Nova Scotia Utility and Review Board

IN THE MATTER OF The Public Utilities Act, R.S.N.S. 1989, c.380, as amended

Post-Tropical Storm Arthur

Review of Nova Scotia Power’s Storm Response

August 19, 2014
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## GLOSSARY OF TERMS

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<td>“911” Calls</td>
<td>Emergency calls into the Distribution Control Center at Ragged Lake.</td>
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<td>CAIDI</td>
<td>Customer Average Interruption Duration Index</td>
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<td>CHC</td>
<td>Canadian Hurricane Center</td>
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<td>CIS</td>
<td>Customer Information System</td>
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<td>CSR</td>
<td>Customer Service Representative (NS Power)</td>
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<td>DCC</td>
<td>Distribution Control Centre</td>
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<td>Distribution System</td>
<td>Medium voltage power lines (greater than 600 volts and less than 69 kilovolts) between substations and transformers that serve customers.</td>
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<td>ECC</td>
<td>Energy Control Centre</td>
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<td>EMO</td>
<td>Emergency Management Office</td>
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<td>EOC</td>
<td>Emergency Operations Centre (NS Power)</td>
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<td>ESRP</td>
<td>Emergency Services Restoration Plan</td>
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<td>ETR</td>
<td>Estimated Time to Restore</td>
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<td>Event</td>
<td>A power interruption to one or more customers with a duration of more than one minute.</td>
</tr>
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<td>GIS</td>
<td>Geographical Information System</td>
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<td>High Potential Incident</td>
<td>A safety incident in which under slightly different circumstances could have resulted in loss to people, property or process.</td>
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<tr>
<td>HRM</td>
<td>Halifax Regional Municipality</td>
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<td>HVCA</td>
<td>High Volume Call Answering</td>
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<tr>
<td>IMC</td>
<td>Interactive Voice Response Message Centre</td>
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<td>IVM</td>
<td>Integrated Vegetation Management</td>
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<td>IVR</td>
<td>Interactive Voice Response</td>
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<th>Term</th>
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<td>Lxxxx</td>
<td>Numbering system for individual transmission lines. The ‘L’ refers to ‘line’, the first number is the voltage class of the line (5 - 69kV, 6 - 138kV, 7 - 230kV, 8 - 345kV), and the remaining three numbers refer to the substation device (breaker, switch, etc.) that feeds the transmission line.</td>
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<td>NSUARB</td>
<td>Nova Scotia Utility &amp; Review Board</td>
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<td>One Of</td>
<td>An individual customer event.</td>
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<td>OMS</td>
<td>Outage Management System</td>
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<td>PDU</td>
<td>Power Distribution Unit</td>
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<td>PLT</td>
<td>Power Line Technician</td>
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<td>Polite Disconnect</td>
<td>This can occur after a customer successfully completes a transaction on the High Volume Call Answering (HVCA) system and waits on the phone line to speak with a Customer Service Representative (CSR). After the HVCA system tries three times to put the customer through to a CSR, if there is still no phone trunk available, the system will ask the customer to phone back later and then it will disconnect the call.</td>
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<td>Pro-Active At Risk Reports</td>
<td>A substandard act or condition that is identified before they cause or contribute to an incident.</td>
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<td>PSTN</td>
<td>Public Switched Telephone Network</td>
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<td>RAL</td>
<td>Ragged Lake work location</td>
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<tr>
<td>Right of Way</td>
<td>The corridor of land under a power line needed to operate the line. The width of the corridor is established by engineering or construction standards.</td>
</tr>
<tr>
<td>RMC</td>
<td>Resource Management Centre (NS Power)</td>
</tr>
<tr>
<td>ROPS</td>
<td>Regional Operations Supervisors</td>
</tr>
<tr>
<td>SAIDI</td>
<td>System Average Interruption Duration Index</td>
</tr>
<tr>
<td>SAIFI</td>
<td>System Average Interruption Frequency Index</td>
</tr>
<tr>
<td>Term</td>
<td>Definition</td>
</tr>
<tr>
<td>---------------------------------</td>
<td>------------------------------------------------------------------------------------------------------------------------------------------</td>
</tr>
<tr>
<td>SCADA</td>
<td>Supervisory Control and Data Acquisition</td>
</tr>
<tr>
<td>Scenario Planning Team</td>
<td>A team at the Ragged Lake Control Center responsible for conducting the storm prediction analysis.</td>
</tr>
<tr>
<td>Span</td>
<td>The length of conductor from one structure to another.</td>
</tr>
<tr>
<td>Standard Protection Code</td>
<td>A Nova Scotia Power document establishing a systematic and coordinated approach to work planning to enhance personal safety and the protection of system equipment against damage.</td>
</tr>
<tr>
<td>Storekeepers</td>
<td>Employees who manage materials in inventory.</td>
</tr>
<tr>
<td>Substation</td>
<td>A set of electrical equipment that reduces the high voltage transmission lines to the medium voltage distribution lines.</td>
</tr>
<tr>
<td>SWSI</td>
<td>Scotia Weather Services Inc.</td>
</tr>
<tr>
<td>TFCC</td>
<td>Twenty First Century Communications</td>
</tr>
<tr>
<td>TIR</td>
<td>Nova Scotia Transportation &amp; Infrastructure Renewal</td>
</tr>
<tr>
<td>Transmission System</td>
<td>High voltage power lines (69 kilovolts to 345 kilovolts) between generating stations and substations. Also used to directly serve power to some large industrial customers.</td>
</tr>
<tr>
<td>WMS</td>
<td>Work Management System</td>
</tr>
</tbody>
</table>
1.0 INTRODUCTION AND EXECUTIVE SUMMARY

Figure 1: Restoration Work on Damaged Equipment

Post-Tropical Storm Arthur

Arthur was the most severe storm to strike Nova Scotia since Hurricane Juan in 2003. It caused significant damage throughout Nova Scotia, with the worst damage along the storm’s track from Southwestern Nova Scotia through the Annapolis Valley. Arthur’s impact on Nova Scotia began early in the morning of July 5, 2014, with wind gusts exceeding 90 km/h in Yarmouth by 5:30 AM and landfall happening shortly before 11:00 AM. Lunenburg saw sustained wind speeds above 60 km/h from 7:00 AM to 10:00 PM, with gusts ranging from 80 to 107 km/h over these hours. The highest wind gusts recorded during the storm were 139 km/h, recorded at 6:00 PM, July 5, at CFB Greenwood. Wind speeds finally started to abate at approximately 11:00 PM that same night.

As an early summer storm, Arthur hit Nova Scotia as trees were full of leaves and the ground was still relatively moist. This meant the trees had lots of “sail” to capture the wind, and were easier to uproot. In later hurricane season storms, the ground is often drier, so trees are more firmly rooted, and leaves are more prone to blowing off in high winds. Falling trees and branches caused the vast majority of power outages related to Arthur.
Post-Tropical Storm Arthur struck Nova Scotia with far more severity than weather forecasting had predicted. Actual peak wind gusts in the Annapolis Valley, where the worst tree damage occurred, were up to 74 percent higher than had been forecast. In Arthur’s wake, 245,000 Nova Scotia Power customers lost their electrical service, with a peak of 137,000 in the early afternoon of July 5. By the end of Wednesday, July 9, (Day 5) we had restored power to 95 percent of our customers (from the 137,000 peak), and the last customer who wasn’t awaiting an electrical contractor for repair of their own equipment was brought back online on Saturday, July 12 (Day 8).

By comparison, New Brunswick Power reported approximately 200,000 customer outages in total, with a peak of 140,000. NB Power had restored 95 percent of affected customers by end of day July 13 (Day 9), and New Brunswick’s Emergency Measures Organization reported on July 22 (Day 18) that the final Arthur-related outages had been restored. The extent of the damage to the electricity systems in Nova Scotia and New Brunswick meant that neither utility could offer to send crews to assist in the other’s restoration efforts until after their own work was done. Arthur also interrupted telecommunications services to many Nova Scotians and New Brunswickers, with Bell Aliant, EastLink and Rogers Communications all reporting service interruptions.

Figure 2: Key Restoration Statistics: Nova Scotia and New Brunswick

<table>
<thead>
<tr>
<th></th>
<th>Nova Scotia Power</th>
<th>New Brunswick Power</th>
</tr>
</thead>
<tbody>
<tr>
<td>Total customer outages</td>
<td>245,000</td>
<td>200,000</td>
</tr>
<tr>
<td>Peak outages</td>
<td>137,000</td>
<td>140,000</td>
</tr>
<tr>
<td>95% of customers restored</td>
<td>July 9 (Day 5)</td>
<td>July 13 (Day 9)</td>
</tr>
<tr>
<td>Last customer restored</td>
<td>July 12 (Day 8)</td>
<td>July 22 (Day 18)</td>
</tr>
</tbody>
</table>

All that being said, Nova Scotia Power acknowledges the considerable impact to our customers who waited days for their power to be restored. As will be seen throughout the remainder of the Report, Nova Scotia Power acknowledges that there are areas for improvement and valuable lessons learned from our experience with Arthur. We have
already started work to resolve some of these issues and wish to work with stakeholders to further refine our Emergency Service Restoration Plan.

Finally, Nova Scotia Power would be doing a large disservice to its employees if we did not acknowledge their tremendous efforts and dedication to serving our customers under very challenging circumstances. Working 24/7 and with a clear focus on safety, our team of power line technicians, damage assessors, engineers, foresters, work planners, electricians, technicians, customer service representatives, supervisors, and others successfully restored service to their fellow Nova Scotians on a timeline consistent with the performance of other utilities across North America.

Summary of Nova Scotia Power’s Response to the Review Notice of Hearing

On July 16, the Nova Scotia Utility and Review Board (UARB, NSUARB, the Board) issued a Notice of Hearing directing Nova Scotia Power to file a report with the Board by August 19 outlining the following four topics:

1. The cause of the power outages, what failed, an outline of the restoration efforts, and an explanation as to why it took the time it did to re-establish service.

These matters are discussed in detail in Sections 3, 4, 5, 6, 7 and 8, along with the associated appendices.

Winds in Annapolis Valley were up to 74 percent higher than forecast. Through many of the towns and communities in the Annapolis Valley, our vegetation management around roadside power lines is limited to light trimming, as some of our rights of way are narrower than industry standard and because adjacent property owners and municipal governments don’t support the removal of trees that are considered ornamental. Higher than forecast winds, gusting well over 100 km/h in a region with an abundance of roadside trees in full early summer leaf, meant the impacts on our electricity system were
far worse than our modeling had predicted. There were more trees on lines, more lines
down, more equipment damaged, and more customers off. There was so much damage
that it took several days to fully assess the impacts on distribution feeders.

Figure 3 shows the wind gusts predicted in the 3:00 PM July 4 forecast, versus those
Nova Scotia Power used for scenario planning, as well as those actually recorded on
Saturday, July 5.

Figure 3: Summary of Variances of Wind Gusts July 5, 2014

It is important to note that the damage prediction model developed under our Emergency
Services Restoration Plan didn’t fail. This model, developed out of the recommendations
of the Hurricane Juan report, is constantly updated with the real-life data of system
damage caused by storms in Nova Scotia. It has worked very well for the past decade.
Following Arthur, we input the actual wind speeds and track of Arthur into the damage
prediction model, and it accurately predicted the damage Arthur caused, and the number
of crew-hours it took to restore all customers. Unfortunately, the forecast available for
Arthur planning purposes significantly underestimated the impact.
The table below provides a day-by-day synopsis of the progress in restoring electricity for our customers and the resources brought to bear.

### Figure 4: Day-by-Day Synopsis of Electricity Restoration Progress

<table>
<thead>
<tr>
<th>Date</th>
<th>Remaining Outage Events at End of Day*</th>
<th>Daily Outage Events Restored</th>
<th>Customers without electricity at end of day</th>
<th>Net reduction in customers without power **</th>
<th>Percentage of customers restored (vs peak of 137,000)</th>
<th># of PLTs</th>
<th>Total PLT hours</th>
<th># of CSRs</th>
<th>Total CSR hours</th>
<th>HVCA Calls</th>
<th>Outage Calls Answered by CSR</th>
</tr>
</thead>
<tbody>
<tr>
<td>Saturday July 5</td>
<td>1,166</td>
<td>280</td>
<td>90,104</td>
<td>46,441</td>
<td>34%</td>
<td>251</td>
<td>4,104</td>
<td>115</td>
<td>1380</td>
<td>216,669</td>
<td>11,014</td>
</tr>
<tr>
<td>Sunday July 6</td>
<td>1,579</td>
<td>521</td>
<td>51,349</td>
<td>38,775</td>
<td>63%</td>
<td>253</td>
<td>4,186</td>
<td>111</td>
<td>1332</td>
<td>118,994</td>
<td>10,604</td>
</tr>
<tr>
<td>Monday July 7</td>
<td>1,598</td>
<td>557</td>
<td>27,808</td>
<td>23,541</td>
<td>80%</td>
<td>271</td>
<td>4,331</td>
<td>113</td>
<td>1356</td>
<td>50,134</td>
<td>5,447</td>
</tr>
<tr>
<td>Tuesday July 8</td>
<td>1,269</td>
<td>666</td>
<td>15,418</td>
<td>12,390</td>
<td>89%</td>
<td>261</td>
<td>4,184</td>
<td>128</td>
<td>1536</td>
<td>20,365</td>
<td>3,909</td>
</tr>
<tr>
<td>Wednesday July 9</td>
<td>1,016</td>
<td>580</td>
<td>6,278</td>
<td>9,140</td>
<td>95%</td>
<td>258</td>
<td>4,227</td>
<td>121</td>
<td>1452</td>
<td>11,255</td>
<td>3,813</td>
</tr>
<tr>
<td>Thursday July 10</td>
<td>599</td>
<td>630</td>
<td>2,693</td>
<td>3,585</td>
<td>98%</td>
<td>250</td>
<td>4,269</td>
<td>113</td>
<td>1356</td>
<td>4,047</td>
<td>2,050</td>
</tr>
<tr>
<td>Friday July 11</td>
<td>234</td>
<td>512</td>
<td>878</td>
<td>1,815</td>
<td>99%</td>
<td>247</td>
<td>3,969</td>
<td>103</td>
<td>824</td>
<td>2,603</td>
<td>1,304</td>
</tr>
<tr>
<td>Saturday July 12</td>
<td>0</td>
<td>329</td>
<td>339</td>
<td>539</td>
<td>100%</td>
<td>224</td>
<td>3,401</td>
<td>19</td>
<td>228</td>
<td>1,068</td>
<td>563</td>
</tr>
</tbody>
</table>

* NOTE: The number of outage “events” increased in the initial days of the storm response, because when larger feeder events were restored, smaller, branch line events were revealed.

** NOTE: Net reduction in customers without power indicates the day-by-day reduction from the peak outage number (137,000). We did not track day-by-day changes from the total outage figure (245,000), as that data cannot be extracted with precision due to the fact that new outage events were occurring as we continued to restore customers.

Among Nova Scotia Power’s **Learnings, Recommendations and Actions** stemming from Arthur, for future storms we will pre-stage more damage assessors to get an earlier comprehensive look at system impacts which will help improve the accuracy of the Estimated Times of Restoration (ETRs) we provide to our customers. As well, we are updating our planning model to consider transmission system damage, which generally doesn’t occur in wind storms, due to the size and integrity of the associated structures, redundancy of the lines, and typically wider rights of way, but did with Arthur. In addition, Scotia Weather Services has conducted a detailed review to determine the cause of the significant inaccuracies in its forecast, particularly with regard to the wind speeds experienced across Nova Scotia. Please refer to Appendix 3.31.
Nova Scotia Power also notes the importance of coordination with other public service entities throughout the province, such as the Department of Transportation and Infrastructure Renewal and emergency management organizations. Although the relationships with these entities are positive and our efforts are generally coordinated, our experience with Arthur emphasized the importance of the Nova Scotia Emergency Management Office activating its Joint Emergency Operations Centre in order to better coordinate the efforts of all entities involved in post-storm recovery efforts.

2. Details with respect to the communication system failures that appear to have taken place during the course of the storm, particularly in light of the significant investigations and expenditures which were made on NS Power's system following a similar failure during Hurricane Juan and the storm of November 13 and 14, 2004. NS Power should outline any action it is taking, or proposes to take, to correct the problems.

Our communications with customers and the problems we encountered are detailed in Section 10. Further detail on our outage communication technology is provided in Section 11.

In the wake of Arthur, we received more calls from our customers than ever before. During peak hours over 300 calls per minute were being taken by our High Volume Call Answering (HVCA) system. Over the eight days of the storm restoration, Nova Scotia Power received 425,123 calls, as compared to the 418,664 calls we received over the 14-day restoration following Hurricane Juan in 2003. More than half of the Arthur calls came on the day of the storm itself – 216,669, as compared to the 122,575 calls received on Day 1 of Juan. During the Arthur restoration, our Customer Service Representatives had 38,702 one-on-one conversations with customers, compared to 48,328 following Hurricane Juan.
Figure 5: Customer Call Comparison: Post-Tropical Storm Arthur and Hurricane Juan

<table>
<thead>
<tr>
<th></th>
<th>Arthur</th>
<th>Hurricane Juan</th>
</tr>
</thead>
<tbody>
<tr>
<td><strong>Total Calls</strong></td>
<td>425,123 over eight days</td>
<td>418,664 over 14 days</td>
</tr>
<tr>
<td><strong>Calls on Day 1</strong></td>
<td>216,669</td>
<td>122,575</td>
</tr>
</tbody>
</table>

Three key communications issues contributed to customer dissatisfaction:

**Communications Issue #1 – Estimated Times to Restore (ETRs)**

Our ETR strategy was developed through the recommendations of the Hurricane Juan review. We target our early ETR communication on outages impacting 100 or more customers, because most customers who lose power in a storm lose it because of a transmission or distribution feeder line outage. This strategy has worked successfully in past storms, but with Arthur we had more than 3,400 outages impacting fewer than 100 customers each – approximately 30,000 customers in total. Customers who were among smaller pockets of outages grew frustrated, because the ETR strategy wasn’t providing information accurate to their situation. Additionally, ETRs were updated multiple times.

ETR strategies have been evolving among North American electric utilities. We recommend as an outcome of this review that Nova Scotia Power work with the UARB’s consultant to further examine current best practices, and bring forward any changes to our ETR strategy that would be in the best interest of customers.
Communications Issue #2 – Outage Map Capacity

Nova Scotia Power’s online outage map is an important part of the way we provide outage and restoration information to our customers. It’s a fast, efficient, and up-to-date source of information. However, on Saturday, July 5, the outage page server was overwhelmed by the high volumes of information requests after reaching its peak processing of approximately 50,000 successful pages per hour. Based on this experience, Nova Scotia Power is in the process of increasing the capacity of our website to handle a greater number of outage requests per hour, with a speed of delivery of five seconds or less.

Communications Issue #3 – High Volume Call Answering (HVCA) system

Our HVCA system, implemented following the recommendations of the November 2004 Ice Storm review, enables large numbers of customers to interact with Nova Scotia Power simultaneously. In cases where the number of customers wishing to speak with a Customer Service Representative exceeds the designed threshold, the HVCA system is designed to inform the customer of the high call volumes, ask the customer to call back later, and then it disconnects the call. Due to the exceptional number of calls following Arthur, more than 24,000 calls were disconnected by the HVCA system on July 5. Some customers could have been disconnected a number of times.

Figure 6 details the call volumes for each day and compares Arthur’s totals to Hurricane Juan and the November 2004 ice storm.
In addition, an issue with our telecommunications supplier resulted in a reduced number of available phone lines to our Customer Care Centre from Monday, July 7, until 1:00 AM Wednesday, July 9.

3. An outline of NS Power's current practices with respect to vegetation management, including, specifically, in the affected areas, and whether those practices need to change as a consequence of the failures during post-tropical storm Arthur.

The role played by Nova Scotia Power’s Vegetation Management team in responding to Post-Tropical Storm Arthur, as well as vegetation management practices through Southwestern Nova Scotia and the Annapolis Valley are discussed in Section 8. Nova Scotia’s overall Integrated Vegetation Management program is detailed in Section 9.

More than 90 percent of the power outages caused by Post-Tropical Storm Arthur were due to trees contacting lines and other system equipment. The tree damage was particularly severe in Western Nova Scotia, where customer outages lasted the longest. In many towns and communities through the Annapolis Valley, roadside ornamental trees...
located on private property are in close proximity to power lines, and the amount of tree trimming Nova Scotia Power can do is limited. The public has a competing desire for the preservation of ornamental roadside trees and electrical service reliability, and there is no clear consensus on the appropriate balance.

Nova Scotia Power’s annual vegetation management spending has ranged from just over $12 million to almost $16 million over the past five years – overall, a significant increase from the previous five years, as shown in the graph below.

**Figure 7: Annual Vegetation Management Investments**

To improve reliability in major storms it is essential to establish clear rights-of-way along power lines. As elaborated on in Sections 8 and 9, Nova Scotia Power requires greater public support to obtain the desired clearances in accordance with industry standards. We also urge the appropriate government authorities to prohibit the planting of trees that are in conflict with power lines, and request prescriptive rights to remove off right-of-way hazard trees that threaten power lines.
4. Any external benchmarks or metrics by which NS Power’s performance may be judged.

Service reliability performance metrics are detailed in Section 12 and external benchmarking by Davies Consulting is detailed in Section 13. Highlights are provided below.

As set out in Section 12 of this Report, Nova Scotia Power’s multi-year Reliability Investment Strategy has significantly improved service reliability for our customers in recent years, with Nova Scotia Power outperforming the average of other Atlantic Canadian utilities on System Average Interruption Frequency Index (SAIFI) and System Average Interruption Duration Index (SAIDI).

As part of the review process, Nova Scotia Power engaged Davies Consulting, a leading consultancy to electric and gas utilities within North America, to provide external benchmarking. They found our performance in Arthur within the industry norm when compared to other utilities responding to similar storms.

Figure 8 shows the performance of Nova Scotia Power during the response to Arthur, relative to the comparators, in terms of length of restoration related to customers out at peak. When compared to other similar events, Nova Scotia Power’s overall performance during Post-Tropical Storm Arthur was within the industry norm.
Figure 8: Restoration Duration Comparison

Restoration Duration vs. Percent Customers Out

Source: Davies Consulting Storm Benchmark Database, 2014

In Conclusion

Post-Tropical Storm Arthur was disruptive to the lives and businesses of our customers. It was a long, difficult eight days for our employees as well, and the work didn’t end on July 12 when we finished restoration. Just as we learned and improved from Hurricane Juan – and the wind, snow and ice storms over the 11 years since Juan – we are confident that the lessons we have learned from Arthur, and the insights that will be brought forward through this review process, will help us better serve our customers during the next major storm.
2.0  OVERVIEW OF NOVA SCOTIA POWER

2.1  Introduction

This section provides a high level look at how we make and deliver electricity for Nova Scotians.

2.2  Nova Scotia Power Basics

Nova Scotia Power provides 95 per cent of the generation, transmission and distribution of electricity in Nova Scotia, serving 500,000 customers across the province – from remote cottages to urban office towers. The electricity we make and deliver powers family homes, small businesses, schools, hospitals, industrial facilities, military bases, and countless other end uses that Nova Scotians rely upon in their daily lives.

We have approximately 1,700 employees. They are dedicated to serving our customers and are focused on safety. Together, we manage $4.1 billion worth of assets, and produce more than 10,000 gigawatt hours of electricity each year. Our facilities can generate as much as 2,453 megawatts of electricity, which is delivered across approximately 32,000 kilometres of transmission and distribution lines throughout Nova Scotia. That’s enough wire to stretch from Halifax to Vancouver seven times, or 80 percent of the way around the circumference of the planet.

2.3  Power Generation

We generate electricity using a portfolio of energy sources – coal, natural gas, wind, biomass, hydro, tidal, and oil – selecting the generation options that are most affordable to our customers, while meeting all environmental and other legislated requirements, including some of North America’s most aggressive targets on renewable energy (40
percent of generation by 2020) and greenhouse gas emissions (25 percent reduction by 2020 from 2010 levels).

Our generation facilities include:

- Four thermal coal plants in Cape Breton (Lingan, Point Aconi, and Point Tupper) and Trenton, Pictou County.

- Three thermal natural gas units at the Tufts Cove plant in Dartmouth. These units can also use oil.

- Two natural gas combustion turbines and a waste heat recovery unit at the Tufts Cove plant in Dartmouth.

- 33 hydroelectric plants on 17 river systems across Nova Scotia. Some date back to the early 1900s. Please refer to Figure 9.

- A tidal energy station at Annapolis Royal, the only plant of its type in North America.

- A biomass plant in Port Hawkesbury.

- Wind farms at Nuttby Mountain (near Truro), Digby Neck, and Point Tupper (49 percent partner with RESL), and two small turbines at Little Brook and Grand Etang. Please refer to Figure 10.

- Oil-fired combustion turbines at Burnside (Dartmouth), Tusket, and Victoria Junction.
In addition to wind farms owned by Nova Scotia Power, we purchase electricity on long-term contracts with independently owned wind farms. In fact, the majority of the wind power generated in Nova Scotia comes from wind turbines owned by independent power producers. Independent power producers (IPP) own 131 of the 180 (73 percent) commercial wind turbines in Nova Scotia. As well, presently there are 8 megawatts of privately owned wind capacity on the Nova Scotia Power system through the province’s Community Feed-in Tariff (COMFIT) program. In total, Nova Scotia now has 339 megawatts of wind capacity online. An additional 116 megawatts of IPP wind will come online in 2015, and an additional 162 megawatts of wind projects have been registered under the COMFIT program.
We also import electricity via our 350 megawatt transmission interconnection with New Brunswick, when economical imports are available. This is, at present, our only interconnection with the North American electricity grid.

There are six municipally owned electric utilities in Nova Scotia that own their own distribution systems and serve customers within their franchise territory: Antigonish, Berwick, Canso (now owned by the District of Guysborough), Lunenburg, Mahone Bay, and Riverport. The municipal utilities buy their electricity from Nova Scotia Power and other sources. Nova Scotia Power has an Open Access Transmission Tariff (OATT) that enables municipal utilities to buy and sell electricity via our wires.

2.4 Transmission and Distribution Systems

While our generation sources are geographically diverse – increasingly so with the rapid development of wind farms over the past decade – Nova Scotia Power’s transmission system was primarily designed and built in the 1970s and 1980s to move electricity from...
the thermal generating stations at the eastern end of the province to central Nova Scotia
and the Halifax load centre.

Nova Scotia’s transmission and distribution system includes:

- 445 substations (including generation substations)
- 5,274 kilometres of overhead transmission lines operating at voltages from 69
  kilovolts (kV) to 345 kV (please refer to Figure 11)
- 26,288 kilometres of overhead distribution lines, including approximately 400
  feeder lines
- 348 kilometres of underground distribution lines
- Approximately 29,500 transmission towers
- Approximately 500,000 distribution poles
- 120,025 overhead distribution transformers
- 32,435 fused cutouts along the distribution lines
- 5,136 distribution switches
- 539 distribution reclosers

Fused cutouts, breakers and reclosers are devices installed along our transmission and
distribution system that operate when an electrical fault (such as a tree or branch
contacting a power line) is detected on our system. By operating to interrupt the flow of
electricity, these devices prevent greater damage to our electrical system. These devices
are strategically positioned in order to “segment” power lines in a way that reduces the
number of customers who experience an outage when a fault occurs on a line.
The various parts of the system work together to instantaneously supply our customers with electricity when they need it. Our generating plants make electricity. High-voltage transmission lines move large amounts of electricity from our plants to the communities we serve. Those transmission lines deliver the electricity to substations, which reduce the voltage of the electricity and send it to lower voltage distribution “feeder” lines. These feeder lines deliver power to areas serving 1,000 to 6,000 customers. Distribution lines spread out like spider webs from the substations, reaching all of our customers. Transformers on power poles convert power to the lower voltages used in homes and businesses. Individual service lines take power from the pole-top transformer to the
individual home or business. Some large industrial customers are supplied directly from
the transmission system. Please refer to Figure 12.

Figure 12: From Generator to Customer

Nova Scotia Power’s transmission system has evolved from a lower voltage system
utilizing 23 kV, 69 kV and 138 kV lines that transmitted electricity from generating
stations relatively close to customer loads, to a higher voltage system utilizing up to 345
kV and capable of transmitting larger amounts of energy from relatively distant
generators to the load centre in and around Halifax. During this evolution, higher voltage
lines have been constructed parallel to, and sometimes replacing, older transmission lines
when additional capacity has been required. This is evident in the east-west transmission
corridors between the Sydney area and Halifax, where a single 138 kV line is paralleled
by up to three 230 kV lines and a 345 kV transmission line. The eastern Annapolis
Valley and South Shore also exhibit this characteristic, where an older 69 kV
transmission system has been paralleled and supported by newer 138 kV transmission
lines. Where transmission requirements have not grown (in particular in the western
Annapolis Valley), the 69 kV lines have been able to serve the transmission requirements
for many years.
In the area from Greenwood west to Yarmouth, transmission requirements are served by a single 69 kV backbone plus a single 69 kV tie line from the Mersey River hydro system near Milton. This 69 kV “backbone” is not a single line but rather a series of four lines that are each segments of the “backbone.” The loss of any two 69 kV lines in this area, while certainly affecting any customers normally supplied from those lines, would not normally result in a service interruption to customers supplied from other lines.

2.5 Control Centre

Nova Scotia Power’s electricity system is managed from our Control Centre in Halifax. The Control Centre is staffed 24 hours a day, 365 days of the year, by system operators who dispatch generation to match instantaneous changes in customer demand for electricity. Control Centre staff monitor and manage our transmission and distribution systems using a variety of information technology systems, including our Supervisory Control and Data Acquisition (SCADA) system, which provides real-time telemetry on system components, and our Outage Management System (OMS).

In major storms like Post-Tropical Storm Arthur, our Emergency Operations Centre (EOC) is activated at the Control Centre, and employees tasked with various EOC roles gather there to manage storm response efforts. This team is comprised of senior leaders from across the company who have been trained in assigned ESRP roles. They bring a wide breadth of knowledge and experience to storm management. Nova Scotia Power also maintains a Back-Up Control Centre, in compliance with Northeast Power Coordinating Council (NPCC) requirements.

2.6 Transmission Reliability Standards

Nova Scotia Power is a member of the Northeast Power Coordinating Council (NPCC), one of eight “regional entities” that operate under the compliance monitoring of the North American Electric Reliability Corporation (NERC). NERC is the international regulatory
authority tasked with enforcing reliability standards and ensuring the reliability of the
bulk power system in North America. NPCC is responsible for Ontario, Québec, Nova
Scotia, New Brunswick, the State of New York and the six New England states. Nova
Scotia Power complies with NERC and NPCC transmission reliability standards, as
approved by the Nova Scotia Utility and Review Board.

2.7 Outage Notification

Nova Scotia Power, like most electric utilities, relies on customer calls to report power
interruptions. Each outage call is processed by the Outage Management System (OMS)
and used in a predictive algorithm to locate the device – fused cutout, breaker or recloser
– that operated to interrupt service. These devices interrupt service when a fault is
detected on a power line in order to minimize the number of customers affected and
safely disconnect the fault.

Supervisory Control and Data Acquisition (SCADA) telemetry can provide immediate
notification of outages of the equipment monitored/controlled by SCADA. System
components monitored/controlled by SCADA includes critical transformers, breakers and
lines, and substations (but not every device in each substation). When a SCADA-
monitored device operates to interrupt service, this information is also passed to the OMS
to create a confirmed outage rather than a predicted one. Confirmed outages are removed
from the predictive algorithm. As information is relayed from personnel in the field, our
OMS is updated with the status of interrupting devices (i.e. whether open or closed) to
continually improve the ability of the OMS to correctly predict interrupting devices.

Nova Scotia Power doesn’t widely employ “smart meter” technology at present. We
have approximately 750 AMR (automatic meter reading) and 550 AMI (advanced
metering infrastructure) meters deployed. Given their limited deployment, we do not use
them for outage monitoring.
3.0 PREPARING FOR POST-TROPICAL STORM ARTHUR

3.1 Introduction

This section describes the work coordinated from our Ragged Lake Control Centre in advance of Arthur’s arrival to monitor detailed weather forecasts and use experience-based models to predict potential impacts on our electricity system. We do this modeling so that we can secure and pre-stage appropriate personnel and resources in order to safely, quickly, and efficiently restore service to our customers during and following storms.

3.2 Emergency Services Restoration Plan

Given Nova Scotia’s climate and geography – jutting out into the Atlantic Ocean – being well-prepared for severe storms, and responding in a planned, efficient manner, is a key function at Nova Scotia Power. Our Emergency Services Restoration Plan (ESRP) sets out a coordinated approach to restoring electrical service to our customers in major storms. We developed the ESRP (included as Appendix 3.01) in coordination with the Nova Scotia Utility and Review Board following Hurricane Juan in 2003.

The ESRP includes a core, corporate plan and five sub-plans: Transmission, Regional Operations, Communications, Customer Coordination and Logistics. The plan has well served Nova Scotia Power and our customers many times over the past 10 years as we’ve responded to blizzards, ice storms, nor’easters, lightning storms, hurricanes and tropical storms. The ESRP is an “evergreen” plan; we update and improve it to reflect lessons learned from each major storm.

In support of the ESRP, Nova Scotia Power has built a corporate storm response culture. Employees are educated and trained in emergency response and many employees have a
storm response role. Personnel participate in annual drills to ensure a continual state of readiness to respond to the effects of adverse weather on the power system.

Prior to Post-Tropical Storm Arthur, 2014, the ESRP was most recently activated for a March 27, 2014 snow storm, as well as February 9, 2013, January 12, 2011 and December 13, 2010, all for winter storms; and September 3, 2010, for Hurricane Earl. Weather forecasts and damage predictions for Arthur bore similarities to what we experienced with Hurricane Earl, so our planning and response to Earl was used as a reference point in our preparations for Arthur.

3.3 Pre-Planning

Nova Scotia Power operational staff members review weather forecasts every day during outage coordination meetings at our Ragged Lake Control Centre. Scotia Weather Services is our primary source of weather information. It's a private firm that provides a weather forecast for the next 72 hours in a format that indicates temperature/dew point, precipitation (by type), wind speed, wind direction, and thunderstorm probability – all within three-hour time intervals. This report is customized to align with our regional operational structure, providing specific forecasts for eight geographic divisions: South Shore, Valley, Halifax, Northern, North Eastern, Eastern Shore, Western Cape Breton, and Eastern Cape Breton. Additionally, we use hurricane and tropical storm data provided by the Canadian Hurricane Centre, and temperature, wind speed and precipitation forecasts from Environment Canada in our storm planning.

The following timeline summarizes Nova Scotia Power’s preparations for the arrival of Arthur in the first week of July 2014:
Tuesday, July 1, 2014

- 8:30 AM – The Nova Scotia Power Storm Lead sent an email to the senior Executive, and Transmission and Distribution (T&D) Operational Managers as awareness to prepare for the possibility of weather impacts from Arthur later that week. Attached to the email was the following track:

Figure 13: Environment Canada Storm Track (6:00 AM July 1)
Wednesday, July 2, 2014

- 2:40 AM – The first information statement received from the Canadian Hurricane Centre (CHC). Please refer to Appendix 3.02.

Figure 14: Environment Canada Storm Track (6:00 AM July 2)

- 9:00 AM – At the Control Centre morning meeting, the T&D Operational Team discussed the pending weather, and any transmission assets out of service and planned outages. They decided to return to service all transmission assets that could be and delay the start of any planned maintenance that would continue
beyond Friday, July 4. Scotia Weather’s 72-hour forecast did not yet have the hurricane within its forecast scope and did not indicate high winds for the upcoming weekend.

- 10:00 AM – A conference call with the Senior Management Team (SMT) included discussion of Arthur and NS Power preparedness. The Storm Lead directed all senior managers to check availability of their staff for the weekend and to be prepared in case a corporate response was required.

- 10:24 AM – The Control Centre Manager sent email notification of the current storm track and Canadian Hurricane Centre statement to key personnel within Nova Scotia Power. Please refer to Appendix 3.03.


- 11:12 AM – The Storm Lead sent an email to T&D operational leads asking them to check and confirm crew/contractor availability for the weekend.

  - There was still no indication of the hurricane in the Scotia Weather Services forecast. Nova Scotia Power’s Control Centre manager called Scotia Weather and was told that information would be available in the afternoon.

- 3:00 PM – Scotia Weather’s forecast indicated warning level winds in the following areas: Halifax, Eastern Shore, and gusts on the South Shore and the Valley up to 100 km/h. Please refer to Appendix 3.05.
3:30 PM – Email notification of current track and Canadian Hurricane Centre statement was forwarded to key personnel within Nova Scotia Power. Please refer to Appendix 3.06.

4:50 PM – Nova Scotia Power received an email from EMO-NS indicating that they were having a briefing on July 3 at 3:30 PM and that Nova Scotia Power was invited to attend. Please refer to Appendix 3.07.
• 9:22 PM – Scotia Weather’s forecast indicated warning level winds (gusting to 90 km/h) on the South Shore only. Please refer to Appendix 3.08.

Thursday, July 3, 2014

• 5:00 AM – Scotia Weather’s forecast indicated warning level winds in Cape Breton East region of the province (gusts to 85 km/h). Please refer to Appendix 3.09.

• Nova Scotia Power contacted PLT contractors in New Brunswick to check availability. Friday, July 4, 11:00 AM was given as the notification time required to ensure any external resources would be pre-staged in Nova Scotia for Friday evening.

• An ESRP scenario planning session was scheduled for 9:00 AM July 4 to allow for time to pre-stage contractor crews if required.

• Nova Scotia Power Control Centre Manager emailed the Lead Forecaster of Scotia Weather Services and spoke with him later in the afternoon, requesting scrutiny of the forecasts as we were using them for operational decisions.

  • The Control Centre Manager requested that 11:00 AM forecasts be created for the areas of the province at risk: Valley, South Shore and Halifax. These would not have been created otherwise because there were no warning level winds forecasted except for Cape Breton East.

• 11:00 AM – Scotia Weather Services forecasts were delivered as requested indicating warning level winds in the Valley, South Shore and Halifax with the highest gusts up to 100 km/h on the South Shore. Please refer to Appendix 3.10.
2:17 PM – NS-EMO sent its second update. Please refer to Appendix 3.11.

3:00 PM – Scotia Weather forecast showed winds gusting to 100 km/h in Halifax, South Shore and North Eastern, and 90 km/h for all other areas of the province. Please refer to Appendix 3.12.

3:30 PM – EMO-NS hosted a WebEx conference attended by Nova Scotia Power Storm Lead, EOC Duty Officer and Control Centre Manager.

4:28 PM – Email notification of current track and Canadian Hurricane Centre statement was forwarded to key personnel within Nova Scotia Power. Please refer to Appendix 3.13.

9:00 PM – Scotia Weather forecast showed winds gusting to 100 km/h in Halifax, North Eastern and South Shore, and not much higher than 90 km/h in the rest of the province. Please refer to Appendix 3.14.

Friday, July 4, 2014

5:00 AM – Scotia Weather forecast showed winds gusting to 100 km/h in the Valley and South Shore, and most other areas gusting to 90-95 km/h or less. Please refer to Appendix 3.15.

Nova Scotia Power sent Scotia Weather Services an email asking that the lead forecaster with Scotia Weather Services be involved in the forecasting, because we were using the forecasts to make decisions on whether to bring crews into the province ahead of the storm.
9:30 AM – The ESRP Scenario Planning Team used the Scotia Weather forecast to model the most likely outage and damage scenario, also running a low and high scenario for planning purposes. Please refer to Section 3.4.

11:00 AM – Scotia Weather forecast showed the Valley and South Shore with winds gusting to 95 to 100 km/h, and most other areas gusting to 90 km/h or less. CB East and West were not updated. Please refer to Appendix 3.16.

11:30 AM – The Event Monitoring Team discussed potential weather. A Level 3 response was declared with the EOC opening at 9 AM July 5. The decision was made to pre-stage 24 external contractor PLT crews (17 distribution and 7 transmission) and seven Damage Assessment crews in advance of the storm. Please refer to Appendix 3.17.

The NS Power Storm Lead called EMO-NS and notified of the 9:00 AM opening of the Nova Scotia Power EOC. EMO-NS indicated they were not planning on opening their EOC.

11:53 AM – EMO-NS update number 3 was provided by Environment Canada. Nova Scotia Power attended an EMO-NS briefing session at 3:30 PM to receive a weather information update. Please refer to Appendix 3.18.

12:35 PM – Nova Scotia Power Duty Officer for the EOC sent out an email regarding the opening of the EOC. Please refer to Appendix 4.02.

3:00 PM – Scotia Weather forecast showed the South Shore with winds gusting up 100 km/h and most other areas gusting to 80 km/h or less. All forecasts were still within Nova Scotia Power’s damage prediction and resource planning scenarios. Please refer to Appendix 3.19.
Post-Tropical Storm Arthur – Review of NS Power’s Storm Response

- 9:00 PM – Scotia Weather forecast showed the South Shore with winds gusting to 100 km/h and most other areas gusts to 90 km/h or less. All forecasts were still within Nova Scotia Power’s damage prediction and resource planning scenarios. Please refer to Appendix 3.20.

Saturday, July 5, 2014

- 5:00 AM – Scotia Weather forecast showed the South Shore with winds gusting to 105 km/h, CB West to 95 km/h, and most other areas gusting to 90 km/h or less. All forecasts were still within NS Power’s damage prediction and resource planning scenarios. Please refer to Appendix 3.12.

- 9:00 AM – Nova Scotia Power EOC activated. Please refer to the EOC timeline in Section 4.6.

- 11:00 AM – Scotia Weather forecast showed winds gusting to 100 km/h on the South Shore, no more than 90 km/h in all other areas, and up to 85 km/h in the Valley. All forecasts were still within Nova Scotia Power’s damage prediction and resource planning scenarios. Please refer to Appendix 3.22.

- 2:48 PM – Final weather update for Arthur issued by EMO-NS. Please refer to Appendix 3.23.

- 3:00 PM – Scotia Weather forecast showed many regions with winds gusting to 90 km/h including the Valley. All forecasts were still within Nova Scotia Power’s damage prediction and resource planning scenarios. Please refer to Appendix 3.24.
3.4 Event Predictions and Scenario Planning

Event prediction is a key part of Nova Scotia Power’s storm preparedness, as outlined in Section 5.1 of our ESRP\(^1\). Our event prediction process uses weather forecasts, system data and the damage experience from past storms to model potential storm impacts to our electrical system, predicting where damage may occur and the magnitude of the damage. We use this in our pre-event planning to guide decisions and preparations. It helps us plan our response level and pre-storm deployment of resources.

The Scenario Planning Team is a group of Transmission & Distribution operational leaders who bring previous storm experience as well as analytical thinking to the process. During the first week of July, as then-Hurricane Arthur approached Nova Scotia, our Event Monitoring Team continually tracked its path and prepared for our response, a detailed list of this activity is included in Section 3.3. The Storm Lead called together the Scenario Planning Team (listed below) at the Ragged Lake Control Centre at 9:30 AM on Friday, July 4.

- Storm Lead (Shift A) – Senior Director of T&D and Control Centre Operations
- Storm Lead (Shift B)
- Customer Lead
- Regional Operations Lead
- EOC Duty Officer
- Former NS Power EOC Duty Officer

\(^1\) Please refer to Appendix 3.01, page 52.
The Scenario Planning team used our three-step event prediction process to model potential impacts from Arthur:

1. **Compare pending weather to historical events that have affected Nova Scotia Power and its power system.** Use past storm experiences to help predict how the event will unfold.

The Scenario Planning team reviewed the most current weather forecasts for Arthur on Friday, July 4, in order to find comparable events that have affected Nova Scotia over the last few years. Particular focus was put on summer events given that the ground in Nova Scotia is no longer frozen, and the trees are full with leaves (two important considerations in damage prediction). Five comparative summer events were considered: Juan (2003), Beryl (2006), Kyle (2008), Earl (2010) and Andrea (2013). Each of these five events were tropical systems that either made landfall within Nova Scotia, or “just missed” the province. Tracks for each of these storms are shown in Appendix 3.25. Two winter events (2010 and 2011) were also referenced due to the fact that they had high wind gusts along the South Shore and in the Valley. Figure 16 shows a comparison of each event including, peak wind speeds, customers affected at peak and the total number of outage events.
Based on this review, it was determined that both Kyle and Earl were the most similar events for comparison purposes. The planning team used the data associated with Hurricane Earl for scenario planning since it had the greatest effect on the power system of the storms considered. This was a more conservative approach for planning.

(2) Use the Nova Scotia Power Damage Prediction Model to determine a low-, medium- and high-case scenario for the event to estimate the number of: customers affected, person-hours of PLT work, person-hours of tree crews work, feeders off, branch lines off, services impacted, conductor spans downed, transformers damaged, poles damaged and the number of trees on spans.

A damage prediction model for Arthur was run several times through the first week of July, but variations in the forecasted wind levels made it difficult to
determine an agreed upon damage scenario. On the morning of Friday, July 4, the Scenario Planning Team used the 5:00 AM weather forecast from Scotia Weather Services as well as the weather update provided on Thursday, July 3, by Environment Canada. Figure 17 shows the weather forecast and the wind levels used for planning purposes. (Planning – Med Case refers to Nova Scotia Power’s prediction of the most likely scenario).

**Figure 17: Forecasted Wind Gusts as of 5:00 AM July 4, 2014**

In order to address the variability in weather forecasting, Nova Scotia Power increased the forecast by up to 33 percent in some areas for planning purposes. This was done to take a conservative view of both the Scotia Weather Services and Environment Canada weather forecasts. The expected wind speeds for the Valley were lower than the wind speeds for the South Shore and Halifax due to the Scenario Planning Team’s historical experience with Atlantic storms with “winds on the right and rains on the left of the track”. This forecast was also supported by the Friday, July 4, 3:00 PM wind forecast from Scotia Weather Services which downgraded the Valley forecast to peak wind gusts of 80km/h as shown in Figure 18.
Three different scenarios were modeled as shown in Appendix 3.26. Based on the current Scotia Weather Services and Environment Canada weather forecasts, the Scenario Planning Team agreed that the most probable outcome was modelled in the Low case (70,474 customers affected and 4,091 person-hours of restoration work). For planning purposes, however, the team considered their experience and the unpredictability of the weather and increased the wind gusts to create a more conservative Medium case (105,195 customers affected and 5,821 person-hours of restoration work).
(3) Use the Nova Scotia Power Scenario Planning Model to determine the expected event duration and restoration curve based on the output from the Damage Prediction Model and the number of available resources.

The Scenario Planning Team next used the Scenario Planning Model (in-house developed, Excel-based tool) to determine the event duration and restoration curve.

The first step in this process is to enter the expected outage durations as shown in Appendix 3.27. Estimates for First Customer Off, Time of Peak Outages, Start of Restoration, and Last Customer On were entered using the outage restoration curve from Hurricane Earl as a reference. The Scenario Planning Team predicted a similar outage restoration rate for this event, so a Last Customer On date of Monday, July 7, at 11:00 PM was chosen for all areas.

The second step in this process is to enter all available resources in the Scenario Planning Model to determine if the desired restoration times can be achieved, or if more resources are required. Current resource levels were entered for Nova Scotia Power crews, in-province contractors, night crews and tree crews as shown in Appendix 3.28, page 1.

With this level of resourcing the model indicated a 10-crew deficit to achieving the desired restoration durations. Next, the team modelled adding 10 outside crews (off-system contractor crews), pre-staged and ready to work on Saturday, July 5, as Arthur made landfall in Nova Scotia. Appendix 3.28, page 2 shows that this model indicated a balanced resource plan with no surplus or deficit of resource. The Scenario Planning Team once again took a more conservative approach in its planning and ran the model with 20 outside crews. Appendix 3.28, page 3 shows that this model run indicated a surplus of 10 crews based on the targeted restoration duration. With this analysis, the decision was made to
recommend pre-staging 20 outside contractor crews within the province in advance of Arthur making landfall in Nova Scotia. The Scenario Planning Team predicted that these conservative assumptions would result in the restoration curve as shown in Appendix 3.29. This restoration curve was very similar to the actual curve achieved after Hurricane Earl in 2010 as shown in Appendix 3.30.

The scenario planning session concluded at 11:00 AM on July 4. Following the meeting, the Storm Lead contacted the Executive VP Customer, Business and Financial Services to obtain approval to pre-stage the outside contractor crews. Approval was granted and the request was initiated to secure the external contact crews.

3.5 Learnings, Recommendations and Actions

1. The actual winds recorded in the province were much higher than forecast, and even higher in the Valley than the conservative estimates used in planning. Scotia Weather Services has conducted a detailed review to determine the cause of the significant inaccuracies in its forecast, particularly with regard to the wind speeds experienced across Nova Scotia. As part of the Scotia Weather Services Report, they confirmed that accepted methodologies were followed in creating their forecasts and that their forecasts were consistent with those of Environment Canada. Please refer to Appendix 3.31 (Scotia Weather Services Report).

Figure 19 summarizes the variance in the 3:00 PM July 4 Scotia Weather Services wind gust forecasts across Nova Scotia versus those we used for scenario planning, as well as those actually recorded on Saturday, July 5. The actual wind gusts in the Valley on Saturday, July 5, were 74 percent higher than Scotia Weather Services forecasted.
1. The actual track of Arthur was very different from forecast and followed a path similar to Hurricane Kyle in 2008, but with much stronger winds in the Valley. Figure 20 shows the peak wind gusts (by year) for Greenwood from 1994 to 2014. The previous peak wind gusts were recorded in 1995 at 124 km/h (12 percent lower than those recorded during Arthur). Figure 20 also shows bar graphs for the number of hours each year when wind gusts were recorded above 70 km/h and above 90 km/h. In 2014, there have been 11 hours in Greenwood with wind gusts above 90 km/h, nearly double any previous full year.
3. In the days following Arthur, Nova Scotia Power ran the Scenario Planning Model using the actual wind speeds recorded on July 5. The model made an accurate prediction of the actual number of customers affected and the crew hours required to restore power.

4. The high winds during Arthur in the Valley led to multiple 69 kV transmission line outages. While we prepare extensively for transmission outages, as detailed in Section 6, our Scenario Planning Model does not model transmission outages or restoration times, because wind storms primarily cause distribution outages. We will update our model to predict both distribution and transmission outages together.
4.0 ARTHUR’S ARRIVAL AND OUR RESPONSE

4.1 Introduction

This section provides detail on the damage Post-Tropical Storm Arthur caused to our electricity system, customer outages, and how restoration progressed. It includes a summary of our safety procedures and record during the response, and a timeline of activities at our Emergency Operations Centre.

4.2 Damage Details

On Saturday, July 5, 2014, Post-Tropical Storm Arthur tore across Nova Scotia, bringing stronger winds than had been forecast and causing significant damage to our electricity system. Wind gusts upwards of 90 km/h were recorded at the Yarmouth airport at 5:30 AM. By 6:00 AM, we had outages to approximately 13,000 customers, along with our first transmission line outage. By 11:00 AM, much of the South Shore and Valley were being battered by wind gusts over 100 km/h, an additional 12 transmission lines were out of service, and 124,000 customers were without power.

The storm’s path from southwest to northeast concentrated the damage in the service areas of Bridgewater, Liverpool, Shelburne, Barrington, Yarmouth, Clare, Digby, Bridgetown, Kingston, Coldbrook and Stellarton. Figure 21 shows a typical example of this damage.
The sustained duration of the storm, with 90 km/h wind gusts continuing past 9:00 PM Saturday, July 5, meant damage to the electrical system continued to occur well into the night. By the end of the day, a peak of 137,000 customers had lost power, as illustrated in Figure 22, and 29 transmission lines had been knocked out of service.

**Figure 22: Customer Outage Profile**
4.3 Restoration Begins: Safety First

The safety of our customers and employees is Nova Scotia Power’s top priority.

The restoration of power following Post-Tropical Storm Arthur was completed safely, with no lost-time injuries. Nova Scotia Power conducted thorough safety preparation prior to the event, and employees adhered to safety practices throughout the restoration. Field personnel, reporting extreme winds, stood down for their safety at 11:00 AM July 5, resuming work at approximately 1:00 PM. The nature of the storm was such that extreme weather would ramp up and down several times throughout the day.

Safety preparations began two days before Arthur arrived. Safety Department members were notified on Thursday, July 3, that if the Emergency Operations Centre (EOC) was activated, they would be deployed to locations across the province where damage was anticipated, beginning on Saturday, July 5. In order to provide provincial coverage, Safety Specialists were positioned in Yarmouth, Sackville and Sydney (one in each), and two were assigned to the EOC, one covering the dayshift (9:00 AM), the other covering the nightshift (9:00 PM). On July 6, the Safety Specialist from Sydney was moved to the Stellarton area when the forecasted weather in Cape Breton did not materialize. During the week, Safety Specialists were also moved to Truro, Bridgewater and Digby.

The Safety Specialists provided daily safety messages that were delivered to all employees involved in the storm response prior to commencement of work. Their messages focused on: risk assessments, Standard Protection Code, back feed from generators and induction from nearby energized lines, traffic control, driving conditions, weather conditions, heat stress, fatigue, defensive driving, environmental conditions, and all potential hazards to both the public and employees.

Before starting every job, crews completed an assessment of all potential risks that could be encountered. Risk assessment forms were completed by the crews when they arrived
at their destination. They identified the hazards and risks associated with the work and put controls in place to eliminate or mitigate the risks. Work days were limited to 16 hours per day, which included travel to and from work.

During Arthur, the Safety Department completed orientations for contractor and off-system mutual aid work groups. Orientations took place in Halifax, Truro and Digby. Safety Specialists also conducted site visits, entered incident reports, investigated first aid events, and participated in Emergency Operation Centre (EOC) meetings and Regional Operation Supervisors (ROPS) calls.

There were three first aid incidents reported during the Arthur storm response, including an injured ankle, an asthma attack, and a fall. None resulted in a recordable safety incident.

The safety statistics from Post-Tropical Storm Arthur are:

- 3 first aid incidents
- 5 high potential incidents
- 14 pro-active at risk reports

4.4 Restoration Priorities

In response to an emergency, Nova Scotia Power places the safety of the public and its employees as its highest priority. We work in partnership with emergency agencies to respond quickly and effectively to the event. In terms of restoration priorities, Nova Scotia Power will respond in the following order:

1. Public Safety/Emergency Situations and Critical Care Customers
2. NS Power Critical Transmission Infrastructure
3. EMO Critical Infrastructure priorities
4. Main line feeders (3 phase)
5. Branch lines (3 phase and 1 phase)
6. Individual services

As a practice, crews will endeavor to repair individual customer services (homes and business) in an assigned area after street side electricity supplies have been restored, and provided the customer’s meter mast is intact and safe to connect.

Figure 23: Individual Service Damage

4.5 Restoration Details Overview

A total of 245,000 individual Nova Scotia Power customers experienced a power outage during this storm. To restore power to these customers, Nova Scotia Power crews responded to over 4,070 unique events. Over the course of the storm response, Nova Scotia Power engaged as many as 271 Power Line Technicians (146 NS Power PLTs and 125 external PLTs) to repair the damage and restore power. The external crews were brought in from Emera Utility Services, Emera Maine and private contractors from New Brunswick.
As transmission lines and main feeders were restored, Nova Scotia Power gained visibility to embedded outages. That is, as each feeder outage was restored, any branch line outage or individual outages remaining were then able to be identified and prioritized for restoration as new outage events. Hence, the number of events grew in the days after the storm. Figure 24 shows the distribution of active outages throughout the storm restoration with a peak of 1,650 events on Monday, July 7, and a total of 4,070 events overall.

The scope of damage to our electrical system was concentrated in the Western region, but significant equipment replacements and repairs were made across the province. Nova Scotia Power rebuilt the equivalent of 47 kilometres of distribution line during the storm, which included rebuilding approximately 938 spans of primary wire and the equivalent of 500 service connections. Further, more than 10,000 spans of primary wire were repaired as a result of storm damage. Additionally, two wood-pole transmission structures were
replaced, with a further 76 transmission structures and six spans of conductor were repaired.

A summary of the materials utilized during the course of the storm is presented in Figure 25, which reflects the volume and type of equipment which sustained damage. The majority of the materials required to repair the damage to the electrical system were utilized in the Western region. Only 3.3 percent of outages were due to equipment failure.

We encountered no material shortages in our response to Post-Tropical Storm Arthur.

Figure 25: Materials Utilized During Post-Tropical Storm Arthur Restoration

<table>
<thead>
<tr>
<th>Material</th>
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<th>Central</th>
<th>East</th>
<th>Total</th>
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</table>
4.6 Emergency Operations Centre

In major storms like Post-Tropical Storm Arthur, our Emergency Operations Centre (EOC) is activated at the Control Centre, and employees tasked with various EOC roles gather there to centrally manage storm response efforts, as per our Emergency Services Restoration Plan (ESRP).

Figure 26: Emergency Operations Center (EOC) at Nova Scotia Power Control Centre

In preparation for the arrival of Arthur, EOC members were contacted on the morning of Thursday, July 3, by the Duty Officer via telephone, rotating twelve-hour shifts were established (A and B shifts), and the availability of personnel was confirmed. A copy of the EOC organization chart and final EOC roster is attached as Appendix 4.01.

Logistic teams were activated for the following areas:

1. Facilities, Goods & Services
2. Fleet
3. Food & Accommodations
Materials  

Logistics planning activities included:

- Regional Storekeepers were asked to check depot material levels on items that are typically used in a storm and to bring stock levels up as contingency.

- Buyers confirmed material availability in Central Stores and made arrangements to bring stocks levels up where needed.

- Critical suppliers were notified about the pending storm, their stock levels were confirmed, and plans were put in place to provide material support if needed.

- Vehicles were staged in a number of areas on Friday, July 4 for the Damage Assessment teams to use.

- Facility inspection reports for regional support hubs were reviewed for potential issues and arrangements were made to have extra IT and communications equipment on hand if needed.

- Staffing arrangements were made for all support functions.

The Scenario Planning Team met at 9:30 AM Friday, July 4, at the Ragged Lake Control Centre to complete storm prediction and scenario planning. The outcome of the scenario planning indicated that Nova Scotia Power should prepare for a Level 3 event (50,000 customers out, or 36 hours to restore). The Early Monitoring Team held a call at 11:30 AM on Friday, July 4, and the decision was made to open the EOC. An email was sent at
1:36 PM by the Duty Officer to the ESRP members and various executives to notify them of the plan to open the EOC (please refer to Appendix 4.02).

The following timeline summarizes Nova Scotia Power’s EOC operations from July 5 through July 11:

Saturday, July 5

- 7:40 AM – ETR strategy version 1 was issued via email from the manager of the Resource Management Centre (RMC). Please refer to Appendix 4.03.
- 8:00 AM – Regional Operations Supervisors (ROPS) conference call.
- 9:00 AM – The EOC opened with the A shift on duty.
- 9:30 AM – EOC conference call with both A & B shifts in attendance.
- 12:00 PM – ROPS conference call.
- 12:49 PM – ETR strategy version 2 was issued via email from the EOC Customer Coordinator. Please refer to Appendix 4.03.
- 3:15 PM – ROPS conference call.
- 4:00 PM – EOC conference call.
- 6:44 PM – ETR strategy version 3 was issued via email from the EOC Customer Coordinator. Please refer to Appendix 4.03.
8:00 PM – ROPS conference call.

9:00 PM – EOC B shift on duty.

10:00 PM – EOC conference call.

Sunday, July 6

4:00 AM – EOC conference call.

6:19 AM – ETR strategy version 4 was issued via email from the EOC Customer Coordinator. Please refer to Appendix 4.03.

7:30 AM – EOC conference call.

9:00 AM – EOC A shift on duty.

9:00 AM – ROPS conference call.

11:30 AM – ETR strategy version 5 (Appendix 4.03) was implemented by the RMC, and a summary was provided via email from the EOC Customer Coordinator at 3:12 PM. A detailed feeder report Excel spreadsheet was included in the email (not attached).

3:30 PM – ROPS conference call.

4:30 PM – EOC conference call.
6:00 PM – ETR strategy version 6 (Appendix 4.03) was implemented by the RMC and a summary was provided via email from the EOC Customer Coordinator at 7:58 PM. A detailed feeder report Excel spreadsheet was included in the email (not attached).

9:00 PM – EOC B shift on duty.

11:00 PM – ETR strategy version 7 (Appendix 4.03) was implemented by the RMC and a summary was provided via email from the EOC Customer Coordinator at 1:08 AM, Monday, July 7.

Monday, July 7

12:25 AM – EOC conference call.

4:00 AM – EOC conference call.

7:30 AM – EOC conference call.

9:00 AM – EOC A shift on duty.

9:00 AM – ROPS conference call.

3:17 PM – ESRP members notified via email from the EOC Duty Officer that a B shift will not be required overnight Monday and that no further EOC conference calls were scheduled.
Post-Tropical Storm Arthur – Review of NS Power’s Storm Response

- 3:30 PM – ROPS conference call.

- 9:00 PM – EOC was officially deactivated. The storm response was reclassified as Level 2: Regional Response and the members of the ESRP were notified via email from the Duty Officer at 9:31 PM (please refer to Appendix 4.02). A copy of the EOC Decision Log is included in Appendix 4.04. The Storm Lead, Regional Operations Lead and the Duty Officer continued to work from the EOC location until Friday, July 11, to provide storm support to the regions and EMO-NS, as required.

- 9:00 PM – ETR strategy version 8 (Appendix 4.03) was implemented by the RMC and a summary was provided via email from the EOC Customer Coordinator at 9:27 PM. A detailed feeder report Excel spreadsheet was included in the email (not attached).

Tuesday, July 8

- 8:30 AM – ROPS conference call.

- 12:00 PM – ETR strategy version 9 (Appendix 4.03) was implemented by the RMC and a summary was provided via email from the RMC Manager at 1:57 PM.

- 9:00 PM – ROPS conference call.

Wednesday, July 9

- 9:00 AM – ROPS conference call.
Coordinated field validation of “one-of” events to verify status and assist in efficient restoration.

Thursday, July 10

- 2:00 PM – ETR strategy version 10 (Appendix 4.03) was implemented by the RMC and a summary was provided via email from the RMC Manager at 2:51 PM.

- Coordinated inquiries and responses to customer escalations through EMO-NS and Nova Scotia Power’s Customer Care Centre.

- Continued to coordinate field validation of one-of events to verify status and assist in efficient restoration.

Friday, July 11

- 9:00 AM – ETR strategy version 11 (Appendix 4.03) was implemented by the RMC and a summary was provided via email from the RMC Manager at 11:10 AM.

- Continued to coordinate inquiries and responses to customer escalations through EMO-NS and Nova Scotia Power’s Customer Care Centre.
5.0 RESTORING POWER: DAMAGE ASSESSMENT

5.1 Introduction

This section describes the role our Damage Assessment teams played in restoring power to our customers following Post-Tropical Storm Arthur, as well as resource allocation of those teams.

Figure 27: Picture from Damage Assessment Team

5.2 Damage Assessment Overview

Assessing of the location, type and extent of damage to the system is critical in every storm response. Trained crews and individuals conduct these assessments in the field to determine the full extent of damage, so we can make appropriate plans to restore power.

Nova Scotia Power uses information from our Outage Management System (OMS), Supervisory Control and Data Acquisition (SCADA) system, and customer call details in
advance of receiving the field validated data to create a preliminary estimate of the resources and time needed for the restoration.

In a large storm, we visually inspect transmission and distribution plant infrastructure as quickly as possible to allow for the most accurate picture of the storm damage and to accelerate the planning process. Nova Scotia Power has a documented and tested damage assessment process to collect this data, as outlined below. While the data is being collected, our planning support teams adjust the priorities in the restoration plan to reflect the type and location of the damage. For more information on the damage assessment process, please refer to Appendix 5.01.

5.2.1 Damage Assessment Pre-Staging and Response

While Post-Tropical Storm Arthur was still active, pre-staged Damage Assessment teams began the work of conducting vehicle patrols of their assigned feeders, starting at the substation and working down line in teams of two (one driver, one assessor) on the morning of Saturday, July 5. Information regarding the severity of the event began to flow from the damage assessment teams into the EOC at 3:00 PM Saturday. With 29 transmission lines out of service, many substations were without a source. Damage Assessment teams were dispatched to the feeders impacted by the transmission outages, so when the source was returned, power could be restored to these areas without further delay.

At 6:00 AM on the morning of Sunday, July 6 (Day 2), with the advantage of clear weather, two helicopters with experienced line personnel began patrolling the damaged transmission lines, reporting their findings in real time where cellular service allowed. The helicopters were used to assess damage to remote distribution lines once the transmission work was complete. This storm impacted 21,595 kilometres of distribution line and 1,109 kilometres of transmission line. Damage Assessment teams needed to
physically review all infrastructure in order to identify the full extent of damage to the electrical system.

At the end of Saturday, July 5, 44 percent of damage assessment on feeder outages had been completed; 68 percent by end of Sunday, and 93 percent by end of Monday. Damage assessment was completed on Tuesday, July 8 (Day 4), after which the Damage Assessors were re-tasked regionally to verify one-of calls to be dispatched once larger outages were restored.

The goal of the Damage Assessment team is to provide the EOC with an overall assessment of the magnitude and extent of the damage to the power system and recommend priorities for restoration. Damage assessment data is collected electronically using a mobile GIS smartphone application. The data is synchronized from the field to a GIS server, and then the magnitude of the damage is reviewed at the EOC. The collected data is also a key input to the Resource Management Centre, which uses the data overnight to plan restoration assignments for teams the following morning.
5.2.2 Damage Assessment Resource Allocation

Pre-event scenario planning is conducted by a core group within the EOC, as detailed in Section 3.4. The number of Damage Assessment teams and where they will be pre-staged is determined and then carried out by the Damage Assessment Coordinator. Based on the predicted path of the storm, in addition to Regional Planners and local Meter Services staff, seven two-person Damage Assessment teams were pre-staged on Friday, July 4, prior to the storm reaching Nova Scotia; two teams on the South Shore (Liverpool), two teams in the Valley (New Minas), and three teams in Halifax. Additional Damage Assessment teams were deployed, primarily to the West, on July 6 and 7. After the EOC was deactivated on July 7, the Western Region continued to deploy Damage Assessors on July 8 through 12, as shown in Figure 29.
As damage assessment data became available, restoration plans were adjusted to reflect the multiple repairs required to restore each event. While crews would normally expect a single issue for each event on the system, such as a failed transformer, they often encountered multiple issues requiring repair for each event; for example, trees on electrical equipment, a broken pole, conductor down, etc. Some feeders required a full day of tree removal before repair of power infrastructure could begin.
5.3 Learnings, Recommendations and Actions

1. We have recognized through previous storms that damage assessment is critical. However, in storms with winds like those experienced in Arthur, having more Damage Assessors pre-staged would help us gain an accurate assessment of the damage in a shorter time frame.
6.0 RESTORING POWER: TRANSMISSION SYSTEM

6.1 Introduction

This section describes the restoration of our transmission system, and the role our Transmission Operations team played in restoring power to our customers following Post-Tropical Storm Arthur.

6.2 Transmission Operations Pre-Staging for Arthur

Transmission Operations planning for Arthur started on the afternoon of Wednesday, July 2, and by the end of that day staff availability lists for internal substation and transmission line resources were in place (please refer to Figure 31). In addition, seven transmission line contractor crews were engaged by the end of the day. These crews were pre-staged across the province in advance of the storm on Friday, July 4; one in Port Hawkesbury, three in Milton, and three in Bridgetown.
Transmission hardware and wood product, such as poles and cross arms, were also pre-staged around the province in Port Hawkesbury, Milton, and Bridgetown. Nova Scotia Power proactively obtained additional overhead line equipment from external contractors to allow our off-road based transmission crews to switch to working overhead “on-road” distribution after the transmission damage was repaired. The transmission inspection database was queried to identify any high priority repairs which should be completed prior to the storm, and none required action. The team consisted of a Transmission Operations Lead with two alternates available and three Transmission Coordinators.
6.3 Transmission Operations Response to Arthur

The Transmission Operations team was in place in the EOC at 7:00 AM on Saturday, July 5, monitoring the progression of the storm and outage events. The team was responsible for planning, developing, and managing the execution of the transmission emergency restoration activities. Crews and inspection teams were dispatched to events as they occurred. The Transmission Operations team coordinated materials, switching and permits, reviewed fault location data and provided crews with efficient access points to the transmission right-of-way.

As the winds continued throughout the day, primarily off right-of-way trees continued to fall into the 69 kV lines while they were de-energized. At the end of the day on July 5, 31,831 customers were affected by transmission outages. Work continued for the EOC Transmission Operations team 24 hours a day, prioritizing the restoration of transmission events, and dispatching all available off-road equipment to these locations. In particular, attention was paid to identifying opportunities to isolate damaged sections of line and restore transmission system integrity as quickly as possible. Priority was given to lines impacting system security first, customer outages next, and finally all remaining issues, as per the restoration priorities in Section 4.4.

At the end of day on Sunday, July 6, there were only two customers still affected by transmission outages: Acadia University (L5035) and the Rio Algom tin mine (L5535). The final restoration to a transmission affected customer occurred at 9:00 PM Monday, July 7. A visual representation of the transmission lines that experienced outages is shown in Figure 32 and a detailed description of the transmission events is included in Appendix 6.01.
6.4 Helicopter Patrols

Most transmission lines run cross-country, through isolated terrain and sometimes environmentally sensitive areas. Generally, we access transmission lines via all-terrain vehicles and other off-road machinery, or review them from the air via helicopter.

Two helicopters left Halifax at 6:00 AM Sunday, July 6, and patrolled transmission lines L5025, L5026, L5532, L5535, L5533, L5531, L5538, and L5035. From the air, the transmission line experts were able to identify the exact location of trees or other damage to the transmission line. When cell service was available, real-time damage assessment...
data was relayed back to the EOC Transmission Operations team for prioritization and planning. The damage was observed to be caused by off right-of-way trees and had resulted in broken spar arms, insulators and conductors. Numerous instances of storm damaged overhead ground wire were proactively identified and repaired.

Helicopter patrols of transmission lines of all voltage classes continued through to Friday, July 11. Trees were removed during short outages to the transmission line (L6004—no customers affected due to multiple transmission supplies), and under live-line techniques to the transmission lines (L5024, L8001, L5545 and L5546).
7.0  RESTORING POWER: DISTRIBUTION SYSTEM

7.1  Introduction

This section describes the restoration of our electricity distribution system following Post-Tropical Storm Arthur. The role played by our Regional Operations team and others in restoring power to our customers is described in detail. A day-by-day synopsis reports the daily progress of our restoration efforts.

7.2  Regional Operations Organization and Field Resources

Nova Scotia Power field restoration was managed and executed by a team of experienced utility personnel who have worked large storms in the past. The Regional Operations Storm Organizational Chart, shown in Figure 33 outlines the depth and breadth of the team involved in the Arthur regional restoration.
By Friday night, July 4, Nova Scotia Power and contractor line crews were staged across Nova Scotia. With them were T&D Supervisors, Regional Planners, Transmission Inspectors, Storekeepers, and Fleet Mechanics. Figure 34 provides a breakdown of the field resources available daily during the restoration process. Administrative and logistical resources were in place to monitor and support safety, environment, materials, and food and lodging requirements.
The work schedule was established such that day shift crews worked 6:00 AM-10:00 PM and night shift crews worked 6:00 PM-10:00 AM, as per the ESRP. This rolling shift continued for all our field crews and personnel until the morning of Sunday, July 13. The Resource Management Centre (RMC) and Distribution Control Centre (DCC) brought in additional staff to ensure 24-hour coverage for event dispatch and to maintain system connectivity throughout the restoration efforts. Critical communication links were established (as per past practice and the ESRP) between the RMC and the field.

7.3 Distribution System Damage Overview

In the hardest hit areas, Post-Tropical Storm Arthur left streets blocked by fallen trees and poles. Many spans of conductor were torn down as trees fell, sometimes with such force that the trees and wire would be found tangled together on the ground. A typical damage site consisted of large trees or groups of trees blown down by high winds, with damage to multiple spans of primary conductor (Figure 35 A). The individual service connections associated with these sites often had damaged service poles and guy wires, as well as damage to the customer’s electrical entrance. The type of damage shown in
Figures 35 A and B would take two line crews approximately a full day to repair. They would be assisted by vegetation crews, traffic control and planners.

**Figure 35: Typical Damage Site**

Distribution system restoration was a 24-hour a day operation. Field personnel focused on restoration during the day and additional crews worked throughout the night restoring power and responding to emergency calls. Restoration planning occurred each night, generating the restoration plan with the list of restoration priorities (outage events) to be addressed by line crews the next day. The events were prioritized based on safely restoring the maximum number of customers in the shortest possible time, as per the restoration priorities detailed in Section 4.4. Nighttime planning continued for the duration of the event, providing resources with event details and crew movement plans for the following day. Crew travel times were considered when developing these plans.

Eighty percent of customers were restored in the first three days of restoration, Saturday through Monday, July 7; 90 percent by noon on Wednesday, July 9 (Day 5), with all customers who could accept power restored by Saturday, July 12 (Day 8). Some customers had sustained damage to their own equipment – most commonly the meter
mast – and needed to have a certified electrician repair the damage before we could safely reconnect power.

7.4 Day-by-Day Detail of Restoring the Distribution System

In the following sections, the distribution storm response is detailed chronologically to provide an overview of the restoration of Nova Scotia Power’s electrical distribution system. Representative photos have been included to illustrate the damage encountered by our crews.

7.4.1 Day 1: Saturday, July 5

During the storm, wind speed and safe work conditions were constantly being evaluated by Operations Managers, T&D Supervisors, and PLT crews. Several times throughout the day, crews in Central and the West stood down as the storm made conditions unsafe for storm response activities.

Wind gusts quickly began to exceed forecasted speeds. Distribution system damage accelerated, with hundreds of outage events occurring and tens of thousands of customers off by early afternoon.

Nova Scotia Power’s storm response in Day 1 was significantly impacted by weather conditions. Over 100 road closures were logged between Nova Scotia Power and the Nova Scotia Department of Transportation and Infrastructure Renewal (TIR). Road closures typically consisted of large trees and sometimes spans of trees, wires, and distribution infrastructure down across the roadway blocking traffic.

Our crews worked 16-hour shifts throughout the storm, responding to emergency events and clearing paths through fallen trees to allow restoration to proceed. The temporary disruption of some internal systems on Saturday afternoon, as discussed in Section
10.5.4, did not hinder or delay field response. Field crews worked under the direction of their local supervisors on the prioritized events.

While the storm was still active across the province, crews were restoring power. By noon, nine more crews (18 PLTs) were en route from New Brunswick, at the request of the EOC. Due to the prolonged high winds, many restored feeder sections would trip off again as new damage continued to occur into Saturday night. Progress during the active storm was difficult. Priority was given to emergency and “911” calls (emergency calls into the Distribution Control Centre). As the first day shift finished, Post-Tropical Storm Arthur was beginning to move out of Nova Scotia.

Large volumes of “911” calls began to come in early in the day on Saturday and continued throughout the storm. By early evening, our night crews provided regional coverage across Nova Scotia. These crews continued to respond to the most critical events including wires down, poles blocking critical roadways, and critical customer restoration including hospitals, medical centres, etc. On Saturday, we restored service to 46,441 customers.

7.4.2 Day 2: Sunday, July 6

Early in the day on Sunday, the decision was made by the EOC to establish a three-node response in the Western territory and deploy additional senior leadership, due to the extent of the damage and the number of outage events. Management centres were created in Yarmouth, Coldbrook, and Bridgewater. This decision allowed management in those three areas to focus in on their unique situations and maximize the resources in the area.

From the beginning of Day 2, all distribution PLTs and supporting employees were focused on the execution of the plan that had been developed overnight and deployed at 6:00 AM, with a primary focus on restoring power to the largest customer count events.
Very early in Day 2, Damage Assessors and field personnel began to see the significance of the damage that had occurred on July 5. Travel routes had been considerably affected by the trees, damaged poles, and lines in the roadways. Often crews had to take detours, or take the time to remove debris from the roadways, before they could continue to an outage. Hundreds of trees and tree limbs had fallen, damaging poles, wires, transformers and guys/anchors, as well as damaging interconnected telecommunications infrastructure.

At the same time, Logistics teams were providing meals, essentials and accommodations, as required. The pre-planning efforts of the Logistics teams meant accessing these necessities did not slow restoration efforts. Crews were provided breakfast in or close to their accommodations, and bag meals were delivered on site to maximize their working hours and reduce travel and down time.

Progress was made throughout the day, with numerous feeder outages restored and roads cleared. Full nighttime coverage continued into Night 2. On Sunday, we restored service to 38,775 customers.
7.4.3 Day 3: Monday, July 7

On Monday, July 7, crews moved east to west across the province as restoration in the East and Central territories was 90 percent complete. In particular, six crews moved from the Central territory and nine crews from the Eastern territory into the Western operating area.

Distribution restoration was focused on the prioritized restoration plan. On Monday, we restored service to 23,541 customers. Crews continued to deal with extensive damage in the field, but most roads were either partially or completely open for traffic.

Figure 37: Extensive Damage

As transmission damage repair was completed, transmission crews switched from off-road equipment to on-road distribution trucks and began to assist the distribution restoration effort.
7.4.4  Day 4: Tuesday, July 8

The Overnight Planning Team recommended eight crews move from the Central territory to West. This plan was initiated Tuesday morning. Crews were moved in a planned manner to minimize total travel.

Damage assessment data confirmed many fallen trees and damaged infrastructure requiring repair in order to restore these single customer events. To facilitate restoration of customers with service damage, the Small Service Inspection protocol was implemented, enabling specially trained PLTs to assist certified electricians in completing service inspections to facilitate customer electrical reconnections.

By end of day Tuesday, we had restored all feeder outages, and 15,418 customers remained without power.

7.4.5  Day 5: Wednesday, July 9

The Overnight Planning Team recommended five crews move from Central to West and nine crews move from East to West. This plan was initiated Wednesday morning. In addition, nine crews arrived from Emera Maine and were dispatched to the Western region. These crews began restoring power safely within hours of entering the province. This was the first day these crews were available as Maine was also impacted by Arthur.

The work conducted on Day 5 was primarily focused on events impacting fewer than 100 customers. By end of the day, there were 6,278 customers without power, and all of the outages in the Eastern region were restored.
7.4.6 Day 6: Thursday, July 10

The Overnight Planning Team made final crew movement recommendations, shifting six Central crews and one Eastern crew into the Western region.

Throughout the day, crews were working a plan designed for the most effective restoration of remaining single customer outages.

By end of Day 6, we had restored power to 3,585 customers, including the last of the outages in the Central territory. A total of 2,693 customers remained without power.
7.4.7 Day 7: Friday, July 11

On Friday, all resources were focused on the remaining 841 active outage events. By the end of the day, 660 customers remained without power. The Small Service Inspection process allowed customers to have service inspections completed throughout the day.
### 7.4.8 Day 8: Saturday, July 12

On Saturday, we completed restoration of all the original distribution outages, with the exception of customers who had damage to personal equipment requiring repair before we could safely reconnect power.

Figure 41 displays the peak number of customers out and the total number of customers out at the end of each day for the remainder of the restoration. This figure illustrates the effect of prioritizing events with higher customer counts early in the restoration.

**Figure 41: End-of-Day Customer Interruptions**

![End-of-Day Customer Interruptions](image)

The number of outages that were restored on each day is depicted in Figure 42.
Figure 42: Outage Events Restored per Day

Figure 43: Damage Assessment - Day 8
7.5 Learnings, Recommendations and Actions

1. During restoration after Arthur, there were instances where tree crews were dispatched to clear roads that were already clear. We will seek to work with the Department of Transportation and Infrastructure Renewal to develop definitions of different levels of road closures, appropriate response protocols, and timely sharing of information. This protocol could be managed via Emergency Management Offices.
8.0 RESTORING POWER: VEGETATION MANAGEMENT

8.1 Introduction

This section describes tree damage caused by Arthur and the role Vegetation Management crews played in restoring power to our customers. The storm caused the most damage in Western Nova Scotia, so details of vegetation management practices in that region are also provided. A more complete accounting of Nova Scotia Power’s Integrated Vegetation Management Program is provided in Section 9.

8.2 Tree Damage to the Electricity System

More than 90 percent of the power outages caused by Post-Tropical Storm Arthur were due to trees (please refer to Figure 45). While broken tree branches account for a percentage of this total, the majority of the outages were caused by trees falling onto the distribution system from outside the right-of-way. Investigations are pending, but most of these trees have not shown any sign of poor health or decay. Often, trees falling into power lines during storms account for over 80 percent of outages; the higher percentage of outages caused by tree limbs and branches during Arthur is considered to be attributed to the high number of large ornamental trees found on the roadsides.
Figure 44: Broken Healthy Tree Limbs

A. Healthy Tree limb broken from stem
B. Healthy tree stem broken at six feet.

Figure 45: Total Outage Cause (CEA) by Percentage – Post-Tropical Storm Arthur

<table>
<thead>
<tr>
<th>Code</th>
<th>CEA Cause Code</th>
<th>Events</th>
<th>%</th>
</tr>
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<tbody>
<tr>
<td>0</td>
<td>Unknown</td>
<td>107</td>
<td>2.6</td>
</tr>
<tr>
<td>1</td>
<td>Scheduled Outage</td>
<td>10</td>
<td>0.2</td>
</tr>
<tr>
<td>2</td>
<td>Loss of Supply</td>
<td>2</td>
<td>0.0</td>
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<tr>
<td>3</td>
<td>Tree Contacts</td>
<td>3,325</td>
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<td></td>
<td><strong>Falling Tree (75%)</strong></td>
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<td></td>
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<tr>
<td></td>
<td><strong>Broken Branch (7%)</strong></td>
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<td></td>
</tr>
<tr>
<td></td>
<td><strong>Branch Contact (19%)</strong></td>
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<td></td>
</tr>
<tr>
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<td>Lightning</td>
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<tr>
<td>7</td>
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<tr>
<td>9</td>
<td>Foreign Interference</td>
<td>91</td>
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</tr>
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<td></td>
<td><strong>Total</strong></td>
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<td><strong>100.0</strong></td>
</tr>
</tbody>
</table>

NOTE 1: The “Scheduled Outage” coding refers to planned outages in order to briefly de-energize a distribution feeder to tie it into another feeder, and the re-energize both feeders together.

NOTE 2: The “Adverse Weather” coding refers to weather causing trees to make contact with power infrastructure.
8.2.1 Tree Crew Response to Post-Tropical Storm Arthur

The priority for tree crews during storm response is to support Power Line Technicians. This includes removing trees lying on power lines that are still up, as well as trees that have broken poles and wires causing power lines to fall to the ground.

Due to the fact that Arthur didn’t behave as predicted by weather forecasts, some tree crews were initially staged in areas of the province where the storm proved to have less impact. We were able to efficiently redeploy those crews to support outage restoration.

Nova Scotia Power has long-term contracts with two vegetation management suppliers: Lucas Tree Experts and Asplundh Tree Service. Both of these companies, along with two subcontractors Atlantic Arborists (Valley) and GPF Contracting (New Glasgow), provided the vegetation management response to Post-Tropical Storm Arthur. Twenty-nine tree trimming crews with bucket-trucks were dispatched to various areas across the province on July 4 to pre-stage in support of restoration efforts. Crews were staged together in groups of three or four crews at various locations between Yarmouth and Sydney.

As the specific outage locations were identified, crews were mobilized to support harder-hit areas. On July 7, crews staged in the eastern end of the province were moved to the Annapolis Valley. On July 10, crews staged in the northeastern area of the province were transferred to the South Shore, and by July 11, 90 percent of all crews were active in the western part of the province until July 14. After this date, four Vegetation Management crews were released to support NB Power, while all remaining crews continued to work on clean-up activities.

Approximately 300 calls per day to the Vegetation Management team were received on July 5 and 6, and subsequent to that, approximately 100 calls per day were received up to July 12. All work associated with services to homes was scoped ahead of the tree crew
being dispatched to ensure adequate use of the resource. Local tree crews were still engaged in storm associated work until July 25.

8.3 Distribution System Vegetation Management in Western Nova Scotia

Post-Tropical Storm Arthur caused the most damage in Western Nova Scotia. Over the past 10 years, vegetation management spending along distribution lines in Western Nova Scotia (the area West of Route 14) has been in excess of $1.5 million per year.

8.3.1 Annapolis Valley

Feeder management throughout a large percentage of the Annapolis Valley has been primarily restricted to aerial trimming, due to the suburban setting of most lines. There is often only a narrow space within the right-of-way available for all the treatment options such as ground clearing, mowing, herbicide application or widening, given the landscaped use of the adjacent property. Trees in conflict with the lines are, for the most part, considered ornamental and therefore few are removed. Customers are consulted on a span by span basis on planned tree work. Requests to remove a tree are only made in the case of a tree being identified as a threat to falling onto the feeder lines.

Although trimming is often the only management treatment option, even that work is compromised in favour of protecting the tree. Due to the size and nature of the roadside trees throughout the Annapolis Valley, Nova Scotia Power is also challenged with obtaining desired clearances from the limbs in close proximity to the power lines without destroying the tree. Establishing a cleared three metre circumference around the power line from a large ornamental tree such as American Elm, sometimes results in full removal of the tree due to the extent of branch and stem cutting.

In the 1990s, Nova Scotia Power led a jointly funded program for the removal of dead or dying large American Elm trees throughout the Annapolis Valley affected by Dutch Elm
Disease. Other funding agencies included municipalities, the provincial transportation department, and Aliant. Over $100,000 annually was directed to removing these large trees. When these huge trees failed, they posed a serious threat to persons and property. The program ceased to exist around 2003, as the number of diseased trees decreased. Nova Scotia Power continues to direct approximately $50,000 per year to the Annapolis Valley, without joint funding, for the removal of large hazard trees. This has resulted in many threats to the system being removed in a timely manner after identification.

8.3.2 South Shore/South West Nova Scotia

Feeder management in the South and South West Nova Scotia has been extensive, as every aspect of Integrated Vegetation Management has been implemented for both reliability improvement and sustaining rights-of-way. Rights-of-way have been re-established through ground clearing and herbicide application in some areas. Widening projects have been undertaken in the less populated areas of Shelburne, Yarmouth and Annapolis counties.

8.4 Transmission System Vegetation Management in Western Nova Scotia

There are approximately 1,260 kilometres of transmission line in the western part of Nova Scotia. Of this, approximately 711 kilometres (56 percent) are 69 kV lines that feed smaller townships and industry. Over 60 percent of the western 69 kV system is between Yarmouth and Windsor on the Annapolis Valley side of the province. Due to the fact that most 69 kV rights-of-way are restricted by easements of 20 metres, we have placed focus on transmission right-of-way widening and danger tree removal in these areas. This work requires Nova Scotia Power to liaise with adjacent property owners to either exercise rights for tree removal as an aspect of the easement, or to request permission in such cases when the easement does not provide for such rights.
Provincially over 100 kilometres of right-of-way has been widened since 2009 on all voltages. Of this total, 27.2 kilometres, or 10 percent of the total kilometers of 69 kV Annapolis Valley area transmission was widened between 2011 and 2014.

There are also two 230 kV transmission lines in the western area of the province governed by North American Electric Reliability Corporation (NERC) requirements, being voltages greater than 200 kV. These corridors have also been widened in specific areas of concern and are inspected frequently against strict clearance criteria to ensure critical reliability.

8.5 Learnings, Recommendations and Actions

1. To improve reliability in major storms it is essential to establish clear rights-of-way on power lines. NS Power requires a greater public support for obtaining desired clearances from power lines.

   • Greater public support should allow increased trim clearances to attain a less-frequent maintenance cycle and an increased probability of capturing branches that are prone to failure during major storm events.

   • Greater public support should allow Nova Scotia Power to increase expenditures for vegetation management within the right-of-way asset renewal program and increase the amount of hazard tree removal projects to ensure that: all rights-of-way are re-established to a desired width within a fixed time frame; and hazard trees associated with those rights-of-way can be mitigated.
9.0 NS POWER’S INTEGRATED VEGETATION MANAGEMENT PROGRAM

9.1 Introduction

This section describes in detail our vegetation management program, including annual expenditures in various program initiatives. It also discusses the challenges faced in balancing vegetation management priorities against public desire to maintain trees in proximity to power lines. Recommendations to promote reliability are provided.

9.2 Integrated Vegetation Management Program Overview

Nova Scotia Power has implemented an integrated vegetation management (IVM) program to improve service reliability by creating sustainable rights-of-way along all distribution and transmission lines. IVM is considered an industry best practice standard (ANSI 300 – Part 7)\(^2\) for controlling the growth of incompatible vegetation that poses a risk to the safe and reliable operation of power lines. IVM treatments such as mechanical mowing and herbicide application, while normally associated with transmission corridors for controlling regrowth from within the right-of-way, are also implemented on distribution rights-of-way in areas of low customer density. In addition to controlling incompatible vegetation within transmission and distribution right-of-way, Nova Scotia Power has a program to expand the cleared width of the right-of-ways and manage off right-of-way hazard trees through tree removal and topping.

Since 2007, under the current vegetation management strategy, the number of outages as well as the duration of those outages, caused by trees, has declined. Please refer to

\(^2\) Please refer to [http://tcia.org/business/ansi-a300-standards/part-7](http://tcia.org/business/ansi-a300-standards/part-7)

9.2.1 Annual Vegetation Management Investments

Please refer to Figure 46 for Nova Scotia Power’s annual investments in vegetation management from 2004 to 2013.

Figure 46: Total Spend for Vegetation Management (2004 – 2013)

![Annual Vegetation Management Investments](chart)

9.2.2 Evolution of the Integrated Vegetation Management Program

Nova Scotia Power roadside distribution rights-of-way constructed prior to 2003 lack easement rights beyond a narrow section of the provincially-owned road right-of-way. In 2000, Nova Scotia Power attempted to coordinate IVM efforts for managing the full right-of-way width with the Department of Transportation and Infrastructure Renewal.
While pilot projects were explored at the regional level over the course of a couple of years, a cooperative program was never developed, due to the fact that often interests and timelines for specific project areas differed.

In 2003, Nova Scotia Power implemented a new engineering standard for establishing power line distribution rights-of-way, essentially doubling the width. A typical right-of-way established prior to 2003 was cleared to approximately 3 metres on each side of the centre of the road. The new standard required rights-of-way associated with primary power lines be established 6.1 metres each side of centre. There were a number of years when this standard was considered excessive by both the general public and municipalities. For example, Halifax Regional Municipality (HRM) requested that the Utility and Review Board (UARB) consider adjusting the width and as such, Nova Scotia Power was mandated to reduce the width to 4.6 metres from centre in the HRM core area. Beyond that restriction, all new rights-of-way constructed are expected to adhere to the standard.

In 2005, Nova Scotia Power extended the herbicide application program, normally associated with managing transmission rights-of-way, to include roadside distribution rights-of-way. Through the chemical treatment of hardwood vegetation, which has the ability to re-sprout after cutting, the tree stem density is dramatically reduced thereby further reducing future management.

Wider rights-of-way and the implementation of various control treatments for managing re-growth combine to create sustainable rights-of-way. On such rights-of-way, there are fewer trees, and given the amount of compatible vegetation, trees are not as likely to re-establish and grow back into the system as quickly. Adjacent trees are far enough away that branch contact is also dramatically reduced. The increased width also reduces the probability that an off right-of-way tree, upon failure, will make contact with the power line.
9.2.3 Current Program Application

Nova Scotia Power implements an integrated vegetation management program on all power line rights-of-way and spends approximately $10.4 million annually on a balanced approach for improving reliability and lowering overall tree management costs to customers.

9.3 Distribution

Total distribution program expenditures have averaged approximately $7.2 million annually over the last five years. Activities within the scope of the distribution right-of-way management program are carried out through a blend of reactive and predictive management approaches. At the outset of the reactive program in 2009, we were spending over $1 million per year on the worst performing distribution feeders. Over the same period, we invested approximately $4 million annually on preventative maintenance and sustainability projects. Since 2012, reactive spending has been reduced below $500,000 per year, thanks to the improved reliability performance produced by sustainable preventative maintenance (please refer to Appendix 9.02). The total number of spans completed in each program is listed in Figure 47. On average, over 1,100 kilometres is managed on an annual basis.

<table>
<thead>
<tr>
<th>Program Description</th>
<th>2009</th>
<th>2010</th>
<th>2011</th>
<th>2012</th>
<th>2013</th>
<th>Grand Total</th>
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<td>Asset Protection</td>
<td>179</td>
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<td>4,849</td>
<td>4,259</td>
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<td>23,606</td>
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<td>8,006</td>
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<td>188</td>
<td>251</td>
<td>704</td>
<td></td>
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<tr>
<td>Hazard Trees</td>
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<td></td>
<td>195</td>
<td></td>
<td>4,090</td>
</tr>
<tr>
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<td>2,394</td>
<td>1,583</td>
<td></td>
<td>12,609</td>
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<tr>
<td>Sustainability</td>
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<td>2,986</td>
<td>4,734</td>
<td>3,965</td>
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</tr>
<tr>
<td><strong>Grand Total</strong></td>
<td><strong>16,788</strong></td>
<td><strong>24,300</strong></td>
<td><strong>23,129</strong></td>
<td><strong>18,876</strong></td>
<td><strong>15,870</strong></td>
<td><strong>98,963</strong></td>
</tr>
</tbody>
</table>

Figure 47: Total Number of Spans Completed by Program Type
9.3.1 Reactive Management Approach

The Reactive Management approach is a response to poor distribution feeder performance or a specific customer request. With respect to feeder performance, Nova Scotia Power analyzes reliability data to determine the worst performing feeders. These feeders are then reviewed in the field to verify the extent of the tree conflict. Work is planned on a priority basis to address those areas of the feeders where trimming and cutting will provide the best contribution to improved reliability.

Reactive work by nature is generally more expensive than preventative work due to the smaller volume of management required at each feeder location/section, and translates into fewer spans of completed work. Control treatment for reactive work includes both tree trimming and ground clearing, and often involves the removal of off right-of-way trees that pose a threat from adjacent properties. Expenditure on reactive projects was $300,000 in 2013; expenditures in this area have been decreasing in recent years due to improved feeder performance levels.

Also considered reactive work is Nova Scotia Power’s response to customer requested work. We respond to all requests for tree trimming where customers have determined a personal concern. Expenditure for customer requested work averages approximately $1 million annually.

9.3.2 Preventative Management Approach

Expenditure on preventative projects averages approximately $5.4 million annually. The weighting of expenditures in favour of preventative work allows for a greater portion of the system to be addressed in a given year due to the unit-based pricing system. Preventative work activities within the plan are scheduled for full feeder sections and are grouped into the following categories: Asset Renewal, Asset Protection, Urban Management, Sustainability, and Hazard Trees.
Asset Renewal

Rights-of-way under this category are managed for sustainability due to the fact there is ample space in the road right-of-way between the power line and the adjacent forested edge to control vegetation growth beneath the power line, as opposed to being restricted to trimming adjacent tree growth (please refer to Figure 48). This space, or the right-of-way floor, is wide enough to be considered for re-establishment and eligible for IVM treatments, including herbicide application. The entire right-of-way is cleared of tree growth and adjacent branches are trimmed or trees are topped to achieve long-term control of all growth. Asset Renewal projects normally cover full sections of feeder lines, which translate into kilometres of completed work. Control treatment options include mowing, manual cutting and chipping, herbicide application (cut stump and foliar), and trimming. Expenditures for asset renewal projects were approximately $1.3 million in 2013.

Figure 48: Asset Renewal

A. Overgrown right of way  
B. Re-established Right-of-way
Asset Protection

Feeder lines managed under this program are defined by the lack of space within the roadside right-of-way and, as such, are considered for aerial trimming and limited ground-clearing (please refer to Figure 49). In such cases, the power lines have either been constructed at the far edge of the roadside easement restricting right-of-way space, or there is conflicting land use such as landscaped yards and ornamental trees. Very few trees are removed under this management option and obtaining desired safe clearances around the primary power line is the main objective. Expenditures for asset protection were approximately $1.1 million in 2013.

Figure 49: Asset Protection

A. Trees considered ornamental by adjacent landowners  
B. Vegetation Management restricted to tree trimming

Urban Management

Similar to projects under Asset Protection, Urban Management projects are defined by the lack of space for power line infrastructure, and the management of that space is
compounded by conflicting interests; mainly the desire to have ornamental street trees (please refer to Figure 50). Projects are normally carried out in coordination with other agencies or municipalities to ensure the interest of all parties concerned are addressed. Desired clearances from trees in such cases are sometimes compromised by conflicting interests and therefore other engineering solutions are sought. One such solution is the use of covered cable technology that can withstand branch contact, thereby preventing an outage. While it is appropriate for some situations, covered cable does not preclude the requirement for safe clearances to be established around the line, and therefore its use is limited. Expenditures for Urban Management were approximately $1 million in 2013.

**Figure 50: Urban Management**

Feeder lines managed under this program have a well-established roadside right-of-way, or it has been recently re-established through the asset renewal program (please refer to Figure 51). The objective of the sustainability program is to achieve the lowest long-term
cost of management. Control treatment options include: manual cutting, herbicide application and mechanical mowing. Expenditures for sustainability were approximately $700,000 in 2013.

Figure 51: Sustainability

A. Right of Way of Incompatible vegetation  B. Right of way of Compatible Vegetation

Hazard Tree Management

The Hazard Tree program is implemented on feeder lines that have well-managed rights-of-way, but are threatened by off right-of-way trees (please refer to Figure 52). This work provides a level of storm hardening. Off right-of-way trees are identified for topping or removal to prevent them from either breaking off or falling into the power lines. While in some instances hazard tree removal is a separate program from right-of-way management, the activity is often also an integral part of Asset Renewal.
Hazard trees are identified by their state of health or exposure to winds. A common focus of this program is the thin buffer of trees that is left along a forest harvest adjacent to a power line right-of-way. Trees in such buffers are susceptible to blow-down even under normal wind conditions. For approximately 10 years, the Hazard Tree program funded the removal of hundreds of large American Elm trees throughout the Annapolis Valley and other towns and communities where Dutch Elm Disease made the trees more susceptible to failure. The limbs of elm trees are essentially the size of mature trees and cause extensive damage to infrastructure when they fail. Expenditures for hazard tree cutting and trimming, was approximately $600,000 in 2013.

9.4 Transmission

Total transmission program expenditures averaged approximately $3.2 million annually over the last 5 years (please refer to Figure 46). Project activities within the scope of the transmission vegetation management program are identified through a predictive approach. Through the use of detailed inventories, management areas along the length of...
the right-of-way are identified and integrated vegetation control treatments are based on that vegetative condition. A computerized growth and treatment response model is then used to forecast future conditions and hence future treatment recommendations. Sensitive ecology, such as land associated with water, and property owner restrictions are the only detriments to the objective for sustainability. Manual cutting and mechanical mowing operations must be completed on a cyclical basis, whereas selective herbicide application can lower the management frequency through sustainability, or the development of more stable compatible plant communities. All transmission rights-of-way are managed to ensure no trees grow within close proximity to the conductors through the application of IVM.

9.5 Storm Hardening (Widening Rights-of-way)

Total expenditures associated with widening transmission and distribution rights-of-way are an aspect of the capital program and averages approximately $1 million annually.

9.5.1 Distribution

Feeders are identified on an annual basis for widening opportunities. Widening is not typically considered in areas where extensive tree removal might negatively impact adjacent land use and therefore is restricted to very rural or remote settings of low customer density (please refer to Figure 53). In these circumstances, the impact to residential property is minimal, and therefore generally accepted by customers. As reliability statistics are affected by customer density, and as historical vegetation management programs tended to focus on reliability improvement, feeders in more remote areas of the province would typically receive less funding. In such cases, rights-of-way are widened to the standard right-of-way width of 6.1 metres each side of centre. The standard right-of-way width is considered the best option for improving reliability performance in the long term by preventing branch contacts and reducing the likelihood that a falling tree will strike the power line. Remote widening projects are often
implemented through the use of forest harvesting equipment along a determined length of right-of-way. Annual expenditures for right-of-way widening on distribution averages approximately $500,000 annually.

Figure 53: Distribution Right-of-Way Widening

A. Narrow right of way associated with road

B. Right-of-way widened to 20’ standard

9.5.2 Transmission

Widening on transmission lines is implemented based upon the identification of off right-of-way trees that are deemed to pose a threat to the power line. These trees are most often identified by line inspectors on foot patrol of the line, or by aerial reconnaissance. Widening entails the removal of all trees within a specified expanded width that captures both the hazard trees and healthy trees. The selective removal of some of the trees can lead to the failure of other trees simply by leaving them exposed. The expanded width removes all real and potential threats as the zone is fully cleared. Projects are carried out in a similar fashion as distribution projects as they are linear; however, transmission widening locations tend to be more sporadic due to the focus on hazard trees rather than forested edge. Often, the areas removed are associated with a thin buffer of trees left after an adjacent woodland harvest. These trees are susceptible to blow-down even under normal wind conditions. Annual expenditure for right-of-way widening on transmission averages approximately $500,000 annually.
9.6 Challenges

While Nova Scotia Power manages a comprehensive integrated vegetation management program on both transmission and distribution, we recognize that not all available treatment options are considered acceptable by all customers. Mechanical operations and herbicide application programs are often regarded negatively by individual property owner, local residents associations, or local government officials. We must work with property owners to find mutually agreeable solutions.

9.6.1 Acceptance of Tree Trimming Clearance Standard

The clearance standard for clearing branches from being in close proximity to distribution feeder lines is 3 metres. This standard is often not met in situations that involve ornamental trees and in cottage areas. In the case of trees on municipal streets, standard clearances are often not achieved due to the fact that many trees would have to be completely removed to accommodate the clearances, given the amount of mature growth in close proximity to the line.
With individual property owners, Nova Scotia Power promotes a “right tree in the right place” program, offering compatible plants in exchange for the tree to be removed. This program has been successful in many areas.

In cottage areas there have been mixed outcomes with respect to line clearing. In some cases, residents associations welcome the clearing, as the potential for a forest fire is considered a larger threat. However, in other cases, cottage owners value their privacy and want as little clearing as deemed absolutely necessary.

In most municipalities and communities, the compromise between sustaining a healthy urban forest and maintaining power line clearances has been very challenging. Particularly in Halifax Regional Municipality, incompatible trees continue to be planted directly under or very near power lines.

9.6.2 Off Right-of-Way Tree Removal/Widening

Most often when trees are removed from off right-of-way, they have been deemed a threat based on the fact that they are unhealthy or prone to falling down. Trees of these characteristics are normally permitted for removal. However, it is often very difficult to acquire wider rights-of-way to mitigate the fall-in threat of many trees, or to top or remove healthy trees. Many property owners do not want to yield any greater portion of their land to accommodate utility service.

Although there is no provision for removing off right-of-way trees on distribution feeder lines, on transmission rights-of-way, easements exist that allow for such. For some no restriction is mentioned and more commonly, it is restricted to 5.2 metres.
9.6.3 **Rural Roadside Vegetation Management by TIR**

As most distribution power lines are constructed within highway easements, incompatible vegetation growing there is managed by Nova Scotia Power to prevent trees from growing up into power lines. Even though the Nova Scotia Department of Transportation and Infrastructure Renewal may brush mow the shoulder and the ditch, management of the space under the power lines happens by exception. Given that Nova Scotia Power often implements vegetation control of the full road right-of-way, including the shoulder and the ditch, a more cooperative scheduling effort would assist Nova Scotia Power in concentrating on that space most affecting the power line.

9.6.4 **Woodland Harvesting Adjacent to Power Lines**

It is not clear precisely how many woodland harvesting operations take place adjacent to power lines. It is, however, a common occurrence. Not knowing the locations of such operations places the electrical system at risk. Mature trees that have not been exposed to open conditions before are often very likely to blow down into the power lines, causing outages and structural damage impeding restoration efforts.

9.6.5 **69 kV Transmission and Cross Country Distribution Easements**

The 69 kV transmission system throughout the province is constructed on 20 metre wide rights-of-way. The 69 kV system is often used to feed electricity to rural centres and industry. When these lines are constructed through the forest, trees along the edge, which are often in excess of 20 metres tall, all have some susceptibility of falling onto the power lines. The only way to ensure that there is limited risk of such would be to double the width of the right-of-way and construct the line on a single pole structure.
Many cross-country distribution lines are constructed on rights-of-way that are only 3 metres wide each side of centre. This is not wide enough to keep tree branches from growing into the lines, or to prevent trees from falling onto lines during a storm.

9.6.6 Response to Tree-On-Line Calls During a Storm

During a storm, many customers call Nova Scotia Power to report a tree on a line. Crews are dispatched and, in some cases, find a tree on another utility wire other than Nova Scotia Power-owned power line. Customers have no way of knowing who owns which lines and often become very frustrated at the fact that Nova Scotia Power crews do not remove all trees. Face-to-face communication is often required to inform customers that there are different owners of wires on the system.

9.7 Learnings, Recommendations and Actions

1. To improve reliability in major storms it is essential to establish clear rights-of-way on power lines. NS Power requires greater public support for obtaining desired clearances from power lines.

   • We seek support from the Board, the Department of Transportation and Infrastructure Renewal, and other stakeholders for the creation and maintenance of tree-free rights-of-way, as set out in ANSI Standard A300, the generally accepted industry standard.

   • We urge the appropriate government authorities to prohibit the planting of trees that are in conflict with power lines.

   • We will seek permission to have prescriptive rights to remove hazard trees threatening power lines, as identified by qualified, trained vegetation management experts.
• We will work with woodland harvest operators and the Nova Scotia Department of Natural Resources to establish a process that would require forest harvests being conducted adjacent to power lines to be reported to a registry. This would ensure we are made aware of newly created hazard trees.
10.0 COMMUNICATING WITH OUR CUSTOMERS

10.1 Introduction

This section discusses our communications with our customers during our response to Post-Tropical Storm Arthur. It provides detail on our planning and staffing preparations, and describes outreach done to assist our critical care customers. It identifies areas where we had technology issues and other challenges, which frustrated customers, and recommends actions for improvement.

10.2 Customer Communications Planning and Staffing for Arthur

Nova Scotia Power followed the Customer Communications ESRP sub-plan during Post-Tropical Storm Arthur. Two Customer Coordinator Leads were in place in the EOC, two Customer Contact Centre Leads were on-site at the Customer Care Centre, and two Communication Leads were on site at the EOC. These positions were staffed 24 hours a day for the entire time the restoration event was a declared Level 3 event.

Nova Scotia Power’s customer communications plan during major events such as Arthur is focused on meeting customer expectations by delivering the best information possible through the event. The information is focused on answering three priority customer questions:

(1) Does Nova Scotia Power know my power is off?
(2) When will my power be restored?
(3) What caused my power to go out?

Every utility faces the challenge of meeting these expectations, but it is especially difficult in the face of large volumes of outages in short periods of time.
Our Customer Care Centre began planning on Wednesday, July 2, completing all staffing logistics and advanced training. Additional trained volunteers were added to the staffing complement and a plan was put into place to keep the centre open 24 hours a day. Figure 55 shows the number of Customer Service Representatives who were on-line each four-hour period of the event.

**Figure 55: Customer Service Representative Staffing Levels July 5-12 2014**

10.3 Record High Customer Interactions

Nova Scotia Power experienced record customer call volumes, website hits, and social media interaction during Post-Tropical Storm Arthur and the restoration work that took place over the days that followed.

In the wake of Arthur, we received more calls from our customers than ever before. Over the eight days of the storm restoration, we received 425,123 calls, as compared to the 418,664 calls we received over the 14-day restoration following Hurricane Juan in 2003. More than half of the Arthur calls came on the day of the storm itself – 216,669, as
compared to the 122,575 calls received on Day 1 of Juan. During the Arthur restoration, our Customer Service Representatives worked around the clock and had 38,702 one-on-one conversations with customers, compared to 48,328 following Hurricane Juan. On July 5, customers reported more than 23,600 outages, received in excess of 106,100 updates on power outages, and reported over 3,350 wires down or emergency situations.

Figure 56 details the call volumes for each day and compares Arthur’s totals to Hurricane Juan and the November 2004 ice storm.

Figure 56: Daily Call Volumes

Figure 57 details the hourly call volumes to Nova Scotia Power’s outage line for Saturday, July 5. During peak hours over 300 calls per minute were being taken by the HVCA system with customers either reporting an outage or receiving outage information.
All callers reaching our outage line were able to either report an outage or receive outage information. A number of situations were reported where customers could not get a dial tone or complete their call to Nova Scotia Power. Given the extreme high volumes of calls in a very compressed timeframe, Nova Scotia Power is aware of some issues experienced by local telephone service providers. Customers may have tried to call and there was no dial tone or they received a busy or fast-busy signal when attempting to dial Nova Scotia Power.

10.4 Critical Care Customers

Nova Scotia Power’s Critical Care Customer Communication Program was activated as part of our response to Arthur. This program is designed for customers whose health is directly dependent on electricity, such as persons requiring oxygen machines or dialysis. The communication program provides direct restoration information when unplanned power outages are expected to last longer than four hours. It also includes direct updates if the restoration time changes. To be included in the program a customer initiates an application with Nova Scotia Power along with a letter from their doctor or registered
medical service provider describing the type of home/critical care the customer is currently receiving that is dependent on electricity. We conduct regular campaigns reaching out to each critical care customer ensuring they still require the service and validating the contact information.

A total of 574 critical care customers, approximately 57 percent of customers in the program, lost power during Arthur. As Nova Scotia Power crews worked to restore power, our Customer Service team reached out directly to these customers, making a call to each one on July 5, though not every customer was reached. Automated and live calls continued through to July 7, updating critical care customers on estimated restoration times and the availability of comfort centres. Also on July 7, we provided these customers with a direct contact line and dedicated Nova Scotia Power staff for personalized updates.

10.4.1 Learnings, Recommendations and Action:

1. Nova Scotia Power is reviewing our contact methods with critical care customers to determine if there are additional methods to reach this customer group.

2. We have initiated discussions with government and non-government agencies that may be able to expand the services to this customer group, especially during larger events.

10.5 Customer Communications Issues

Three key communications issues caused customer dissatisfaction:

- Updates to estimated times to restore (ETRs)
- Inability to access our online outage map
• Disconnections and message scripting on our High Volume Call Answering (HVCA) system

10.5.1 Communications Issue #1 – Estimated Times to Restore (ETRs)

The goal of our ETR strategy is to provide the best possible information to customers throughout an outage restoration. This leaves us, as is the case for other utilities, with the difficult task of trying to provide reasonable ETRs during storms before all damage has been assessed. To deliver on this strategy, Nova Scotia Power focuses on trying to communicate to the great majority of customers who will have power restored during the first half of the event. For most customers, the power will be off because of damage to a transmission line or distribution feeder; when that type of damage is fixed, power is restored to a great number of customers at one time. Therefore, we target our early ETR communication to outage events where greater than 100 customers have lost power.

During restoration efforts after Arthur, our practice of first communicating ETRs applicable to outage events impacting 100 or more customers frustrated customers who were among smaller pockets of outages, or even individual outages. In many cases, they might have seen a restoration time applicable to their broader community, but it wasn’t applicable to their street, or their end of their street, or their individual address. ETRs for these smaller groups of customers are determined and communicated later in the outage event.

This ETR strategy has worked successfully in past storms, but with Arthur we had more than 3,400 outage events impacting fewer than 100 customers on each event. This was approximately 30,000 customers in total. This volume represents more than the total number of outage “events” in any one of the storms detailed in Figure 16 earlier.

In addition, ETRs were updated multiple times. Our initial ETRs were modeled based on the weather forecast. When the actual weather turned out to be significantly worse than
the forecast, it meant that the resultant damage to the electricity system was worse than our modeling predicted, and, thus, restorations would take longer. Secondly, because of the large number of transmission outages, ETRs were based on when the transmission lines were to be back on line. Once repaired, we were only then able to identify the extent of damage on distribution lines and the resultant additional impact on ETRs.

10.5.1.1 Synopsis of ETRs

On Saturday, July 5, the storm ETR strategy was implemented. While the storm was still active, the ETR strategy was aligned to match the advance storm prediction model. As stated earlier, this model was based on a number of variables including weather forecasts, the geographical location of the storm’s impact, and past storm experiences. This early ETR strategy determined that customers may experience a power outage until the end of day on Sunday. By 6:00 PM Saturday, the actual outages had exceeded the forecasted model and communication was updated to target having feeders back on by 11:30 PM Sunday, and all customers restored by 11:30 PM Monday.

After the storm had ended, and damage assessment was in its early stages, the ETRs for major feeders were updated to 11:30 PM Sunday. This information was based on the fact there were 10 transmission outages that were targeted to be restored by Sunday evening. These ETRs remained in place throughout Sunday as work on the transmission system continued. As the transmission system came on-line, it became evident that there were many distribution related events behind the transmission events and customers in those areas would have extended outages. At 11:00 PM Sunday, July 6, with this new information, ETRs on large outage events were updated to 11:30 PM Tuesday, with the last customer back on by 11:30 PM Wednesday. This meant approximately 50,000 customers had their ETR updated.

Throughout the day on Monday, more damage assessment information was being collected and the number and severity of smaller outages was much greater than
forecasted. Monday at 9:00 PM, the estimated time for restoration of the outage events with fewer than 100 customers was updated to 11:30 PM Friday. The ETRs on larger outage events remained unchanged.

On Thursday, the ETR strategy then focused on the outage events with fewer than 100 customers. New ETRs were determined and communicated by individual community to approximately 6,300 customers with an additional table that was added to the online outage map information page and Customer Service Representatives.

10.5.1.2 Learnings, Recommendations and Actions

1. Nova Scotia Power’s ETR strategy was implemented after the November 2004 ice storm, and has been successfully employed during numerous storms since then. However, practices in ETR strategies have been evolving among North American electric utilities that are exposed to severe weather. We recommend that Nova Scotia Power work with the UARB’s consultant (who has experience in this area) to further examine our ETR strategy, current best practices, and bring forward any changes to the ETR strategy that would be in the best interest of customers including any potential changes to the telephone systems.

10.5.2 Communications Issue #2 – Outage Map Capacity

Not all customers and stakeholders were able to access outage information on the outage map page of our website. The size of technology infrastructure in place to deliver outage information over the Internet could not process the peak volumes of requests. The outage map provides a graphical view of important power outage information, as well as text descriptions of outage locations, number of customers without power, and estimated times of restoration. The outage map is an important part of Nova Scotia Power’s outage communication strategy with provincial and local government leaders, customers, the media, and other interested parties.
On a typical day, the website delivers up to 90 percent of the page requests successfully. The 10 percent not successfully delivered usually stem from an incorrectly entered Internet address, or the type of device or browser is not supported and therefore no information can be delivered. On Saturday, July 5, the outage page server was overwhelmed by the high volumes of information requests. It reached a peak processing of approximately 50,000 successful pages per hour being delivered to people, at which time the processing capacity of the technology infrastructure reached 100 percent utilization and began degrading in service. This led more customers to call the outage line increasing its volume of calls. Figure 58 shows the requested vs successful pages delivered by day.

**Figure 58: Daily Web Traffic**

![Daily Web Traffic](image)

Figure 59 shows the outage map page views in 2014. The July 5 peak usage is over 60 percent greater than the previous peak reached during an outage in late March. During that event the outage map page experienced no capacity related issues.
Figure 59: Outage Map Page Views – 2014

![Outage Map Page Views 2014](image)

Figure 60 shows the hourly view of the outage map page successful requests to customers. After the outage map reached its peak capacity around 10:00 AM on Saturday there was an immediate degradation in service. This was the result of the computer reaching its maximum processing capability and having no more resources to respond to customer requests.

A power outage at Nova Scotia Power’s Data Centre (for more detail refer to Section 10.5.4) on July 5 resulted in a loss of data for the outage page to present. This lasted from approximately 11:30 AM until 1:30 PM, during which time outage information became unavailable to the public. The web technology was functioning during the Data Centre outage; however, it was delivering error message pages to customers. Figure 60 reflects the fact no pages with outage information were being delivered to customers during this period.
Corrective actions were taken Monday, July 7, (Day 3) to increase the volume of requests that the website could process. A switch was made during the day to remove the actual outage map and present the text based descriptions of the outage locations and ETRs. This allowed more requests to be successfully processed. In addition, the technology was being monitored and controlled manually, ensuring that all server functions were being utilized to the most benefit of customer requests.

Also regarding the outage map, the page includes the disclaimer: “This site shows information on outages affecting more than 100 customers.” Some customers have commented that because they don’t know whether their outage involves fewer than 100 customers, they’re left uninformed, or they are left with a lack of confidence in the information being provided.
Learnings, Recommendations and Actions

1. We are in the process of increasing the capacity of our website to handle a greater number of outage requests per hour, with a speed of delivery of five seconds or less.

Communications Issue #3 – High Volume Call Answering (HVCA) System
Disconnections and Message Scripting

As part of the Utility and Review Board’s review of the November 2004 ice storm, it was agreed by all parties, and the UARB approved, a capital work order to invest in a High Volume Call Answering (HVCA) system. This system was designed to assist customers in reporting an outage or an emergency, and in receiving power outage information, through automation during the high call volume periods. The HVCA system enables high numbers of customers to interact with Nova Scotia Power simultaneously.

The HVCA system also provides our customers with the option to speak with a Customer Service Representative. In cases where the number of customers wishing to speak with a Customer Service Representative exceeds the designed threshold, the HVCA system informs the customer of the high call volumes, asks the customer to call back later, and then disconnects the call. The system is designed this way to allow all customers to report outages and receive outage information during peak calling periods, and ensures that Customer Service Representatives are available for emergency situations. Due to the exceptional number of callers following Arthur – during peak hours, over 300 calls per minute – some customers could have been disconnected a number of times.

Figure 61 below details the number of times a customer was asked to call back during our response to Post-Tropical Storm Arthur. If customers called the customer service line instead of the outage line and pressed the prompt to report an outage, they too could have been asked to call back and then been disconnected.
Figure 61: Incidents where HVCA asked Customers to Call Back Later, then Disconnected

<table>
<thead>
<tr>
<th>Date</th>
<th>05-Jul</th>
<th>06-Jul</th>
<th>07-Jul</th>
<th>08-Jul</th>
<th>09-Jul</th>
<th>10-Jul</th>
<th>11-Jul</th>
<th>12-Jul</th>
</tr>
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<tr>
<td></td>
<td>24,424</td>
<td>2,255</td>
<td>7,104</td>
<td>2,213</td>
<td>46</td>
<td>11</td>
<td>7</td>
<td>0</td>
</tr>
</tbody>
</table>

Related to the issues around our ETR strategy, some customers who phoned our Outage Information Line found the messaging confusing. For example, a caller affected by one of the outages of fewer than 100 customers may have called and successfully reported their outage, either live or via self-service on our High Volume Call Answering (HVCA) system. If they called back later, they would have heard the ETR for a larger feeder event, not their smaller outage event. The larger feeder event would have been restored first and closed within the Outage Management System. If they called back, they would have heard the system message: “There are no widespread outages in your area.” Their outage would have still been on the Outage Management System, but because the ETR communication plan first speaks to outages impacting 100 customers or more, the customer might think we didn’t know they were still without power. In that case, the customer might then have tried to report their outage again.

As well, after we’ve restored power to a feeder, we initiate an automated outbound calling campaign to customers on the restored feeder to confirm whether their power is back on. The automated message states: “This is an automated callback from Nova Scotia Power. Our records indicate power has been restored to your area. If you are still
without power then press ‘1’ now.” In some cases, customers who were part of a smaller outage event embedded within a restored feeder found this message confusing or frustrating.

Also related to Nova Scotia Power’s phone system, we have a separate telephone number for power outages (1-877-428-6004), in addition to our regular Customer Service Line (1-800-428-6230). When customers phone either number, there is a designed capacity of 122 trunks to speak with a customer service representative. During large events like Arthur those trunks become fully utilized at peak intervals. On Monday, July 7, through Friday, July 11, Nova Scotia Power was open for regular business, which increased the number of people trying to reach a Customer Service Representative. This dynamic was a driver of why we established a separate power outage line.

In addition, an issue with our telecommunication’s supplier resulted in a reduced number of available phone lines to our Customer Care Centre from Monday July 7 until 1:00 AM on Wednesday July 9.

10.5.3.1 Learnings, Recommendations and Actions

1. We will build a customer communications plan to help better inform customers on outage restoration and communications during future large storm events.

2. We are updating the scripting and process flows for power outage customer communications, focused on customers impacted by outage events of fewer than 100 customers.

3. Please see recommendation #1 in section 10.5.1.2 for further improvements to customer communications as related to the ETR strategy.
10.5.4 Data Centre Outage

A power outage at Nova Scotia Power’s Data Centre on Saturday, July 5, caused our Outage Management System (OMS) to go down from approximately 11:30 AM until 1:30 PM. This resulted in updated outage information not being delivered to the power outage line High Volume Call Answer system, or the outage map on the website. Both of these situations frustrated customers and created multiple attempts to reach Nova Scotia Power for information.

As a result, service levels in the Customer Care Centre for July 5 were severely impacted by all these factors. Figure 62 shows the number of calls that were offered to the Customer Care Centre, the volume answered, and the number of callers who abandoned their call before being answered. Staffing levels are also indicated. The high level of abandoned calls at 7:00 AM and 8:00 AM corresponds to Arthur hitting Nova Scotia earlier than forecast. The spike in calls offered to agents at 12:00 noon correlates to the high volume of people not able to access the outage map on the website.
10.5.4.1 Cause of the Data Centre Outage

At approximately 11:30 AM Saturday, July 5, utility power from the street to our Data Centre was lost due to the storm. The back-up generators both engaged as designed, supplying the full Data Centre load. Shortly after the generators started, a breaker tripped that serviced auxiliary load associated with generator “B”. One of the devices served on the auxiliary load were the fans that cooled the room for generator “B”. Without the fans in service, the generator became overheated and tripped off. That left generator “A” serving over 90 percent of Nova Scotia Power’s IT assets. An investigation found an improper setting on a relay was the root cause of the auxiliary load breaker trip and has since been corrected and tested.
Nova Scotia Power was in the final stages of completing the Data Centre upgrade project, which is replacing end-of-life electro-mechanical equipment and implementing redundant power and cooling systems. One of the final stages of this project was to transfer the remaining IT servers that were being powered through the older electrical power distribution units (PDU). This PDU is to be decommissioned as part of the upgrade project. One of the applications still remaining on the server powered by the old PDU was our Outage Management System (OMS). It has been on that same power supply since it went into service and was scheduled to be moved to the new power supply infrastructure within the month. As one of most complex applications, it was scheduled for the summer, in the later part of the project, to reduce the risk when it is moved.

The loss of OMS meant that there were no new power outage events being fed to the High Volume Call Answering (HVCA) system, or the outage map on the website for approximately two hours. The HVCA continued to communicate the most recent information in the system, but no new information was being received. For the outage map, without OMS there was no information to present to customers, and therefore an error message was delivered.

Power was restored from the street approximately 20 minutes after the PDU lost power supply, and the servers began powering up. The OMS was then restarted and following regular restart procedures was back in regular production mode at approximately 1:30 PM.

We perform regular maintenance on the electrical back-up system for the Data Centre on a monthly basis. This includes starting up the generators. This maintenance had been completed successfully throughout 2014. The maintenance program also includes an annual electrical back-up system test at full load. This was completed successfully in March on both generators. A separate test was successfully completed in July, following Post-Tropical Storm Arthur on both generators at building load to validate the corrective action taken on the breaker.
11.0 OUTAGE COMMUNICATION TECHNOLOGY OVERVIEW

11.1 Introduction

This section details our outage communication technology.

11.2 Early days of HVCA and OMS

In June of 1999, Nova Scotia Power introduced a new power outage phone number for customers and an elementary High Volume Call Answering (HVCA) system. The dedicated 1-877-428-6004 telephone number provided direct access to NS Power’s power interruption reporting process. The HVCA system provided increased capacity for large volumes of customers to obtain outage information and exit the system, thus making capacity into our call centre available to other callers wishing to report an outage or emergency.

In April of 2002, we introduced our Outage Management System (OMS). The OMS system provides a province-wide view of system outages and a single place to manage the information that customers are seeking (e.g. restoration times). The integration of OMS and HVCA allowed current information on the locations of power outages, restoration times, and the cause to be communicated to many customers at the same time.

11.3 Current HVCA System

Following significant outage events in 2003 and 2004 and subsequent reviews, we set out to improve our outage call handling capabilities. The systems in service at that time had capacity restrictions, functionality gaps and were decreasing in effectiveness due to cell phone proliferation, local number portability and increasing customer expectations. In 2008, we made a significant improvement in outage call handling and outage communications for customers. With UARB approval, we invested $2.2 million in a
HVCA replacement project to improve outage communications. Nova Scotia Power entered into an agreement with Twenty First Century Communications (TFCC) for the provision of outage call handling services. TFCC is a leader in mass call event management and provides outage call handling services to many of North America’s largest utilities, including the majority of those in hurricane prone geographies.

As part of the HVCA replacement project, we conducted focus groups and customer surveys to better understand customer requirements and gaps in the existing solution. Experts in system design were engaged to assist with call flow design and customer usability testing. Service providers were engaged to rigorously test the new HVCA system to ensure it could deliver under the most extreme calling conditions.

In December 2008, our new HVCA solution went live to customers following rigorous stress testing. The HVCA replacement project implemented industry leading, best-in-class solutions, for high volume call answering and eliminated many of the previous issues by ensuring:

- No busy signals. All customer calls are answered – subject to the constraints of the Public Switched Telephone Network (PSTN).
- Customers are able to report an outage in the automated system.
- Emergency calls (e.g. wires down calls) are identified in main menu and transferred to our Customer Care Centre with priority.
- Information on outages is specific to the customer’s location.
Post-Tropical Storm Arthur – Review of NS Power’s Storm Response

- All customers have the option to talk to a Customer Service Representative (CSR), although this does not significantly increase the percentage of customers who get to speak with a CSR.

- Fewer “polite disconnects,” while ensuring the customer is still able to log a trouble ticket.

- Ability for customers to request information and report outages for multiple locations.

UARB consultants monitored and reviewed our new HVCA implementation and concluded in their 2009 report to the UARB:

…NSPI has replaced its old HVCA outage communications system with a new, customer-designed, stress-tested, system capable of consistently handling 40,000 callers per hour. NSPI has developed and implemented a near-real time interactive (2-way) high volume outage reporting and messaging service so that all callers can report outages and hear information about their location (feeder-based).

NSPI has also improved emergency call handling through the implementation of the new HVCA. In the past, emergency calls were getting blocked by customers waiting to report outages, hear more information about restoration status, or to address other calling needs. The old HVCA system did not give emergency calls any priority over other callers. Emergency “wire-down” calls can now be easily routed to the first available representative to be handled expeditiously.

Overall, NSPI has significantly improved the level of service provided to customers during a large storm.\(^3\)

In conjunction with the launch of the new HVCA solution, we also launched our outage map, making outage information accessible online for the first time. Initially of interest mainly to media, the proliferation of smartphones has made the outage map a source of outage information for many customers.

11.4 Outage Communication Technology

Nova Scotia Power uses a number of technology systems to enable the delivery of power outage information to customers and other stakeholders. The integration of these systems is configured to deliver the best possible information to customers quickly and make it assessable. The various components are described below, followed by a schematic and description of Nova Scotia Power’s integrated outage communication technology.

11.5 Supervisory Control and Data Acquisition (SCADA)

This is the system which Nova Scotia Power uses to monitor and control the transmission system and, to a limited extent, the distribution system. It is composed of a large number of Remote Terminal Units (RTUs) that provide the status of protective devices, meter readings, loading, etc. In conjunction with computer hardware and software in the Ragged Lake Control Centre, SCADA enables Nova Scotia Power System Operators to control devices throughout the province. It provides information on breaker and recloser status directly to the OMS.

11.6 Customer Information System (CIS)

CIS is the repository of Nova Scotia Power’s information on our customers. On a nightly basis, current customer information is updated from CIS to provide an accurate customer-to-telephone number-to-location match for outage management. This information is transferred to the Interactive Voice Response Message Centre (IMC) and used by the High Volume Call Answer (HVCA) system to identify the customer who is calling and to quickly deliver outage status information and to enable the customer to report an outage.
11.7 Geographic Information System (GIS)

The Geographic Information System is a database that holds customer location information and the distribution electrical model used by OMS. The data is stored in a spatial format allowing OMS to have an accurate understanding of what customers are served by which components of the electrical grid.

11.8 Work Management System (WMS)

WMS is an application used to plan and manage distribution field work. OMS can generate work to line crews for follow-up after restoration activities.

11.9 High Volume Call Answer (HVCA)

Nova Scotia Power provides a High Volume Call Answer system for customers to call to report an outage, or emergency, and to receive updated outage information. The HVCA is scaled to work in all sizes of outage events. It can handle outages when only one customer has to report an outage or when large volumes (up to 40,000) customers simultaneously want to report an outage or receive power outage information. All customers who dial Nova Scotia Power's dedicated outage number (1-877-428-6004 or 428-6004 in Halifax) are first connected to the HVCA system. The HVCA system offers menu driven options for customers to:

1. Report outages and receive outage updates: Outage information (location, cause and estimated time of restore) is provided based on matching the calling line ID or telephone number the caller enters into the system, to Nova Scotia Power’s outage information. If there are no outages greater than 100 customers matching that location, then customers will hear the message: “There are no widespread outages reported in your area.” All customers can report their outage using the automated system. An outage ticket is generated and sent to OMS for processing.
2. Report wires down or other emergencies. All callers reporting a "wires down" or emergencies are transferred to Nova Scotia Power’s Customer Care Centre with high priority to speak directly to a Customer Service Representative (CSR). The CSR will create a high priority ticket in OMS.

3. Report bright, dim, flickering lights or other power problems. All callers reporting bright, dim, flickering lights or other power problems are transferred to our Customer Care Centre to speak directly to a Customer Service Representative.

The HVCA system ensures all customers calling the dedicated outage line can receive outage information and report an outage or emergency. In extreme call volumes, some callers trying to speak with a CSR may be asked to call back.

11.10 Interactive Voice Response Message Centre (IMC)

The IMC system receives summary outage information from OMS and enables that information to be distributed to the HVCA system and the external website via the outage map. The IMC system also enables enhanced ETR management capabilities to manage ETRs at more macro level than OMS can provide.

11.11 nspower.ca

Our website provides a one-stop portal for power outage related information under the title of “Outage Centre.” The section includes our outage map, which details where the power is out, the cause of the outage, number of customers impacted, and the estimated time of restoration.
11.12 General Outage Information Flow and the Outage Management System

Notification of a power outage is received by the Outage Management System (OMS) either through automatic notification from the Supervisory Control and Data Acquisition (SCADA) system, customers reporting their power is out, or information from our crews or emergency services. This information is all input to determine the probable location
and extent of a power outage. The analysis engine of OMS examines the available information to electrically identify a common up-stream interrupting device that is the most probable cause of the outage. OMS then generates an outage event and notifies a dispatcher. If the outage has been identified as an emergency situation then it is flagged as priority and is placed at the top of the dispatch queue. Once the outage event has been created, it is automatically updated in the telephone systems and website for customer and stakeholder communication. The information to be updated includes the expected location of the outage, when the power was known to be interrupted, and the estimated time of restoration (ETR). Once crews are on site, have assessed the damage and have a plan to safely restore power, this information is updated in OMS by the crews calling the dispatcher. Once updated in OMS, the information being communicated to customers and stakeholders is automatically updated.
12.0 RELIABILITY PERFORMANCE METRICS

12.1 Introduction

This section discusses Nova Scotia Power’s Reliability Investment Strategy and provides statistical data demonstrating that the strategy has improved service reliability for our customers.

12.2 Reliability Investment Strategy & Results

Nova Scotia Power’s multi-year Reliability Investment Strategy has resulted in a step-change towards improved reliability for our customers. Our reliability investments have produced some of our best reliability performance metrics in recent years, 2011 to 2013 in particular. In 2012, Nova Scotia Power had the best reliability in Atlantic Canada as compared to the average of the other Atlantic utilities. Nova Scotia Power also experienced its best Customer Average Interruption Duration Index (CAIDI) and System Average Interruption Frequency Index (SAIFI) ever in 2012.

We are outperforming the average of other Atlantic Canadian utilities on System Average Interruption Frequency Index (SAIFI) and System Average Interruption Duration Index (SAIDI), as shown in Figure 64, Figure 65 and Figure 66.

Figure 64: Reliability Performance Metrics 2011-2013

<table>
<thead>
<tr>
<th></th>
<th>2011</th>
<th>2012</th>
<th>2013</th>
</tr>
</thead>
<tbody>
<tr>
<td><strong>SAIFI</strong></td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>Atlantic Utilities</td>
<td>3.75</td>
<td>2.87</td>
<td>3.85</td>
</tr>
<tr>
<td>Nova Scotia Power</td>
<td>3.73</td>
<td>1.86</td>
<td>2.51</td>
</tr>
<tr>
<td><strong>SAIDI</strong></td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>Atlantic Utilities</td>
<td>8.80</td>
<td>5.45</td>
<td>13.04</td>
</tr>
<tr>
<td>Nova Scotia Power</td>
<td>7.90</td>
<td>3.06</td>
<td>6.24</td>
</tr>
</tbody>
</table>
Figure 65: Historical Outage Frequency 2011-2013

![Historical Outage Frequency Chart]

Figure 66: Historical Outage Duration 2011-2013

![Historical Outage Duration Chart]
As can be seen in Figure 67 and Figure 68, customers are experiencing fewer interruptions and shorter total duration of outages, and results for 2013 metrics are similar to 2012. The following charts break out the contribution that storms have made to the annual SAIFI and SAIDI since 2010. The storms have been broken out into Non-Major Storm Days, Major Storm Days. Note that 2012 did not have any Non-Major or Major Storm days. A specific day is classified a Major Storm if its total Customer Hours of Interruptions exceeds a calculated threshold. This threshold is calculated using IEEE Standard 1366-2003. Based on weather-normalized data, the system reliability continues to improve.

**Figure 67: NS Power Annual SAIFI 2010-2013**
Figure 68: NS Power Annual SAIDI 2010-2013

Figure 69 and Figure 70 demonstrate the number of outage events and total customers affected from loss of supply due to transmission line or substation events has improved in recent years. Notwithstanding 2013 experiencing higher or equal supply outage events and supply customer interruptions, compared to 2009 to 2012, they are still significantly lower than those experienced in 2007 and 2008.
Figure 69: Annual Unplanned Loss of Supply Outage Events 2007-2013

Figure 70: Annual Unplanned Loss of Supply Customer Interruptions 2007-2013

Figure 71 and Figure 72 demonstrate reliability gains realized through upgrades and replacements of targeted distribution equipment. There has been a steady improvement in both the customer interruptions and customer hours of interruption due to deteriorated equipment.
In 2010, Hurricane Earl had a significant effect on customer interruptions and hours due to trees. However, Figure 73 and Figure 74 demonstrate both customer interruptions and hours due to tree contacts are trending towards improved customer reliability overall.
Nova Scotia Power continually monitors outages and performance of transmission, substation and distribution assets, and future investments will continue at an appropriate level to ensure affordable and reliable service.
13.0 EXTERNAL BENCHMARKS

This section presents a comparison of Nova Scotia Power’s restoration performance after post-Tropical Storm Arthur using external benchmarks. Nova Scotia Power engaged Davies Consulting, LLC, to assist with this analysis, both to support the post-event critique process specified in the Nova Scotia Power Emergency Services Restoration Plan (ESRP) and to respond to the directive from the NSUARB. Davies Consulting, a leading consultancy to electric and gas utilities within North America, has conducted this type of analysis in response to numerous public utility board inquiries after major storms. Please refer to Appendix 13.01 for additional information about the Firm’s experience.

Davies Consulting compared Nova Scotia Power’s experience to other restorations after similar weather events using information from its confidential and proprietary Storm Response Benchmark Database. Initiated in 2003, the database currently contains key statistics from approximately 98 major event responses by 43 electric utilities across North America. Updates to the database occur frequently and current data reflect responses to a number of major storms through the end of July 2014.

13.1 Overview of the NS Power Benchmarking Analysis

Benchmarking is a valuable tool in evaluating how a utility’s performance compares to that of other utilities in similar circumstances. This kind of analysis is not intended to provide a precise, scientifically-validated evaluation; rather it provides a “relative” or directional view of the performance across the events selected for comparison.

It is important to interpret the results of a benchmark effort with an understanding of the underlying differences that may cause variances in utility performance. For example, one should recognize that each weather event is unique – with different wind speeds, levels of precipitation, paths, accuracy of forecasts, and specific geographic impact. Additionally, each utility has a unique set of operating and system design characteristics that have
evolved over the years. These may necessitate the use of restoration strategies that differ from those of other utilities responding to similar events.

Also, it is important to recognize that the information contained in the storm benchmark database is “self-reported” by each utility and that individual companies may calculate certain kinds of data differently. For example, some utilities calculate the completion of a restoration when 99 percent of the customers are restored, while others use 100 percent. Similarly, some companies start counting restoration days after the weather system has cleared the service territory and it is safe to begin restoration work, while others start the count as soon as the first outages related to a storm occur. The eight-day restoration by Nova Scotia Power after Arthur includes both the day of the storm (July 5) and the last day of restoration when all 100 percent of the customers who lost power as a result of the storm were restored, representing a conservative representation of the restoration duration.

The benchmark analysis of Nova Scotia Power’s performance includes 32 other storm restorations, across the following types of events:

**Figure 75: Storm Events Included in NS Power Benchmarking Analysis**

<table>
<thead>
<tr>
<th>Type of Event</th>
<th>No. of Events</th>
</tr>
</thead>
<tbody>
<tr>
<td>Hurricane Category 1</td>
<td>17</td>
</tr>
<tr>
<td>Tropical Storms</td>
<td>8</td>
</tr>
<tr>
<td>Thunderstorm</td>
<td>4</td>
</tr>
<tr>
<td>Wind Storm</td>
<td>3</td>
</tr>
<tr>
<td>Total</td>
<td>32</td>
</tr>
</tbody>
</table>

In addition to those events and Nova Scotia Power’s response to post-Tropical Storm Arthur, the analysis includes two other Nova Scotia Power restorations: Hurricane Juan
in 2003 and Hurricane Earl in 2010. All of the Nova Scotia Power events are highlighted and labeled in the analysis. The key statistics related to the three Nova Scotia Power events are shown in Figure 76:

**Figure 76: NS Power Storm Response Benchmarking Statistics**

<table>
<thead>
<tr>
<th>Storms</th>
<th>Restoration Duration (days)</th>
<th>Customers Out at Peak (000s)</th>
<th>Total Customers Out (000s)</th>
<th>Poles Out</th>
<th>Total Line Resources Deployed</th>
</tr>
</thead>
<tbody>
<tr>
<td>Arthur (2014)</td>
<td>8</td>
<td>137</td>
<td>245</td>
<td>217</td>
<td>266</td>
</tr>
<tr>
<td>Earl (2010)</td>
<td>3.5</td>
<td>186</td>
<td>220</td>
<td>46</td>
<td>300</td>
</tr>
<tr>
<td>Juan (2003)</td>
<td>14</td>
<td>221</td>
<td>300</td>
<td>761</td>
<td>342</td>
</tr>
</tbody>
</table>

13.2 **Benchmarking Results**

The comparison to similar events in the Davies Consulting Storm Response Benchmark Database indicates that the overall duration of Nova Scotia Power’s restoration of outages caused by post-Tropical Storm Arthur was in line with the performance of other utilities after similar events. This performance was notable considering Nova Scotia Power experienced a relatively higher amount of infrastructure damage as a result of the storm, as indicated by the Poles Replaced per Thousand Customers Out at Peak metric shown in Figure 78.

Figure 77 shows the performance of Nova Scotia Power during the response to Arthur, relative to the comparators, in terms of length of restoration related to customers out a peak. When compared to other similar events, Nova Scotia Power’s overall performance during post-Tropical Storm Arthur was within the industry norm.
An important variable in assessing restoration effectiveness is the level of system damage caused by an event. For benchmarking purposes, a proxy for storm-related damage is the number of poles that had to be replaced. This is a reasonable substitute to use because the level of effort to replace a pole generally requires an equivalent level of effort across different companies. Also, the number of poles down captures both the intensity of the storm and, depending on the distribution of poles, the general spread of the storm across the service territory.
Figure 78\textsuperscript{4}, indicates the relative damage sustained by Nova Scotia Power from Arthur as compared to other similar events in the group of comparators. A restoration with a value of one means that there was one pole replaced per thousand customers out at peak.

Nova Scotia Power replaced approximately 1.6 poles for every thousand customers during Arthur. In terms of the relative level of system damage, Arthur was in the top one-third of all events where data was available among the comparators (information for 28 restorations was available to calculate this ratio). Notably, Nova Scotia Power replaced approximately half the number of poles per thousand customers out at peak during Arthur than were replaced during Hurricane Juan.

\textsuperscript{4} Some companies did not make available all information related to the restoration for each of the 32 events, so this benchmark analysis includes fewer than 32 comparators.
Figure 78: Poles Replaced per Thousand Customers Out at Peak

Source: Davies Consulting Storm Benchmark Database, 2014
14.0 FINANCIAL IMPACTS OF POST-TROPICAL STORM ARTHUR

14.1 Introduction

This section provides accounting of the costs Nova Scotia Power incurred in our response to Post-Tropical Storm Arthur. It also discusses the value for customers in using contracted Power Line Technicians to supplement our own crews during storm response.

14.2 Overview

Restoration costs for Post-Tropical Storm Arthur are higher than any storm since Hurricane Juan. It is estimated that the total restoration effort will cost approximately $8.4 million: $3.9 million in capital expenses and $4.5 million in operating, maintenance and general (OM&G) costs.

As of the end of July, Nova Scotia Power has incurred $10.5 million in OM&G expenses year-to-date for storm recovery for Arthur and other storms. The full year amount for storm recovery included in 2014 electricity rates is $10.5 million.

We are committed to providing safe, reliable, cost effective electricity to customers. Nova Scotia Power has always optimized the staffing complement in the Transmission and Distribution (T&D) area, among others, to meet normal workloads. We use contractor personnel to augment our workforce for construction work and storm response. A thorough review has determined that using contractors to balance workload provides the best value and most affordable option for our customers.
14.3 **Future Impacts and Affordability**

Post-Tropical Storm Arthur will not impact customer costs in 2014, nor will it impact rates in the future. Storm restoration costs were funded in the 2013-14 General Rate Application (GRA) based on historical trends that included the possibility of costly large storms like Arthur. We expect storm costs over the two-year GRA period to approximate what was provided in rates.

14.4 **Supplementing NS Power PLTs with Contractors**

Power Line Technicians (PLTs) are key front-line personnel in storm response. These highly qualified tradespeople safely repair damage to downed power lines, broken poles, blown transformers and other equipment during storm restoration. Nova Scotia Power has put significant effort, over the past number of years, into assessing the optimal number of PLTs to meet service levels and the demands of construction timelines. We have determined that augmenting our internal workforce with contractors, as needed, is the best way to provide the most reliable service to customers at the lowest cost.

We employ contractors to manage peaks in demand for PLT labour, not only for construction and service, but also for storm restoration. Our primary vendor for flexible PLT labour, Emera Utility Services (EUS), was selected through a rigorous and reviewed RFP process, and we also engage PLTs from New Brunswick, New England, and occasionally elsewhere, for storm response. Hiring these contractors during a storm is a much more cost-effective way to ensure that an adequate number of PLTs is available for a safe, timely and efficient restoration of power than would be the case if Nova Scotia Power hired those same PLTs as a part of the permanent internal workforce.
14.5 Cost of Post-Tropical Storm Arthur

The initial cost estimate for Post-Tropical Storm Arthur is $8.4 million as shown in Figure 79. Generally speaking, during the restoration effort for Arthur, PLTs and other field workers spent approximately 40 percent of their time working on capital jobs, and 60 percent on OM&G jobs.

Figure 79: Initial Cost Estimate for Post-Tropical Storm Arthur ($M)

<table>
<thead>
<tr>
<th></th>
<th>OM&amp;G</th>
<th>Capital</th>
<th>Total</th>
</tr>
</thead>
<tbody>
<tr>
<td>Total NS Power Labour</td>
<td>1.7</td>
<td>1.0</td>
<td>2.7</td>
</tr>
<tr>
<td>PLT Services</td>
<td>1.9</td>
<td>1.4</td>
<td>3.3</td>
</tr>
<tr>
<td>Vegetation Management</td>
<td>0.4</td>
<td>0.2</td>
<td>0.6</td>
</tr>
<tr>
<td>Flagging &amp; Backhoe</td>
<td>0.1</td>
<td>0.5</td>
<td>0.6</td>
</tr>
<tr>
<td>Total Contractor Labour</td>
<td>2.4</td>
<td>2.1</td>
<td>4.5</td>
</tr>
<tr>
<td>Materials</td>
<td>0.1</td>
<td>0.6</td>
<td>0.7</td>
</tr>
<tr>
<td>Travel, Meals &amp;</td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>Incidentals</td>
<td>0.2</td>
<td>0.2</td>
<td>0.4</td>
</tr>
<tr>
<td>Other</td>
<td>0.1</td>
<td>-</td>
<td>0.1</td>
</tr>
<tr>
<td>Total Non-Labour</td>
<td>0.4</td>
<td>0.8</td>
<td>1.2</td>
</tr>
<tr>
<td><strong>Total Storm</strong></td>
<td><strong>4.5</strong></td>
<td><strong>3.9</strong></td>
<td><strong>8.4</strong></td>
</tr>
</tbody>
</table>

Of particular note are the contractor costs as compared to the internal direct labour costs, which include Nova Scotia Power PLTs, and other staff such as electricians and meter readers. External contractors are more costly compared to internal labour when viewed strictly on an hour-by-hour basis. This is mostly because the hourly contractor cost includes all costs associated with providing that resource, whereas internal labour is the labour cost of the employee. The contractor rate is recovering costs for such items as the
capital and operating costs of vehicles, training, sick and vacation days, supervisory and administrative burden, as well as a profit margin.

Nova Scotia Power has pre-agreed hourly storm response rates with EUS, for all contractors from New Brunswick, and a pre-negotiated Mutual Assistance Agreement with contractors from New England.

14.5.1 Arthur Compared to Other Major Storms

Current estimates indicate that the restoration from Hurricane Arthur will cost approximately $8.4 million. By comparison, Hurricane Juan cost $14.6 million (2003 dollars), and Hurricane Earl cost $7.3 million (2010 dollars). Please refer to Figure 80.

Figure 80: Cost Comparison ($M)

<table>
<thead>
<tr>
<th></th>
<th>Arthur 2014</th>
<th>Juan 2003</th>
<th>Earl 2010</th>
</tr>
</thead>
<tbody>
<tr>
<td>Operating Costs</td>
<td>4.5</td>
<td>6.0</td>
<td>6.5</td>
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<tr>
<td>Capital Costs</td>
<td>3.9</td>
<td>8.6</td>
<td>0.8</td>
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<tr>
<td><strong>Total</strong></td>
<td><strong>8.4</strong></td>
<td><strong>14.6</strong></td>
<td><strong>7.3</strong></td>
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</table>
15.0 COMMUNICATIONS AND PUBLIC AFFAIRS

15.1 Introduction

This section details our public communications activities before, during and after Post-Tropical Storm Arthur. It describes the Communications and Public Affairs team’s role in providing timely, relevant and consistent messaging to a variety of stakeholders, including the public, media, employees, government officials. It also discusses a growing expectation for customer service through social media platforms.

15.2 Communicating with One Voice

As per the ESRP communications sub plan, Nova Scotia Power executed on a media communications, stakeholder and social media plan to provide the public with timely, relevant information in the lead up to Post-Tropical Storm Arthur, during the storm, and through the restoration work that followed.

As during regular business days, the Communications and Public Affairs team followed a “one voice” approach, ensuring that messaging and information was consistent across all platforms to all audiences, including customers, media, employees, elected officials, and other stakeholders. As per the ESRP, while the Emergency Operations Centre was activated Saturday, July 5, to Monday, July 7, this one voice approach was managed by the Corporate Communications Lead, who attended the EOC and gathered information to craft messages that were approved by the Storm Lead. Once approved, the Corporate Communications Lead provided messaging to the Communications and Public Affairs Team (headquartered at Nova Scotia Power’s Lower Water Street offices) for use in media interviews, social media posts, and email updates to internal and external stakeholders. Messages were shared with the EOC Customer Communications Lead.
The Corporate Communications Lead updated messaging, as events warranted, throughout the EOC activation period. After the EOC deactivated, the Communications and Public Affairs Team continued to follow a one voice approach through to the completion of outage restoration.

15.3 Public Communications in Advance of Arthur

Our public messaging on Post-Tropical Storm Arthur began on Thursday, July 3, when we issued a news release reminding customers that a storm was approaching. The release included a link to the outage preparedness and electrical safety tips sections of our website. It also provided customers with a link to our outage map and the phone number for the Customer Care Centre outage line. We also posted the same messages on Twitter.

On the two days before the storm we tweeted Arthur-specific messages twice. On July 3, we posted our news release. It was retweeted 12 times. On July 4, we tweeted a link to our website, which provided tips to our customers to help them prepare for outages. It was retweeted six times.

Nova Scotia Power also emailed all Nova Scotia MLAs and town councillors with the same messaging, and provided contact information for the Government Relations contact on the Communications and Public Affairs team, should they have any direct questions.

15.4 Public Communications during Arthur Response

Throughout the storm, the Communications and Public Affairs team kept media, government and other stakeholders informed of progress of restoration and changes to ETRs. Beginning on Saturday, July 5, Nova Scotia Power communicated with government officials and key staff almost daily to provide updates on storm damage and progress of restorations. Communications also took place with government Opposition

On Saturday, the Communications and Public Affairs team responded to 27 media inquiries related to Arthur. This was significantly more than past storms, and was potentially related to the outage map problems detailed in Section 10.5.2. Throughout Saturday, we continued to Facebook and tweet safety tips and provide information about ETRs as they were posted. We also provided messaging asking customers to contact the outage line to report outages or access ETR information, and apologizing for the limitations to the outage map. No calls were received on Saturday by our Government Relations lead from MLAs or councillors seeking information.

On Sunday, July 6 (Day 2), the number of media inquiries reduced significantly. Media outlets are commonly at low staffing levels on Sundays. Thirteen interviews were provided on request. We did an additional seven Facebook postings, 15 tweets, and 69 retweets. Because of the challenges with the outage map, ETRs were being communicated as quickly as possible by region on Twitter and Facebook. The challenges with the outage map and the phone system resulted in requests by customers on Facebook for specific ETR information. As much as possible, Communications staff worked to connect customers with the Customer Service team by asking customers to provide contact information and then relaying this to Customer Service so they could contact customers directly. Communications staff also provided ETR information to customers as it was available.

On Monday, July 7, because of the high volume of media requests and customer contacts through social media, extra resources were brought in to assist the Communications and Public Affairs team. On Monday, 25 media interviews were delivered by one of two designated spokespeople, along with eight Facebook posts, 18 tweets and 204 retweets. This continued throughout the week until full restoration was achieved.
On Wednesday, July 9, a media advisory was issued providing a media availability for Bob Hanf, President and CEO of NS Power, in Port Williams, in one of the harder hits areas of the province. Mr. Hanf visited with crews, provided a brief statement to reporters, and answered questions from media. Four media outlets were present and CBC broadcast the entire event live online. A news release was issued and Mr. Hanf thanked employees for their hard work throughout the storm. Please refer to Appendix 10.1.

On Thursday, July 10, the Communications and Public Affairs team worked with various other departments in order to post on the website and regularly update ETRs for areas where smaller pockets of outages remained. This was the first time Nova Scotia Power provided this type of granular information on its website.

We continued to communicate timely, relevant information for customer through media interviews, Facebook and Twitter until the final restorations were completed on Saturday, July 12.

15.5 Social Media Messaging

We generally updated Facebook and Twitter with the same messaging. Messages and themes relayed included:

- Providing the outage line phone number for customers to report an outage, downed power line, or to find out estimated restoration times.

- At times, providing our customers a link to the outage map.

- Giving our customers safety tips, along with direction to avoid downed power lines and encouraging them to report.
• Photos from the field that showed the extent of the damage to our equipment, and fallen trees.

• A diagram and explanation of what a broken meter mast looks like, and how customers must have it fixed before Nova Scotia Power can restore power.

• Updates on the number of restorations and crews in the field.

• At points in time, we publically posted on our Facebook wall and Twitter estimated restoration times for certain regions (Saturday evening).

• Reminding customers that crews were working as safely as possible to quickly restore power.

On Facebook, we had 143 private message interactions with customers. Our Communications and Public Affairs team often liaised with Customer Service to find out ETRs for our customers, and to report downed lines and trees on their behalf. Throughout the storm, there were a total of 215,000 views of the Nova Scotia Power Twitter page, and the height of our peak reach on Facebook occurred on July 7, with one post reaching 16,000 people.

On Thursday, July 3, we had 600 Facebook friends and 9,900 Twitter followers. Our social media following grew throughout the duration of the storm. From July 5 to 14 we added 813 Facebook friends. On Twitter, between July 5 and 12, we gained 1,402 new followers.
15.6 Public Communications Statistics

Figure 81 provides day-by-day statistics on public communications efforts.

**Figure 81: Day by Day Statistics**

<table>
<thead>
<tr>
<th>Date</th>
<th>July 5</th>
<th>July 6</th>
<th>July 7</th>
<th>July 8</th>
<th>July 9</th>
<th>July 10</th>
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<th>July 13</th>
<th>July 14</th>
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<td>22</td>
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<td>3</td>
<td>10</td>
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</tr>
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<td>7</td>
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<td>1</td>
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<td>0</td>
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<tr>
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<td>18</td>
<td>11</td>
<td>2</td>
<td>7</td>
<td>4</td>
<td>3</td>
<td>1</td>
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<td>33</td>
<td>27</td>
<td>14</td>
<td>19</td>
<td>10</td>
<td>NA</td>
<td>753</td>
<td></td>
</tr>
<tr>
<td>Tomorrow’s Power</td>
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<td>1</td>
<td>2</td>
<td>6</td>
<td>4</td>
<td>6</td>
<td>1</td>
<td>1</td>
<td>0</td>
<td>0</td>
<td>23</td>
</tr>
</tbody>
</table>

15.7 Government Officials and UARB

Throughout the event, Nova Scotia Power stayed in regular contact with government officials in the Department of Energy, the Premier’s office, opposition leaders, and MLAs. A total of 133 calls and emails were logged from elected officials by the Resolve Team and the Government Relations lead. On Thursday and Friday, July 10 and 11, because of fewer media stories and general coverage, Nova Scotia Power provided daily updates to all elected officials with total restorations completed, ETRs by region, and information on the extent of the damage in some areas. Updates were also provided to government and opposition members on the final two days of restoration, July 11 and 12.

The UARB was provided daily updates starting on Saturday, July 5, and continuing throughout the restoration efforts. These updates provided information on number of outages, extent of damage, number of crews working to restore power and updated ETRs.

15.8 Learnings, Recommendations and Actions

1. Customer interaction on social media increased significantly throughout this event over what we have experienced in previous storms. We will develop a social
media customer service plan to better meet this new customer expectation. This could potentially reduce the number of calls into the Customer Care Centre by providing customers with another option for communicating with Customer Service and receiving responses specific to their needs.
16.0 COORDINATION WITH OTHER AGENCIES

16.1 Introduction

This section describes our interactions with provincial and municipal emergency management offices and the provincial Department of Transportation and Infrastructure Renewal in preparation for, and response to, Post-Tropical Storm Arthur.

16.2 General Coordination Procedures

In all outage events, restoration priorities are set based on ensuring public safety and security, followed by restoration of electricity from its source through to our customers’ premises. Once safety hazards and Emergency Management Office (EMO) priorities are addressed, efforts are focused on safely restoring the most customers as quickly as possible.

During major storm events, Nova Scotia Power typically assigns EMO Coordinators to report directly to the NS and HRM EMO offices, when they are open. These Coordinators are responsible for managing all requests for support and service to and from EMO (NS and HRM), including critical infrastructure lists, specific additional resources (i.e. plows, major road clearing, etc.) and any need for Armed Forces personnel. Requests for support and service will come in and out from both organizations, facilitated by single points of contact on each end.

The EMO Coordinators are responsible for providing Nova Scotia Power Emergency Operations Centre (EOC) with information on all requests from EMO and status updates on EMO plans and activities. This includes identifying emerging issues and effective strategies to respond. This will happen on conference calls and through direct contact with the Storm Lead and Regional Operations Coordinator.
The EOC is responsible for providing the EMO Coordinators with all requests for service or support that require EMO action. This will happen through direct contact between the Storm Lead, Regional Operations Coordinator and EMO Coordinators and on conference calls.

Public communications from either organization about status of power restoration or management of joint issues will be facilitated by the EMO Coordinators working with the Corporate Communications Coordinator and the EMO Public Information Officers.

During storm events where Nova Scotia Power has activated its Emergency Operations Centre but EMO-NS and/or HRM EMO have not, our EMO Coordinators will work from our EOC to coordinate requests for support to/from the EMO contacts. Nova Scotia Power’s Regional Operations and Customer Service staff also have working relationships with Municipal Emergency Management Coordinators. Close coordination between EOC, EMO Coordinators, and regional staff with EMO responsibilities is a priority.

16.3 Coordination During Post-Tropical Storm Arthur

On the evening of July 4, Nova Scotia Power notified the Director of the Nova Scotia Emergency Management Office (EMO-NS) that we were activating our Emergency Services Restoration Plan (ESRP) and opening our Emergency Operations Centre (EOC) on the morning of July 5 in anticipation of the landfall of Arthur. At that time, on July 4, the Director of the EMO-NS indicated they did not plan to open their EOC. The EMO-NS EOC did not open throughout the duration of this event. The HRM’s Emergency Management Office opened its EOC at 7:45 AM Saturday, July 5. Nova Scotia Power’s HRM EMO Coordinator was onsite at the HRM EOC for duration of Saturday, attended Nova Scotia Power’s EOC conference calls, and provided HRM with regular updates.

Since the EMO-NS was not activated, all EMO-NS requests were handled at the Nova Scotia Power EOC.
Nova Scotia Power’s Storm Lead was in regular contact with the various provincial Emergency Measures Coordinators (EMCs) throughout the duration of the event. Daily conference calls were held to discuss local issues and priorities. All EMO-escalated issues were handled and addressed.

The absence of having the EMO-NS Emergency Operations Centre open led to communication gaps between other agencies, such as the Department of Transportation and Infrastructure Renewal (TIR) and Nova Scotia Power. In a storm the size of Arthur, the EMO-NS typically would have handled contact between the Nova Scotia Power EOC and TIR. For example, inquiries related to critical customers and road closure issues were being delivered to the Nova Scotia Power’s EOC and presented as emergencies needing urgent attention. In some cases, these issues had already been resolved, or were actually not urgent, taking valuable outage restoration resources away from their work.

Regional Comfort Centres were setup by several municipalities and local fire stations across parts of western Nova Scotia. Nova Scotia Power directly provided these communities with restoration estimates and progress reports to assist in locating, opening and closing these centres.

16.4 **Learnings, Recommendations and Actions**

1. Information flow and support could be better coordinated if EMO-NS activated its Emergency Operations Centre in conjunction with Nova Scotia Power’s EOC.

2. The Critical Care Customer list and process should be reviewed to ensure a common understanding between all agencies as to who is (and who is not) a critical customer.
17.0 LEARNINGS, RECOMMENDATIONS AND ACTIONS

17.1 Introduction

This section summarizes the key learnings, recommendations, and actions found in the Executive Summary and throughout the report.

17.2 Preparation for Storm

1. The actual winds recorded in the province were much higher than forecast, and even higher in the Valley than the conservative estimates used in planning. Scotia Weather Services has conducted a detailed review to determine the cause of the significant inaccuracies in its forecast, particularly with regard to the wind speeds experienced across Nova Scotia. Please refer to Appendix 3.31. The actual wind gusts in the Valley on Saturday, July 5, were 74 percent higher than Scotia Weather Services forecasted.

2. In the days following Arthur, Nova Scotia Power ran the Scenario Planning Model using the actual wind speeds recorded on July 5. The model made an accurate prediction of the actual number of customers affected and the crew hours required to restore power.

3. The high winds during Arthur in the Valley led to multiple 69 kV transmission line outages. While we prepare extensively for transmission outages, as detailed in Section 6, our Scenario Planning Model does not model transmission outages or restoration times, because wind storms primarily cause distribution outages. We will update our model to predict both distribution and transmission outages together.
17.3 Restoring Power

1. We have recognized through previous storms that damage assessment is critical. However, in storms with winds like those experienced in Arthur, having more Damage Assessors pre-staged would help us gain an accurate assessment of the damage in a shorter time frame.

2. During restoration after Arthur, there were instances where tree crews were dispatched to clear roads that were already clear. We will seek to work with the Department of Transportation and Infrastructure Renewal to develop definitions of different levels of road closures, appropriate response protocols, and timely sharing of information. This protocol could be managed via Emergency Management Offices.

3. To improve reliability in major storms it is essential to establish clear rights-of-way on power lines. Nova Scotia Power requires a greater public support for obtaining desired clearances from power lines.
   - Greater public support should allow increased trim clearances to attain a less-frequent maintenance cycle and an increased probability of capturing branches that are prone to failure during major storm events.
   - Greater public support should allow Nova Scotia Power to increase expenditures for vegetation management within the right-of-way asset renewal program and increase the amount of hazard tree removal projects to ensure that: all rights-of-way are re-established to a desired width within a fixed time frame; and hazard trees associated with those rights-of-way can be mitigated.
17.4 Vegetation Management

1. We seek support from the Board, the Department of Transportation and Infrastructure Renewal and other stakeholders for the creation and maintenance of tree-free rights-of-way, as set out in ANSI Standard A300, the generally accepted industry standard.

2. We urge the appropriate government authorities to prohibit the planting of trees that are in conflict with power lines.

3. We will seek permission to have prescriptive rights to remove off right-of-way hazard trees threatening power lines, as identified by qualified, trained vegetation management experts.

4. We will work with woodland harvest operators and the Nova Scotia Department of Natural Resources to establish a process that would require forest harvests being conducted adjacent to power lines to be reported to a registry. This would ensure we are made aware of newly created hazard trees.

17.5 Customer Communications

1. Nova Scotia Power is reviewing our contact methods with critical care customers to determine if there are additional methods to reach this customer group.

2. We have initiated discussions with government and non-government agencies that may be able to expand the services to this customer group, especially during larger events.

3. Nova Scotia Power’s ETR strategy was implemented after the November 2004 ice storm, and has been successfully employed during numerous storms since then.
However, practices in ETR strategies have been evolving among North American electric utilities that are exposed to severe weather. We recommend that Nova Scotia Power work with the UARB’s consultant (who has experience in this area) to further examine our ETR strategy, current best practices, and bring forward any changes to the ETR strategy that would be in the best interest of customers including any potential changes to the telephone systems.

4. We are in the process of increasing the capacity of our website to handle a greater number of outage requests per hour, with a speed of delivery of five seconds or less.

5. We will build a customer communications plan to help better inform customers on outage restoration and communications during future large storm events.

6. We are updating the scripting and process flows for power outage customer communications, focused on customers impacted by outage events of fewer than 100 customers.

7. Customer interaction on social media increased significantly throughout this event over what we have experienced in previous storms. We will develop a social media customer service plan to better meet this new customer expectation. This could potentially reduce the number of calls into the Customer Care Centre by providing customers with another option for communicating with Customer Service and receiving responses specific to their needs.

17.6 Coordination With Other Agencies

1. Information flow and support could be better coordinated if EMO-NS activated its Emergency Operations Centre in conjunction with Nova Scotia Power’s EOC.
2. The Critical Care Customer list and process should be reviewed to ensure a common understanding between all agencies as to who is (and who is not) a critical customer.