

Unitil Energy System, Inc. Response

Regarding the New Hampshire Public Utilities Commission Staff's

After Action Report of November 26, 2014 Thanksgiving Storm

**Overview:** On November 19, 2015, Unitil submitted its initial comments regarding the New Hampshire Public Utilities Commission's Staff's After Action Report on the November 26, 2014 Thanksgiving Storm. Described below are specific changes the Company has made or is in the process of making, in response to the Staff's recommendations with respect to the Company's ERP or operational processes. Unitil submits that it is already in compliance with a majority of the recommendations. There are also a few items and processes that, if changed in accordance with the Staff's recommendations, would be counterproductive to an effective restoration, and alternative recommendations are provided.

**Section III.B. – Staff Recommended Corrective Actions Regarding Utility Emergency Planning and Preparedness**

1. Each utility shall ensure that the ERP Event Levels in their ERP Plan are consistent with the ERP Event Levels that the State of New Hampshire has established in the PUC 300 Rules for Electric Service (NH PUC 306.09(g)). Each ERP for all utilities shall clearly outline how Event Levels are derived from an impending forecast for potential wide-scale storm events.

*Unitil is in compliance – refer to Unitil's ERP Section IV – Pre-Planning Activities (Event Type Classification Table 4 Pg. 216)*

2. At a minimum, each utility shall review the data available from the December 2008 Ice Storm, the February 2010 Wind Storm, the 2011 Tropical Storm Irene, the October 2011 Snowstorm, the 2012 Hurricane Sandy and the 2014 Thanksgiving Snowstorm, to develop indices that facilitate the prediction of potential impacts of wide-scale emergency related storms of varying magnitudes. For utilities already utilizing ERP Event Levels as a pre-planning tool, any potential updates to the indices based on the most recent storm event is required to be incorporated within the ERP. Impact indices to be incorporated into each utility's ERP shall be updated to reflect potential impacts and shall be filed with the Commission no later than December 31, 2015.

*Unitil is in compliance – refer to Unitil's ERP Section IV.B – Pre-Planning Activities (Weather Alert Levels Pg. 208).*

3. Each utility shall incorporate into its impact indices factors such as snow accumulations including moisture content variability, ice thickness, average wind speeds and gusts, foliage conditions, and weather forecast confidence levels that will allow utilities to estimate, by ERP Event Level, the number of predicted customer outages and predicted troubles<sup>10</sup> that could result from a forecasted weather event. For utilities already utilizing ERP Event Levels as a pre-planning tool, any potential updates based on the 2014 Thanksgiving Snowstorm event are required. Any amendments made are to be incorporated into each utility's ERP and shall be filed with the Commission no later than December 31, 2015.

*Unitil is in compliance – refer to Unitil's ERP Section IV.B – Pre-Planning Activities (Weather Alert Levels Pg. 208).*

*Updated EEI Criteria based on previous storm(s):*

**Energy Event Index (EEI) – Revised Nov 2015**

*Forecasted Weather Conditions **\*WITH LEAVES\*** (April 1<sup>st</sup> – November 15<sup>th</sup>)*

Level	Wind Speed	Wind Gusts	Snow (Dry)	Snow (Wet)	Ice
EEI = 1	< 20 mph	< 30 mph	> 6 in.	> 4 inches	> 1/10 in.
EEI = 2	≥ 20 mph	≥ 30 mph	≥ 12 in.	≥ 4 inches	≥ 1/10 in.
EEI = 3	≥ 25 mph	≥ 40 mph	≥ 18 in.	≥ 6 inches	≥ 3/8 in.
EEI = 4	≥ 40 mph	≥ 50 mph	≥ 24 in.	≥ 12 inches	≥ 1/2 in.
EEI = 5	≥ 45 mph	≥ 60 mph	≥ 24 in.	≥ 24 inches	≥ 1 in.

*Forecasted Weather Conditions **\*NO LEAVES\*** (November 15<sup>th</sup> - March 31<sup>st</sup>)*

Level	Wind Speed	Wind Gusts	Snow (Dry)	Snow (Wet)	Ice
EEI = 1	< 26 mph	< 40 mph	> 18 in.	> 6 in.	> 1/10 in.
EEI = 2	≥ 26 mph	≥ 40 mph	≥ 18 in.	≥ 6 in.	≥ 1/10 in.
EEI = 3	≥ 30 mph	≥ 45 mph	≥ 24 in.	≥ 8 in.	≥ 3/8 in.
EEI = 4	≥ 40 mph	≥ 50 mph	≥ 36 in.	≥ 12 in.	≥ 1/2 in.
EEI = 5	≥ 45 mph	≥ 60 mph	≥ 48 in.	≥ 24 in.	≥ 1 in.

Confidence Levels	
<b>Low</b>	< 30% Chance
<b>Medium</b>	≥ 30 < 60% Chance
<b>High</b>	≥ 60% Chance

- ERP Event Levels shall also include the predicted number of additional line crews required to restore power to the predicted percentage of potential customers without power as well as to repair the potential number of troubles, per ERP Event Level. Any changes required are to be incorporated into each utility’s ERP and shall be filed with the Commission no later than December 31, 2015.

*Unitil is in compliance – refer to Unitil’s ERP Section IV – Pre-Planning Activities (Event Type Classification Table 4 Pg. 216)*

- Not Applicable
- Each utility shall develop a detailed list (Plan) of potential recommendations on what the utility can do differently to effectively pre-stage line crews prior to the onset of a wide-scale emergency storm event, and effectively increasing external line crews as early as possible. In such detail, the Utility will include any changes recommended for consideration for inclusion in Commission rules, or other actions for the Commission to consider that would assist utilities in

this effort to pre-stage and effectively increase external line crews as early as possible. Each utility’s plan shall be filed with the Commission no later than December 31, 2015.

**Pre – Staging Resource Plan:**

The Staff’s After Action Report recommends that each utility develop a detailed plan to effectively pre-stage line crews prior to the onset of a known wide-scale emergency storm event. The utilities were asked, “In detail, provide any changes recommended for consideration for inclusion into the Commission rules or other actions the Commission should consider that would assist utilities in the effort to pre-stage and effectively increase external line crews as early as possible.” The utilities were requested to file these changes or “Plan” no later than December 31, 2015.

Unitil believes it would be helpful to outline its current protocols related to resource acquisition. Unitil maintains a contact database of over 90 contractors, including those engaged in line construction, forestry, damage assessment, wires down standby, and logistical support. This database is organized by the contractor’s location, with those closest (local) to the impacted regions served by the Company (i.e., less than 12 hours away) being called first, followed by those that are 12-24 hours away (reflects travel time needed to reach the impacted region more so than mobilization time) and finally those that are more than 24 hours away.

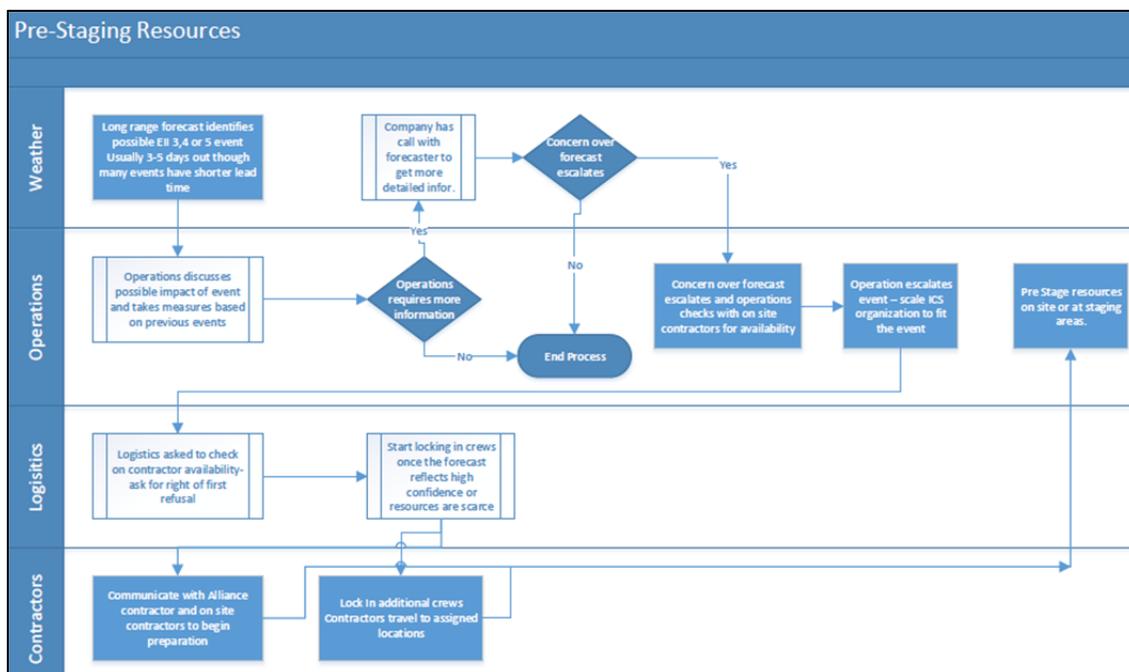


Figure 1 - Pre-Staging Resources Process

The resource acquisition process polls the contractor community in advance of a forecasted event to confirm availability, as well as inform them that Unitil may be looking for resources. By following this process, the Company usually receives return calls (updates) from the contractors when other utilities are also requesting their services or when they commit to another utility and are no longer available. The return call rate is a bellwether as to the status of available resources in the area. There are also options as to how resources are retained, which are strictly up to the contractor’s discretion. Some local contractors are willing to make arrangements to be on “stand-by” or “on-call.” Stand-by is when crews remain at their home base ready to travel but are not fully committed because the Company is uncertain as to the impact or timing of the

event. Typically, there is a reduced rate for stand-by. On-call is when the Company pays for a number of crews (typically in 12-hour blocks) to be available for response and are used for smaller events, when the impact is likely not as severe. In this case the worker remains at home until called. Both stand-by and on-call are atypical of contractor acquisition.

The Company also has an arrangement with a specific contractor who assembles resources only in response to forecasted storms. Under this prearrangement, the Company has the right of first refusal; however, this comes at a financial price, and few contractors are willing to agree to this approach. The fact that this contractor does not normally work for any utility is important because the North Atlantic Mutual Assistance Group (NAMAG) administrative guidelines (all New Hampshire utilities are NAMAG members) detail that a member cannot acquire contracted resources until the entire NAMAG membership is notified of the resource request. The only contractors that can be acquired are those working on a member’s property or not working for another utility anywhere. The notification process typically initiates a heightened response, including coordination calls with other regional mutual assistance groups (RMAGs), which tends to delay the process of assembling resources. However, it also opens the door for a wider pool of resources for a smaller, regional event (an event only impacting a few states) but also tends to be more costly due to crews traveling from outside the NAMAG region. By having a right of first refusal with its contractor, the Company can bypass the notification process, saving time. If the desired resource count cannot be acquired through the normal company calling process, a NAMAG call is requested. If there are still outstanding resource requests after the NAMAG call, additional calls will occur with adjacent RMAGs.

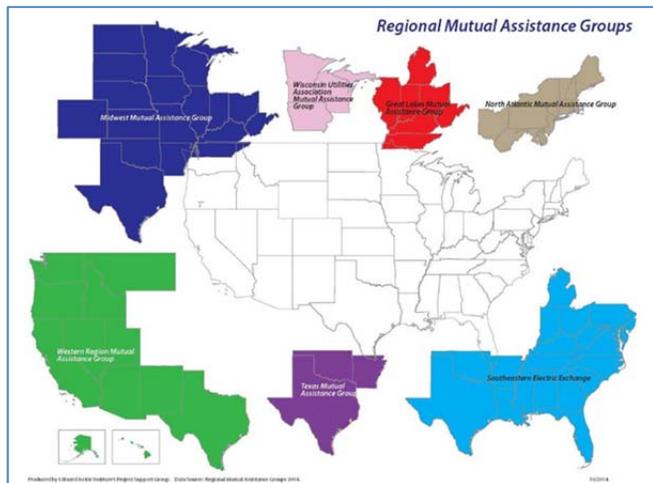


Figure 2 - US Mutual Assistance Groups

The size of the event usually dictates the complexity and difficulty of obtaining resources. For example, during the planning response to Hurricane Joaquin, NAMAG members requested 12,000 linemen. These requests were made prior to understanding where or even if the tropical cyclone was going to impact the mid-Atlantic and/or New England regions, which it ultimately did not. A request of this magnitude could not have been filled even from surrounding RMAGs, leaving everyone short of their desired crews. The point is that resources are now being secured much earlier and in much greater numbers when compared to how resources were acquired previously for similar events – due primarily to changing restoration expectations.

The question is how do we get crews pre-staged more quickly, assuming that they are available?

The answer is iterative in nature. First, an understanding of the weather event forecasted to impact the region and its timing are required, and second, an awareness of current resources available in the general area is needed.

A utility can acquire resources days in advance of a possible event, which would ensure a reasonable start to the restoration, and then adjust the count based upon the actual impact. The concern is that “locking in” crews days in advance is costly – especially when the event may

never come to fruition or even cause damage, as forecasting accuracy diminishes significantly beyond 48-72 hours. The chart below highlights the average hourly cost of a crew working storm response. It's evident that in-house and local contractors are the best value, but these resources are limited with those that are available very much in demand.

Hourly Rates - 2 Person Crew With A Vehicle			
Based on Double Time			
In-House	Avg. Local Contractors	Avg. Out-side Contractors	Outside with Mobilization <sup>1</sup>
\$193.00	\$522.00	\$810.00	50-70% adder/hr. \$1,360

However, given the changing expectations and the competitive environment of resource acquisition, locking in crews prior to having a high confidence in the weather forecast is the best way to ensure resource availability. The Company's present plan, as outlined in the ERP (Section IV and V), addresses the acquisition of resources, starting at least three days in advance of the forecasted events with the potential for significant impact to its service territory. The Company is not in favor of changing its existing protocols, which have been developed based on multiple, successful restorations since the 2008 Ice Storm. Unutil's storm responses have been satisfactory, when following the process outlined above.

One restriction that the Company encourages the Commission to revisit is the recovery criteria for forecast confidence levels. Today, the Company cannot access the reserve fund unless the forecast's EEI Level is 3 or more with high confidence. This is problematic due to the timing as to when the forecasters provide high confidence, which usually occurs just hours before an event commences. When the Company initially developed this process, it was not familiar with the timing of the confidence declaration from its forecaster, since this has never been a criterion for cost recovery. If Staff recalls, the addition of the confidence level to the forecast was as a result of a recommendation by the consultant hired by the Commission (Mr. Cannata), who sought a way to assure that the Company would not be over-preparing for every storm with an EEI Level of 3 or more. The Company has demonstrated over the years that it prepares for events in a responsible manner and, if anything, has been conservative with the use of the reserve fund. By eliminating the requirement of the confidence level, the Company would be able to prepare earlier without the threat of a disallowance of preparatory costs when audited by the Commission Staff.

Additionally, the Company would like to comment on Table 306.1 of the PUC 300 rules. Upon further review, the percentage (%) of Customers out does not align well with the Company's ERP event level chart, which reflects impact and resources needed based on historical data. For instance, the PUC table indicates that for a Level 3 event, more than 5% but less than 10% of a Company's customers would be impacted, which for Unutil is up to 7,500 customers. Although an outage effecting 7,500 customers could easily result from the loss of a single line, which could be restored employing in-house resources, the Company Level 3 would require us to bring in 10-40 additional line crews. The Company submits that a different criteria should be used (for example, miles of over-head conductor or tree miles of conductor) to dictate Event

<sup>1</sup> Mobilization and demobilization can vary widely depending on the company and the distance. The % adder is the average of what Unutil has seen over the past several years.

Levels rather than just a percentage of customers out, or the Rules should allow each utility to develop its own chart based on utility-specific data and eliminate the generic chart altogether.

<b>Table 306-1</b>			
<b>Utility</b>	<b>ERP Event Level</b>	<b>% Customers Out</b>	<b>Outage Duration (Hrs.)</b>
	5	≤2	<12
	4	>2≤5	0-24
	3	>5 ≤10	24-48
	2	>10≤20	48-144
	1	>20	48-240

**Figure 3 - Table 306-1 (from PUC 300 Rules)**

7. The Commission shall review each utility’ plan of potential recommendations on what the utility can do differently to effectively pre-stage line crews prior to onset of a wide-scale emergency storm event, and to effectively increase external line crews as early as possible.

*Unitil files its ERP annually with the Commission, and to date there has been no requested changes to the plan from Staff. Unitil will make the appropriate changes in relation to the Staff report and submit a revised version to the Commission no later than December 31, 2015.*

**Section III.C. – Staff Recommended Corrective Actions Regarding Weather Forecasting**

1. Not Applicable
2. Not Applicable
3. Not Applicable
4. Not Applicable

**Section III.D. – Staff Recommended Corrective Actions Regarding Emergency Response**

1. Not Applicable
2. All utilities shall add Major Holiday periods in each of their ERPs to address the need to accelerate standard planned actions when monitoring weather forecasts and the need to enhance/anticipate the preplanning and pre-staging of line crews prior to and during Major Holiday periods. These required changes shall be incorporated into each utility’s ERP and shall be filed with the Commission by December 31 2015.

*Unitil will specifically discuss holidays in its ERP; however the Company feels strongly that the procedures already outlined within the ERP accounts for such conditions. Refer to Unitil’s ERP Section IV.D Pre-Planning Activities (Pre-Event Preparations & Reporting Pg. 221)*

**Section III.E. - Staff Recommended Corrective Action Regarding Restoration Response**

1. Utilities that procure and coordinate resources through their parent companies shall document those decisions as well as notes of those decisions made by the parent utility concerning response and recovery actions. These decision points shall be included in Post-Storm After-Action Reviews.

*The process in use today complies with Staff’s recommendation. Unitil Service Corp. (“Unitil Service”), an affiliate company of UES, makes many of the logistical arrangements during*

*emergencies, including the acquisition and coordination of resources. Unitil Service also prepares the After Action Report on behalf of its distribution company affiliates. As a result, decisions made by Unitil Service are well documented in the After Action Report.*

2. Each utility shall include in its Emergency Response Plan procedures for pre-staging crews in the event of wide-scale emergencies that have the potential of affecting 10% or more of the customer base.
  - a. Provide a methodology for determining how many crew resources will be needed based on forecasts.
  - b. Pre-establish an available pool of resources.
  - c. Factor in travel times.
  - d. Incorporate its own historical restoration data as well as relevant data from other utilities from detailed reviews of the most recent wide-scale storms.
  - e. Provide for the cancellation of employee vacations as needed for major storm events.

*Unitil's ERP addresses each of these suggestions today. Refer to Unitil's ERP Section V.E & G Mobilization (Mutual Assistance/Crew Allocations Pg. 238 & Storm Assignment List Pg. 242).*

3. Not Applicable

### **Section III.F - Staff Recommended Corrective Actions Regarding Utility Communications**

1. To the extent this is not already being done, utilities shall provide their customer representatives with customer specific ETR information. Additionally, websites should provide real-time mapping and show outage locations with number of customers affected at each location, as well as ETR's for each location.

*Unitil has in place procedures that provide ETR information expeditiously and use multiple channels to disseminate the information to its customers. Refer to Unitil's ERP Section VI Corporate Communications (Pg. 244).*

2. Not Applicable
3. Not Applicable
4. All utilities will staff their call centers to be able to receive customer calls in real time during major outages.

*Unitil has staff assigned to the call center 24/7 during all major events. Refer to Unitil's ERP Section II.13 (Customer Operations Officer Pg. 25).*

- End of Document -

***After-Action Report***  
***Of***  
***November 26, 2014 Thanksgiving Snowstorm***



***New Hampshire's Regulated Utilities'***  
***Preparation and Response***

*Report Prepared by the Staff of the  
New Hampshire Public Utilities Commission*

*September 29, 2015*

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## **Glossary of Acronyms**

AWC	Area Work Center
EOC	Emergency Operations Center
ERO	Emergency Response Organization
ERP	Emergency Response Plan
ETR	Estimated Time of Restoration
GIS	Geographic Information System
GSEC	Granite State Electric Company
HSEM	New Hampshire Homeland Security & Emergency Management
NEMAG	Northeast Mutual Aid Group
NHEC	New Hampshire Electric Cooperative
NHPUC	New Hampshire Public Utilities Commission
NOAA	National Oceanic and Atmospheric Administration
NU	Northeast Utilities, parent company of PSNH
NWS	National Weather Service
OMS	Outage Management System
PSNH	Public Service Company of New Hampshire d/b/a Eversource Energy
SRC	Strategic Response Committee
UES	Unitil Energy Systems, subsidiary of Unitil Corporation

## I. Overview

New Hampshire utilities have seen a series of major storms resulting in widespread power outages since December 2008. The New Hampshire Public Utilities Commission (Commission) conducted extensive after-action reviews following two of the largest recent storms, the December 2008 Ice Storm and the October 2011 Snowstorm, to assess utility preparedness and emergency response capabilities in New Hampshire. This report, while less comprehensive, constitutes the third major after-action wide-scale emergency storm event review. The previous after-action storm reports included a number of directives to utilities to implement improvements in their emergency planning and response procedures. These past reports will serve as a foundation of Commission Staff's (Staff's) assessment of the 2014 Thanksgiving Snowstorm and, in particular, whether the utilities were better prepared for the storm as a result of actions taken following the two earlier wide-scale emergency storm events referenced above. All data contained herein were received from the utilities through their responses to Staff's data requests, required submitted utility after-action reports, as well as information provided to the Energy Support Functional Area at the State Emergency Operations Center (EOC) during the 2014 Thanksgiving Snowstorm event.

On November 26, 2014 the sixth wide-scale storm in a recent string of powerful storms to hit New Hampshire and the Region caused widespread damage and prolonged outages as heavy, wet snow, combined with moderate winds resulted in numerous broken branches and fallen trees that closed roads and downed power lines. With over 238,000 power outages, the 2014 Thanksgiving Snowstorm ranks as the fourth largest outage event in the State of New Hampshire after the December 2008 Ice Storm, the February 2010 Wind Storm and the October 2011 Snowstorm. This storm was the first wide-scale emergency storm event to occur during a major holiday, Thanksgiving, and the effect of the holiday time period upon restoration efforts was noticeable.

The Staff reviewed electric utility response to the 2014 Thanksgiving Snowstorm power restoration effort. Staff has identified areas of improved and poor performance as compared to the prior significant storm events that had required corrective actions. This report recounts and evaluates pre-storm planning and preparedness as well as the power restoration response taken by the State's four electric distribution utilities, which are further described in Appendix A: Public Service Company of New Hampshire d/b/a Eversource Energy (PSNH, Eversource)<sup>1</sup>, Unil Energy Systems (UES)<sup>2</sup>, Liberty Utilities (LU)<sup>3</sup> and the New Hampshire Electric

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<sup>1</sup> PSNH is a subsidiary of Eversource Energy (Eversource). Eversource was formed in February 2015 in an effort to rebrand the holding company, Northeast Utilities, and subsidiaries with a unified name.

<sup>2</sup> UES is a subsidiary of Unil Corporation (Unil). Where Unil is noted rather than UES, it is because the function described is performed by Unil on behalf of UES, either directly or through Unil Service Corp., another subsidiary.

Cooperative (NHEC).<sup>4</sup> This report does not focus on Liberty Utilities other than including data for total outages because this storm did not have a significant effect on their service territory. Finally, it does not address actions taken by municipal electric utilities, which fall outside the Commission's jurisdiction.

A significant winter storm moved into New Hampshire and western Maine during the day on Wednesday, November 26, 2014. As predicted by the National Weather Service in Grey, Maine, snow began to fall around 10:00 AM in southern New Hampshire and continued to expand northward throughout the day. The precipitation was a heavy, wet snow that was expected to accumulate to greater than 12" in the Concord area, with lesser amounts along the seacoast due to a changeover to rain. By the time the storm passed out of New England Wednesday evening, most of New Hampshire saw accumulations of 8"- 14" of heavy, wet snow. The weight of the snow resulted in numerous downed trees, road closures and widespread power outages.

Thursday, November 27, 2014 was a state and national holiday, Thanksgiving Day, and the loss of power disrupted many families' holiday gatherings and travel plans.

At its peak, the storm resulted in over 238,000 of New Hampshire's approximately 700,000 electric utility customers losing power concurrently, which for many customers in the state means losing water and heat, as well as the use of lighting and electric appliances.<sup>5</sup> The loss of power affected a population of approximating 480,000 [equivalent to nearly 37% of the 1.3 million NH citizens].

Utility line crews and personnel resources worked long and difficult hours to restore power. It should be noted as well that no significant injuries to restoration crews occurred during the restoration period. That result indicates the high degree of value placed on safety by all four electric utilities, for which they should be commended. The percentage of customers without power during the peak of the storm varied among each of the electric utilities and are summarized in Table I-1 below.

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<sup>3</sup> LU is owned by parent company, Liberty Utilities (NH) Corp, based in Londonderry, NH

<sup>4</sup> NHEC is a public utility, though not fully regulated by the Commission, because it is a member cooperative with a certificate of deregulation on file, pursuant to RSA 362:2, II. The Commission retains jurisdiction over NHEC in limited matters, including the requirement that it provide safe and reliable service. The Commission issued Order No. 25,645 April 1, 2014 outlining an MOU with NHEC that included an obligation to provide after-action reports for wide scale emergencies.

<sup>5</sup> Customers of municipal electric utilities are not included in totals. In total they account for less than 1% of New Hampshire's electric customers.

**Table I-1**

Electric Utility	Number of Customers Without Power at Peak	Percentage of Customers Without Power at Peak	Time When Nearly All Restorations Complete
UES	34,575	46%	Sunday morning (2AM) November 30
NHEC	29,308	36%	Sunday afternoon (5 PM), November 30
LU	2,900	7%	Friday morning (1AM), November 28
PSNH	207,359 <sup>6</sup>	41%	Monday morning (5 AM), December 1
State wide	274,142	39%	Non Concurrent Totals

As in the case of other major wide-scale emergency storm events that have resulted in widespread power outages, the Staff at the Commission's request, launched an 'after-action review' of the 2014 Thanksgiving Snowstorm soon after power restoration was complete and utility after-action reports were submitted.

On December 1, 2014, Governor Maggie Hassan indicated that the Commission would conduct an after-action review regarding the length of time it took to restore power to some New Hampshire citizens. The Governor inquired of the Commission whether New Hampshire's utilities were sufficiently prepared for the storm and what steps could have been taken to reduce the number and length of outages.

In conducting its review, the Staff issued data requests to each of the electric utilities as needed and conducted interviews when necessary to clarify utility responses. The Staff's findings follow in Section III. The Commission conducted a similar review of New Hampshire's electric utilities' response to the October 2011 Nor'easter Snowstorm. Staff's analysis of the status of completion of recommended action items in the Commission's October 2011 review is found at Appendix C of this report.

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<sup>6</sup> In January 2015, PSNH reported to the Commission the exact peak number of outages as 207,359. In its post-storm self-assessment report released on January 29, 2015, page 3. PSNH reported a peak of 207,359 customers at 11 am. This is inconsistent with data response of March 27, 2015 which state it was 179,124 peak customers.

## II. Purpose and Scope of Review

### A. Statutory Authority

The Commission has broad regulatory powers over the provision of safe and reliable service to the public. Below is an example of some of the State Statutes that are applicable to this report:

- Public utilities, defined in RSA 362:2, shall “furnish such service and facilities as shall be reasonably safe and adequate and in all other respects just and reasonable” as required under RSA 374:1. Accordingly, the Commission has the purview to review utility emergency planning and response in the event of major power outages, such as occurred in the wake of the 2014 Thanksgiving Snowstorm.
- RSA 365:4 gives the Commission investigative authority to investigate or make inquiry in such manner to be determined by the Commission.
- RSA 365:6 allows the commission at any time to inspect the methods used by any public utility. This would include review of emergency response methods, plans and procedures.
- The commission per RSA 365.19 may hold a hearing prior to or after making an independent investigation as in its judgment the public good may require; provided, that, whenever such investigation shall disclose any facts which the commission shall intend to consider in making any decision or order, such facts shall be stated and made a part of the record, and any party whose rights may be affected shall be afforded a reasonable opportunity to be heard with reference thereto or in denial thereof.

### B. Utilities Included in this Review

The 2014 Thanksgiving Snowstorm caused widespread power outages across New Hampshire. Three of the four electric service providers experienced what the Commission refers to as a wide-scale emergency storm event<sup>7</sup>. UES, PSNH and NHEC were heavily affected by the storm, are regulated by the Commission, and are included in this review. Liberty Utilities was the least affected and thus only minor consideration was given to their efforts within this after-action report. Further information on the four electric utilities, including a map of their respective service territories, is included at Appendix A.

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<sup>7</sup> Puc 302.24 defines wide-scale emergency as an event that results in, or is or expected to result in: a sustained interruption of electric service to 10% or more of the utility’s customers, or 40,000 of the utility’s customers, whichever is less **and** restoration of electric service to any of these customers takes more than 24 hours; or a government declared official state of emergency involving an interruption of electric service.

### C. Scope of Review

The report focuses on actions taken by New Hampshire’s regulated electric utility companies:

- 1) prior to the onset of the 2014 Thanksgiving Snowstorm, including weather monitoring and analysis, assessment of resource requirements, in-house and off-system line crew<sup>8</sup> levels, procurement of off-system resources, and the pre-staging of materials and external crews, and annual utility required storm restoration practice drills;
- 2) initial damage assessment and deployment of resources during the storm;
- 3) post-storm activities, including line crew scheduling, restoration of service; the review of 60 day after-action reports completed by each utility, and review of utility expenditures.
- 4) communications with municipal officials, as well as with the general public.

The report also evaluates the status of corrective actions that came out of the Commission’s October 2011 Snowstorm report and a reassessment of any outstanding areas of concern from the Commission’s December 2008 Ice Storm After-Action Report.

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<sup>8</sup> A crew generally consists of two people with a truck and equipment. Line crews are responsible for switching and repair of equipment and hardware, and the final energizing of the line; digger crews are responsible for replacing utility poles; tree crews are responsible for removing and relocation of downed trees and limbs to eliminate safety hazards from the work site. See *NHPUC December 2008 Ice Storm After-Action Review* (December 3, 2009) at II-4.

### **III. Findings and Corrective Actions**

The detailed factual basis on which the following findings and recommendations by Staff can be found in Section IV, Planning and Preparedness, and in Section V, Restoration Response.

#### **A. Staff's General Findings**

1. Heavy wet snow blanketed the majority of the state and occurred when most trees were devoid of leaves. These conditions are not unusual for New Hampshire during late November and often cause major outages. As a result, such conditions should be taken into account in electric distribution outage planning. This was the first wide-scale storm to occur during a major holiday period (Thanksgiving). [The significance of the holiday] affected the level of resources available to respond in a timely manner and the restoration efforts of the affected electric utilities.
2. Although the precise area and level of impact of the 2014 Thanksgiving Snowstorm may have been difficult to predict, it was clear by early Tuesday, November 25 that New Hampshire was going to receive at least 8 to 10 inches of heavy wet snow resulting in a high likelihood of wide-scale and prolonged power outages.
3. A wide-scale storm of this magnitude requires effective weather forecasting, as well as extensive preparation and emergency resource acquisition prior to the storm's onset, including procurement of external line crews, tree crews, damage assessors, and support personnel, as well as emergency stock for facility repairs and replacement.
4. Early acquisition and pre-staging of external line crews prior to the onset of the storm are crucial to reducing outage duration. The more widespread the storm is predicted to be, and the later a utility's management team begins to seek additional resources, the more difficult it is to obtain the necessary resources.
5. After six historic wide-scale storms, there is no definitive specific report that quantifies the economic and social impact of wide scale storm events for the businesses and citizens of New Hampshire. The Staff recommends that the Commission form a committee with no more than two representatives from each utility, Staff and other applicable state agencies to assist in developing a request for proposal to provide an economic report. The report shall consider and determine the cost impact and hourly impact for delays of power restoration upon the New Hampshire state economy using data from each of the previous wide-scale storms that collectively affected over 150,000 customers per storm. Economic, social and safety costs should be quantified. It is imperative that utilities

cooperate by providing data of storm expenditures and by assisting in developing the RFP. The Staff recommends that the Final Report be completed prior to July 2016 and submitted to the Commission for review.

## **B. Staff Findings and Corrective Actions Regarding Utility Emergency Planning and Preparedness**

### **Staff Findings:**

1. Puc 306.09, effective May 2014, requires one full readiness exercise and one table top exercise to be conducted annually. The utilities are required to invite applicable state agencies and Commission Staff to participate in such exercises. These exercises were completed for all utilities as required.
2. Utilities' internal crews are the first level of resources for power restoration. Line crew levels used for non-emergency operations during the past decade at UES and NHEC have been maintained at a near constant level. PSNH does show a decline of 7% in their number of distribution line crews over the past decade and therefore 7% fewer internal crews were available for the 2014 Thanksgiving Storm compared to available crews 10 years ago<sup>9</sup>. LU increased the number of internal crews by approximately 40% from pre-2012 levels.
3. Utilities rely heavily on weather forecast reports from their contracted weather forecast provider to determine if a forecasted weather event is severe enough to cause extreme damage to their electrical system. Based on the forecast received, utilities may or may not begin the process of pre-staging line crews prior to the storm event. Good utility practice would dictate that utilities not rely solely on one weather forecast from one weather forecaster as the only data point utilized to make decisions regarding whether to pre-stage line crews. It is imprudent to rely so heavily on a single forecast to determine an effective response to potential wide-scale weather events. By not utilizing many data points to determine the potential effects a pending storm could have on a utility's electrical system, the utility places itself in a poor planning position in the case of a less accurate single forecast.
4. All utilities continue to lack effective prediction modeling tools and generally rely on

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<sup>9</sup> Reference Figure IV-1, PSNH didn't provide consistent reporting of crew levels throughout the 10 year period regarding unfilled positions.

past experience when estimating system damage, or wait to experience actual outages and troubles, which in major events can contribute to delay in seeking external line crews and completing system restoration.

5. UES, LU and NHEC use a resource procurement planning method utilizing estimations of storm-related damage predictions prior to and during an Emergency Response Plan (ERP) Event. The approach used by UES and LU is superior to solely relying on past experience or responding to a storm's magnitude of damage after the impact has arrived. This iterative planning process can be continually improved by reviewing [actual data results] as each storm occurs coupled with updated weather forecasts to refine the appropriate weighting of various input factors based on the resulting damage and success of each updated storm restoration effort.
6. PSNH's lack of a predetermined system of damage prediction, including estimates of anticipated potential customer' outages and potential duration of restoration in their ERP, affected their ability to effectively respond to the damage on their electrical system caused by the 2014 Thanksgiving Snowstorm. As a result, some PSNH customers were without power longer than necessary.
7. UES and LU are the only utilities that incorporate the probability of an event's occurrence into its ERP Event Levels. They also reflect potential numbers of line crews required for each ERP Event Level. The classification of emergency events by level of impact and severity allows a utility to make a more accurate prediction of damage expected from forecasted weather events. Lack of consistency in the definition and use of ERP Event Levels can lead to poor communications with State officials, imprecise damage prediction and result in ineffective resource procurement decisions.
8. PSNH typically does not pre-stage external crews from other states prior to the onset of major storm events.
  - a) Although PSNH's ERP does have a plan for staging crews once damage has occurred, their most recent ERP, dated March 5, 2015, does not provide for pre-staging in explicit terms as a result of receiving a weather forecast of a pending storm event which is anticipated to reach a wide-scale emergency level.
  - b) PSNH's ERP does not have a procedure for predetermining the potential number of customer outages and potential troubles on their electrical system prior to the actual onset of a storm.
  - c) PSNH management did not pre-stage additional external crews for the 2014 Thanksgiving Snowstorm from other states as was done for the December 2013 potential ice storm that never ultimately materialized. This may be due primarily to the weather forecasts used prior to the day of the 2014 Thanksgiving Snowstorm.

Also, the timing of the storm event just prior to a major holiday impacted line crew availability compared to crew availability in the December 2013 potential storm. This indicates a lack of commitment to attaining an effective contingency of additional external line crews until after the storm damage had occurred.

- d) PSNH goes through its parent company for resource procurement of external out-of-state line crews when needed, thereby potentially hindered its own ability to obtain needed resources in a timely manner for New Hampshire when there are also storm restoration efforts anticipated or needed in affiliate companies.
9. PSNH does not have as a part of its ERP Plan a pre-established number of potential line crews required in each of their Readiness Conditions, or ERP Event Levels, to effectively restore customer outages during wide-scale emergency related storm events. The other three electric utilities do indicate quantity of potential line crews within their respective ERP's.

**Staff Recommended Corrective Actions Regarding Utility Emergency Planning and Preparedness:**

1. Each utility shall ensure that the ERP Event Levels in their ERP Plan are consistent with the ERP Event Levels that the State of New Hampshire has established in the PUC 300 Rules for Electric Service (NH PUC 306.09(g)). Each ERP for all utilities shall clearly outline how Event Levels are derived from an impending forecast for potential wide-scale storm events.
2. At a minimum, each utility shall review the data available from the December 2008 Ice Storm, the February 2010 Wind Storm, the 2011 Tropical Storm Irene, the October 2011 Snowstorm, the 2012 Hurricane Sandy and the 2014 Thanksgiving Snowstorm, to develop indices that facilitate the prediction of potential impacts of wide-scale emergency related storms of varying magnitudes. For utilities already utilizing ERP Event Levels as a pre-planning tool, any potential updates to the indices based on the most recent storm event is required to be incorporated within the ERP. Impact indices to be incorporated into each utility's ERP shall be updated to reflect potential impacts and shall be filed with the Commission no later than December 31, 2015.
3. Each utility shall incorporate into its impact indices factors such as snow accumulations including moisture content variability, ice thickness, average wind speeds and gusts, foliage conditions, and weather forecast confidence levels that will allow utilities to estimate, by ERP Event Level, the number of predicted customer outages and predicted

troubles<sup>10</sup> that could result from a forecasted weather event. For utilities already utilizing ERP Event Levels as a pre-planning tool, any potential updates based on the 2014 Thanksgiving Snowstorm event are required. Any amendments made are to be incorporated into each utility's ERP and shall be filed with the Commission no later than December 31, 2015.

4. ERP Event Levels shall also include the predicted number of additional line crews required to restore power to the predicted percentage of potential customers without power as well as to repair the potential number of troubles, per ERP Event Level. Any changes required are to be incorporated into each utility's ERP and shall be filed with the Commission no later than December 31, 2015.
5. PSNH shall update its current ERP plan dated March 5, 2015 to ensure that high consideration is taken to obtain additional external line crews in a more timely manner and pre-staged prior to a predicted wide-scale emergency storm event at the earliest appropriate time after receiving a weather forecast of a pending storm event which is anticipated to potentially affect 10% or more of the customer base. This required change to PSNH's ERP shall be filed with the Commission no later than December 31, 2015.
6. The Commission is focused on the goal of minimizing the required time it takes to restore power to each utility's customers during wide-scale emergency storm events. Pre-Staging line crews prior to the onset of a wide-scale emergency storm event that is forecasted for the service territory of each utility, as well as effectively increasing external line crews at the earliest practical time, will help shorten customer restoration times<sup>11</sup>.
  - Each utility shall develop a detailed list (Plan) of potential recommendations on what the utility can do differently to effectively pre-stage line crews prior to the onset of a wide-scale emergency storm event, and effectively increasing external line crews as early as possible.
  - In such detail, the utility will include any changes recommended for consideration for inclusion in Commission rules, or other actions for the Commission to consider that would assist utilities in this effort to pre-stage and effectively increase external line crews as early as possible.
  - Each utility's plan shall be filed with the Commission no later than December 31, 2015.

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<sup>10</sup> Troubles refers to specific damage to the system, such as downed wires, a broken pole or blown fuse; a single "trouble ticket" could result in an outage affecting one customer or multiple customers.

<sup>11</sup> This was previously stated in the Commission's *After-Action Review December 2008 Final Report* and the after-action review of the *October 2011 Snowstorm Report*.

7. The Commission shall review each utility’ plan of potential recommendations on what the utility can do differently to effectively pre-stage line crews prior to the onset of a wide-scale emergency storm event, and to effectively increase external line crews as early as possible. If any utility’s plan recommends a change in Commission rules, the Commission may open a proceeding with all utilities to determine the applicability, merit and extent of recommended changes for the Commission to consider, and how any such recommended changes would affect each utility.

### C. Staff Findings and Corrective Actions Regarding Weather Forecasting

#### Staff Findings Regarding Weather Forecasting:

1. UES, LU and PSNH all received forecasted updates regarding the 2014 Thanksgiving Snowstorm through contracted commercial weather forecasting services that include some combination of forecasts for the current day, next day, 48 hours, 2-to-3 day extended outlooks, and 3-to-5 day extended outlooks. NHEC does not subscribe to a commercial weather service, but monitors a number of weather information sources.
2. UES receives three weather forecast updates upon conditions when an EII of 3 is expected [6 AM, 1 PM, 6 PM]. Liberty receives two weather forecasts [8 AM, 4 PM] regardless of EII indices. PSNH also only receives two weather forecasts [6 AM, 1 PM] regardless of EII indices. All three utilities have the ability to get updates on an as needed basis via 24/7 access to the forecasters.
3. Comparisons of weather forecasts between UES and PSNH differed throughout the forecasting period leading up to the storm even though they were received at exactly the same time and from the same weather service provider.

Examples of this are as follows;

- a. At 6:00 AM EST on Tuesday, November 25, 2014:
  - i. UES received a forecast from Schneider Electric which reflected an **EII of 3 with medium confidence** for the Seacoast and Capital Regions of New Hampshire for Wednesday, November 26. In the narrative of the forecast for UES, Schneider Electric lists details of a chance of EII-4 level snow with a 60% to 80% confidence level between the two UES zones.
  - ii. PSNH received a forecast from Schneider Electric which reflected an **EII of 3 with medium confidence** for the Central South Region, and Western Region of New Hampshire for Wednesday, November 26. In the narrative of

the forecast for PSNH, Schneider Electric lists details of a band of 3 to 6 inches of snow along Central South Region and Western Region of New Hampshire.

- b. At 1:00 PM EST on Tuesday, November 25, 2014:
    - i. UES received a forecast from Schneider Electric which reflected an **EII of 3 with high confidence** for the Seacoast and Capital Regions of New Hampshire for Wednesday, November 26.
    - ii. PSNH received a forecast from Schneider Electric which reflected an **EII of 3 with medium confidence** for the Central South Region, Lakes Region and Western Region of New Hampshire for Wednesday, November 26.<sup>12</sup>
  
  - c. At 6:00 PM EST on Tuesday, November 25, 2014:
    - i. UES received an additional forecast from Schneider Electric which again reflected an **EII of 3 with high confidence** for the Seacoast and Capital Regions of New Hampshire for Wednesday, November 26.
    - ii. **PSNH did not receive a forecast at this time.**
  
  - d. At 6:00 AM EST on Wednesday, November 26, 2014:
    - i. UES received a forecast from Schneider Electric which reflected an **EII of 3 with medium confidence** for the Seacoast and Capital Regions of New Hampshire for Wednesday, November 26.
    - ii. PSNH received a forecast from Schneider Electric which reflected an **EII of 3 with high confidence** for the Central South Region, Lakes Region and Western Region of New Hampshire for Wednesday, November 26.
  
  - e. At 1:00 PM EST on Wednesday, November 26, 2014:
    - i. UES received a forecast from Schneider Electric which reflected an **EII of 3 with high confidence** for the Seacoast and Capital Regions of New Hampshire for Wednesday, November 26.
    - ii. PSNH received a forecast from Schneider Electric which reflected an **EII of 3 with high confidence** for the Central South Region, Lakes Region and Western Region of New Hampshire for Wednesday, November 26.
4. It is noted that although UES and PSNH have geographic service territories, zones or regions which overlap in some areas of New Hampshire, weather forecasts of nearly the same general geographical area for each utility are not consistent with the level of confidence stated for EII levels predicted at very nearly the same time of day for each forecast.

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<sup>12</sup> North Country Region was an EII of 2 with high Confidence; Seacoast South Region was an EII of 2 with medium confidence.

5. The level of detail that UES received in the narrative of the weather forecast for each of their regions within New Hampshire is far greater than the level of detail PSNH received for their regions within New Hampshire. Utilities make important power restoration planning actions as a direct result of the details contained within forecasts.
6. The weather forecasts PSNH receives includes forecasts for all of Eversource’s service territory in Connecticut, Massachusetts and New Hampshire (12 sub regions in total) which includes the PSNH’s five regions within the report. The format supplied by the weather service forecast provider within the written narrative appears to be inconsistently presented from day to day with little emphasis directly on New Hampshire other than an EEI index<sup>13</sup>.
7. PSNH’s New Hampshire forecasts do not align with the Company's five operating regions (Central, Eastern, Northern, Southern & Western), but rather contain five customized weather zones that share similar topography and meteorological features. They are Central South, Lakes Region, North Country, Seacoast South and Western.
8. While not specifically stated within their ERP, PSNH also receives additional weather related data points such as the National Weather Service in Grey, Maine. These additional data points should be useful in validating any one forecast that the utility may rely on for their own “probability of confidence” in a forecast received. While PSNH may have considered the additional National Weather Service information for comparison to the Schneider Electric forecasts for the 2014 Thanksgiving Snowstorm it did not result in any further advancement or implementation of quicker response actions.

**Staff Recommended Corrective Actions Regarding Weather Forecasting:**

1. PSNH should align the geographic regions it receives from the weather forecast service provider with the organizational structured geographic regions it conducts operations from.
2. In addition to the services it currently receives, PSNH should add, at a minimum, a third daily Schneider weather forecast, such as 6:00 PM, when there is a potential for a wide-scale emergency storm event. This additional forecast was previously identified in the Commission’s October 2011 Snowstorm recommendations. PSNH shall exercise its

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<sup>13</sup> Staff is concerned that too much information of a larger geographical area responsibility can be challenging for any one forecaster and has the potential to dilute focus on New Hampshire specific details.

existing contract provisions to receive more frequent written unscheduled proactive forecast updates during potential wide-scale emergency events.

3. PSNH shall include in its ERP a process to evaluate the contracted weather forecast services it currently receives from their weather forecast provider to compare against other public or private available forecast information.
4. PSNH after-action reports submitted to the Commission shall include a post-storm-event critique of the forecast(s) they received from their weather service provider(s) prior to the predicted wide-scale emergency related storm event to determine the accuracy of the predictions they are receiving from their weather forecasting provider. PSNH shall utilize the knowledge obtained from each of their post-storm-event critiques to improve their ERP pre-storm planning and preparedness.

#### **D. Staff Findings and Corrective Actions Regarding Emergency Response**

##### **Staff Findings Regarding Emergency Response:**

1. Although PSNH and UES held internal conference calls and internal emergency response planning meetings throughout the day on Tuesday, November 25, each utility was unable to identify the ultimate magnitude and effects of the 2014 Thanksgiving Snowstorm, and did not obtain a sufficient amount of additional external (from out-of-state) line crews early enough, thereby delaying restoration by at least a day in some communities.
2. Although PSNH and UES did pre-stage additional NH-based contractor line crews for the morning of Wednesday, November 26, additional external line crews from outside the state should have been requested, committed and pre-staged to the largest extent possible.
3. PSNH's "After-Action" self-assessment of the 2014 Thanksgiving Snowstorm failed to identify in their pre-storm planning on Tuesday, November 25 that a larger quantity of external line crews would be required to handle the potential number of customer outages and troubles until the storm actually arrived on Wednesday, November 26, and customer outages and troubles were already occurring.
4. PSNH's "After-Action" self-assessment of the 2014 Thanksgiving Snowstorm failed to identify any type of investigation or questioning regarding their weather forecasts received on Tuesday, November 25. Wording used in PSNH's narratives did not correspond well with the Schneider EII rating. Specifically, within both forecasts

received at 6:00 AM and 1:00 PM on November 25<sup>th</sup> the narrative of the forecast did not reflect criteria consistent with rating of a Schneider EII Level 3 with high confidence. PSNH's after-action review did not recognize the importance of the additional critical narrative detail within the weather forecast which could have been used in making timelier emergency planning decisions.

5. Municipalities are natural partners with utilities. They have the capabilities and an interest to assist in damage assessment and the conveyance of restoration information to local residents. As in past wide-scale emergency storm events, municipalities were not used to the extent they could have been by all utilities to help identify damage. This failure was identified previously in both the December 2008 Ice Storm and October 2011 Snowstorm Reports.
6. PSNH and NHEC did not hold daily municipal conference calls with town officials to inform the municipalities of daily action plans for restoration, where crews were going to be located, nor which were the focus and priorities for restoration. PSNH did utilize their community relations' staff to communicate to municipal officials. PSNH's process of assigning many different utility personnel to communicate with individual municipalities creates a potential miscommunication throughout all municipalities within a geographic region.
7. PSNH's current OMS is inadequate, cannot portray precise numbers of customers affected, and does not depict outages at the street level or Estimated Times of Restoration (ETRs). PSNH has recommitted to replacing its existing system with an improved OMS and commits to having it installed and fully functioning by end of September 2015.<sup>14</sup>
8. The 2014 Thanksgiving Snowstorm arrived on Wednesday, November 26, 2014 which was the day before Thanksgiving Day. As mentioned previously in this report, the timing of the storm event occurred just prior to a major holiday which appears to have had an impact contacting, securing and the arrival of external line crews and support staff. Although PSNH stated that this storm restoration response was not affected by the timing of the storm prior to a major holiday, the documented lag-time associated with the arrival of external line crews strongly suggest differently. During major holiday periods external line crews and restoration resources may not be as easily available as other times when there are no holidays on the calendar. Major Holiday periods are not addressed in any of the four utilities' ERP.
9. PSNH could have improved overall response times between 18 hours and 24 hours.

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<sup>14</sup> As of September 23, 2015, staff has learned PSNH has fully implemented its OMS.

10. Customer outage information regarding when the peak occurred provided by PSNH that originates from its Outage Analysis and Reporting System (OARS) and Trouble Analysis System (TAS) lagged by approximately 14 hours compared to the other utilities.
11. At a minimum, the Holiday “effect” resulted in approximately an additional 5 to 6 hour restoration time for all utilities.
12. UES, Liberty and PSNH did not go to full internal crew capability until many hours after the onset of storm. Liberty never went to its full capability of 13 crews. For a long period including the onset of the storm Liberty’s contractor crews outnumbered their internal crews. PSNH went to full internal crew complement 46 hours after onset of the storm and UES did not have full complement until 27 hours after onset. NHEC had full complement of internal crews from the onset of the storm. It was the single electric provider to do so.

**Staff Recommended Corrective Actions Regarding Emergency Response:**

1. PSNH’s OMS will be fully installed and effectively operable by the end of September 2015. PSNH shall provide the Commission a report on the status and expectations of the utility’s GIS integration with OMS by November 15, 2015. PSNH shall also schedule a demonstration of the utility’s OMS with integrated GIS for Commission Staff by December 1, 2015.
2. All utilities shall add Major Holiday periods in each of their ERPs to address the need to accelerate standard planned actions when monitoring weather forecasts and the need to enhance/anticipate the preplanning and pre-staging of line crews prior to and during Major Holiday periods. These required changes shall be incorporated into each utility’s ERP and shall be filed with the Commission no later than December 31, 2015.

## **E. Staff Findings and Corrective Actions Regarding Restoration Response**

### **Staff Findings Regarding Restoration Response:**

1. UES peak customer outages occurred at about 9:00 PM on Wednesday, November 26 and its pace and timeliness of restoration outpaced all other power providers. Crew levels (line and service) reached peak resources approximately 57 hours after the onset of the storm to a level of 3.4 times that of beginning of the storm.
2. NHEC's customer outages peaked at about 7:00 PM on Wednesday, November 26. NHEC achieved the lowest rate in restoring power to customers because it did not procure the same level of incremental crews beyond the initial levels in place at the onset of the storm until much later in the storm at approximately 97 hours. At that time, peak crew levels reached 1.9 times that of the onset of the storm.
3. PSNH's customer outages peaked at about 11:00 AM on Thursday, November 27. The number of crews deployed did not peak until approximately 85 hours after the onset of the storm. PSNH crew levels in the first 40 hours of the storm were approximately 1.9 times that at the onset of the storm. Once additional crews arrived they made steady progress and restored power rapidly. Crew levels peaked at 5.35 times that of the onset of the storm after approximately 72 hours.
4. Early requests for mutual assistance are critical to having additional resources arrive as quickly as possible and in sufficient quantities.
5. PSNH did not provide the Commission with consistent information regarding line crew levels and availability during the restoration effort of this storm.

### **Staff Recommended Corrective Actions Regarding Utility Restoration Response:**

1. Utilities that procure and coordinate resources through their parent companies shall document those decisions as well as notes of decisions made by the parent utility concerning response and recovery actions. These decision points shall be included in future Post-Storm After-Action Reviews.
2. Each utility shall include in its Emergency Response Plan procedures for pre-staging crews in the event of wide-scale emergencies that have the potential of affecting 10% or

more of customer the base. The Plan shall;

- a) Provide a methodology for determining how many crew resources will be needed based on forecasts.
- b) Pre-establish an available pool of resources.
- c) Factor in travel times.
- d) Incorporate its own historical restoration data as well as relevant data from other utilities from detailed reviews of the most recent wide-scale storms.
- e) Provide for the cancellation of employee vacations as needed for major storm events.

Any changes required are to be incorporated into each utility's ERP and shall be filed with the Commission no later than December 31, 2015.

3. PSNH needs to provide the Commission with consistent information regarding crew levels and availability during wide-scale emergency storm events.

## **F. Staff Findings and Corrective Actions Regarding Utility Communications**

### **Staff Findings Regarding Utility Communications:**

1. During the 2014 November Snowstorm and throughout the resulting restoration efforts, utilities provided outage and other restoration information using websites and social media, which are appropriate, but for those customers without internet access these tools may not be useful. Utility information on the radio is minimal and so generic it provides little assistance.
2. A major concern expressed by customers continues to be the prolonged lack of information on ETRs in any channel of communication. This information was critical to customers' planning on how to deal with the power outages.

A general reaction from customers contacting the PUC Consumer Affairs Division was "This happens far too often and it takes too long for power to be restored. "

### **PSNH**

- a) As late as Friday evening, nearly 60 hours after the storm began, PSNH was still using a global ETR message of "Monday, or sooner" rather than town specific

information. The Commission has stated in its view that this information should reach the street and neighborhood level<sup>15</sup>.

- b) PSNH experienced outage map data inaccuracies and at one point PSNH took the outage map down, making it unavailable to customers for several hours.
- c) PSNH experienced other IT issues during this event as three of its servers went down, impacting some of its network and web access for approximately 12 hours.
- d) On Saturday morning PSNH began reporting town specific ETRs. The term “Substantially Complete” was used as the current status for many towns in the reporting. This created additional stress to customers still without power and provided no meaningful assistance to customers who needed to make decisions regarding their homes and businesses, especially with regard to heat and water for those customers on private wells.

### **NHEC**

- a) The NHEC normal business operations and call center were closed down during the Thanksgiving holiday.
- b) A pre-storm press release/email to members issued on Wednesday morning noted the availability of a toll-free 24-hour outage call center and real-time outage map and restoration information posted to the NHEC web page. Social media would also be used to deliver outage and restoration information on Facebook and Twitter.
- c) Between the close of business on Wednesday until Friday morning, numerous customers reported the NHEC 24-hour toll-free call center was simply a recording that provided global ETR and 211 information about shelters, rather than a live person that could respond to specific questions and concerns.
- c) An email from NHEC to members, providing outage and town specific ETR information, was sent out at 10:02 AM on Friday morning; approximately 47 hours after the storm began.
- d) As of mid-morning Friday, customers calling the call center reported the option to speak with someone live, rather than listening to a recording.

### **UES**

- a) Issued a press release on Thursday, 6:17 PM, with a global ETR expecting the majority of its customers without power to be restored by Friday evening.

3. Callers to the PUC Consumer Affairs Division reported that ETR information from utility

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<sup>15</sup> The Commission previously expressed desire for ETRs see Commission’s October 2011 Snowstorm Report, section III, Findings and Corrective Action page 10.

call centers was equally non-specific during the Thanksgiving Holiday, adding to customer frustration and inhibiting customer ability to plan for their families and/or businesses.

**Staff Recommended Corrective Actions Regarding Utility Communications:**

1. To the extent this is not already being done, utilities shall provide their customer representatives with customer specific ETR information. Websites should provide real-time mapping that shows outage locations with numbers of customers affected at each location, as well as ETRs for each location.
2. PSNH shall incorporate meaningful ETR information into its outage map system, specific to each town, at the start of the restoration phase of a major event.
3. PSNH shall clearly inform customers on its web page when outage system information has been removed from its web pages due to technical or other problems.
4. All electric utilities shall staff their call centers to be able to receive customer calls in real time during a major outage event.

## **IV. Planning and Preparedness**

### **A. Utility Pre-Storm Preparedness Actions**

Pre-storm preparedness actions include general preparations that occur prior to any forecasted storm, as well as more targeted planning activities to respond to a storm's particular circumstances, in this case, the 2014 Thanksgiving Snowstorm. Each utility establishes their emergency planning and response procedures in an Emergency Response Plan (ERP). ERPs are designed by each New Hampshire utility to provide guidelines for effective action in the wake of an emergency event and serves as a manual for personnel involved in emergency response activities. The ERPs set forth an Incident Command Structure, which is an internal decision-making and operational structure based on the National Incident Management System guidelines established by the U.S. Department of Homeland Security. ERPs are submitted to the Commission annually and must be reviewed and updated by each New Hampshire utility at least once a year.

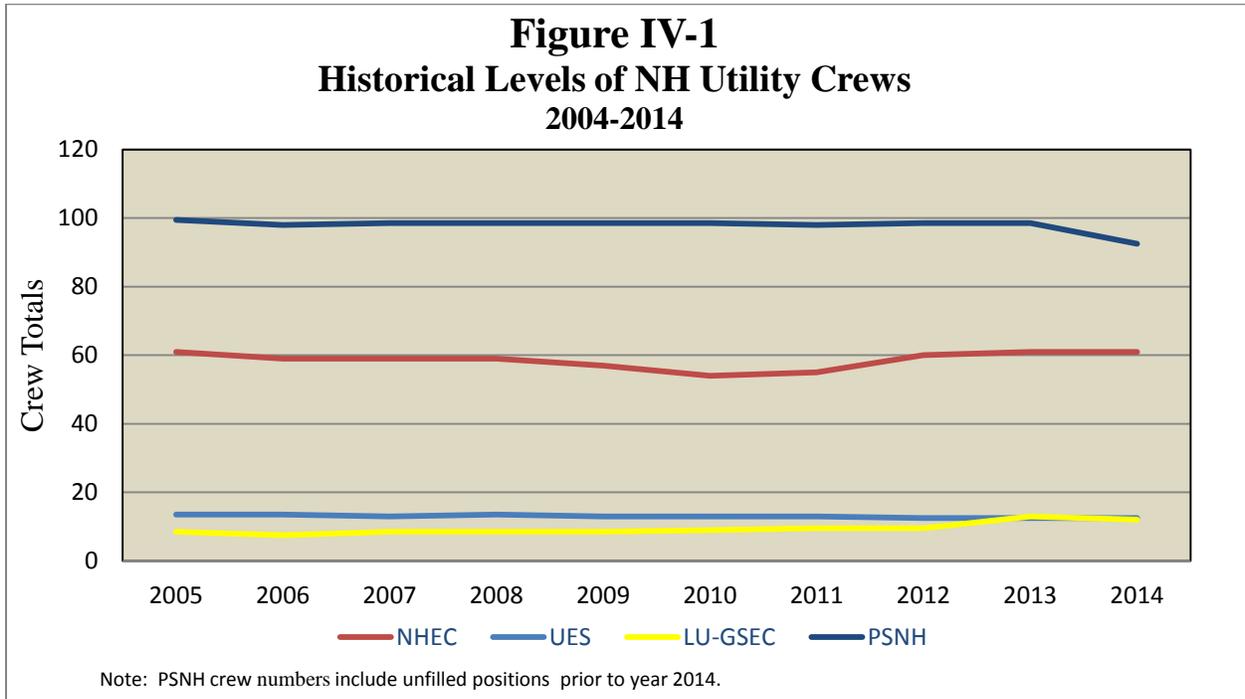
#### **1. Annual Emergency Operation Drills**

The Commission requires at least one full readiness emergency drill and one tabletop exercise per year to maintain proficiency in emergency response skills and to educate and train new participants. The emergency events simulated during the annual drill generally are wide-scale emergency storm events, with drill activities focused on preparing for total mobilization. As required, all companies held practice drills within their organizations in 2014. These were all completed prior to the 2014 Thanksgiving Snowstorm. All companies review the performance of their own drill and implement changes to their ERPs if deficiencies are noted. All NH utilities are required to invite applicable state agencies, including state regulators to participate in their drill exercises. UES and LU also invite municipal officials to participate in their drill exercises. All companies conduct announced drills so that the employees involved can effectively plan their schedules and to avoid conflicts regarding commitments related to serving customers.

#### **2. Historical Levels of Utility Crews**

Reference footnote 8 page 5 for definitions of a crew. A review of each utility's distribution line crew levels maintained during the past decade indicates that field staffing levels have remained fairly constant since 2005 (see Figure IV-1 below). Nonetheless, PSNH shows a decline in their number of distribution line crews during the past year. For 2014, the PSNH total available crews declined by six (6) when compared to the number reported for 2005, reflecting a 7% net reduction. According to PSNH, the crew numbers reported from 2005 through 2013 included

unfilled positions, while the 2014 total no longer includes unfilled positions<sup>16</sup>. LU has increased its crews since 2012 from 8.5 crews to 12 crews, a 40% increase. NHEC and UES have remained constant.



### 3. Overall Utility Determination of Storm Resource Requirements

Pre-storm restoration prediction models are critical in determining storm resource requirements. Prediction model inputs should include region-specific weather forecasts for each utility, as well as estimated system impacts based on each utility’s historical wide-scale emergency storm restoration efforts for each of their regions, and should incorporate each utility’s storm restoration experience and knowledge. Common inputs into restoration prediction models include levels of wet snow, ice thickness, time of year, wind speeds, and forecast confidence levels. Each of these factors can influence the extent of damage that occurs to each utility’s electrical distribution system during wide-scale emergency storm events.

Restoration prediction, which takes various forms, enhances each utility’s preparedness and response by indicating the expected magnitude of the wide-scale emergency storm event for which the utility should plan, based on particular forecasts from their contracted weather

<sup>16</sup> Reference Figure IV-1, PSNH didn’t provide consistent reporting of crew levels throughout the 10 year period regarding unfilled positions.

forecast provider(s). Modeling practices vary among the four electric providers.

Each utility has included some form of ERP Event Levels, not necessarily in the format outlined in the PUC 300 rules for Electric Service [NH PUC 306.09(g)] for reporting purposes in their ERP plans (see Table IV-1). ERP Event Levels categorize predicted storm events by the anticipated event level of severity. Predicted levels of severity are based upon the information known at the time of the estimation, including the amount of customer outages, and the duration of the outages.

For clarification, prior to the onset of a forecasted wide-scale emergency storm event, the anticipated ERP Event Level reflects, the current estimated damage of a utility’s electrical distribution system, and the projected effect on a utility’s customer base during the preplanning process of a wide-scale emergency storm event.

**Table IV-1**  
**NH Public Utilities Commission**  
**Puc 306.09(g), Table 306-1**

Utility	ERP Event Level	% Customers Out	Outage Duration (Hrs.)
Applies to All Utilities	5	≤2	<12
	4	>2≤5	0-24
	3	>5 ≤10	24-48
	2	>10≤20	48-144
	1	>20	48-240

When utilized effectively in pre-storm planning, ERP Event Levels are a critical means to categorize forecasted weather events prior to their arrival. ERP Event Levels assist in the prediction of the potential impacts on a utility’s electrical distribution system which leads to the prediction of the potential impacts on a utility’s customer base. Prior to the onset of a forecasted weather event, factors embedded into a utility’s weather forecasting service accompanied with a confidence level combine to generate a predicted event impact index level (EII).<sup>17</sup> Each utility provides to the weather forecasting service the inputs used determine the EII level for each weather factor. These weather event levels do not directly correspond to utility ERP Event Levels. It is only when the EII is coupled with recent historical wide-scale events that the utility has essential information to effectively begin a process of pre-staging internal and external line crews, and procuring outside resources, if appropriate. This is a critical point when the utility has the information necessary to determine the associated resource needs and to activate those resources in a timely manner. It is imperative that the utility make early decisions regarding resource attainment so as to not compromise the safety and operations of the state, municipalities, businesses, and residents. These effective pre-storm planning procedures allow the utility to efficiently begin the storm related restoration process as quickly and safely as

<sup>17</sup> Note: PSNH uses term EII = Event Impact Index, Unitil uses as similar term as EII – Estimated Impact Index

possible.

Not all companies are effectively using ERP Event Levels to predict the potential effects on their electrical distribution systems prior to forecasted wide-scale emergency storm events. This is a vital step for companies to assist in predetermining the number of customer outages and related troubles. This predetermination is necessary to assist a utility in assessing the potential number of line crews required to ensure the timeliest restoration of their customers' electrical service.

#### **4. Individual Utility Methodology of Storm Resource Requirements**

##### **NHEC**

NHEC does not use a commercial pre-storm restoration prediction model.

NHEC uses a system of five priority “Levels” assigned during potential events, relating to the number of members affected, the amount and complexity of damage, estimated restoration times, available resources (personnel), and the number of service restorations required, all based on NHEC historical storm event data and experiences. The NHEC priority levels are scaled from 1 to 5, where level 1 is considered “Normal” and level 5 is considered “Full Scale”, an event expected to have more than 20,000 outages. While the NHEC priority levels do not correspond precisely to the Commission’s defined ERP Event Levels as spelled out in PUC 300, Table 306-1, NHEC has incorporated the concept of Event Levels that allows clear communication with the Commission and identifies the quantity of crews anticipated.

NHEC develops estimated times of restoration (ETRs) after the onset of a storm using data obtained from member calls into the Member Solution Call Center where the information is then entered into the Outage Management System (OMS). During non-business hours member calls are received at the NHEC Control Center. The Control Center operated 24/7 and the outage information is entered into the OMS. Overflow calls are channeled into the NHEC Interactive Voice Response (IVR) system, where the information is then populated into the OMS. The 2014 Thanksgiving Snowstorm did not incorporate the recently installed “smart meter” features to enhance outage information.

NHEC has established a predicted potential number of line crews required to handle the restoration effort reflected in each of its identified Event Levels detailed in its ERP Plan, which include levels for a wide-scale emergency storm event. NHEC’s ERP does not, however, specifically call out pre-stage external line crews prior to a forecasted wide-scale emergency storm event. See Table IV-2 for a summary of the NHEC priority levels.

**Table IV-2  
New Hampshire Electric Cooperative  
Emergency Response Event Levels (Summarized)**

Utility	ERP Event Level	Number of Customers Out	Outage Duration (Hrs.)	Anticipated Crew Levels
NHEC	1 – Normal Operations	Zero to Minimal	Minimal, Non-Event	Normal Daily Crew
	2 – Upgraded Alert	Up to 2,000	Within 24 Hours	Normal Daily Crew
	3 – Heightened Alert	≤ 4,000	Possible Multi-Day	Normal + 15 to 20 NHEC+ 15 to 20 contract crews
	4 – Extreme Weather	≤ 20,000	Multi-Day	Normal + 15 to 20 NHEC+ 15 to 25 contract crews
	5 – Full Scale	> 20,000	Multi-Day	Normal + 15 to 20 NHEC+ 25 to 30 contract crews

**UES**

UES does not use a commercial pre-storm restoration prediction model. It uses a classification system to determine actions that are done at 3 days ahead, 2 days ahead, 1 day ahead, and the opening of the System-wide EOC. Specific tasks are assigned for each of the milestone points including resource acquisition.

For its pre-planning activities, UES uses Weather Alert Levels in its ERP that begin with the Schneider Weather Forecast predicted EII Levels. For the 2014 Thanksgiving Snowstorm the Schneider Levels were scaled 5 through 1, with a level 5 being isolated general storms and a level 1 being a catastrophic storm event.<sup>18</sup> UES reviews each weather forecast in detail as part of a comprehensive after-action report. In its after-action report, UES attempts to determine the accuracy of the weather forecast to actual conditions as well as damages incurred. For the 2014 Thanksgiving Snowstorm, UES requested a separate Schneider self-assessment as part of its internal after-action report. UES was concerned with the lack of advance notice of the forecasted event, as well as the accuracy. Table IV-3 shows the EII levels used by UES.

UES then translates the Schneider EII level into its Unitil Event Type (scaled 5 through 1, with an Event Type 1 carrying the most significant potential for outages and damages and an Event Type 5 being a typically normal operations day). UES considers Event types 1, 2 and 3 as

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<sup>18</sup> The Unitil ERP of May 2014 used EII levels 5 for least impact through 1 for most impact. The Unitil ERP of May 2015 has since reversed the EII scale as 1 for least impact through 5 for most impact. Schneider had suggested that Unitil change for consistency among utilities and other weather event scales such as the Saffir-Simpson Hurricane Wind Scale.

“Emergency Events”. The Unitil Event Types do not correspond precisely to the Commission’s defined ERP Event Levels as spelled out in PUC 300, Table 306-1. UES does predict the potential number of line crews that will be required to handle the restoration efforts reflected in each of its identified ERP Event Types during wide-scale emergency storm events. UES has a process to pre-stage internal and external line crews prior to a forecasted wide-scale emergency storm event when that event is forecasted by the UES’ weather forecasting service with a high confidence level. See Table IV-4 for a summary of the Schneider Weather Forecast Weather Alert Level and Unitil Event Types.

**Table IV-3  
Schneider Electric – Energy Event Index for UES**

	<i>Wind</i>				<i>Snow<sup>19</sup></i>		<i>Ice Accretion</i>
	<i>With Leaves Apr - Oct</i>		<i>Without Leaves Nov - Mar</i>		<i>With Leaves Apr - Oct</i>	<i>Without Leaves Nov - Mar</i>	<i>Year Round</i>
	<i>Sustained mph</i>	<i>Gusts mph</i>	<i>Sustained mph</i>	<i>Gusts mph</i>	<i>Snow in Inches</i>	<i>Snow in Inches</i>	<i>Ice in Inches</i>
<i>EII-5</i>	< 30	< 35	< 40	< 45	< 4	< 6	-
<i>EII-4</i>	>= 30	>= 35	>= 40	>= 45	>= 4	>= 6	>1/10
<i>EII-3</i>	>= 45	>= 50	>= 50	>= 55	> 6	> 8	> 3/8
<i>EII-2</i>	>= 60	>= 65	>= 60	>= 70	> 12	> 12	> 1/2
<i>EII-1</i>	>= 70	>= 75	>= 70	>= 85	> 24	> 24	> 1

<sup>19</sup> UES Table Amounts assume low moisture content. UES requests notification alerts when wet snow amounts are predicted to be more than 2 inches.

**Table IV-4  
Unitil Energy Systems  
EII Alert Levels vs. Unitil Event Types (Summarized)**

<b>Schneider EII Level</b>	<b>Weather Conditions</b>	<b>Unitil Event Type</b>	<b>Estimated Outage/ Damage Potential</b>	<b>Outage Duration (Hrs.)</b>	<b>Anticipated Crew Levels</b>
5	Isolated general storms (Light lightning, <30 mph wind gusts)	5	None to very few	Minimal, Non-Event, Normal Operations	Normal Daily Crew 12 + 8 contract crews
4	Scattered strong storms isolated 30-50 mph wind gusts)	4	Isolated	<= 24 hours	Normal Daily Crew 12 + 10 contract crews
3	Strong storm (Moderate/severe lightning, recurring 30-50 mph gusts)	3	Typically, 5% - 10%	Possible Multi-Day Event; Greatest uncertainty >= 36 hours < =72 hours	Normal Daily Crew 12 + 10 to 40 contract crews
2	Severe widespread storm (Moderate/severe lightning, widespread gusts >50 mph, tornadoes, tropical storms )	2	Typically, 25% - 50%	Multi-Day Event > 72 hours <= 120 hours	Normal Daily Crew 12 + 10 to 50 contract crews
1	Catastrophic storm (Hurricane, major Nor'easter, widespread wind gusts >75 mph)	1	Extensive, Typically, > 50%	Multi-Day Event > 120 hours	Normal Daily Crew 12 + 100 contract crews

**LU**

LU is using the PUC 300 Table 306-1 ERP Event Levels in its ERP plan to effectively communicate the level of a wide-scale emergency storm even to the Commission. LU also has predicted the potential number of line crews required to handle the restoration effort reflected in each ERP Level Event during a wide-scale emergency storm event. LU does have a process to pre-stage internal and external line crews prior to a forecasted wide-scale emergency storm event when that event is forecasted by the utility’s weather forecasting service with a high confidence level.

LU does not currently use its Outage Management System (OMS) as a pre-storm restoration prediction modeling tool. Instead, it develops Estimated Times of Restoration (ETRs) after the onset of a storm based on data obtained from its Outage Management System (OMS), information drawn from its automated customer call-in system, and information obtained through the damage assessment process by a Damage Appraisal Patroller in the field. LU’s local work center supervisors develop ETRs using all of this information, including historical utility data, past experience, weather conditions and available line crews assigned to each trouble.

**Table IV-5  
Schneider Electric – Energy Event Index for LU**

<i>Level 20</i>	<i>Wind</i>				<i>Snow</i>		<i>Ice Accretion</i>
	<i>With Leaves Apr - Oct</i>		<i>Without Leaves Nov - Mar</i>		<i>With Leaves Apr - Oct</i>	<i>Without Leaves Nov - Mar</i>	<i>Year Round</i>
	<i>Sustained mph</i>	<i>Gusts mph</i>	<i>Sustained mph</i>	<i>Gusts mph</i>	<i>Snow in Inches</i>	<i>Snow in Inches</i>	<i>Ice in Inches</i>
<i>EII-5</i>	< 30	< 35	< 40	< 45	< 2	< 4	-
<i>EII-4</i>	>= 30	>= 35	>= 40	>= 45	>= 4	>= 6	> 1/10
<i>EII-3</i>	>= 45	>= 50	>= 50	>= 55	> 6	> 8	> 3/8
<i>EII-2</i>	>= 60	>= 65	>= 60	>= 70	> 12	> 12	> 1/2
<i>EII-1</i>	>= 70	>= 75	>= 70	>= 85	> 15	> 24	> 1

**Table IV-6  
Liberty Utilities – Electric Operations  
Classification of Emergency Types (Summarized)**

<b>ERP Event Type</b>	<b>% of Customer Outages</b>	<b>Outage Duration (Hrs.)</b>	<b>Anticipated Crew Levels</b>
5 – Small Impact	≤ 2%	< 12 Hrs.	Normal Daily, Local Crews (< 5)
4 – Moderate Impact	> 2% ≤ 5%	0 – 24 Hrs.	Normal Daily, Local Crews, 5 – 10 Contract Crews
3 – Serious Impact	> 5% ≤ 10%	24 – 48 Hrs.	Normal Daily, Local Crews, 10 – 20 Contract Crews
2 – Major Impact	> 10% ≤ 20%	48 – 144 Hrs.	Normal Daily, Local Crews, 20 – 30 Contract Crews
1 – Catastrophic Impact	> 20%	48 – 240 Hrs.	Normal Daily, Local Crews, > 30 Contract Crews

**Eversource/PSNH**

At the time of the 2014 Thanksgiving Snowstorm event, PSNH was operating under its 2013 Emergency Response Plan, which was adopted in December 2013. PSNH was also in a

<sup>20</sup> LU Table Amounts from ERP 7/1/2014, did not specifically list Schneider EIIs but the descriptions matched and aligned with the ERP Event Levels. Staff noticed the foliage criteria was reversed as well as the general description on p. 2 of Event Levels were also reversed. As of ERP 8/5/2015 these have been corrected although Table IV-3 is no longer included in the ERP.

transition period, moving toward utilizing Eversource Energy’s Emergency Response Plan in which revision 1 was submitted to the NHPUC on March 5, 2015<sup>21</sup>. Various terms used in PSNH 2014 Thanksgiving Snowstorm related documents that have been submitted to the Commission have reflected information derived from portions of both versions. For this Planning and Preparedness section of the Commission after-action report there are two key tables that PSNH used during the 2014 Thanksgiving Snowstorm Event. The first table is the Schneider Electric (specialized weather forecaster) Energy Event Index (EII),<sup>22</sup> which was detailed in Appendix U of the 2013 ERP and is now a supplemental document to the 2015 plan. See Table IV-7 below for the Schneider Electric Energy Event Index. The second table is the Readiness Conditions Table, described in detail in section 2 of Eversource Energy’s Emergency Response Plan. Unless referenced otherwise, this section of the Commission after-action report will reference the terms used in the Eversource Energy Emergency Response Plan that was issued on March 5, 2015.

**Table IV-7  
Schneider Electric – Energy Event Index for PSNH**

	<i>Wind</i>				<i>Snow</i> <sup>23</sup>		<i>Ice Accretion</i>
	<i>With Leaves Apr - Oct</i>		<i>Without Leaves Nov - Mar</i>		<i>With Leaves Apr - Oct</i>	<i>Without Leaves Nov - Mar</i>	<i>Year Round</i>
	<i>Sustained mph</i>	<i>Gusts mph</i>	<i>Sustained mph</i>	<i>Gusts mph</i>	<i>Snow in Inches</i>	<i>Snow in Inches</i>	<i>Ice in Inches</i>
<i>EII-1</i>	< 30	< 35	< 40	< 45	< 4	< 6	< 1/10
<i>EII-2</i>	>= 30	>= 35	>= 45	>= 45	>= 4	>= 6	>= 1/10
<i>EII-3</i>	>= 45	>= 50	>= 50	>= 55	> 6	> 8	> 3/8
<i>EII-4</i>	>= 60	>= 65	>= 60	>= 70	> 12	> 12	> 1/2
<i>EII-5</i>	>= 70	>= 75	>= 70	>= 85	> 24	> 24	> 1

PSNH uses the Eversource Energy Readiness Conditions model to monitor, assess, and prepare for events that have the potential to impact the all of Eversource’s service territories within New England. This approach is used internally to predefine Readiness Conditions and to communicate each Operating Company’s or Business Unit’s readiness posture. The Readiness Conditions identified in its ERP, as defined in section 2.4, include the following four conditions: *Normal*, *Monitoring*, *Warning* and *Emergency*. See Table IV-8 below for the Eversource Energy Readiness Conditions.

<sup>21</sup> The Eversource Energy revision 1 (2015) ERP references a revision 0 version that was developed in the spring of 2014. See section 11.1, Eversource Energy 2015 ERP.

<sup>22</sup> PSNH uses the term EII (Energy Event Index) which is equivalent to the term EII (Estimated Impact Index) throughout its ERP and Weather Forecasts received.

<sup>23</sup> PSNH Table Amounts assume low moisture content.

**Table IV-8  
PSNH ERP Readiness Conditions**

<b>Readiness Condition</b>	<b>Normal</b>	<b>Monitoring</b>	<b>Warning</b>	<b>Emergency</b>
Situational awareness of resources and systems	X	X	X	X
Mobilization of resources		0	0/X	X
Activation of Incident Management Teams			Notification/ Standby	X
Activation of Emergency Coordination Team			Notification/ Standby	0 / X
Activation of Executive Oversight Group			Notification	0

X - Likely

0 – Possible

Generally speaking, a readiness condition of “Normal” would indicate normal everyday operations, while a readiness condition of “Emergency” would indicate emergency event conditions are imminent and it has been predicted that conditions could cause or have caused significant impact on one or more of Eversource’s Business Units. Everyday operations would also be performed under a readiness condition of “Monitoring”, but some or all of the Company’s Operations or Business Units would be working under a heightened level of situational awareness. General everyday operations are also being performed under a readiness condition of “Warning”, but conditions are developing or are soon to exist that have a relatively high probability of impacting one or more of Eversource’s Business Units. Mobilization of internal resources and acquisition of (some) external resources are considered and could begin. In general, PSNH prepares for activation of its Incident Command Center (ICC) when it is anticipated that there could be 200 or more outage troubles and 10,000 or more customers without electric service. When possible, advance warning advisories are issued by NH Electric Operations Emergency Preparedness prior to the declaration of an emergency.

Prior to the 2014 Thanksgiving Snowstorm, PSNH did not incorporate written Event Levels as shown in Table IV-1 into the 2014 Emergency Response Plan and the 2014 ERP was not submitted to the Commission. The Event Levels specified by the Commission became effective May 2014. In the most recent March 2015 ERP edition, PSNH does include the Commission’s ERP Event Levels and “notes that the State of New Hampshire references for reporting.” The plan does not explicitly provide a clear path for the user to connect the PSNH Schneider Event Index of Table IV-7 to Readiness Conditions Levels of Table IV-8 or to the Commission’s ERP Event Levels of Table IV-1.

Staff could not find within PSNH’s plan any meaningful process that predicts the amount of customer outages and global estimated duration of restoration. PSNH has stated “each storm is

unique and that this cannot be done.” This lack of prediction process is similar to the Commission’s finding for PSNH in the 2011 Snowstorm Report.

PSNH does not predetermine the potential number of line crews required to handle the restoration effort reflected in each ERP Level Event during a wide-scale emergency storm event. PSNH does not have plans in their March 5, 2015 ERP for pre-staging external line crews prior to a forecasted wide-scale emergency storm event. Nonetheless, Staff notes that PSNH did pre-stage external crews from company affiliates prior to the onset of the forecasted ice storm in December of 2013. Although the December 2013 storm ultimately did not impact New Hampshire and PSNH’s service territory, PSNH did effectively pre-stage with company affiliated out-of-state line crews and external contractor line crews, in preparation to begin the restoration process once the forecasted ice storm had wound down. The Staff also notes that the company affiliates were not affected by or forecasted to have potential impacts from the ultimately non materializing December 2013 ice storm.

PSNH still does not detail in their most recent ERP when the utility will pre-stage line crews prior to the onset of a forecasted wide-scale emergency storm event.

Staff notes that on October 26, 2012, PSNH filed a Petition for Recovery of Pre-staging Costs through the Major Storm Cost Reserve (MSCR). PSNH proposed to employ an Energy Event Index with five escalating levels of storm severity. For weather events having a “high” probability, that is, greater than 60% of reaching EII Level 3, pre-staging costs would be charged to the MCSR. On February 26, 2013, the Commission issued Order 25,465 approving PSNH’s petition for recovery of pre-staging costs through its Major Storm Cost Reserve, as modified by the December 19, 2012 revised testimony.

During Staff’s meeting with PSNH, PSNH referenced the elements contained in the Major Storm Cost Reserve Order, and stated that those elements affect the determination of pre-staging crews.

Staff emphasizes that the Major Storm Cost Reserve is not the only mechanism to recover pre-staging costs; it is one of several remedies available. The recovery mechanisms should have no bearing on the attainment of resources for wide-scale storm events.

Like the other utilities, PSNH does not currently use any formal pre-storm restoration prediction method. As noted in the October 2011 Snowstorm report, PSNH continues to use an in-house spreadsheet calculation process after the storm’s onset. The calculation is to estimate the number of crews required to restore power within a set timeframe based on the number of crews available and historical utility data regarding the average time needed per crew to correct each trouble in storm events. No weather or event-specific data are input into the spreadsheet calculations and individual runs conducted in the lead-up to a storm are not saved. Rather, PSNH enters in the

number of troubles reported during the course of a storm event and uses an average restoration time of so many hours per trouble, based on current weather conditions and damage assessment, to estimate the number of crews needed. Calculations are not begun until after the onset of a storm when damage and outages have occurred. Thus, there appears to be no formal methodology for predicting additional resource requirements before a wide-scale emergency storm event occurs.

PSNH has stated that they are committed to placing a new OMS into service in September 2015 which will improve restoration modeling and execution<sup>24</sup>. See Appendix D for OMS recommendations from the October 2011 Snow Storm report.

## **B. November 2014 Snowstorm Weather Monitoring and Analysis**

Weather forecasts are used to predetermine the potential effect on a utility's electrical distribution system during a wide-scale emergency storm event, to determine a utility's resources required, to effectively respond to a major storm event, and to determine where a utility's resources should be deployed before the storm hits the utility's service territory. All four electric companies include the ERP Event Levels in their ERP plan, thereby results in communications to the Commission about wide-scale emergency storm events that are consistent.

### **1. Company Weather Monitoring Services Used in Generic Weather Events**

PSNH, UES and LU have contracts for meteorological services with Schneider Electric, who purchased Telvent DTN, the company that previously supplied the meteorological services. Each contract provides for forecasts by region and service territory, including a daily operating forecasts delivered via e-mail at least twice per day. In general, the contracts cover the following weather events:

- Thunderstorms (including probability of occurrence, timing and intensity);
- Heavy rain and snow;
- Strong winds (including gusts and sustained wind speeds);
- Ice accumulation from freezing rain;
- Tropical and hurricane events; and
- Lightning
- Forecasted EII levels based on each utility's criteria for the above factors
- The forecaster's confidence level (Low, Medium, High) of each EII level forecasted

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<sup>24</sup> As of September 23, 2015, staff has learned PSNH has fully implemented its OMS.

The forecasting service also includes 24 hours a day, 7 days a week availability of updates for the specified utility service area, including impacts that have the potential to disrupt operations, and automatic notification of weather events that meet pre-defined threshold conditions contained in the contracts.

NHEC does not subscribe to a commercial weather service, but monitors a number of weather information sources. NHEC's control center is staffed 24 hours a day 365 days a year and monitors weather through the NWS storm prediction center on the National Oceanic and Atmospheric Agency's (NOAA's) website, [www.spc.noaa.gov](http://www.spc.noaa.gov), and the forecasts of Intellicast at [www.intellicast.com](http://www.intellicast.com), as well as several local news and weather stations, including the National Weather Service out of Gray, Maine; New England Cable News out of the Boston area; and WMUR-TV 9 out of Manchester.

## **2. Event Summary of Forecasts used by PSNH and UES**

Staff notes that at 1:00 PM EST on Tuesday, November 25, 2014, UES received a forecast from Schneider Electric which reflected an EII of 3 with high confidence for the Seacoast and Capital Regions of New Hampshire for Wednesday, November 26. Staff also notes that at 1:00 PM EST on Tuesday, November 25, 2014, PSNH received a forecast from Schneider Electric which reflected an EII of 3 with medium confidence for the Central South Region, Lakes Region and Western Region of New Hampshire for Wednesday, November 26<sup>25</sup>.

UES also received another forecast from Schneider Electric at 6:00 PM EST on Tuesday, November 25, 2014 which again reflected an EII of 3 with high confidence for the Seacoast and Capital Regions of New Hampshire for Wednesday, November 26. There is no corresponding 6:00 PM EST estimate for PSNH.

At 6:00 AM EST on Wednesday, November 26, 2014, UES received a forecast from Schneider Electric which reflected an EII of 3 with medium confidence for the Seacoast and Capital Regions of New Hampshire for Wednesday, November 26. At 6:00 AM EST on Wednesday, November 26, 2014, PSNH received a forecast from Schneider Electric which reflected an EII of 3 with high confidence for the Central South Region, Lakes Region and Western Region of New Hampshire for Wednesday, November 26.

At 1:00 PM EST on Wednesday, November 26, 2014, UES received a forecast from Schneider Electric which reflected an EII of 3 with high confidence for the Seacoast and Capital Regions of New Hampshire for Wednesday, November 26. At 1:00 PM EST on

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<sup>25</sup> Reference section IV.B.4 below for greater detail related to the Schneider weather forecasts received by PSNH and UES.

Wednesday, November 26, 2014, PSNH received a forecast from Schneider Electric which reflected an EII of 3 with high confidence for the Central South Region, Lakes Region and Western Region of New Hampshire for Wednesday, November 26.

The Staff concludes the following:

- There is inconsistency between companies on the confidence levels of the forecasts given by the same weather forecast service provider at the same time.
- UES receives 3 daily forecasts once an EII 3 level is achieved while PSNH only receives 2 daily forecasts regardless of the EII level.
- Even though each utility supplies the criteria for EII levels to be reported by the forecast weather service provider, there appears to be few differences if any in respective EII levels.
- PSNH New Hampshire forecasts do not align with the Company's five operating regions (Central, Eastern, Northern, Southern & Western)<sup>26</sup>, but rather five customized weather zones that share similar topography and meteorological features. They are Central South, Lakes Region, North Country, Seacoast South and Western.
- UES New Hampshire forecasts do align with the Company's two operating regions. (Seacoast and Capital)

### 3. Publicly Available Weather Forecasts

As early as Friday, November 21, 2014, publically available weather forecasters were talking about a potential storm for the Thanksgiving time period. By Monday, November 24, weather forecasts on the Internet, television and radio were predicting a significant storm for the New England region. The predicted storm did not present a high confidence factor for specific sub-regions within New England. This appeared due to the unusually warm weather temperatures present in New England during Monday, November 24 and Tuesday, November 25. Forecasters consistently predicted heavy rain turning to heavy snow, but were unable to pinpoint where and when the changeover would occur. Toward the evening of Tuesday, November 25, local forecasts were **consistently** predicting heavy wet snow to affect central and southern regions of New Hampshire by noon on Wednesday, November 26. Ultimately, heavy rain did changeover to heavy wet snow by noon on Wednesday, November 26 as the Tuesday forecasts predicted.

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<sup>26</sup> Reference Appendix B for map depicting PSNH operating regions

Below are examples of information available to the public during the time leading up to the storm.

## Monday, November 24, 2014 - WMUR at 5 AM



(Commission-captured screen shot)

This is the news 9 weather report for November 24, 2014 at 5:00 AM

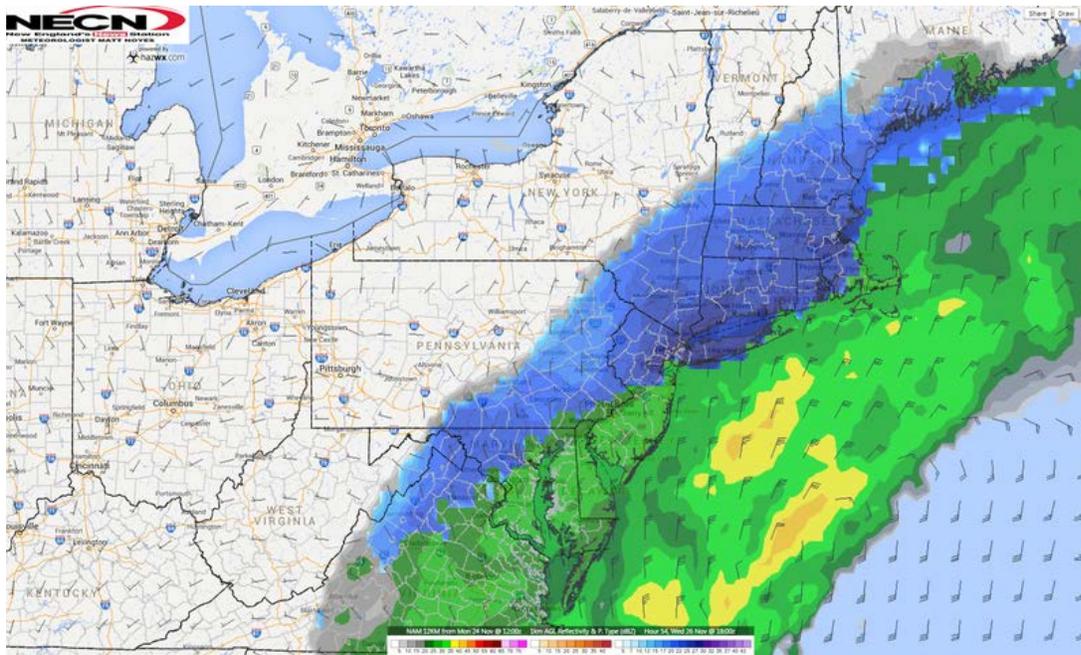
<https://www.youtube.com/watch?v=-s2kQILRbA0>

## Monday, November 24, 2014 -NECN at 1:30 PM

### Already-busy travel Tuesday likely to be best travel day for weather, Wednesday snow & rain ahead

Travel south out of New England will be slow, right out of the gate, Wednesday morning, with rain along Interstate 95, and snow in the mountains and hills of Virginia, West Virginia and Pennsylvania.

Thereafter, the storm will move north and impact New England with rain, changing to snow for many, though not all. This storm, as of this Monday writing, has remarkably low predictability - in other words, if you examine all possible scenarios for Wednesday into Wednesday night and look for agreement, you'll find no more than 10% of the available solutions in agreement. What this suggests, is that you, the user of forecast information, and I, the meteorologist, should be very careful how much trust we put in the details. That is, a forecast of rain moving in and changing to snow, particularly through the interior, during the day Wednesday, is a pretty safe forecast. Issues of rain/snow line placement, hour-by-hour forecasts, and precise snow amounts will very likely be broadcast today, but the uncomfortable part about this, is you're walking a razor-thin margin, scientifically, if you put too much trust in these solutions that cannot carry more than 10% predictability. So...I encourage all to take the storm forecast into account and do our best to plan around it - a miss is not at all likely, and even rain would substantially impact travel Wednesday. That said, use caution, particularly on the southeast side of the forecast snow shield, as a deviation farther northwest is still quite possible. For now, here's the "best estimate" of Wednesday afternoon's map, around 1 PM:



(Commission-captured screen shot)

NECN Weather report for November 24, 2014 at 1:30 PM

[http://www.mattnoyes.net/new\\_england\\_weather/2014/11/already-busy-travel-tuesday-likely-to-best-travel-day-for-weather-wednesday-snow-rain-ahead.html](http://www.mattnoyes.net/new_england_weather/2014/11/already-busy-travel-tuesday-likely-to-best-travel-day-for-weather-wednesday-snow-rain-ahead.html)



(Commission-captured screen shot)

NECN Weather report for November 24, 2014 at 1:30 PM

[http://www.mattnoyes.net/new\\_england\\_weather/2014/11/already-busy-travel-tuesday-likely-to-best-travel-day-for-weather-wednesday-snow-rain-ahead.html](http://www.mattnoyes.net/new_england_weather/2014/11/already-busy-travel-tuesday-likely-to-best-travel-day-for-weather-wednesday-snow-rain-ahead.html)

## Tuesday, November 25, 2014 – USA TODAY at 6:19 PM

Though the precipitation will start as rain early Wednesday, as much as a half-foot of snow is possible in the New York City area, according to the National Weather Service. Totals for the other big cities include 1-3 inches in Boston and Philadelphia and maybe an inch in Washington, D.C.

But much more snow is forecast just to the north and west of the big cities: "Heavy snow is likely to begin in the central Appalachians early Wednesday morning, spreading northeast through the interior Mid-Atlantic into New England by Wednesday night," the weather service reports.

"In most cases, the worst time to travel in the mid-Atlantic and New England due to the storm will be on Wednesday and Wednesday night," said AccuWeather meteorologist Elliot Abrams.

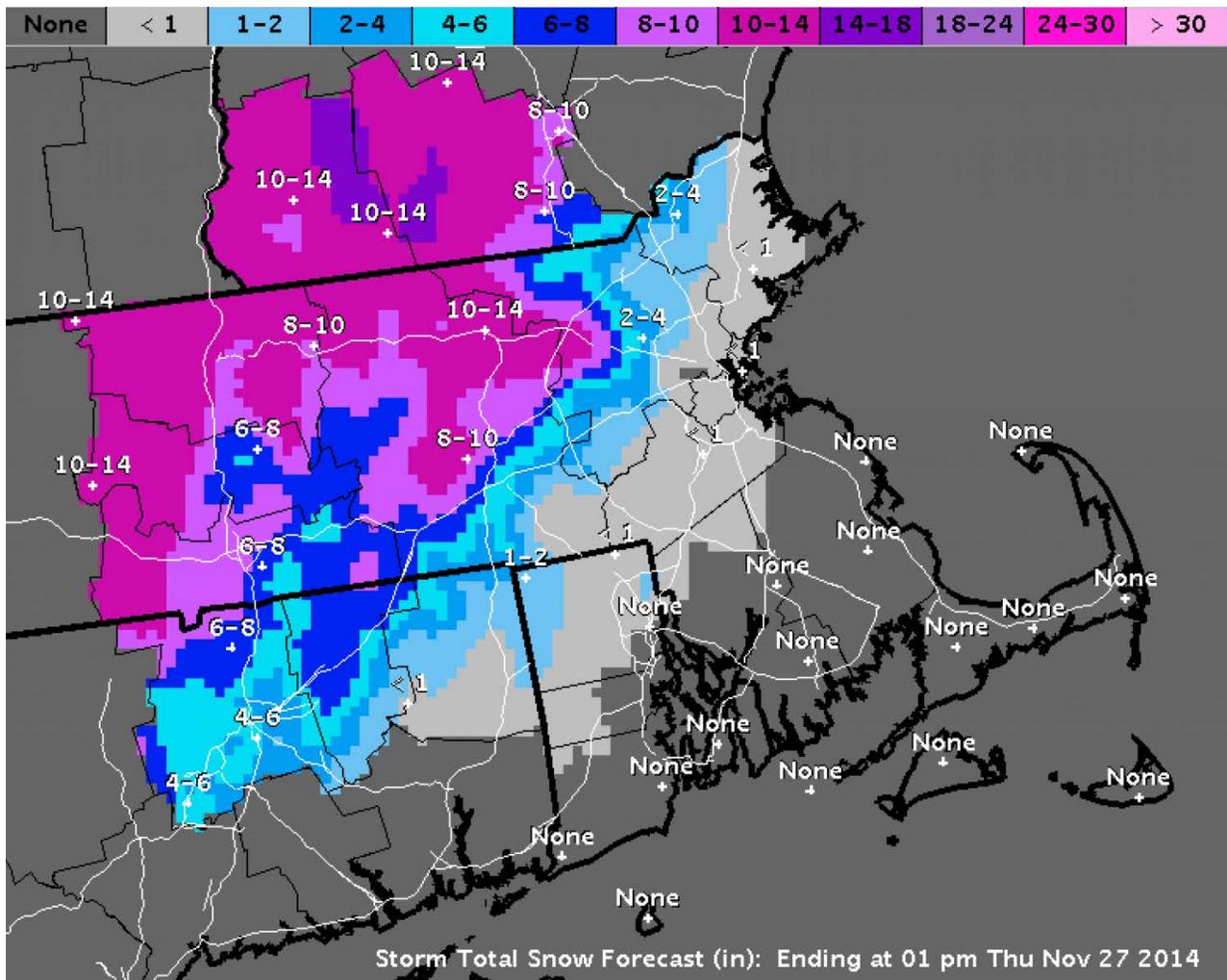


(Commission-captured screen shot)

This is the USA Today weather report for November 25, 2014 at 6:19 PM

<http://www.usatoday.com/story/weather/2014/11/25/winter-storm-east-coast-thanksgiving/70084800/>

## Wednesday, November 26, 2014 - Washington Post at 2:20 PM.



NOAA / National Weather Service



(Commission-captured screen shot)

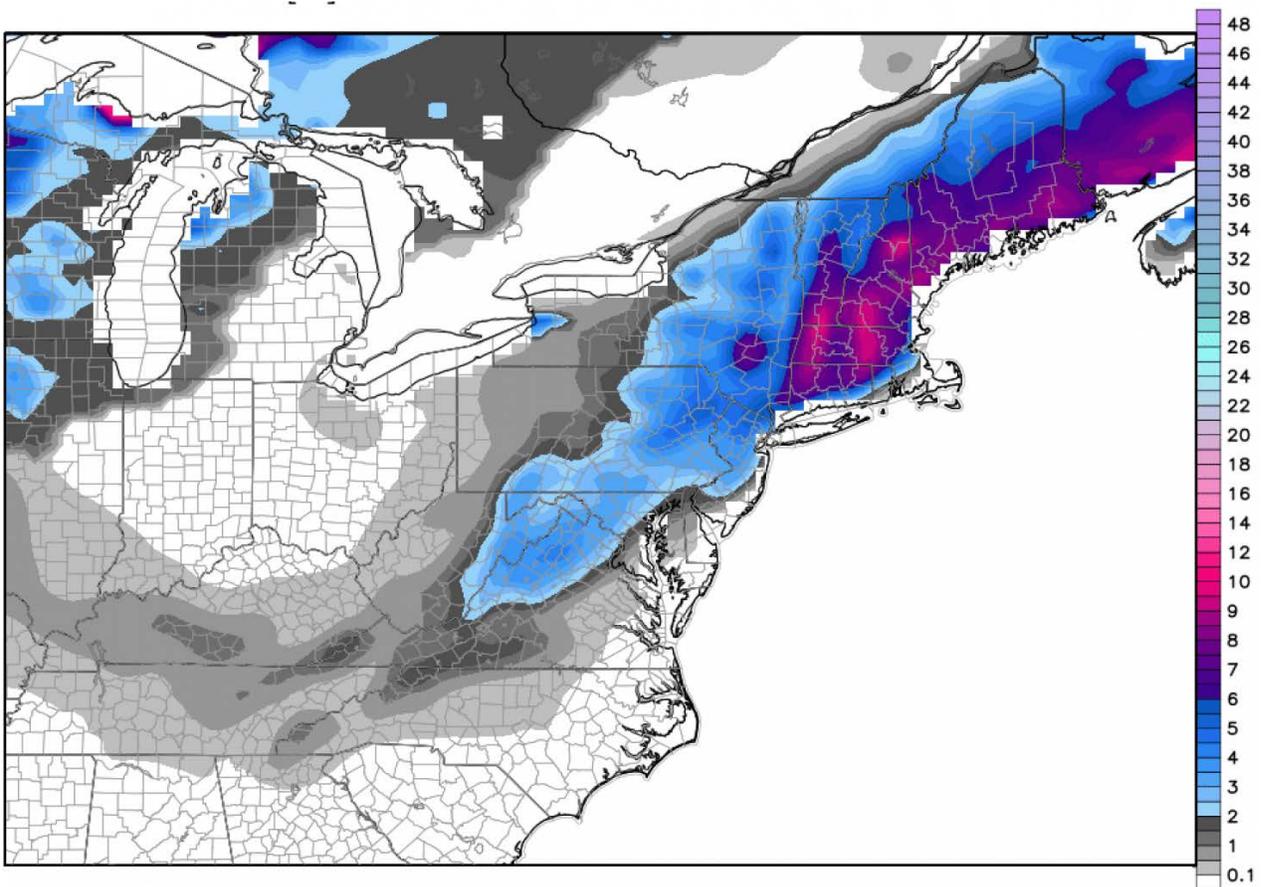
washingtonpost.com weather related blog for November 26, 2014 at 2:20 PM

<http://www.washingtonpost.com/blogs/capital-weather-gang/wp/2014/11/26/updates-winter-storm-knocks-east-coast-with-heavy-rain-snow-on-the-eve-of-thanksgiving>

The back edge of our pre-Thanksgiving Nor'easter is working its way north through Virginia, and east through Pennsylvania. Heavy snow will continue to fall in eastern Pennsylvania through midnight, and from Upstate New York through New England through Thursday morning.

Snowfall totals in New England could reach 18 inches in the higher elevations of western Massachusetts and southern Vermont.

Rain changed over to snow on Wednesday afternoon after the temperature dropped to just above the freezing mark. So far just a coating has fallen in the Boston metro area. We recommend following Eric Fisher at WBZ for Massachusetts and New England storm updates through the evening.



(Commission-captured screen shot)

washington post.com weather related blog for November 26, 2014 at approximately 4:00 PM

<http://www.washingtonpost.com/blogs/capital-weather-gang/wp/2014/11/26/updates-winter-storm-knocks-east-coast-with-heavy-rain-snow-on-the-eve-of-thanksgiving>

#### **4. Company-Specific Forecasts for the 2014 Thanksgiving Snowstorm used by UES, PSNH, LU and NHEC.**

##### UES

Monday, November 24 at 6:00 AM from Schneider Electric

At 6:00 AM EST, UES received a forecast from Schneider Electric which reflected an EII of 5 with medium confidence for the Seacoast and Capital Regions of New Hampshire for Wednesday, November 26.

UNITIL SERVICE AREA 3-5 DAY OUTLOOK: A strong low pressure system will move up the coast on Wednesday bringing a good chance for precipitation for Wednesday afternoon and evening.

Seacoast and Portland areas will likely begin, as rain near mid-day while inland areas will begin as a rain snow mix. Precipitation will turn to all snow in the mid to Late afternoon with snow showers likely through the evening Gusty winds also possible from this system with gusts 35-40 mph expected for Wednesday afternoon and evening. Winds will diminish overnight. Snow showers will continue overnight diminishing to isolated light snow showers before dawn on Thursday. These lighter snow showers may linger through mid-day on Thanksgiving Day with dry weather expected to return for the afternoon and evening hours. Snowfall totals will range from 3-5 inches in the Capital and Fitchburg areas, to 1-3 inches in the Seacoast area, and 2-4 inches in the Portland areas. It should be noted that much will depend on the track of the low and heavier snow bands could shift further west, lowering amounts in some areas.

Confidence: Confidence is high for rain/snow mix turning to snow on Wednesday but confidence in accumulation is only medium to low due to differences in guidance and the fact that there will be a very sharp cut off between heavy snow and minor amounts not far from the service territory. At this time we are going with the following probabilities: Chance for EII-5 level snow: 90%. Chance for EII-4 level snow: Fitchburg/Capital: 50%; Seacoast: 30%; Portland: 40%. Chance for EII-3 level snow: 10% for Fitchburg/Capital. Confidence is medium that hazard wind gust will occur: Wind chances: EII-4: 30%.

Monday, November 24 at 1:00 PM from Schneider Electric

At 1:00 PM EST, UES received a forecast from Schneider Electric which reflected an EII of 4 with medium confidence for the Capital Region of New Hampshire for Wednesday, November 26.

UNITIL SERVICE AREA 3-5 DAY OUTLOOK: A strong low pressure system will move up the coast on Wednesday bringing a good chance for precipitation for Wednesday afternoon and evening. Seacoast and Portland areas will likely begin as rain near mid-day while inland areas

will begin as a rain snow mix. Precipitation will turn to all snow in the mid to late afternoon with snow showers likely through the evening. Gusty winds also possible from this system with gusts 35-40 mph expected for Wednesday afternoon and evening. Winds will diminish overnight. Snow showers will continue overnight diminishing to isolated light snow showers before dawn on Thursday. These lighter snow showers may linger through mid-day on Thanksgiving Day with dry weather expected to return for the afternoon and evening hours. Snowfall totals will range from 3-5 inches in the Capital and Fitchburg areas, to 1-3 inches in the Seacoast area, and 2-4 inches in the Portland areas. It should be noted that much will depend on the track of the low and heavier snow bands could shift further west, lowering amounts in some areas.

Confidence: Confidence is high for a rain/snow mix turning to snow on Wednesday but confidence in accumulation is only medium to low due to differences in guidance and the fact that there will be a very sharp cut off between heavy snow and minor amounts not far from the service territory. At this time we are going with the following probabilities: Chance for EII-5 level snow: 90%. Chance for EII-4 Level snow: Fitchburg/Capital: 50%; Seacoast: 30%; Portland: 40%. Chance for EII-3 level snow: 10% for Fitchburg/Capital. Confidence is medium that hazard wind gust will occur: Wind chances: EE1-4: 30%.

Tuesday, November 25 at 6:00 AM from Schneider Electric

At 6:00 AM EST, UES received a forecast from Schneider Electric which reflected an EII of 3 with medium confidence for the Seacoast and Capital Regions of New Hampshire for Wednesday, November 26.

UNTIL SERVICE AREA 48 HOUR OUTLOOK:

CAPITAL: Dry today with southwest winds of 8-12mph occasionally gusting 20-25mph during the late morning and afternoon. A mixture of rain/snow beginning 8:00 AM-10:00 AM on Wednesday. Turning to all snow after 12:00 PM. Snow likely through the afternoon into the evening with periods of heavy snow possible. Diminishing gradually after midnight, becoming insignificant flurries by 6:00 AM Thursday. Flurries ending by 11:00 AM. 6-8” of snowfall expected from this system. Gusty winds also possible on Wednesday with occasional gusts 30-35 mph possible between 10 AM Wednesday and 6 AM Thursday.

Confidence: Confidence is high that no hazards will occur on Tuesday. Confidence is high that wet snow will occur on Wednesday. Chance for EII-4 level snow is 80%. Chance for EII-3 level snow is 60%. Chance for EII-4 level wind gust is 10%.

SEACOAST: Dry today with southwest winds of 8-12 mph occasionally gusting 20-25 mph during the late morning and afternoon. Rain showers beginning 9 AM-11 AM on Wednesday. Turning to rain/snow mix after 3:00 PM and all snow after 6:00 PM. Snow likely through the evening with periods of heavy snow possible. Diminishing gradually after 1 AM, becoming insignificant flurries by 7:00 AM Thursday. Flurries ending by 11:00 AM. 4-7” of snowfall expected from this system. Gusty winds also possible on Wednesday with occasional gusts 30-35 mph possible between 10:00 AM Wednesday and 6:00 AM Thursday.

Confidence: Confidence is high that no hazards will occur on Tuesday. Confidence is high that wet snow will occur on Wednesday. Chance for EE1-4 level snow is 60%. Chance for EII-3 level snow is 40%. Chance for EEI-4 level wind gust is 10%.

Tuesday, November 25 at 1:00 PM from Schneider Electric

At 1:00 PM EST, UES received a forecast from Schneider Electric which reflected an EII of 3 with high confidence for the Seacoast and Capital Regions of New Hampshire for Wednesday, November 26.

UNITIL SERVICE AREA 48 HOUR OUTLOOK:

CAPITAL: Dry today with southwest winds of 8-12 mph occasionally gusting 20-25 mph during the afternoon. A mixture of rain/snow beginning 7:00 AM-8:00 AM on Wednesday. Turning to all snow after 12:00 PM. Snow likely through the afternoon into the evening with periods of heavy snow possible. Diminishing gradually after midnight, becoming insignificant flurries by 6:00 AM Thursday. Flurries ending by 11:00 AM. 8-10” of snowfall expected from this system. Gusty winds also possible on Wednesday with occasional gusts 30-35 mph possible between 4 PM Wednesday and 6:00 AM Thursday.

Confidence: Confidence is high that no hazards will occur on Tuesday. Confidence is high that wet snow will occur on Wednesday. Chance for EII-4 level snow is 80%. Chance for EE1-3 level snow is 60%. Chance for EII 2 snow is 10%. Chance for EII-4 level wind gust is 10%.

SEACOAST: Dry today with southwest winds of 8-12 mph occasionally gusting 20-25 mph during the afternoon. Rain showers beginning 9:00 - 11:00 AM on Wednesday. Turning to rain/snow mix after 2:00 - 3:00 PM and all snow after 5:00 - 6:00 PM. Snow likely through the evening with periods of heavy snow possible. Diminishing gradually after 1 AM, becoming insignificant flurries by 7:00 AM Thursday. Flurries ending by 11:00 AM. 4-7 of snowfall expected from this system along and east of 1-95, with 7-9” further inland. Gusty winds also possible on Wednesday with frequent gusts 30-35 mph possible between 10:00 AM Wednesday and 6:00 AM Thursday. Peak gusts will run to 40 mph.

Confidence: Confidence is high that no hazards will occur on Tuesday. Confidence is high that wet snow will occur on Wednesday. Chance for EII-4 level snow is 70%. Chance for EII-3 level snow is 40%. Chance for EII-4 level wind gust is 10%.

Tuesday, November 25 at 6:00 PM from Schneider Electric

At 6:00 PM EST, UES received a forecast from Schneider Electric which again reflected an EII of 3 with high confidence for the Seacoast and Capital Regions of New Hampshire for Wednesday, November 26.

UNITIL SERVICE AREA 48 HOUR OUTLOOK:

CAPITAL: Dry conditions are expected for the remainder of the evening and overnight with west-northwest winds at 6-12 mph occasionally gusting 20-25 mph through the overnight. A mixture of rain/snow will begin between 7:00 - 8:00 AM on Wednesday. This mixture is expected to turn to all snow after 12:00 PM. Snow will be likely through the afternoon and into the evening with periods of heavy snow possible. Snow will diminish gradually after midnight, becoming insignificant flurries by 6:00 AM Thursday. Flurries are expected to end by 11:00 AM. Total snowfall amounts from this system are expected to be between 8-10". Gusty winds will also be possible on Wednesday with occasional gusts 30-35 mph possible between 4 PM Wednesday and 6:00 AM Thursday.

Confidence: Confidence is high that no hazards will occur today. Confidence is high that wet snow will occur on Wednesday. Chance for EII-4 level snow is 30%. Chance for EEJ-3 level snow is 60%. Chance for EII 2 snow is 10%. Chance for EII-4 level wind gust is 10%.

SEACOAST: Dry conditions are expected for the remainder of the evening and overnight with west-northwest winds at 5-10 mph. Rain showers will begin between 9:00 - 11:00 AM on Wednesday. Rain is expected to turn to a rain/snow mix after 2:00 - 3:00 PM and all snow after 5:00 - 6:00 PM. Snow will be likely through the evening with periods of heavy snow possible. Snow will diminish gradually after 1 AM, becoming insignificant flurries by 7:00 Thursday. Flurries are expected to end by 11 AM. 4-7" of snowfall are expected from this system along and east of I-95, with 7-9" further inland. Gusty winds will also possible on Wednesday with frequent gusts 30-35 mph possible between 10:00 AM Wednesday and 6:00 AM Thursday. Peak gusts will run up to 40 mph.

Confidence: Confidence is high that no hazards will occur today. Confidence is high that wet snow will occur on Wednesday. Chance for EII-4 level snow is 70%. Chance for EII-3 level snow is 40%. Chance for EII-4 level wind gust is 10%.

Wednesday, November 26 at 6:00 AM from Schneider Electric

At 6:00 AM EST, UES received a forecast from Schneider Electric which reflected an EII of 3 with medium confidence (this may be a typo) for the Seacoast and Capital Regions of New Hampshire for Wednesday, November 26.

UNITIL SERVICE AREA 48 HOUR OUTLOOK:

CAPITAL: A mixture of rain/snow will begin between 7:00 – 8:00 AM this morning. This mixture is expected to turn to all snow after 12:00 PM. Snow will be likely through the afternoon and into the evening with periods of heavy snow possible. Heaviest expected to fall from 1:00 - 11:00 PM. Snow will diminish gradually after midnight, becoming insignificant flurries by 6:00 AM Thursday. Flurries could extend into the early afternoon hours before diminishing by the evening. Total snowfall amounts from this system are expected to be between 8-11". Gusty winds will also be possible today with occasional gusts 30-35 mph possible between 4:00 PM today and 4:00 AM Thursday.

Confidence: Confidence is high that wet snow will occur today. Chance for EII-4 level snow is 80%. Chance for EII-3 level snow is 60%. Chance for EII 2 snow is 10%. Chances are high that no hazards occur Thursday.

SEACOAST: Rain showers will begin between 9 AM-11 AM this morning. Rain is expected to turn to a rain/snow mix after 2:00 - 3:00 PM and all snow after 5:00 - 6:00 PM. Snow will be likely through the evening with periods of heavy snow possible. Heaviest expected to fall from 1 PM-11:00 PM. Snow will diminish gradually after 1 AM, becoming insignificant flurries by 7:00 AM Thursday. Flurries could extend into the early afternoon hours before diminishing by the evening. Snowfall amounts of 4-7" are expected from this system along and east of I-95, with 7-9" further inland. Gusty winds will also be possible today with frequent gusts 30-35 mph possible between 2:00 PM today and 6:00 AM Thursday. Peak gusts will run up to 40 mph.

Confidence: Confidence is high that wet snow will occur today. Chance for EII-4 level snow is 70%. Chance for EII-3 level snow is 40%. Chances are high that no hazards occur Thursday.

Wednesday, November 26 at 1:00 PM from Schneider Electric

At 1:00 PM EST, UES received a forecast from Schneider Electric which reflected an EII of 3 with high confidence for the Seacoast and Capital Regions of New Hampshire for Wednesday, November 26.

UNITIL SERVICE AREA 48 HOUR OUTLOOK:

CAPITAL: Snow will continue this afternoon and this evening with periods of heavy snow possible. The heaviest snow will fall between 2:00 - 11:00 PM. Snow will weaken and diminish gradually after midnight, becoming flurries by 6 AM Thursday. Flurries could extend into the early afternoon Thursday before diminishing by the evening. Dry conditions are then expected Thursday night and into Friday afternoon. Total snowfall amounts: 9-12". Winds today/tonight 12-18 mph, gusting 25-30 mph, isolated peak gusts 30-35 mph.

Confidence: Confidence is high that wet snow will occur today. Chance for EII-4 level snow is 80%. Chance for EII-3 level snow is 60%. Chance for EII 2 snow is 20%. Chances are high that no hazards occur Thursday.

SEACOAST: Snow will continue this afternoon and evening with periods of heavy snow possible. Periods of sleet could mix in at times this afternoon and evening. The heaviest snow will fall between 4:00 PM - 12:00 AM. Snow will weaken and diminish gradually after 2:00 AM, becoming flurries by 7:00 AM Thursday. Flurries could extend into the early afternoon Thursday before diminishing by the evening. Dry conditions are then expected Thursday night into Friday afternoon. Total snowfall: 4-7" along/east of I-95, 6-9" west of I-95. Winds today/tonight 15-22 mph, gusting 30-35 mph, isolated peak gusts 35-40 mph.

Confidence: Confidence is high that wet snow will occur today. Chance for EII-4 level snow is 70%. Chance for EE1-3 level snow is 40%. Chances are high that no hazards occur Thursday.

### PSNH

#### Monday, November 24 at 6:00 AM from Schneider Electric

At 6:00 AM EST, PSNH received a forecast from Schneider Electric which reflected an EII of 2 with medium confidence for the Central South Region and Western Region of New Hampshire for Wednesday, November 26.

NEW HAMPSHIRE: Rain likely through 3 PM. Rainfall amounts of 0.25" to 0.50" expected. Strong southerly winds of 15-22 mph may occasionally gust 35-40 mph throughout the late morning and afternoon but should diminish in the evening. A few peak gusts of 40-45 mph will be possible with heavier rain showers with the best chances over the Seacoast and in the higher terrain.

DAY 2-3 OUTLOOK FOR SERVICE AREA: Dry on Tuesday with west/southwest winds occasionally gusting 30-35 mph. Wednesday will bring a strong coastal low pressure with rain or a rain/snow mix developing in the late morning or early afternoon. Turning to snow in the afternoon hours with snow showers likely through the evening. Gradually diminishing overnight, ending for western Mass and Connecticut by sunrise but a few lingering light snow shower possible for

PSNH through mid-day on Thanksgiving day. Strong winds also possible for the afternoon and evening hours on Wednesday with gusts 35-40 mph possible. Highest gusts will be most likely for southern Connecticut and the Seacoast area of PSNH. Snow totals from this system will see a band of 3-6 inches extending from northwestern Connecticut, across southwestern Massachusetts, into southern New Hampshire, including portions of the Western and Central regions. Snow totals will decrease to the north over PSNH with amounts of 3-5 inches for the Lakes Region and the North country. Over the Seacoast region 1-3 inches looks likely. There may be a sharp cut off in Connecticut as well with amounts dropping to 1-4 inches over the Eastern Division. Heavy snow totals will be most likely for areas north of I-84. It should be noted however with such a sharp cut off between heavy snow and minor amounts the line could shift only slightly, greatly changing the forecast for any given area. Much will depend on how close to the coast the low passes and how much cold air can be pulled into the system while precipitation is ongoing.

#### Monday, November 24 at 1:00 PM from Schneider Electric

At 1:00 PM EST, PSNH received a forecast from Schneider Electric which reflected an EII of 2 with medium confidence for the Central South Region and Western Region of New Hampshire for Wednesday, November 26.

NEW HAMPSHIRE: Rain ending from west to east by 4:00 PM. Dry conditions across most of the state through tonight; however, a few rain showers may be possible in Coos county at times.

Additional rain: 0.20 or less. Dry conditions statewide on Tuesday morning. South winds at 10-20 mph with gusts of 22-35 mph through this afternoon. Winds weaken after sunset becoming west-southwest sustained at 6-12 mph after midnight. Tuesday morning, winds become west-southwest sustained at 8-16 mph with gusts of 20-30 mph.

DAY 2-3 OUTLOOK FOR SERVICE AREA: Dry on Tuesday with west/southwest winds occasionally gusting 30-35 mph. Wednesday will bring a strong coastal low pressure with rain or a rain/snow mix developing in the late morning or early afternoon. Turning to snow in the afternoon hours with snow showers likely through the evening. Gradually diminishing overnight, ending for western Mass and Connecticut by sunrise but a few lingering light snow shower possible for PSNH through mid-day on Thanksgiving Day. Strong winds also possible for the afternoon and evening hours on Wednesday with gusts 35-40 mph possible. Highest gusts will be most likely for southern Connecticut and the Seacoast area of PSNH. Snow totals from this system will see a band of 3-6 inches extending from northwestern Connecticut, across southwestern Massachusetts, into southern New Hampshire, including portions of the Western and Central regions. Snow totals will decrease to the north over PSNH with amounts of 3-5 inches for the Lakes Region and the North country. Over the Seacoast region 1-3 inches looks likely. There may be a sharp cut off in Connecticut as well with amounts dropping to 1-4 inches over the Eastern Division. Heavy snow totals will be most likely for areas north of I-84. It should be noted however with such a sharp cut off between heavy snow and minor amounts the line could shift only slightly, greatly changing the forecast for any given area. Much will depend on how close to the coast the low passes and how much cold air can be pulled into the system while precipitation is ongoing.

Tuesday, November 25 at 6:00 AM from Schneider Electric

At 6:00 AM EST, PSNH received a forecast from Schneider Electric which reflected an EII of 3 with medium confidence for the Central South Region and Western Region of New Hampshire for Wednesday, November 26.

NEW HAMPSHIRE: Dry today with southwest winds of 10-15 mph occasionally gusting 25-30 mph.

DAY 2-3 OUTLOOK FOR SERVICE AREA:

NEW HAMPSHIRE: Precipitation beginning between 9:00 AM and 10:00 AM Wednesday. Likely beginning as rain for Seacoast south. Portions of the Central South will begin as rain/snow while elsewhere conditions will likely begin as snow. Turning to all snow in the Central/south after 12 PM while turning to a rain/snow mix in the Seacoast except along the immediate coast line where it may take until 3:00 PM before mixing. All areas will turn to all snow by 6:00 PM. Snow likely through the evening into early Thursday. Gradually diminishing in the early morning hours becoming light flurries between 6:00 AM and 8:00 AM Thursday morning. Accumulations are expected as follows. Western: 6-8" with localized 8-10" possible in the southwest portions of the region. North Country: 3-6". Lakes Region: 6-8". Central South Region: 3-6" with localized 8-10 inches west of I-93. Seacoast Region: Ranging from 1-3" near

the coast to 3-6" inland. Northeast winds on Wednesday may occasionally gust 35-40 mph with a few peak gusts of 45 mph possible in the Seacoast South Region between 12:00 PM Wednesday and 7:00 AM Thursday. Lingering flurries late Thursday morning will not produce more than 1/2 an inch additional accumulation and should end Thursday afternoon. Winds becoming northerly at 8-12 mph gusting 20-25 mph for Thursday afternoon and evening.

Tuesday, November 25 at 1:00 PM from Schneider Electric

At 1:00 PM EST, PSNH received a forecast from Schneider Electric which reflected an EII of 3 with medium confidence for the Central South Region, Lakes Region and Western Region of New Hampshire for Wednesday, November 26.

NEW HAMPSHIRE: Dry from this afternoon through tonight. Southwest winds of 10-15 mph, occasionally gusting 25-30 mph.

DAY 2-3 OUTLOOK FOR SERVICE AREA:

NEW HAMPSHIRE: Precipitation will move into southern portions of the state around 8:00 - 10:00 am Wednesday and into Coos county around noon - 2:00 PM Wednesday. Likely starting as rain in Seacoast South and a rain/snow mix in Central South. Elsewhere, precipitation starts as snow. Turning to all snow in the Central South around 12:00 - 1:00 PM Wednesday, while turning to a rain/snow mix for interior Seacoast South. Precipitation transitioning to all snow west to east in Seacoast South from 4:00 - 7:00 PM Wednesday. Snow likely statewide Wednesday evening into early Thursday morning, becoming light snow showers between 6:00 - 8:00 AM Thursday. These snow showers to end Thursday evening. Total snow accumulations of 8-10" in Western, Lakes and Central South regions, with localized 12" amounts possible. For the North Country, total snow accumulations of 6-8" in the south to 3-5" in the north. For Seacoast South, total snow accumulations of 4-6" along/east of I-95; 7-9" further inland. Northerly winds sustained at 10-25 mph across the state. Common gusts: 22-35 mph. Isolated peak gusts: 35-40 mph in Seacoast South. Northerly winds sustained at 8-12 mph gusting 20-25 mph for Thursday afternoon and evening.

Wednesday, November 26 at 6:00 AM from Schneider Electric

At 6:00 AM EST, PSNH received a forecast from Schneider Electric which reflected an EII of 3 with high confidence for the Central South Region, Lakes Region and Western Region of New Hampshire for Wednesday, November 26.

NEW HAMPSHIRE: Precipitation will move into southern portions of the state around 8:00 - 10:00 AM and into Coos county around noon - 2:00 PM. Likely starting as rain in Seacoast South and a rain/snow mix in Central South. Elsewhere, precipitation starts as snow. Turning to all snow in the Central South around 12:00 - 2:00 PM, while turning to a rain/snow mix for interior Seacoast South. Precipitation transitioning to all snow west to east in Seacoast South from 4:00 - 7:00 PM. Snow likely statewide this evening into early Thursday morning, becoming light snow showers between 6:00 - 8:00 AM Thursday. Total snow accumulations of 8-10" in

Western, Lakes and Central South regions, with localized 12" amounts possible. For the North Country, total snow accumulations of 6-9" in the south to 4-6" in the north. For Seacoast South, total snow accumulations of 4-6" along/east of I-95; 7-9" further inland. Northerly winds sustained at 10-25 mph across the state. Common gusts: 22-35 mph. Isolated peak gusts: 35-40 mph in Seacoast South.

DAY 2-3 OUTLOOK FOR SERVICE AREA: Any lingering snow showers across Coos County in PSNH will end by 10:00 AM Thursday leaving the region dry. This dry period will not last long as a few flurries/light snow showers could be seen during the afternoon and evening hours. Any accumulations will be negligible. Dry conditions then move in overnight and last through the day and night Friday. No hazards anticipated over the extended.

Wednesday, November 26 at 1:00 PM from Schneider Electric

At 1:00 PM EST, PSNH received a forecast from Schneider Electric which reflected an EII of 3 with high confidence for the Central South Region, Lakes Region and Western Region of New Hampshire for Wednesday, November 26.

NEW HAMPSHIRE: Precipitation will continue to spread northeastward across the region today. Precipitation could be a rain/sleet mix initially in the Central South and the Seacoast South, but should change to snow in the Central South around 2 PM and closer to 4:00 - 7:00 PM in the Seacoast South. Snow is likely statewide this evening into early Thursday morning, becoming light snow showers between 6:00 - 8:00 AM Thursday. Total snow accumulation: 8-12 in Western, Lakes, and Central South; 7-10 southern North Country and 6-8 northern North Country; 4-6 along/east of I-95 in Seacoast South and 5-9 west of I-95 Seacoast South. Winds: North at 15-25 mph, gusting 25-35 mph. Isolated peak gusts: 35-40 mph from 6:00 PM today to 4:00 AM Thursday, mainly in the Seacoast South.

DAY 2-3 OUTLOOK FOR SERVICE AREA: Any lingering snow showers across Coos County in PSNH will end by 10:00 AM Thursday leaving the region dry. This dry period will not last long as a few flurries/light snow showers could be seen during the afternoon and evening hours across all areas. Any accumulations will be light, if any. Dry conditions then move in overnight and last through the day and night Friday. No hazards are anticipated over the extended period.

LU

Due to the low number of customer outages during the 2014 Thanksgiving Snowstorm event for LU, this report focuses on the companies which did experience a high level of customer outages and troubles.

NHEC

Wednesday, November 26 at 9:21 AM from NHEC for Immediate Release

## NHEC Preparing for Possible Power Outages

PLYMOUTH, NH - New Hampshire Electric Cooperative (NHEC) is preparing for possible power outages as a result of a winter storm that is predicted to bring heavy snow to most of New Hampshire in the coming days.

According to forecasters, snow is predicted to begin in the afternoon today and continue overnight into Thanksgiving morning. Nine to 12 inches of potentially heavy snow is predicted throughout most of NHEC's service territory, with lesser amounts in southern parts of the state. There is the potential for some icing in the towns served by NHEC in the southwestern and southeastern parts of the state posing a threat of power outages.

### **5. Actions Taken by Each Company Leading Up to the 2014 Thanksgiving Snowstorm**

#### UES

UES began tracking the event over the weekend of November 22nd. The System Incident Commander held the first, internal coordination call with all ICS section chiefs on the morning of the Tuesday, November 25th. UES continued with subsequent, internal calls twice daily throughout the event to ensure the effective coordination of resources. According to UES, due to an ever changing forecast, it became evident that the snow amounts and liquid equivalent ratio were escalating with each additional forecast. As a result, UES opened the System Emergency Operations Center (EOC) on the afternoon of November 26th. According to UES, resource acquisition (both internal and external) was a challenge due to the Thanksgiving Holiday and escalating nature of the event.

UES made a commitment to its local contractors on Tuesday, November 25th and subsequently brought in additional external resources to pre-stage on the morning of Wednesday, November 26th. Preliminary pre-stage resources included 12 internal line, 23 contractor line, and 25 tree crews, as well as 16 wires down/damage assessors. Later on Wednesday with increased snow accumulations again being forecasted, UES sought to retain additional resources. By the evening of Friday, November 28th, this retention resulted in over 127 line/tree/service crews and wires down/damage assessors working for UES in New Hampshire.

#### PSNH

PSNH weather forecasts throughout the weekend of November 22, 2014 from Schneider and the National Weather Service reflected concerns for a possible snow event on Wednesday evening with low confidence at that time.

On Monday, November 24, 2014 PSNH continued to monitor weather forecasts which reflected the possibility of an EII Level 2 with medium confidence. PSNH raised awareness internally and assessed available local contractors in case the forecast deteriorated.

On Tuesday, November 25, 2014 PSNH received the weather forecast from Schneider at 6:02 AM which forecasted an EII of 3 with a medium confidence, listing the potential of heavy snow and high winds across portions of PSNH's service territory. At 6:40 AM PSNH Emergency Preparedness issued a company-wide PSNH Weather Advisory with a Readiness Condition of "Monitoring" in response to the forecast. The utility decided to hold all available resources, including contractor line crews currently working on the system, through the end of the day Wednesday, November 26. Following a call with the National Weather Service in Grey, ME a PSNH Emergency Planning Advisory was issued at 9:15 AM with a Readiness Condition of "Warning". At 1:00 PM the Schneider Weather Forecast was received and included an EII Level 3 in three of PSNH's regions with medium confidence. PSNH notified internal personnel to prepare for a multi-day event.

On Wednesday, November 26 at 6:02 AM, Schneider issued the morning forecast with an EII of 3 for Central South, Lakes and Western Regions with High Confidence. The utility issued a revised Weather Advisory and continued to secure and confirm local contracted line resources. The utility decided to secure 50 external line crews. This included the contract line crews already on the system. The PSNH Incident Command Center (ICC) was partially activated at noon in anticipation of increased weather related outages and to assist with the deployment of additional resources to affected areas.

PSNH began incurring storm-related damage at approximately 12:05 PM. 72.5 PSNH line crews and 51 contracted line crews began responding to priority calls as directed by the Area Work Centers (AWCs). In addition, the 92 vegetation management (Tree) crews and the 10 service crews already working throughout the PSNH system were redeployed strategically throughout the State.

At 1:00 PM the Schneider Weather Forecast was received and included an EII Level 3 in three of PSNH's regions with high confidence. At 3:00 PM there were approximately 9,600 customers without power.

#### LU

As previously stated in this report, due to the low number of customer outages during the 2014 Thanksgiving Snowstorm event for LU, this report focuses on the companies which did experience a high level of customer outages and troubles.

#### NHEC

In light of the predicted snowstorm, NHEC requested Wednesday morning, November 26 that all line and tree contractors working on its system be available for purposes of emergency response. All contract line and tree crews were put on standby at 6:00 AM.

## V. Restoration Response

The effectiveness of restoration efforts varied among the four utilities due to a number of factors, including geographic differences in service territories and the relative impact of the storm in those territories. This snowstorm began and ended on November 26, 2014, the day before Thanksgiving. Thanksgiving, a major holiday travel period, made it more challenging for New Hampshire’s utilities to pre-stage line crew resources from contractors, affiliates and other sources. Many businesses closed for the entire four-day weekend, making communications and resource procurement logistics considerably more complicated. From a typical customer perspective, long durations and continued interruptions of electric supply could not have occurred at a more inconvenient time.

Of critical importance in any restoration response to a major storm event such as the 2014 Thanksgiving Snowstorm is a utility’s ability to effectively and efficiently procure off-system resources in a timely manner, its management of restoration crews, and the internal coordination and communication of emergency response decision-making. Unexceptional performance in any one of those areas can contribute to delays in the restoration of power.

Table V-1 displays the magnitude and the overall response time per utility for the 2014 Thanksgiving Snowstorm. Placing LU aside due to the storm’s lesser effect on its customer base, UES had the highest percentage of customers without power, yet yielded the fastest rate of restoration.

<b>Table V-1</b>			
Electric Utility	Number of Customers Without Power at Peak	Percentage of Customers Without Power at Peak	Time When All Restorations Complete (# hours/days)
UES	34,575	46%	Sunday morning, November 30 (87 hours/3.6 days)
NHEC	29,308	36%	Sunday afternoon, November 30 (102 hours/4.25 days)
LU	2,900	7%	Thursday afternoon, November 27 (30 hours/1.25 days)
PSNH	207,359	41%	Monday morning, December 1 (114 hours, 4.75 days)

### A. Utility Restoration Timeframes

Power restoration varied by utility. The following chart and narrative details the chronological restoration efforts of each utility. Figure V-1 depicts the overall restoration for each utility and percentage of customers without power at various time intervals during the restoration process.

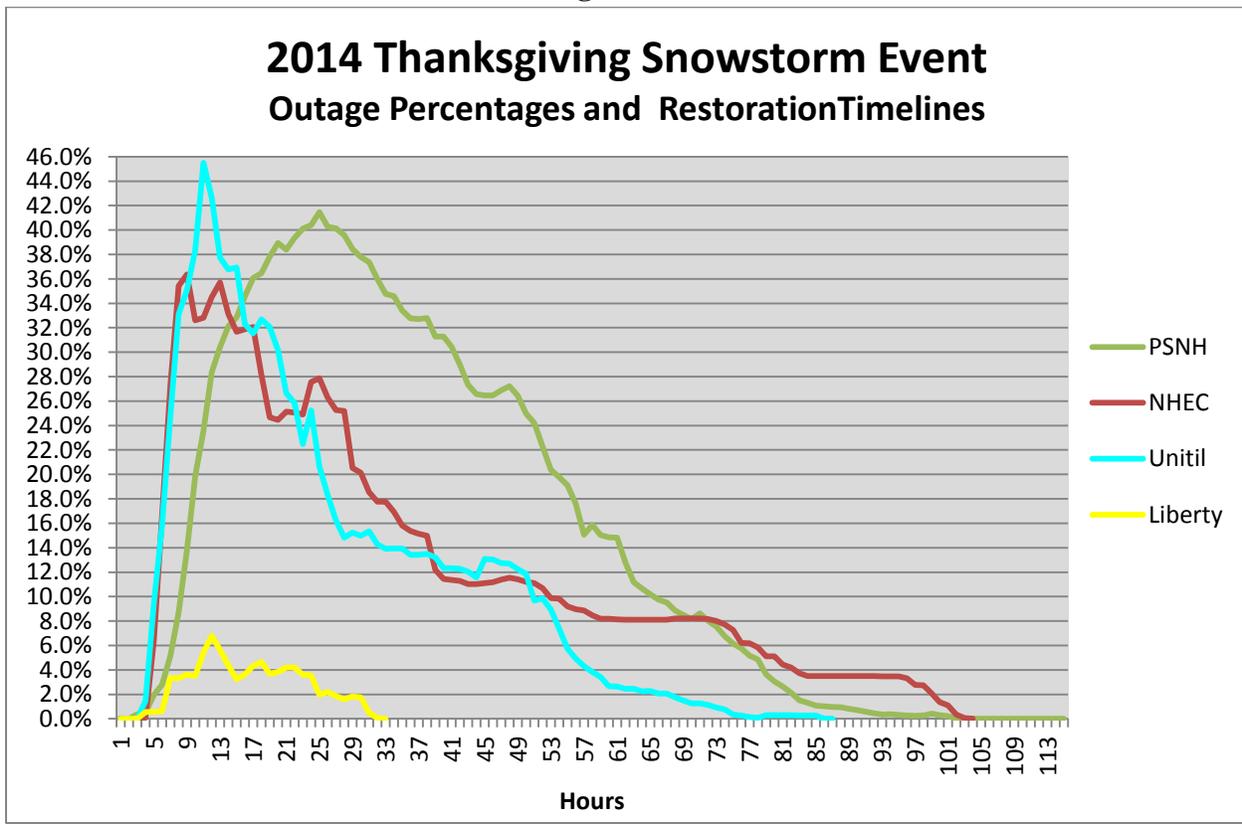
Table V-1, read in conjunction with V-4 below, reveals that LU's territory was the least affected of the four electric utilities, hence its response curve is shown merely for inclusion and little analysis was conducted by Staff. Full restoration was completed in 30 hours.

Table V-1, read in conjunction with V-3 below, shows that UES had the greatest percentage (46%) of customers out of power in the wake of the 2014 Thanksgiving Snowstorm, yet achieved the quickest restoration time (excluding Liberty Utilities) at 87 hours. UES' peak customer outages occurred at 9:00 PM on Wednesday November 26. Its pace and timeliness of restoration outpaced the other three utilities. Crew levels (line and service) reached their peak of 3.4 times that of the onset of the storm on hour 57 into the storm.

NHEC's performance, as depicted in Figures V-1 and V-2, shows that its system peaked even earlier at about 7:00 PM on Wednesday November 26 and achieved the lowest rate in restoring power to customers. It did not procure the same level of incremental crews beyond the initial levels in place at the onset of the storm until much later in the storm at hour 97 of the storm. Peak crew levels reached 1.9 times that was available at the onset of the storm. Staff observes that this is typical and consistent with NHEC's response rate historically.

PSNH's restoration curve shows that the outages were handled in a relatively steady manner over time at a pace similar to UES but approximately 24 hours later, reflecting the fact that the number of crews deployed did not peak until approximately 81 hours after the onset of the storm, as shown in Figure V-5. PSNH's restoration curve reflected that once crews arrived they made steady and rapid restoration, and crew levels in the first 40 hours of the storm were approximately 2.4 times that at the onset of the storm but peaked at 6.3 times crew levels at the onset of the storm. It should be noted that the peak customer outage levels were recorded for PSNH on Thanksgiving Day at 11:00 AM which is more of an indicator of the capability of the outdated quasi OMS system that PSNH utilized during the 2014 Thanksgiving Snowstorm. PSNH's Trouble Analysis System (TAS) and Outage Analysis and Reporting System (OARS) are based on older algorithms that do not take advantage of PSNH's updated GIS system, and yield results that are much different than the commercial products used by other New Hampshire electric utilities. PSNH has now installed in a new OMS. It became operational in early September in New Hampshire.

Figure V-1.



**UES**

UES’s first outage was reported at 1:00 PM on Wednesday, November 27; peak outage of 34,575 customers occurred on Wednesday, November 27 at 9:00 PM. Additional outside crews contracted for UES arrived on Wednesday, November 27 through Friday, November 29, allowing restoration efforts to be substantially ahead of the other electric utilities in New Hampshire with the exception of LU. By 8:00 PM on Friday, November 29, UES’s New Hampshire system-wide service territory had been 99% restored. The Capital Region got hit particularly hard with 85% of the troubles identified for downed wires occurred in the Capital Region while only 15% originated from the Seacoast Region. In particular, the main feeder lines of UES were simultaneously damaged causing nearly all of the Concord area to lose power. Ninety-eight percent of the Seacoast Region had power restored by early afternoon of Thanksgiving Day, November 27. Fortunately, much of the governmental buildings and business and school systems were closed on November 27 and November 28 so the impact wasn’t as large as it was for commercial businesses. Commercial retailers were impacted as the outages occurred on one of the busiest shopping days of the year. A large portion of residential

customers were inconvenienced as Thanksgiving activities were disrupted because of the loss of power.

On Tuesday November 25, at 11:00 AM, UES began acquiring crews and was able to have many of the crews available to work by the early evening on November 26. This proved to be invaluable as the Concord region suffered extensive customer outages and UES was able to begin the restoration phase the night prior to Thanksgiving. Repeat outages occurred on many circuits so that much of the restoration became temporary in nature and permanent restoration required multiple trips to some locations.

## **PSNH**

PSNH's large service territory meant that not all areas were affected by the November 2014 Snowstorm to the same degree. PSNH's service territory is divided into five separate regions of the State, each containing between two and four work centers. Portions of PSNH's Western and Northern Regions<sup>27</sup> did receive damage, but to a much lesser extent than did the other regions. Three of PSNH's regions received the bulk of the power interruptions: Central South Region, Lakes Region and Western Region. This is also where the largest population densities exist on PSNH's system.

In terms of crew acquisition and resource attainment, the following occurred:

- On Monday, November 24, PSNH assessed its existing internal line crew availability at the local Area Work Center (AWC) level. PSNH's full complement of internal line crews was not used. Seventy-two and one-half line crews were to be initially deployed and it wasn't until Saturday that their maximum of 81 internal line crews was deployed.
- On Tuesday, November 25, PSNH retained on-system contractor crews that were already doing maintenance or construction activities within PSNH's service territory.
- On Wednesday, November 26 at 6:02 AM, Schneider issued the morning forecast with an EEI of 3 for Central South, Lakes and Western Regions with High Confidence. The company issued a revised Weather Advisory and continued to secure and confirm local contracted line resources. The company decided to secure 50 in-state contractor line crews. This included the contract line crews already on the system. The PSNH Incident Command Center (ICC) was partially activated at noon in anticipation of increased weather related outages and to assist with the deployment of additional resources to affected areas.

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<sup>27</sup> (See Appendix A for PSNH's 5 regions and 14 area work center coverages.)

- On Wednesday, November 26 at 3:00 PM, 4 hours after the onset of the storm, PSNH put a request in to Eversource (at that time Northeast Utilities<sup>28</sup>) for an additional 75 contractor line crews. PSNH did not provide the results of each request so it is uncertain how many of these crews arrived and at what times. PSNH had approximately 14,000 customers out at the start of the hour and 34,000 customers out at the time of the request. Customer outage numbers were rapidly increasing.
- On Wednesday, November 26 at 5:00 PM, 6 hours after the onset of the storm, PSNH had 72.5 line crews and 23 contractor crews with 13 additional pole and service crews for a total of 108.5 crews that were qualified to work on lines. PSNH estimates that it had approximately 40,000 customers out at this time but PSNH's data is inconsistent on the total outages as reflective of the algorithms used in the OMS system available at the time and predicated on customer calls received through the PSNH call center.
- On Wednesday, November 26 at 7:00 PM, 8 hours after the onset of the storm, PSNH had approximately 69,000 customers out. The line crew levels remained the same.
- On Wednesday, November 26 at 10:00 PM, 11 hours after the onset of the storm, PSNH requested an additional 230 line crews through Eversource. By this time PSNH had approximately 142,000 customers without power.
- On Thursday, November 27 at 9:00 AM, 22 hours after the onset of the storm, some of the line crews requested began to arrive. There were now 79 internal line crews, 48 contractor line crews with 15 additional pole and service crews for a total of 142 crews who were qualified to work on lines. This equates to an approximate 30 percent increase in available line crews from the start of the storm. The peak number of outages, approximately 207,000, occurred at 11:00 AM.
- On Friday, November 28 at 9:00 AM, 46 hours after the onset of the storm, additional line crews arrived and there were now 80.5 internal line crews, 52 line crews from PSNH affiliates CL&P or NSTAR, and 125 contractor line crews, with 25 additional pole and service crews for a total of 282.5 crews that were qualified to work on lines. This equates to approximately 2.6 times the quantity available at the start of the storm. By this time PSNH had approximately 114,000 customers without power [source: PSNH hourly outage report by town].

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<sup>28</sup> As stated in footnote 1, Eversource was formed in February 2015 in an effort to rebrand the holding company and subsidiaries with a unified name.

- On Saturday, November 29 at 9:00 AM, 70 hours after the onset of the storm, the arrival of additional line crews occurred resulting in 81 internal line crews, 92 line crews from PSNH affiliates CL&P or NSTAR, and 370 contractor line crews with 92 additional pole and service crews, for a total of 635 crews that were qualified to work on lines. This equates to approximately 5.9 times the quantity available at the start of the storm. This workforce remained at this level throughout the day. PSNH had approximately 37,000 customers without power at the time.
- On Sunday, November 30 at 9:00 AM, 94 hours after the onset of the storm, additional line crews arrived. There were now 80.5 internal line crews, 119 line crews from PSNH affiliates CL&P or NSTAR, and 217 contractor line crews with 87 additional pole and service crews for a total of 493.5 crews that were qualified to work on lines. This equates to approximately 4.5 times the quantity available at the start of the storm. This workforce began to be released throughout the day on Sunday. By mid-day, PSNH had approximately 1,400 customers without power remaining.
- On Monday, December 1 at 5:00 AM, PSNH restored power to the final customer who was affected by this wide-scale emergency storm event and then contacted the PUC with that information.

The six largest hit communities were: Manchester (approximately 20,000 outages), Nashua (approximately 12,000 outages), Merrimack (approximately 6,700 outages), Goffstown (approximately 5,000 outages), Hudson (approximately 4,900 outages), and Hopkinton (approximately 4,000 outages)

The last communities to have power restored by PSNH were: Bedford, Dunbarton, Webster, Henniker, and Warner.

## **LU**

LU was spared much of the 2014 Thanksgiving Snowstorm. It was able to restore all of its customers within 30 hours and did not have a need to call in many external line crews. It was able to allow some of the line crews to have the holiday off and it did not require all line crews to report. At peak, less than 7% of the system had lost power which translates to an Event Level of only 4 for LU's service territory.

## **NHEC**

In light of the predicted snowstorm, NHEC requested Wednesday morning, November 26 that all contract line crews and tree crews working on its system be available for purposes of emergency

response. All contract line crews and tree crews were put on standby at 6:00 AM Wednesday, November 26. By Wednesday November 26 at 7:00 PM, NHEC had lost 36% of its members, approximately 29,300 members. NHEC started the storm with its internal crews of 26 line crews and 10 external line crews from other Cooperatives in New England. On Saturday, November 29, at 6:00 AM, an additional 21 line crews were added to help with restoration. This was approximately 67 hours from the onset of the storm and at the time 8% of the member base remained without power. The delay in realizing situational awareness was that NHEC was experiencing a high demand on its OMS and GIS which caused the computer system to crash. This forced the restoration of members' power to be achieved without the ability "to see" what was actually happening on their electrical system in the field. As a result, NHEC's ability to assess its need to attain additional line crews was delayed. An additional 8 to 11 line crews were added Sunday morning, November 30, to help with final restoration. This was approximately 91 hours after the onset of the storm.

NHEC stated that it reached its peak number of members without power, 29,308, at 7:00 PM on Wednesday, November 26. Final restoration occurred 102 hours after the onset of the storm at approximately 5:00 PM on Sunday, November 30.

NHEC had a number of problems with its website and phone systems throughout the storm making it difficult to depict an accurate portrayal of the number of customers out at any one time. Its restoration rate is significantly slower than those of PSNH and UES. The 2014 Thanksgiving Snowstorm exemplified the pattern that has typically been experienced with NHEC during the last six wide-scale storms. In general, the member base of NHEC is significantly more rural than PSNH or UES, and its amount of restoration work per member/customer is greater.

## **B. Procuring External Crew Resources after the Onset of the Storm**

The three regulated electric companies have arrangements with the Northeast Mutual Aid Group (NEMAG), through which they may request additional resources in the event of a major storm and power outage. PSNH also belongs to the New York Mutual Aid Group. NHEC belongs to the Northeast Association of Electric Cooperatives mutual aid group, the Northeast Public Power Association mutual aid group, and the National Rural Electric Cooperative Association mutual aid group.

Generally, each utility's ERP assumes that on-system line crews (internal line crews as well as contract line crews working on the utility's system) can handle outages without outside help for events that are expected to result in outage times of two days or less. ERPs provide for escalated

levels of response actions and procurement needs in accordance with event size categories, from local events, such as a tornado, that impact only a small portion of the system, to large, wide-scale emergency storm events, such as a major ice or snow storm. ERP scalability breaks down, however, for high-damage level wide-scale emergency storm events that are regional in impact, because utilities typically will not be in a position to release line crews to others until outages on their own systems are restored or they have confirmation that the storm event will not greatly impact their own customer base. In such a case, utility ERPs generally anticipate that outages that are expected to last more than two days will require the procurement of external crews through mutual assistance arrangements with other utilities throughout the Northeast Region and, in the case of particularly wide-scale emergency storm events, throughout the country. As a result, the procurement of restoration line crews for a wide-scale emergency storm event can require several days of travel time for line crews to reach New Hampshire, thereby contributing to further delay in the restoration of power to customers.

### **C. Management of Crew Resources for Power Restoration**

As discussed throughout this report and previous reports, pre-staging of restoration crews is critical to effective emergency response when a major storm event is anticipated. Once a storm event occurs, timely damage assessment with prompt, if not instantaneous reporting, is necessary to determine whether additional mutual assistance is needed and where it should be deployed. For a major regional wide-scale emergency storm event, resources are typically 2 to 3 days distant in terms of travel and logistical timing. Utility preference is for in-region resources to be obtained for a variety of reasons, including the following:

- Travel time is less, thus in-region crews are a less expensive source of man power.
- With shorter travel, crews can get started right away, resulting in immediate productivity.
- Line crews have familiarity with local climate conditions, terrains and road locations, contributing to greater work efficiency.
- Utilities have greater ability to control the safety of crews, because crews are familiar with infrastructure construction techniques used in the area.

Once additional line crews arrive, whether from near or far, the utilities all seem effective at managing and deploying the additional resources. Nonetheless, the delayed arrival of those additional crews, whether due to the timing of procurement requests, travel distance, crew availability, prolonged damaged assessment, or a combination of factors, can prolong the restoration process.

Damage assessment is a critical element in an effective restoration effort. The assessment of

damage caused by a major storm event is time-consuming, which makes the prompt reporting of troubles and system conditions back to command centers and work centers extremely important. Currently, each utility conducts damage assessment largely through a manual, handwritten process, that records damage to the system on paper forms and reports information back to command centers, generally at the end of the day. Typically, however, only major electrical distribution and transmission system' damage is reported immediately from the field. The use of electronic devices to report assessed system damage more expeditiously would enable more efficient management of available line crew resources, assuming information systems are effectively in place on the receiving end to efficiently accept and organize the incoming damage assessment reports.

#### **D. Decision-making Location as a Factor in Restoration Effectiveness**

The incident command process within each corporate entity is structured to coordinate emergency response actions and resource allocation among subsidiaries, including those located in neighboring states. The proximity of decision-makers to territories affected by a major storm event can play a critical role in the timing and effectiveness of restoration response.

#### **UES**

UES coordinates restoration of its electric utilities in New Hampshire and Massachusetts through a centralized incident commander based in New Hampshire and three regional incident commanders who cover the Capital and Seacoast territories in New Hampshire and Fitchburg in Massachusetts. The centralized incident commander has final decision-making authority.

#### **PSNH**

PSNH makes on-the-ground storm restoration decisions from its headquarters in Manchester, New Hampshire, but works through its Connecticut-based parent, Eversource, to procure resources for storm restoration, including mutual aid. The 2014 Thanksgiving Snowstorm was mostly managed out of the Manchester, New Hampshire emergency operations center but there were elements that utilized the centralized system such as, lodging procurement, additional management personnel, and assistance from office support resources, during the storm response.

#### **LU**

LU had relied on the service company of its predecessor Massachusetts-based parent company, National Grid, for restoration decisions in the past, including during the October 2011

Snowstorm. The 2014 Thanksgiving Snowstorm was the first wide-scale storm that LU has been subjected to since its acquisition by Liberty Utilities. LU’s capability was not tested during this event because the snow storm had limited impact on its territory.

## **NHEC**

NHEC has no parent company or affiliates, and makes all decisions related to storm restoration within its service territory at the company’s local headquarters at 579 Tenney Mountain Highway, Plymouth, New Hampshire.

### **E. Utility Procurement of Line Crews during the 2014 Thanksgiving Snowstorm**

Figures V-2 through V-5 reflect the line crew information submitted to the State Emergency Operations Center by each of the utilities.

## **UES**

Figure V-3 shows that at the onset of the storm, UES had not fully pre-staged with any significant amount of external line crews. At the onset of the storm 50% of UES line crews were reported as available, and eventually came to full strength at 27 hour after the onset of the storm. By this time, 22 contractor line crews had arrived in addition to the 2 contractor line crews on system at the onset of the storm. Twenty-Seven hours into the event, UES had climbed to 5 times its initial level or 2.9 times what it normally would have at the onset of a storm. Clearly the holiday had affected the amount of internal line crews, and external line crews available at the onset of the storm. UES continued to add contractor line crews, ultimately reaching 98 line crews, which is approximately 7.5 times its initial contingency of internal line crews and contractor line crews on system at the onset of the storm. This did not occur until hour 57 on Friday, November 28 at 8:00 PM. By hour 74, restoration was substantially complete and line crews began to be released to NHEC and PSNH. From a historical perspective, UES did not improve on the performance of the previous 5 storms, mostly because of the inability to attract as many crews as possible for its pre-staging effort as had been done for other storms. UES did rapidly add contractor line crews throughout the storm restoration effort, but at duration points longer into the storm than occurred during previous storms. Nearly all the contractor line crews were localized in the Capital Region. UES did utilize some State of New Hampshire facilities in Concord for line crew and resource personnel accommodations, something it had never done before.

## **PSNH**

Figure V-5 shows PSNH increased its normal on-system contractor line crews from 22 to 51 as part of a pre-staging effort. PSNH did not achieve its full staffing of internal line crews until hour 70. At the onset of the storm, it quickly became apparent that it was not nearly enough. It took approximately 43 hours after the onset of the storm for PSNH to double the number of line crews that PSNH maintains in the normal course of business. Three hours later the contractor line crew contingency increased to 3.75 times the initial amount. By hour 85, PSNH had increased to 5.3 times the initial line crew amount. Within 12 hours of attaining this peak, PSNH began releasing line crews, approximately 20 hours prior to the completion of restoration. By hour 114, restoration was substantially complete and crews were released or off duty.

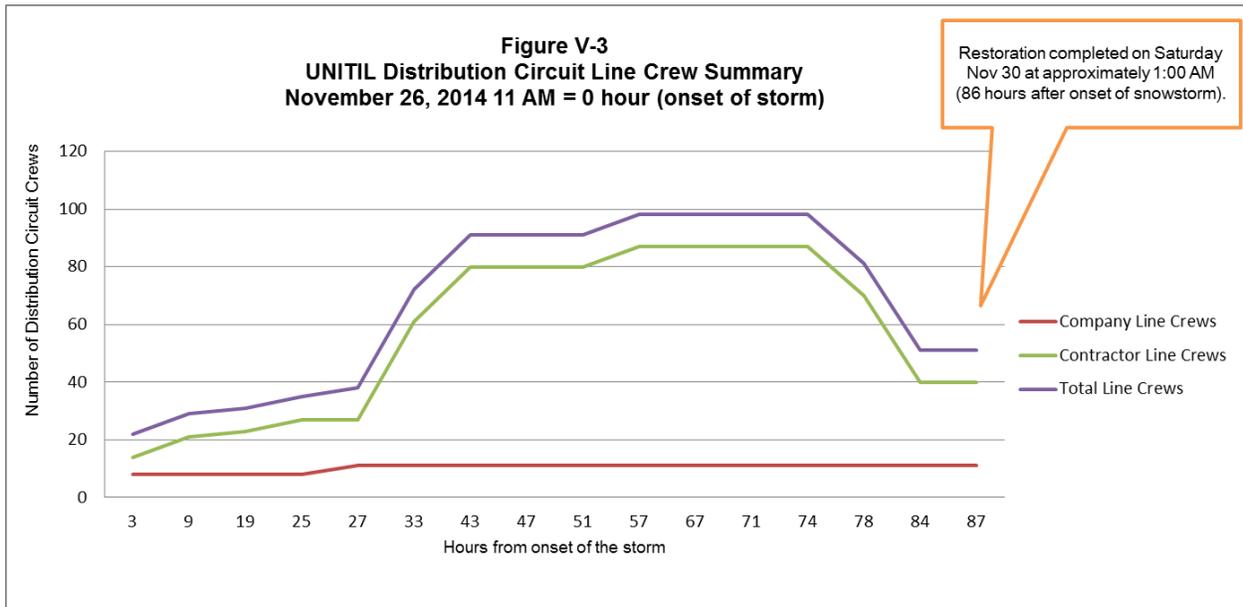
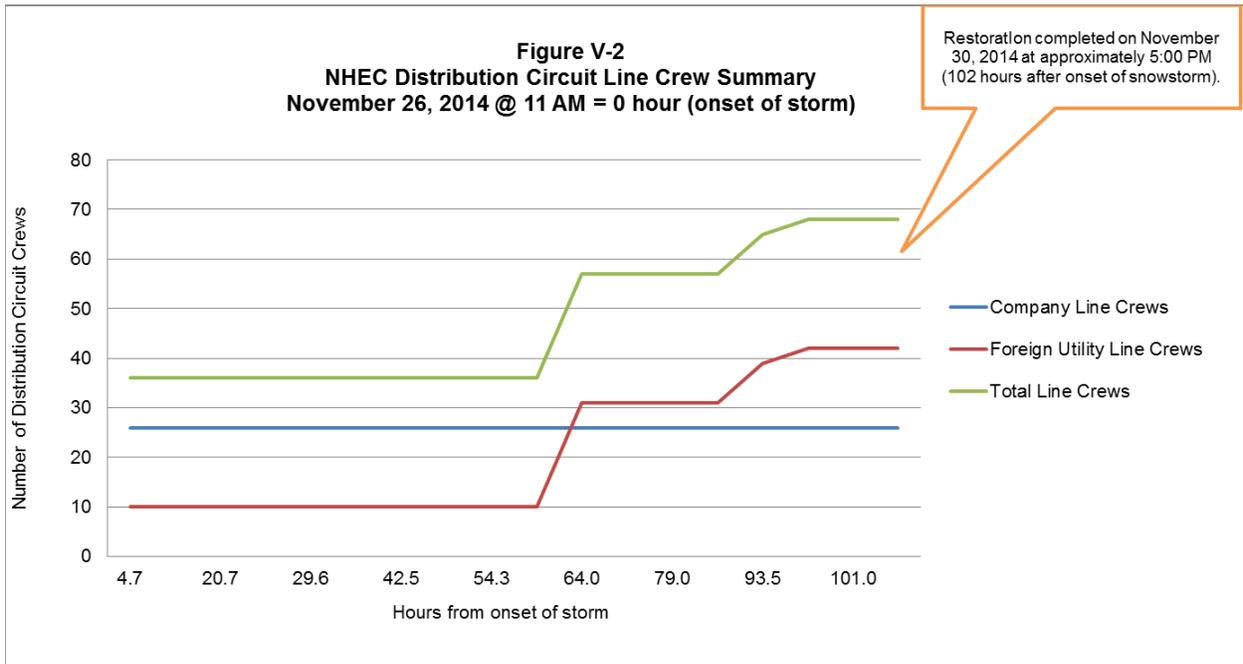
From a historical perspective, PSNH acquired the second largest number of line crews for the 2014 Thanksgiving Snowstorm second only to the December 2008 ice storm. PSNH was able to use service crews to reinstall secondary service wire to residents and commercial businesses that facilitated complete power restoration once the primary distribution lines were re-energized.

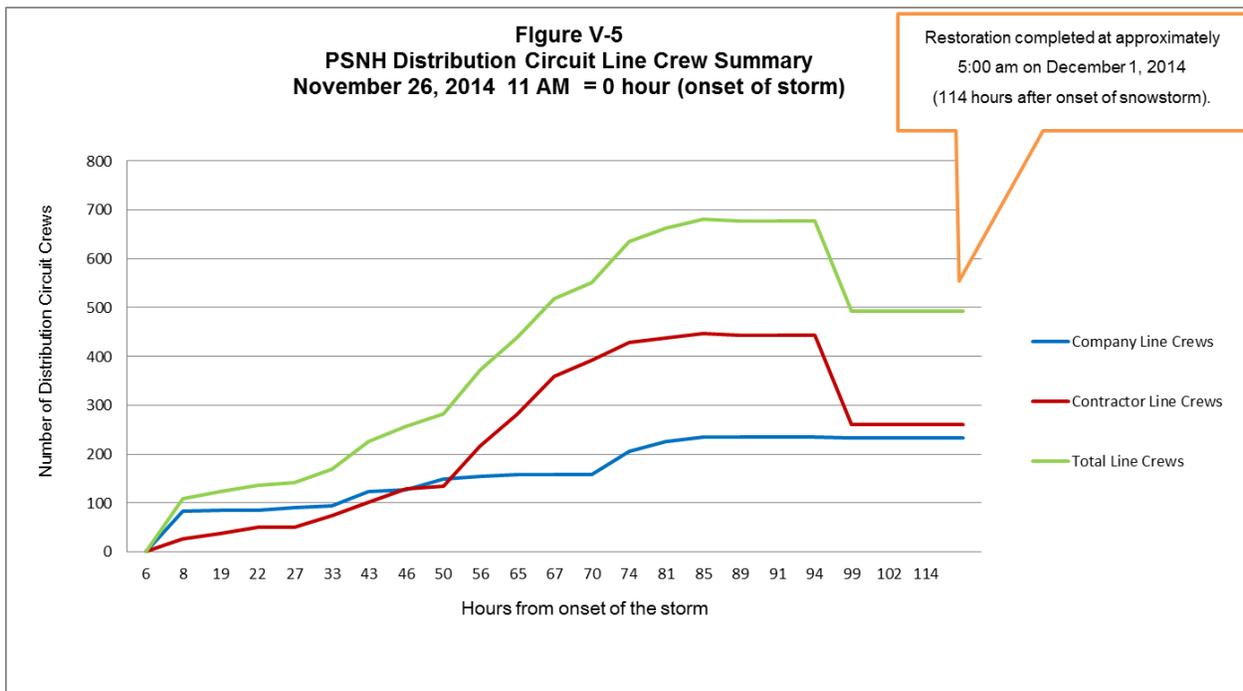
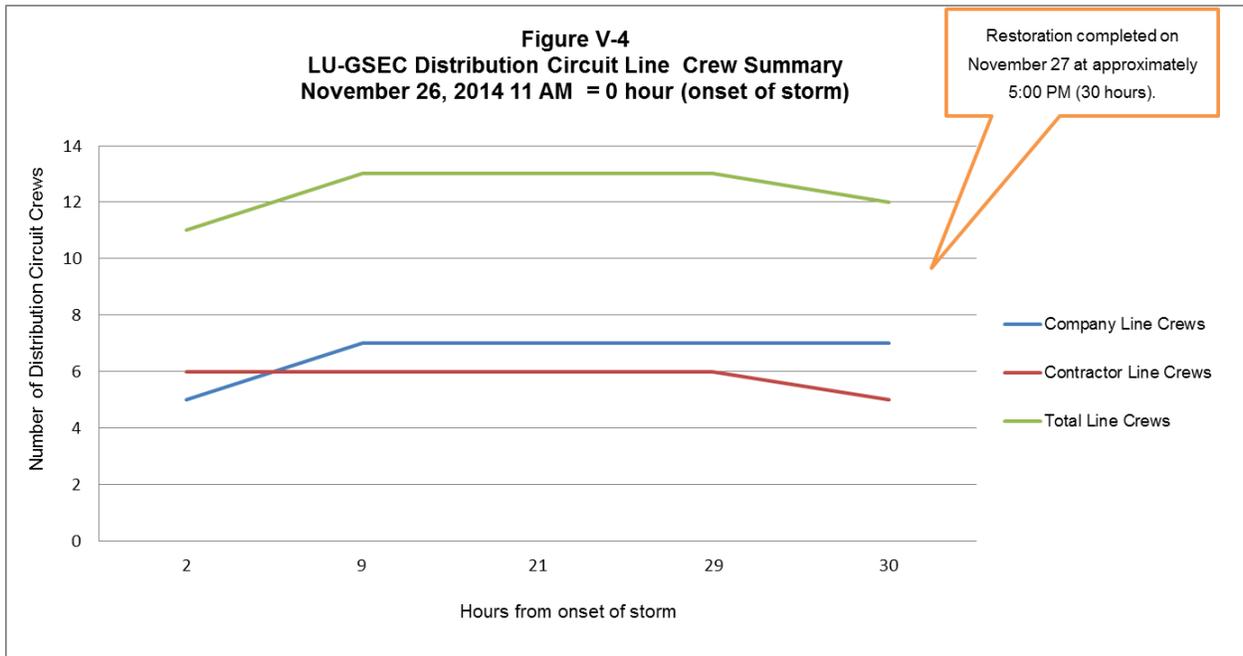
## **LU**

Figure V-4 indicates that LU had added 1 crew and 2 trouble shooters at night on a permanent basis to its crew levels. At the onset of the storm, though, LU had less than half of its internal line crews available and had more contractor crews working on the system than internal line crews. Fortunately for LU, the 2014 Thanksgiving Snowstorm did not severely affect its customers. LU did not have to rely on National Grid for additional line crews as it had done previously. LU only increased its crew contingency to a maximum of 1.2 times its initial levels at a combined 13 line crews. Nearly all LU customers were restored within 30 hours after the onset of the storm.

## **NHEC**

Figure V-2 shows that NHEC deployed all 36 of its internal crews and added 21 additional contractor crews 40 hours after the storm's onset. At hour 93, NHEC added another 8 crews and yet another 3 crews at hour 97. It added no further crews during the restoration effort. By the 103rd hour after the onset of the storm, restoration was substantially complete and line crews were released or off duty. NHEC's maximum crew ratio peaked at 1.9 times the initial crew level.





## VI. Utility Expenditures & Utility Communications

### A. Historical Storm Restoration Costs

The 2014 Thanksgiving Snowstorm incurred a collective estimated amount of \$38 million dollars in expenditures by utilities. It became the second largest amount ever expended for storm restoration, second to the December 2008 Ice Storm. Appendix E provides a breakdown for utility expenditures for each of the utilities for the six largest storms. The annual Gross Domestic Product (GDP) for New Hampshire in real dollars is approximately \$66 billion<sup>29</sup>. In terms of current dollars, the GDP is \$74 billion and ranks approximately 40 nationally. Each hour without power negatively impacts the New Hampshire economy as well as has other negative socio-economic effects and safety impacts.

Since 2008, the PUC has formally advocated that it is less costly to pre-stage external crews and shorten the overall duration of customer outages by quickly ramping up the restoration crews with large amounts of external crews. Given the geographic challenges that New Hampshire encounters regarding storm movements and the increasing public dependency on electric power, the PUC has promoted triggering of action plans at the earliest practical moment even though potential storms may not ultimately materialize. The Commission, as well as utilities, lacks a New Hampshire-based economic impact study of local, county and state impacts. After six historical storms, the PUC staff believes there should be sufficient data to analyze the effects and believes a committee should be created with the purpose of creating a detailed request for proposal that will either definitively confirm or reject this philosophy. A recommendation is made in Section III to develop such a proposal and associated study.

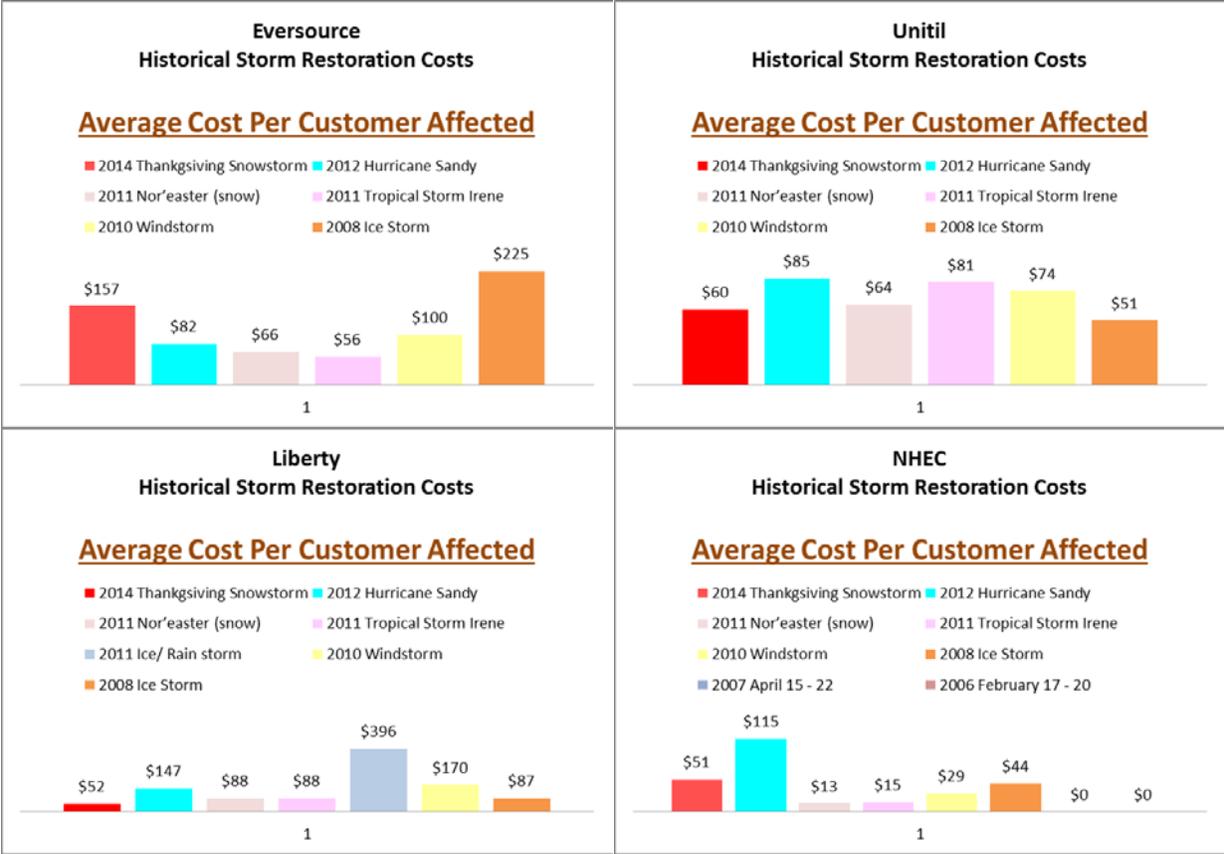
Figure VI-A-1 displays charts that reflect *average cost per customer affected* for the wide-scale emergency storm events that have impacted each utility's operations over the past ten years in New Hampshire. These charts list the average costs per customer affected during each storm for Eversource (PSNH), UES, LU and NHEC<sup>30</sup>. These costs are derived by taking the total storm restoration costs divided by the number of customers affected by loss of power, per storm, as reported by each utility.

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<sup>29</sup> Source: US Bureau of Economic Analysis 2014 Table of State Real GDPs (reference [http://bea.gov/newsreleases/regional/gdp\\_state/gsp\\_newsrelease.htm](http://bea.gov/newsreleases/regional/gdp_state/gsp_newsrelease.htm))

<sup>30</sup> Please note that some historical storm related cost information was not available for NHEC.

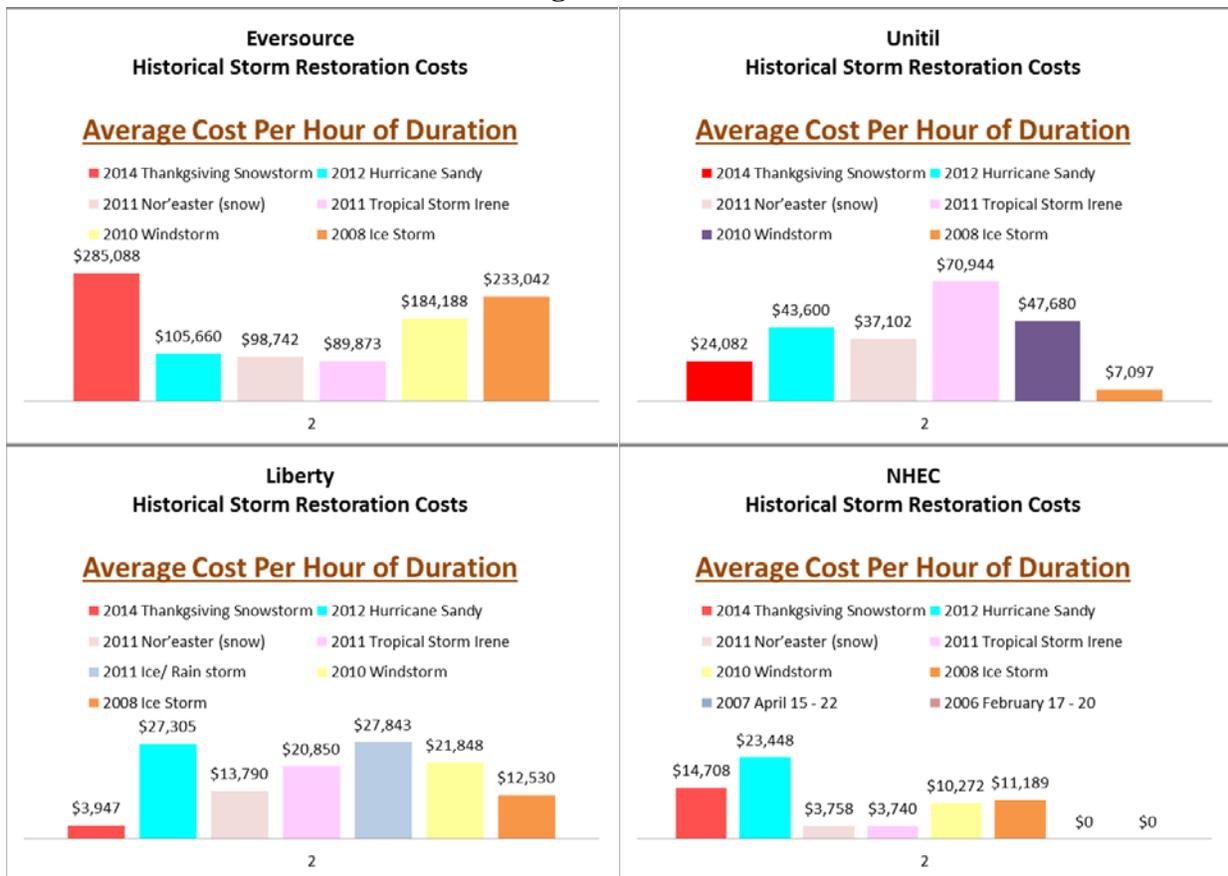
Figure VI-A-1



All cost figures presented in this series of charts are for information purposes only.

Figure VI-A-2 displays charts that reflect the *average cost to restore power* for the wide-scale emergency storm events that have impacted each utility’s operations over the past ten years in New Hampshire. These charts list the average cost per hour for the power restorations during each storm of consequence for Eversource (PSNH), UES, LU and NHEC. These costs are derived by taking the total costs per storm restoration, as identified by each utility divided by the total hours of duration for each utility to restore all customers affected during the storm event. The total hours of restoration are derived from the onset of the storm to the time that the last customer(s)’ power is restored as reported by each utility.

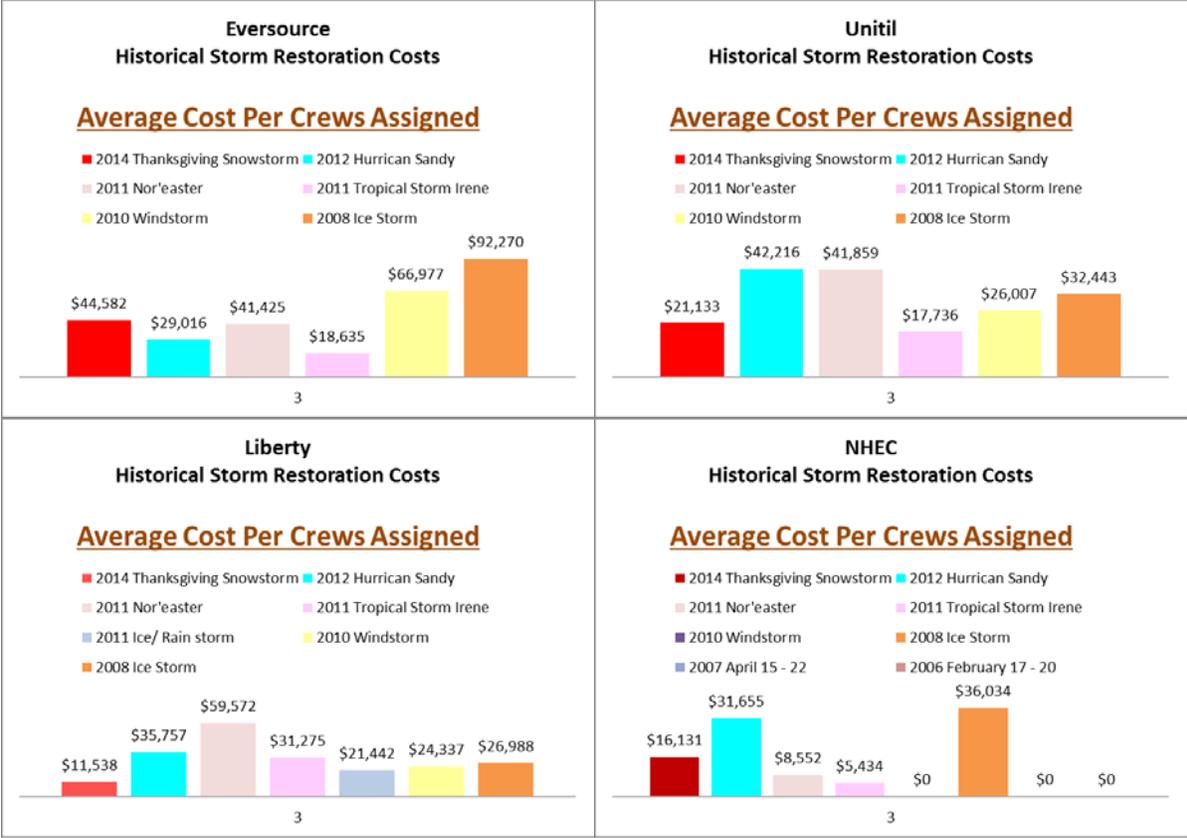
**Figure VI-A-2**



**All cost figures presented in this series of charts are for information purposes only.**

Figure VI-A-3 displays charts that reflect the *average costs per line crew* for the wide-scale emergency storm events that have impacted each utility’s operations over the past ten years in New Hampshire. These charts list the average cost per line crew assigned to work during each storm of consequence for Eversource (PSNH), UES, LU and NHEC. These costs are derived by taking the total costs per storm restoration divided by the total number of line crews, service crews, pole crews and contractor crews assigned as reported by each utility.

**Table VI-A-3**



All cost figures presented in this series of charts are for information purposes only.

**B. Staff Findings Regarding Utility Communications:**

During the 2014 November Snowstorm and throughout the resulting restoration efforts, utilities provided outage and other restoration information using websites and social media, but for those customers without internet access these tools are not helpful. Generally, the utility information

that was communicated to the public related to storm restoration progress and ETRs on the broadcast media and was nonspecific to communities at neighborhood and street levels. Eventually, town-by-town and global ETRs were established.

### **UES**

UES issued a global ETR in a press release on Thursday at 6:17 PM, and stated that it expected its customers to be restored by Friday evening.

### **PSNH**

As late as Friday evening, nearly 60 hours after the storm began, PSNH was still using a global ETR message of “Monday, or sooner” rather than town specific information.

PSNH experienced outage map data inaccuracies by as much as 20% and at one point the company took the map down, making it unavailable to customers for several hours during the height of the restoration process.

PSNH experienced other IT issues during this event as three of its computer servers went down, impacting some of its network and web access for approximately 12 hours.

On Saturday morning PSNH began reporting town specific ETRs. The term “Substantially Complete” was used as the current status for many towns in the reporting. This created additional stress to customers still without power and provided no meaningful assistance to customers who needed to make decisions regarding their homes and businesses, especially with regard to heat and, for those customers on private wells, water.

### **NHEC**

The NHEC normal business operations and call center were closed down during the Thanksgiving holiday.

A pre-storm press release/email to members issued on Wednesday morning noted the availability of a toll-free 24-hour outage hotline and real time outage map and restoration information posted to the NHEC web page. Social media would also be used to deliver outage and restoration information on Facebook and Twitter.

During the storm, NHEC’s phone system was ultimately overwhelmed by calls and was inaccessible to the majority of members. NHEC’s After-Action Storm Review revealed that its GIS and OMS had been in place for 11 months with data conversion and clean-up work still in process which impacted accurate outage prediction, and contributed to systems not performing as

designed. The OMS, phone system, and computer network were all affected, making it extremely difficult to get real-time accurate information, communicate with crews or receive outage calls from members.

Not until after the company's IT/tech support team worked to resolve issues with the various systems and with its phone vendor did things improve. Unfortunately this did not occur until approximately three days from the onset of the storm. As systems came back, critical information became available again which enabled, the assessment, outage management, and restoration process to proceed.

The Staff observes the following about NHEC's communications;

- Between the close of business on Wednesday, November 26 until Friday morning, November 28, numerous customers reported the NHEC 24-hour toll-free hotline was simply a recording that provided a global ETR and the 211 information about shelters, rather than a live person that could respond to specific questions and concerns.
- Other customers complained to the Commission that they were unable to get through to the NHEC 24-Hour toll-free hotline.
- An email from NHEC to members, providing outage and town specific ETR information, was sent out at 10:02 AM on Friday, November 28, approximately 47 hours after the storm began.
- As of mid-morning Friday, November 28, Hotline callers reported the option to speak with someone live, rather than listening to a recording.

**C. Customer' Generic Concerns Expressed to the PUC Consumer Affairs Division:**

- A major concern expressed by customers for all utilities continued to be the prolonged lack of information on ETRs in any channel of communication. This information was critical to customers' planning on how to deal with the power outages.
- Callers to the PUC Consumer Affairs Division reported that ETR information from all the utility call centers was non-specific during the Thanksgiving Holiday, adding to customer frustration and inhibiting customer ability to plan for their families and/or businesses.

- A general reaction from customers contacting the PUC Consumer Affairs Division was “This happens far too often and it takes too long for power to be restored.”

## **Appendix A – New Hampshire’s Electric Utilities**

The electric utility franchise map shown in Figure A-1, below, indicates the franchised service territory of each electric utility, as follows:

**PSNH**, shown in blue, serves most of New Hampshire’s larger population areas, including the heavily populated southern tier of New Hampshire, including the cities of Manchester, Nashua, Portsmouth, Merrimack, Londonderry, Portsmouth, Dover, Rochester, and Keene.

**UES**, shown in light blue, supplies two distinct service territories – the Capital Region centered in the greater Concord area and the Seacoast Region centered around the greater Hampton/Exeter area.

**Liberty Utilities (LU)**, shown in yellow, consists of two discrete areas: a densely populated area along the New Hampshire-northeast Massachusetts border, including Salem and Pelham, and a more sparsely populated area along the New Hampshire-Vermont border in the Upper Valley region.

**NHEC**, shown in red, serves the more rural areas of New Hampshire. The green areas on the map represent municipal electric service territories.

PSNH is a subsidiary of Eversource, a large electric and natural gas holding company headquartered in Boston, Massachusetts and Hartford, Connecticut. It has affiliated electric distribution companies operating in Connecticut and Massachusetts. In April 2012, Northeast Utilities and NStar, an electric and natural gas holding company headquartered in Boston, completed the merger of their two companies. Eversource was formed in February 2015 in an effort to rebrand the holding company and subsidiaries with a unified name. After the 2014 Thanksgiving Snowstorm, PSNH officially became part of Eversource in February 2015. The Commission continues to exercise its regulatory responsibility over PSNH and its parent, Eversource.

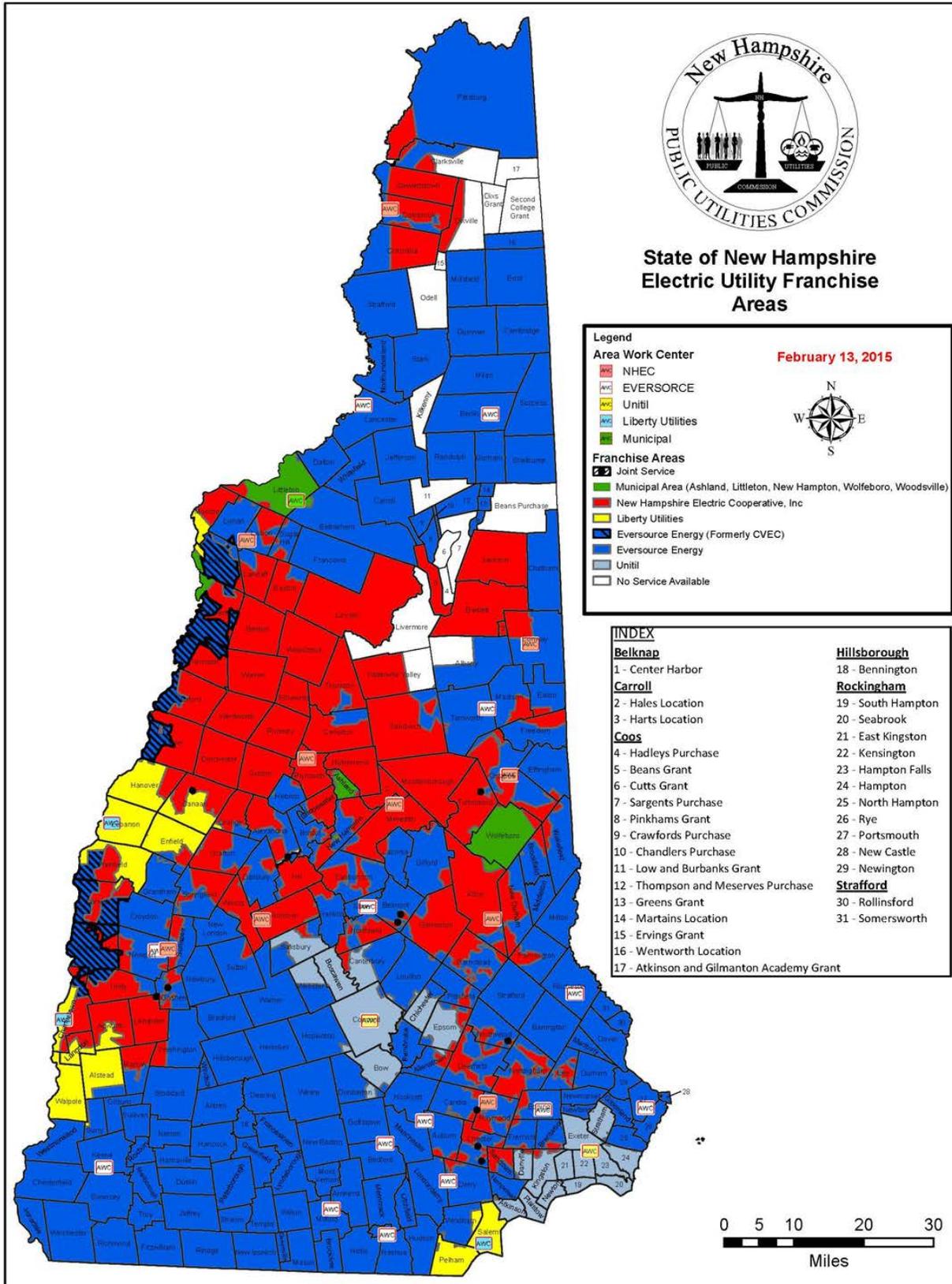
UES is a subsidiary of Unitil Corporation, a public utility holding company headquartered in Hampton, New Hampshire. Unitil’s main subsidiaries include a natural gas distribution utility, Northern Utilities that operates in New Hampshire and Maine, an electric and natural gas distribution utility in Massachusetts, Fitchburg Gas and Electric Light Company as well as UES, which provides electric distribution service in New Hampshire.

Liberty Utilities is a subsidiary of Algonquin Power, based in Ontario, Canada.

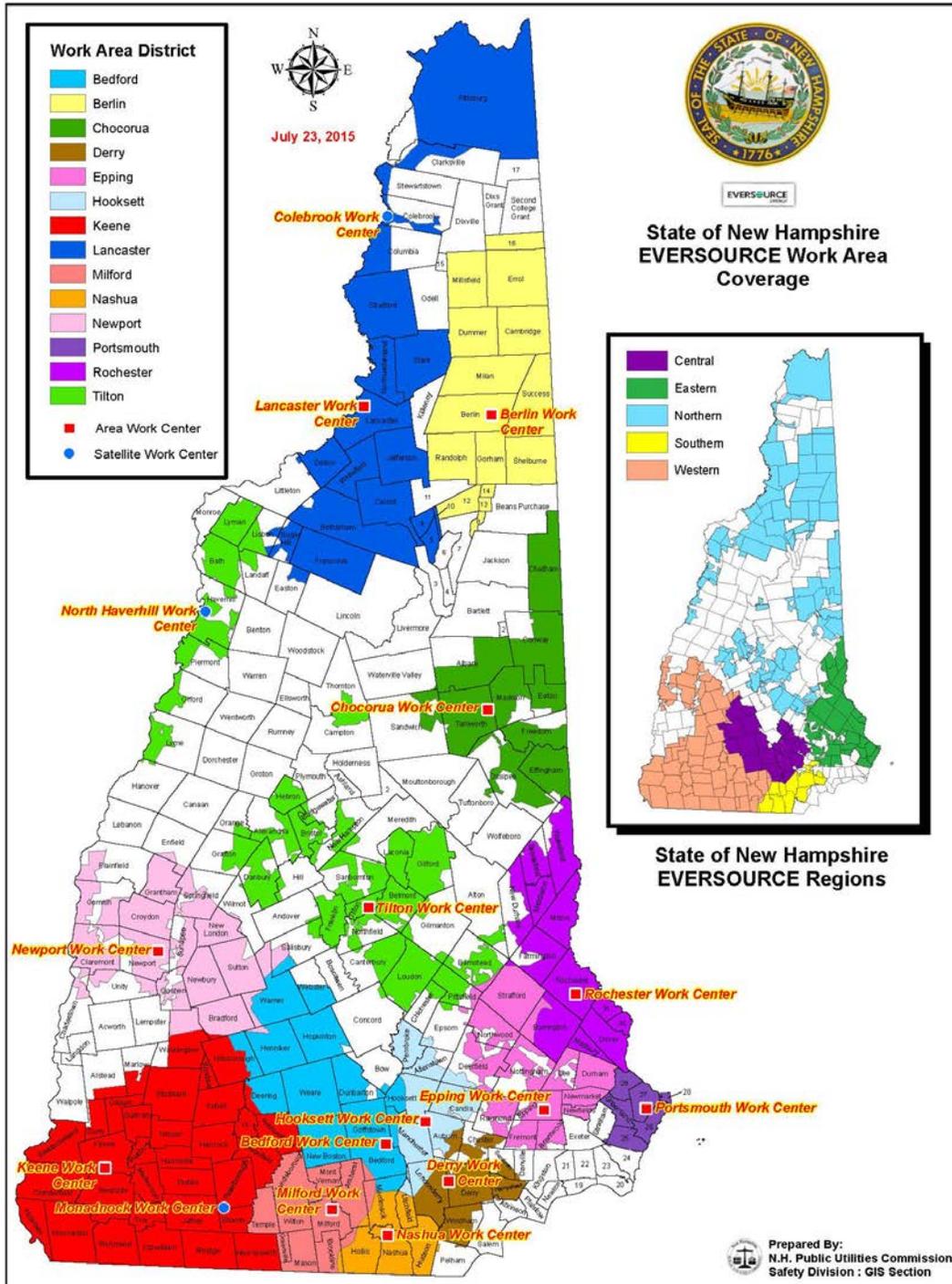
Tables A-1 and A-2 provide an overview of the regulated electric utilities in New Hampshire.

<b>Table A-1</b>			
<b>Electric Provider</b>	<b>Number of Customers</b>	<b>Total Square Miles of Service Territory</b>	<b>Total Miles of Transmission and Distribution</b>
New Hampshire Electric Cooperative (NHEC)	80,608	2,419	5,586
Unitil Energy Systems (UES)	76,003	408	1,568
Liberty Utilities ( LU)	42,736	810	1,768
Public Service of New Hampshire (PSNH)	511,459	5,628	13,804
Total	710,806	9,265	22,726

<b>Table A-2</b>				
<b>Electric Company</b>	<b>Number of Towns Fully Served</b>	<b>No. Customers Within Towns Fully Served</b>	<b>Number of Towns Partially Served</b>	<b>No. Customer Within Towns Partially Served</b>
New Hampshire Electric Cooperative	18	22,756	99	57,852
Unitil Energy Systems	8	23,649	23	52,354
Liberty Utilities	3	24,290	19	18,446
Public Service of New Hampshire	95	330,267	117	181,192
Total	124	400,962	258	309,844



# Appendix B – PSNH Regions and Work Centers



## **Appendix C – Status Report on the October 2011 Snowstorm After-Action Review**

The October 2011 Snowstorm remains the third worst New Hampshire electric outage event in recent history. Approximately 300,000 of New Hampshire electric customers were without power at the peak of the storm. The Commission’s After-Action Review of the October 2011 Snowstorm provided a comprehensive and detailed review of utility planning and response to this widespread outage event.

This staff report on the November 2014 Snowstorm provides an opportunity to revisit the recommendations made by the Commission after the October 2011 Snowstorm, assess the status of each after-action item from the above report, and identifies remaining actions that are still outstanding, as outlined in the chart below.

Denotes action completed

- ✓ Denotes action completed
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- ✘ Denotes action not yet taken

**October 2011 Snow Storm  
After-Action Review Corrective Actions Status Report**

AREA OF CONCERN	STATUS	COMMENTS
<b>Emergency Planning and Preparedness Actions</b>		
<p>1. Each utility shall review the data available from the December 2008 Ice Storm, the February 2010 Wind Storm, 2011 Tropical Storm Irene, the October 2011 Snowstorm and Hurricane Sandy, to develop indices that facilitate the prediction of impact of storms of varying magnitudes. Indices to be incorporated into utility ERPs shall be filed with the Commission no later than March 1, 2013.</p>	✓ NHEC	<p>NHEC "P.10 NHEC uses a system of priority "Levels" assigned during potential events according to number of members affected, amount &amp; complexity of damage, estimated restoration times, personnel, services required, based on NHEC <b>historical storm/event data</b> and experiences. Specific 6 storms are not named.</p> <p>P.2 NHEC When possible, advance warning advisories will be issued by the Service Continuity Manager prior to the declaration of an emergency, and Operations shall not be curtailed or suspended until the emergency condition is terminated."</p>
	✓ UES	UES has completed this action see page 225 of ERP that takes into account historic storms.
	✓ GSEC	GSEC has completed this action. See page 17 of ERP that takes into account historic storms.
	○ PSNH	PSNH No reference identified in December 2013 ERP or March 2015 ERP filing
<p>2. Each utility shall incorporate into its impact indices factors such as snow accumulations, ice thickness, wind speeds, and foliage conditions that will allow utilities to estimate, by event level, the number of troubles<sup>31</sup> and resulting outages that could result from a forecasted weather event.</p>	○ NHEC	NHEC may do this, but it is not stated in ERP. No pre-planning impact indices listed which related pre-storm weather forecasts to their priority "levels" assigned during potential events.
	✓ UES	UES includes this detail in their ERP page 207. UES had this completed prior to Oct 2011 Storm.
	✓ GSEC	GSEC includes this detail in their ERP section 101 P. 9. Liberty filed in Jan 2012 Impact Indices and now included in ERP.
	○ PSNH	PSNH reviews the Energy Event Index in appendix T and in 2015 EP-PSNH-2000-JA-005 Rev 0, Schneider Forecast Regions for PSNH and Schneider Electrical Event Index but does not predict the number of troubles from this information.

<sup>31</sup> Troubles refers to specific damage to the system, such as downed wires, a broken pole or blown fuse; a single "trouble ticket" could result in an outage affecting one customer or multiple customers.

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*Appendix C–Status Report on the October 2011 Snowstorm After-Action Review*

3. Each utility shall establish clear ERP Event Level tables, including maximum system-wide duration of outages, minimum and maximum percentage of customers without power per event level, and normalized number of troubles. Event Levels should be consistent among all four electric utilities and should include at least five levels of event magnitude.		Table 306-1 of PUC of 306.09(g) was effective May 2014. Established levels 1-5.
	✓ NHEC	NHEC ERP P.14 has completed this action. (note: should be reversed order to be consistent with PUC rules)
	✓ UES	UES ERP P. 215 has completed this action.
	✓ GSEC	GSEC has Event Levels listed consistently with Puc Rules except EPR P. 10.
	○ PSNH	PSNH Dec 2013 ERP states only 3 levels. PSNH March 2015 ERP states page 16 Events Levels 1-5 but does not clearly indicate how Schneider Electric Event Indices relate to Readiness Conditions relate to Event Level.
4. Impact indices and their use in determining resource requirements for wide-scale storm planning and preparedness procedures shall be incorporated within each utility’s ERP before the next annual ERP filing.	✓ NHEC	NHEC ERP P. 10 has completed this action.
	✓ UES	UES ERP P. 215 has completed this action.
	✓ GSEC	GSEC ERP section 101 P. 4 Has completed this action.
	○ PSNH	PSNH See Comments above because crews not attained quick enough for the 2014 Thanksgiving Snowstorm.
5. Using the event levels and revised ERPs submitted by the utilities, the Commission will evaluate the need to establish maximum restoration targets based on worst case conditions for large-scale, widespread storms, to be incorporated into utility pre-storm planning.	✘ PUC	This is the concept of having an established worst case scenario of restoration completed within 4 days (96 hours) or maximum of 5 days (120 hours) by corporate management. Reference Dec 2008 NEI Report III-7 and Puc Dec 2008 Report Action Item 4.4.  PUC to reevaluate the concept and necessity of establishing max restoration targets to see if can be supported when results from the proposed Economic Report from General Finding 5 (p.6) of this 2014 Thanksgiving Snowstorm Report .
6. NHEC, GSEC and PSNH shall incorporate forecast confidence levels into pre-storm restoration models in a manner similar to that used by UES.	✓ NHEC	NHEC does have confidence levels in ERP.
	✓ PSNH	PSNH reviews the Schneider Energy Event Index in appendix T and in 2015 EP-PSNH-2000-JA-005 Rev 0, Schneider Forecast Regions for PSNH and Schneider Electrical Event Index
	✓ GSEC	GSEC has confidence levels in ERP.
7. The Puc 300 electric service rules will be revised in Docket DRM 12-271 to consider emergency response.	✓ PUC	Puc 302.24 wide scale emergency definition mentions ER, 306.09 clearly addresses ER.
8. PSNH shall improve its emergency resource planning procedures to ensure that outside resources are obtained in a timelier manner.	○ PSNH	PSNH did not make sufficient progress in its procedures to initiate triggering mechanisms early enough. They attained significant level of crews for restoration of damage from the 2014 Thanksgiving Snowstorm but not in a timelier manner. An estimated 18 to 24

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*Appendix C–Status Report on the October 2011 Snowstorm After-Action Review*

		hours could have been shaved off the total duration of 2014 Thanksgiving Snowstorm.
<b>Weather Forecasting</b>		
1. PSNH should add at least two additional intervals to the weather forecast services it currently receives.	○ PSNH	ERP does not specify additional weather forecasts. PSNH receives a 6:00AM and a 1:00 PM forecast from Schneider Electric. ERP of 2015 also does not state more than 2 forecasts. Contract allows for more frequency and is available 24/7 but seldom utilized.
2. Each utility shall evaluate the services it uses for accuracy and service territory detail, and obtain the forecasts most appropriate for its service territories.	○ NHEC	NHEC does not, but they have employed a local meteorologist (retired) to supplement their weather forecasts.
	○ GSEC	Liberty’s plan says “several times daily” weather service forecasts but does receive 4 regions forecasts: Charleston, Walpole, Lebanon, Salem twice daily [8 AM, 4 PM].
	✓ UES	Unitil is divided into 2 regions and gets forecasts for service territory as appropriate.
	○ PSNH	PSNH 2014 forecasts is broken into 5 regions as well as latest ERP of March 2015 but the forecast regions don’t align with regions of designated company regions
<b>Emergency Response</b>		
1. PSNH’s GIS schedule should be accelerated. PSNH shall provide the Commission by January 31, 2013, the financial and resource impacts to fully deploy GIS by December 31, 2013.	✓ PSNH	PSNH fully installed their new GIS system in spring of 2015.
2. PSNH shall submit a detailed plan by January 31, 2013, for an improved OMS to be implemented no later than July 2014 with fully functional capabilities and integration with all company emergency response processes.	○ PSNH	OMS was not implemented by July 2014. PSNH state that their new OMS will be fully installed and functional by September of 2015.
<b>Restoration Response</b>		
1. Utilities that procure and coordinate resources through their parent companies shall document those decisions as well as notes of decisions made by the parent company concerning response and recovery actions	✓ PSNH	PSNH has submitted such documentation for the 2014 Thanksgiving Snowstorm event.
2. Each utility shall include in its Emergency Response Plan procedures for pre-staging crews in the event of wide-scale emergencies that have the potential of affecting 20% or more of customer base <sup>32</sup> . The Plan should (1) provide a methodology for	○ NHEC	NHEC does not mention pre-staging in ERP.
	✓ UES	UES has completed all five in ERP.
	✓ GSEC	GSEC has completed all five in ERP.
	○ PSNH	PSNH does cover 2 and 3 within the text of page 24 of the ERP issued on March 5, 2015.

<sup>32</sup> 20% was prescribed in Oct 2011 Snowstorm Report; PUC rule 302.24 defined wide-scale to be 10% or more which is now in effect

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*Appendix C–Status Report on the October 2011 Snowstorm After-Action Review*

determining how many crew resources will be needed based on forecasts; (2) pre-establish an available pool of resources; (3) factor in travel times; (4) incorporate its own historical restoration data as well as relevant data from other utilities from detailed reviews of the most recent wide-scale storms; and (5) provide for the cancellation of employee vacations as needed for major storm events		
3. Each utility shall develop early resource procurement plans and incorporate those plans into their ERPs.	<ul style="list-style-type: none"> <li>○ NHEC</li> <li>✓ UES</li> <li>✓ GSEC</li> <li>○ PSNH</li> </ul>	See above for all.
4. The Commission will establish through rulemaking specific reporting data requirements consistent for all utilities during major storms that allow for meaningful Commission review of resource acquisitions and restoration efficiency, including allocation of resources among affiliates in other states.	<ul style="list-style-type: none"> <li>✓ PUC</li> </ul>	PUC completed this action. See Puc 307.08.
5. In the event a utility decides to release crews from New Hampshire to an operating affiliate in another state prior to restoration of all New Hampshire customers, it shall notify the Commission within 2 hours of its decision. That decision shall be documented in writing and signed by a senior level management employee. The utility shall further provide the Commission written documentation within 14 days of the decision that includes justification for the release of crews and demonstrates that the release of crews did not unduly delay restoration of power to New Hampshire customers.	<ul style="list-style-type: none"> <li>✓ UES</li> </ul>	Unitil performs this function through a communication email to the Commission.
	<ul style="list-style-type: none"> <li>✓ PSNH</li> </ul>	PSNH performs this function through a communication email to the Commission.
6. Given the competition for limited resources within the region, New Hampshire electric utilities shall explore mechanisms for pooling aggregate resource needs, especially field and line crews. Cost sharing and mechanisms regarding resource attainment and allocation are to be explored and developed resulting in a report jointly filed by the four electric utilities describing the feasibility of such an arrangement, filed with the Commission by June 30, 2013.	<ul style="list-style-type: none"> <li>✓ NHEC</li> <li>✓ UES</li> <li>✓ GSEC</li> <li>✓ PSNH</li> </ul>	<p>The companies filed an aggregated report on June 27, 2013 that said that pooling resource needs would not be beneficial.</p> <p>On July 11, 2013 the Commission expressed the lack of detail.</p> <p>PUC Staff created an internal memo on October 2, 2013 showing the deficiencies regarding the NAMAG process.</p>

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*Appendix C–Status Report on the October 2011 Snowstorm After-Action Review*

<b>Utility Communications</b>		
1. Utilities shall broaden their communications outreach, by exploring ways to use radio and television to provide more targeted information to customers on a local level, such as a scroll identifying areas of concentration for restoration, road closures and regularly updating municipal officials so that they can convey restoration estimates to residents.	✓ NHEC	NHEC has completed this action in ERP page 6.
	✓ UES	UES has completed this action in ERP page 242.
	✓ GSEC	GSEC has completed this action in ERP page 89.
	✓ PSNH	PSNH has completed this action in ERP page 37.
2. Utilities shall incorporate ETRs into their emergency response and allow their customer representatives to share that information with customers. Websites should provide real-time mapping that shows outage locations with numbers of customers affected at each location, as well as ETRs for each location.	○ NHEC	NHEC does not address ETRs in their ERP but does put it on website.
	✓ GSEC	GSEC has completed this action which is listed in their ERP on page 89.
	○ PSNH	PSNH determines ETRs once they have a determination of the damage. This is listed in their ERP on page 37. ETRs are not available on website or outage map and are not down to the street or neighborhood level..
3. Utilities shall coordinate with municipalities, by sharing information through regular outreach in the form of municipal conference calls, providing ETR updates so that municipalities can respond meaningfully to residents’ inquiries, and coordinate emergency response actions. The training and use of municipal workers can help in damage assessment reports, with digital photographs, identification of road closures, etc. and should be explored.	<ul style="list-style-type: none"> <li>○ NHEC</li> <li>○ UES</li> <li>○ GSEC</li> <li>○ PSNH</li> </ul>	All utilities do coordinate and communicate with municipalities. However, they do not use them for damage assessment assistance.
4. PSNH shall develop a meaningful ETR protocol, such as that used by Unitil, that provides real information at the start, rather than at the conclusion, of the restoration phase of a major event.	○ PSNH	PSNH has not developed this ETR protocol and does not issue ETRs until later in the restoration. Once the storm has passed and the number of customers interrupted has peaked, the Planning Section develops restoration projections based on: The number of trouble locations; The relative geographic scope of those locations; The condition of the transmission system; The number of circuit breakers and reclosers affected; The number of service-related trouble spots.

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- ✘ Denotes action not yet taken

- ✓ Denotes action completed
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- ✘ Denotes action not yet taken

## **Appendix D – Outstanding Items Remaining from the December 2008 Ice Storm After-Action Review**

The Commission’s December 2008 Ice Storm After-Action Review contained numerous “action items” for each utility, as well as the Commission and other state agencies. Since then, New Hampshire has experienced several major weather events that have caused significant damage and resulted in widespread power outages. Appendix D of the October 2011 Snowstorm report gave a status report of the progress made by utilities of recommendations from the December 2008 Ice Storm After-Action Report.

This Appendix D of the 2014 Thanksgiving Snowstorm provides an opportunity to revisit again those outstanding action items referenced in Appendix D of the October 2011 Snowstorm Action Report.

The Staff reassessed the outstanding issues that remain and noted any progress made as outlined in the chart below.

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- ✘ Denotes action not yet taken

- ✓ Denotes action completed
- Denotes action undertaken but not yet completed
- ✘ Denotes action not yet taken

**December 2008 Ice Storm  
After-Action Review Corrective Actions Status Report**

**(Open Items)**

AREA OF CONCERN	STATUS	COMMENTS
<b>Emergency Planning Actions</b>		
1.3 Utilities work with municipalities to integrate and coordinate emergency response plans and efforts	○ PSNH	PSNH states it cannot compel municipalities to integrate plans, and thus cannot implement this action.  PSNH although not specifically required in Puc 306.09 (e) should include municipal officials as invitees to drills and coordinate response plans to the extent possible.
1.4 Utilities expand emergency readiness drills to include in-house and external participants typically involved in emergency response. Drills should be conducted at least annually, preferably twice annually	* PSNH	PSNH holds annual emergency readiness drills. PSNH opposes external responders in drills because it cannot compel their participation. Puc 306.09 now states one full and one tabletop exercise is required.  External responders should be offered the opportunity to attend, but not compelled to participate.
<b>Vegetation Management Actions</b>		
2.3 Utilities compile results of inspections, including GIS mapping, and submit annually to Commission	○ NHEC ○ UES ○ GSEC ○ PSNH	All 4 utilities filed the results of inspections, but without GIS mapping included with submission.  Future submissions shall include GIS mapping for those utilities with GIS deployment.
2.6 Commission review NHEC's tree trimming practices, report by April 2010	✓ PUC	Staff reviewed current practices and file report of March 2014 Memorandum of Understanding and accepted in Commission Order No. 25645
<b>Outage Management System Actions</b>		
3.1 Commission consider, as part of PSNH rate case, adequacy of PSNH's outage management system	✓ PSNH	Commission approved PSNH's acquisition of GIS, installation has been completed. OMS is scheduled to go-live in September 2015

- ✓ Denotes action completed
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- \* Denotes action not yet taken

*Appendix D–Outstanding Items Status Report from the December 2008 Ice Storm After Action Review*

<b>Resource Planning and Procurement Actions</b>		
4.3 Utilities file summaries of mutual aid arrangements, external contracts, municipal outreach efforts	<ul style="list-style-type: none"> <li>○ NHEC</li> <li>○ UES</li> <li>○ GSEC</li> <li>○ PSNH</li> </ul>	UES provides summary in its ERP. PSNH does not support filing external contracts due to competitive nature of acquiring resources. Each utility shall file its summaries in its ERP filed with the Commission.
4.5 Emergency Response Plan should include standard trigger points for resource procurement based on clear benchmarks	<ul style="list-style-type: none"> <li>○ PSNH</li> </ul>	PSNH ERP shall develop standard trigger points for resource procurement based on clear benchmarks that tie to the ERP Event Levels as listed Table 306-1 of PUC 306.09 (g)
<b>Emergency Response Actions</b>		
5.1 Each utility should gather and analyze weather and damage information during and immediately following weather events and develop improved models to predict damage	<ul style="list-style-type: none"> <li>○ NHEC</li> <li>○ PSNH</li> </ul>	NHEC and PSNH shall develop such modeling.
5.6 Utilities communicate with regulators, municipalities and public location of crews deployed, preferably by town or street; use of GIS helpful	<ul style="list-style-type: none"> <li>○ NHEC</li> <li>○ PSNH</li> </ul>	NHEC and PSNH have not been doing municipal outreach as frequently as they should. NHEC exploring new communications strategies with municipalities. PSNH developing web-based system, doesn't recommend information by street, no crew schedules made available to state or local officials.
<b>Communications Actions</b>		
6.4 HSEM, Dept of Fire Safety could consider non-endorsed list of licensed electricians for emergency events	<ul style="list-style-type: none"> <li>○ HSEM</li> <li>○ Fire Safety</li> </ul>	Commission to follow-up with HSEM and Fire Safety.
6.6 Electric and telephone utilities should coordinate to improve restoration efforts, including sharing daily work plans, joint conference calls with municipalities	<ul style="list-style-type: none"> <li>○ NHEC</li> <li>○ UES</li> <li>○ GSEC</li> <li>○ PSNH</li> </ul>	All 4 utilities have processes to coordinate with telephone companies; should expand to include all pole attachers, such as cable providers, municipal alarm, and non-regulated telephone entities.

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- ✗ Denotes action not yet taken

*Appendix D–Outstanding Items Status Report from the December 2008 Ice Storm After Action Review*

<p>6.7 When assigning communications personnel to be embedded with municipalities, PSNH should assign span of control ratio of 5-6 towns per person</p>	<p>✓ PSNH</p>	<p>PSNH has assigned communications liaisons for each of the 14 area work centers and 5 regions and has assembled an organizational chart within its ERP. While this is not precisely a six town span of control it is reasonable considering storms may not impact each community equally or at all.</p>
<p>6.8 PSNH should have dedicated municipal room as best practice in emergency response</p>	<p>○ PSNH</p>	<p>PSNH believes this is impractical, and not necessary with new communications liaison. PSNH in a memo dated Jan 2013 Next steps: PSNH must improve outreach and coordination with municipalities, Commission is willing to consider PSNH’s municipal initiatives that may not include a dedicated municipal room. PSNH shall file in its annual ERP details of its municipal outreach and responses.</p>

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## **Appendix E – The November 2014 Snowstorm in Historical Perspective**

Table Appendix E-1 displays the ranking and magnitude of the November 2014 Snowstorm when comparing the largest historical storms and associated power outages to occur in New Hampshire for the four largest electric providers. Overall the November 2014 Snowstorm ranks as the fourth highest behind the October 2011 Snowstorm in terms of the total number of outages statewide at one time. For PSNH and UES, it was the fourth largest customer outage ever recorded in New Hampshire on their respective distribution systems. For NHEC the November 2014 Snowstorm ranked as the fifth largest outage; for LU it was the seventh largest recorded.

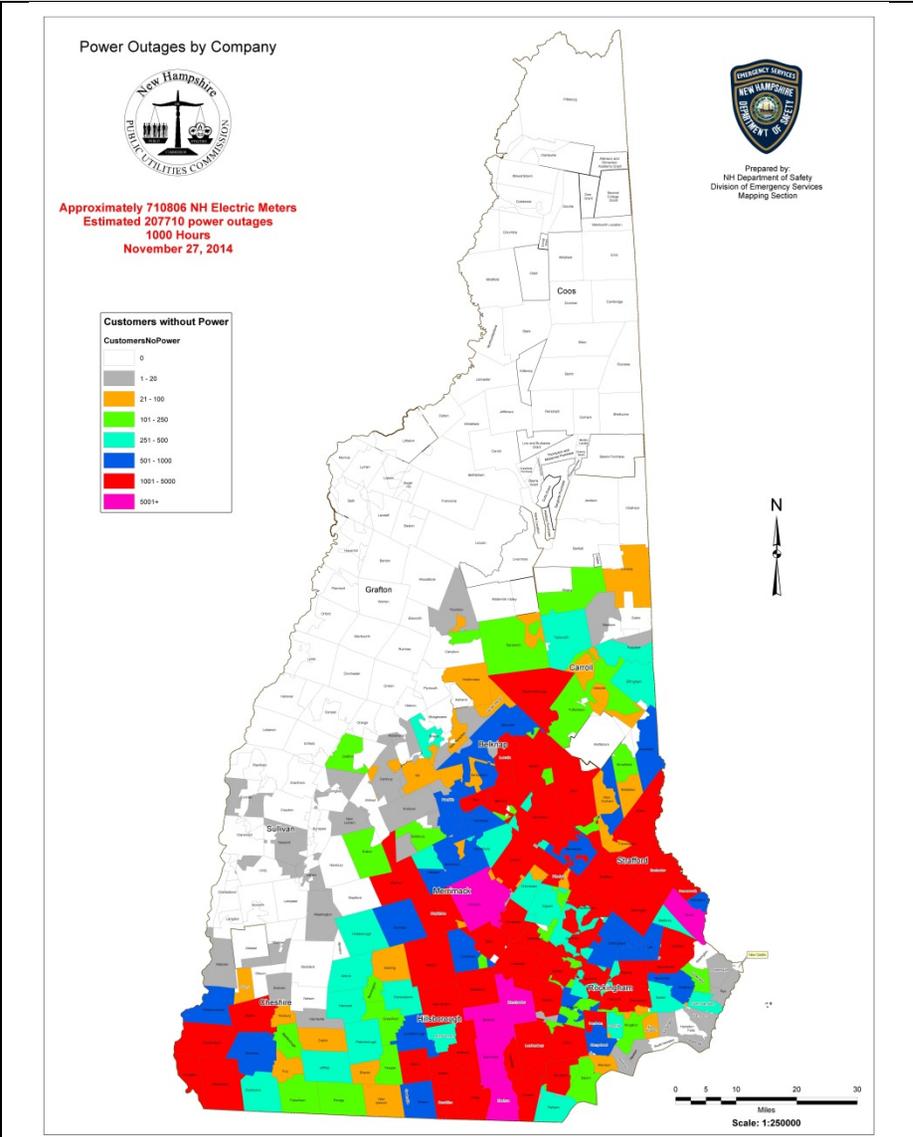
Table Appendix E-1

		NEW HAMPSHIRE HISTORICAL OUTAGES ALL UTILITIES For WIDE SCALE STORMS							
		Prepared by NHPUC Safety Division Rev 06/12/2015							
		Worst Outage	2nd Worst Outage	3rd Worst Outage	4th Worst Outage	5th Worst Outage	6th Worst Outage		
Eversource	Event Name	December 11-24, 2008 Ice Storm	February 25-March 4, 2010 Windstorm	Oct 29-Nov 4, 2011 Nor'easter (snow)	Nov 26 - Dec 1 2014 Thanksgiving Eve Snowstorm	Oct 26 - 31 2012 Hurricane Sandy	Aug 28 - Sept 1 2011 Tropical Storm Irene		
	# of Customers Affected	322,438	265,728	237,000	207,359	137,070	125,714		
	% of Customers Affected	66%	53%	47%	41%	27%	25%		
	Duration of Restoration	312	144	159	114	106	79		
	# of Restoration Crews(ex Tree/Dmg Assrs)	788	396	379	729	386	381		
	Wire Reattached/Replaced (ft)	554,400	168,960	89,760	97,803	116,160	63,360		
	# of Transformers Replaced	1,300	592	196	129	299	155		
	# of Poles Set	783	175	177	59	161	57		
	# of Cross-arms Replaced	1,255	Unknown	Unknown	157	Unknown	Unknown		
	Total Cost	\$72,709,000	\$26,523,000	\$15,700,000	\$32,500,000	\$11,200,000	\$7,100,000		
NHEC	Event Name	December 11-24, 2008 Ice Storm	February 25-March 4, 2010 Windstorm	February 17 - 20, 2006	April 15 - 22, 2007	Nov 26 - Dec 1 2014 Thanksgiving Eve Snowstorm	Oct 26 - 31 2012 Hurricane Sandy	Aug 28 - Sept 1 2011 Tropical Storm Irene	Oct 29-Nov 4, 2011 Nor'easter (snow)
	# of Customers Affected	48,230	45,000	40,000	35,000	29,308	22,000	19,436	18,687
	% of Customers Affected	61%	59%	51%	45%	36%	28%	29%	24%
	Duration of Restoration (hrs)	190	128	72	168	102	108	77	66
	# of Restoration Crews(ex Tree/Dmg Assrs)	59	63	Unknown	Unknown	93	80	53	29
	Wire Reattached/Replaced (ft)	6,959	40,000	Unknown	316,800	820	Unknown	Unknown	Unknown
	# of Transformers Replaced	82	80	Unknown	Unknown	3	Unknown	Unknown	Unknown
	# of Poles Set	70	70	Unknown	75	17	Unknown	Unknown	Unknown
	# of Cross-arms Replaced	120	180	Unknown	Unknown	4	Unknown	Unknown	Unknown
	Total Cost	\$2,126,000	\$1,314,854	Unknown	Unknown	\$1,500,165	\$2,532,429	\$288,000	\$248,000
Unitil	Event Name	February 25-March 4, 2010 Windstorm	Oct 29-Nov 4, 2011 Nor'easter (snow)	December 11-24, 2008 Ice Storm	Nov 26 - Dec 1 2014 Thanksgiving Eve Snowstorm	Oct 26 - 31 2012 Hurricane Sandy	Aug 28 - Sept 1 2011 Tropical Storm Irene		
	# of Customers Affected	61,602	51,262	39,996	34,575	31,437	31,355		
	% of Customers Affected	84%	69%	55%	46%	42%	42%		
	Duration of Restoration (hrs)	96	88	288	86	61	36		
	# of Restoration Crews(ex Tree/Dmg Assrs)	176	78	63	98	63	144		
	Wire Reattached/Replaced (ft)	103,600	5,700	93,012	18,599	21,819	2,400		
	# of Transformers Replaced	66	8	71	14	23	13		
	# of Poles Set	137	9	67	9	18	0		
	# of Cross-arms Replaced	325	35	239	46	26	10		
	Total Cost	\$4,577,281.00	\$3,265,000.00	\$2,043,881.00	\$2,071,048.00	\$2,659,587.00	\$2,554,000.00		
Liberty	Event Name	December 11-24, 2008 Ice Storm	Oct 29-Nov 4, 2011 Nor'easter (snow)	Aug 28 - Sept 1 2011 Tropical Storm Irene	February 25-March 4, 2010 Windstorm	Oct 26 - 31 2012 Hurricane Sandy	March 7 - 10 2011 Ice/ Rain storm	Nov 26 - Dec 1 2014 Thanksgiving Eve Snowstorm	
	# of Customers Affected	24,164	17,000	11,400	11,319	10,200	4,709	2,900	
	% of Customers Affected	63%	41%	28%	27%	25%	11%	7%	
	Duration of Restoration (hrs)	168	108	48	88	55	67	38	
	# of Restoration Crews(ex Tree/Dmg Assrs)	78	25	32	79	42	87	13	
	Wire Reattached/Replaced (ft)	12,980	Unknown	Unknown	Unknown	Unknown	Unknown	5,000	
	# of Transformers Replaced	29	Unknown	Unknown	Unknown	Unknown	Unknown	5	
	# of Poles Set	48	Unknown	Unknown	Unknown	Unknown	Unknown	10	
	# of Cross-arms Replaced	250	Unknown	Unknown	Unknown	Unknown	Unknown	25	
Total Cost	\$2,105,065.00	\$1,489,292.00	\$1,000,796.00	\$1,922,639.00	\$1,501,777.00	\$1,865,469	\$150,000.00		

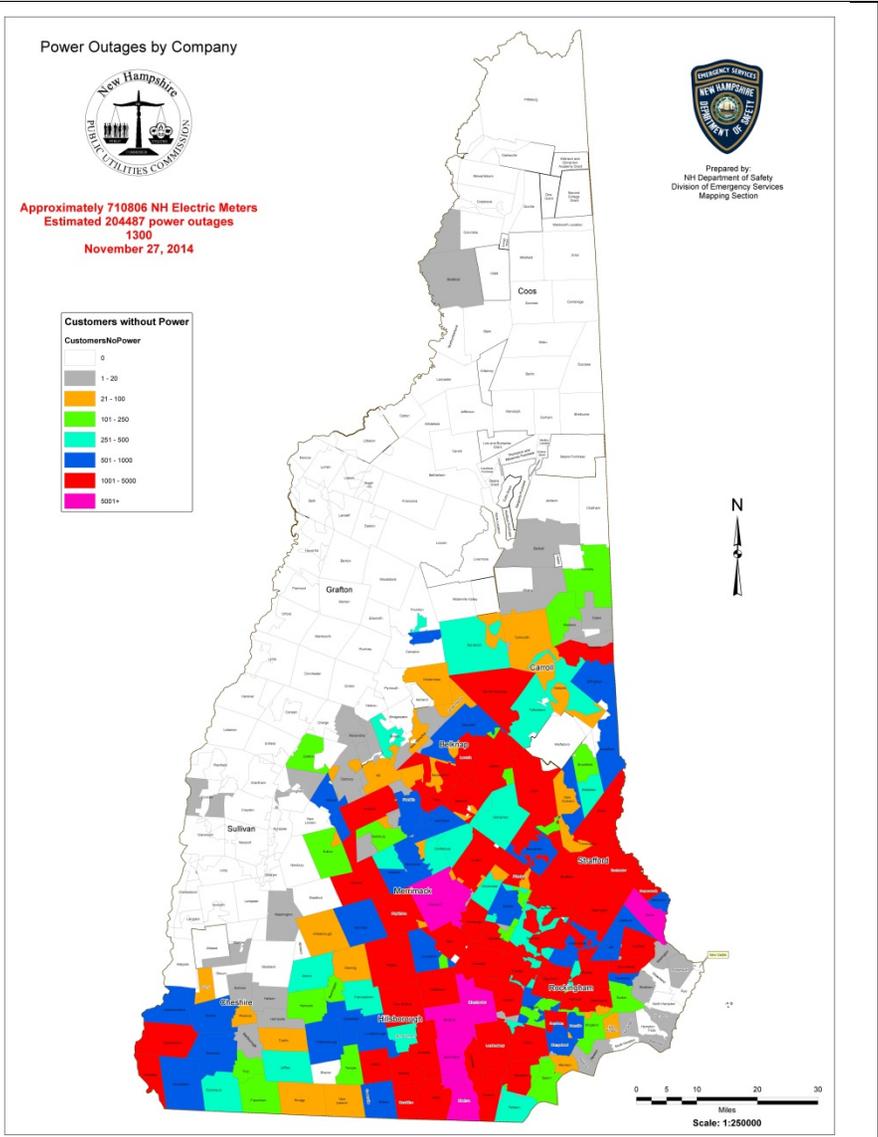
		NEW HAMPSHIRE HISTORICAL OUTAGES ALL UTILITIES For WIDE SCALE STORMS					
		Prepared by NHPUC Safety Division Rev 06/12/2015					
		Worst Outage	2nd Worst Outage	3rd Worst Outage	4th Worst Outage	5th Worst Outage	6th Worst Outage
State Wide	Event Name	December 11-24, 2008 Ice Storm	February 25-March 4, 2010 Windstorm	Oct 29-Nov 4, 2011 Nor'easter (snow)	Nov 26 - Dec 1 2014 Thanksgiving Eve Snowstorm	Oct 26 - 31 2012 Hurricane Sandy	Aug 28 - Sept 1 2011 Tropical Storm Irene
	Concurrent Peak Customers Affected	432,632	337,542	299,235	238,865	190,000	184,701
	% of Concurrent Customers Affected	63%	50%	43%	34%	27%	27%
	Duration of Restoration (hrs)	312	144	159	114	108	79
	Non Concurrent Peak Customers Affected <sup>23</sup>	434,828	383,649	323,949	274,142	200,707	187,905
	% of NonConcurrent Customers Affected	63%	57%	47%	39%	29%	27%
	# of Restoration Crews (ex Tree/Dmg Assrs) <sup>23</sup>	988	714	511	933	571	610
	Wire Reattached/Replaced (ft) <sup>23</sup>	667,351	Incomplete Data	Incomplete Data	122,222	Incomplete Data	Incomplete Data
	# of Transformers Replaced <sup>23</sup>	1,482	Incomplete Data	Incomplete Data	151	Incomplete Data	Incomplete Data
	# of Poles Set <sup>23</sup>	968	Incomplete Data	Incomplete Data	95	Incomplete Data	Incomplete Data
# of Cross-arms Replaced <sup>23</sup>	1,864	Incomplete Data	Incomplete Data	232	Incomplete Data	Incomplete Data	
Total Cost <sup>23</sup>	\$78,983,946.00	\$34,337,774.00	\$20,702,292.00	\$36,221,213.00	\$17,893,793.00	\$10,942,796.00	

<sup>23</sup> Restoration Crews in Table Appendix E-1 includes all contractor, affiliate, mutual assistance and internal crews (commonly referred to as: line crews, digger crews, service crews, but excludes tree trimming crews).

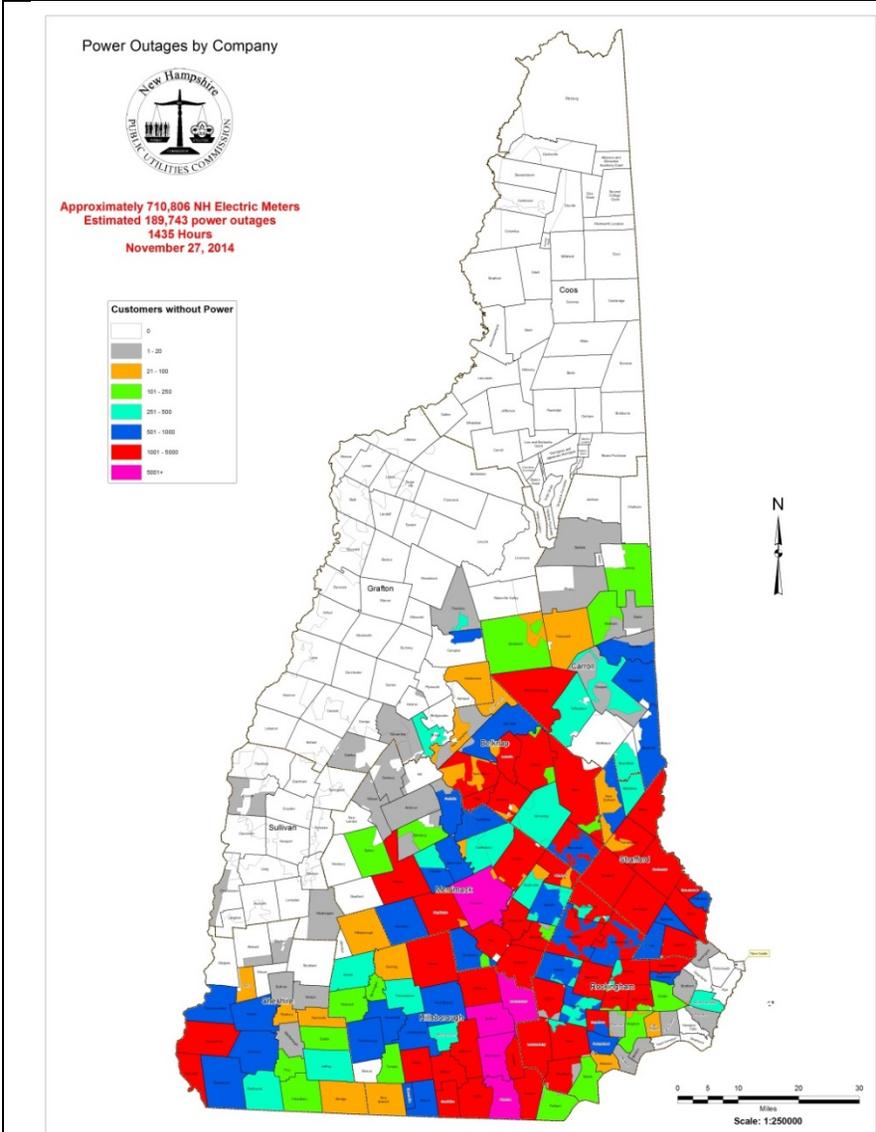
# Appendix F – Sequential Storm Event Outage Maps



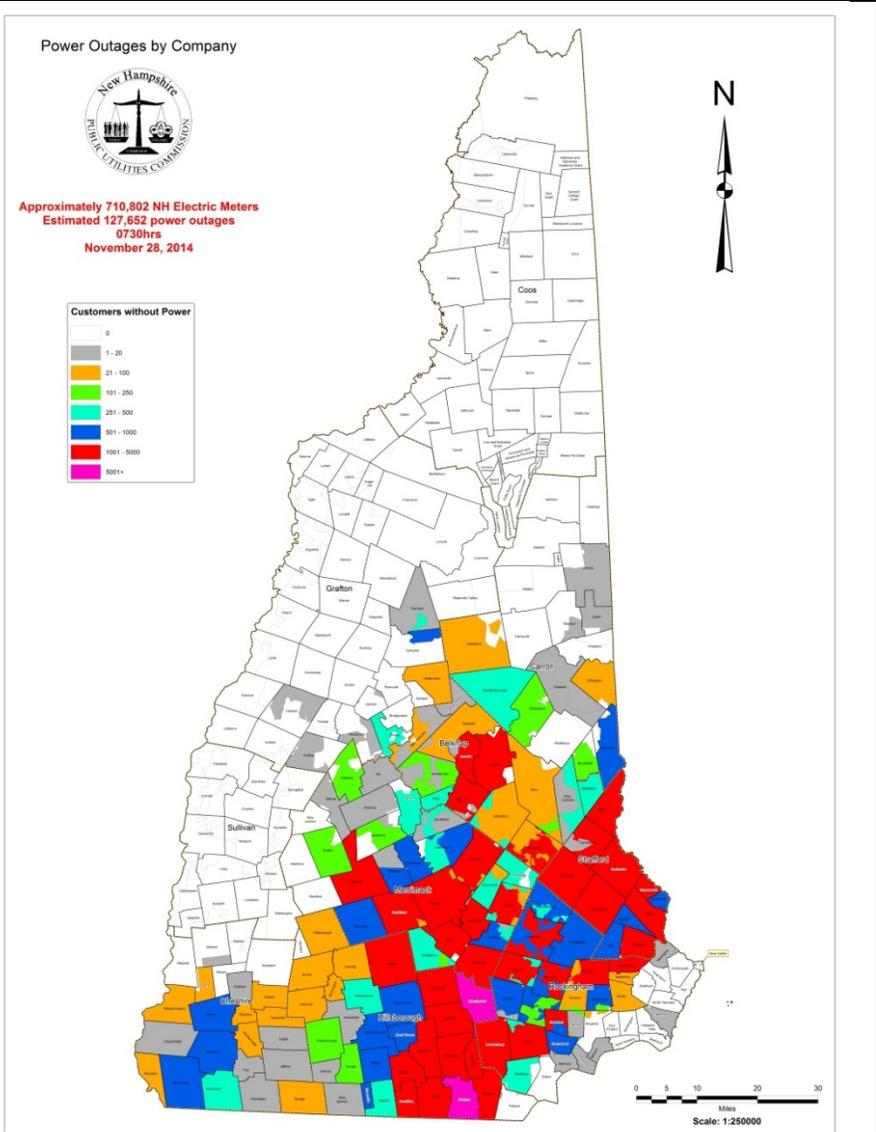
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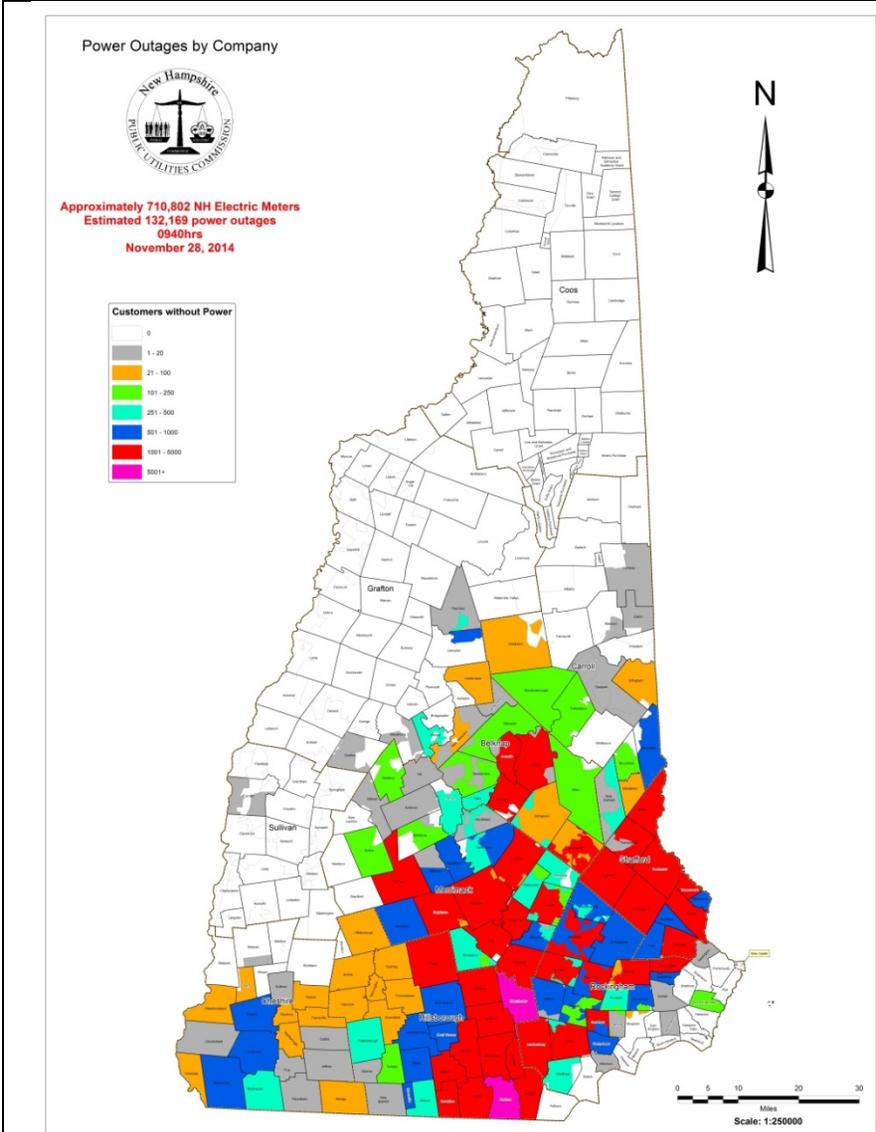
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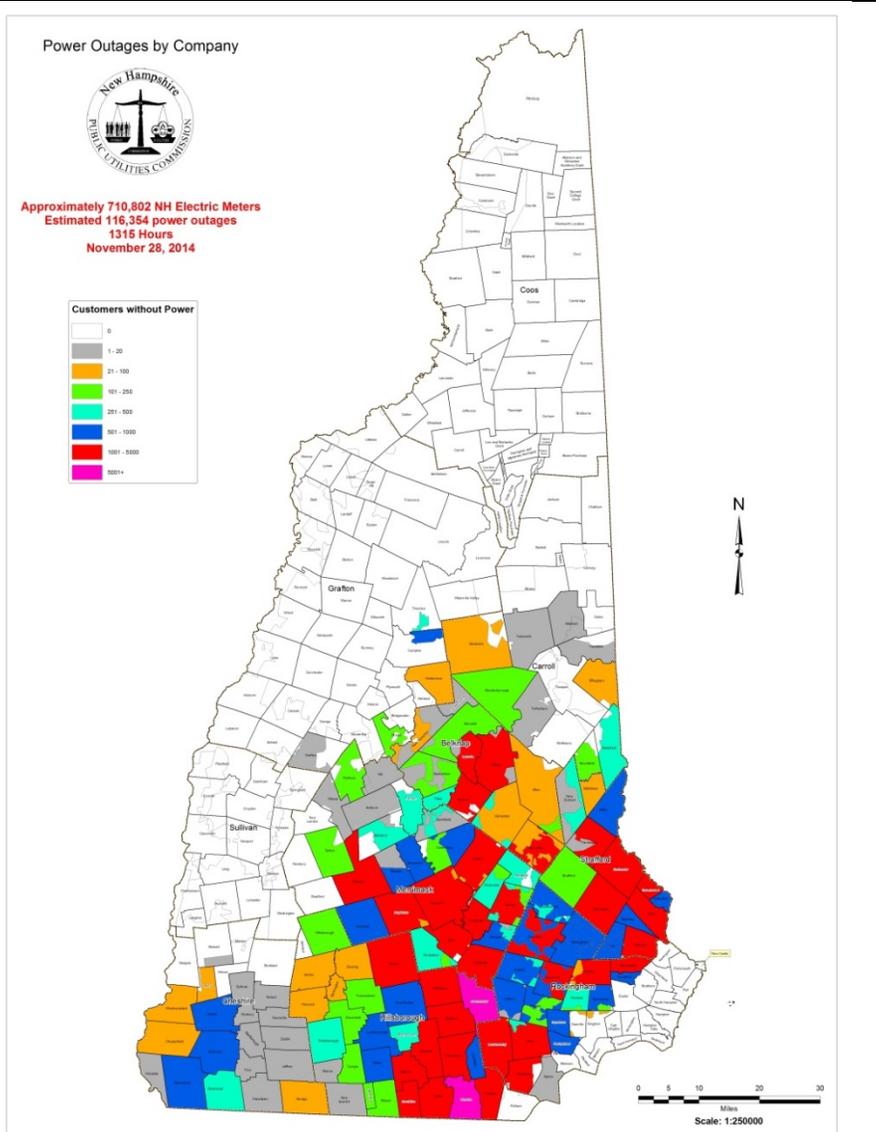
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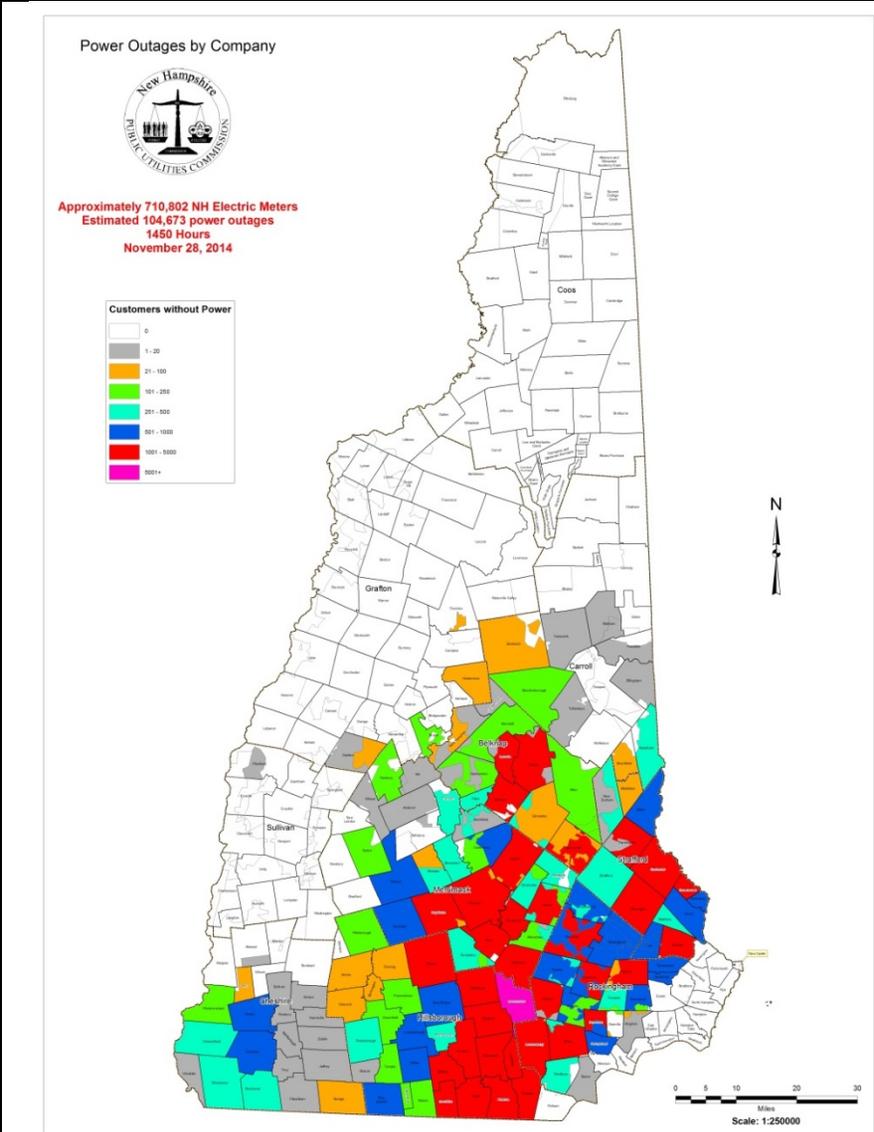
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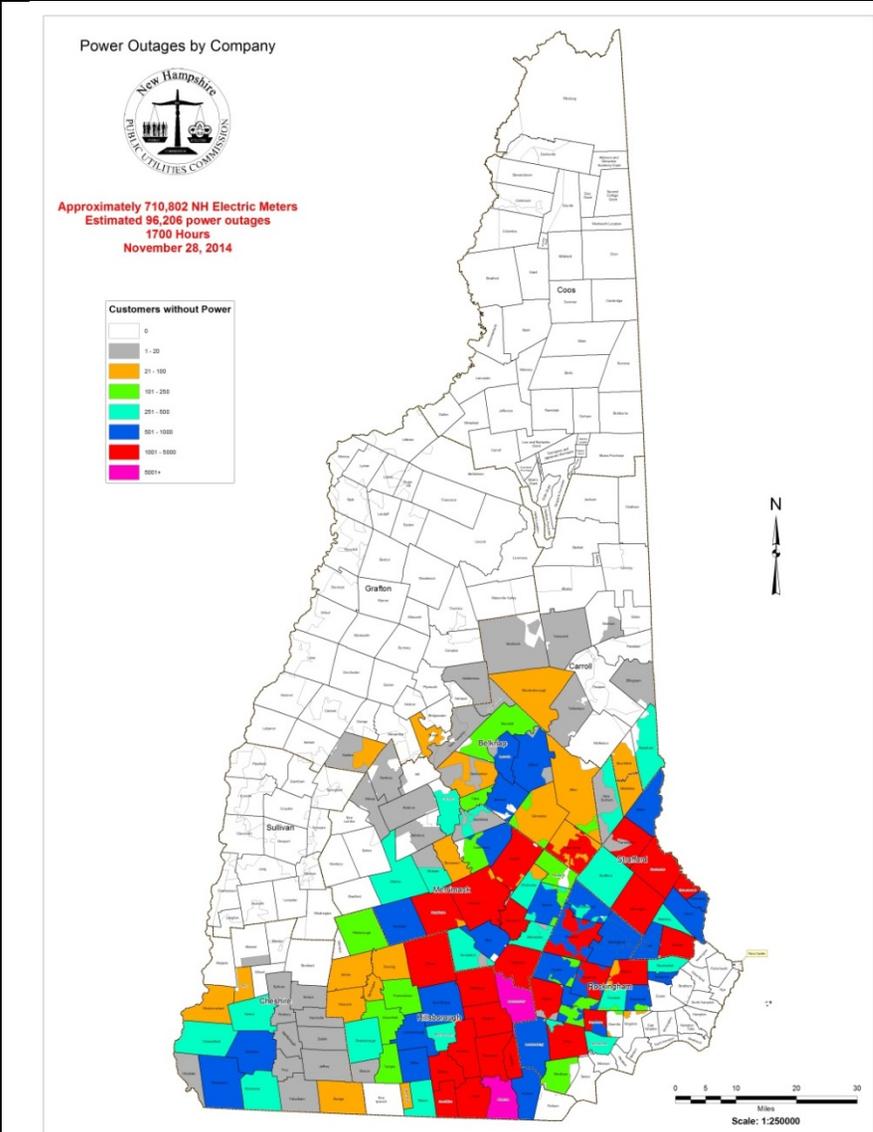
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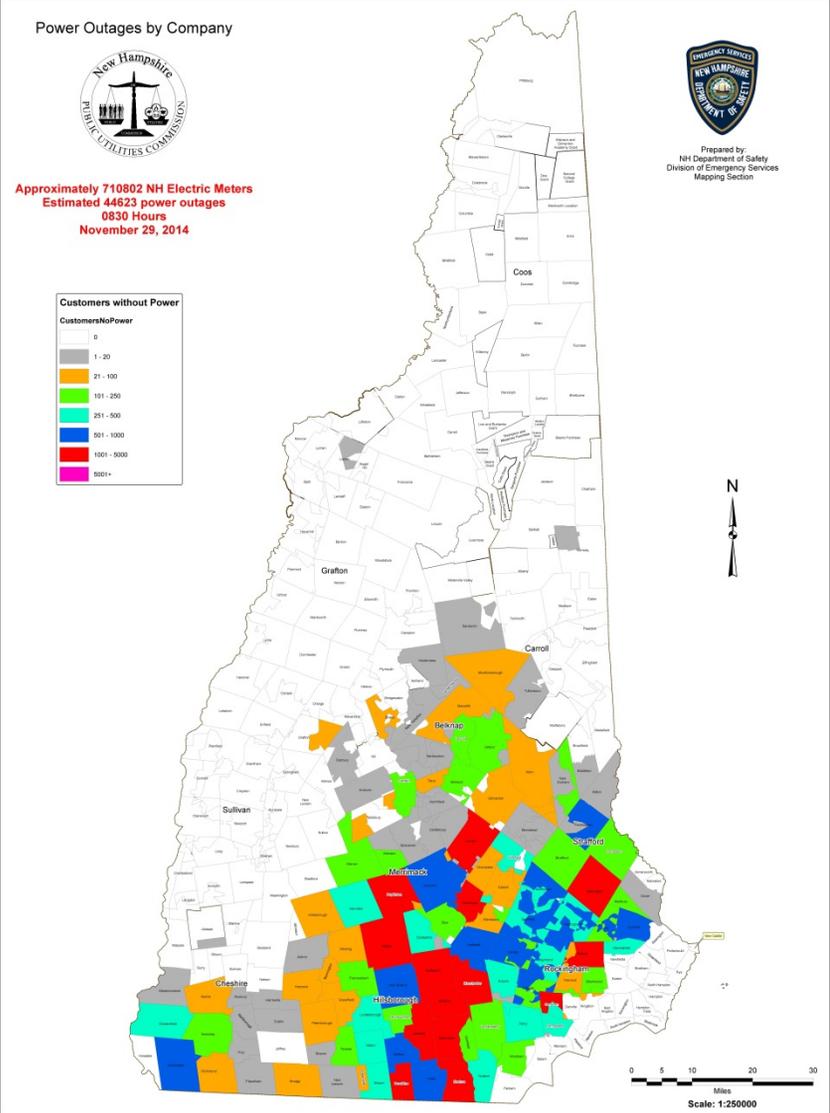
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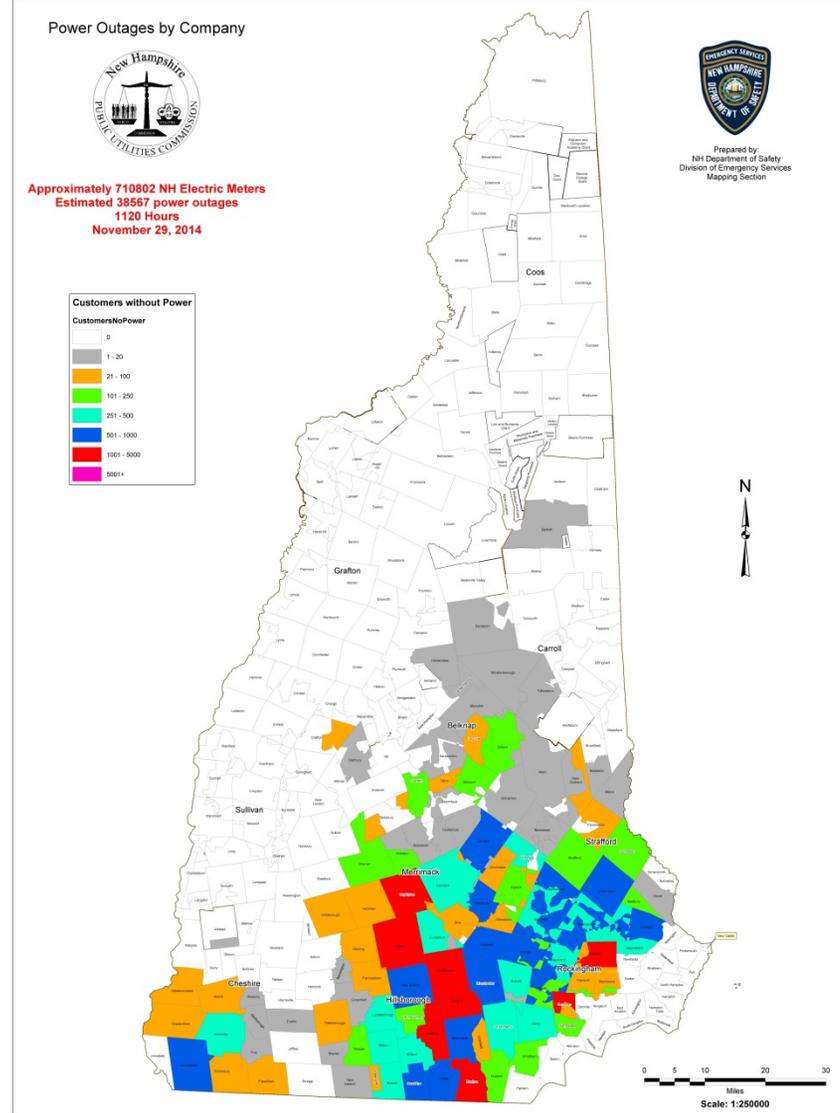
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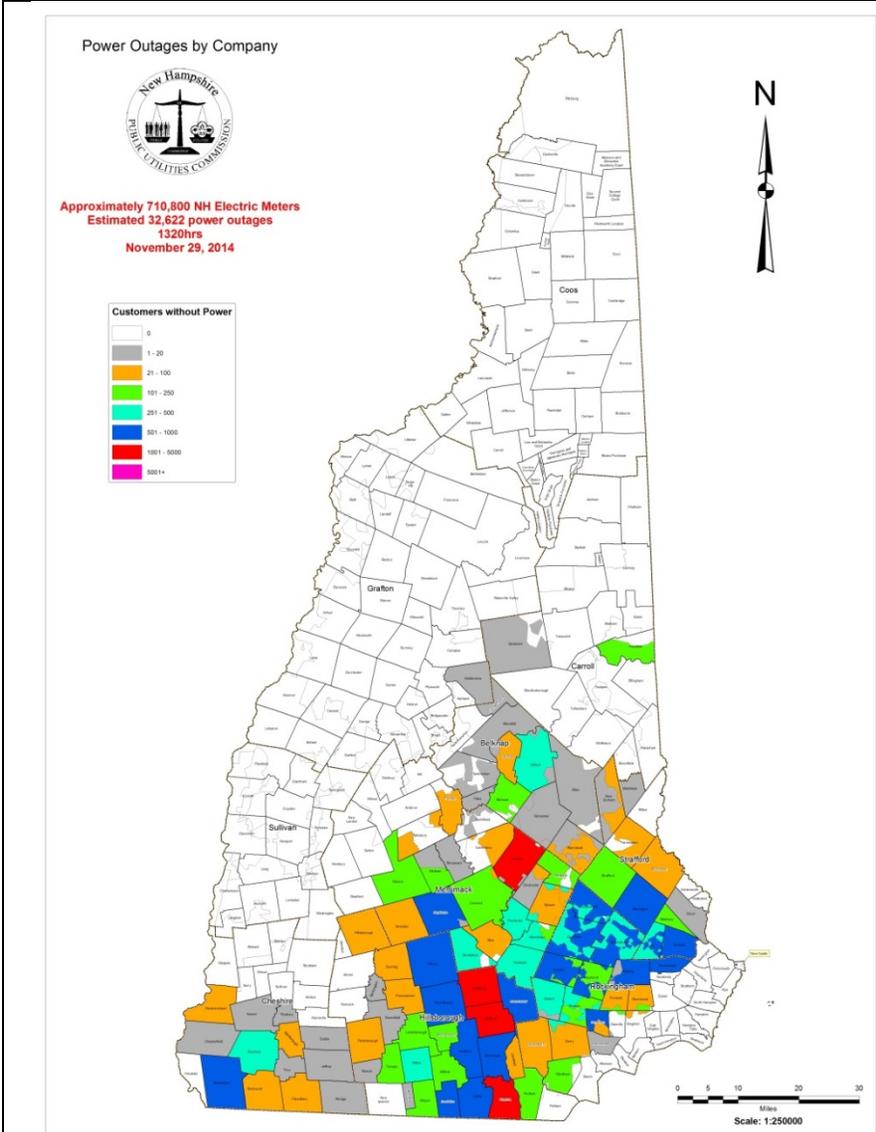
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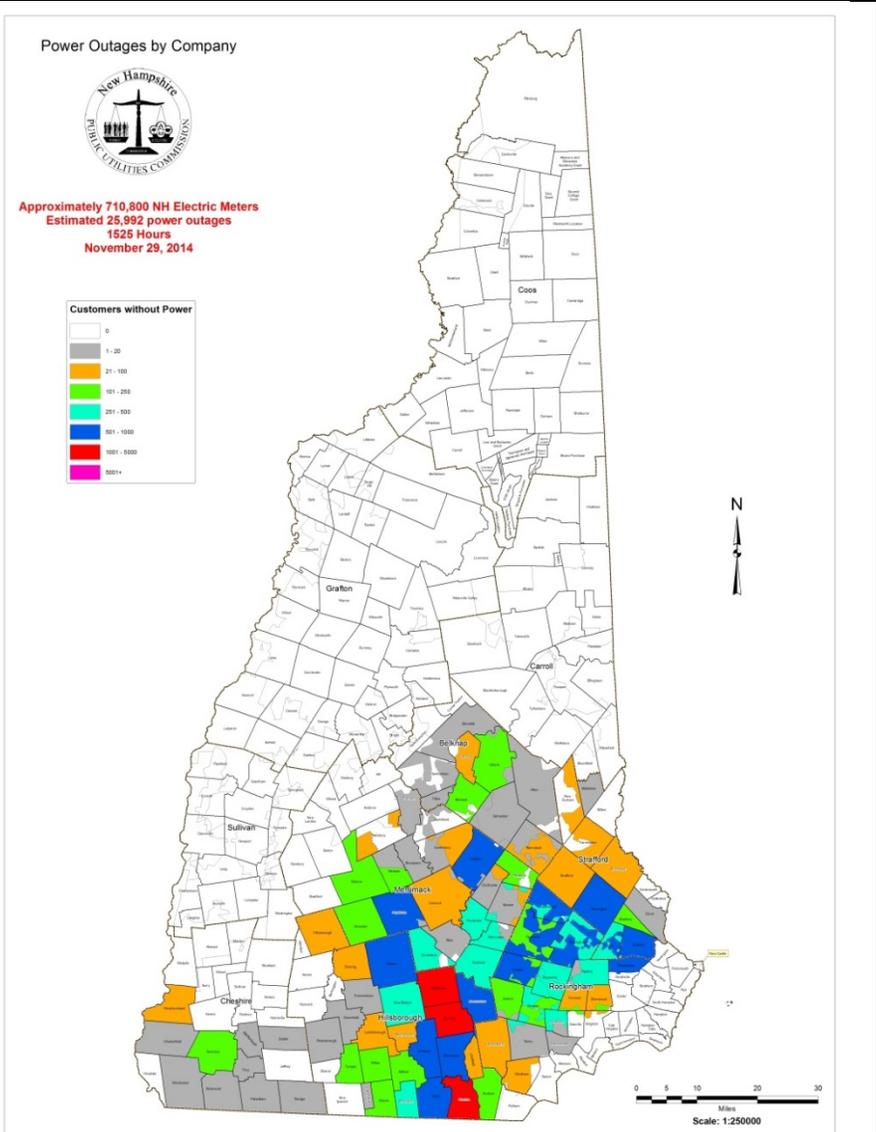
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Power\_Outage\_1120\_11\_29\_2014



Power\_Outage\_1320\_11\_29\_2014



Power\_Outage\_1525\_11\_29\_2014

