor's office, and the Town of Salem Emergency Operation Center. This group used various forms of communication during the storm, such as:

- Notifying officials that a dedicated phone line was activated for communicating with municipal officials
- Hosting conference calls for public officials
- Face-to-face visits between Company personnel and local officials
- Proactive outreach to communities on a daily basis
- Follow up meetings with police and fire officials

At 6:00 a.m. on Day 2, Friday, December 12, the Municipal Room in North Andover, Massachusetts was activated and readied to accept calls from the southern communities of National Grid's New Hampshire service territory – Derry, Pelham, Salem, and Windham. A letter faxed to police, fire, and other public officials provided the direct phone number and the "wire-down" number. This was followed up with a phone call to each community asking if they received the faxed information and that they understood that the municipal phone line was activated.

National Grid also conducted frequent conference calls with public officials during the ice storm. The calls included a high-level overview of available resources, identified problem areas, and provided an estimate as to when power would be restored. Specific questions, such as requests

[156] Unitil. (February 27, 2009). Data Response STAFF 1-42. NHPUC.

[157] Unitil. (February 27, 2009). Data Response STAFF1-42. NHPUC.

for ETRs for individual locations, were discouraged because of the large number of people participating in the call. Individuals with specific questions were encouraged to call the number designated for communicating with municipal officials. Five daily conference calls were conducted. National Grid implemented face-to-face visits with communities that had large numbers of customers interrupted, on Day 4, Sunday, December 14. By that time in the restoration process, National Grid had mostly completed its damage assessment of the impacted areas. Representatives from both the Energy Solutions Services department and the division also met with police and fire chiefs at the Town of Salem Emergency Operations Center. An update of the Company's restoration activities and priorities was presented to the officials during these face-to-face visits.[158]

NHEC

Following the storm NHEC reached out to its members by placing calls to all emergency shelters to provide updates regarding the outage and projected restoration times as they were determined. NHEC also placed calls to town managers, police & fire chiefs in affected towns to update them on the progress of the restoration effort. Estimated times of restoration were first communicated on Day 5, Monday, December 15, to the seventeen towns still experiencing outages. From then on, daily outreach calls to each of the towns were directed to the appropriate fire and rescue, police or emergency center where one existed. Each town was provided with the latest estimate for the completion of restoration work and a direct call-back phone number should questions arise before the next outreach call. Estimated restoration times were provided to customer service operators, the state news media, and posted on the NHEC website. The NHEC website has a real-time outage map that provides outage information. During the ice storm additional more detailed outage information provided on a web page that was created during the storm.[159]

Recommendation No. 4: Each electric utility should improve procedures for communications with state and municipal government officials and emergency response agencies during major storms.

- The electric utilities should establish specific contact points with state agencies and municipalities to inform and educate customers regarding the company's emergency plans and what to expect during major storms.
- The electric utilities should establish a process for providing accurate and frequent ETRs for each town. This may take the form of web pages or other web-based systems, communications with town officials, and announcements to local media.
- The electric utilities should strengthen liaisons with emergency response agencies and identify areas where communications channels can be enhanced.

[158] National Grid. (April 1, 2009). New Hampshire, 2008 Ice Storm Report, pg 13.
[159] NHEC. (March 25, 2009). Data Response STAFF 2-15.NHPUC.

- The electric utilities should establish a single point of contact for each town throughout the service territory and assign responsibility to that person for providing information from the utility to the town officials or contacts.

Conclusion: All four electric utilities took the initiative to develop lessons learned from the ice storm.

PSNH

In January of 2009, PSNH began a thorough review of events surrounding the December 2008 ice storm. Completed in February, the results were published in mid-April in a confidential document entitled, "Incident Management System Review, December 11, 2008 Ice Storm." The document contains approximately fifteen pages of observations and suggestions for improving the company's methods and procedures for responding to major storms. Roles and responsibilities, organizational strengths, and opportunities are discussed and overall comments are offered regarding the key positions in the incident management system structure. The content is primarily complimentary; however, many significant shortcomings are identified. PSNH needs to follow through with detailed implementation plans for each of the perceived deficiencies.

Unitil

In early January, 2009, Unitil conducted a self-assessment to review the company's performance in restoring power to all of its customers (both in Massachusetts and New Hampshire) following the December 2008 ice storm. The purpose of the review was 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. Unitil's report includes a review of the circumstances that existed prior to the ice storm, restoration activities by all participants in the effort, and actions taken subsequent to storm. The report contains 28 specific recommendations related to Unitil's ability to prepare for major storms and restore outages that occur. The recommendations cover preparations for an impending storm, conducting damage assessment, staffing and training, field 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 supporting organizations to help with storm response. Some of the initiatives have already been implemented.[160] Detailed implementation plans are needed for the remaining recommendations.

National Grid

National Grid conducted three storm critiques that included New Hampshire and addressed the December 2008 ice storm. Each of the storm critiques identified improvement opportunities, which require further investigation and evaluation. National Grid needs to follow through with

[160] Unitil. (February 27, 2009). Data Response STAFF 1-48. NHPUC.

detailed implementation plans for each of the perceived deficiencies identified during those critiques.

NHEC

In early 2009, NHEC had competed storm critiques with key personnel. Lessons learned were communicated throughout the cooperative. New storm restoration improvement initiatives were identified and assigned for further review during more in-depth discussions. They will be included in the emergency restoration plan as appropriate.[161]

Conclusion: Staffing levels at the customer call centers for Unitil, NHEC and PSNH were inadequate to manage all CSR offered calls during the December 2008 ice storm. NHEC, in addition, did not have enough phone lines available to manage the call volume during the storm.

PSNH

PSNH has 238 telephone lines for incoming calls from customers within New Hampshire and another 119 incoming lines for customer calls generated outside the state. These incoming lines can also be used as overflow when the all 238 of the New Hampshire lines are busy. PSNH also has 69 incoming lines that are dedicated to handling Manchester local traffic only. Manchester customers may also have access to the 238 New Hampshire lines by dialing the company's 800 number. PSNH employs Twenty First Century Communications (TFCC) based in Columbus, Ohio, to handle overflow traffic when an usually high volume of calls occurs, such as during the ice storm. TFCC guarantees a certain number of lines will be available to each of its customers. If other TFCC customers are not using their lines, their lines are also available to PSNH.[162] For approximately one hour on Day 2, Friday, December 12, when call volume exceeded PSNH's capacity, customer calls were routed to TFCC.[163]

PSNH (NUSCO) employs about 62 customer service representatives (CSRs) during normal weekday hours to handle all calls both in New Hampshire and outside New Hampshire. The average peak staffing for the Manchester call center that handle PSNH calls is 45 employees. Actual staffing varies depending upon the particular time of day and day of the week. Staffing levels after hours and on weekends and holidays are substantially lower due to the decreased volume of calls. Peak staffing at the call center during the ice storm varied considerably as shown in Figure II-22. This chart shows staffing levels during the storm as compared with typical staffing levels for those days.

[161] NHEC. (February 19, 2009). Data Response STAFF 1-48. NHPUC.
[162] PSNH. (March 6, 2009). Data Response STAFF 2-9. NHPUC.
[163] PSNH. (March 6, 2009). Data Response STAFF 2-11. NHPUC.

Staffing was commensurate with call volume during the period, with the exception of Day 2, Friday, December 12; Day 10, Saturday, December 20; and day 11, Sunday, December 21.[164] Figure II-23 shows the call volume each day compared to the normal call volume on that day of the week. It may be seen that on Day 2, Friday, December 12, call volume was about twice as high as any other day during the storm, yet call center staffing levels were only slightly above normal. It is apparent from these graphs that PSNH did not ramp up staffing in anticipation of customer calls related to the storm. On the Day 10, Saturday, December 20 and Day 11, Sunday, December 21, staffing levels dropped dramatically despite the fact that customer calls were still well above normal levels.

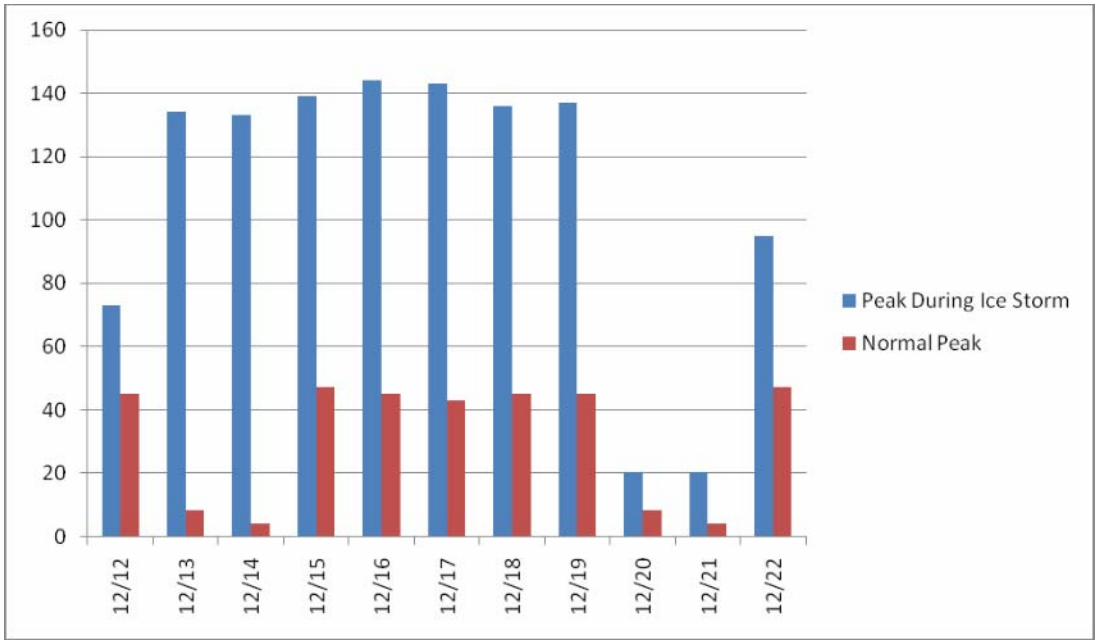

Figure II-22 – Graph showing the PSNH call center staffing levels and normal staffing levels on the days shown.[165]

[164] PSNH. (March 6, 2009). Data Response STAFF 2-9. NHPUC.

[165] PSNH. (March 6, 2009). Data Response STAFF 2-9. NHPUC.

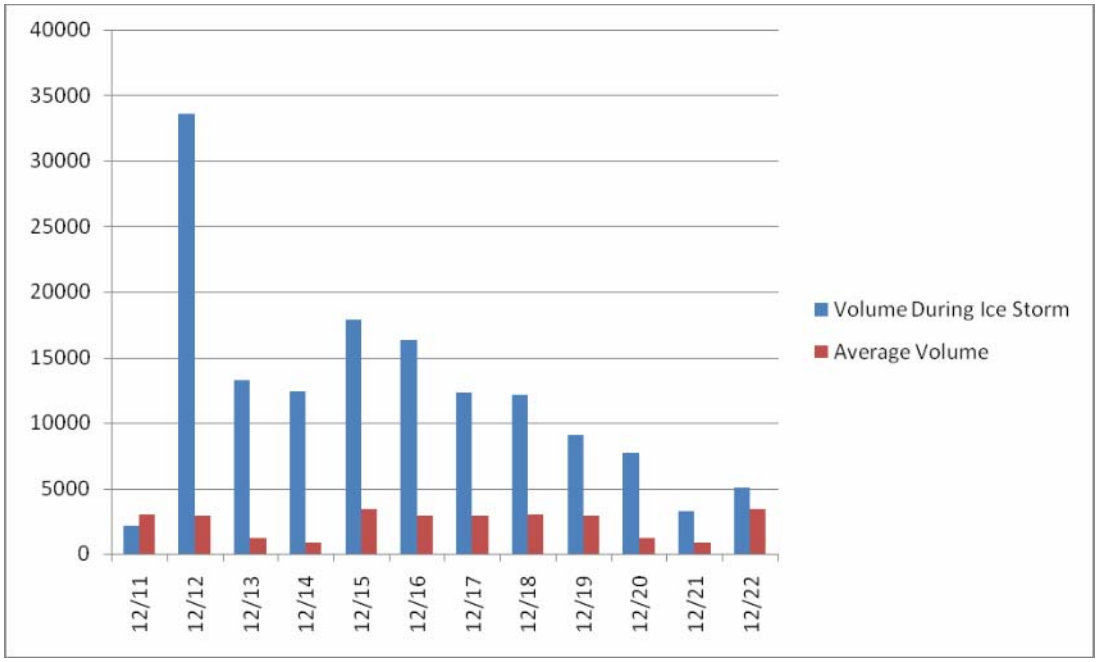

Figure II-23 – Graph showing PSNH call center call volume and the normal call volume on the days shown (CSR offered calls).[166]

[166] PSNH. (March 6, 2009). Data Response STAFF 2-9. NHPUC.

Unitil

Unitil's Customer Service Call Center is located in Concord, NH and is the central call center operation for all of the Unitil companies. At the time of the 2008 ice storm, the company had 72 lines on three 24-channel circuits. Four lines were reserved for system connectivity, leaving 68 available for incoming calls. As depicted in Table II-11, normal customer call volume at the call center requires approximately 15 customer service representatives (CSRs) to be available simultaneously during the peak period of the day. This would correspond to a normal daily call volume of approximately 1,000 calls received by the interactive voice response (IVR) system and approximately 650 answered by CSRs or 43.3 calls per representative. During the ice storm, 41 CSRs were available simultaneously to answer customer calls during the peak period of the outage which corresponded to 24,880 calls received by the IVR and 3,855 answered by the CSRs. The average number of calls answered per CSR was 94, more than twice the normal average, which indicates CSR staffing should have been higher.

Table II-11 – Volume of calls Unitil received and staffing CSR staffing levels following the storm.[167]

	Staffing	Calls Answered by CSRs	Calls Answered Per CSR
Normal	15	650	43.3
December 2008 Ice Storm	41	3,855	94

National Grid

National Grid's Customer Contact Center has 238 incoming lines along with an additional 236 backup for a total of 531 lines. At peak, National Grid's Customer Contact Center had approximately 165 employees taking incoming calls. To further streamline the process the Center shifted to handling only power outage calls during the storm event. Automatic messages from the IVR explained to customers that due to the storm, power outage and emergency calls were the priority but customers with routine requests could use the IVR menu to enter a request that would be addressed by the Company after the restoration was completed. Table II-12 represents the call volume that National Grid representatives managed for New Hampshire during each day of the ice storm.[168] The fact that nearly 100% of all calls received during the storm restoration effort were answered indicates that National Grid's call center staffing levels were appropriate.

[167] Unitil. (March 27, 2009). Data Response STAFF 2-9.NHPUC.
[168] National Grid. (April 1, 2009). New Hampshire, 2008 Ice Storm Report, pg 14..

Table II-12 – Volume of calls National Grid CSR's received and answered following the storm.[169]

Date	Calls Offered	Calls Abandoned	Total Calls Answered	% Calls Answered
Dec 11	802	4	798	99.5%
Dec 12	5,591	77	5,514	98.6%
Dec 13	1,832	40	1,792	97.8%
Dec 14	1,887	6	1,881	99.7%
Dec 15	1,327	10	1,317	99.2%
Dec 16	953	3	950	99.7%
Dec 17	575	8	567	98.6%
Dec 18	395	1	394	99.7%
Dec 19	315	0	315	100.0%

NHEC

NHEC staffs its customer call center in Plymouth, New Hampshire with ten full time employees Monday through Friday from 8 a.m. to 5 p.m. After hours and on weekends and holidays one dispatcher is on duty to take calls. During the ice storm the call center was staffed 24 hours a day beginning on Day 1, Thursday, December 11, at approximately 9:30 p.m. Around the clock operations were maintained through 5:00 p.m. on Day 8, Thursday, December 18. At the peak staffing point 18 people were available to take calls.[170]

NHEC's telephone system has the capacity to handle a combined maximum of 115 inbound or outbound calls at one time. Any inbound calls that exceed that limit automatically go to the IVR system queue for the next available agent. While in the IVR system callers can select and listen to prerecorded messages or wait for the next available customer service representative. Normal daily call volume averages about 900 calls. Average daily inbound call volume for the outage period from Day 1, Thursday, December 11 and Day 8, Thursday December 18 was 16,778. This number represents all calls received, both normal and outage, and includes overflow calls, i.e. those calls that were not answered and resulted in a busy signal. Out of a total of 114,517 calls received, 108,391 were received by NHEC's IVR, meaning 6,126 calls could have received a busy signal.[171] These numbers indicate that some additional staffing could have been helpful to respond to customer inquiries.

Recommendation No. 5: Each electric utility should modify emergency planning procedures in order to implement a more effective means of estimating resource requirements.

- The electric utilities need to recognize that customer expectations have changed and will continue to escalate both during normal business and in emergencies.

[169] National Grid. (April 1, 2009). New Hampshire, 2008 Ice Storm Report, pg 14.
[170] NHEC. (March 24, 2009). Data Response STAFF 2-9. NHPUC.
[171] NHEC. (March 24, 2009). Data Response Staff 2-9. NHPUC.

- The electric utilities should develop and implement a more thorough means of estimating the number of outages expected during an emergency and use this information to estimate the number of customer calls that will need to be answered as a result.
- The electric utilities should develop and implement a procedure for rapidly increasing customer call center staffing levels based on the estimates.