STRATEGIES FOR COMPLEX ORGANIZATIONS

Final Report

The Response of Toronto Hydro-Electric System Limited to the December 2013 Ice Storm

June 19, 2014

Prepared for:

The Toronto Hydro Independent Review Panel

David J. McFadden, Chair

Sean Conway

Joseph Pennachetti

Carlos D. Torres

Prepared By:

daviesconsulting

MESSAGE FROM THE INDEPENDENT REVIEW PANEL

June, 2014

The ice storm which hit Toronto in late December 2013 caused widespread electricity outages and disrupted the lives of hundreds of thousands of Torontonians. Many people experienced the Christmas season without heat or light.

Our panel was appointed by Toronto Hydro in January, 2014 to oversee the work undertaken by Davies Consulting, LLC, to review and evaluate Toronto Hydro's preparedness for and response to an outage of this scale and to recommend steps which could be taken to prevent future outages or to speed up recovery efforts.

We are pleased to provide our Report to Toronto Hydro and, more generally, to the people of Toronto. The panel worked closely with Davies Consulting on the design and approach of the review and then on the identification of findings and the development of the recommendations contained in the Report.

We were impressed by the almost universal praise of the hard work and dedication displayed by Toronto Hydro's team during the outage often under very adverse working conditions. However, our Report offers a number of recommendations to improve the safety and reliability of the electricity system and future recovery efforts. Also, we identify steps which the City, the Ontario Government and community organizations should consider to protect vulnerable members of our community in the event of future outages.

We wish to thank the Davies Consulting team for their excellent work in developing this Report. We would also like to thank the management and staff of Toronto Hydro and the many citizens of Toronto who provided valuable information and insight which was essential to the preparation of the Report.

We hope that the Report will have a positive role in making Toronto's electricity distribution system more reliable and safe in the years to come.

David J. McFadden, Q.C.
Chair

Sean Conway
Member

Joseph Pennachetti
Member

Carlos D. Torres
Member

Table of Contents

Table of Tables

Table of Figures

1. Executive Summary

In early January 2014, Toronto Hydro System Limited (Toronto Hydro or the Company) executive management commissioned an Independent Review Panel (IRP) to review the Company's response to the 2013 Ice Storm. The intention of the review was to confirm emergency management practices that are working well and areas in need of improvement. Toronto Hydro retained Davies Consulting LLC, a leading management consulting firm with extensive experience in utility emergency response throughout North America, to conduct the assessment under the direction of the IRP. This Executive Summary to the IRP Final Report includes: a brief overview of the 2013 Ice Storm and Toronto Hydro's response; a description of the scope of the review; and highlights of the findings and recommendations of the Panel.

1.1. Synopsis of the 2013 Storm and Toronto Hydro's Response

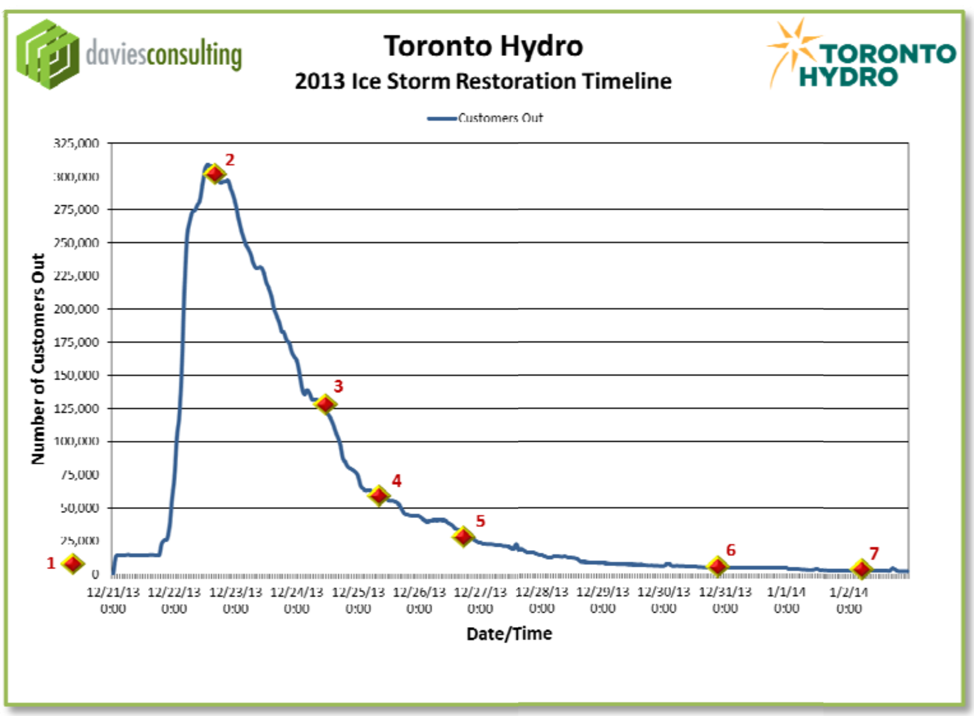
On December 21 and 22, 2013, the Greater Toronto Area (GTA) was at the epicentre of a freezing rain event that brought between 20 and 30 millimetres of freezing precipitation – more than two-year's worth – in two days. This severe ice storm resulted in 313,000 service interruptions (at peak) to Toronto Hydro customers. Approximately 57% (416,000) of the customers served by Toronto Hydro lost power at one point during the event, which ultimately affected more than one million City residents. Most of the damage was caused by tree limbs falling on power lines, either creating faults or breaking the lines. In addition to widespread power outages, the event caused extensive property damage and economic losses.

Toronto Hydro quickly mobilized its management team and called in available resources, which began restoration work by 8 a.m. on December 22, 2013, before the storm system departed the Company's service area. Power was restored to all customers who could receive service by the morning of January 2, 2014, 11 days after the restoration began. Toronto Hydro resumed normal operations on January 3, 2014. Approximately 98% of Toronto Hydro's core trade workers supported the restoration effort, aided by another 450 field workers (line and forestry) from contractors and ten other utilities, as well as the company management and professional office staff. Notably there was only one recordable safety incident at Toronto Hydro over the course of the restoration and no deaths attributed to the storm.

Figure 1 shows the progress of Toronto Hydro's restoration after the 2013 Ice Storm, noting the following milestones:

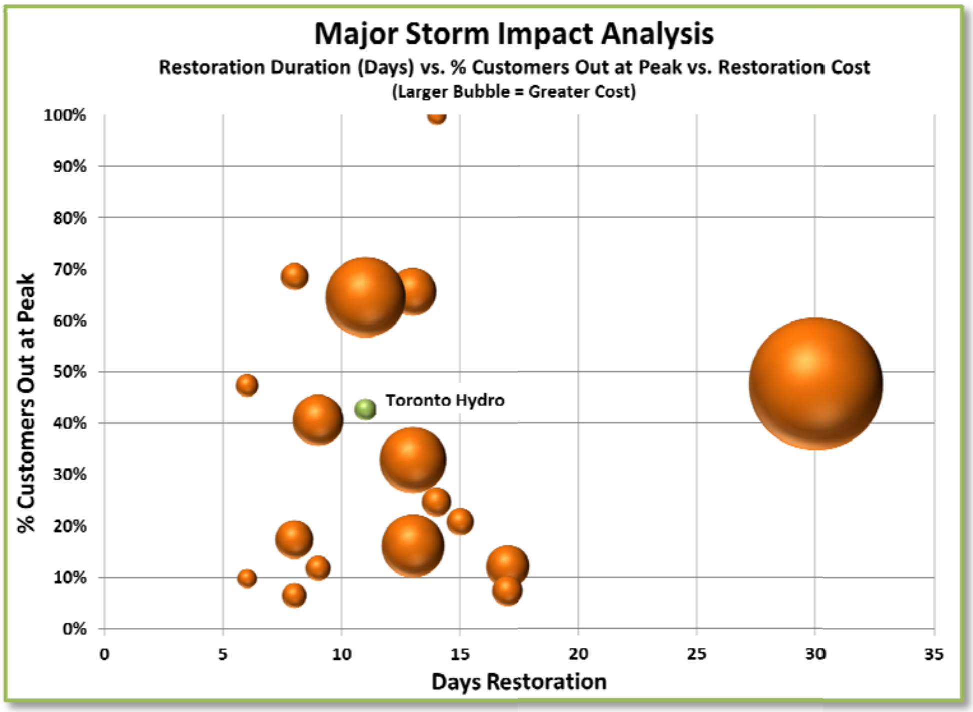
1. Initial weather statements warning of a potential ice event;
2. Initial request for mutual assistance issued by Toronto Hydro;
3. Power restored to all critical facilities designated by the City Emergency Operations Centre (EOC);
4. Approximately 86% of all customers affected restored (72 hours from the start of restoration);
5. Approximately 90% of customers out at peak restored;
6. Approximately 99% of customers out at peak restored; and
7. All customers who can accept service restored.

Figure 1: 2013 Ice Storm Restoration Timeline with Key Milestones



When compared to the performance of other utilities conducting ice and snow storm restorations, Toronto Hydro's overall performance is well within the industry norm as shown in Figure 2.

Figure 2: Event Benchmark Comparison



Source: Davies Consulting Storm Response Benchmark Database, 2014

1.2. Review Scope and Approach

The organizing framework for the Toronto Hydro review is the widely-used emergency management (EM) life cycle, as adapted to the utility environment. Figure 3 depicts this four-phase cycle, anchored by a comprehensive incident communications strategy.

Figure 3: Utility Emergency Management Life Cycle

The review addressed nine areas of Toronto Hydro's response. Table 1 shows how they align to the utility emergency management life cycle.

Table 1: Alignment of Toronto Hydro Assessment Scope to Emergency Management Lifecycle

Emergency Management Life Cycle	Toronto Hydro Review Scope
Prepare	▪ Emergency Planning and Preparedness
Respond and Recover (Restore)	▪ Resource Acquisition and Allocation ▪ Damage Assessment and Restoration Planning ▪ Restoration Execution ▪ Information Systems and Technologies ▪ Toronto Hydro – City Coordination
Mitigate	▪ Vegetation Management and System Hardening/Resilience
Incident Communications	▪ Communications – Customer Contact ▪ Communications – Other Stakeholders

The Davies Consulting team used a structured, comprehensive, principles-based approach to conduct the 2013 Ice Storm Review. They interviewed nearly 80 stakeholders, received close to 100 public comments through Town Halls and email, reviewed relevant internal plans, reports and documentation, and considered pertinent City and Provincial regulations, policies, and emergency management practices. The approach taken by the team preserved the confidentiality of information provided by stakeholders and lead to findings and recommendations that were objective, data-centered, and informed by leading practice.

1.3. Summary of Findings and Recommendations

The review of Toronto Hydro's response to the 2013 Ice Storm revealed both well-executed emergency management practices and areas in need of improvement. The summary findings for each area evaluated, are:

- Toronto Hydro followed an Incident Command System-based approach at the management level, but had not fully developed, trained, and exercised the approach across the Company;
- Customers could not obtain timely and accurate information about their outage status (including estimated time of restoration, or ETR) during the event;
- The Company's incident communication performance, with a defined media strategy and unity of message, met or exceeded industry best practices;
- The Company secured and deployed mutual assistance resources early in the restoration and executed the overall mutual assistance process generally well;

- The process for determining restoration priorities was in line with industry leading practices; however, the damage assessment process was not fully executed;
- While the restoration approach varied among the Local Command Centres, the overall restoration duration was similar to that of comparable events in the industry;
- Toronto Hydro has implemented some advanced operational and information technology systems, but has not fully integrated them to provide adequate restoration support and situational awareness; and
- The circuit-based vegetation management preventive program is on a three-year cycle which meets or exceeds industry best practice and follows industry pruning standards and City of Toronto by-laws.

The IRP identified 25 recommendations for consideration by Toronto Hydro management. The following list is a summary of these recommendations by area evaluated:

- Update emergency response plans to align with vision and strategy, incorporate the documentation of key processes and procedures, and train response roles and structure;
- Improve situational awareness capabilities to enable development of accurate ETRs and facilitate focus on critical priorities;
- Develop capacity to provide customers timely access to report and obtain critical information related to their outages, during day-to-day, as well as large-scale outages;
- Work with key stakeholders to identify, agree upon, and fund cost-beneficial system hardening and resilience initiatives, including vegetation management and targeted conversion of line segments to underground construction;
- Educate customers and stakeholders to ensure that they understand their responsibilities and are better prepared and more fully informed when incidents occur (e.g., impacts requiring repair of damaged equipment on customer property);
- Codify the process for rapid access to and deployment of trained, certified, and equipped resources;
- Pre-define restoration approaches that are scaled to outage levels and can be executed efficiently and safely;
- Update and further integrate key information and operational systems to provide real or near-real time intelligence during major events; and

- Enhance collaboration between Toronto Hydro and the City to integrate outreach, messaging, and education to improve citizen preparedness and awareness of major events.

1.4. Moving Forward

The 2013 Ice Storm was an unprecedented event that disrupted the lives of most Toronto residents and tested the mettle of the first responders, as well as the City and Toronto Hydro personnel involved in the recovery effort. Through a dedicated, coordinated, and intensive response, the community was safely restored to normalcy within a reasonable timeframe given the amount and type of damage suffered. Toronto Hydro performed the restoration in a manner consistent with industry norms. The Company's management and approach to the restoration was prudent, diligent, and safe. As expected with any large incident, the recovery from this ice storm also exposed several aspects of the emergency response that can be further improved.

In accordance with the commissioned scope of the Panel review, the recommendations presented in this report focus mainly on the improvements that Toronto Hydro can make to further enhance its ability to respond to future events that cause widespread power outages. Additionally, and notably, several of the recommended improvements call for closer cooperation among Toronto Hydro, the City of Toronto and the Province of Ontario to prepare the community for future major outage events. This report should serve as the starting point for a more sustained, coordinated effort among all of these parties.

2. Introduction

On December 21 and 22, 2013, a severe ice storm struck the greater Toronto area, resulting in approximately 313,000 service interruptions (at peak) to Toronto Hydro customers[1]. Approximately 57% (416,000) of the customers served by Toronto Hydro lost power at one point during the event, which ultimately affected more than one million city residents. In addition to widespread power outages, the event caused extensive property damage and economic losses. Toronto Hydro deployed approximately 1,250 field resources, including more than 400 from other utilities and contractors (i.e., off-system), restored service to 75% of customers within 48 hours from the time the restoration began. Crews completed restoration of all customers who could accept power by January 2, 2014. Notably, there was only one recordable safety incident at Toronto Hydro over the course of the restoration and no deaths attributed to the storm.

2.1. Purpose, Governance, Scope

On January 9, 2014, Toronto Hydro executives held a press conference to brief the public on the Company's emergency preparedness planning, restoration approach and priorities, and communications strategy during the incident. Anthony Haines, President and CEO of Toronto Hydro, remarked that the 2013 Ice Storm was "the most disruptive incident we have faced." At that time, the Company announced its establishment of an independent panel to oversee a review of its response to the 2013 Ice Storm. The intention of the review was to confirm practices that are working well and to identify areas in need of improvement. The role of the Independent Review Panel (IRP) was to ensure the objectivity of the review and provide guidance and subject matter expertise. IRP members are:

- David J. McFadden, Panel Chair and Partner, Gowling Lafleur Henderson LLP;
- Joseph Pennachetti, City Manager, City of Toronto;
- Sean Conway, Visiting Fellow, Centre for Urban Energy – Ryerson University; and
- Carlos D. Torres, Vice President of Emergency Management, Consolidated Edison of New York, Inc.

Toronto Hydro retained Davies Consulting LLC, a leading management consulting firm with extensive experience in utility emergency response throughout North America, to conduct the review under the direction of the IRP. The effort began in late January 2014.

[1] The peak number of customer interruptions represents the highest number of customers who were interrupted *at the same time*. Since the event lasted for several days, additional customers lost power at different points in time, ultimately resulting in 416,000 customers experiencing an interruption during the Ice Storm.

The scope of the assessment included all aspects of the widely-used emergency management (EM) life cycle, as adapted to the utility environment. Figure 3 depicts this four-phase cycle, centered by a comprehensive incident communications strategy.

The main components assessed within each phase of the utility emergency management life cycle are:

- **Preparedness**
  - Organization and responsibility for emergency management
  - Emergency Response Plan structure and completeness
  - Emergency (or second) roles process
  - Emergency management training program
  - Exercises (table top and functional)
- **Response and Recovery (Restoration)**
  - Mobilization and level declaration
  - Resource acquisition and allocation
  - Response structure and roles/responsibilities
  - Logistics
  - Restoration strategy and execution efficiency
  - Situational awareness and damage assessment
  - Wires down and cut, clear and make safe process
  - Work planning and prioritization
  - Demobilization
- **Incident Communication**
  - Communication strategy
  - Estimated Time of Restoration (ETR) development, dissemination, and tracking
  - Key message development
  - One-voice communication
  - Social media
  - Liaison program
  - Customer call centre
- **Mitigation (Distribution Infrastructure Maintenance and Improvement)**
  - Vegetation management
  - Pole inspection
  - Storm hardening
- **Use of Supporting Technology Systems (Operational and Information)**

2.2. Approach and Methodology

The Davies Consulting team conducting the assessment used a structured, comprehensive, principles-based approach to evaluate Toronto Hydro’s response to the

2013 Ice Storm. They interviewed nearly 80 stakeholders, received close to 100 public comments through Town Halls and email, reviewed relevant internal plans, reports, and documentations, and considered pertinent City and Provincial regulations, policies, and emergency management practices. Throughout the assessment process, the following core principles guided the work of the Davies Consulting team:

- Transparency – consultants conducting fact-finding and analysis have full access to Company information and personnel;
- Inclusiveness – representatives of stakeholder groups have an opportunity to contribute through interviews, public town halls, and email feedback;
- Data-centered analysis– findings and recommendations are substantiated by quantitative and qualitative data and original sources of data are used to the extent possible;
- Informed by leading practice – knowledge of industry leading practices is used to develop interview questions and to guide analysis; this knowledge is drawn from Davies Consulting's project work with more than 35 investor-owned and municipal utilities, participation in industry associations, and proprietary research; and
- Confidentiality – source information provided by individual interviewees and interested parties is not shared outside Davies Consulting and findings are not attributable to individuals or groups.

Davies Consulting used the following methodology to conduct the assessment of Toronto Hydro:

1. *Understand the impact of the storm on Toronto Hydro's system.* Characterized the magnitude of the 2013 Ice Storm's impact on Toronto Hydro's distribution system, using weather reports, Toronto Hydro-provided documentation, and interviews.
2. *Collect pertinent data about Toronto Hydro's performance.* In collaboration with Toronto Hydro management and the IRP, identified participants and other stakeholders in the 2013 Ice Storm emergency management and restoration process. Conducted interviews with a representative cross-section including: Toronto Hydro management and front-line personnel; Union leadership; City of Toronto employees; and City of Toronto elected leaders. Collected public feedback through three town hall meetings and via public email address (torontoicestorm@daviescon.com) for those who were not able to attend. Submitted approximately 50 data requests for operational, call centre, system, and other program data. Review documentation provided along with pertinent City and Provincial policies and regulations (e.g., electric safety code, building code, tree trimming standards).

3. *Analyze data to develop findings and recommendations.* Evaluated each aspect of Toronto Hydro's response, comparing Company performance against its plans and standards, industry standards, and leading practices. Compared aspects of Toronto Hydro's performance (e.g., restoration duration, cost) to those of other utilities using Davies Consulting proprietary Storm Response Benchmark Database, which is described later in this report. Formulated findings of strengths and opportunities for improvement. Developed actionable recommendations to address areas in need of improvement.
4. *Develop final report.* Prepared a comprehensive written report that described Toronto Hydro's emergency management and restoration performance, summarized leading or expected practice in each of the nine areas addressed within the scope of the review, and detailed the findings and recommendations for Toronto Hydro management consideration.

2.3. Evaluation Areas

The Davies Consulting review addressed nine areas of Toronto Hydro's emergency planning, preparedness, and response practices. The first eight of these areas relate to the emergency response life cycle as shown on Table 2. The ninth addresses the numerous and significant areas of overlap and integration that occur between Toronto Hydro and City responders when supporting the recovery of the community after an event like the 2013 Ice Storm.

Table 2: Alignment of Toronto Hydro Assessment Scope to Emergency Management Lifecycle

Emergency Management Life Cycle	Toronto Hydro Review Scope
Prepare	▪ Emergency Planning and Preparedness
Respond and Recover (Restore)	▪ Resource Acquisition and Allocation ▪ Damage Assessment and Restoration Planning ▪ Restoration Execution ▪ Information Systems and Technologies ▪ Toronto Hydro – City Coordination
Mitigate	▪ Vegetation Management and System Hardening/Resilience
Incident Communications	▪ Communications – Customer Contact ▪ Communications – Other Stakeholders

3. Overview of Toronto Hydro System

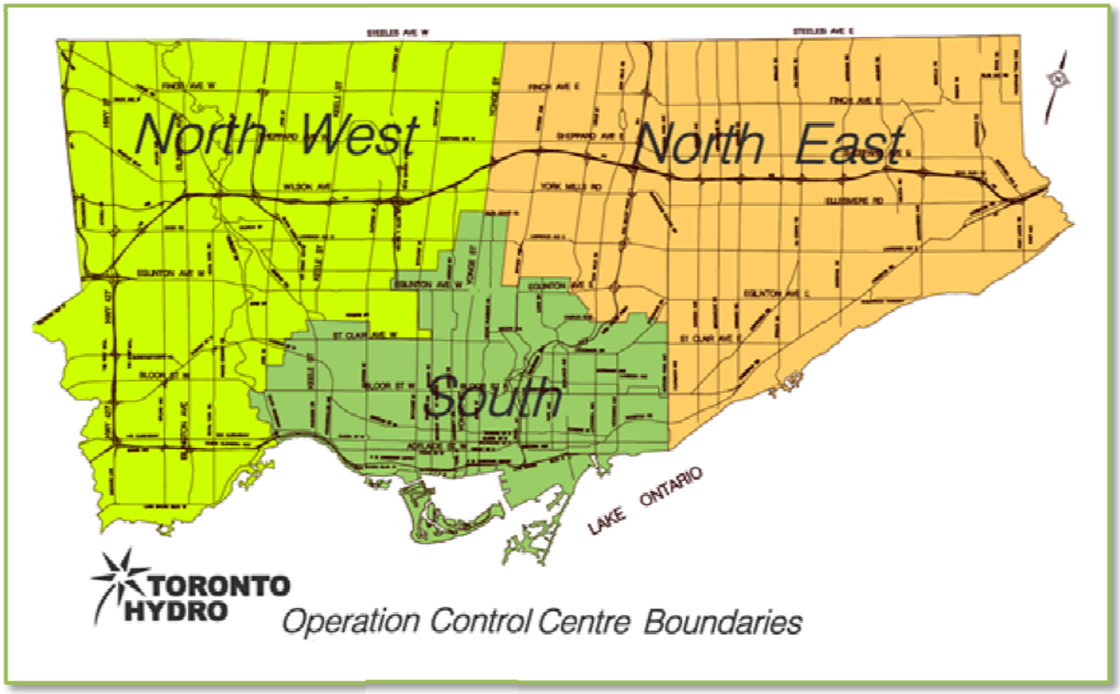
Toronto Hydro began operation on May 2, 1911. Today, more than 100 years later, Toronto Hydro owns and operates $2.6 billion of capital assets comprised primarily of an electricity distribution system which delivers electricity to more than 730,000 customers located in the City of Toronto. It is the largest municipal electricity distribution company in Canada and distributes approximately 18% of the electricity consumed in the Province of Ontario.

Toronto Hydro is wholly-owned by Toronto Hydro Corporation, a holding company incorporated under the Ontario Business Corporations Act in 1999 by the City of Toronto (the "Corporation"), its sole shareholder. In 1998, Bill 103 amalgamated six municipal electric utilities into one, nearly tripling Toronto Hydro's customer base to approximately 650,000 customers. Table 3 provides a snapshot of Toronto Hydro's distribution system characteristics and Figure 4 is a map of Toronto Hydro's service territory.

Table 3: Toronto Hydro System Statistics

Population	2.8 million
Customers	733,800
Service Territory Size	630 square kilometers (240 square miles)
Employees	1,570
Distribution	
▪ Distribution circuits (number)	1,710
▪ Overhead (miles)	15,000 km (9,321 miles)
▪ Underground (miles)	11,200 km (6,959 miles)
▪ Overhead transformers	60,650
▪ Poles	175,400
▪ Switches	16,000
Substations	169 municipal stations/35 transmission stations (shared)
Meters (12/31/13)	648,000 distribution and 85,800 industrial/commercial

Figure 4: Toronto Hydro Service Territory

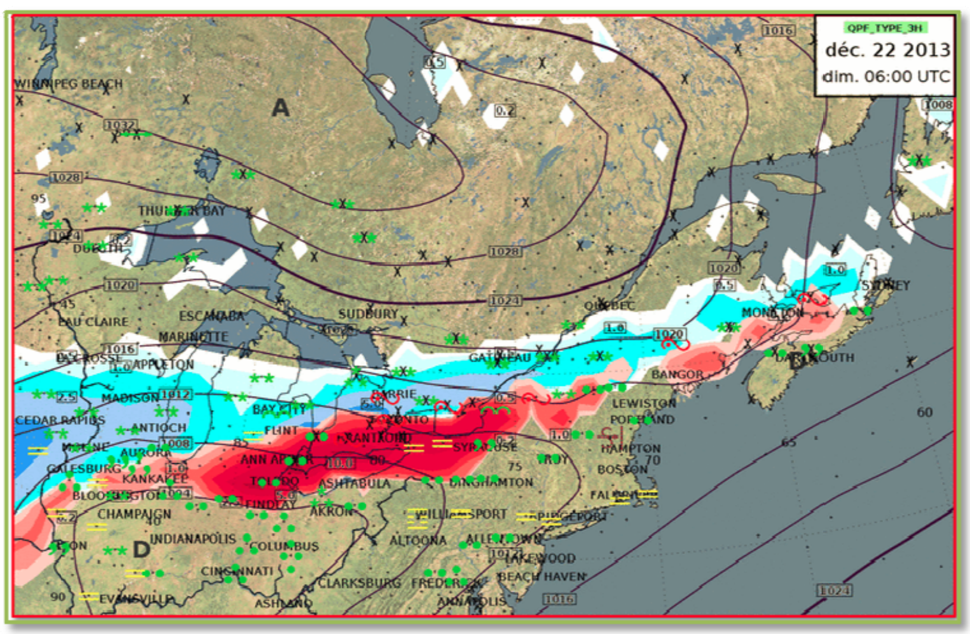


4. The December 2013 Ice Storm and Toronto Hydro's Response

On Thursday, December 19, 2013, Toronto Hydro began to track weather warnings from Environment Canada, indicating the probability of an ice event. Starting around 3:00 p.m. on Saturday, December 21, 2013, and into Sunday December 22, 2013, the Toronto Hydro service territory was at the epicentre of a freezing rain event that brought between 20 and 30 millimetres of freezing precipitation (more than two-year's worth in two days),[2] resulting in significant ice accumulation on trees and power lines. The ice accumulation left roads and sidewalks slick and dangerous and knocked down trees and tree limbs across the region causing widespread power outages. In addition to wreaking havoc across the Greater Toronto Area, the storm crippled North American transportation at one of the busiest travel times of the year.

The surface map of the storm-affected area, in Figure 5 below, shows the concentration of freezing rain over the Greater Toronto Area at the peak of the storm on Sunday December 22, 2013, at 6:00 a.m. (red color represents the freezing rain, while white/blue areas are snowfall). The freezing rain stopped around 9:00 p.m., on Sunday, December 22, 2014.

Figure 5: Surface Map of 2013 Ice Storm at Peak Intensity



Power outages started shortly after 8 p.m. on Saturday and peaked early on Sunday morning when 313,000 customers were without power. The remnants of the weather system continued through the morning of Monday, December 23, 2013, and the

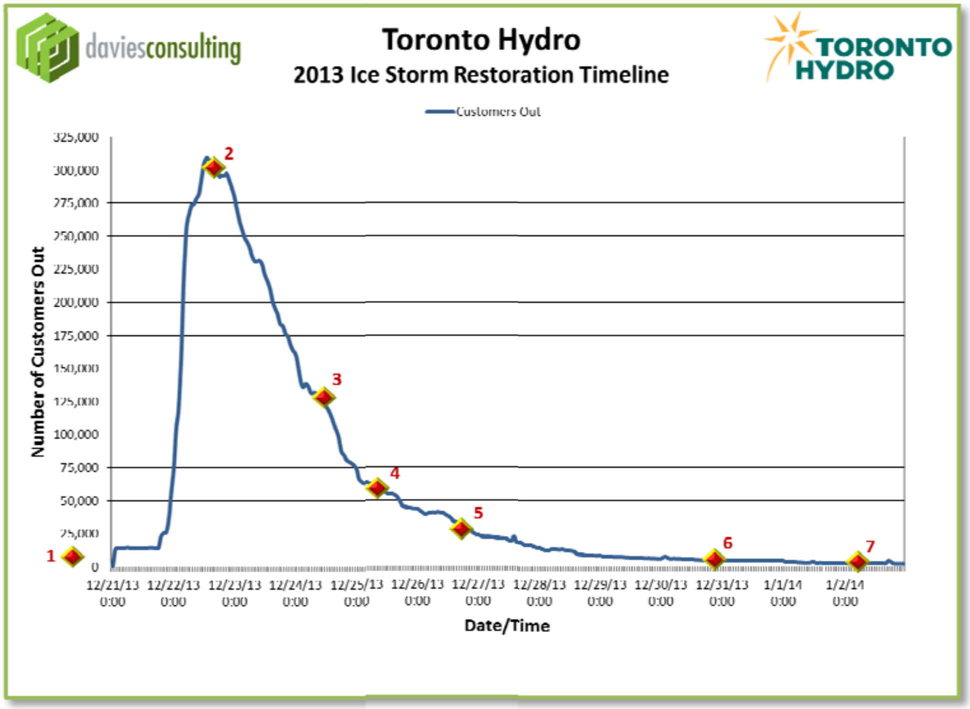
[2] Source: Environment Canada

Company continued to experience additional outages as it began initial restoration. Ultimately, approximately 416,000 customers, or 57% of all Toronto Hydro customers, experienced service interruptions as a result of the Ice Storm, affecting more than one million Toronto residents. The majority of the damage was caused by tree limbs falling on power lines, either creating faults or breaking the lines.

Toronto Hydro quickly mobilized its management team and called in available resources, which began restoration work by 8 a.m. on December 22, 2013, when it was safe to work. Service was restored to all customers who could receive power by January 2, 2014, 11 days after the restoration began. Toronto Hydro resumed normal operations on January 3, 2014, after restoring the remaining customers who experienced damage on their property and required permits from the Electrical Safety Authority (ESA) to be reconnected to the grid. Approximately 98% of Toronto Hydro's core trade workers supported the restoration effort, aided by another 450 field workers (line and forestry) from contractors and 10 other utilities. Figure 6 below shows the restoration progress timeline with the following key milestones:

1. Initial weather statements warning of ice event;
2. Initial request for Mutual Assistance issued by Toronto Hydro;
3. Power restored to all critical facilities designated by the City Emergency Operations Centre (EOC);
4. Approximately 86% of all customers affected restored (72 hours from the start of restoration);
5. Approximately 90% of customers out at peak restored;
6. Approximately 99% of customers out at peak restored; and
7. All customers who can accept service restored.

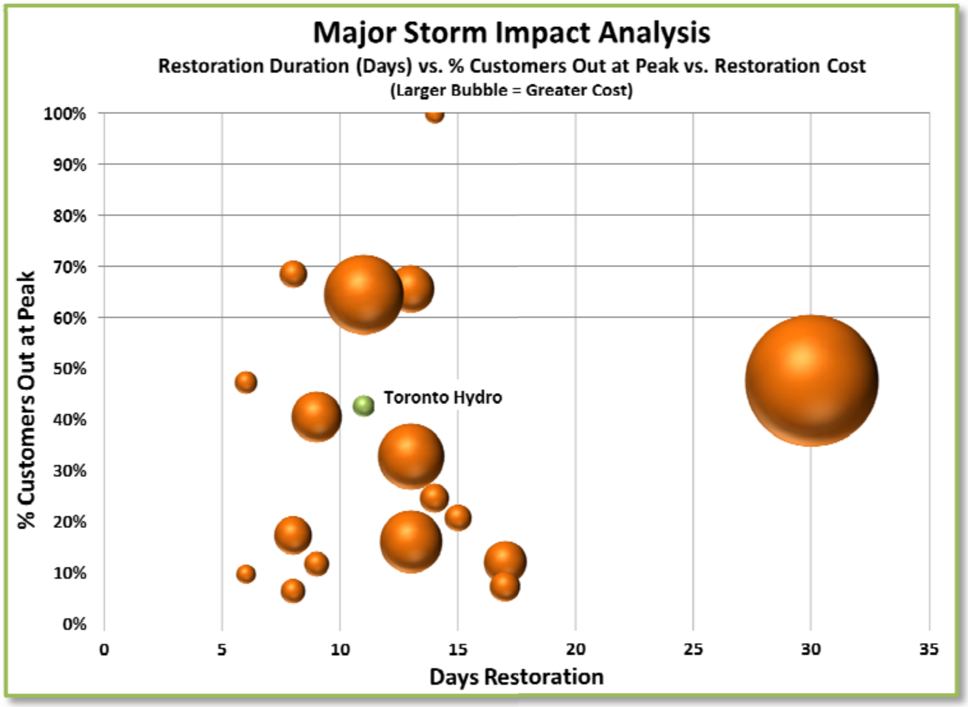
Figure 6: 2013 Ice Storm Restoration Timeline with Key Milestones



As part of the review of Toronto Hydro's restoration effort during the 2013 Ice Storm, Davies Consulting compared the Company's response to other ice and snow storm restorations, using information from its confidential and proprietary Storm Response Benchmark Database.[3] Figure 7 depicts the restoration duration (on the X-axis), percent of customers affected at peak (on the Y-axis) and the total cost of restoration (indicated by the size of the bubble). When compared to other similar events, according to these metrics, Toronto Hydro's overall performance during the 2013 Ice Storm was within the industry norm.

[3] Davies Consulting began to develop its confidential and proprietary Storm Benchmark Database in 2003. The database currently contains key statistics from more than 95 major event responses by over 42 electric utilities across North America. While each event is unique and the comparisons among utilities have to be carefully evaluated, benchmarking can be valuable to identify areas where potential improvement opportunities exist.

Figure 7: Event Benchmark Comparison



5. Findings and Recommendations

5.1. Overview

The following sections describe the findings from the review and provide 25 recommendations to address opportunities for improvement. The findings and recommendations are grouped within the nine evaluation areas described in Section 2.3 of this report. The areas are presented in the following order: Emergency Planning and Preparedness; Resource Acquisition and Allocation; Damage Assessment and Planning; Restoration Execution; Communications – Customer Contact; Communications – Other Stakeholders; Information Systems and Technologies; Vegetation Management and System Hardening/Resiliency; and Toronto Hydro-City Coordination.

Each finding of a strength and area of improvement is addressed in detail within each evaluation area. The following statements distill the key findings:

- Toronto Hydro followed an Incident Command System-based approach at the management level, but had not fully developed, trained, and exercised the approach across the Company;
- Customers could not obtain timely and accurate information about their outage status (including estimated time of restoration or ETR) during the event;
- The incident communication process, with a defined media strategy and unity of message, was in line with industry leading practices;
- The Company secured and deployed mutual assistance resources early in the restoration and executed the overall mutual assistance process generally well;
- Restoration priorities were in line with industry practices; however, the damage assessment process was not fully executed;
- While the restoration approach varied among the Local Command Centres, the overall restoration duration was in line with similar events in the industry;
- Toronto Hydro has implemented some advanced operational and information technology systems, but has not fully integrated them to provide adequate restoration support and situational awareness; and
- The circuit-based vegetation management preventive program is on a three-year cycle which is in line with industry practices and follows industry pruning standards and City of Toronto by-laws.

Likewise, each recommendation is detailed within each evaluation area. The following list is a top line summary of the recommendations by area evaluated:

- Update emergency response plans to align with vision and strategy, incorporate the documentation of key processes and procedures, and train response roles and structure;
- Improve situational awareness capabilities to enable development of accurate ETRs and facilitate focus on critical priorities;
- Develop capacity to provide customers timely access to report and obtain critical information related to their outage, including blue-sky and full-scale major events ;
- Work with key stakeholders to identify, agree upon, and fund cost-beneficial system hardening and resilience initiatives, including vegetation management and targeted conversion of line segments to underground construction;
- Educate customers and stakeholders to ensure that they understand their responsibilities and are better prepared and more fully informed when incidents occur (e.g., impacts requiring repair of damaged equipment on customer premise);
- Codify the process for rapid access to and deployment of trained, certified, and equipped resources;
- Pre-define restoration approaches that are scaled to outage levels and can be executed efficiently and safely;
- Update and further integrate key information and operational systems to provide real or near-real time intelligence during major events; and
- Enhance collaboration between Toronto Hydro and the City to Integrate outreach, messaging, and education to improve citizen preparedness and awareness of major events.

Appendix C provides a summary table of all of the findings (including strengths and opportunities for improvement) and recommendations organized by evaluation area.

For easy reference, each recommendation has an alpha-numeric key associating it to one of the evaluation areas (e.g., EPP-1, EPP-2). The following table lists the reference key for each evaluation area.

Table 4: Recommendations Reference Keys

Reference Key	Evaluation Area
EPP	Emergency Planning and Preparedness
RA	Resource Acquisition and Allocation
DAP	Damage Assessment and Restoration Planning
RE	Restoration Execution
CCC	Communications – Customer Contact
COS	Communications – Other Stakeholders
IT	Information Systems and Technologies
VMSH	Vegetation Management and System Hardening/Resiliency
TH – C	Toronto Hydro – City Coordination

5.2. *Emergency Planning and Preparedness*

Across the electric utility industry in North America, emergency management is receiving heightened attention. Over the last 10 years, weather-related events have grown in frequency and magnitude, as illustrated by a number of recent catastrophic-level storms (e.g., Hurricane Katrina, Hurricane Sandy, Hurricane Irene, the Alberta and Ontario floods of 2013, and the arctic blasts of early 2014). In addition to the weather events, there are growing concerns about and significant efforts to address other types of emergencies/hazards, such as cyber-attacks, physical attacks, and pandemics. Recognizing that utilities play an essential role in community recovery once a major event occurs, utility leaders are making emergency management a core corporate competency, as illustrated in the Canadian Electrical Association 2013 Annual Report:

> "CEA member companies understand how important electricity is to virtually every aspect of the lives of Canadians, making emergency preparedness a critical business priority."

Leading practice utilities are strengthening emergency management by:

- Establishing an emergency management vision, guiding principles, and strategy;
- Incorporating the Incident Command System (ICS)[4];

[4] Incident Command System (ICS) is a standardized on-site management system designed to enable effective, efficient incident management by integrating a combination of facilities, equipment, personnel, procedures, and communications operating within a common organizational structure.

The ICS is used to manage an incident or a non-emergency event, and can be used equally well for both small and large situations (Source: ICS Canada).

The Province of Ontario has developed the Incident Management System (IMS) that provides standardized organizational structures, functions, processes, and terminology for use at all levels of emergency response in Ontario. IMS addresses the need for coordinated responses to all types of incidents and is closely related to the Incident Command System (ICS). ICS is used by some first responders in Ontario and many first responders (wild land fire, search and rescue, etc.) across Canada.

- Developing a set of emergency response plans that are comprehensive, useable, scalable, and address all-hazards;
- Designating formal emergency response roles and responsibilities, ideally managed within a central emergency management organization;
- Conducting annual system-wide exercises designed to stress response processes and enable the Company to identify improvement opportunities prior to an actual event;
- Coordinating with local and state/provincial governments in planning and exercising efforts;
- Partnering with regulatory stakeholders to ensure that the emergency management organization and program is appropriately staffed and resourced; and
- Tying emergency management and preparedness to key performance indicators for staff.

The infusion of emergency management knowledge, skills, and discipline across an organization takes persistent leadership attention, significant investment, and dedicated time. It may take five or more years to fully develop plans, train staff, and exercise capabilities.

This assessment of Toronto Hydro's emergency management planning and preparedness capabilities in advance of the 2013 Ice Storm addressed the following:

- Adherence to ICS principles and practices;
- Emergency management planning;
- Emergency management organization and resourcing;
- Resourcing emergency roles;
- Emergency training and exercises; and
- Liaison/Coordination with external stakeholders (e.g., City of Toronto staff, elected officials, Provincial agencies, first responders).

5.2.1. Emergency Planning and Preparedness Findings

Since 2008, Toronto Hydro has had dedicated emergency planning staff, ranging between one and four full-time equivalents (FTEs). Notably, Toronto Hydro centralized the corporate emergency management function in 2012, placing it within the Strategy and Risk Management Group. This group is responsible for the overall corporate emergency preparedness (all hazards), including developing emergency response plans, facilitating table top simulations and functional exercises, training staff, benchmarking, and coordinating emergency management activities across the Company. The Grid Response Plan provides the framework for responding to major events; however, it does not include sufficient description of all key processes and procedures. Additionally, the Grid Response Plan defines three levels of emergencies which may not be sufficient to address a larger-scale event.

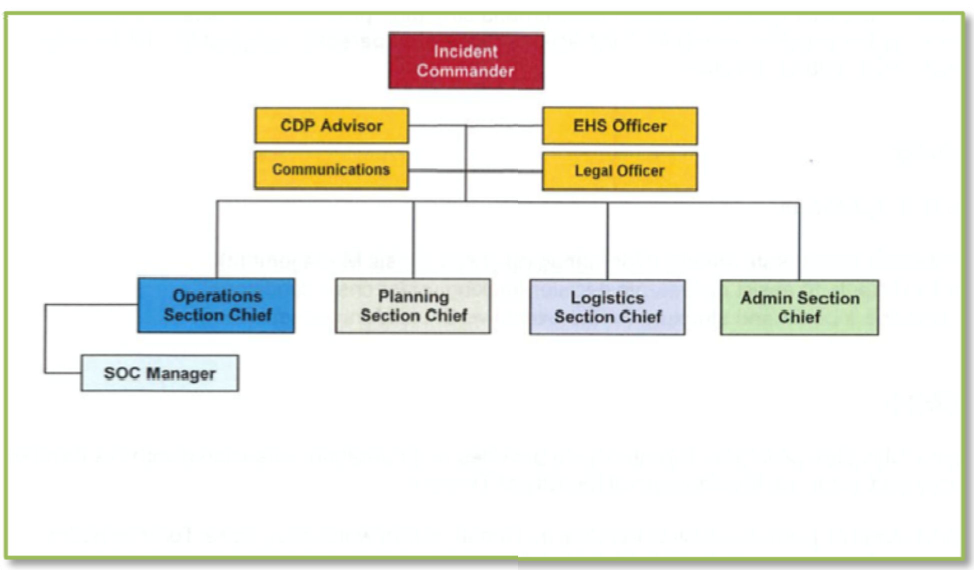
Emergency Planning and Preparedness Strengths

1. Emergency response structure largely aligns with the Incident Command System, which is considered to be the industry leading practice in emergency response.

Toronto Hydro uses ICS[5] to manage all types of emergencies. The initial focus of Toronto Hydro's ICS implementation was to establish the Crisis Management Team and Incident Management Team roles and structure and train executives and managers who fill those roles in the Emergency Operations Centre (EOC) and System Operations Centre (SOC). This approach is consistent with comparably-mature ICS programs at other utilities.

Toronto Hydro's ICS structure is described in the Company's Crisis Management Plan and Grid Disruption Plan. It closely aligns to the Canadian and Provincial ICS models (See Figure 8 and Figure 9).

Figure 8: Toronto Hydro Incident Command System Structure



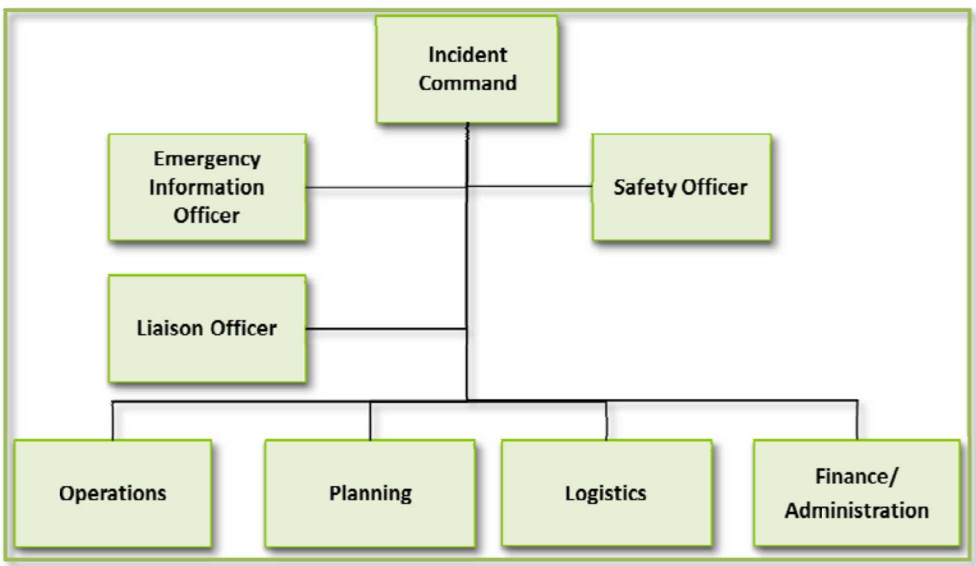
[5] The Province of Ontario has developed the Incident Management System (IMS) that provides standardized organizational structures, functions, processes and terminology for use at all levels of emergency response in Ontario. IMS addresses the need for coordinated responses to all types of incidents and is closely related to the Incident Command System (ICS). ICS is used by some first responders in Ontario and many first responders (wild land fire, search and rescue, etc.) across Canada.

The Company's ICS structure includes most of the command staff roles such as Incident Commander, Communications (Public Information Officer), Environmental, Health and Safety Officer (Safety), and general staff roles (Operations, Planning, Logistics, and Administration Section Chiefs). There are two notable differences between the Toronto Hydro structure and the Canada/Ontario structure:

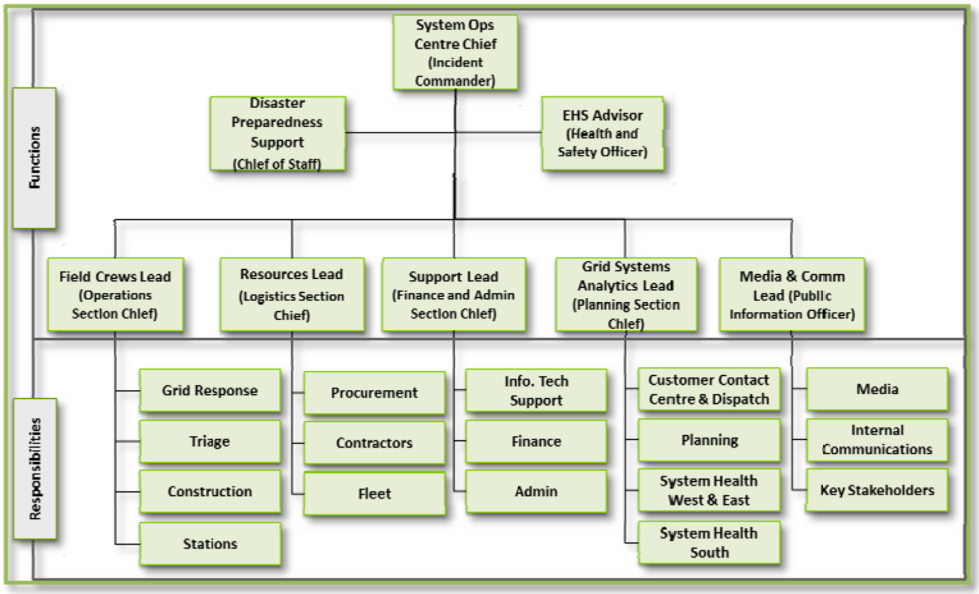
1. Toronto Hydro's Crisis Management Team includes a legal officer, a role common within a private company ICS; and
2. Omission of the liaison officer role.

At Toronto Hydro, the Corporate Disaster Preparedness (CDP) Advisor serves as the liaison officer, acting as the primary interface with the City of Toronto Office of Emergency Management. Lastly, the SOC Manager oversees system operations including all the work protection activities on the distribution system.

Figure 9: Canada and Ontario EM Incident Management System Structure



The Grid Disruption Plan, which governs the restoration of major electric distribution outages, also uses an ICS-based response structure. Toronto Hydro used this plan to guide the 2013 Ice Storm restoration. While the roles in this plan have different titles than those defined by ICS, they address the same general staff functions (See Figure 10).
Figure 10Figure 10: Toronto Hydro Grid Disruption Response Organization



2. Corporate Emergency Management organization is centralized and addresses all hazards.

Toronto Hydro has a standalone emergency management organization that addresses all-hazards. Following an unfavorable rate case that resulted in management restructure in 2011-2012, Toronto Hydro downsized its group of full-time emergency management professionals from four to one, centralized the function, and placed it within the Strategy and Enterprise Risk Management group. Previously, the organization with responsibility for emergency response was within the Electric Grid Operations group and its primary focus was on grid disruption events.

This move to establish a discrete emergency management function (managed outside of operations) is in line with practices of leading utilities. The separation of the traditional "storm response" group from operations helps to ensure that the focus is all-hazards. In addition, this structure enables the group to better engage the entire corporation in a response, versus just the operations group.

Increasingly across the utility industry, the leader of this emergency management organization has the role of Director or Vice President, denoting the corporate importance of this function. The emergency management responsibilities typically include: maintenance and integration of emergency plans; risk management; weather tracking; training and exercises; modeling and analytics; business continuity planning; benchmarking with utilities and other industries and ICS implementation. Since the electric grid is the key asset of a utility, central emergency management groups often include a grid operations expert. Alternatively, they work closely with the grid emergency management lead in the electric delivery business unit.

3. Trained and exercised System Operations Centre (Command Centre) roles and responsibilities prior to the event.

Toronto Hydro has a training and exercise program for Senior Management Stand-by (SMS) – a group of on-call leaders, SOC staff and the Crisis Management Team (CMT). Toronto Hydro conducted the following training and exercises in 2013:

- Two CMT training sessions;
- Six Grid Disruption Plan training sessions with the SMS; and
- Six exercises:
  - Executives only;
  - Communications team only;
  - Executives and the support team;
  - Executives, support team, and the Independent Electricity Systems Operator (IESO) and North American Electric Reliability Council (NERC) Grid Exercise II (GridEx II);
  - Executives, SMS, and the City of Toronto OEM; and
  - The City of Toronto OEM only.

4. Pre-event weather monitoring process in place and used to support activation decisions.

Building accurate situational awareness is critical when preparing for or responding to emergencies. An important component is the weather forecast. In preparation for the December 2013, Toronto Hydro monitored weather information provided by Environment Canada, the government source of weather and meteorological information. This effort began early in the week of December 16 and continued throughout the restoration.

On December 19, Toronto Hydro issued the following press release (See Figure 11) in which it warned of severe weather and noted the risk of potential and extended power outages.

Figure 11: December 19, 2013 Press Release

Toronto Hydro-Lert: Bad weather approaching
December 19, 2013 3:24 p.m.
Pre Ice Storm Release #1

TORONTO, Dec. 19, 2013 /CNW/ - Environment Canada is predicting everything from snow and ice pellets to freezing rain and rain, beginning this evening and over the next few days. Toronto Hydro-Electric System Limited (Toronto Hydro) is anticipating this storm and organizing its emergency operations to respond to potential and extended power interruptions. Toronto Hydro will be providing updates via the online newsroom, as well as Twitter (@torontohydro).

This approach to weather monitoring is in line with standard practices of utilities that do not have an in-house meteorologist.

Emergency Planning and Preparedness Opportunities for Improvement

1. **Emergency response plans provided an overall structure for response, but did not include detailed descriptions of key processes and all roles.**

Toronto Hydro has two emergency response plans: a Crisis Management Plan and a Grid Disruption Plan (GDP).

The Crisis Management Plan describes how the senior executives work in a crisis. The Crisis Management Plan serves as a "core" plan overlaying the GDP, which many utilities describe as an "annex". The GDP "outlines the way in which decision makers use the additional powers and authority accessed through the declaration of a grid emergency."[6] It includes such information as emergency declaration procedures, emergency triggers and levels, coordination between the Crisis Management Team and System Operations Centre, and guidance for plan maintenance, along with checklists for SOC roles, and forms for high-level damage assessment, objective setting, tactical planning, and stand down assessment. Toronto Hydro emergency response staff used the GDP during the 2013 Ice Storm.

The overall format of the GDP (core plan plus annexes) is reasonable for a newly constructed plan, but currently it does not include:

- Definition of key response processes (e.g., damage assessment, cut and clear, mutual assistance deployment);
- Different response strategies for varying incident levels;
- Sufficient detail about the response organization and roles below the SOC level (e.g., the Local Information Command Centres, or LICCs);

[6] Grid Disruption Plan, Toronto Hydro, October 28, 2013

- Checklists, forms, and job aids for response staff; and
- Communications protocols and processes, including stakeholder outreach/liaison.

2. Toronto Hydro characterizes grid incidents on a three-level scale, which may not adequately address full-scale events.

Toronto Hydro currently designates three levels of grid emergency in the GDP. As shown on Figure 12, the criteria used to establish the severity of an incident include: expected restoration duration, impact to customers and key accounts, the potential threat to public and employee safety, the expectation of environmental damage, and reputational impact. These emergency levels do not adequately address the complexity and potential impact of incidents where restoration times will exceed 72 hours.

Figure 12: Toronto Hydro Grid Emergency Levels

Emergency Level	Duration	Impact Severity on Customers	Key Accounts	Public Safety	Employee Safety	Environment	Reputation	Reg/ Gov Involvement
1	> 3hrs	Limited impact		No threat to broader public	Employee injury	Some impact	Limited impact	Report to be filled with government regulator
2	3 hrs – 48 hrs or incident is escalating	Broader customer impact	Key accounts impacted	Threat to public safety	Fatality	Moderate impact	Major impact/ Significant local news coverage	
3	72 + hrs outage or regional/ provincial outage	Major impact on customers		Public safety is jeopardized		Significant and on-going	Critical damage/ intensive nation new coverage	

At the federal level in Canada, there are three emergency levels. In the United States, the standard in public sector emergency management is a five-level scale. The U.S. utility sector is migrating to the five-level standard as well. The City of Toronto uses a four-level scale (0-3).

Many utilities have adopted a wider range of levels in order to better understand and communicate the scale and complexity of an incident. A more extensive scale is useful when trying to understand and communicate the implications of emergencies that last up to three days (as planned for at Toronto Hydro), incidents that last up to 10 days (as experienced in the 2013 Ice Storm), and incidents that last up to 30 days, as experienced by some Canadians in the aftermath of a 1998 ice storm.

3. Key restoration strategies and processes were not defined or understood at all levels of the Company with roles in the response.

The restoration strategy touches on all aspects of the response, including the restoration approach (circuit-based, area-based, order based)[7], call volume management, work order management, and the process to develop estimated time of restoration (ETR). The absence of a commonly-known restoration strategy during the Ice Storm response caused the LICC managers to create their own strategies and processes. For example, managers in one LICC did not have sufficient training or experience in managing an incident of this scale and continued to apply an order-based approach, while another LICC implemented circuit-based restoration based on lessons learned from work in Long Island during Hurricane Sandy.

4. Many Toronto Hydro employees did not have a pre-assigned and trained role for major incidents.

Utilities that use ICS typically assign and provide training on a second set of duties to many employees who are not operationally qualified. These secondary duties, increasingly called emergency response roles, are activated when the magnitude of an incident requires a level of support that exceeds the capacity of the day-to-day operations staff. A person filling an emergency response role (or "storm role") often performs tasks during emergency conditions that are different from their "normal" work activities. Some examples of emergency roles are damage assessor, wires down guard, customer service representative, materials handler, and staging site manager.

Toronto Hydro did not have in place a systematic, comprehensive process for assigning and managing emergency response roles. Many employees didn't have a pre-assigned role, while some, who were pre-assigned roles such as LICC management and support, were unfamiliar or ill-suited to the job tasks – or didn't have access to necessary systems and locations.

A few areas that would have benefitted from more effective response role support during the 2013 Ice Storm were:

- Incident management;
- Damage assessment;
- Logistics support;
- Wires down guards;
- Work order management; and
- Crew support, including clearing debris in the field and supporting certified power line persons.

[7] Different restoration approaches are described under the section 5.5.1. of this report.

5. Toronto Hydro conducted exercises and training at the Command Centre level, but did not perform sufficient training and exercise in the Local Incident Command Centres.

Prior to the 2013 Ice Storm, the roles and responsibilities as well as processes at the LICCs were not widely trained and exercised. The approach to focus emergency response training at the central command level first is consistent with that of many other utilities that are implementing ICS and emergency management programs. It can, however, lead to some breakdown in execution if the company has not adequately trained personnel responsible for managing the decentralized operations being managed by the LICCs.

5.2.2. Emergency Planning and Preparedness Recommendations

EPP-1 Reaffirm and communicate emergency management vision and strategy throughout all of Toronto Hydro.

Toronto Hydro executive leadership should affirm its belief that emergency management is a core competency of the Company. This can be achieved through a compelling vision statement and set of guiding principles that will drive the Company's response in the future. Executives should communicate these to the entire organization and incorporate them into the corporate emergency management plan. Nearly every Toronto Hydro staff member interviewed in this effort wanted to participate in improving the process. The emergency management vision and guiding principles should capture and "unify" this interest.

EPP-2 Continue to inculcate the ICS-based approach to emergency response.

- Expand the use of emergency response roles (i.e., second roles);
- Formalize the pre-event activation and communication process;
- Update the emergency levels to include worst-case planning assumptions; and
- Expand the training and exercise program to the service centres.

The adoption of ICS is a cultural shift for any organization. It can take years for a company to move from espousing the principles of ICS to having front line personnel use it on a daily basis. Learning from the public sector's adoption of ICS over the course of several decades and the experiences of other utilities, the deployment of ICS is deemed successful only when the senior management, middle management, and front line personnel use it on a regular basis. In order to achieve the frequent, more "routine" use of ICS, Toronto Hydro should focus on formalizing the second roles process and broadening training and exercises to include more front-line response staff.

Second Roles

A comprehensive second (or emergency response) roles process should include:

- Assigning an alternate set of duties to employees;
- Training and/or certifying employees to conduct those duties; and
- Providing them the opportunity to demonstrate competency through periodic exercises.

The effort should be conducted via collaboration between the emergency management organization, human resources, and Company operating groups.

Toronto Hydro should establish an "inventory" of second roles, documentation of the desired competencies (knowledge, skills, and abilities) or certifications desired for each, and a list of one or more staff members who fit the requirements. New employees should receive a second roles assignment upon hire, and current staff could receive assignments during the annual review process. Individual development plans should include metrics related to second roles. To start, Toronto Hydro could review current rosters to determine:

- Missing roles that should be added immediately (e.g., damage assessors, customer service representatives);
- How well the competencies of those currently assigned match with second role requirements; and
- Other internal sources of staff to fill roles (e.g., Finance, Human Resources).

Event Levels

Toronto Hydro should expand the emergency levels on the grid emergency scale it uses to address full-scale incidents (e.g., Level 4 or greater). When determining the associated triggers to use, Toronto Hydro should consider developing several planning scenarios (bounding scenarios) including one that details a "worst case" incident. This "worst case" would likely exceed the 2013 Ice Storm in terms of damage, employee and customer impact, and public safety risk. Toronto Hydro should develop the hazard scenarios in consultation with the City and Provincial emergency managers to support closer integration of planning and response.

Training and Exercises

Toronto Hydro should extend its ICS roles and process training to staff in the Local Incident Command Centres at a minimum. This would include classroom or on-line courses and periodic, planned exercises (table tops and functional) to reinforce and test capabilities. The training program should be put in place to support staff assigned to second roles, with refresher training offered annually. Additionally, the Company should require all employees who could be engaged in emergency response to complete basic

ICS training (on line or classroom) and require staff filling key command roles to be ICS-certified.

EPP-3 Enhance centralized emergency management group resources to support full implementation and sustainment of ICS and ongoing relationships with key stakeholders.

Toronto Hydro should maintain a centralized emergency management organization and continue to support on an all-hazards approach to emergency management. The assignment of a Director or higher-level executive to lead the group would indicate executive support of this role in driving emergency management discipline and capabilities across Toronto Hydro. The Company also should seek to increase the size of the organization. Ideally, it should include full-time, dedicated staff responsible for such functions as grid operations emergency response, training and exercise, plan management, ICS implementation and sustainment, emergency management coordination with the City and regulators, and possibly strategy and analysis.

EPP-4 Add dedicated grid operations emergency management resources.

In order to support the expansion and implementation of the Grid Disruption Plan, Toronto Hydro should seek adequate funding to increase the number of resources dedicated to its centralized emergency management organization as well as a specific grid operations emergency management group. This grid operations emergency management group would be responsible for updating the Grid Response Plan, developing specific restoration processes, and designing training curriculum. It could report directly to the centralized organization and reside within the grid operations organization, or report to the Senior VP of grid operations with a dotted line reporting relationship to the centralized emergency management group. This dotted line relationship will ensure alignment between grid operations and emergency management vision, principles, and strategy.

EPP-5 Update the Emergency Response Plan to improve comprehensiveness and usability.

The Emergency Response Plan should retain the current, all-hazards focus and should be enhanced to include roles and responsibilities of LICC and field response staff, especially during the grid disruption response. This effort will be substantial since it will include aligning key preparedness and response functions across the organization, documenting the processes (flow charts, forms, checklists) in the Emergency Response Plan, and identifying the roles and responsibilities of all who are responsible for executing them.

Toronto Hydro should focus first on updating function-specific process descriptions for overhead and underground outages, and other related documentation in the Grid Disruption Plan. Eventually, the Emergency Response Plan should include other function-specific and hazard-specific annexes (e.g., pandemic, physical security attacks, and flooding).

5.3. Resource Acquisition and Allocation

When a major incident occurs, the readiness of a utility to secure and deploy sufficient resources (i.e., personnel and equipment) directly affects the safety, speed, and efficiency of restoration. Addressing a number of outages that is orders of magnitude higher than experienced day-to-day, is a complex task requiring significantly more skilled workers, proficient supervisors, specialized tools, gear, and materials. Some staffing needs may be met through redeployment of internal resources, for example, using engineers to conduct damage assessments. Current vendors may be able to expedite delivery of equipment and services, such as standard gauge wire, poles, and meals.

Responses to larger events, however, typically necessitate the use of mutual assistance to secure people and equipment. As noted by the Edison Electric Institute, the association that represents all United States (U.S.) shareholder-owned electric companies, "Mutual assistance is an essential part of the electric power industry's service restoration process and contingency planning." The recent series of widespread, devastating weather events bear this out:

- Tens of thousands of utility workers representing 80 utilities from across the U.S. and Canada were deployed during the response to Hurricane Sandy and Nor'easter Athena in October/November 2012;
- 30,000 utility workers responded to the June 2012 Derecho that hit the mid-Atlantic west to Ohio, including crews from Canada; and
- Nearly 50,000 line workers and crews, including crews from Canada, assisted in the restoration efforts in response to Hurricane Irene in August 2011[8].

The mutual assistance network is a voluntary partnership of electric utilities across North America that is committed to helping restore power whenever and wherever assistance is needed. Electric utilities impacted by a major outage event are able to increase the size of their workforce by 'borrowing' crews from other utilities.

In the U.S., the mutual assistance network, initiated decades ago, is organized into Regional Mutual Assistance Groups (RMAGs) that manage the voluntary agreements among electric utilities within the same region. Members initiate requests for restoration assistance through the RMAG, which then facilitates the process of identifying available crews, coordinates logistics, and locates specialized resources as needed (e.g., tree trimmers, call centre support). In addition to belonging to one or more RMAGs, most U.S. utilities also participate in a nationwide mutual assistance agreement through the Edison Electric Institute.

[8] Source: Edison Electric Institute

Members of the Canadian Electricity Association (CEA), the national forum and authoritative voice of the electrical industry in Canada, have been active in RMAGs within Canada and the U.S. A number of Canadian utilities are members of RMAGs, primarily the North Atlantic Mutual Assistance Group (NAMAG) which was formed in 2013 through a merger of three smaller RMAGs. In response to increasingly frequent and severe weather events that tax RMAG capabilities, the CEA convened a National Mutual Assistance Working Group (NWAWG) in February 2013. This group will serve as a forum for sharing leading practices and improving all aspects of coordinating cross-border mutual assistance. [9]

Other sources of personnel to meet outage restoration demands are organizations that supply contract personnel. Often utilities use contractors to fill blue sky roles (e.g., line crews, tree trimmers, call centre representatives), and may have agreements in place to draw upon additional resources in the event of an emergency. These kinds of agreements tend to be tailored to reflect the particular needs of the utility and capabilities of the contractor, whereas mutual assistance agreements are more standardized.

As resource procurement gears up, utilities need to have in place the essential infrastructure to support more personnel, such as equipment, materials, fuel, transportation, personal care (lodging, food, laundry, etc.), along with crew mobilization, supervision, and demobilization processes, and alternate work and crew staging sites. Leading practice is to pre-establish agreements with multiple vendors, or have "turn-key" contracts (i.e., where a vendor handles significant portions of logistical support). Pre-established plans and agreements provide for the "scaling" and specialization of resources needed to support response to all incident levels and hazards. It is important to note that contractor resources that are released by one utility to support restoration at another utility are considered a part of the mutual assistance process. They are allocated according to the agreements between or among the relevant RMAGs.

The assessment of Toronto Hydro's resource acquisition proficiency addressed the following:

- Resource acquisition strategy;
- Determination of types and quantities of resources needed for an efficient restoration;
- Procurement of off-system support, including mobilization criteria, process, and agreements;

[9] Canadian Electricity Association, *Electricity Matters*, January 2013.

- Procurement of equipment, materials, transportation and fuel, housing, feeding and care of crews, and all other logistical needs;
- On-boarding process and procedures, including safety training;
- Deployment of off-system resources such as work assignment, supervision, and coordination with internal crews; and
- Demobilization of resources, including criteria and processes.

5.3.1. Resource Acquisition and Allocation Findings

Nearly all of Toronto Hydro's core trade workers (98%), management and professional office staff, along with 450 mutual assistance field resources supported restoration following the 2013 Ice Storm. A wide range of crew types was used, including overhead line, underground line, forestry, construction, and trouble shooters. The Company sourced the supplemental crews through sustained contractors (who have agreements in place to provide support), other contractors, the City of Toronto, and mutual assistance from other utilities. Notably, this was the first time that Toronto Hydro had used mutual assistance. Ten utilities from within and outside the Province of Ontario supplied approximately 250 linemen.

The Company called upon existing relationships with its third-party warehouse provider, an expediter, and corporate food service provider to quickly source and make available the equipment, materials, and meals to support the incoming and Toronto Hydro crews. The arrangements for people and the resources needed to support them were in place within 48 hours. These included the provision of flight transportation, trucks, equipment, lodging, and food for mutual assistance crews from Manitoba Hydro.

While the mutual assistance process worked well and accelerated the restoration process, most of the procedures were developed just-in-time. The current plan does not detail the mutual assistance process and procedures or include contracts with third-party vendors to accommodate a large influx of resources. Also, at the time of the event, Toronto Hydro did not belong to any of the U.S. RMAGs. The Company has since applied to join the Northern Atlantic Mutual Assistance Group (NAMAG).

Resource Acquisition and Allocation Strengths

1. Safely deployed the largest number of resources for any response in Toronto Hydro history.

Toronto Hydro management began to reach out to off-system resources immediately, starting with an email to other utilities on December 22, 2013, at 3:40 p.m. In total, 10 utilities provided approximately 250 lineman and forestry workers. See Appendix B for a list of utilities that supplied mutual assistance. The total number of resources supporting restoration following the 2013 Ice Storm, including internal staff and field personnel, contractors, and mutual assistance, was nearly 1,400 – the largest number of any response conducted by Toronto Hydro.

During the course of the restoration, only one recordable safety incident occurred. A recordable is defined as an incident that causes a worker to miss work time. This statistic is noteworthy as the persistent ice and freezing temperatures following the storm made work locations (uneven surfaces, back yards, heavily canopied areas, locations requiring ladders to access) hazardous.

2. Developed and applied mutual assistance processes in real time that generally worked.

Toronto Hydro crews have provided mutual assistance to other utilities several times in recent years including restorations following Hurricane Irene (August 2011), the Derecho (June 2012), and Hurricane Sandy (October 2012). Many linemen also supported the lengthy restoration effort following the 1998 Quebec ice storm. While Toronto Hydro has experience *offering* mutual assistance, the first time the Company *requested* mutual assistance, was for the response to the 2013 Ice Storm.

Toronto Hydro executives and the Logistics Resource lead, who was responsible for mutual assistance intake and support processes, relied upon established relationships with other utility executives and agreements, practices, and processes in place to support daily operations to bring on and support mutual assistance providers. They were able to call upon current vendors to expedite materials and equipment deliveries, expand food services, and provide fuel. The logistics group also was able to quickly procure other services, such as lodging, when pre-existing agreements or processes did not exist.

Beginning on Sunday afternoon December 22, 2013, approximately 12 hours after the outages started and after the Company declared the Level 3 emergency, the Toronto Hydro Planning Section Chief initiated calls to other utilities within the Province of Ontario and in the neighbouring Province of Manitoba, to request line and forestry crews. This decision was based on the number of customers affected and the conditions in the field. The sustained contractor (a company with an agreement in place for daily construction work) was contacted at 4:00 a.m. on Sunday, December 22. It is important to note that some of the neighbouring utilities were impacted by the same event and were restoring their own systems and therefore not in the position to provide assistance to Toronto Hydro. Some of these companies eventually sent resources after they restored outages to their customers.

Mutual assistance crews (including some forestry crews) began to arrive on Tuesday, December 24. Contractor crews (ranging from 2-4 crews, with 3-6 members each) were on site by Sunday, December 22. Contractor-provided forestry crews began work on Sunday, December 22, and forestry crews provided by the City of Toronto engaged on Tuesday, December 24.

After securing mutual assistance crews from external sources, Toronto Hydro staff from the Human Resources and Safety, Power Systems, and Operation Support Services

Divisions drew upon experiences from responding to other Level 3 incidents (e.g., Hurricane Sandy) to quickly develop the content for onboarding briefings to off-system mutual assistance and forestry crews.

Also, Toronto Hydro provided “bird-dog” supervisory support to all but a few (later arriving) mutual assistance crews. Supervisors identified to fill these roles (approximately 60) were experienced in responding to emergency situations. They knew the number of resources needed and processes required to keep crews fully engaged in restoration (e.g., work protection clearances, access to tools and equipment, coordination with other crews, etc.).

3. **Flew in, equipped, and deployed mutual assistance resources from Manitoba within 48 hours.**

When feasible, mutual assistance crews arrive with their own equipment (e.g., trucks, specialized tools, clothing, etc.). In order to expedite their arrival, the 42-member contingent from Manitoba Hydro was flown to Toronto. This was the second largest number sent by a responding utility. Crew members arrived with their own personal protective equipment and tailboards. Toronto Hydro supplied everything else they needed to support the restoration. This included bucket and passenger trucks (for crews and supervisors), equipment, tools, materials, supplemental clothing, and additional safety equipment requested.

Toronto Hydro transported, outfitted, and deployed all Manitoba crews and supervisors within two days of placing the call for assistance to Manitoba Hydro management. Toronto Hydro resource leads began to prepare on Monday, December 23, for the intake of the Manitoba Hydro workers. Crews were out and working by mid-day on December 25. This was a unique feat. By contrast, a number of utilities attempted to fly in crews from the West Coast during the Hurricane Sandy restoration, but ran into significant barriers and delays.

4. **Conducted thorough mutual assistance on-boarding process and safety briefings.**

Upon arrival, mutual assistance crews were transported and checked-in to their respective hotels, conveyed to the LICC from which they would be dispatched, and given an extensive orientation briefing that addressed local safety rules and conditions, high-level work protection code information, and what to expect on the streets. Trades training staff from the Human Resources and Safety Division conducted 14 training sessions. The Manager of the Mutual Assistance LICC conducted 2 training sessions. In addition, each day, mutual assistance crews would receive safety briefings prior to being dispatched to work locations.

5. **Strong collaboration between City and Toronto Hydro tree crews on restoration activities.**

The City of Toronto Urban Forestry’s top priority during the aftermath of the 2013 Ice Storm was to provide resources to Toronto Hydro to restore power. The City Director of

Forestry participated in daily planning conference calls that included Toronto Hydro executives, to review progress and identify needs. The City provided forestry crews directly to the LICCs, or to work locations, as directed by Toronto Hydro.

Resource Acquisition and Allocation Opportunities for Improvement

1. **Mutual assistance processes and agreements with other utilities across Canada and North America were not formalized.**

As a member of the CEA-sponsored National Mutual Assistance Working Group (NMAWG), Toronto Hydro is engaged in discussions with other utilities across Canada, to establish a national mutual assistance agreement, share leading practices, and improve cross-border mutual assistance. Toronto Hydro also is awaiting approval of its application to join NAMAG. Going into the 2013 Ice Storm, the Company did not have written mutual assistance agreements in place with other utilities, nor did it belong to regional or national mutual assistance groups. For the 2013 Ice Storm response, Toronto Hydro obtained mutual assistance from other Canadian utilities through personal, peer-to-peer contacts.

This less formal approach worked in large part because other utilities were experienced in providing mutual assistance, could quickly agree to terms (e.g., right to leave if needed, billing for just expenses incurred), and had crews available. If the 2013 Ice Storm had been more widespread, it likely would have taken longer to secure the additional line and forestry resources to restore in a reasonable amount of time. Most North American utilities participate in one or more regional mutual assistance groups, and/or a nationwide mutual assistance agreement to mitigate the risk of not having inadequate numbers or types resources to execute a restoration safely and reasonably.

2. **The process to acquire and coordinate the deployment of City forestry crews was not defined in advance.**

The 2013 Ice Storm affected large portions of the tree canopy of the City of Toronto, in turn causing significant and prolonged outages for Toronto Hydro customers. The nature of the damage called for deployment of a significant number of forestry crews. On a blue-sky day, Toronto Hydro typically uses between seven and eight contractor forestry crews and one Company forestry crew. In addition to the company contractors and crew, and the City forestry resources, approximately 200 forestry resources obtained through mutual assistance, executed tree cutting and clearing work, in support of the restoration.

Urban Forestry Operations of the City of Toronto was a logical source for this assistance. In the course of their work, City forestry crews communicate with Toronto Hydro every day, are familiar with the territory, and are local. Although Toronto Hydro and City Urban Forestry were participating in periodic discussions about emergency and work planning, they did not mutually define and document processes and guidelines for communicating strategic priorities, establishing work hours, assigning supervisory roles, or sharing contractor-supplied crews. The initial contact to “get crews on the road,” along with the daily SOC calls worked well, but communication became less effective among the middle and field ranks.

3. Toronto Hydro has limited ability to accommodate a large influx of mutual assistance resources.

Ten utilities sent approximately 250 line personnel to support Toronto Hydro’s Ice Storm restoration. As one manager interviewed observed, “This is the size of a small company.” Utilities experienced in managing large numbers of mutual assistance workers typically have in place comprehensive plans, processes, and roles to support all aspects of crew management, including onboarding, lodging, food, laundry and other personal care, equipping, transporting, work assignment, supervision, and demobilization. During a response to a larger event, a significant number of host utility resources are needed for orientation/training, off-system crew supervision, and logistical support.

Toronto Hydro’s Grid Disruption Plan does not address mutual assistance specifically. In the absence of defined and trained procedures and roles, Toronto Hydro accommodated incoming mutual assistance crews through “just in time” assignment of internal staff who were able to draw upon personal experience and lessons learned providing mutual assistance to other utilities (e.g., during Hurricane Sandy and the 1998 Quebec ice storm). They were able to put together training and safety briefings, roster enough experienced trades people to serve as “bird-dogs” for most mutual assistance crews, secure adequate lodging, and equip crews who arrived without trucks or other equipment.

While interviews with mutual assistance providers indicate that Toronto Hydro handled the additional resources well, the approach used may not scale to an even larger event. Virtually all available internal supervisory resources were used and there would have been a shortage of bucket and commercial vehicles had crews been flown in (in addition to the Manitoba Hydro crews).

4. The demobilization process for mutual assistance crews was not clearly defined.

Leading mutual assistance practices address the full lifecycle of off-system resource management, from acquisition through release. Determining when to wind down the use of mutual assistance crews can be difficult, especially when there are lasting effects (ongoing outages) from a storm, like Toronto Hydro experienced after this storm. The mutual assistance portion of an Emergency Response Plan should describe the process and criteria for releasing crews along with procedures, checklists, and forms for collecting equipment and conducting a formal check-out. Mutual assistance agreements address demobilization guidelines and authorities as well.

Toronto Hydro management did not have a shared understanding of how and when to release mutual assistance crews. In the absence of clear direction, the utilities providing mutual assistance resources determined when they would be leaving. In one case, the crews from one utility decided to leave, with Toronto Hydro's concurrence, and then were brought back from the airport to work another day.

5.3.2. Resource Acquisition Recommendations

RA-1 Adopt a resource management strategy that provides for deployment of all available resources, seamless integration and coordination of crews, and optimal supervisory span of control.

Building on the informal processes and relationships used to access mutual assistance during the 2013 Ice Storm, Toronto Hydro should formulate a resource strategy to support emergency response that addresses:

- All likely sources of mutual assistance;
- Numbers and types of resources needed for all incident levels; and
- Criteria for triggering mutual assistance requests.

As part of the emergency plan documentation, agreements should be put in place with utilities, contractors, and City agencies. The companion mutual assistance plan would:

- Detail the mutual assistance processes, (i.e., mobilization, onboarding, care and feeding, equipping, deployment, supervision, demobilization);
- Establish roles and responsibilities and authorities;
- Provide criteria for demobilization and policies; and
- Include template and job aids (e.g., standard expense forms).

Also, the plan would specify the number of supervisors needed for "bird-dog" and other oversight support to mutual assistance crews, along with a roster of qualified and trained internal and contractor staff.

- **Establish mutual assistance process and agreements that encompass all potential sources of crews: regional, national, cross-border utilities, contractors, and City.**

The mutual assistance strategy will distinguish types and sources of mutual assistance desired to support all levels and types of likely hazardous incidents. Primarily, this assistance will be limited to line and forestry crews, but could include other roles, like damage assessors and underground crews. Toronto Hydro should put in place written agreements with identified primary and backup providers.

With utilities, this may be done through joining one or more RMAGs (within Canada or including U.S. RMAGs), participating in the national mutual assistance agreement, or creating individual agreements. Toronto Hydro should continue to pursue membership in NAMAG and explore joining other RMAGs in the United States, including the Great Lakes Mutual Assistance Group (GLMAG).

With City departments, Toronto Hydro should accelerate current discussions and include terms and expectations in the respective Company and City emergency response plans (or in a joint emergency response plan). With sustained and other contractors, Toronto Hydro should review current terms and add "scaling" requirements to ensure availability of resources when significantly more crews are needed.

- **Document the process, with pre-defined decision criteria, to mobilize and demobilize mutual assistance**

Toronto Hydro's Emergency Response Plan should include documentation of all activities, decisions, roles, and infrastructure needed to support incoming mutual assistance. Since activating mutual assistance can be costly (i.e., as soon as the utility orders crews, and the crews start mobilizing and traveling, all the costs are borne by the requesting utility), it's important that Toronto Hydro establish specific, comprehensible criteria to guide the responsible parties to make timely, appropriate decisions. Criteria could include:

- Number of outage spots;
- Number of customers affected;
- Projected level of damage;
- Capacity to effectively deploy off-system resources;
- Availability of internal crews and supervision;
- Skills needed (e.g., forestry); and
- Public perception (e.g., Why are crews leaving when my power is off still?).

- **Source and prepare supplemental supervisors to accommodate maximum crew scale-up.**

As a corollary process to instituting second roles, Toronto Hydro should identify and train internal staff that are qualified to serve as mutual assistance crew "bird-dogs" and/or supervisors. These additional supervisors may be needed if utilities providing mutual assistance are unable to send a suitable number. The size of the internal pool should be large enough to provide adequate span of control (1-2 crews for bird-dogs; each with 5-7 bird dogs per supervisor). Sources of qualified personnel could be former crew supervisors currently employed in other positions, retirees, former trades people on modified assignments (due to medically-documented reasons), and sustained contractors.

RA-2 Create a comprehensive, scalable logistics plan as part of the Emergency Response Plan.

A logistics plan describes the infrastructure and services needed to support restoration, particularly with regard to mutual assistance resources. The processes, agreements, and roles detailed in the plan should scale in accordance with the incident level. For example, a staging site may be needed in the wake of a large hurricane, or super storm, but not for a Level 3 ice storm.

Agreements with vendors should be negotiated in advance (at least in part) to ensure that vendors can plan accordingly. These discussions will provide valuable planning information to vendors, help Toronto Hydro assess vendor capability to support a large-scale response, ensure that priority is given to Toronto Hydro, and uncover any issues or risks (e.g., potential materials shortages). Some utilities contract with vendors that provide "turnkey" support, taking care of virtually all logistical needs related to mutual assistance.

5.4. Damage Assessment and Restoration Planning

Effective planning and damage assessment are essential for a rapid and effective restoration. The information gathered through a damage assessment process provides the planning team with the insights necessary to:

- Determine the type and number of resources required to support the restoration;
- Create the most efficient restoration plan based on the extent and type of damage and available resources;
- Develop accurate restoration estimates (ETRs);
- Support daily work plan development and customer communications; and
- Identify safety issues/dangerous conditions.

The objective is to perform damage assessment as early as possible, often within the first two to three days after it is safe to begin work in the field. Assessments are usually conducted by feeder (circuit) according to a pre-established priority.

The information captured in the field is entered into the outage management system (OMS) and used by the Planning Section in the SOC to prioritize restoration work and develop ETRs. A large incident may necessitate more than one cycle of damage assessment:

- First, a quick, higher-level scan to understand the amount and type of damage; and
- Second, a more thorough assessment to capture detailed damage information on each circuit, including the number of poles, wire spans, and equipment to be replaced at each specific location.

During major events, utilities use damage assessment teams, often referred to as patrollers, to evaluate damage before a line crew is dispatched to perform repairs. Damage assessors patrol circuits to identify trouble locations and assess the extent of the damage. They document what they find on a pre-developed form or a circuit map. Some of the more advanced utilities have implemented tools, such as tablets, that allow damage assessors to enter the information directly into a system linked to the GIS and OMS systems.

During day-to-day operations or minor events, line crews or "trouble crews" typically handle damage assessment, but additional resources are usually needed to conduct this process when a major event occurs. Other pre-qualified resources, such as engineers, designers, or retired linemen or supervisors may perform this role. Using other suitable personnel to conduct damage assessment allows trouble and line crews to focus exclusively on repairing the damage and restoring power.

In addition to conducting damage assessment, leading utilities have implemented a forensic analysis process to collect detailed information on specific equipment and structure failures. They use this data in statistical analyses to determine causes of outages during major events, which then supports subsequent analysis of different options to harden the distribution system for future events.

The review of Toronto Hydro's damage assessment and restoration planning competency addressed the following:

- Definition and execution of a damage assessment process;
- Capture and use of damage assessment data;
- Development of ETRs;
- Establishment and adherence to restoration priorities;
- Work planning practices; and
- Use of standard planning tools.

5.4.1. Damage Assessment and Restoration Planning Findings

Following the industry leading practice, Toronto Hydro established priorities early in the restoration and restored customer service in accordance with those priorities. The Company maintained focus through frequent Command Centre conference calls and communicating the specific priorities for the subsequent planning period. The overnight planning activities, however, were not conducted consistently by all of the LICCs.

Toronto Hydro used its "triage"[10] process to gather damage information. This process served other needs, apart from damage assessment, including evaluating the wire down locations being reported by the customers, crews and first responders, and making them safe for public and utility employees participating in the response. Toronto Hydro used underground crews, service crews, and designers (who are not directly involved in the physical restoration of the electric system) to conduct the triage process.

Toronto Hydro established restoration priorities early and restored customer service in accordance with those priorities. Response leads at the SOC and LICCs maintained focus on priorities through frequent Command Centre conference calls and communicating the specific priorities for the subsequent planning period.

Damage Assessment and Restoration Planning Strengths

1. Overall restoration priorities were in line with industry practices.

Toronto Hydro established and followed restoration priorities during the 2013 Ice Storm response that followed typical industry practices. These priorities were:

- Public safety (911 calls and live down wires);
- Critical customers (e.g., hospitals, water pumping stations, 911 call centres);
- Substation and feeder backbone restoration (i.e., portions of the system that provide service to large blocks of customers);
- Lateral sections of the circuits (i.e., branches of the circuit that are typically single phase lines that serve several streets in a neighbourhood); and
- Customer service drops (i.e., lines that connect the house to the overhead transformer and typically service one or two customers).

Since Toronto Hydro serves a densely populated urban area, its electric distribution system has a number of connection points between different circuits (i.e., circuit ties) that allow them to quickly restore service to a portion of customers by switching load from one feeder to another. The initial focus of restoration was to secure any known locations that could compromise public safety. The second priority was to restore customers designated as critical by the City of Toronto. The City identified this group by the morning of December 24, 2013.

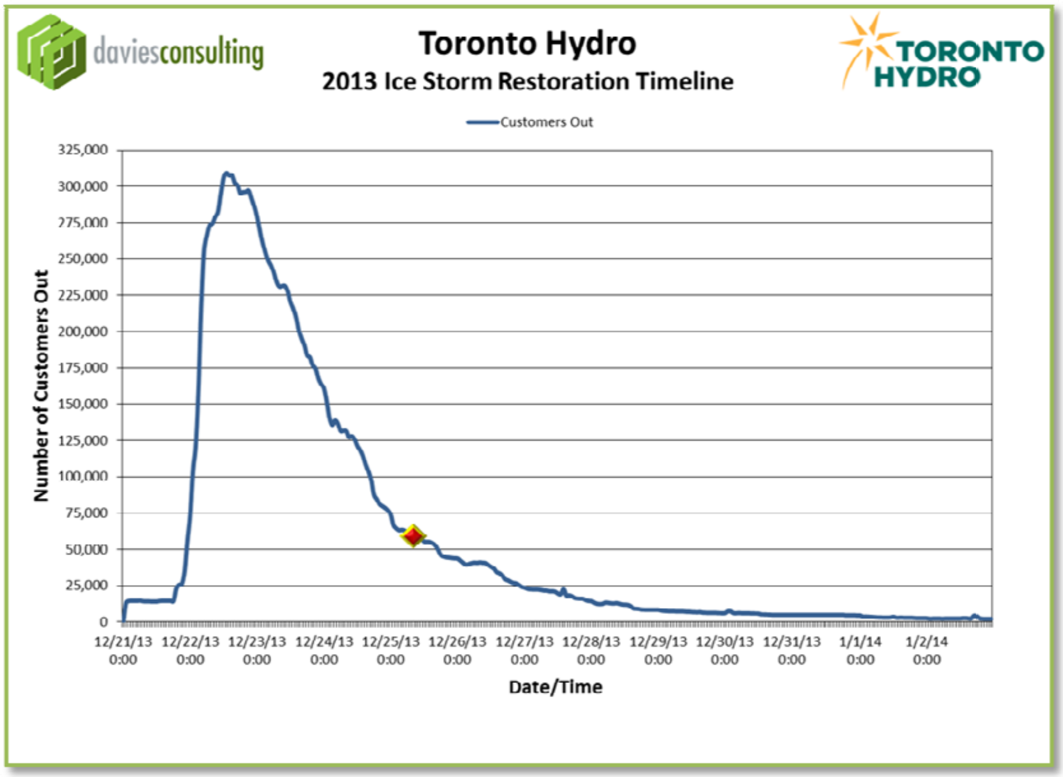
The restoration continued by restoring feeder backbones, then laterals, and lastly, individual customer connections. It is important to understand that in order to keep

[10] "Triage" refers to the process developed by Toronto Hydro to conduct field evaluation of downed wire reports received from customers and either make the location safe or escalate it to a more appropriate resource. As a part of the process, the resources dispatched to the location gather data on the specific damage (e.g., pole, transformer, wire) to ensure that, subsequently, the right resources and the required equipment are dispatched to repair the damage.

crews productive during a large restoration, some priorities are addressed in parallel. This is especially true during periods of transition between categories of priorities.

By following these priorities, which addressed larger blocks of customers first, Toronto Hydro was able to restore power to 86% of the customers who were out at peak within the 72 hours from the start of the field restoration (See Figure 13).

Figure 13: December 2013 Ice Storm Restoration



2. The Command Centre coordination calls (every three hours) provided useful information and maintained alignment of Local Incident Command Centres to restoration priorities.

Once the Command Centre (System Operations Centre) was activated on Sunday morning, December 22, 2014, the Incident Commander held coordination calls every three hours. The standard industry practice is to conduct these calls twice a day. Toronto Hydro chose to hold them more often given the degree of damage caused by the ice storm.

These calls were essential to maintaining response organization alignment to restoration priorities. They provided a platform for participants to share restoration progress updates and readjust plans for the subsequent planning period. The participants on the calls included the general staff within the Command Centre as well as the leads from the LICCs.

3. Some Local Incident Command Centres conducted planning activities overnight to facilitate work assignments and crew deployments for the subsequent shift.

A utility industry leading practice is to use the overnight shift to plan and organize assignments for the subsequent day shift. Conducting work planning at night affords the day shift managers and supervisors more time for crew support and for the extensive coordination with external stakeholders that typically occurs during the day. In addition, the restoration data from completed jobs is updated at the end of the day shift to provide the overnight shift planners with the most accurate job status information.

In some of the LICCs at Toronto Hydro, the leads established a process for planning the specific work for the next day, making crew assignments and creating job packets overnight. This practice aided the deployment of the day crews.

Damage Assessment and Restoration Planning Opportunities for Improvement

1. Lack of real, or near real-time situational awareness of outages and work progress below the feeder level.

A critical element of a major event restoration process is maintaining an understanding of the current state of the system. This includes having real or near-real time knowledge of the restoration status and field conditions, as well as any other information that can support decision making around priorities and resources. While Toronto Hydro could assess the outage status at the feeder level, primarily through its SCADA (remote control and dispatch analysis) system, the outage status below that level (e.g., street) and associated damage assessment information were not readily available throughout the event.

2. Damage Assessment process was not defined, documented, or consistently applied across the Local Incident Command Centres.

Toronto Hydro's triage process addresses portions of the damage assessment process but does not provide for the systematic evaluation of the system condition in the field, capture of infrastructure damage information, or timely provision of that information to other stakeholders (e.g., Planning Section, ETR developers, and Communications). The Grid Disruption Plan does not include a comprehensive, detailed damage assessment process. Lacking information about the process flow, roles and responsibilities, forms, checklists, and other job aids, some LICCs addressed elements of damage assessment as part of the triage process, or developed ad hoc guidance in real time.

3. Restoration estimates were not developed at various levels of specificity.

During an incident, the Restoration Planning section within the Central Command Centre is responsible for developing estimated times of restoration (ETRs) throughout the incident response. At the start of a restoration, while the damage assessment is in progress, utilities can provide this information at a high-level only – a global ETR. As the restoration progresses, planners can refine estimates, providing information at a substation, circuit, or individual customer level. An ETR usually is the most critical piece of information to a customer. The Company did not have in place a systematic and documented process for creating accurate and timely ETRs at multiple levels of specificity (e.g., circuit, customer).

4. Work planning practices varied across Local Incident Command Centres.

The planning activities that took place at the LICCs included developing the work plan for the next period and creating associated work packets. These packets typically include print-outs of the OMS outage record, a circuit map, and any damage information collected by the assessors. At Toronto Hydro, each LICC manager used an "individually-developed" work planning process. Some generated assignments overnight and planned multiple jobs for the crews in advance, while others assigned new jobs to the crews as they completed their work.

5. The Central Command Centre and Local Incident Command Centres did not use standard planning tools.

A leading practice in the utility industry is to use standard forms to capture and consolidate planning information throughout an event. Using a common template accelerates information exchange and ensures that the same level of detail is captured and made available to all restoration participants. Toronto Hydro's Grid Disruption Plan does not reference specific tools and forms (e.g., Incident Action Plan) that the Planning Section should use to collect, consolidate, and share commonly-used planning information.

5.4.2. Damage Assessment and Restoration Planning Recommendations

DAP-1 Institute a damage assessment process that defines the required approach, procedures, and competencies to establish situational awareness and planning inputs within the specified timeframe (e.g., within 48 hours).

Toronto Hydro should set objectives for establishing overall situational awareness and conducting the initial damage assessment in major events. These objectives should include the timeframe within which the initial damage assessment will be completed and the level of information required to support key decisions. For example, for a Level 2 event, the global ETR should be made available within 24 hours and for a full-scale event within 48 hours. Once it has established these objectives, the Company should work with selected stakeholders, such as the City, to identify the information required for each key decision throughout the event, then create a process and assign responsibilities for capturing that information in a timely and accurate manner.

Specific to damage assessment, within the current triage process, the Company should separate the wires down investigation component from the damage information gathering process. There should be a clearly defined, end-to-end processes for addressing both wires down and damage assessment with pre-assigned responsibilities, data collection specifications, and required competencies and training, Also, the Company should determine the number of assessors required to complete the assessment within the pre-defined timeframes and identify potential sources of qualified personnel, which can include third-party contractors and mutual assistance.

- **Build a stronger damage data reporting interface with OMS and alternate data capture processes and tools.**

In addition to instituting the process for conducting damage assessment, Toronto Hydro should evaluate different options for automating the capture and integration of damage assessment field data. One example is providing tablets with GPS capabilities to assessors to use to identify specific equipment in the Company's GIS system.

DAP-2 Develop a process to establish (calculate) timely and accurate ETRs.

Most customers experiencing an extended outage want to be able to develop a coping plan. They need to have a reasonably accurate sense of how long they may be without refrigeration, heat, or air conditioning. This information is especially critical for vulnerable populations.

Toronto Hydro should develop a more rigorous process for developing ETRs throughout the course of an event. The Company should first understand stakeholder needs and then develop realistic goals for creating ETRs. Customers generally understand that in the aftermath of a particularly damaging event, like the 2013 Ice Storm or a major hurricane, a utility has to spend some time assessing the situation in order to provide reasonable restoration estimates. So, for example, the earliest time by which Toronto Hydro could provide an initial ETR may be within 48 hours in a full-scale event.

Toronto Hydro should set specific thresholds for issuing the initial ETR (usually at the global level) as well as the timeframes for refining that estimate to more detailed levels (e.g., neighbourhood/sub-station, circuit, individual customer) at different points of restoration and for different levels of events. Table 5 below provides an example of a tool the Company could develop to support the ETR process.

Table 5: Example of an ETR Timing Matrix

Storm Level	Level 1	Level 2	Level 3	Level 4 or Greater
Definition	Estimated restorations of 8 hours or less	Estimated restorations of more than 8 & less than 24 hours	Estimated restorations of more than 24 hours & less than 3 days	Estimated restorations greater than 3 days
ETR Communication Guidelines	Individual specific ETR available at first call	Individual specific ETR available at first call	Post Assessment 12 hrs.– global 24 hrs. – county 36 hrs. – circuit 48 hrs. – individual	Post Assessment 24 hrs. – global 48 hrs. – county 72 hrs. – circuit 96 hrs. – individual
Coping Information	Specific information about local damage	Specific information about local damage	General information to begin with increasing granularity	General information to begin with increasing granularity

Also, the Company should assign responsibilities for developing and monitoring the ETRs, so that any potentially expiring estimates are evaluated ahead of time and either addressed or adjusted in advance.

DAP-3 Establish standard work planning processes and procedures; train and exercise response personnel to drive consistency across central and local commands.

Toronto Hydro should develop, document, and communicate the process to be used for work planning during major events. This would include activities such as: identifying priorities, developing incident action plans, assigning work to the available field crews, and creating work packets. A set of standard forms and tools should accompany this process.

Also, the Company should detail the roles and responsibilities for this process, specify the requisite competencies, and pre-assign personnel to fill these roles during an incident. The Grid Disruption Plan should include process and role documentation along with the standard forms and other job aids. In order to ensure compliance with the new process, the emergency management group should develop and execute a training program, including a table top exercise, to provide adequate opportunities for staff to understand and practice their roles.

5.5. Restoration Execution

The keys to successful restoration are persistent attention to employee and public safety, sustained focus on restoration priorities, ability to decentralize restoration and avoid bottlenecks, and effectiveness of crew deployment throughout the event.

Preserving the safety of public and utility workers is the most important aspect of the restoration execution. Methods that utilities use to conduct restoration efforts safely include safety orientations for incoming crews, daily safety briefings at the start of each shift, and daily safety bulletins. Some utilities also have developed handbooks that provide an overview of their system configuration and typical hazards, which are used by off-system crews to familiarize themselves with the potential field conditions.

Effective restoration of large outage events often requires the use of off-system resources. This influx can create a workforce that is far larger in size than the one that carries out the day-to-day work. Efficient and safe deployment of such a large number of resources requires careful coordination, effective field management, and adequate pre-planning of the work.

In large events that affect significant portions of the system, utilities decentralize the restoration function and manage the work locally. The intention is to reduce bottlenecks, such as processing switching orders or dispatching crews. Since utilities have different switching procedures, it is important to carefully manage the transition to a decentralized model in order to ensure the safety of public and utility workers.

A restoration typically follows a set of agreed upon priorities, starting with the critical infrastructure first. In some cases, however, in order to re-energize certain essential facilities, utilities may have to restore less critical parts of the system first. For example, when restoring a hospital that is at the end of a circuit, crews may need to restore the substation, and main sections of the distribution circuits (i.e., feeders). As a result, a number of other customers who are not deemed to be part of the critical infrastructure would be restored along with the hospital.

As mentioned earlier, public safety is the number one priority during restoration, with handling downed wires and making the system safe a high priority that presents several challenges. Fallen overhead wires that are energized pose a public safety threat. It is difficult to differentiate electric wires from telecommunications wires, or evaluate if downed electric wires are energized. Therefore, a large number of downed wire locations throughout the service territory creates an urgent demand for restoration resources.

Since downed wire locations can often number in the thousands, utilities typically focus first on those locations that are reported though 911 emergency calls and where wires are visibly arcing, smoking, or on fire. At these locations, crews cut, clear, and make safe locations so that restoration crews can repair the damage according to the restoration priorities. The utilities use public campaigns and communications channels to educate the public on the dangers of approaching downed wires during major events.

Service lines that serve single residences or small groups of customers are frequently restored at the end of the event, resulting in a long “tail” on the restoration curve, with multiple days at the end spent restoring very small enclaves of customers. Some utilities have service crews and electricians who are not qualified to work on primary voltage lines and an effective restoration practice is to deploy these resources early to begin restoration of the service drops, which are typically handled last, while line crews work on restoring primary lines.

The assessment of Toronto Hydro's restoration execution addressed the following:

- Safety performance;
- Restoration strategy and execution efficiency;
- Cut, clear, and make safe process;
- Wires down;
- Dispatch; and
- Coordination with external stakeholders (e.g., City, Province)

5.5.1. Restoration Execution Findings

When compared with similar events in the past, the overall customer restoration curve during the 2013 Ice Storm was in line with industry experience. The restoration curve shows the number of customers out over time throughout the restoration period and depicts the rate of restoration (See Figure 13). Since public and worker safety is paramount, it is important to note that Toronto Hydro safety performance during the 2013 Ice Storm restoration was excellent. There was only one recordable incident during the event.

In addition, the Company worked with the ESA to introduce flexibility depending on situation based on safety risk for reconnecting services to reduce the hardship by the customers. It also managed the work protection and special requests well to ensure that there were no unusual delays in restoring the customers. The single largest area of opportunity in the restoration process is the inconsistent coordination of the work across the Local Incident Command Centres, including adherence to restoration approach and use of standard dispatching practices.

Restoration Execution Strengths

1. Safety performance was excellent.

Among the approximately 1,250 field resources involved in the restoration over an 11-day period, there was only one recordable incident. Typically, safety performance during major events is better than day-to-day safety performance. When compared to the performance of other utilities during similar events, however, Toronto Hydro's results rank among the best.

In order to ensure safe restoration, Toronto Hydro created an on-boarding curriculum for the off-system crews that included a comprehensive safety orientation. The supervisors held safety briefings at the start of each shift to update crews on safety hazards and emphasize the need to follow safety procedures. In addition to the exceptional worker safety record during the restoration, there were no deaths in the greater Toronto area that were directly attributed to the 2013 Ice Storm. This is a notable outcome for all the City staff and first responders who came together to restore normalcy to the residents.

2. **Dispatch functions were decentralized to Local Incident Command Centres early in the restoration process.**

In line with leading industry practices, during major events Toronto Hydro separates its service territory into local areas that are managed through Local Incident Command Centres (LICCs). This provides the Company with the ability to decentralize the dispatch function, thereby reducing the potential for bottlenecks at the central dispatch location. Through decentralization, Toronto Hydro doubled the number of dispatchers during the 2013 Ice Storm. Most of these dispatchers were located in the LICCs and had access to the outage management system (OMS) and could perform dispatch functions in accordance with local restoration priorities at the time.

3. **Coordination with the Electrical Safety Authority (ESA) to reconnect customer premises was adjusted during the event to reduce hardship.**

Standard ESA guidelines for restoring service connections require the equipment on the customer premise to be safe in order to reconnect power. During major events, the mast with the meter head may be damaged (See Figure 14), requiring the customer to perform repairs before service can be restored. The work is typically performed by a qualified electrician hired directly by the customer.

Figure 14: Example of Mast Damage

When utility workers attempt to restore a service where they deem equipment on the customer premise to not to be in proper condition, they are directed by ESA regulation to disconnect the customer service. In the initial days of the 2013 Ice Storm response, Toronto Hydro crews found some instances where the customers had power but their equipment was not in proper condition and they were forced to disconnect customer services. The Company quickly realized that this would create an unnecessary burden on customers who didn't lose power. Toronto Hydro worked with the ESA to amend the process, creating a form for customers to sign acknowledging that they would repair their equipment within a certain period of time, so their service would not be disconnected. The new process worked well for the majority of customers, but has not been fully adopted for future events.

4. Special requests were handled within the pre-defined priority order.

During major restorations, utilities often receive requests from elected officials and other influential stakeholders to restore a specific customer or commercial premise sooner than the restoration strategy would dictate. As a result, responding to a special request could cause a utility to deviate from focusing on the priorities in the restoration plan. During the 2013 Ice Storm, members of the Toronto City Council and local government for the most part allowed Toronto Hydro to restore according to the pre-established priorities and only intervened when there were truly life-threatening emergencies. In those occasions when a special request was made that did not seem to be warranted, Toronto Hydro executives stayed firm and did not deviate from the restoration strategy.

5. **The work protection process did not cause unusually long delays in restoration.**

According to interviews with the field crews from Toronto Hydro, there were some normal and expected delays in performing the work protection. The practice of work protection (i.e., "switching and tagging") provides clear guidelines under which a line crew can operate different devices that allow it to reconfigure the circuit and restore power to portions of customers more quickly as they repair the damage. This is an area of restoration where utilities typically encounter delays because a substantially larger number of switching requests from the field arrive at the central location (i.e., system control centre) at the same time. Sometimes, these delays can exceed one hour depending on the number of orders simultaneously requested which are handled by a relatively small group of qualified system operators. Toronto Hydro operators were able to issue switching orders within a reasonable amount of time without causing any delays beyond those that are typical for a restoration effort of this magnitude.

6. **"Bird-dogging" of mutual assistance crews worked well.**

Off-system crews that are brought in through mutual assistance often are not familiar with the local electric distribution system. A leading practice is for the host utility to provide them with a local resource to help with daily work needs (e.g., navigating the territory, coordinating work with other crews, ensuring the safety of the work site, accessing food). These resources, referred to as "bird dogs," are typically local company line workers and recent retirees who are familiar with the system and are trained to operate the switching devices in the field. Bird dogs may support one or more crews.

Toronto Hydro adopted the practice of providing bird dogs to many of the mutual assistance crews, particularly those arriving during the first few days of the restoration. They dealt with system control for work protection, completed customer-premise paperwork, and facilitated work assignment, in coordination with dispatchers. Interviews with utilities providing mutual assistance indicate that Toronto Hydro executed the bird dog role proficiently.

Restoration Execution Opportunities for Improvement

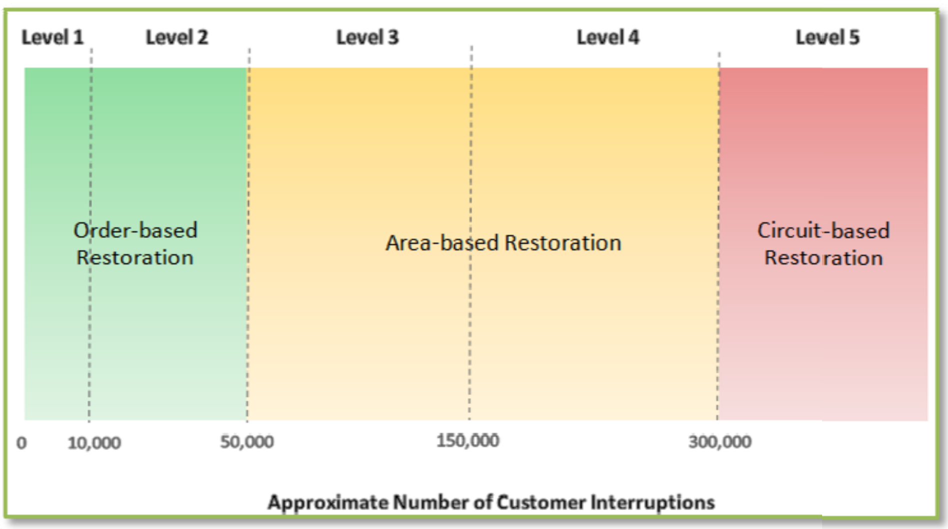
1. **Restoration approach was not consistent, varying between "order-based" and "feeder-based."**

During major events utilities typically can use one of three restoration approaches: order-based, area-based, or circuit-based. The choice of approach corresponds to the severity and amount of damage across the service territory. Figure 15 illustrates how a utility could apply these approaches across a range of incident levels.

Order-based restorations are typically limited to small events, where the utility manages resources and work based on individual outage management system (OMS) orders. In area-based responses, a utility will decentralize crew and work management to regions or divisions. A central system operations group retains control over crews restoring feeder lockouts and responding to 911 calls, but all major restoration work is referred to the decentralized region. The regions prioritize work, identify resource needs, manage resources, and develop ETRs.

A circuit-based approach is typically used in the highest level events (Level 3 and greater), where the widespread devastation requires complete rebuilding of the electric delivery infrastructure. In circuit-based restorations, crews are assigned to rebuild an entire circuit or portions of a circuit. The circuit is usually isolated from the rest of the system to ensure that it does not become energized during the work. The field crews energize portions of the circuit as work is completed.

Figure 15: Restoration Approaches



Toronto Hydro does not have a formally-defined process to transition among different restoration approaches. During the 2013 Ice Storm restoration, the Company used a circuit-based approach to start, restoring the feeder sections of the circuits, and then used an order-based approach once it moved into restoring lateral sections instead of restoring all of the remaining damage on that circuit. In this storm response it might have been more appropriate to use an area-based approach and repair the damage in an entire area (i.e., substation). This might have minimized the travel time by multiple crews and enabled better coordination of work assignments. Lastly, the restoration approach varied slightly across the LICCs.

2. Lack of full coordination among decentralized dispatch functions led to some inefficiency in crew deployment.

Restoration following a large, unplanned event, like the 2013 Ice Storm, requires a significant amount of ad-hoc coordination. The reason for this is that initially, while the necessary resources are being mobilized, the amount and location of damage is largely unknown. This caused the planning phase and the execution phase of the restoration to be carried out in parallel with some level of inefficient work execution. Emergency plans help to reduce these inefficiencies, but cannot completely eliminate them.

At the start of restoration, Toronto Hydro quickly decentralized its dispatch functions into the LICCs, which is in line with leading industry practice. It appears, however, that the dispatch process was not fully synchronized among the LICC dispatchers, central dispatch, and the supervisors who were working with mutual assistance and contractor crews. This resulted in some actual and perceived inefficiencies such as:

- Crews were dispatched to a location that had been restored already;
- Different types of crews would be dispatched to the same location to perform different aspects of the necessary repairs with a significant time lag in between;
- Customers didn't understand why crews left before restoring power; and
- Crews had to wait after completing a job to receive their next assignment from the dispatcher.

One challenge to the dispatch process was a delay in closing trouble tickets in the outage management system once crews completed the work. Most utilities experience this problem during an event the size of the 2013 Ice Storm. Field crews focus on restoring power as quickly as possible and tend to turn in their completed tickets at the end of the day instead of calling them in as repairs are completed.

3. Local Incident Command Centre structure (three geographic and two functional locations) added complexity to crew deployment and work coordination.

During the 2013 Ice Storm response, Toronto Hydro activated five LICCs. Three of the centres were responsible for Toronto Hydro crews restoring distinct geographic areas of the service territory:

- Monogram – western part of the service territory;
- Milner – eastern part of the territory; and
- Commissioners – the downtown area.

Two LICCs handled externally-provided crews, with one for the mutual assistance crews and the other for contractor crews. The off-system resources (both contractors and mutual assistance crews) worked across the service territory, but dispatchers in each of the three geographically-based LICCs did not have full visibility into all the off-system resource assignments and availability. This lessened their ability to fully coordinate the dispatch process.

4. **Restoration execution approaches were not followed consistently by all Local Incident Command Centres.**

The SOC established the overall restoration strategy and monitored progress against priorities, but the LICCs applied different approaches to implement the strategy. For example, some of the LICCs used a feeder-based restoration approach, while others applied an order-based approach when responding to similar conditions. Since the level and type of damage may vary across a service territory, LICCs should have some flexibility to determine what approach best meets restoration objectives. The damage from the 2013 Ice Storm, however, was similar across the affected areas within Toronto Hydro's territory. This suggests that the LICCs should have been following the same restoration approach.

5. **Toronto Hydro has different work protection processes than other utilities in the Province of Ontario, limiting the type of work that mutual assistance crews can perform.**

Toronto Hydro's electric distribution system includes a large underground network that feeds most of the downtown area. This network provides reliable service to customers through redundancy of power sources (i.e., if one feeder is interrupted, the network will continue to operate without causing customer outages because other feeders will pick up the lost load). It also requires a unique set of skills to operate -- demanding proficiencies that are different from those required to operate an overhead system. In addition, during amalgamation of the utilities operating in Toronto, the decision was made to adopt the switching and tagging (i.e., system protection) practices that were in place at that time on the legacy Toronto Hydro system, to provide continuity for the network system operation. As a result, Toronto Hydro's system protection practices are different from those of other utilities in the province.

The key differences are in the coding and coloring of signage that is used to mark the devices controlled by field personnel. These differences can be addressed during an emergency restoration through the provision of guidelines that allow external utility crews to isolate a section of the system and then use their own switching and tagging processes to restore that section. As Toronto Hydro did not have guidelines like these in place, it was not able to use the full capabilities of off-system resources.

5.5.2. Restoration Execution Recommendations

RE-1 Pre-determine best restoration approach for each emergency Level (e.g., 1-4).

Toronto Hydro should reassess the emergency level scale it currently uses to categorize major distribution outages and consider adding a Level 4 or greater event definition. The Company should then refine or establish criteria (with ranges) for activating the different levels of response. Activation criteria could include number of customers affected, number of trouble spots, and expected duration of restoration.

This refined definition and characterization of events should provide a clearer indication of the preferred restoration approach for each event level (e.g., order-based, circuit-based, or area-based). The pre-determined approaches should be used to drive consistency in restoration execution, but provide enough flexibility to accommodate meaningful differences in field conditions among the Local Incident Control Centres.

- **Amend work protection and restoration guidelines to enable off-system crews to "take over" and restore portions of the system in a catastrophic outage.**

The Company should consider amending its switching and tagging rules during major events to allow off-system crews to take over the control of portions of the system. While it is unreasonable to expect outside crews to learn local company procedures, a number of utilities have created processes to isolate parts of the system during major events, so mutual assistance resources can support more aspects of the restoration and control sections of the circuits without compromising safety.

- **For each restoration approach, provide standard processes and procedures, and secure adequate resources to expedite dispatch work.**

For each pre-established restoration approach, Toronto Hydro should identify the commensurate number of qualified dispatchers needed. The Grid Disruption Plan should include a description of the process procedures and associated forms for assigning, tracking, and closing work during major events. The processes should address both centralized and decentralized dispatch functions.

RE-2 Eliminate centralized mutual assistance and contractor Local Incident Command Centres and encompass those resources within the three geographic LICCs.

Toronto Hydro should eliminate the centralized LICCs for mutual assistance and contractors to facilitate coordination of dispatch across the geographic LICCs. Once the restoration process is decentralized to LICCs, the off-system resources (mutual assistance and contractors) should be assigned to one of the three geographic LICCs based on the need (capabilities and numbers). At that point, the geographic LICCs would take control of the off-system resources and use them as required to restore outages within their portion of the system.

After a LICC has completed restoration or no longer needs certain types of crews (e.g., forestry), it can release them to another LICC. The process, criteria, and responsibility for assigning off-system resources should be clearly defined in the Grid Disruption Plan.

5.6. Communications – Customer Contact

The ability of a utility to handle a significantly larger volume of customer calls during a major outage is essential to a successful restoration. During the first few days of a major storm, or other event causing widespread outages, incoming calls increase dramatically as compared to the expected daily volume. Although the Internet has provided additional channels for customers to communicate with utilities during outages (e.g., email or website), many still want to talk to a representative, particularly during an extended outage.

It is critical that the utility have plans in place to satisfactorily address this spike in customer calls. These emergency response plans must be executed swiftly to minimize customer frustration, reduce the likelihood of repeat calls to resolve problems, and avoid complaints to regulators. Actions to handle the anticipated increase in calls could include:

- Training in-house resources from outside the call centre, who have system access, to take outage calls;
- Contracting in advance with vendors to supply trained customer service representatives; and
- Establishing mutual assistance arrangements with other utility call centres.

Successful plans are usually anchored by effective interactive voice response (IVR) applications. These allow customers to self-report outages and receive restoration information. Overflow telecommunications capacity for these systems can be provided through contracts with technology companies that specialize in providing utilities with IVR capacity, including interfaces to outage management systems.

An emergency plan for customer communication might also include a strategy to *proactively* reduce incoming calls. For example, outbound messaging (i.e., robo calls, texts, or emails) to individual customers about expected or actual outage status can eliminate numerous incoming calls. Providing additional channels of communication for customers can reduce call volume as well. Website, email, mobile, and texting applications allow customers to report outages and track outage status. Also, social media avenues (e.g., Twitter, Facebook) provide ways for customers to obtain information in lieu of calling.

Utilities use a few different organizational models to conduct the function of answering outage calls from customers. For example, some utilities place the responsibility in the call centre which also handles business calls related to customer billing and other general inquiries. Others route customer calls related to outages to their dispatch function within field operations. Many use third-party call centres for primary or supplemental support.

The assessment of Toronto Hydro's management of customer contact throughout the 2013 Ice Storm addressed the following:

- Availability of a plan to address the increased volume of calls from customers;
- Plan effectiveness and thoroughness of implementation;

- Availability of alternatives to speaking with a representative by which customers can report an outage or receive information about restoration;
- Process for reporting outages, including ease of use and clarity of navigation scripts; and
- Process for providing accurate and timely messages on all customer-facing systems and applications.

5.6.1. Communications – Customer Contact Findings

The day-to-day responsibility for handling outage calls at Toronto Hydro resides in the Distribution Grid Management Division, specifically in the dispatch section of the Power System Planning & Logistics organization. All customer calls to the main customer number to report a power outage, wire down, or power quality problem are handled through the IVR. It directs them to "select 1," which allows a caller to self-report an outage in the IVR, or enter the queue to speak with a dispatcher. A wire down or power quality call goes into the queue for the caller to speak directly to a dispatcher, as do calls that are not successfully completed in the outage application. The dispatch volume averages 135 calls per day during blue sky conditions.

When a major outage occurs, however, dispatch requests a specific number of resources from Customer Care to augment the dispatch team and help respond to incoming calls. This allows some of the dispatchers to be reassigned from handling incoming outage calls to dispatching field crews. Customer service representatives from the call centre and, as needed, from other areas of Customer Care, are assigned to answer emergency calls in 8- or 12-hour shifts, 24-hours-a-day.

Toronto Hydro experienced an unprecedented call volume during the 2013 Ice Storm. A total of 397,500 calls entered the IVR from the main customer phone number from December 21, 2013, through January 2, 2014. Of those, it is estimated that 374,200[11] were storm calls and 23,300 were non-storm calls (i.e., 14,300 calls were directed to the residential and commercial queues and an estimated 9,000 calls were non-storm calls to all other business functions within the Company). Just over one-third of the total storm calls (127,800) were received the first full day of the storm on Sunday, December 22, 2013.

On December 22, 2013, the number of calls entering the dispatch queue was 947 times greater than the average of 135 received during normal operations. For the following

---

[11] Calls to areas of the Company other than dispatch and the residential/commercial queues were significantly higher than during normal operations. Toronto Hydro categorized the number of higher than expected calls as storm calls. The estimated number of storm calls likely is conservative because it doesn't include storm calls answered in the residential and commercial queues (other than those which were reported as being transferred from those queues to the dispatch queue).

five days the incoming storm calls averaged 40,800 (302 times the average number of calls handled in the dispatch queue during non-crisis times).

Communications – Customer Contact Strengths

1. The ability to use an external contract call centre as a back-up call centre site.

Since 2007, the Toronto Hydro Customer Care organization has contracted with a local call centre outsourcer, to provide call handling and clerical services. The outsourcer agents answer calls to the residential queues weekdays between 8:00 a.m. and 4:30 p.m. The outsourcer's staff is trained to take all non-outage residential calls, which represent the majority of calls to Toronto Hydro. The Toronto Hydro in-house call centre handles the more complex commercial calls.

Call volumes vary depending on the day of the week, time of the month, and holiday schedules. The highest call volumes typically occur on Mondays, at the beginning and end of each month, and the day following holidays. On a typical Monday near the beginning or end of the month, the outsourced call centre answers about 2,500 Toronto Hydro calls.

The contract with the outsourcer provides a potentially reliable source of additional staff to answer calls during times of major outages. Equipment is in place to route calls easily from the Company to outsourced call centre and some call centre staff are familiar with Toronto Hydro procedures. From the perspective of emergency management, there is another major advantage: geographic diversity. If an incident renders the Toronto Hydro call centre inaccessible, calls can be readily directed to a contractor site at another location.

2. The Key Accounts organization within Customer Care implemented an effective process to inform key and commercial accounts of outage status.

There is a group within Toronto Hydro responsible for managing the relationships with its "key" accounts. Key accounts are customers with consumption of 1 megawatt hours or higher annually (at one site or in aggregate). There are approximately 550 such accounts.

The key account managers serve as an access point into Toronto Hydro to help answer customer questions and facilitate solutions. The key accounts program includes a group of about 15 employees (the key accounts staff plus a group of employees and contractors from the Conservation Demand Management team), who provide on-call service to their key accounts during normal business hours. Each week, on a rotating basis, one person from the group is assigned to take calls outside of normal business hours.

During the 2013 Ice Storm, key account representatives worked 12-hour shifts to keep their customers advised of restoration efforts. This continued until January 2, 2014, when power was restored to all key accounts. In addition to providing extended call coverage, key accounts sent daily group emails to customers with general information about Toronto Hydro's plans and progress. Key customers gave positive feedback about receiving this additional information.

Recognizing that other commercial customers (with usage below the key account threshold) had a similar need for restoration information during an outage, Customer Care had been developing a proactive commercial customer outage communications program in the months prior to the 2013 Ice Storm. Commercial customers received letters asking them to enroll in the program and provide an email address for outage communications. On December 20, 2013, the day before the storm, an email was sent to 4,500 customers who had enrolled, thanking them for registering and informing them the program would start in the spring.

When the ice storm hit the next day, Customer Care was able to initiate a "light" version of the planned program. It communicated general restoration information to the enrollees via group emails. Also, Customer Care set up an email inbox to allow two-way communication with these customers.

3. **The control room, dispatch, call centre, and key accounts staff are co-located, enabling more effective information exchange.**

At the time of the 2013 Ice Storm, the control room, dispatch, call centre, and key accounts functions were all located at the same facility. The proximity of controllers, dispatchers, customer service, and key accounts personnel provided for easier, quicker face-to-face communication. In-person communication is especially important during an emergency response, when key staff is focused on completing assigned tasks and may not have as much time to monitor the channels of communication they use during non-emergency times. The nearness to control and dispatch allowed key account managers more timely access to updates on restoration status, improving their responsiveness to customers. Likewise, Customer Care supervisors had access to dispatch to discuss individual customer situations.

Communications – Customer Contact Opportunities for Improvement

1. **There was insufficient overflow capacity (system and staffing) to take outage calls, so that the majority of callers were not able to report or get information on outage status.**

<u>Telephony Capacity</u>

The telephone system associated with the main customer phone number has eight T1 lines which are limited to 152 channels to match the number of IVR Integrated Voice Recognition ports. Thus 152 customers can be served concurrently. Some of the ports are dedicated to the IVR and others to the queues to be answered by representatives. If the number of calls into the main number exceeds this threshold (i.e., when all ports are in use) the customer will hear a fast busy signal. Toronto Hydro does not get information regarding the number of customers who get fast busy signals, so the number of customers who heard busy signals during the 2013 Ice Storm is unknown.

To address the issue of telephone port constraints during high call volume periods, Toronto Hydro adjusts system parameters to play a message, referred to as the "initial high call volume message." Callers hear this message when volumes are greater than can be handled by the capacity of the system. This message is played as soon as customers enter the IVR system to inform them that the telephone system has reached its maximum usage. For example: "Thank you for calling Toronto Hydro. Please be advised that due to the large volume of outages across the city we cannot accept any non-emergency or power outage calls at this time." The intent is to reduce the number of customers getting a busy signal and inform callers Toronto Hydro is aware of the outage. This message varies depending on the situation and is updated as a restoration progresses.

Toronto Hydro did not have a plan in place to add telephone lines to accommodate the significant increase in call volume. So, during the 2013 Ice Storm, 117,800 customers (31% of storm callers) heard this initial high call volume message. The inability to complete a call to report an outage was one of the most common problems customers raised at the town halls and through email feedback.

IVR Outage Self-Service Application

When Toronto Hydro customers call to report outages, the initial IVR menu instructs them to select "1", which takes them down a path to report one of three things: an outage; wire down; or other power quality issue. The second menu instructs the caller to select "1" to report an outage and that selection puts the customer into the outage self-service application. (If the customer selects "2" for a wire down or selects "3" for a power quality issue, the call is put into the queue for a dispatcher.) The outage self-service IVR leads the caller through a process to provide the account number or address associated with the outage. Because the IVR outage application interfaces with the outage management system (OMS), when the customer successfully finishes providing the information required, a trouble ticket is automatically created in OMS.

If the IVR system cannot understand a customer's answers or there are other problems in the interaction, the call is transferred to the queue to speak to a representative. Of the 374,200 total storm calls, 13,800 (4%) were completed in the Company's self-serve outage application without the assistance of a representative. The Davies Consulting storm database contains company-reported self-service IVR outage statistics for eight major storms. Across all the storms, at least 50% of incoming calls were handled in self-service IVR outage applications. The completion rate in three of the storms exceeded 70%.

Comments from employees and customers pointed out features of the Toronto Hydro IVR that could be improved to improve its containment rate (i.e., the percentage of calls successfully completed in the IVR without the assistance of a representative). For example, providing an account number is cumbersome and discourages some from trying to complete their outage in the automated system. Another is that the IVR voice recognition system does not distinguish accents well.

Staffing to Answer Calls

The Customer Care organization can draw from approximately 80 representatives to answer calls during periods of high volume. This number includes approximately 30 Toronto Hydro employees (those working in the in-house call centre and those who have rotated from the call centre into customer billing and collections functions) and 50 call centre staff. The full complement of available representatives (both internal and from outsourcer) was fully deployed until December 27, 2013.

Lack of prior training on handling outage calls caused some of the delay in deploying resources to answer calls. It precluded the use of a few Toronto Hydro employees during the 2013 Ice Storm because of union rules which restrict offering overtime to an employee who has no experience in the specific role. And, as noted previously, the outsourced call centre employees had not been trained to answer outage calls prior to this storm.

A few days into the 2013 Ice Storm, Toronto Hydro contacted the outsourced call centre for back-up support to handle storm calls. The outsourcer provided 66 additional agents to take calls in the dispatch queue, including the pool of 50 noted above. Toronto Hydro staff provided training to the outsourced agents on how to answer customer questions and about which information to pass to their supervisors to enter tickets for new outages. The supervisors were given more detailed training and access to OMS Web Entry. Toronto Hydro did not have other agreements in place to access additional staff to handle the sharp increase in customer calls.

Of the total storm calls, 21,000 (5%) were handled by company representatives. By comparison, the Davies Consulting Storm Benchmark Database shows that in one major storm, 24% of the 1.1 million storm calls were answered by a pool of 350 employees from the affected company and its sister company. In another case, 31% of the 194,000 storm calls were answered by a pool of over 500 employees from the company's in-house and contracted call centres.

Dispatch Queue High Call Volume Message

A large number of customers who called when there was an available telephone port still heard a message that the Company could not receive any more calls at that time. Those callers experienced a high call volume message after their calls had been accepted by the IVR and they made a selection within the outage menu which put them into the dispatch queue. (If they selected "1" to report an outage and were not able to successfully complete the report in the self-service IVR, they were transferred to the dispatch queue. Callers who selected “2” or “3” to report a wire down or other issue also were placed in the dispatch queue.)

During normal operations when there are not many outages, the system is set to allow approximately 30 calls in the queue to dispatchers during business hours and 10 calls outside of business hours. Adjustments are made depending on the number of incoming calls and staff available to handle calls. After the maximum number of callers has entered the queue, the next customer hears a message that “no additional calls can be accepted at this time.” Of the total callers that entered the dispatch queue during the 2013 Ice Storm, 136,000 (84% of callers entering the dispatch queue or 36% of all storm callers) received this message.

Abandoned Calls

During the 2013 Ice Storm, 20% of callers who were able to enter the outage queue to talk with a representative abandoned their calls while waiting. An abandoned call is one when the caller, after entering the queue to speak to a representative, hangs up before the call is answered. At Toronto Hydro, the percentage of abandoned calls is this number compared to the total calls entering the queue that do not receive a high call volume message.

Although abandoned call goals vary among companies, a range of up to 5% or 6% is considered acceptable within the call centre industry, with a tolerance of up to 8% or even 10%. The Toronto Hydro call centre, for example, has a scorecard goal of 3% abandoned calls during non-emergency periods. The Davies Consulting Storm Benchmark Database includes data on abandoned calls for eight storms. For these storms, the percentage of abandoned calls is 12% or less.

Average Speed of Answer

Average Speed of Answer (ASA) is a call centre measure of the average number of seconds from the time a customer requests to be transferred to a representative to the time the representative answers the call. The overall average ASA for customers in the dispatch queue during the 2013 Ice Storm period was 7 minutes and 14 seconds.

Many different companies across a variety of industries use call centres. This variation makes it difficult to establish a “standard” ASA goal. A frequently seen company ASA goal is at or about 40 seconds, but this goal normally would not apply during an emergency. Davies Consulting has evaluated call centre performance for major storms at two utilities which accomplished 43 second and 62 second ASAs during major outages. At both those utilities, 50% or more of the incoming calls were successfully handled in the self-service outage IVR application and their in-house and outsource call centres provided a significantly larger pool of representatives to handle calls.

2. The Integrated Voice Recognition system was difficult to navigate, not intuitive, and did not effectively support customers who are non-native English speakers.

As noted above, 14,000 (4%) of the total incoming outage calls were completed in the Company's self-service outage application, as compared to other utilities with completion rates of 50% or more. Comparisons to other utilities and information gleaned from interviews with employees familiar with the IVR system indicate the following gaps:

- The outage IVR provided inaccurate information to many customers regarding the status of their outages. Large numbers of customers received false messages that their power had been restored causing confusion and frustration, as well as an increase in call volumes. Contributing factors were delays in closing outage tickets in the OMS and inadequate interface between the IVR and OMS.);
- The IVR's voice recognition system does not distinguish many of the accents associated with languages commonly spoken in the Toronto area causing callers to be bumped out of the self-service outage application;
- The outage IVR initially asks for a customer's account number, which, if in hand, is cumbersome to enter. Often this discourages customers from trying to complete their outage reports in the automated system;
- The IVR does not provide a service order ("ticket") number to customers to confirm that an outage is recorded; and
- Once a customer selects the path to report an outage, there is no option to return to the previous menu if, for example, a mistake is made when entering an address. When something like this occurs, the customer must hang up and call back to start over.

3. Outage status information was inadequate and often inaccurate.

Dispatchers and customer service representatives answering outage calls often encountered weary, impatient, sometimes angry, customers. Many were frustrated from the necessity of calling multiple times before reaching a representative. As discussed above, large numbers received information from the IVR that power had been restored to their homes when, in fact, it was not.

In addition, customers received inaccurate information from the outage map on the Toronto Hydro website. This map is created using postal codes and is not fully integrated with OMS. As a result, it displayed erroneous information, driving customers to call the Company.

During any outage, and particularly during extended outages, customers may have to make decisions regarding their living arrangements and businesses. Fundamentally, they need to know when their power will be restored. When Toronto Hydro representatives answered customer calls, they had minimal information to satisfy customers' needs. Information regarding estimated restoration times was not available. For the most part, dispatchers and customer service representatives had to use the Company's messaging from press releases and general communications to employees when speaking with customers.

When calls were escalated to supervisors, they could access dispatch to try to get more specific information. Although ETR information was not usually available, other information about what was happening in the field could be garnered to put together enough information to respond to the customer inquiries. Some of the representatives were physically located at workstations in dispatch and could also glean some additional information to use in conversations with customers.

4. Alternate paths to contact Toronto Hydro (e.g., email, web) were in place, but all were not monitored frequently enough.

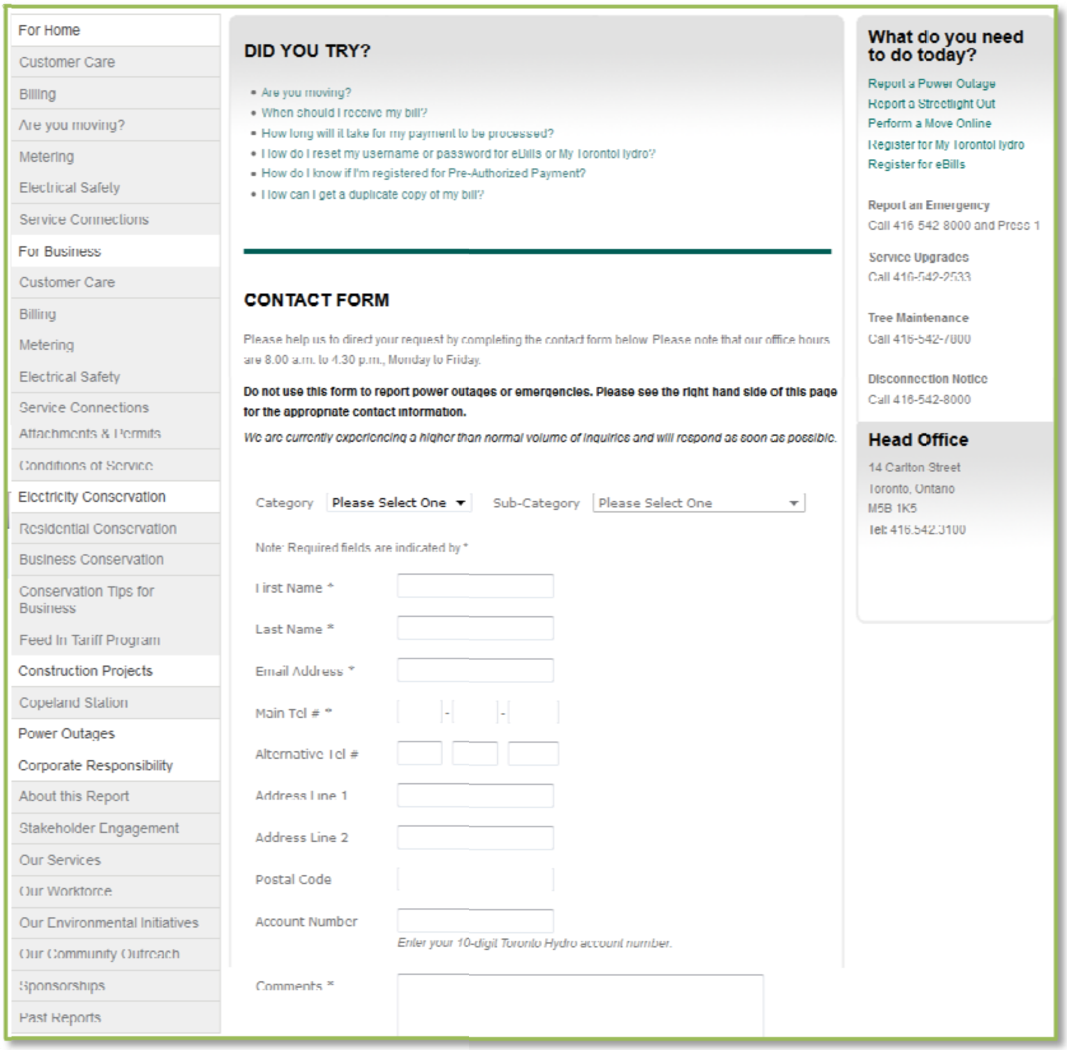
In addition to calling, Toronto Hydro customers used three web-based options to contact the Company during the 2013 Ice Storm:

- Free-form email;
- Website contact form; and
- Website power outage reporting form.

Customers sent comments or inquiries using an unstructured format to the Company via contactus@torontohydro.com or a contact form provided on the corporate website (See Figure 16). The intended use of the contact form is for customer inquiries related to billing, other account information, and general questions. During the 2013 Ice Storm, however, the majority of contact forms (and free-form emails) submitted were related to outages. Day-to-day, a dedicated team of three customer service representatives and/or student interns from the Toronto Hydro call centre respond to these inquiries.

During this storm, student interns responded to the emails and contact forms by scanning them for wire down or other safety concerns which merited priority reporting and outages not previously reported. They would create an outage ticket as indicated. The interns monitored the emails and contact forms only during normal business hours on non-holiday workdays.

Figure 16: Web-based Contact Form

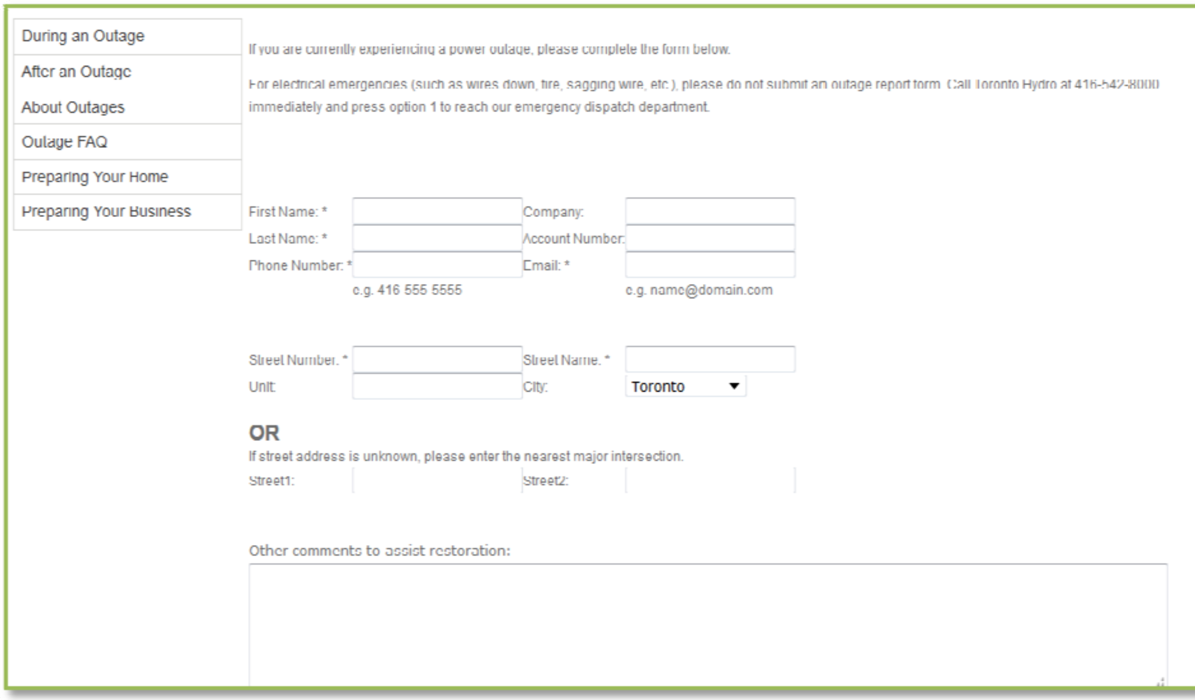


The number of emails and contact forms forwarded to the Toronto Hydro call centre team for response from December 22, 2013, through January 2, 2014, was 2,028. Daily totals for those dates ranged from a low of 42 on January 1, to a peak of 392 on December 24. Normally, the team receives 80 to 120 account related emails per day on weekdays and 50 or fewer per day on weekends.

Customers also used the Toronto Hydro corporate website to report an outage using the form shown in Figure 17. The dispatch group is responsible for following up on the power outage reporting forms, which involves manually entering each form into OMS. Unlike many utilities today, Toronto Hydro has not developed an automatic interface from the form to OMS. During the 2013 Ice Storm, customers forwarded 106,000 outage reports using this form.

During the storm response, from time-to-time, dispatch supervisors would request a few representatives to review these forms and input outages not already reported to OMS. Resources were not assigned to regularly review the power outage reporting forms throughout the restoration.

Figure 17: Power Outage Reporting Form


During an Outage
After an Outage
About Outages
Outage FAQ
Preparing Your Home
Preparing Your Business

If you are currently experiencing a power outage, please complete the form below.

For electrical emergencies (such as wires down, fire, sagging wire, etc.), please do not submit an outage report form. Call Toronto Hydro at 416-542-8000 immediately and press option 1 to reach our emergency dispatch department.

First Name: *
Company:
Last Name: *
Account Number:
Phone Number: *
e.g. 416 555 5555
Email: *
e.g. name@domain.com

Street Number: *
Street Name: *
Unit:
City: Toronto

OR
If street address is unknown, please enter the nearest major intersection.
Street1:
Street2:

Other comments to assist restoration:

5. Toronto Hydro does not provide mobile capability to report or track outages.

As the penetration of smart devices increases, so do customer expectations to receive information they need and want, at any time, and through the communication channel they prefer. In response, many companies have developed applications to allow their customers to do business with them more easily on cell phones and tablets. Many utilities (including Hydro One) offer free mobile applications that allow customers to report and check the status of power outages. Toronto Hydro does not have a mobile application and did not provide customers with the ability to report their outages through text messaging.

6. There was no capability to transfer Toronto Hydro-related calls from the 311 call centre.

During the 2013 Ice Storm, some Toronto Hydro customers called the City of Toronto 311 call centre to report their outage or get restoration information. The call centre representatives had no information or procedures to use in order to help these customers. They had not been trained on the restoration process for widespread electricity outages, nor had they been made aware of the outage reporting form available on the Toronto Hydro website. No technological interfaces (such as the capability to transfer calls to the Toronto Hydro call centre) were available between the two entities.

5.6.2. Communications – Customer Contact Recommendations

The volume of customer inquiries and the sustained need for outage status information resulting from the 2013 Ice Storm revealed gaps in emergency preparedness, insufficient scalability of telephony and staffing, and the need for additional and broader training. During widespread outages Toronto Hydro must be able to rely on technological solutions (self-service IVR and web-based applications) to accurately handle the vast majority of customer contacts without the intervention of a representative. Specific recommendations to improve customer contact communications are:

CCC-1 Secure capacity (people and technology) to support timely customer contact during an incident:

- **Enhance the customer self-service IVR outage application to handle significantly more calls.**

Toronto Hydro should invest in improving its self-service IVR outage application so that its performance during emergencies is in line with peer utilities. If Toronto Hydro customers had successfully completed 50% of incoming storm calls in the IVR, an additional 172,100 calls would have been satisfactorily completed.

In redesigning or replacing the application, Toronto Hydro should consider surveying other utilities with high containment-rate systems to determine what changes and new features would be most effective. These could include:

- Upgrading the voice recognition technology to enable more customers to complete their transactions in the IVR;
- Deleting the request for an account number to identify the outage location;
- Providing options for a customer to return to the front of the outage IVR menu and/or other points in the interaction;
- Providing the customer a ticket or reference number to confirm that the outage has been recorded and to allow quicker, easier access to outage status information; and
- Correcting issues in the current interface to the OMS.

In concert with the technological enhancements, Toronto Hydro should adopt procedures to more frequently (in near real time) update restoration information in the OMS. With system improvements and implementation of those procedures, customers calling for outage status could receive accurate information without the assistance of a representative.

- **Secure sufficient capacity and surge capability during periods of extremely high call volume to eliminate busy signals.**

Toronto Hydro should explore alternatives through either expanding the capacity of its IVR, or contracting with a third-party high-volume call processing company to ensure that the customers do not receive busy signals during full-scale events. Call processing companies can provide a cost-effective alternative to purchasing telephony capacity adequate to handle infrequent high call volumes. There are a number of services available from these companies, but most frequently utilities contract for additional capacity, so more customers can be handled concurrently through self-service outage IVR. Utilities contracting with these companies have reduced or completely eliminated fast busy signals during full-scale events.

For example, a third-party company specifically set up for outage communications provided additional telephone ports and using the client utility's IVR application, successfully handled over 233,000 of the 1.1 million calls the utility received during a recent major storm. On the peak call volume day in another storm, customers completed 19,800 calls in another utility's self-service IVR using 21st Century Communications ports. In both cases, the outage reports were successfully interfaced to the utilities' OMS systems, providing customers with accurate outage status information.

The call transfer to the third-party call processor is seamless for customers. Customers needing to report a wire down or talk to a representative for other purposes are transferred to the dispatch queue in the same way that they would be if their call was answered by telephony at the utility rather than at the third-party call processor.

The use of a third-party call processor to handle overflow calls, when paired with an improved Toronto Hydro self-service outage IVR, could potentially eliminate the need for the initial high call volume message which was heard by 31% of storm callers during the ice storm.

- **Identify and train customer representatives within Toronto Hydro and at outsourcer to service outage calls and website contacts during major incidents.**

The Dispatch Group should analyze how many customer contact resources would be needed under various emergency scenarios and develop a plan in collaboration with Customer Care that would allow them to deploy the amount of resources needed to satisfactorily handle the maximum number of estimated calls and website contacts. The analysis should consider factors such as: how the crisis impacts the use of either the in-house or contract call centre facilities, telephony capacity, IVR containment rates for customers reporting outages and seeking outage status information, estimates of how many customers will report outages using the website outage form and whether or not the outage form is interfaced to OMS.

Using this evaluation as a base, Toronto Hydro can determine how many trained resources will be needed at all times, and implement a training program and schedule to ensure this level of readiness. Training topics should include:

- The use of all automated systems involved in outage reporting at Toronto Hydro (self-service outage IVR, OMS, Web Access, the website outage form, the website outage map, and any other systems that may be developed in the future to allow customers to report outages or receive restoration information);
- Communicating ETRs to customers;
- Handling of difficult customers. (Toronto Hydro training staff might identify representatives who are able to better handle customers during a storm and ask them to role-play handling calls.);
- Refresher courses; and
- Implement web-based and mobile outage applications to support high volume self-service.

The outage information that customers report on the corporate power outage reporting forms does not automatically feed into the OMS. Each form completed by a customer must be manually entered to OMS. An on-line interface would reduce or eliminate the need for staff to input outage information during an emergency (and day-to-day). When an interface is developed, consideration should be given to providing a service order or ticket number to customers when they successfully submit a form, to assure them the outage had been recorded and provides a reference number.

The Company should also develop and implement mobile outage applications to provide customers the ability to report outages and track restoration status from their smart phones and tablets. This should reduce calls to representatives. Various utilities offer free applications that allow customers to report outages and find outage status. Some provide outage maps, searchable by address, which are updated with OMS information, as often as every 15 minutes. In a few cases, these applications provide cause, crew status, and estimated time of restoration (when it is known).

CCC-2 Improve the process for ensuring accurate and uniform outage status messages across every mode of communication to customers (e.g., IVR, web, mobile application, low tech channels).

The previous recommendation suggests methods to improve outage status accuracy when customers use the self-service outage IVR. Many of the same programming and procedural changes for outage status accuracy should be applied to the outage form on www.torontohydro.com and to any mobile applications implemented in the future. The keys to consistent accuracy are enhancing the automated interface with OMS and entering restoration information to OMS on a near real-time basis.

A process also, should be put in place to provide field status information to dispatch and call centre staff. Implementation of recommendations elsewhere in this report to improve the ETR process are essential to providing representatives the information they need to properly serve customers during outages. Until those recommendations can be successfully implemented, dispatch and Customer Care need to develop a method by which more granular information regarding field activities can be communicated to all representatives answering calls and Internet inquiries.

CCC-3 Employ outbound calling/texting to inform customers of outage status and other pertinent information.

Toronto Hydro uses outbound calling software to support the collection of Accounts Receivable. A leading practice employed by some utilities is to use this software to provide messaging to customers during storms. This application can push telephone calls to customers, with or without a representative attending the call. Outbound calling campaigns designed for outage purposes normally do not require interface with a representative.

The use of outbound calling before and during incidents could enhance the Company's effectiveness in meeting communications objectives. For example, some utilities use outbound calling to give customers pertinent information to better prepare for a forecasted major storm. Another common use is to message customers served by feeders that have been restored, telling them the Company has restored service in their area, and asking them to confirm if they have or have not been restored.

Customer Care and Corporate Communications staff should develop plans for the proactive use of outbound calling and texting during extended outages. Surveying other utilities regarding their use of outbound calling and texting technology might be useful in planning and designing campaigns. Those selected for implementation should be designed and tested to ensure timely execution when needed.

CCC-4 Work with City of Toronto to evaluate options for using 311 capabilities.

The Toronto City 311 call centre and Toronto Hydro Customer Care staff have begun to discuss ways to improve the handling of outage-related calls during an incident. Some ideas being discussed include providing outage communications updates to the 311 representatives on a regular basis during extended outages and training 311 representatives to complete website outage forms for customers who may not have access to the Internet during the outage. The evaluation should address:

- The capacity needed to meet anticipated call volumes at all incident levels;
- The knowledge and skills needed to support single call resolution;

- The potential impact on service levels to other City agencies and organizations that the 311 call centre serves; and
- Ways to automate communication between Toronto Hydro and the City during large-scale incidents.

5.7. Communications – Other Stakeholders

A utility's ability to effectively communicate to internal and external stakeholders during a major incident is equally as important as the efficiency of the physical restoration. In order to return the community back to "normalcy" in the shortest time possible, and maintain customer and stakeholder satisfaction during major power outages, a utility must:

- Demonstrate that it knows the customer is without power;
- Convey a sense of urgency about restoring power;
- Provide consistent and accurate information on restoration progress; and
- Provide customers with accurate and reasonable estimated times of restoration.

While the first and fourth points are addressed in the previous section of this report, this area of review focuses on the broader aspects of crisis communications during the 2013 Ice Storm, specifically answering the following questions:

- Have processes been put in place to ensure "one voice" communication during major events and are these processes followed?
- Was Toronto Hydro able to maintain a sense of control - continually apprising its stakeholders of the restoration approach and progress?

During an event, the utility should designate a single individual who is responsible for communicating with the media and public, leaving the rest of the staff free to focus on the restoration. The content of the messages delivered during the restoration should be confined to helping stakeholders understand the prioritization and restoration process, issuing safety advisories, delivering progress updates, and providing ETRs. Introducing additional "voices" during a major restoration effort can lead to inconsistent, disjointed messaging. This can create confusion among customers and other stakeholders, which then must be addressed in a "clarification" effort which can draw resources away from restoration.

When incidents occur, leading utilities ensure that messages:

- Are consistent and effective across all communications channels;
- Reach the proper audiences; and
- Are understood by spokespersons and compliment overall communications objectives.

Toronto Hydro had the process in place to ensure that messages were consistent with the communications strategy (evaluated daily) and performed well in several channels of communication.

The review of Toronto Hydro's communications to other stakeholders throughout the 2013 Ice Storm restoration addressed the following:

- Communications strategy and roles;
- Execution of "one voice" communication;
- ETR process;
- Methods and modes of communication, including social media;
- Alignment of internal and external communications;
- Synchronization of messaging and communications processes with the City and Province; and
- Outreach to vulnerable populations.

5.7.1. Communications – Other Stakeholders Findings

Throughout the event, Toronto Hydro was able to maintain unity of message, demonstrate the level of understanding and control over the incident, and provide stakeholders with a clear understanding of the restoration priorities and progress. It is important to recognize that the strengths in the communication process to stakeholders were somewhat muted by the Company's shortcomings in providing customers with the ability to report their outages and receive updates on their status. See Section 5.6 for more details.

Toronto Hydro worked closely with City and Provincial officials to coordinate the messaging to the public and used social media to distribute the message. Some customers did not have access to radio, TV, and social media, and the officials did not provide alternative sources of information such as town meetings, loudspeakers, or door hangers to reach these populations.

Communications – Other Stakeholders Strengths

1. **As the face of the Company and the executive spokesperson, the CEO performed his role well.**

When used, the executive spokesperson is the most visible and important role in incident and crisis communication. During the 2013 Ice Storm, the President and Chief Executive Officer (CEO) served as the primary spokesperson for the Company. As the face of the Company, he was present, on-message, empathetic, transparent, and consistent in his external communication. Conducting upwards of 25 interviews between, December 19, 2013, and January 2, 2014, his messages were aligned with press release content, maintaining a sense of consistency that was received well by the stakeholders. The frequency and quality of communication provided by the executive spokesperson, given the information available about restoration status, was comparable to leading practice within the industry.

2. **Proactive media campaign and consistent messaging (use of "one voice"), including coordination with the Systems Operations Centre, worked well.**

Toronto Hydro presented a consistent message across all of its communication channels, aligning with the "one voice" concept, which is considered a leading practice. The Company also used a sound communication methodology, delivering messages crafted by the media and communications lead and approved by the incident commander. Toronto Hydro's communication department ensured that all communications channels disseminated consistent message content.

On the whole, messages were coordinated with and ultimately approved by the incident commander and were part of the daily discussion in the SOC and the Grid Emergency Report, a form of an incident action plan (IAP). This was accomplished through a communications meeting that occurred at 6 a.m. every day. During this meeting, the messages of the day were created in preparation for the 7 a.m. news cycle. The messages were updated throughout the day.

All internal and external communication stemmed from approved press releases that were distributed to the media. Once press releases were issued, communications staff used them to craft messages for different communications channels (e.g., press conferences, interviews, e-mails to key stakeholders) and employees were sent approved messages to ensure the entire Company was in alignment with respect to its response. The spokesperson was consistent in conveying the messages of the day throughout the event.

One area of criticism was that messaging on the first day of restoration created an expectation that the restoration would take 72 hours. An in-depth analysis of all the communication issued at the time, including the press conference footage, the media reports, and internal messaging and plans, has not revealed the source of this information. The Grid Emergency Report noted the key message on the first day was that the restoration would take "at least 72 hours." Given that the Toronto Hydro emergency levels used 72 hours as the lower threshold for the largest events, it is understandable why the Company would consider messaging the 72-hour timeframe in the early stages of the response, before the damage assessment was completed.

3. Toronto Hydro was viewed as an effective partner in City and Provincial communications.

Toronto Hydro continuously communicated with the City of Toronto and made the Company spokesperson available for City press conferences. The level of effort to communicate jointly is a leading practice for a utility during major events and enabled Toronto Hydro to be seen as an effective partner with the City and Provincial governments. There were at least 15 press conferences between City Hall and Queen's Park that the CEO attended with City leaders. While the City and Toronto Hydro spoke about different aspects of the emergency, their messages were consistent and complementary.

Many citizens turned to the City Council for answers when Toronto Hydro could not provide them information through its own Call Centre. When the City Councillors became overwhelmed with inquiries, they turned to one of a few Toronto Hydro staff members. They were prolific communicators with the City Council, answering questions for the Councillors about the restoration. Throughout the interviews, participants repeatedly noted that Toronto Hydro was a strong and committed partner in communication to the public throughout the event.

4. Toronto Hydro used a variety of methods to reach the public, including social media.

Toronto Hydro used various communication channels to reach external stakeholder groups. These channels include broadcast media, print media, radio, social media, and the corporate website, as well as phone and email for some stakeholder groups. Social media proved to be the channel with the biggest growth and stakeholder engagement. Toronto Hydro's Facebook fan page garnered 3,000 new fans and over 6,000 unique comments while the Company's Twitter account accumulated approximately 24,000 new followers and 20,633 retweets during the 2013 Ice Storm. The number of retweets is a valuable metric as it indicates the value of the message to the subscriber as well as indicates the potential number of ultimate views. Figure 18 shows samples of Twitter messages posted during this storm.

Figure 18: Sample Twitter Messages

Communications – Other Stakeholders Opportunities for Improvement

1. Process for developing and issuing timely and accurate ETRs (estimated times of restoration) was not clearly defined.

Toronto Hydro did not have an effective process or the technology in place to provide estimated times of restoration consistently and automatically for the magnitude of outage that occurred as a result of the 2013 Ice Storm. Across the industry, ETRs are by far the most sought after piece of information when a utility experiences widespread outages. The processes at Toronto Hydro do not currently support the provision of ETRs outside of normal or blue-sky day outages. While this is not uncommon in many other utilities, providing customers with an accurate and timely restoration estimate is becoming an expectation during major events.

On December 22, 2013 (the first day of restoration), one of the key messages from the System Operations Centre was that the restoration would last at least 72 hours. This estimate was translated into a restoration time of 72 hours, essentially omitting the 'at-least' reference from the 72-hour restoration message. It was soon apparent that this ETR was not aligned with the key message of the day and it did not accurately reflect the level of damage or the effort that would be required to restore the damage. From that point on, Toronto Hydro wisely did not issue any other projections for restoration, because it did not have a strong process for developing and validating restoration estimates at the time of the event. As a result of this decision, customers were not provided any specific estimates of their outage durations.

2. Liaison roles with some stakeholder groups were not clearly defined.

Overall, Toronto Hydro's liaison presence was seen in a favorable light, but there was a slight disconnect in the expectations between the Company and the City Office of Emergency Management. Additionally, there were no clearly defined expectations and guidelines to address information and other assistance needed by the City Council members. Toronto Hydro did, however, manage critical restoration requests from the public sector very well. It responded promptly to building fires at Toronto Fire's request and was responsive to the Office of Emergency Management's critical infrastructure and public safety requests. Additionally, Toronto Hydro avoided 'special' requests for preferential restoration. The Company also provided Council members with three dedicated contact people who were very responsive, according to the interviews.

Toronto Hydro staffed liaison positions at the Office of Emergency Management, but the type of information that stakeholders needed and the level of interaction that they wanted from Toronto Hydro were not defined in advance. The operational liaison at the City Office of Emergency Management effectively maintained operational communication and solved emerging restoration priorities including City critical facilities that lost primary and back-up generation. As the event progressed and Toronto Hydro was unable to provide its liaison to the OEM with actionable, operational information, the need for an executive presence increased. Because of that, the City OEM had to engage Toronto Hydro executives to resolve issues.

Due to shortcomings in Toronto Hydro's call centre, City of Toronto Councillors received an unexpected numbers of requests from citizens. Toronto Hydro corresponded with Councillors and their staff in approximately 7,000 emails and over 100 direct phone calls.

3. Messages were not always accessible to all stakeholders (e.g., customers with no access to TV, radio, or social media).

During an extended power outage, many customers lost access to habitually-used information channels, such as radio, television, and social media. In addition, Toronto's population includes a significant portion of people who are not technology savvy and this, along with the inaccessibility of the call centre, left them with little or no information on outage status. During the 2013 Ice Storm, the Company did not provide sufficiently for alternative ways to communicate with the customers, such as town hall meetings, neighbourhood updates, loudspeaker messaging or door hangers.

5.7.2. Communications – Other Stakeholders Recommendations

COS-1 Develop a process to communicate timely and accurate ETRs at different levels of specificity.

Toronto Hydro should update its entire estimated time of restoration (ETR) process to enable the automatic provision of estimates to customers. This process will require

Toronto Hydro to provide a realistic timeframe for restoration for varying levels or sizes of incidents to set expectations with its stakeholders. It should advise customers about the unavoidable limitations in ETR delivery immediately following a complex outage and create communication strategies around these limitations.

The Company should identify all potential channels for providing the ETR updates to various stakeholders and develop a process to ensure that the messaging is consistent and accurate across all venues. These channels should include non-traditional ways of communicating to address the needs of those populations that are not technically savvy or do not have access to traditional media due to an extended outage.

COS-2 In collaboration with the City of Toronto, develop an education program to improve stakeholder literacy of: restoration process, customer responsibility, and preparedness.

Toronto Hydro should work with the City of Toronto to develop a program and execute an education campaign about the power restoration process to the citizens of Toronto. Educating the population on personal preparedness and resiliency is the responsibility of the public emergency managers. Providing educational information on electric (and gas) utility restoration is the responsibility of the utility. Working together, Toronto's Office of Emergency Management and Toronto Hydro should determine how best to conduct joint or complementary personal preparedness education.

Toronto Hydro, in partnership with the City and Provincial Emergency Management organizations, should develop a public education program for external customer and stakeholder groups. The Canadian Electric Association may consider bringing together Hydro companies across Canada to create an education e in conjunction with national emergency management organizations. The annual program should educate customers on the following:

- Delivering electricity from the power plant to the meter in order to provide a general understanding of how the system works;
- Specifying what stakeholders are responsible for and what they should do before and during a Toronto Hydro response to an incident, including special needs customers, use of electricians to restore the damage on customer property, etc.;
- Responding to outages during blue sky days versus during an incident to illustrate the complexity of responding to a single outage and how the complexity changes when multiple outages occur;
- Understanding priorities and how they play a role in the manner in which Toronto Hydro responds to incidents; and
- Ensuring stakeholders are aware of what they need in order for their residence to accept service from Toronto Hydro.

A program like this would equip stakeholders with information that will help them set realistic expectations, so they can make informed decisions to protect their health, safety, and comfort during an outage.

COS-3 Expand liaison role to address education, communication, and coordination with key community stakeholders (e.g., elected leaders, public safety) during major incidents.

One of the most critical responsibilities of the utility emergency manager is to create relationships with public and private sector emergency partners *prior to* an emergency. According to public safety professionals in the Toronto government, Toronto Hydro has recently improved its capabilities in the liaison role. This effort started at the beginning of 2013 and markedly improved during and after the July 2013 floods. Toronto Hydro should further improve its capability to provide the following:

- Operational information to City of Toronto (OEM, police and fire, transportation);
- An avenue to review restoration priorities in real time;
- Executive level interface in the most demanding responses;
- An ability to embed and coordinate Toronto Hydro assets with City public safety and public works assets, and vice versa, during a response;
- A process for coordinating public communication and leveraging each other's communication channels;
- Pre-established guidelines for handling special requests; and
- Appropriate interface/liaison to City Councillors to arm them with the unified message and support other specific information and outreach needs.

COS-4 Formalize process for developing, approving, and disseminating key messages.

Toronto Hydro's communications team was deliberate in ensuring that the press releases issued to the media were the basis of information used to develop all other external and employee communications. Some of the processes used to support the messaging process were developed "just in time." Toronto Hydro should document the process for developing key messages, and potentially enhance it further, based on any lessons learned. This documentation should become a part of the Emergency Management Plan going forward. For example, the process should capture the following:

- All of the internal and external stakeholder touch points;
- The most appropriate channels to disseminate information to those internal and external stakeholders;
- Commonly requested information for each touch point;

- Specific roles for the message development team, including responsibilities for message development and approval;
- Process map depicting a step-by-step message development and approval process; and
- Pre-scripted messages in the key languages used by the residents of the Greater Toronto Area.

Documenting these processes and procedures will ensure the consistent use of messaging during major events and consistency in the training of new team members in preparation for an event.

5.8. Information Systems and Technologies

The role of the information and operational technologies in major events is two-fold. They provide incident managers with the ability to identify, process, and comprehend critical restoration information (e.g., customers out, location of outages, devices that have operated, location of crews) in order to establish "situational awareness" and provide data and intelligence to inform restoration decision making. The level of deployment and integration of these systems and tools can directly affect the incident response team's ability to make timely and informed command and control decisions at the strategic, operational, and tactical level.

The operational and information technology systems commonly used by utilities during major events are:

- Outage management system (OMS);
- Geographic Information System (GIS);
- Customer Information System (CIS);
- Supervisory Control and Data Acquisition system (SCADA);
- Integrated voice response system (IVR);
- Mobile Data System (MDS);
- Automated metering infrastructure (AMI, smart meters); and
- Radio communications, web sites and web-enabled applications.

The integration of the different systems provides the utility with an end-to-end ability to manage outages. For example, when a customer calls a customer service representative (CSR) or the IVR to report a power outage, a trouble ticket is produced in OMS that represents that individual customer's outage. As additional notifications are received from the IVR or other CSRs indicating more customer outages in the same area as the initial call, OMS will use algorithms to determine what upstream device (e.g., fuse, recloser, or breaker) operated to interrupt service to the entire group of customers.

OMS will then create an outage ticket for that specific device. In companies with MDS, dispatchers send the trouble tickets to trouble or line crews' MDS terminal. In utilities without MDS, a dispatcher will typically radio the ticket information to the crew and the crew will then initiate a paper ticket process to provide the required information to clear the ticket from OMS.

The OMS plays a critical role in the end-to-end process. It captures, evaluates, and tracks the status of outages across the service territory. It integrates with the IVR system and CIS to generate outage records for individual customers tracks group calls related to outages, and generates outage tickets for repair. It links to the GIS system provides information about electric distribution system connectivity, and generates reports on the status of outages across the system for further analysis.

During major events, there is an exponential increase in the number of people interfacing with the OMS and the number of transactions that OMS has to handle. This level of activity often creates the risk of a system slow-down or shut-down when the number of transactions approach or exceed the capacity of the system.

GIS is used to enhance a utility's ability to track assets, develop circuit maps, and, in some cases, view tree canopy in relation to the system's equipment and assets.

MDS aids the development of situational awareness and operational decision making. MDS terminals installed in line trucks provide GPS and trouble spot information and enable restoration crews to interface directly with work management systems, OMS, and dispatchers to streamline execution of operational decisions. MDS can be used to capture damage assessment information, or as a tool to better communicate ETRs from crews in the field to customers. A drawback is the cost to outfit an entire vehicle fleet. Currently, all of the grid response vehicles and supervisors at Toronto Hydro have installed MDS terminals on their vehicles. In addition, meter technicians and inspectors use handheld mobile units.

SCADA systems provide an understanding of the scope of the outages and allow operators to remotely open and close devices in the field. This improves reliability on a day-to-day basis and can be used early in a large event response to re-energize those circuits that have ties to other feeders that have not been affected by the outage. This remote restoration can result in faster restoration of some customers. SCADA also provides support throughout a restoration by allowing the system operators to remotely switch circuits as repairs are made.

Since the early 21st century, utilities have been adopting and implementing advanced metering infrastructure (AMI), also known as smart meters. These systems provide utilities with the ability to carry out two-way communication with meters, and can be used to "ping" a meter (i.e., send a signal) to determine whether there is power at the premise. While this is a functionality that the smart meters provide, the primary objective in installing AMI was to support energy efficiency initiatives and enable customers to manage their energy usage. As a result, most of the AMI systems are not capable of conducting mass surveys ("pings") of customer meters to provide immediate status of the outages.

The IVR and CIS are described in Section 5.6 Communications – Customer Contact.

The assessment of the Toronto Hydro information systems and technologies used to support the 2013 Ice Storm restoration encompassed the following:

- Systems scalability;
- Systems integration;
- Availability of critical data (e.g., for accurate situational awareness, ETRs);
- Accommodation of new users;
- Use of mobile-based technologies; and
- Alternatives when technology is down/unavailable.

5.8.1. Information Systems and Technology Findings

Like most other utilities, Toronto Hydro has implemented and integrated each of the systems described above, to support day-to-day operations. Generally, they support blue sky day operations and smaller outage events (i.e., Level 1 or 2) with great proficiency. The volume of transactions and interfaces generated by the 2013 Ice Storm, stressed the capacity of the system, pushing some portions of the technology infrastructure to their limits.

Information Systems and Technology Strengths

1. One of the early adopters of smart meter technology.

In 2006, Toronto Hydro was one of the first utilities in North America to deploy smart meter technology, called Automated Metering Infrastructure (AMI). As a part of an Ontario Energy Board (OEB) initiative to improve energy efficiency, regulators provided funding for the Company to install the AMI infrastructure. Today, there are 648,000 retail customer and 85,800 industrial/commercial smart meters on Toronto Hydro's system. This extensive smart meter network provides Toronto Hydro with the ability to remotely outages. Since energy efficiency was the primary objective for AMI, the system is not set up to support a large-scale restoration. For example, the current system uses a manual process to ping each meter, requiring excessive time to determine the status of an outage for a group of customers (e.g., an entire circuit).

2. An extensive Supervisory Control and Data Acquisition (SCADA) system with 85,000 control points on more than 4,000 devices.

Over the years, Toronto Hydro has implemented an extensive SCADA system with connectivity to more than 90% of its distribution circuit breakers. Approximately 140 circuit breakers on the 4kV system do not have SCADA controls. As a result, Toronto Hydro's SCADA system provides relatively strong penetration of the devices for an overhead system of its size and construction.

This allows Toronto Hydro to perform remote sensing and control of devices on the electrical distribution system. During an event like the 2013 Ice Storm, the SCADA system was used to initially determine the number of feeder lock outs (i.e., circuits that were completely out of power) and perform remote switching and restoration operations. These resulted in some portion of customers being restored within the first 24 hours from when the event started. Since the SCADA system feeds information into the Outage Management System (OMS), the outage tickets associated with the circuit lockouts were created immediately for field review and restoration.

3. **Mobile Data Terminals available in a portion of Toronto Hydro vehicles.**

Approximately 20% of Toronto Hydro trucks used during the 2013 Ice Storm restoration and were equipped with full MDS terminals and another 30% had mobile connectivity. These mobile units, typically laptops located in each vehicle with cellular technology and automatic vehicle locating technology (AVL) or Global Positioning Satellite (GPS) Technology, allow the crews to receive, accept, update, and close outage tickets from their truck and provide a more timely status of each outage in the OMS. At the same time, GPS location provides the dispatchers with real-time visibility into crew locations so that they can assign work to the crews that are closest to the outage.

Information Systems and Technology Opportunities for Improvement

1. **OMS hardware and interfaces were not scalable to handle the number of concurrent users during the 2013 Ice Storm.**

Toronto Hydro's OMS license can accommodate 33 concurrent users, which provides enough bandwidth to operate the system on a blue sky day and during Level 1 and 2 outage events. Per the Emergency Response Plan, during the 2013 Ice Storm, Toronto Hydro decentralized the dispatch function to local incident command centres to more efficiently manage the restoration work. As a result, the volume of concurrent transactions exceeded the capacity of the system and caused a brief outage.

In addition, the version of the OMS system that was implemented does not include the web-interface for managing basic transactions. The current OMS was designed for use by "super users" – staff who need broader access to system functions to conduct their daily work. In addition to enabling basic OMS transactions, such as opening and closing outage tickets, assigning ETRs for individual customers, and running basic outage status reports, this "super-user" interface provides the ability to make changes to the connectivity model, 'un-nest' outages that the OMS has logically tied to a single device, and purge incorrectly created outage tickets. Super users access OMS through a more sophisticated interface that typically requires training and significant on-the-job experience to master. A more basic interface for managing the outage tickets and running basic reports would require much less training and use less bandwidth than the "super user" version.

2. Groups of smart meters could not be pinged quickly to determine the outage status and a portion of them do not have "last gasp" technology.

As mentioned earlier, Toronto Hydro was one of the early adopters of AMI technology comprising the smart meter hardware, software, and communication network. At the time the AMI system was installed, the primary purpose was to support energy efficiency initiatives through the provision of highly reliable consumption usage readings, so that customers can better manage their energy usage. While smart meters can be used to identify or verify outages, the existing system allows for serial communication (one meter at a time) only, which is done through a highly manual process. This process does not support effective (near real-time) "pinging" of meters to assist in identifying "nested" outages.

In addition to this limited capability to provide outage status on a large scale, approximately two-thirds of Toronto Hydro's smart meters do not have "last gasp technology." This technology sends an automatic notification to the OMS the moment an outage occurs on the meter and enables the OMS to match premises with outages.

3. The GIS system does not have fully accurate connectivity at the meter level.

Similar to leading electric utilities, Toronto Hydro has an integrated GIS system that provides connectivity of its electric network from the substation breaker level through the customer meter. Currently, the accuracy of meter connectivity to the correct transformer is approximately 85% in the core of the City (legacy Toronto Hydro service territory) and 95% across the rest of the system. While maintaining 100% accuracy of meter connectivity may not be achievable, because of the frequent changes in system configuration, the current level of accuracy does not provide the Company with the ability to ensure accurate prediction of the outage levels and customer counts, especially during major events.

4. Lack of connectivity among different information technology systems caused inaccuracy of outage status information available to customers.

Leading utilities have integrated their main IT and OT systems to automatically collect key outage information, analyze the data, and provide status updates to customers through a variety of channels (e.g., web-site, text, mobile app, outage map, IVR). Toronto Hydro systems are integrated to a level that provides sufficient support for day-to-day operations. In a large-scale event, however, the level of manual intervention required to process information and transactions prevents Toronto Hydro from providing timely and accurate information to customers regarding their outage status.

5.8.2. Information Systems and Technology Recommendations

IT-1 Include IT/OT technologies that provide real or near real-time intelligence in the technology strategic roadmap.

As Toronto Hydro updates its strategic roadmap for IT/OT systems and invests in new technologies could support larger-scale restorations, it should:

- Identify what information is needed by Toronto Hydro decision makers, customers, and key stakeholders like the City of Toronto Office of Emergency Management, first responders, public safety agencies, and other public officials during an large scale, complex restoration;
- Update and automate, where indicated, the processes that support the delivery of this information to those groups; and
- Identify alternatives to support communication and information management when systems are down or unavailable.

Toronto Hydro should develop cost estimates for the priorities confirmed through the road mapping projects. There could be new systems or enhancements to current systems.

- **Expand mobile platforms for operational communication (e.g., mobile data terminals, mobile platforms for damage assessment).**

Toronto Hydro should expand the use of mobile technology to all crews to further automate the exchange of information between the field and command centres. Providing more smart devices supported by a back-end software system that is integrated with OMS and GIS would allow field personnel to enter damage information, receive work orders remotely, estimate restoration times, and close work orders in a timely manner, with minimal human intervention in the command and control centres.

- **Evaluate enhancements to smart meter technologies to improve situational awareness during large-scale outage.**

With the advancement of smart metering technology and the communications network, Toronto Hydro should continue with its plan to replace the data collectors, which will expedite the ability to “ping” groups of meters. Also the Company should investigate the costs of upgrading the meters that currently don’t have the “last gasp” technology.

- **Upgrade the outage management system (OMS) and create an OMS-lite (thin client or web-based) version to support decentralized command and control.**

The OMS at Toronto Hydro, including hardware, software, servers, and other associated infrastructure, should accommodate different types of users (super users, users with “read only” needs) and a larger number of concurrent users. Enhancements to consider include:

- Implementing a more current version of the OMS software;
- Arranging access to provisional licensing to support a short-term uptick of users; and
- Providing a scaled-down version of OMS for non-super users.

The access to this version could be through a terminal or it can be web-based.

- **Ensure that primary data systems (i.e., GIS, OMS, CIS, outage map) integrate to provide key data for customers and decision makers**

Toronto Hydro should assess the current system architecture, particularly integration points between key operational systems (e.g., OMS, GIS) and information systems (e.g., CIS, website). The Company should address the interface point between main systems where information links are slow, where needed information isn't available to provide an accurate portrayal of system or outage status, or where critical information isn't accessible at all. Once critical gaps are known, Toronto Hydro should identify and include needed enhancements on the technology roadmap.

5.9. Vegetation Management and System Hardening/Resilience

The increased frequency of severity of weather events, along with changing expectations and lower tolerance for long duration outages by customers, have spurred utilities to explore ways to improve storm performance of their distribution systems (durability and resilience). Durability[12] refers to the ability of the system to withstand the impacts of storms without damage and includes materials or equipment that resist damage, the arrangement of existing equipment to resist or avoid damage, and technologies that help protect the system from damage. Resilience[13] is defined as the ability to continue to operate despite damage to some parts of the distribution system. It encompasses the configuration of system components to reduce the numbers of outages, reconfiguration of the system to maintain service, and application of system resources to continue service to customers while the electric system is restored. Some commonly used durability and resilience enhancement techniques include:

- Improving the strength of poles and structures;
- Burying overhead lines;

[12] Edison Electric Institute (EEI) defines hardening as those activities that: "improve the durability and stability of infrastructure to withstand the impacts of severe weather events with minimal damage," *Before and After the Storm*, March 2013.

[13] The Edison Electric Institute also defines resilience as those "measures (that) do not prevent damage; rather they enable facilities to continue operating despite damage and/or promote a rapid return to normal operations," *Before and After the Storm*, March 2013.

- Enhancing flexibility of the electric system through circuit ties and system automation; and
- Increasing vegetation clearances around power lines.

System Hardening/Resilience

Most system hardening initiatives span multiple years, involving sequential cycles of investment to yield improvement. Leading utilities have worked with their key stakeholders (in particular, regulators) to identify the best options, evaluate the costs and benefits for each option, determine the optimal portfolio of projects to enhance the durability and resilience of their distribution systems, and ultimately secure funding for this work. There is no standard approach within the utility industry to evaluate the costs and benefits associated with hardening options, but the three most commonly-used methodologies are: probability based; relative comparison; and recent event baseline.

Each of these methods requires the use of a set of assumptions that can be supported by historical data if it is available. It's a challenge for utilities to have enough actual data to fully assess the benefits of each hardening option. There are not many major events, the impact of each event can vary substantially, and utilities have tended to focus resources on restoration activities, rather than data gathering.

Converting Overhead Lines to Underground

Over the past decade and immediately after a major event that causes extensive power outages, customers, regulators, legislators, and other external stakeholders tend to express interest in the conversion of overhead distribution facilities to underground construction. Underground facilities reduce, if not eliminate, the risk of failure due to high wind, falling trees, and ice accumulation. On the other hand, they are more exposed than overhead lines to other hazards such as heat and flooding. Damage related to heat and flooding often requires more time and higher cost to restore.

In addition to the potentially higher cost of underground restorations, all of the studies that have been commissioned by different regulators and state legislators across the U.S. have deemed widespread "undergrounding" to be cost prohibitive. Some of the preliminary estimates for converting the remaining overhead infrastructure (approximately 58% of circuit lines) at Toronto Hydro to underground range from $11-$16 billion dollars. Another concern is that the actual conversion process inconveniences property owners and creates aesthetic issues – yard excavation, driveway removal and replacement, damage to tree root systems, and padmount transformers placed on customers' property.

As an alternative to implementing large conversions, some utilities have converted selected overhead circuits or sections of circuits to improve the reliability of service to critical infrastructure facilities. These include hospitals, water filtration plants, 911 call centres, etc. Usually sections that are targeted for conversion to underground are located in heavily-treed areas, in back-lots with difficult access, and areas that are not prone to flooding.

Vegetation Management

Vegetation is typically the single largest culprit of outages during major events. Trees and limbs tend to fall into distribution lines and take down wire and equipment, including poles, creating interruptions to customer service. Most utilities clear vegetation around lines, typically using a pre-defined cycle. Trees and limbs that cause outages in major events tend to fall in from outside the typical clearances or rights-of-way (ROW).

Some utilities have expanded their vegetation management programs to increase clearance specifications, remove overhangs, and take out hazard trees from outside the ROW. Aggressive VM programs can reduce damage during major events, but are difficult to execute since they require access and approvals by property owners. It is important to note that most of the utilities do not trim around service drops.[14] This is usually the responsibility of a property owner. Most of the utility vegetation management work is outsourced to contractors who specialize in maintaining line clearance for utilities.

Also, VM programs often must comply with external regulations, particularly when utilities serve urban areas with denser tree canopy. The arboriculture industry pruning standard defines proper pruning techniques to ensure that any pruning does not negatively affect the health of the tree. Workers must follow these standards when maintaining vegetation around distribution lines. In addition, many municipalities, and some neighbourhoods, have specific requirements to protect their tree canopy. These may prescribe the amount of clearance around a line, how to remove dying or deceased trees, and sometimes even access to trees that are on private property.

Pole Maintenance

In addition to investing in vegetation management, most utilities conduct periodic wood pole inspection and replacement programs. The inspection cycles typically range from 8-to-15 years and include a combination of visual, sounding, ground line, and boring methods for assessing the integrity of wood poles. The poles which do not pass the test are stratified by priority (i.e., When do they need to be replaced based on their condition?) and replaced within a pre-defined target period.

Utility hardening programs usually must comply with externally-imposed policies and guidelines, too. For example, in order to ensure the safety of electric utility construction, utilities adhere to electric safety codes which establish guidelines for pole loading based on historic weather patterns by geographic area. They are expressed in terms of the

[14] A service drop is an overhead electrical line running from a utility pole to a customer's building or other premises. It is the point where electric utilities provide power to their customers.

minimum wind speeds and ice loading that the structures are expected to withstand. Utilities are expected to follow these guidelines to ensure that their construction standards and structures, including wood poles, meet loading standards at the time of installation.

The review of Toronto Hydro's vegetation management and system hardening and resilience programs addressed the following:

- Program scope and management;
- Conformance to industry standards and performance as compared to leading practices;
- Adherence to local by-laws; and
- Resiliency-building approaches and methods.

5.9.1. Vegetation Management and System Hardening/Resilience Findings

The damage that Toronto Hydro experienced during the 2013 Ice Storm was mostly caused by tree limbs falling on distribution lines and breaking the conductors. During the entire storm, the Company had to replace only 17 out of approximately 101,000 wood poles on its distribution system. Given the small fraction of poles that were broken during the ice storm and the well-defined wood pole inspection and replacement program in place, it can be concluded that the strength and integrity of the Company's wood pole plant did not contribute to the number of outages experienced during this storm and may have actually prevented a larger amount of damage. As a part of the Company's asset management effort, Toronto Hydro conducts a Planned Wood Pole Inspection program (PWPI) on a 10-year cycle.

Throughout the Company's history, Toronto Hydro has maintained clearances around its power lines using different methods and programs. In 2008, Toronto Hydro renegotiated its vegetation management contract and established a three-year, circuit-based cycle for maintaining clearances across its system, which is an industry leading practice. The current VM program follows the CSA and ANSI standards as well as City of Toronto Line Clearance Guidelines[15].

[15] Canadian Standard Association (CSA) C22.3 No. 1-10
- Flashover distance for AC System Conductors to trees

ANSI A300 – Standard Practices for Tree Care Operations
- Recommended standard by the International Society of Arboriculture (ISA) and the Tree Care Industry Association (TCIA)

City By-Laws – City of Toronto Forestry Cycle Pruning Guidelines
- 15 cm (0.5 ft.) clearance from house service
- 30 cm (1 ft.) clearance from secondary conductors
- 90 cm (3 ft.) clearance from primary conductors

In 2008, Toronto Hydro conducted a study to explore different system hardening options. As a result of that study, the Company began to implement several hardening efforts including, but not limited to better pole guying,[16] stronger insulators, and fiberglass brackets for pole line equipment support.[17] It is important to note that over the past 30 years, Toronto Hydro has been installing underground systems in all new developments. This has been a standard industry practice, with developers bearing a portion of the cost.

Vegetation Management and System Hardening/Resilience Strengths

1. **Toronto Hydro has been following a circuit-based trimming program since 2008 and adheres to accepted industry and City of Toronto pruning standards.**

In 2008 the Company re-negotiated its VM program and implemented a circuit-based approach. The approach used until then was grid based, focused on clearing distribution lines by geographic areas (i.e., sections of the City) irrespective of the electric system configuration. The circuit-based approach focuses the yearly VM spending on circuits where it will provide the best reliability improvement while ensuring that the system is still maintained in adherence with the accepted industry and City of Toronto pruning standards. Similar to most utilities, the Company does not trim around service drops.

2. **Vegetation management preventive maintenance program is in line with industry practices (i.e., three-year cycle).**

The duration of the vegetation trim cycle for an electric distribution utility depends on a number of factors, such as tree species, local by-laws, customer priorities, and the electric system configuration. The cycle for line clearances typically ranges between three and seven years on the distribution system. Toronto Hydro maintains its circuit clearances on a three-year average cycle, meaning that circuits are pruned every two to five years, depending on their reliability performance. This VM preventive cycle is often considered a leading industry practice.

3. **Over the past six years, Toronto Hydro has maintained a consistent scope of the vegetation management program (e.g., clearances, miles completed) while reducing the cost of the program.**

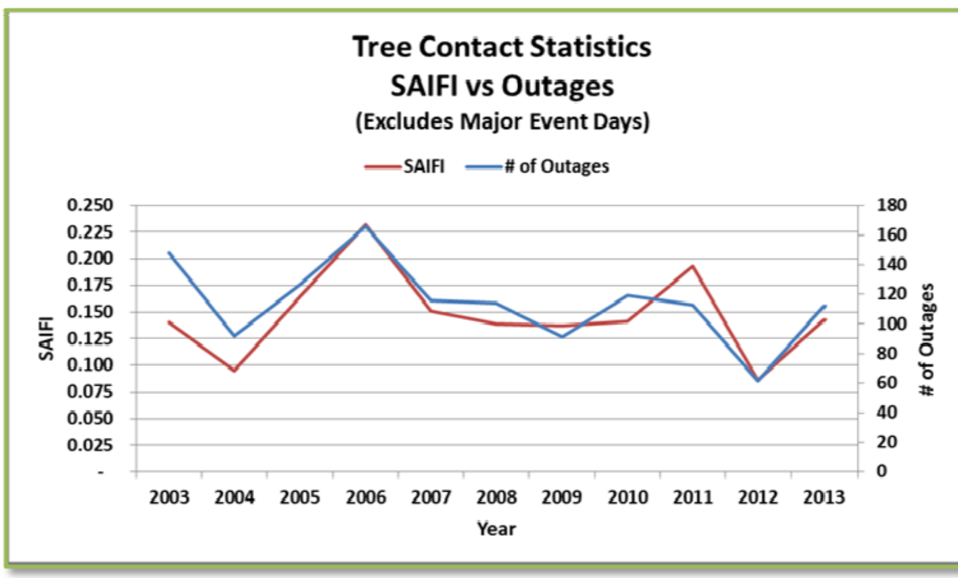
As mentioned earlier, most utility vegetation management work is conducted by outside contractors that specialize in electric line clearance. Toronto Hydro uses an outside contractor for all preventive trimming. It has retained one vegetation management crew in-house that focuses on customer requests and corrective maintenance work. There is a certified arborist in-house.

[16] Includes installing a tensioned wire on poles, designed to add stability to a free-standing structure.
[17] Fiberglass brackets are not subject to as much decay as the wood brackets.

When Toronto Hydro transitioned from the area-based to circuit-based approach in 2008, it requested bids from outside contractors. The Company was able to reduce the overall cost of the program while continuing to maintain the same clearances (in line with industry and City of Toronto standards) on a three-year average cycle. This strategy reduced the costs of the overall program while providing the same (or better) day-to-day reliability.

Figure 19 depicts Toronto Hydro's vegetation-related reliability on a blue sky day over the period 2003 through 2013. The red line represents the System Average Interruption Frequency Index (SAIFI) and the blue line shows the total number of outages caused by trees. SAIFI is a standard industry metric used to evaluate the reliability performance and it represents the number of interruptions that an average customer would have in a 12-month period. The calculations do not include major outage event days, but they do include outages related to annual weather patterns and smaller events, which cause the fluctuations in performance from year-to-year. Despite these fluctuations, statistics indicate that the vegetation-related reliability performance has remained constant or slightly improved for Toronto Hydro since the implementation of the changes to the contract in 2008.

Figure 19: Toronto Hydro Vegetation-Related Outages and SAIFI (2003-2013)



4. Toronto Hydro's wood pole program is in line with industry leading practice.

For more than 15 years, Toronto Hydro has been conducting a PWPI program on a 10-year cycle. The work is performed by contractors specializing in this field. The program includes a two-step assessment (visual and sounding assessment and a bore test)[18] with standard remediation alternatives for wood poles that do not pass the inspection. The Company has established timeframes within which the rejected poles have to be addressed. The cycle and scope of the Company's PWPI program are in line with industry leading practices.

Vegetation Management and System Hardening/Resilience Opportunities for Improvement

1. **City of Toronto line clearance by-laws are defined for blue sky reliability, not for preventing outages during major incidents.**

With the recent increase in frequency of major weather events across North America, the City of Toronto line clearance guidelines may not provide for an adequate balance between tree canopy objectives and the need for larger clearances to reduce the risk of widespread, prolonged power outages. The current clearance guidelines provide for a 3' clearance around primary lines and 1' around secondary wires. These are not sufficient to protect the lines during major weather incidents, whether they are related to ice, wind, heavy snow, or wind.

2. **Coordination of clearing efforts with City vegetation management crews during an incident and day-to-day.**

Toronto Hydro crews focus on power line clearance only, and City crews focus on parks and street-side tree maintenance. While the scope and primary objectives of their daily work differ), Company and City forestry crews often work together during major events to restore power to City residents. During the 2013 Ice Storm, Toronto Hydro and the City did not have a standard process to communicate the availability of City forestry resources and expected working hours each day, a procedure to transfer control of the crews to Toronto Hydro, or a consistent approach for requesting and assigning crews.

---

[18] The first step always is a visual and sounding assessment of the pole. The pole is inspected for external signs of decay, feathering, through-checks, mechanical damage, insect infestation, etc. A hammer is also used to strike the pole from the ground level up to eight feet above; the sound characteristics of the hammer blow help determine if there are internal cavities caused by decay. This is done on all wood poles. For poles less than 20 years old, a visual and sounding inspection is adequate to confirm the integrity of the pole (barring observed defects).

The second step is a bore test or a resistograph test. This is performed on poles older than 20 years, and on any other poles that are suspected to have an internal defect, even if they are less than 20 years old. For the bore test, a 13mm diameter bit is used to bore into the pole on a 45-degree angle, at ground level. The resultant shavings are examined for signs of decay and then the hole is plugged. An alternate technology to the bore test is a resistograph test, in which a 2mm diameter drill bit connected to a measuring instrument is used to drill into the pole. The resultant graph showing drill position and power consumption can be analyzed to identify internal cavities. The advantage of the resistograph test is that it leaves only a very small hole in the pole that does not require plugging.

5.9.2. Vegetation Management and System Hardening/Resilience Recommendations

VMSH-1 Evaluate all viable options to improve distribution system resilience during major weather events, including converting lines to underground for sections of circuits where it will enhance the reliability of services to critical infrastructure and facilities.

Toronto Hydro should conduct an in-depth study to identify and evaluate options for enhancing the distribution system resilience during major weather events. The study should quantify the value and costs associated with each alternative and identify the best combination of projects to improve system performance during these incidents. The Company will need to work with the City of Toronto to identify mutually acceptable and cost-effective options related to increasing vegetation management clearances around power lines.

Initiatives that the Company should consider include, but are not limited to:

- Increase right-of-way width or removal of "overhang" (aggressive vegetation management);
- Install breakaway disconnects on the pole side of the service lines;
- Increase structure loading to withstand high wind and ice;
- Replace small conductors;
- Improve circuit sectionalization to provide more flexibility;
- Convert overhead back-lot to underground, or move to the front lot (street side);
- Upgrade overhead structures/circuits to heavy loading standard;
- Convert overhead lateral (tap) lines to underground;
- Convert entire overhead circuits to underground; and
- Develop micro-grids.

These measures, including the conversion of overhead lines to underground, can enhance the reliability of services during major weather events (e.g., ice, wind, hurricane) to critical infrastructure and facilities such as hospitals, water filtration plants, and 911 call centres.

VMSH-2 Gain support from key stakeholders on the level of resilience required and related funding.

The costs associated with improving distribution system resilience are significant. In order to implement the improvements identified in the study, Toronto Hydro should work with the Ontario Electricity Board, the City of Toronto, and other stakeholder groups to gain agreement on the level of resilience desired – and the amount of investment required. Once there is a shared understanding of the target level of resiliency and the costs associated to achieve it, stakeholders will need to agree to a cost recovery mechanism.

5.10. Toronto Hydro-City Coordination

Over the course of the assessment, stakeholder interviews and public comments[19] revealed various aspects of emergency management at the community level that could benefit from a closer collaboration between Toronto Hydro and the City of Toronto. The Independent Review Panel requested Davies Consulting to review and make recommendations for areas where joint efforts between Toronto Hydro and the City could improve emergency preparedness and response. These include:

- **Personal preparedness** – advance planning undertaken by individual citizens or groups of citizens to be able to meet basic living needs during an extended power outage. This could include having: a several-day supply of food, water, and household supplies; alternative living arrangements; an evacuation plan; clothing and blankets to withstand lack of heat; a battery-powered radio; a back-up supply of medication and other critical health supplies; and (possibly) a back-up generator.
- **Communication when technology is "down"** – disseminating coping information (e.g., restoration priorities and status, availability of city services, safety messages) when channels powered by electricity are not available (i.e., Internet, television, cell phone, radio).
- **Support for vulnerable populations** – availability of assistance for groups of residents who have limited ability to cope during an emergency, including the economically disadvantaged, the uninsured, low-income children, the elderly, the homeless, those with serious health conditions, and the mentally impaired.
- **Shelters/warming centres** – locations made available by the City that provide alternative housing, a place to re-charge devices, and access to heat.
- **Planning and communication of restoration priorities** – joint identification of critical facilities to re-energize first and messaging of priorities to the public throughout the restoration.
- **Explanation of customer responsibility** for electrical equipment repairs on their premise – clearer definition and communication of the obligation of the homeowner/dweller, as established by the Ontario Electrical Safety Authority, to fix equipment on his/her property, such as standpipes, so that customers can arrange for repairs early in the event.

[19] See Appendix D for a summary of public comments.

- **Explanation of building codes** – standards maintained by Toronto Building that enable or hamper ingress or egress within high rise buildings and provide for emergency power supply.
- **Use of 311 call centre for back-up support** – feasibility of using the City of Toronto facility to handle overflow calls for Toronto Hydro during an emergency.
- **Coordination of urban forestation policies and plans** -- mindful of the needs for reliable and more resilient electricity distribution system, joint consideration of City, Toronto Hydro, and other key stakeholders when developing standards and procedures to manage the urban tree canopy and forestation efforts.
- **Emergency response coordination** (police, fire, other) – maintaining frequent, if not continuous, contact between Toronto Hydro and first responders during major power outages.

5.10.1. Toronto Hydro – City Coordination Findings

City of Toronto staff and public officials interviewed, uniformly noted how well Toronto Hydro responded to the 2013 Ice Storm given the extreme cold, hazardous working conditions, and extensive, tree-related damage. Both Toronto Hydro and the City of Toronto recognized that this was a community recovery, as well as customer restoration effort. They were able to accomplish both through an effective collaboration over the course of the event to coordinate restoration priorities, public communication, forestry, and outreach.

The ways in which Toronto Hydro was able to work effectively with the City include:

- **Identification of critical load priorities** – The City and Toronto Hydro had in place a pre-determined list of critical facilities to be restored first and Toronto Hydro's restoration plans aligned with these priorities. Toronto Hydro participated on daily planning calls with the City and other stakeholders where it provided updates on restoration process.
- **Sharing of vegetation management resources** – Toronto Hydro needed a number of additional forestry resources to address the tree-related damage to the system. In addition to the Company contractors who supplied additional resources, the City of Toronto provided many City forestry crews to support the effort.
- **Public communication** – Toronto Hydro executives and staff supported the communication efforts of the City of Toronto through participation in daily press conferences, attendance at Provincial meetings, and responding to the thousands of emails received by Councillors.

5.10.2. Toronto Hydro – City Coordination Recommendations

THC-1 Strengthen emergency management coordination between City of Toronto and Toronto Hydro.

- **Identify and monitor vulnerable and special medical needs populations.**

Public comments received at three town hall meetings and through emails to torontoicestorm@daviescon.com indicate that residents may not understand that outreach and support to vulnerable populations is a responsibility of the City of Toronto, not Toronto Hydro. Toronto Hydro does maintain a list of customers who, because of medical needs, would be in a life threatening situation in the event of a power outage. Customers voluntarily provide this information to the Company. The Company uses the information provided to alert effected customers of *planned* outages. In case of emergency, Toronto Hydro shares this information to the City for follow up.

As a central and visible participant in the community recovery after a major event, Toronto Hydro should consider offering additional communications and outreach support to the City. Balancing the requirement to maintain privacy of customer information with the need to ensure the safety and health of customers, Toronto Hydro should consider ways to use its customer database and knowledge of its external liaisons and other employees who routinely interface with the public, to assist the City in reaching those most in need.

Toronto Hydro could use its communication channels (e.g., website, social media) to support outreach to vulnerable groups during an event (i.e., "check in on your neighbour," locations of shelters and warming centres). Prior to an event, Toronto Hydro could include reminders in personal preparedness communications directed to populations who need more support. Also, the City and elected officials should consider targeted outreach to high rise building owners and neighbourhood associations to encourage them to check in on neighbours and tenants during an emergency.

- **Educate customers/citizens about emergency preparedness.**

In areas where major events, are infrequent, it's easy for people to have little knowledge of or have become complacent about emergency preparedness. The respective websites of both Toronto Hydro and the City of Toronto include tips and guidelines to help customers and citizens better cope when power is out. An example is a checklist for a 72-hour emergency kit. Both should consider supplementing this "passive" source of information with a more active outreach campaign, such as public service announcements on radio and television, bill inserts, announcements on community on-line bulletin boards, participation at town meetings, and providing mobile applications. Also, Councillors' communications may be a useful channel to reinforce the importance of personal emergency readiness.

- **Conduct joint planning, training, and exercises.**

Leading practice utilities ensure that their emergency management strategy, plans, training programs and exercises are closely aligned with those of key, external stakeholders, especially local governments. During a major event, utility workers function as first responders, necessitating a seamless coordination with local emergency management organizations, police, and fire/rescue professionals. This requires cooperative planning, agreement on planning scenarios, and joint participation in functional exercises. The City of Toronto and Toronto Hydro should continue and consider increasing the frequency of current planning discussions. They should agree to planning scenarios (i.e., the type and severity of incident), share and vet emergency plans, and schedule joint exercises to test readiness.

THC-2 In collaboration with the City of Toronto (Urban Forestry), update related urban forestry plans to ensure adequate line clearances to withstand major events.

In urban areas with dense tree canopy, like the Greater Toronto area, there are often competing objectives between increasing the number of trees and decreasing the number of vegetation-related outages. Toronto Hydro forestry crews adhere to standards set forth by the CSA, ANSI, and the City of Toronto, which do not provide for sufficient clearances to reduce the likelihood of tree-related outages during incidents like the 2013 Ice Storm. The City of Toronto urban forestry team should work closely with the Toronto Hydro staff to update the Urban Forestry Plan to ensure that the reliability of customer service is incorporated in the plan.

THC-3 Request the Province to require all new and existing buildings to have adequate back-up generation within the next 10 years.

The Provincial building code that regulates emergency power supply for buildings is "intended to accommodate the safe evacuation of occupants within the building in case of a fire emergency and assist in firefighting operations in case of a fire emergency."[20] The regulation does not address the provision of emergency power supply for essential needs (e.g., refrigeration, heat, phone service) during an extended outage. Many of the public comments expressed concern for the safety and health of family, friends, neighbours, and elderly people who had limited ability to leave their high rise residences. The IRP recommends that the Provincial government consider a requirement for all new and existing building to provide a means for back-up power for a longer period of time. This will allow for the safe evacuation of and access to vulnerable populations that live in high-rise buildings.

[20] Briefing Note, Chief Building Official, Toronto Building, July 11, 2013

6. Moving Forward

The 2013 Ice Storm was an unprecedented event that disrupted the lives of most Toronto residents and tested the mettle of the first responders, as well as the City and Toronto Hydro personnel involved in the recovery effort. Through a dedicated, coordinated, and intensive response, the community was safely restored to normalcy within a reasonable timeframe given the amount and type of damage suffered. Toronto Hydro executed the restoration in a manner consistent with industry practices. The Company's management and approach to the restoration was prudent, diligent, and safe. As expected with any large incident, the recovery from this ice storm also exposed several aspects of the emergency response that can be further improved.

In accordance with the commissioned scope of the panel review, the recommendations presented in this report focus mainly on the improvements that Toronto Hydro can make to further enhance its ability to respond to future events that cause widespread power outages. Additionally, and notably, there are several areas, primarily described in Section 5.10 Toronto Hydro-City Coordination, where heightened attention from and cooperation among Toronto Hydro, the City of Toronto, and the Province of Ontario can improve the community's capability to better cope with and manage the response to a large-scale event in the future. This report should serve as the starting point for a more sustained, coordinated effort among all of these parties, the outcome of which will be meaningful improvement in community preparedness for future major outage events.

Appendix A: Glossary of Terms

Term	Description
Bird Dog	A local utility resource dedicated to helping off-system/mutual assistance crews with daily work needs (e.g., navigating the territory, coordinating work with other crews, ensuring the safety of the work site, accessing food). These resources are typically local company line workers and recent retirees who are familiar with the system and are trained to operate the switching devices in the field. Bird dogs may support one or more crews.
Backbone	The main three phase portion of a distribution circuit that is connected directly to the substation circuit breaker. All load in a circuit is served either directly from the backbone or from three, two and single phase lines (laterals) tapped off the backbone.
Blue Sky	Refers to day-to-day, normal operations
Canadian Electric Association (CEA)	The industry association for Canadian electric utilities.
Circuit	A continuous flow of electricity from a source to a load or loads. In utility distribution, a circuit is the main (usually 3 phase) line and all three, two, and single phase sections (laterals) served by a single substation circuit breaker.
Circuit sectionalization	The practice used by utilities to break an electric circuit into sections that can be isolated from the rest of the circuit in case of an outage to protect all of the customers from getting an outage as a result. This also allows the utility to switch the source of power to the circuit from one feeder or substation to another during an outage, if another source is available.
Damage Assessment	The process for systematically collecting damage information in the field to support the restoration planning, resource acquisition, and development of restoration estimates.
EHS Officer	Environmental, Health, and Safety Officer
Estimated Time of	An estimate of the restoration time. The ETR can be

Term	Description
Restoration (ETR)	provided at multiple levels, including global, regional, neighbourhood/substation, circuit, and individual customer.
Functional Exercise	A functional exercise simulates an emergency in the most realistic manner possible, short of moving real people and equipment to an actual site. As the name suggests, its goal is to test or evaluate the capability of one or more functions in the context of an emergency event.
Incident Command System (ICS)	A standardized, on-site management system designed to enable effective, efficient incident management by integrating a combination of facilities, equipment, personnel, procedures, and communications operating within a common organizational structure. ICS is used to manage an incident or a non-emergency event, and can be used equally well for both small and large incidents.
Last Gasp Technology	When the smart meter loses power, it records state information to flash memory or sends out a wireless signal that it has lost power—the meter's "last gasp." Not all smart meters on Toronto Hydro's system have this technology.
Lateral	A three, two or single phase section off the main line (backbone) of the circuit, constructed to extend to loads that are not directly in the path of the main line. Laterals are typically connected to the main line through fuses or reclosers.
Mutual Assistance	The process by which electric utilities provide resources to each other to support major restoration efforts. This process is unique to the industry and is crucial for responding to large emergencies since no single utility has adequate resources to quickly restore normalcy after full-scale events.
Off-System Resources/Crews	Individuals who do not work on Toronto Hydro system day-to-day but who are deployed by their company (a contractor or another utility) to support the restoration effort. Once the restoration is completed, these resources return to their home company.
Pole Guying	The practice of installing one or more tensioned wires on poles designed to add stability to a free-standing

Term	Description
	structure so that it can withstand higher speed winds without blowing over.
Service Drop	An overhead electrical line running from a utility pole to a customer's building or other premises. It is the point where electric utilities provide power to their customers.
Smart Meter	Usually a digital device that records consumption of electric energy in intervals of an hour or less and communicates that information, at least daily, back to the utility for monitoring and billing purposes. Smart meters enable two-way communication between the meter and the central system.
Storm Hardening	Activities that a utility may undertake to improve the durability and stability of infrastructure to withstand the impacts of severe weather events with minimal damage.
System Operations Centre (SOC)	A facility that houses system operators and data management system, providing real-time status and the ability to remotely operate the distribution system. The Incident Management Team at Toronto Hydro uses an SOC during major events.
Tabletop Exercise	A tabletop exercise simulates an emergency situation in an informal, stress-free environment. The participants – usually the decision-makers during an emergency – gather around a table to discuss general problems and procedures in the context of an emergency scenario. The focus is on training and familiarization with roles, procedures, or responsibilities. An advantage of a tabletop exercise is that it can allow people to test a hypothetical situation without causing disruption in the community.
Triage Process	Process used by Toronto Hydro during storms to verify the downed wire reports received from customers. The "triage" crew determines if the wire is live, makes the location safe by grounding it if possible, or collects the data and refers the job to the appropriate resource to resolve.
Vegetation Management (VM)	Refers to the cyclical and reactive program for maintaining trees and tree limbs at a safe distance from the distribution power lines. A VM program is

Term	Description
	guided by a set of industry standards and local City by-laws as well as the electric distribution company guidelines.

Appendix B: Utility Mutual Assistance Providers

The following 10 utilities provided mutual assistance to Toronto Hydro during the restoration of power outages caused by the 2013 Ice Storm:

- Brant Hydro;
- Entegrus;
- Enwin;
- Horizon;
- Hydro One;
- Manitoba Hydro;
- Norfolk Hydro;
- Ottawa Hydro;
- Sault Saint Marie PUC; and
- Sudbury Hydro.

Appendix C: Summary of Findings and Recommendations

Evaluation Areas	Findings		Recommendation
	Strengths	**Opportunities for Improvement**	
Emergency Planning and Preparedness	1. Emergency response structure largely aligns with the Incident Command System, which is considered to be the industry leading practice in emergency response.	1. Emergency response plans provided an overall structure for response, but did not include detailed descriptions of key processes and all roles.	EPP-1: Reaffirm and communicate emergency management vision and strategy throughout all of Toronto Hydro.
	2. Corporate Emergency Management organization is centralized and addresses all hazards.	2. Toronto Hydro characterizes grid incidents on a three-level scale, which may not address full-scale events adequately.	EPP-2: Continue to inculcate the ICS-based approach to emergency response.
	3. Trained and exercised System Operations Centre (Command Centre) roles and responsibilities prior to the event.	3. Key restoration strategies and processes were not defined or understood at all levels of the company with roles in the response.	EPP-3: Enhance centralized Emergency Management group resources to support full implementation and sustainment of ICS and ongoing relationships with key stakeholders.
	4. Pre-event weather monitoring process in place and used to support activation decisions.	4. Many Toronto Hydro employees did not have a pre-assigned and trained role for major incidents.	EPP-4: Add dedicated grid operations emergency management resources.
		5. Toronto Hydro conducted exercises and training at the Command Centre level, but did not perform sufficient training and exercise in the Local Incident Command Centres.	EPP-5: Update the Emergency Response Plan to improve comprehensiveness and usability.

Evaluation Areas	Findings: Strengths	Findings: Opportunities for Improvement	Recommendation
Resource Acquisition and Allocation	1. Safely deployed the largest number of resources for any response in Toronto Hydro history.	1. Mutual assistance processes and agreements with other utilities across Canada and North America were not formalized.	RA-1: Adopt a resource management strategy that provides for: deployment of all available resources, seamless integration and coordination of crews, and optimal supervisory span of control.
	2. Developed and applied mutual assistance processes in real-time that generally worked.	2. The process to acquire and coordinate the deployment of City forestry crews was not defined in advance.	RA-2: Create a comprehensive, scalable, logistics plan as part of the Emergency Response Plan.
	3. Flew in, equipped, and deployed mutual assistance resources from Manitoba within 48 hours.	3. Toronto Hydro has limited ability to accommodate a large influx of mutual assistance resources.	
	4. Conducted thorough mutual assistance on-boarding process and safety briefings.	4. The demobilization process for mutual assistance crews was not clearly defined.	
	5. Strong collaboration between City and Toronto Hydro tree crews on restoration activities.		
Damage Assessment and Restoration Planning	1. Overall restoration priorities were in line with industry practices.	1. Lack of real, or near real-time situational awareness of outages and work progress below the feeder level.	DAP-1: Institute a damage assessment process that defines the required approach, procedures, and competencies to establish situational awareness and planning inputs within the specified timeframe (e.g., within 48 hours).

Evaluation Areas	Findings		Recommendation
	Strengths	Opportunities for Improvement	
	2. The Command Centre coordination calls (every three hours) provided useful information and maintained alignment of Local Incident Command Centres to restoration priorities.	2. Damage Assessment process was not defined, documented, or consistently applied across the Local Incident Command Centres.	DAP-2: Develop a process to establish (calculate) timely and accurate ETRs.
	3. Some Local Incident Command Centres conducted planning activities overnight to facilitate work assignments and crew deployments for the subsequent shift.	3. Restoration estimates were not developed at various levels of specificity.	DAP-3: Establish standard work planning processes and procedures; train and exercise response personnel to drive consistency across central and local commands.
		4. Work planning practices varied across Local Incident Command Centres.	
		5. The Central Command Centre and Local Incident Command Centres did not use standard planning tools.	
Restoration Execution	1. Safety performance was excellent.	1. Restoration approach was not consistent, varying between "order-based" and "feeder-based."	RE-1: Pre-determine best restoration approach for each emergency Level (e.g., 1-4).
	2. Dispatch functions were decentralized to Local Incident Command Centres early in the restoration process.	2. Lack of full coordination among decentralized dispatch functions led to some inefficiency in crew deployment.	RE-2: Eliminate centralized mutual assistance and contractor LICCs and encompass those resources within the three, geographic LICCs.
	3. Coordination with the Electrical Safety Authority (ESA) to reconnect customer premises was adjusted during the event to reduce hardship.	3. Local Command Centre structure (three geographic and two functional locations) added complexity to crew deployment and work coordination.	

Evaluation Areas	Findings		Recommendation
	Strengths	**Opportunities for Improvement**	
	4. Special requests were handled within the pre-defined priority order.	4. Restoration execution approaches were not followed consistently by all Local Incident Command Centres.	
	5. The work protection process did not cause unusually long delays in restoration.	5. Toronto Hydro has different work protection processes than other utilities in the Province of Ontario, limiting the type of work that mutual assistance crews can perform.	
	6. "Bird-dogging" of mutual assistance crews worked well.		
Communications - Customer Contact	1. The ability to use an external contract call centre as a back-up call centre site.	1. There was insufficient overflow capacity (system and staffing) to take outage calls, so that the majority of callers were not able to report or get information on outage status.	CCC-1: Secure capacity (people and technology) to support timely customer contact during an incident.
	2. The Key Accounts organization within Customer Care implemented an effective process to inform key and commercial accounts of outage status.	2. The Integrated Voice Recognition (IVR) system was difficult to navigate, not intuitive, and did not effectively support customers who are non-native English speakers.	CCC-2: Improve the process for ensuring accurate and uniform outage status messages across every mode of communication to customers (e.g., IVR, web, mobile application, low tech channels).
	3. The control room, dispatch, call centre, and key accounts staff are co-located, enabling more effective information exchange.	3. Outage status information was inadequate and often inaccurate.	CCC-3: Employ outbound calling/texting to inform customers of outage status and other pertinent information.

Evaluation Areas	Findings		Recommendation
	Strengths	Opportunities for Improvement	
		4. Alternate paths to contact Toronto Hydro (e.g., email, web) were in place, but all were not monitored frequently enough.	CCC-4: Work with City of Toronto to evaluate options for using 311 capabilities.
		5. Toronto Hydro does not provide mobile capability to report or track outages.	
		6. There was no capability to transfer Toronto Hydro-related calls from the 311 call centre.	
Communications - Other Stakeholders	1. As the face of the company and the executive spokesperson, the CEO performed his role well.	1. Process for developing and issuing timely and accurate ETRs was not clearly defined.	COS-1: Develop a process to communicate timely and accurate ETRs at different levels of specificity.
	2. Proactive media campaign and consistent messaging (use of "one voice"), including coordination with the Systems Operations Centre, worked well.	2. Liaison roles with some stakeholder groups were not clearly defined.	COS-2: In collaboration with the City of Toronto, develop an education program to improve stakeholder literacy of: restoration process, customer responsibility, and preparedness.
	3. Toronto Hydro was viewed as an effective partner in City and Provincial communications.	3. Messages were not always accessible to all stakeholders (e.g., customers with no access to TV, radio, or social media).	COS-3: Expand liaison role to address education, communication, and coordination with key community stakeholders (e.g., elected leaders, public safety) during major incidents.
	4. Toronto Hydro used a variety of methods to reach the public, including		COS-4: Formalize process for developing, approving, and

Evaluation Areas	Findings		Recommendation
	Strengths	Opportunities for Improvement	
	social media.		disseminating key messages.
Information Systems and Technologies	1. One of the early adopters of smart meter technology.	1. OMS hardware and interfaces were not scalable to handle the number of concurrent users during the 2013 Ice Storm.	IT-1: Include IT/OT technologies that provide real-time or near real-time intelligence in the technology strategic roadmap.
	2. An extensive Supervisory Control and Data Acquisition (SCADA) system with 85,000 control points on over 4,000 devices.	2. Groups of smart meters could not be pinged quickly to determine the outage status and a portion of them do not have "last gasp" technology.	
	3. Mobile Data Terminals available in a portion of Toronto Hydro vehicles.	3. The GIS system does not have fully accurate connectivity at the meter level.	
		4. Lack of connectivity among different information technology systems caused inaccuracy of outage status information available to customers.	
Vegetation Management and System Hardening/ Resilience	1. Toronto Hydro has been following a circuit-based trimming program since 2008 and adheres to accepted industry and City of Toronto pruning standards.	1. City of Toronto line clearance by-laws are defined for blue sky reliability, not for preventing outages during major incidents.	VMSH-1: Evaluate all viable options to improve distribution system resilience during major weather events, including converting lines to underground for sections of circuits where it will enhance the reliability of services to critical infrastructure and facilities.

Evaluation Areas	Findings		Recommendation
	Strengths	**Opportunities for Improvement**	
	2. Vegetation management preventive maintenance program is in line with industry practices (i.e., three-year cycle).	2. Coordination of clearing efforts with City vegetation management crews during an incident and day-to-day.	VMSH-2: Gain support from key stakeholders on the level of resilience required and related funding.
	3. Over the past six years, Toronto Hydro has maintained a consistent scope of the vegetation management program (e.g., clearances, miles completed) while reducing the cost of the program.		
	4. Toronto Hydro's wood pole program is in line with industry leading practice.		
Toronto Hydro-City Coordination			THC-1: Strengthen emergency management coordination between City of Toronto and Toronto Hydro.
			THC-2: In collaboration with the City of Toronto (Urban Forestry), update related urban forestry plans to ensure adequate line clearances to withstand major events.
			THC-3: Request the Province to require all new and existing buildings to have adequate back-up generation within the next 10 years.

Appendix D: Summary of Public Comments

An objective of the Independent Review Panel (IRP or Panel) was to consider feedback, insights and suggestions from representatives of each stakeholder group affected by the Ice Storm. Along with collecting input from Toronto Hydro employees, City and Provincial staff, first responders, and other parties involved with the recovery, the Panel invited input from Toronto residents and business owners on Toronto Hydro's preparation for and response to the December 2013 Ice Storm. Citizens had an opportunity to provide verbal or written comments at a town hall meeting, or email feedback via a dedicated address monitored solely by Davies Consulting.

Approximately 50 people in total, attended the town hall meetings, coordinated by the City of Toronto and held on Thursday March 6, from 7:00 p.m. to 9:30 p.m. at the following locations:

- North York Civic Centre, 5100 Yonge Street, Council Chamber
- Etobicoke Civic Centre, 399 The West Mall, Council Chamber
- Scarborough Civic Centre, 150 Borough Drive, Council Chamber

IRP members moderated each meeting, with the assistance of a Davies Consulting team member. Each attendee who wished to address the Panel had the opportunity to do so either verbally, or by submitting written comments. Representatives from Toronto Hydro were not present at the meetings, so that Torontonians could speak freely.

Over 80 comments were submitted via torontoicestorm@daviescon.com, between February 27, 2013, and March 31, 2013, the period for public comment. Davies Consulting monitored this email address daily. Team members collated and reviewed these comments, along with those received at the Town Halls.

The prevalent themes from the public comments were:

- Praise about the efforts of the Toronto Hydro linemen, commending them for their performance under adverse conditions;
- Poor or inaccurate communication to the public, including: inaccurate or not available estimated times of restoration (ETRs); incorrect restoration information given by call centre representatives; inability to see outage information in general (e.g., maps); lack of information about restoration priorities; and limited access to messages when technology was down (e.g., no internet, radio or television);
- Limited-to-no access to call center, including prolonged inability to reach a representative by phone; long wait times if able to connect; lack of information on the website; and limited on-line alternatives to report outages and receive updates;

- Tree trimming and pruning, including the adequacy of clearances and vegetation management budget; and
- Communication and outreach to vulnerable populations, including: pre-identification of those with critical needs; direct outreach to vulnerable populations after an event; provisions for back-up power to high-rise buildings; and clearer communication of locations of warming centres and shelters.

The Panel considered the comments and suggestions offered by the public as it developed the findings and recommendations presented in this report.