Newfoundland & Labrador

BOARD OF COMMISSIONERS OF PUBLIC UTILITIES

IN THE MATTER OF AN

INVESTIGATION AND HEARING

INTO

SUPPLY ISSUES AND POWER OUTAGES ON THE ISLAND INTERCONNECTED SYSTEM

PHASE ONE REPORT

SEPTEMBER 29, 2016

BEFORE:

Andy Wells
Chair and Chief Executive Officer

Darlene Whalen, P.Eng.
Vice-Chair

Dwanda Newman, LL.B.
Commissioner

James Oxford
Commissioner

EXECUTIVE SUMMARY

Background

During the period January 2 to 8, 2014 electricity customers on the Island Interconnected system were subjected to widespread rotating and extended power disruptions. As many as 200,000 customers were without power, often for several hours at a time.

The Board initiated an investigation into the circumstances leading up to and surrounding the outages and retained The Liberty Consulting Group ("Liberty") to assist with the investigation. The Board's Interim Report, dated May 15, 2014, concluded that there was a continuing and unacceptably high risk of outages on the Island Interconnected system and identified the immediate actions needed to reduce the risk of further outages.

As the investigation progressed the Board decided to proceed in two phases, with Phase One to focus on immediate reliability issues. While it was expected that the issue of the adequacy and reliability of supply on the Island Interconnected system until interconnection with the Muskrat Falls generating facility would be concluded as a part of Phase One, this issue continues to be a concern and will therefore be further considered in Phase Two of this investigation.

This report concludes Phase One of the Board's investigation and reflects information gathered over the past two years, including evidence presented in Hydro's general rate application and prudence review relating to the issues raised in this investigation.

Overall Conclusions

The widespread outages on the Island Interconnected system in January 2014 undermined customers' confidence in the electrical system in the province. Concerns were heightened by the fact that it was the second consecutive year in which there had been a widespread outage and were exacerbated by a subsequent outage in March 2015.

The Board concludes that the widespread and extended supply disruptions in 2013, 2014, and 2015 were the result of multiple failures by Hydro across various aspects of its operations over the course of a number of years. Hydro failed to meet the standard of generally accepted sound public utility practice and failed to fulfil its obligation to provide an adequate and reliable supply of power to customers. The Board believes that Hydro let down its customers and the people of this province, who ultimately will bear the significant financial burden associated with Hydro's failures. While Newfoundland Power has a role to play in the adequacy and reliability of supply on the Island Interconnected system, it is clear that Newfoundland Power did not cause or contribute to the January 2014 outages.

A great deal of work has been done since the January 2014 outages; however, there are several outstanding matters which will be addressed by way of a further direction to Hydro and ongoing monitoring by the Board. The most concerning issue is that now, more than two years later, there continue to be significant risks in relation to the adequacy and reliability of supply on the Island Interconnected system. The Board believes that it is imperative that Hydro acknowledge the serious ongoing issues and immediately focus on the work necessary to ensure meaningful and sustained change.

Causes and Contributing Factors

The January 2014 outages involved two distinct events on Hydro's system - rotating outages beginning January 2, 2014 associated with a generation shortfall, and extended outages beginning January 4, 2014 associated with transmission system and terminal station equipment failures. The Board concludes that the January 2014 outages originated on Hydro's system and were the result of Hydro's failure to effectively plan and manage its assets, and specifically:

- Hydro caused or contributed to the generation shortfall and the resulting rotating outages beginning on January 2, 2014 by failing to appropriately assess the circumstances and account for the risks in its generation planning and supply and generation asset management.
- Hydro caused the failure of the Sunnyside transformer and the air-blast circuit breakers at Sunnyside and Western Avalon which led to the extended outages beginning on January 4, 2014 by failing to effectively execute its asset management program for its transmission system and terminal station equipment.
- Hydro extended the outages by failing to have experienced personnel onsite during the restoration efforts and by failing to adequately address issues on the Hydro Place generator.
- Hydro caused the outage on January 5, 2014 by failing to ensure that maintenance on the Holyrood air-blast circuit breaker was conducted in accordance with good utility practice.
- Hydro caused the January 8, 2014 outage by failing to effectively communicate with Newfoundland Power.

In the Board's view Hydro's management and operation of the Island Interconnected system in the period leading up to and during the January 2014 outages did not meet the standard of generally accepted sound public utility practice.

Utility Response and Reporting

Hydro and Newfoundland Power substantively addressed the required actions and recommendations set out in the Board's Interim Report and in Liberty's Phase One Reports. The Board will issue a further direction to Hydro in relation to aspects of its load forecasting and the filing of a final Integrated Action Plan.

March 2015 Outage

Operational and communication failures by Hydro were the primary factors in the March 2015 outage. The Board concludes that Hydro failed to proactively manage circumstances which Hydro knew would pose a threat to the continued supply of power on the Island Interconnected system. Hydro has not demonstrated that it has fully addressed the recommendations set out by Liberty in its March 2015 outage report and the Board will direct Hydro to report in relation to its work in this area.

Outage Communications and Rotating Outages

During the investigation concerns were raised by the parties and the presenters in relation to the impacts of the rotating outages and whether adequate progress had been made in relation to outage communications. Throughout the investigation Hydro continued to make improvements to its outage communications protocols and processes and the Board believes that progress in this area was evident in 2016. In addition both Hydro and Newfoundland Power implemented changes which should reduce the impact of rotating outages in the future. The Board agrees that the transparency associated with the designation of critical customers could be improved and will direct both Hydro and Newfoundland Power to report in relation to this issue.

Adequacy and Reliability of the Island Interconnected System

Despite the progress that has been made throughout this investigation the Board believes that there are continuing serious risks to the adequacy and reliability of supply on the Island Interconnected system. The primary ongoing concerns relate to Hydro's transmission asset management execution, operating culture, generation planning and supply, and generation asset management.

In relation to Hydro's transmission asset management execution, improved processes have been put in place. However, in light of the significant issues identified in relation to Hydro's maintenance practices and the age of its system, the Board will implement ongoing monitoring of Hydro's transmission asset management execution.

In relation to Hydro's operating culture, serious issues with Hydro's approach to the management of the Island Interconnected system have been demonstrated over the last few years. Aside from the failures that caused the January 2014 outages, Hydro also failed to ensure that the lube oil system involved in the 2013 outage worked as intended; failed to adequately address black start capability at Holyrood; and failed to address the risks associated with the potential voltage issues that had been identified prior to the March 2015 outage. The Board is not satisfied that Hydro has made real progress in addressing the systematic issues that contributed to the outages in January 2013, January 2014 and March 2015 and therefore will review this matter as part of Phase Two of this investigation.

It is clear that supply on the Island Interconnected system will remain tight until completion of the Muskrat Falls project and that there are significant ongoing risks to adequacy and reliability. These risks have been heightened by the recent performance of Hydro's thermal generating units and the announced delay in full power from the Muskrat Falls generating facility. This issue remains a critical outstanding matter which will continue to be assessed as a part of Phase Two of the investigation. In the meantime, the Board will direct Hydro to complete a full supply review.

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1.0 BACKGROUND

1.1 Introduction

During the period January 2-8, 2014 electricity customers on the Island Interconnected system experienced both rotating and extended power interruptions with as many as 200,000 customers without power for several hours. The outages were significant both in terms of the immediate impact on customers and also in terms of the implications for the operation of the Island Interconnected system.

On January 10, 2014 the Board of Commissioners of Public Utilities (the "Board") initiated an inquiry and hearing into the circumstances leading up to and surrounding the power outages and system disruptions. The focus at the time related to whether load requirements on the Island Interconnected system could be met for the remainder of the 2014 winter and the immediate actions needed to reduce the risk of outages in the upcoming winter seasons.

This report concludes Phase One of the Board's investigation of the January 2014 outages. It sets out the circumstances surrounding the outages and the Board's views as to the causes and contributing factors, the response of the utilities and ongoing concerns and risks in relation to the operation of the Island Interconnected system. A second report will be issued by the Board in relation to Phase Two of this investigation which, among other things, will also address adequacy of supply and reliability on the Island Interconnected system.

1.2 Investigation Process

The supply issues and power interruptions of January 2014 were extraordinary in many ways. It was the first time that rotating power interruptions were required to address a generation shortfall on the Island Interconnected system. In addition the extended outages which began on January 4, 2014 as a result of transmission system equipment failures were both widespread and long lasting. There was a great deal of public frustration and anger expressed in the days following these outages and questions were raised as to how the outages could have happened.

The January 2014 outages raised serious concerns for the Board. This outage resulted in extensive damage to equipment and extended outages for customers on the Island Interconnected system. It was also the second year in a row where there was a major power outage on the Island Interconnected system.

On January 6, 2014, the Board directed Newfoundland and Labrador Hydro ("Hydro") to attend a meeting to provide information in relation to the status of the system and the steps being taken to ensure that the system was able to meet forecast load requirements for the remainder of the 2014 winter season. A similar meeting was subsequently held with Newfoundland Power Inc. ("Newfoundland Power") at which the company provided an update in relation to its response, restoration efforts and customer impacts of the system disruptions.

In the days that followed, the Board received several requests for an inquiry and/or public hearing into the circumstances of the outages.[1]

The Board advised Hydro on January 10, 2014 that sufficient grounds existed to warrant an inquiry and hearing into the events and circumstances surrounding and leading up to the Island Interconnected system supply issues and power outages. Hydro's ability to meet load requirements throughout the remainder of the winter and the next several winter seasons would be addressed on a priority basis. Hydro was directed to file daily system updates, setting out forecast generation availability and peak demand, and any changes in the status of generating units and capacity. At the same time the Board also issued a media advisory that it was commencing an inquiry and hearing.

On January 17, 2014 Newfoundland Power was advised that it would be a party in the investigation. At the same time the Board advised Newfoundland Power, Hydro and the Consumer Advocate that the investigation would initially focus on load requirements on the Island Interconnected system in the near term, and might also inquire into other issues such as asset readiness, maintenance practices, load forecasting, planning criteria and assumptions, equipment performance and reliability, emergency preparedness, system response and restoration efforts. A pre-hearing conference was scheduled for February 5, 2014 and Hydro and Newfoundland Power were requested to file issues lists in advance of the pre-hearing conference. Notice of the pre-hearing conference was published and the Board wrote the individuals that had filed complaints or requests for a hearing to advise as to the process for the investigation.

The Board engaged the services of The Liberty Consulting Group ("Liberty") to provide expertise and assist the Board in the investigation and hearing. Liberty is a consulting group based in Pennsylvania with extensive experience in management and operation audits and more than 30 years practice in the utility industry with a focus on system planning, forecasting, system and plant operations, customer service and regulatory affairs.[2]

In advance of the pre-hearing conference the Board received Intervenor submissions from: the Consumer Advocate, Thomas Johnson; Corner Brook Pulp and Paper Limited, North Atlantic Refining Limited and Teck Resources Limited (the "Industrial Customer Group"); and Danny Dumaresque. Hydro, Newfoundland Power and the Consumer Advocate each filed a proposed

[1] Requests for an inquiry and/or hearing were received from:

i) the Consumer Advocate on January 6, 2014;
ii) Lorraine Michael, MHA, Signal Hill-Quidi Vidi, Leader, New Democratic Party (as she then was), on January 7, 2014;
iii) Dwight Ball, MHA, District of Humber Valley, Leader of the Official Opposition (now Premier) on behalf of the members of the Official Opposition Caucus on January 8, 2014 who filed a formal complaint under s. 84 of the *Act*;
iv) two individuals (David Vardy and Ronald Penney) on January 8, 2014; and
v) five individuals (Brian Grant, Cabot Martin, Cornelius O'Brien, John Parsons and Desmond Sullivan) on January 9, 2014 who also filed a complaint under s. 84 of the *Act* and asked that the investigation be broadened to include reliability issues after integration with Muskrat Falls.

[2] Liberty's clients include regulators in the United States and Canada. Liberty has conducted post-outage assessments of utilities in both the United States and Canada, including for the Nova Scotia Utility and Review Board on the Nova Scotia power system after an outage which affected 100,000 customers in 2004 and in Illinois following storms in July and November 2006.

list of issues in advance of the pre-hearing conference. Subsequently, Mr. Dumaresque and the Industrial Customer Group also filed issues lists.

At the pre-hearing conference the Board heard from the utilities and persons requesting intervenor status. The Board also received written presentations and comments from several interested persons.[3]

On February 19, 2014 the Board issued Order No. P.U. 3(2014) which identified the intervenors and the issues to be considered, and set out the rules of procedure and timelines. Certain issues were identified to be addressed in an interim report of the Board with longer term issues to be addressed subsequently in the final report of the Board issued on completion of the investigation. The issues to be addressed on a priority basis included the measures necessary to prepare for the 2014-2015 and 2015-2016 winter seasons and how Hydro and Newfoundland Power would ensure adequacy and reliability on the Island Interconnected system. Longer term issues requiring analysis of the adequacy and reliability of the system after the commissioning of Muskrat Falls and the Labrador Island Link were set aside for later consideration.[4]

Subsequently, the Board granted a request from Grand Riverkeeper Labrador, Inc. to be considered an intervenor in the investigation and hearing.[5]

In accordance with the established schedule Hydro and Newfoundland Power filed reports on March 24, 2014 addressing:

1. the events of and leading up to the January 2014 outages
2. plans, procedures and processes relating to the supply issues and power outages as anticipated and as executed, including identification of gaps, lessons learned and improvement opportunities
3. adequacy and reliability of the Island Interconnected system for the period 2014-2016
4. risks and vulnerabilities regarding reliability for 2014-2016
5. current and future planned activities and alternatives related to further investigations
6. the results of any customer surveys or other similar efforts regarding the outage events of January 2014

On April 12, 2014 the Board published notice inviting written comments for the consideration of the Board in its interim report.

Liberty filed its interim report *Supply Issues and Power Outages Review Island Interconnected System* ("Liberty's Interim Report") on April 24, 2014. This report set out the interim results of Liberty's review of the events contributing to the January 2014 outages, immediate causes, and the management and operations issues underlying those events. The report set out 46 specific recommendations that identified priority actions that Hydro and Newfoundland Power should

[3] Presentations were made by or on behalf of Nu-Quest Distribution Inc., K& P Contracting Ltd and Heat Seal Limited, Desmond Sullivan, Cabot Martin, the Official Opposition, David Vardy and Ron Penney, Wade Marusiak, Captain Wilfred Bartlett, NEWFOUND Energies and Labrador Coastal Equipment Ltd.
Written comments were received from Cathy White, JM, the Sierra Club of Canada, BG, Maurice Adams, Winston Adams, Cabot Martin, Chad Warren of Canadian Energy, FO, Zach Howard, and GP.

[4] The scheduled date for interconnection at the time was winter of 2017.

[5] Order No. P.U. 15(2014).

undertake prior to the in-service of Muskrat Falls to reduce the risks of future outages and improve response to any outages that may occur. The recommendations covered a wide range of issues including load forecasting, generation capacity planning, generation and transmission availability, asset management, customer service, and inter-utility coordination. Liberty's Interim Report was circulated to the parties and posted on the Board's website.

The Consumer Advocate filed comments on April 30, 2014 setting out suggestions for the Board's consideration. Both Hydro and Newfoundland Power filed comments on May 2, 2014. The Board also received submissions from the Industrial Customer Group and Grand RiverKeeper Labrador, Inc. Hydro also filed an Integrated Action Plan on May 2, 2014 which identified required actions based on its internal review.

The Board issued its interim report on May 16, 2014 ("Board's Interim Report") setting out the required key actions that should be completed before December 1, 2014 in relation to generation asset readiness, terminal station transformers, air-blast circuit breakers, protection and control systems, and inter-utility coordination.

Over the summer and into the fall of 2014 Liberty continued work towards completion of its final report and the Board monitored the utilities' progress in relation to the required key actions for the upcoming winter. Hydro continued to provide updates and reports as directed in the Board's Interim Report and, where necessary, additional reports and information were requested.

On October 8, 2014 the Board advised the parties that, as a result of delays in receiving requested information from Hydro, the investigation would proceed in two phases. Phase One of the investigation would focus on the immediate reliability issues for the Island Interconnected system prior to the interconnection with Muskrat Falls and Phase Two would proceed thereafter to address issues related to reliability after interconnection with Muskrat Falls.

On December 17, 2014 Liberty filed two Phase One reports, one related to Hydro and another related to Newfoundland Power.[6] The parties were provided the opportunity to file questions in relation to these reports, and Hydro and Newfoundland Power were requested to specifically address each of Liberty's conclusions and recommendations. Hydro and Newfoundland Power filed submissions on or before February 6, 2015.[7]

A hearing was scheduled for March 30, 2015 and the Board published notice inviting public participation. At the hearing Hydro and Newfoundland Power made presentations and responded to questions.[8] In addition the Board received a presentation from the Honourable Dwight Ball,

[6] *Report on Island Interconnected System to Interconnection with Muskrat Falls Addressing Newfoundland and Labrador Hydro* and *Report on Island Interconnected System to Interconnection with Muskrat Falls Addressing Newfoundland Power.*

[7] Hydro submission: *Newfoundland and Labrador Hydro's Response to the Phase 1 Report by Liberty Consulting,* February 6, 2015; Newfoundland Power submission: *Response to Liberty Consulting Group Final Conclusions and Recommendations (December 17, 2014).*

[8] Rob Henderson, Vice-President of Hydro (at the time), Dawn Dalley, Vice-President of Corporate Relations and Customer Service of Nalcor (at the time), and Paul Humphries, Vice-President of System Operations and Planning of Hydro, presented as a panel on behalf of Hydro. Gary Smith, President and Chief Executive Officer, and Gary Murray, Vice-President Engineering and Operations, presented as a panel on behalf of Newfoundland Power.

then Leader of the Official Opposition (now Premier), and Mr. Keith Morgan on behalf of Nu-Quest Distribution Inc.

The Consumer Advocate, the Industrial Customer Group and Danny Dumaresque filed written submissions on or before April 29, 2015. Hydro and Newfoundland Power filed reply submissions on May 6, 2015. The Board also received several submissions and letters of comment from other interested persons.[9] Over the period December 22, 2015 to January 11, 2016 further submissions were filed by Hydro, Newfoundland Power and the Consumer Advocate.

1.3 Hydro's General Rate Application and Prudence Review

During the investigation of the January 2014 outages Hydro's general rate application was ongoing. [10] In addition, on February 27, 2015 the Board began a review of whether Hydro acted prudently in relation to a number of expenditures and projects over recent years, some of which related to the outages in 2013 and 2014.

The Board engaged Liberty to assist with the prudence review and on July 6, 2015 Liberty filed its prudence report. Liberty reviewed a number of projects and expenditures related to the 2013 and 2014 outages:[11]

- Procurement and installation of the new Holyrood combustion turbine
- Holyrood Unit 3 forced draft fan motor replacement
- Sunnyside replacement equipment after the January 4, 2014 transformer failure
- Western Avalon Terminal Station T5 Tap Changer replacement following the January 2014 transformer failure
- Overhauls of Sunnyside B1L03 and Holyrood B1L17 230 kV breakers following the January 2014 failures
- Black start capability at Holyrood
- Restoration of Holyrood Unit 1 Turbine Generator after the January 11, 2013 storm

Liberty testified in relation to its report during the hearing of Hydro's general rate application.

On April 26, 2016 the Board issued Order No. P.U. 13(2016) setting out its findings in relation to the prudence of certain of Hydro's actions and associated costs. These findings as well as some of the evidence presented in Hydro's general rate application were relevant to aspects of this investigation.

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[9] Cabot Martin, Cathy White, Fred Winsor (on behalf of the Sierra Club Canada), Maurice Adams, Winston Adams, Chad Warren and Zach Howard as well as other individuals who asked that only initials be used: JM, BG, FO and GP.

[10] Hydro filed its general rate application in July 2013 but advised in June 2014 that it intended to revise this application and filed an amended general rate application in November 2014. The public hearing of Hydro's general rate application began on September 9, 2015 and the evidence portion of the hearing continued until December 3, 2015. Submissions in Hydro's general rate application were filed over the period December 21, 2015 to January 22, 2016. Final arguments were heard on January 25, 2016.

[11] Liberty Report, July 6, 2015, pages 1-2; Liberty also addressed other items: restoration of the Black Tickle Diesel Plant following a fire; project execution of the upgrades to the Labrador City Terminal Station; and the 2014 Revenue Deficiency.

1.4 Legislation and Role of the Board

The Board is an independent, quasi-judicial body established under legislation to regulate public utilities in the province. The Board's authority is derived from its statutory powers and responsibilities as set out in the *Public Utilities Act (R.S.N.L.1990, Chapter P-47)* (the *"Act"*) and the *Electrical Power Control Act 1994 (S.N. 1994, Chapter-E-5.1)* (the *"EPCA"*). The Board's responsibility for the supervision of public utilities in the province arises from section 16 of the *Act*:

> 16. The board shall have the general supervision of all public utilities, and may make all necessary examinations and inquiries and keep itself informed as to the compliance by public utilities with the law and shall have the right to obtain from a public utility all information necessary to enable the board to fulfil its duties.

In addition the Board is mandated by section 4 of the *EPCA* as follows:

> 4. In carrying out its duties and exercising its powers under this Act or under the Public Utilities Act, the public utilities board shall implement the power policy declared in section 3, and in doing so shall apply tests which are consistent with generally accepted sound public utility practice.

The power policy of the Province relevant to this investigation is set out in section 3 of the *EPCA*:

> 3. It is declared to be the policy of the province that
>
> (a) the rates to be charged, either generally or under specific contracts, for the supply of power within the province
>
> (i) should be reasonable and not unjustly discriminatory;
> (ii) should be established, wherever practicable, based on forecast costs for that supply of power for 1 or more years;
> (iii) should provide sufficient revenue to the producer or retailer of the power to enable it to earn a just and reasonable return as construed under the Public Utilities Act so that it is able to achieve and maintain a sound credit rating in the financial markets of the world; and
> (iv) should be such that after December 31, 1999 industrial customers shall not be required to subsidize the cost of power provided to rural customers in the province, and those subsidies being paid by industrial customers on the date this Act comes into force shall be gradually reduced during the period prior to December 31, 1999;
>
> (b) all sources and facilities for the production, transmission and distribution of power in the province should be managed and operated in a manner
>
> (i) that would result in the most efficient production, transmission and distribution of power;
> (ii) that would result in consumers in the province having equitable access to an adequate supply of power;

> (iii) that would result in power being delivered to consumers in the province at the lowest possible cost consistent with reliable service…

The *Act* also sets out the responsibilities of a public utility:

> 37. (1) A public utility shall provide service and facilities which are reasonably safe and adequate and just and reasonable.

The Board has a broad discretion in its choice of methodologies and approaches to achieve the purpose of the legislation and to implement the provincial power policy as set out in the *EPCA*.[12] Nevertheless, the Board is not the manager of the utility as succinctly explained by the Court of Appeal of the province:

> Although some of the activities of the utility are regulated within the framework of the statutory objectives, the utility nevertheless remains subject to business risks and the effects of management decisions. To that extent, the financial risks associated with the operation of the utility, just as in the case of any private business, are to be born [sic] by the investors in the enterprise, not the consumer of the service.
>
> The corollary of this position is that the utility must be accorded a degree of managerial flexibility in decision-making in order to be able to minimize the risks to which it must respond. Thus, it is often said that the powers of the Board must be regulative and corrective, but not managerial, and they do not therefore contemplate a retroactive adjustment of the actions of management.[13]

The Board supervises the activities of utilities to determine if the requirements set out in the legislation have been satisfied and that generally accepted sound utility practice has been followed. The role of the Board is to ensure, through appropriate regulatory objectives and mechanisms, that the provision of electricity in the province is consistent with the legislative provisions, including equitable access for consumers to an adequate supply of power provided at the lowest possible cost consistent with reliable service. To this end the Board has established reporting and compliance processes, including annual financial reviews, quarterly reporting, incident/outage reports, audits and compliance monitoring. The Board may, where warranted, conduct a more formal process, including a public hearing, on an application filed by a utility for the approval of the Board.

The Board also has the authority to conduct an investigation into the service provided by a utility, of its own motion, where it determines that it is appropriate, or where a duly constituted complaint has been filed. Sections 82, 84 and 87-89 of the *Act* specifically address investigations and complaints. This investigation has been conducted in accordance with the Board's authority under these provisions.

[12] Reference re s. 101 of the Public Utilities Act (Nfld.), 164 Nfld. & P.E.I. R. 60, paragraph 36.
[13] Ibid., paragraph 31 and 32.

1.5 Report Scope and Structure

This report concludes Phase One of the Board's investigation of the January 2014 outages on the Island Interconnected system. When this investigation began in January of 2014 the Board did not anticipate the extent of the issues that would be raised or the time that it would take to complete the work required to address these issues, many of which had serious implications for the operation of the Island Interconnected system. In addition, during the investigation it became clear that some of the information learned in other matters before the Board was relevant to the issues raised in the investigation.[14] To the extent that this information is relevant it is reflected in the Board's discussion and conclusions.

In this report the Board addresses the work that was done in Phase One of the investigation and sets out its views as to the issues raised. In particular this report details the work completed in relation to the required actions in the Board's Interim Report, and the recommendations in Liberty's Phase One Reports for both Hydro and Newfoundland Power and in its March 2015 outage report. This report sets out the Board's views and conclusions as to the causes and contributing factors of the January 2014 outages, the March 2015 outage, outage communications and rotating outages, and adequacy and reliability of the Island Interconnected system.

2.0 SUPPLY DISRUPTIONS

The purpose of this investigation was to inquire into the events and circumstances surrounding and leading up to the Island Interconnected system supply issues and power outages in January 2014. As the investigation progressed it became apparent that the circumstances surrounding other supply disruptions on the Island Interconnected system in the previous and subsequent winters, raise issues which may be relevant to the issues raised during this investigation. The circumstances surrounding the outages in January 2014 as well as the outages in January 2013 and March 2015 are described below.

2.1 January 2014 Outages

During the period January 2 to 8, 2014 there were widespread rotating and extended outages on the Island Interconnected system. These power interruptions followed several weeks of reduced generation capacity associated with unavailable or de-rated generating units on Hydro's system. This reduced capacity combined with higher loads associated with sustained cold temperatures and additional seasonal load required rotating power outages beginning on January 2, 2014. On January 4, 2014, while rotating power outages were ongoing, equipment failures on Hydro's bulk transmission system resulted in widespread system disruptions and outages over the course of several days, impacting the majority of customers on the Island Interconnected system. These outages involved two distinct events on Hydro's system: i) insufficient available generation which led to rotating power outages beginning on January 2, 2014, and ii) transmission equipment failures which caused extended outages beginning on January 4, 2014.

[14] Hydro's amended general rate application filed November 10, 2014 (originally filed July 30, 2013), the Board's prudence review, Order No. P.U. 13(2016), April 26, 2016 and the review of the March 4, 2015 outage.

2.1.1 Generation Shortfall

In December 2013 there were insufficient available generation resources on the Island Interconnected system to meet customer demand. This deficiency originated on Hydro's system and resulted from a combination of unavailable generating units and de-rated units. The generation availability issues involved several different generating plants:

- As of December 1, 2013 the Hardwoods 50 MW combustion turbine was unavailable. In early 2013 Hydro determined that the Hardwoods unit required major work. It was taken out of service on October 3, 2013 with a planned return to service date of December 19, 2013. On December 20, 2013, when the unit was being returned to service, a fuel control valve failed. Hydro did not have a spare valve and key vendor support was not available. The unit could not be returned to full service until January 12, 2014.
- As of December 1, 2013 the Stephenville 50 MW combustion turbine was de-rated by 25 MW. In the summer of 2013, when this unit was returned to service following a 20-month forced outage, it was de-rated because of worn insulating blankets. These were not replaced during the scheduled outage and Hydro did not solicit bids for the insulating blankets until October 2013. On December 11, 2013 this unit became unavailable when a pump was removed and installed at Hardwoods. The unit was restored to 25 MW on December 23, 2013 when a new pump was installed.
- On December 15, 2013 the Grand Falls hydro unit operating level was reduced by 50 MW due to the accumulation of ice.[15] The unit returned to full capacity on January 15, 2014.
- On December 16, 2013 Granite Canal hydro capacity was reduced by 8 MW as a result of vibration issues, likely associated with ice. It was returned to full service on January 4, 2014.
- On December 25, 2013 Holyrood Unit 2 capacity was reduced by 25 MW, as a result of the failure of a control valve. It was returned to full service on January 3, 2014.
- On December 26, 2013 Holyrood Unit 3 capacity was reduced by 100 MW as a result of the failure of a forced draft fan motor. Hydro did not have a spare motor and the unit could not be returned to full service until January 12, 2014.

Due to the reduced generation available to meet the forecast load Hydro began implementation of the Generation Loading Sequence Generation Shortage Protocol on December 26, 2013. [16] As a result of the reduced generation capacity and high forecast loads, Hydro's Generation Loading Sequence Generation Shortage Protocol was followed from December 29, 2013 through January 2, 2014. During this period Corner Brook Pulp and Paper Limited was asked to shed processing load and Newfoundland Power was asked to take action to reduce peak loading on the system, specifically by running its thermal generating units, implementing customer load curtailment and carrying out system voltage reduction.

[15] The capacity reduction was only 25 MW as the unit had been operating above capacity.

[16] Hydro report, *An Internal Review of Supply Disruptions and Rotating Outages: January 2-8, 2014*, March 24, 2014, Volume I, Schedule 1, page 2.

On December 31, 2013 Hydro reached a short-term capacity assistance agreement with Corner Brook Pulp and Paper Limited. This arrangement provided an additional 40 MW of capacity on the Island Interconnected system during the January 1, 2014 system peak of 1,440 MW.

On the morning of January 2, 2014 Hydro's short-term forecast indicated that the evening peak load would surpass available supply. At 2:00 p.m. Hydro issued a public advisory to request that customers on the Island Interconnected system take steps to conserve electricity where possible. Shortly after 4:00 p.m. on the same day Hydro requested that Newfoundland Power implement rotating power outages.

Rotating power outages commenced at 4:13 p.m. on January 2, 2014 and continued throughout January 3, 2014 with both Hydro and Newfoundland Power rotating feeders. Due to load concentrations and operational factors, the rotating outages had a greater impact on Newfoundland Power's customers. On the evening of January 2, 2014 there were 77 feeder rotations for Newfoundland Power customers with an average duration of 88 minutes and 6 for Hydro customers with an average duration of 30 minutes. Throughout the day on January 3, 2014 there were 141 feeder rotations for Newfoundland Power customers with an average duration of 44 minutes and 25 for Hydro customers with an average during of 30 minutes.[17]

2.1.2 Transmission System and Terminal Station Equipment Failures

With Hydro's ability to supply customers already seriously compromised by the reduced generation capacity, transmission equipment failures on Hydro's system from January 4 to 8, 2014 resulted in extended power interruptions for most customers on the Island Interconnected system.

At approximately 9:00 a.m. on January 4, 2014 a transformer fault and fire at Hydro's Sunnyside Terminal Station resulted in the loss of all three Holyrood generating units, 230 kV transmission lines, as well as several other Hydro generating units. The supply of power was interrupted to approximately 187,500 Newfoundland Power customers. At approximately 3:30 p.m., as Hydro was restoring the system, a second major disruption occurred at Hydro's Sunnyside Terminal Station. This resulted in an interruption in the supply of power to approximately 165,000 Newfoundland Power customers. Power was substantially restored by 8:30 p.m., January 5, 2014.

On the morning of January 5, 2014 customers again experienced rotating power outages. Throughout the day and evening there were 158 Newfoundland Power feeder rotations with an average duration of 54 minutes and 5 Hydro feeder rotations with an average duration of 60 minutes. Units 2 and 3 at Holyrood were brought back online and power was substantially restored to customers by 8:30 p.m.

At approximately 9:30 p.m. on January 5, 2014 an electrical fault at the Holyrood Thermal Generating Station resulted in the loss of Units 2 and 3 and an interruption in the supply of power to over 100,000 Newfoundland Power customers. There were further rotating power

[17] Hydro report, *An Internal Review of Supply Disruptions and Rotating Outages: January 2-8, 2014*, March 24, 2014, Volume I, Schedule 1, page 5.

outages to Newfoundland Power customers during the morning on January 6, 2014, with 39 feeders rotated for an average duration of 47 minutes. Power was substantially restored to customers by noon on January 6, 2014.

On January 8, 2014 customers again experienced rotating power outages from approximately 3:23 p.m. until 5:42 p.m. with 32 Newfoundland Power feeder rotations averaging 25 minutes and three Hydro feeder rotations averaging 30 minutes. On that same day at approximately 5:45 p.m. Hydro experienced a trip on a transformer at the Western Avalon Terminal Station which resulted in a thirty minute interruption in the supply of power to approximately 29,000 Newfoundland Power customers.

2.2 January 2013 Outage

In January 2013 there was an outage on the Island Interconnected system which, though not directly related to the January 2014 outages, became an issue during this investigation.[18] On the morning of January 11, 2013 a severe winter storm caused salt contamination at the Holyrood Terminal Station resulting in faults at the station and adjacent transmission lines. All three units at the Holyrood Thermal Generating Station went offline and, as Unit 1 was winding down, there was a loss of oil lubrication. This resulted in high vibration and, when oil was restored, fires resulted. The customer impact was island-wide with total loss of supply of 700 MW and over 175,000 customers affected.

As a part of its submission in the investigation of the January 2014 outages Hydro filed several reports in relation to the 2013 outage.[19] These reports set out the comprehensive reviews undertaken by Hydro in a number of areas including: a life safety review of the Holyrood Thermal Generating Station; power system performance; the energy management system; storm preparation and response; the Holyrood Unit 1 failure root cause analysis; the Holyrood Unit 1 refurbishment; and the corporate emergency response.

One of the reports filed by Hydro set out 56 recommendations for further action in the areas of transmission and rural operations, thermal generation, protection and control engineering, electrical engineering, transmission and distribution engineering, system operations and energy systems, systems operations and planning, and hydro generation.[20] In another report Hydro stated in relation to the similarity of the 2013 and 2014 outages:

> The impact of the events on January 11, 2013 were similar to those experienced on January 4 and 5, 2014, in that they each had system wide customer impacts with significant terminal station problems affecting the Avalon Peninsula. During each event, the Holyrood units were tripped offline, and the restoration time of these units impacted the duration of customer outages. Both had incidents originating at the Holyrood Terminal Station (HRD TS) that involved a failure of the 230 kV breaker, B1L17 but the causes of these breaker failures are unrelated.[21]

[18] A summary of the events is set out in Hydro's report, *Events of January 2013, March 24*, 2014.

[19] Several reports in relation to the January 2013 outage were attached as appendices to Hydro's report, *Events of January 2013*, March 24, 2014.

[20] *January 11, 2013 - Winter Storm Events, Power System Performance Review Report*, June 2013.

[21] Hydro report, *Remedial Actions from the January 11, 2013 System Events*, March 24, 2014, page 2.

Hydro explained that some of the recommendations implemented following the 2013 outage helped to mitigate or lessen the customer impact in the 2014 outages. In particular Hydro noted that it strengthened its readiness procedures including having crews onsite and ensuring clear access routes to major facilities.[22]

As a result of its experience during the January 2013 outage Newfoundland Power also implemented a number of enhancements to its operational and customer response systems. It increased its Customer Contact Center phone capacity by over 25%, enhanced telephone message handling and mobile phone access to outage information, upgraded its website for improved customer access to outage related information and trained additional employees for service on the Customer Contact Center during major system events.[23]

2.3 March 2015 Outage

On March 4, 2015 another major outage occurred on the Island Interconnected system affecting approximately 83,000 customers. Although the outage event was relatively short in duration it was significant as it was the first major event on the Island Interconnected system following the January 2014 outages and it was not associated with unusual weather.

The March 2015 outage originated at the Holyrood Thermal Generating Station. Unit 1 at Holyrood had been taken out of service in late February 2015 as the result of a lubrication oil leak. Hydro planned to return Unit 1 to service at 8:00 p.m. on March 3, 2015 but it was not able to bring the unit on line as planned. This unit continued to be unavailable for morning peak on March 4, 2015. An attempt to start the new combustion turbine at Holyrood to meet the morning peak was not successful. Shortly after 7:00 a.m. on March 4, 2015 the Island Interconnected system began to collapse. Rotating outages were implemented beginning at 8:05 a.m. and continued through 10:30 a.m. All load was restored by 12:30 p.m.

While Hydro was investigating this outage the Board received several written comments and presentations from interested persons raising concerns in relation to this outage and how it related to the January 2014 outages. At the March 30, 2015 hearing, the Honourable Dwight Ball, then Leader of the Official Opposition (now Premier), commented that 2015 marked the third consecutive year of significant power outages.[24] The Consumer Advocate and Mr. Dumaresque asked the Hydro presenters several questions in relation to the March 2015 outage.[25] Mr. Gary Smith, President and CEO of Newfoundland Power, stated that the March 2015 outage indicated a need for continued concern for the reliability of the electric system.[26] In a letter filed in advance of the hearing, David Vardy and Ronald Penny noted that this was the third year in a row that there were outages and urged the Board to engage consultants to review the 2015 outage.[27]

[22] Ibid., pages 7-8.
[23] Newfoundland Power Interim Report, March 24, 2014, page 28.
[24] Transcript, March 30, 2015, pages 15-16.
[25] Ibid., pages 85 and 125.
[26] Ibid., page 145/16-19.
[27] Letter filed in the Board's investigation of the January 2014 outages, dated March 27, 2015.

On April 10, 2015 Hydro filed a detailed report in relation to the March 2015 outage. Further information and reports were filed on May 15, 2015 and July 20, 2015.

On July 31, 2015 the Board wrote Hydro, Newfoundland Power and the parties in Hydro's general rate application to advise that it had engaged Liberty to undertake a review in relation to the March 2015 outage. This review included a review of Hydro's role and effectiveness in preparing for, recognizing and responding to the unplanned outage. In addition the Board explained that, as the outage was raised by several presenters and participants at the hearing on March 30, 2015, the Board had also asked Liberty to comment specifically on linkages, if any, to the underlying causes and contributing factors of the January 2014 outages.

Liberty filed its report in relation to the March 4, 2015 outage on October 26, 2015.

3.0 BOARD'S INTERIM REPORT

The Board's Interim Report outlined the events that occurred leading up to and during the January 2014 outages and, the required key actions and reporting for the utilities. The required key actions related to: load forecasting and generation planning, generation availability, terminal station transformers, air-blast circuit breakers, protection and control systems, alarms and recording devices, Hydro Place emergency power, staffing, transmission system and terminal station safety, communication, coordination and response, and Hydro's integrated action plan.

The Board highlighted Liberty's Interim Report conclusion that there was a continuing and unacceptably high risk of outages on the Island Interconnected system for 2015-2017. The Board set out a number of required actions aimed at addressing this issue, including the installation of additional generation and securing economically available interruptible load. Even before issuing its interim report, the Board approved Hydro's purchase and installation of a 100 MW combustion turbine to increase generation capacity on the Island Interconnected system.[28] In light of the significance of Hydro's generation asset unavailability in the January 2014 outage events the Board directed that Hydro undertake a number of actions to ensure winter readiness of its generation assets. Given the importance of this issue and the concerns expressed in the Board's Interim Report, progress in relation to generation asset availability was monitored closely.

The Board found that the failure of terminal station transformers and air-blast circuit breakers played a significant role in the January 2014 events. The Board also found that Hydro's failure to complete the 2013 scheduled transformer preventive maintenance and recommended testing at Sunnyside was critical, and that the condition of Hydro's air-blast circuit breakers posed an ongoing risk for the Island Interconnected system. The Board directed Hydro to complete all 2014 and outstanding prior year testing as well as overdue and scheduled maintenance work on terminal station transformers and air-blast circuit breakers. At the Board's direction Hydro filed regular status reports/updates, responded to information requests and met with Liberty and Board staff in relation to the significant work undertaken with regard to its transformers and air-blast circuit breakers.

[28] Order No. P.U. 16(2014), issued May 7, 2014.

Protection and control issues were also found to be factors in the January 2014 outages. The Board noted a number of recommendations were outstanding from previous reviews in 2010, 2011 and 2013 and stated that, given the events of January 2014, it was appropriate for Hydro to review the work that was outstanding and reconsider and prioritize the work in the context of the required key actions arising from this review.

Other required actions were identified by the Board in relation to alarms and recording devices, the generators that provide emergency power to Hydro Place, and the emergency generation system for the energy management system. In addition the Board shared Liberty's concern in relation to the adequacy of Hydro's staffing resources to address the required transmission system and terminal station work.

A number of issues related to Hydro's and Newfoundland Power's customer service and communications arose as the utilities responded to the supply shortages and power outages in December 2013 and January 2014. These areas included customer service accessibility and response as well as public and media communications. Inter-utility coordination was also an issue in terms of its impact on outage communications and emergency response.

Throughout this investigation significant progress was made in relation to the required key actions set out in the Board's Interim Report. This work was monitored closely by the Board with regular, comprehensive reporting. Appendix A details the key required actions that were identified by the Board and the associated actions and reporting.

4.0 LIBERTY'S PHASE ONE REPORT – HYDRO

Liberty filed a report on December 17, 2014 following its comprehensive review of all aspects of Hydro's operations. This report confirmed the causes of the 2014 power outages identified in Liberty's interim report, addressed Hydro's progress in relation to ongoing work, and set out immediate-term actions for Hydro in relation to the reliability of service in the longer term.

This section sets out Liberty's recommendations, and Hydro's response as well as related presentations and submissions.

4.1 Liberty's Conclusions and Recommendations

The areas of Hydro's operations reviewed by Liberty included aspects of planning and supply, asset management programmatic aspects, transmission and distribution system planning and design, transmission and rural operations asset management, system operations, outage management, emergency management, customer service and outage communications issues, and governance and staffing.

4.1.1 Planning and Supply

Liberty reviewed several issues associated with Hydro's planning and supply, including load forecasting, supply adequacy, the new combustion turbine, interruptible load, unit availability and conservation and demand management as discussed below.

i) Load Forecasting

Liberty addressed a number of issues related to Hydro's load forecasting, including its short-term forecasting tool, system losses, the weather variable, and peak forecasts. Prior to the January 2014 outages Hydro's primary tool for short-term forecasting, Nostradamus, had not been predicting load accurately, and in January 2014 it proved inaccurate in the extreme. According to Liberty inaccurate load forecasts hampered Hydro's ability to respond in a supply emergency, caused delays in communications to customers and reduced its ability to plan for and mitigate generation shortages. Liberty also noted that there were unexpected system losses during the 2014 outage and unusual peak forecast variances in the winter of 2013/2014. In addition Liberty identified concerns with the weather variable used by Hydro in determining its peak load forecast.

Liberty concluded that Hydro responded to the load forecasting recommendations identified in its interim report and also implemented other improvements flowing from its own review. Liberty explained that short-term operating forecast work is ongoing and concluded that determining the effectiveness of these changes will take time.

Liberty also explained that, before the January 2014 outages, Hydro was using a P50 forecast as the weather variable in determining its peak load forecast. After the January 2014 outages Hydro began using a P90 forecast as a sensitivity case in its power supply planning but continued to use the P50 forecast as the base case. Liberty expressed its opinion that a weather variable of P90 is the preferred planning base, explaining that there is a 50 percent chance that the P50 forecast will be exceeded in a year and only a 10 percent chance that a P90 forecast will be exceeded. Liberty stated:

> Liberty continues to believe that the rationale for using a P50 forecast as the base forecast remains unconvincing because of the likelihood that it will be exceeded so frequently. Moreover, such a low probability forecast increases the exposure that when it is exceeded, it will be by more extreme amounts.[29]

Liberty concluded with respect to Hydro's load forecasting:

- Major improvements were made in relation to load forecasting capabilities.
- Improvements to the short-term operating forecasts have not yet been fully proven.
- Work to relate transmission losses to generation configurations is not complete.
- The P90 forecast is the preferred planning base and Hydro uses it as a sensitivity case but continues to use the P50 forecast as the base case.
- A number of load forecasting process improvements were implemented during 2014.

ii) Supply Adequacy

Liberty examined Hydro's planning criteria and practices, specifically with respect to reserve margins and the risks to supply adequacy on the Island Interconnected system.

[29] Liberty Report - Hydro, December 17, 2014, page 16.

Liberty explained that Hydro uses an estimated loss of load hours ("LOLH") criterion of 2.8 hours, which equates to a one chance in five years of a supply-related interruption. Liberty suggested Hydro's current LOLH criterion is not in line with that used by North American utilities, which equate to a one chance in ten years of a supply-related interruption. While acknowledging that the definition of "adequate" reserves is subject to debate, Liberty believes that acceptable margins should also consider the nature of the system (isolated versus interconnected) and the type and capacity of the generation units on the system. Liberty estimated that, using Hydro's modelling assumptions, the level of generation reserves would be 10-12%. Liberty believes that that adequate reserve margins for the Island Interconnected system should be higher than 10-12%, and noted that Hydro's forecasted reserve margins on the Island Interconnected system are below 15% until the Muskrat Falls interconnection.

In assessing the adequate reserve margin in the period until Muskrat Falls interconnection Liberty suggested that the contribution of Hydro's thermal generating units in meeting the forecast peak load is an important consideration. Liberty estimated the contribution of Hydro's thermal units to the forecasted peak load for the 2017-2018 winter to be 8.3% for Holyrood Unit 3, 9.4% for each of Units 1 and 2 at Holyrood, 2.8% for each of Hardwoods and Stephenville combustion turbines, and 6.6% for the new combustion turbine at Holyrood.[30] As noted by Liberty a 10% reserve margin would essentially be wiped out with the loss of Unit 1 or Unit 2 at Holyrood. Liberty stated: "it does not take much in the way of assumed full or partial outages to gain confidence that margins in the mid-teens are appropriate."[31]

Liberty explained that the value of adding more capacity before interconnection with Muskrat Falls must be questioned on the basis of the new combustion turbine and the imminent capacity addition with Muskrat Falls. Liberty concluded that the addition of more generation would appear to not be economic but, if availability decreases or load increases, new generation may be necessary. The continuing low reserve margins allows no room for deterioration in performance with respect to generation availability and levels of forced outage rates must be maintained or reduced.

With respect to the supply and availability of generation up to Muskrat Falls Liberty concluded that, despite adding nearly 200 MW of additional generation and demand-side resources, the supply situation is expected to remain tight until Muskrat Falls comes into service. Liberty stated:

> Our Interim Report found, and we continue to believe, that there exists a continuing and high risk of supply-related emergencies until Muskrat Falls and the Labrador-Island Link come into service. That time will be the winter of 2017/2018, at the earliest. A significant source of this continuing risk results from Hydro's modeling of required generation capacity and reserves. Hydro has used its current approach for decades, but its modeling, as currently constructed and used, does not produce acceptable levels of reserves.[32]

[30] Ibid., page 20.
[31] Ibid.
[32] Liberty Report - Hydro, December 17, 2014, page 3.

iii) New Combustion Turbine

According to Liberty Hydro had identified the possible need for new generation for a number of years. Its 2008 analysis suggested a capacity deficit by 2012 but the load did not materialize and the forecasted deficit was pushed out. Liberty explained that Hydro's November 2012 generation planning issue report forecasted capacity deficits starting in 2015 and identified a 50-60 MW combustion turbine as a solution. Hydro did not proceed to procure new generation at that time. In March 2014, after the January 2014 outages, Hydro began work to purchase an already manufactured 120 MW combustion turbine to be in service for the winter of 2014-2015. Liberty found the procurement, engineering and construction efforts of Hydro to get the unit in service for 2014-2015 commendable.

iv) Interruptible Load

Liberty explained that the interruptible load that Hydro secured in early 2014 helped in mitigating the supply shortage that existed. According to Liberty, Hydro's interruptible load arrangement of 60 MW with one source and 15 MW with another corresponded well with views of practical limits for interruptible load.

v) Unit Availability

Liberty concluded that Hydro made reasonable progress in 2014 in structuring and executing a winter readiness plan to address unit availability and the positive results achieved should contribute to reliability for the winter of 2014-2015. Liberty concluded that during 2014 Hydro made progress in relation to planned capital projects and maintenance initiatives for generating units. However, Liberty noted the following in relation to generation availability:

- Despite improvement initiatives in 2014, availability remains a major challenge.
- Despite substantial progress in addressing winter readiness, lingering problems with Hydro's existing combustion turbines pose supply adequacy threats for the 2014-2015 winter.
- While progress was made in assessing spare parts criticality for generating units, Hydro has yet to complete the procurement of critical spares.
- The new combustion turbine is urgently needed and must be expedited into service as quickly as possible.

According to Liberty, if the combustion turbines at Hardwoods and Stephenville are found to be too unreliable to count on for supply planning purposes, then new generation is required to maintain adequate reserve margins and the procurement process would have to start immediately. Liberty recommended that Hydro continue to focus on steps to improve the availability of these units. Liberty stated that the Board needs to be kept informed about causes and solutions for lingering uncertainties about the status of the Stephenville and Hardwoods gas turbines.

vi) Conservation and Demand Management

Liberty explained that, while conservation and demand management programs to date have focused on cost-effective energy reductions, given the concerns for generation capacity and reserve margins for the period up to interconnection with Muskrat Falls, a focus on demand (versus energy) reduction has particular importance. Liberty stated:

> The particular importance of supply considerations over the next few years, as they relate to demand management, centers upon the question of pay-back periods for potential demand-side options. A program designed to reduce demand may not look effective if one assumes that Muskrat Falls and the link to the Island Interconnected System arrive as scheduled. The question in that event becomes how long a delay it would take to make a program a net effective contributor to supply adequacy. Clearly, a meaningful answer to that question requires a robust range of potential in-service dates for new capacity.[33]

Even with the uncertainties with respect to Muskrat Falls schedule and costs Liberty concluded that this work should proceed immediately. Liberty suggested this work should be done transparently and in partnership with Newfoundland Power, with results shared with the Board and stakeholders.

vii) Planning and Supply Recommendations

Liberty made several recommendations for Hydro in relation to planning and supply:

- Provide the Board with monthly updates on the status of Nostradamus upgrades until the production model is fully in-service and shaken down.
- Provide the Board an assessment of the effectiveness of Nostradamus during the 2014-2015 winter and the sufficiency of the model for continued future use.
- Provide the Board with the guide on system losses under various configurations and any instructions for their use.
- Continue to include the P90 load forecast prominently in all evaluations of power supply adequacy.
- Provide data on the actual values of the weather variable.
- Report in relation to the reconstructed 2013-2014 peak.
- Validate a reasonable and practical criterion for reserve margins, and characterize the degree of risk associated with that criterion.
- Report quarterly on the rolling 12-month performance of its units, including actual forced outage rates and their relation to: (a) past historical rates, and (b) the assumption used in the LOLH calculations.
- Report promptly to the Board any potential change in the outlook for the adequacy of supply, including increases in forecasted peaks or reductions in unit availabilities.
- Continue to focus on steps to improve reliability of the Hardwoods and Stephenville combustion turbines.
- Report on the status of the program for critical spares, its results versus expectations of the master plan, a listing of spares to be procured and when they would be available.

[33] Liberty Report - Hydro, December 17, 2014, page 33.

- Complete planned demand management analysis on a Hydro/Newfoundland Power jointly scoped, conducted, and developed basis and report to the Board a structured cost benefit analysis of short-term program alternatives.

4.1.2 Asset Management Programmatic Aspects

Liberty concluded that Hydro has an appropriate approach to asset management except that the program did not reflect appropriately the age and condition of Hydro's assets. While Liberty also concluded that the design and scope of Hydro's asset management program is sound and conforms to best practices, Hydro's execution of asset management activities raises issues.

Liberty did not make any recommendations in relation to asset management programmatic aspects.

4.1.3 Transmission and Distribution System Planning and Design

Liberty examined Hydro's transmission and distribution systems, including planning, design and reliability performance and concluded:

> Hydro has made substantial progress in addressing its problems that contributed to transmission equipment failures. The actions it has taken will mitigate the risk that such failures may contribute to outages over the next few winter seasons. Continuing action is required at least through 2015 to complete the necessary work. Hydro also needs to focus on a number of areas that will contribute to improved reliability over the longer term.[34]

Liberty explained that it reviewed recent year reliability metrics to determine base level performance, to identify the impacts on performance of major events in recent years, and to disclose any particular areas of concern or emphasis for Liberty's review of transmission and distribution management and operations. Liberty reviewed five years of transmission and distribution data and commented:

> Hydro experienced declining transmission reliability performance from 2009 to 2013 even after adjusting for the consequences of major outage events. Overall performance in this area has been below that of Canadian comparators. Distribution performance, however, is consistent with Canadian experience, after adjusting for such events.[35]

Liberty reached a number of conclusions in relation to reliability:

- Planned transmission system maintenance resulted in a greater number of lengthy interruptions than forced interruptions.
- Transmission-forced outage frequencies and durations both increased from 2009 to 2013.
- Distribution outage frequencies and durations have increased, but remain consistent with Canadian averages after adjustment for major events.
- Loss of supply and scheduled outages have been the largest contributors to outages.

[34] Liberty Report - Hydro, December 17, 2014, pages ES 1-2.
[35] Ibid., page ES 3.

- Connectors, switches, and insulators made the largest contribution to equipment-caused outages.
- The lack of a focused worst-feeder program creates a gap in addressing reliability issues.
- Hydro does not compare cost with projected avoidance of customer interruption numbers or minutes in prioritizing distribution upgrade projects.
- Despite a structured process for prioritizing projects, it is not clear that Hydro sufficiently emphasizes SAIFI and SAIDI.[36]

Liberty reviewed Hydro's transmission and distribution systems planning organization, its criteria for planning capacity and reliability projects and its provision of support for Energy Control Center activities. Liberty examined whether Hydro's design practices conform to the needs of its customers and good utility practices. Liberty's review included Hydro' protection and control organization, maintenance practices for electrical mechanical relays, investigation of relay malfunctions and the extent of modernization. Liberty reached a number of conclusions in relation to planning and design, and protection and control:

- Transmission and distribution systems planning for load growth and other technical constraints is done on an appropriate basis.
- Distribution system planning criteria are consistent with good utility practices.
- Some of Hydro's 138 kV transmission circuits and nearly all of its 66/69 kV transmission circuits on the Island Interconnected system are radial, causing customer outages for forced and planned circuit outages.
- Transmission lines and distribution feeders are built in excess of Canadian Standards Association (CSA) Overhead Systems criteria and in conformity with good utility practice.
- IEEE Standard transmission and distribution conductor and transformer capacity are used for planning and operating its electric systems, which conforms to good utility practices.
- Redundancy has been incorporated in its transmission lines and terminal station buses consistent with the needs of the system.
- Distribution lightning protection, use of downstream reclosers, and distribution power system studies are consistent with good utility practices.
- Practices for transmission system raptor protection, lightning protection, and galloping conductor prevention conform to good utility practice.
- Protection and control staffing is appropriate.
- Protective relay scheme designs conform to good utility practice.
- Relay testing cycles conform to good utility practice and backlogs are reasonable.
- Hydro has resumed replacement of obsolete electrical mechanical relays.

In addition Liberty noted a number of issues associated with temporary overloading, SCADA[37] monitoring or control, animal guards and spare transformers.

[36] System Average Interruption Frequency Index (SAIFI) is calculated by dividing the number of customers that have experienced an outage by the total number of customers in an area. System Average Interruption Duration Index (SAIDI) is calculated by dividing the number of customer-outage-hours (e.g. a two hour outage affecting 50 customers equals 100 customer-outage-hours) by the total number of customers in an area.

Liberty recommended a number of actions to be taken by Hydro with respect to its transmission and distribution system planning and design:

- Investigate and report on methods that can reduce planned T-SAIDI.
- Analyze and report on the benefits of a dedicated capital program component dedicated to addressing the previous year's worst performing feeders.
- When prioritizing reliability projects, include a factor that relates cost to anticipated avoided customer interruption numbers and minutes.
- Increase the weighting given to resulting SAIFI, SAIDI and numbers of customer interruptions and minutes when prioritizing proposed projects.
- Perform a structured analysis of the costs and benefits of maintaining a spare for the 125 MVA transformers, considering age and equipment condition and the recent failures of the T1 transformer at Sunnyside Terminal Station and the T5 Transformer at Western Avalon Terminal Station.
- Conduct a structured analysis of expanding the SCADA system to include more and perhaps all distribution substations, in order to reduce customer's minutes of interruption, and to reduce SAIDI.
- Apply animal guards at distribution substations when conducting maintenance work in the substations.

4.1.4 Transmission and Rural Operations Asset Management

Liberty reviewed transmission and rural operations asset management organization, equipment age, inspection and maintenance scheduling, transmission lines and poles, distribution equipment, vegetation management, terminal stations, air-blast circuit breakers, distribution substations, generation, critical spare parts, capital expenditures and status of the ongoing work. Liberty concluded:

- The advanced age of Hydro's transmission and distribution equipment will require substantial levels of maintenance and replacement.
- Vegetation management is consistent with good utility practice.
- Recent improvements in air-blast circuit breaker maintenance has produced conformity with good utility practice.
- Skilled resources may not be sufficient to prevent undue backlogs in maintenance work.
- Operations and maintenance work has been appropriately funded.
- Transmission and distribution capital expenditures have been increasing.

Liberty also noted that: the radial configuration of the distribution system and portions of the transmission system (particularly 66 kV) leads Hydro to defer maintenance work to avoid required customer outages; Hydro does not make available to its field personnel the electronic equipment that has come into common use in the industry; and there is a general pattern of year-over-year increases in backlogged work orders.

In relation to preventive and corrective maintenance procedures, Liberty found that maintenance procedures conform to good utility practices but Hydro has not succeeded in executing some

[37] SCADA refers to Supervisory Control and Data Acquisition.

activities on a timely basis. In relation to transformers Liberty found that Hydro has not been meeting the six-year cycle for its 105 power transformers (66 kV to 230 kV) for some time.[38] In relation to air-blast circuit breakers Liberty noted that preventive maintenance between 2010 and 2013 for air-blast circuit breakers was also problematic. Hydro extended the cycles for maintenance for both air-blast circuit breakers and transformers which did not appropriately reflect the advanced age of the equipment involved. Neither did it respond well to the observed conditions of the equipment.

With respect to protection and control Liberty noted that in 2012, following the evaluation of relay applications, Hydro developed a plan to replace obsolete relays for the Holyrood to Hardwoods transmission line during the 2013-2015 time period. While Hydro decided in 2013 not to replace the relays because the future installation of the Soldier's pond terminal station would have required further changes, it now plans to implement the recommendations from these studies.

Liberty noted that following the January 2014 outages and the Board's Interim Report Hydro substantially escalated maintenance and concluded: [39]

> Hydro has focused substantial attention and resources to address the Interim Report recommendations including addressing the deferred transformer and air blast circuit breaker maintenance and to repair or replace power transformers that failed during the January 4, 2014 outage. It will take a number of years for Hydro to complete all necessary activities affecting transmission and distribution. Hydro should demonstrate that its efforts for improving work order completion performance are actually reducing its annual backlogs of preventive maintenance and corrective maintenance work activities.

According to Liberty maintenance backlogs raised concerns about the sufficiency of skilled resources with some backlogs accumulating year over year. Liberty acknowledged that Hydro has increased efforts to reduce its backlog of preventive and corrective maintenance but stated that Hydro should develop a comprehensive plan to bring maintenance backlogs to a more appropriate sustained level. Liberty also stated that Hydro should consider increasing the number of its field resources. Liberty suggested that Hydro complete the plan, adjust resources as required, and provide a report to the Board on the plan and actions taken by December 15, 2015. Liberty recommended that Hydro should formulate a comprehensive and structured plan to bring maintenance backlogs to a more appropriate sustained level and perform a cost/benefit analysis of providing crews with laptop computers.

4.1.5 System Operations

Liberty found Hydro's operation of the Energy Control Center to be consistent with good utility practices and made no recommendations in relation to system operations.

[38] Liberty Report – Hydro, December 17, 2014, page 90.
[39] Ibid., pages 77-78.

4.1.6 Outage Management

Liberty reviewed Hydro's response to outages on the transmission and distribution systems, outage management practices, outage cause coding, and communications with Newfoundland Power regarding planned transmission system equipment outages. Liberty concluded that Hydro's manual paper-based outage management process does not conform with best utility practices. Liberty explained that an outage management system would improve customer service, SAIDI metrics, communication with outage responders and estimated restoration time accuracy, as well as save time for responders and eliminate outage reporting paper burdens and manual calculation of outage statistics. Liberty also suggested that automated meter reading would enhance capability to detect customer outages. According to Liberty Hydro has adequate protocols for communication with Newfoundland Power regarding planned transmission, generation, and terminal station equipment outages.

Liberty recommended that Hydro should study the costs and benefits of a variety of outage management system opportunities.

4.1.7 Emergency Management

Liberty reviewed Hydro's emergency management with a focus on preparation for and conduct during and after severe weather events and generation and transmission system shortfalls. A number of issues associated with emergency management were addressed, including the emergency operations center, emergency response organization, emergency planning, severe weather procedures, winter preparedness, rotating outage procedures, and inter-utility communications.

Liberty concluded that the emergency operations center conforms to good utility practice; the emergency response plan is generally sufficient but does not give managers guidance in classifying an event; the severe weather preparedness protocol is sufficient but does not address certain matters; and Hydro enhanced and formalized communications with Newfoundland Power and winter readiness exercises for 2014-2015.

Liberty recommended that Hydro should include guidelines for determining how to classify an outage event in both the Corporate Emergency Response Plan and the Severe Weather Preparedness Protocol, and that a Restoration Protocol should also be developed.

4.1.8 Customer Service and Outage Communications

Liberty reviewed Hydro's progress in addressing outage communication and inter-utility coordination and investigated Hydro's customer research and communications support for its large commercial and industrial customers.

Liberty explained that Hydro and Newfoundland Power worked jointly and individually to tackle outage communications issues and to improve inter-utility coordination. Liberty concluded that Hydro and Newfoundland Power had reported significant progress on the outage improvement

recommendations set out in its interim report, with remaining work on track for completion. Liberty detailed Hydro's progress as follows:

- The Customer Service Strategic Roadmap 2015-2017, filed by Hydro on September 30, 2014, sets out plans to enhance and improve customer service related technologies over the next three years. Near-term improvements include revising outage protocols and formalizing after hours support. Liberty noted that the funding required to achieve the strategic initiatives outlined in the plan had not been addressed to date. In addition Newfoundland Power and Hydro explored opportunities for possible synergies for shared customer contact and outage communication technologies.
- Hydro and Newfoundland Power conducted joint customer research to understand customer expectations regarding outage-related communications. Hydro filed a report with the Board on September 3, 2014, setting out the results which indicated increased customer expectations in the areas of conservation education, timing and preparation for potential outages, and outage power restoration timing. This information has been incorporated into revised outage communication and storm preparation protocols.
- Hydro plans to replace call center technology over the next two to three years and has committed to testing any future changes to its website and telephone.
- Hydro contracted a consultant to review its business continuity plans and a report was expected by the end of 2014. A call center specific business plan to ensure continued operation was in progress.
- Hydro plans to replace its self-service technologies (website, contact center telephony, and customer service system) over the next two to three years. Possible synergies and opportunities for Hydro to leverage Newfoundland Power's front-facing technologies were explored.
- Hydro and Newfoundland Power jointly developed an advance notification communications protocol for customer communications when generation reserve margins are expected to fall below certain threshold values. The protocol is staged based on forecasted severity with guidelines for customer notifications at each stage. These guidelines include timing for when customers are asked to conserve electricity and when advisories are to be issued to prepare for rotating outages.
- Hydro and Newfoundland Power developed a Joint Communications Plan to guide customer communications during large outages or events. The plan provides strategies, tools and templates to effectively communicate with customers and others during outage situations.
- Hydro and Newfoundland Power conducted a joint "lessons-learned" session to review the January 2014 outages. Similar joint lessons-learned sessions will be conducted following any future events.
- A committee of senior managers from both utilities met regularly to oversee joint recommendations, discuss action items and coordinate activities. This committee's work resulted in the development of the joint advance notification protocol, the joint communications plan, provision of real-time data by Hydro to Newfoundland Power, and testing of new communications protocols and plans. According to Liberty these meetings are continuing to address any issues requiring inter-utility cooperation.
- Hydro's largest customers are supported through Hydro's System Operations rather than the customer service department.

- Hydro has conducted an annual customer opinion survey but Hydro's industrial and large commercial customers are not surveyed. Hydro does not routinely conduct transactional customer satisfaction surveys of specific interactions with the utility and has not conducted any recent customer research using focus groups or customer panels both of which can provide more actionable feedback that can be used to improve business processes, modify service offerings and coach and develop employees.

Liberty noted that all but two of its interim report recommendations were reported as having been completed and completion of the remaining recommendations related to business continuity plans and multi-channel communication was imminent. Liberty recommended that Hydro develop a key accounts management program to support and serve large industrial and commercial customers and that Hydro should conduct customer research to better understand its largest customers.

4.1.9 Governance and Staffing

Liberty examined Hydro's Board governance structure and executive level organization, as well as the overall resource structure used by Nalcor to provide asset management, project management, and technical services to Hydro. Liberty did not find a direct link between composition and structure of Hydro's Board of Directors and management and the January 2014 outages. Liberty did, however, set out a number of recommendations to enhance the effectiveness of the governance framework and support a strong focus on Hydro's utility operations. Specific areas of review relate to governance, organization structure, and enterprise risk management.

Liberty reviewed Hydro's Board of Directors in relation to the usual model for holding company structures and found a number of areas that may enhance its effectiveness. Liberty noted that Hydro's Board of Directors was the same as Nalcor's Board of Directors and suggested the appointment of two directors to the Hydro Board that do not sit on the Nalcor Board. Liberty also suggested that Hydro's Board should include members with backgrounds appropriate to overseeing Hydro's operations. In terms of best practice Liberty found that there should be more engagement by Hydro's Board of Directors in the annual planning process, more and detailed reporting on and engagement with management on matters such as service quality, infrastructure conditions, and operational performance.

With respect to Hydro's executive organization structure Liberty concluded that Hydro lacked a needed, single executive under which it can consolidate the principal functions associated with delivering utility service. Liberty recommended that an executive position of utility chief operating officer or President of Hydro should be filled soon and that it was essential that the person chosen be a leader with proven, top level utility executive experience. Liberty also suggested putting in place a regulatory affairs executive that would report to the Hydro executive leader. While Liberty does not directly tie the approach or structure of regulatory affairs at Hydro to service reliability consequences it does highlight that common industry practice is to consolidate the regulatory affairs function at a more senior level.

Liberty also examined the nature and level of common services and shared resources between Nalcor and Hydro to determine whether this common services approach played a role in the supply disruptions and outages. Liberty noted that support is provided to Hydro from Nalcor in certain areas but determined that the common shared services and resources approach did not play a role in the supply disruptions and power outages. Liberty concluded that the use of the Project Execution and Technical Services Group (PETS) to provide common services benefits Hydro and is appropriately managed, but lacks transparency in certain respects.

Hydro's approach to enterprise risk management, particularly as it relates to infrastructure and operations, was also reviewed by Liberty. Liberty found that Hydro has made strong first steps in establishing and implementing enterprise risk management. Liberty commented that, even given the strength of efforts to date, it remains important to enhance the use of risk management to address Hydro's infrastructure and operating risks.

Liberty made a number of recommendations in the area of governance and staffing:

- Adjustments should be made to bring the structure and operations of Hydro's Board of Directors more in line with the prevailing utility/holding company models.
- The executive should be restructured to create a consolidating executive position within Hydro. The regulatory affairs function should be at the level of officer, reporting to the Hydro consolidating executive.
- Hydro should submit to the Board a comparison of PETS work assignments resulting from the work planning process with home base assignments.
- Hydro should enhance and finalize the draft master enterprise risk document.

4.2 Hydro's Response

4.2.1 Planning and Supply

Hydro substantially agreed with Liberty's planning and supply recommendations. In relation to load forecasting Hydro explained that it would:

1. file monthly updates in relation to Nostradamus;
2. file by March 1, 2015 the guide on system losses under various configurations, the data relating to the weather variable on the 2013-2014 winter annual peak forecast exceedances and the additional analyses in relation to peak load;
3. report by April 30, 2015 in relation to the effectiveness of Nostradamus during the 2014-2015 winter and the sufficiency of the model for continued future use; and continue to include the P90 load forecast prominently in all evaluations of power supply adequacy.

Hydro noted that Liberty did not recommend that P90 be the sole weather variable and submitted that the approach it adopted in 2014 to evaluate reserve calculations on both a P50 and P90 basis gives sufficient visibility to the P90 case.

In relation to supply adequacy Hydro submitted that the central question is "What is the lowest reasonable level of reserve for the IIS between now and 2017/18 or 2018/19 knowing that the Island will be interconnected through both Labrador and Nova Scotia once Muskrat Falls

interconnections are in-service?"[40] According to Hydro the Island Interconnected system can supply all customer demand under multiple contingencies through the period 2014-2018. Further a reserve margin of 13% or 240 MW would be necessary to meet the minimum spinning reserve and the N-1 generation contingency. Hydro believes that the risk of generation shortfall does not materially increase until reserves fall below this level. Hydro also noted that these reserves are based on the P90 load forecast so that there is a 90% probability that actual reserves will be greater. Hydro believes that in the absence of higher forecast load, decreased generation performance, and/or a delay in Muskrat Falls interconnection, there is no compelling reason to increase generating capacity further at this time. Hydro agreed to report annually in relation to changes in the outlook for the adequacy of supply and undertook to advise if there are changes that result in forecast reserve falling below 13% or 240 MW.

With respect to unit availability Hydro agreed to report to the Board, on a quarterly basis, the rolling 12-month performance of its generating units. Hydro explained that it would continue to focus on the maintenance and capital programs required to ensure that the existing combustion turbines are available for peak load capacity support. Hydro advised that it had created the new position of General Manager, Gas Turbines and Diesels with responsibility for all aspects of asset management related to these units.

In relation to conservation and demand Hydro submitted that available cost-effective options for demand reduction between 2015 and interconnection with Muskrat Falls may be limited. However, Hydro explained that it is committed to exploring all possibilities and it is possible that a review may identify cost-effective longer term options.

4.2.2 Transmission and Distribution System Planning and Design

Hydro agreed with Liberty's recommendations in relation to transmission and distribution system planning and design. Hydro committed to investigate ways to reduce planned outage T-SAIDI and complete an analysis of the potential benefits of a worst feeder program. Hydro also stated that it would adopt the recommendations in relation to its capital project ranking process. Hydro acknowledged Liberty's conclusions in relation to interruptions due to planned transmission system maintenance but noted Liberty's comment that this is not surprising given the additional and increasing effort required to maintain its aging infrastructure. Hydro explained:

> The age and condition of Hydro's transmission and distribution assets have been major factors in reliability performance over the last several years. In addition to its ongoing maintenance program, Hydro's continuing and significant re-investment in the renewal of its assets is a key pillar of its asset management strategy for improving transmission and distribution outage frequencies and durations over time.[41]

Hydro submitted that, while delivery point forced outage frequencies and durations increased from 2009 to 2013, there are significant variances from one year to the next.

[40] Hydro Submission, February 6, 2015, page 13.
[41] Ibid., page 44.

Hydro agreed to complete a cost/benefit analysis of the option of securing a spare transformer but explained that, in its experience, planning the deployment of power transformers based on an N-1 contingency is prudent from a system reliability and cost standpoint. Hydro stated that in 2016 it will complete a structured analysis of the potential for reducing outage durations by expanding the SCADA system. In relation to animal guards, Hydro explained that there were no sub-station and feeder incidents involving animals over the five year period 2009-13 but agreed to assess this issue in 2015. Hydro stated that it will review its current limitations on "hot spot" temperatures in temporary overloading of transmission lines.

4.2.3 Transmission and Rural Operations Asset Management

Hydro acknowledged and substantially agreed with Liberty's conclusions but stated that Liberty's conclusion in relation to resources and undue backlogs in maintenance work "is not definitive but rather is directional in nature."[42] Hydro stated that it worked diligently throughout 2014 to reduce maintenance backlogs and that it increased deployment of temporary and contractor resources. Hydro stated it would continue to do so in 2015 "as required to maintain a stable level of work in the backlog which ensures that critical work is completed, and recognizes the reality of increasing maintenance activities resulting from aging equipment and its components."[43]

Hydro reported significant progress in 2014 and stated that it is confident that the changes it has made will improve the efficient execution of maintenance work.[44] Hydro explained that its budget allocations aim to ensure adequate resources and that it has focussed more attention on processes for work planning and execution to ensure that maintenance work is planned and completed in an efficient and timely manner.

Hydro accepted the recommendation to complete a comprehensive and structured plan to bring maintenance backlogs to a more appropriate sustained level and stated that the necessary activities to complete this plan would be incorporated into its 2015 work plan.

In relation to the use of mobile devices in the field, Hydro explained that it completed a pilot test on the use of tablets by field crews for work method purposes in 2014 and found that these devices did not provide any meaningful value. Hydro noted that there are areas of the province which do not have reliable network coverage but acknowledges that there may be satellite-based alternatives and further that there may be other "passive" work tool field uses. Hydro stated that it will complete an analysis of mobile technology options and costs.

4.2.4 Outage and Emergency Management

Hydro agreed with Liberty's recommendations in relation to outage management and emergency management. Hydro advised that it would complete a cost/benefit analysis of the available outage management system options, explaining that it would integrate its review of its SCADA

[42] Ibid., page 50.
[43] Ibid.
[44] Ibid., page 48.

systems with this effort. Hydro agreed that further guidance and documentation may be of benefit in relation to Outage management.

4.2.5 Customer Service and Outage Communications

Hydro substantively agreed with Liberty's findings and recommendations in relation to customer service and outage communications. Hydro explained that an extensive amount of work was completed to improve customer communication and coordination, some of which was in response to Liberty's interim recommendations and others that were identified by Hydro through its own investigations.[45] In particular Hydro noted the implementation of a formal protocol in relation to outage communication and a set of guidelines for notifications in relation to possible supply issues and conservation requests. Hydro noted that its 2014 Integrated Action Plan included 17 actions related to customer communication and coordination, and that all but one were completed by the end of 2014. Hydro acknowledged that it has not been as formal in its approach to research with industrial and larger commercial customers compared to residential customers. According to Hydro these are customers with whom it has direct customer relationships; however, Hydro agreed there are opportunities for strengthening management of these accounts.

4.2.6 Governance and Staffing

Hydro did not agree with Liberty's recommendation in relation to its Board of Directors or executive structure but agreed with the recommendations in relation to common services and shared resources and also enterprise risk management.

Hydro noted that matters related to the Board of Directors of Hydro, including the size and composition of the Board and appointment and remuneration of directors, are made by the Lieutenant Governor in Council in accordance with the *Hydro Corporation Act (2007).* Hydro points out that the appointment of a Chief Executive Officer is also made by the Lieutenant Governor in Council under the *Hydro Corporation Act (2007).* Hydro also believes that the level of Board activity in 2014 is indicative of the active engagement of its Board of Directors in Hydro's business. In view of Liberty's comments Hydro states that it will engage its Board on this matter in the context of Nalcor's ongoing development of its governance strategy.

In relation to executive structure Hydro acknowledged that its structure below the level of President and CEO did not consolidate all principal functions associated with the delivery of a utility service under one single executive. Hydro noted that the structure observed by Liberty with two senior level executives was implemented shortly after formal sanction of Muskrat Falls in December 2012. This structure was intended as a transitional structure that ensured a greater level of focus on the future integration of Muskrat Falls with existing electricity operations from a technical system operations perspective while maintaining senior level operational accountability for Hydro's ongoing operations. In early 2014 two new positions were created: i) a Chief Operating Officer, responsible to the Vice-President of Hydro for generation and transmission operations; and ii) a General Manager, Gas Turbines and Diesels, responsible for all aspects of asset management related to gas turbines and diesels.

[45] Hydro Submission, February 6, 2015, pages 58-59.

With respect to the regulatory affairs function Hydro acknowledged that in a regulated utility this role is a critical one and that it should have the profile and authority that is appropriate in that context. Hydro advised that the manner in which Hydro and Nalcor will be structured for longer term electricity operations was under review, and that this structure would be different from Hydro's current organizational structure.

In relation to common services and shared resources Hydro acknowledged that transparency in relation to common services is important for regulators and stakeholders. Hydro noted that it has provided information on this issue as part of the ongoing general rate application and also as part of the investigation. Hydro committed to providing the comparison as requested by Liberty to the Board by March 1, 2015.

In relation to enterprise risk management Hydro stated that it will ensure that operations personnel are fully engaged in identifying, sizing and planning for the mitigation of operational risks within Hydro's risk register.

4.3 Presentations and Submissions

Both Hydro and Newfoundland Power made presentations at the March 30, 2015 hearing which were detailed and informative in relation to the issues raised during the investigation. In particular, the utilities addressed communication issues and the improvements which had been implemented. In relation to the rotating outages Mr. Gary Murray, Newfoundland Power's Vice-President Engineering and Operations, explained that Newfoundland Power did not provide customers with specific advance notice of the precise timing and location of rotating outages because of the dynamic and uncertain state of affairs on the electrical system, explaining that advance notice would have meant that more customers would be without power at any given time.[46]

Dwight Ball, then Leader of the Official Opposition (now Premier), explained in his presentation that, while the January 2014 outages were the result of failures in equipment, operations, leadership and communications, his focus was Hydro's failure to communicate.[47] He stated that Hydro should have engaged the public much earlier with concrete ways to conserve energy and should have simultaneously communicated the possibility of extended power outages. He acknowledged that Hydro had since developed a customer service strategy road map but noted that it still needed to commit funding and implement the plan. He noted that Hydro failed to follow the recently established advance notification protocol during the March 2015 outage.[48]

Mr. Keith Morgan made a presentation on behalf of Newfoundland Power's customer Nu-Quest Distribution Inc. It was his view that the implementation of the rotating power outages was not in accordance with the utility's obligation to distribute power fairly to all customers.[49] He suggested that there should be public oversight of critical customer lists and of the process for feeder

[46] Transcript, March 30, 2015, page 142/18-25.
[47] Ibid., page 10/14-19.
[48] Ibid., page 15.
[49] Ibid., pages 29/1-4 and 30/ 3-4.

selection and rotating outages to make sure that the utility's obligations are met and customers are treated fairly.

In his written submission the Consumer Advocate recommended that a new protocol to advise the public of system vulnerabilities be developed as soon as practical. The Consumer Advocate commented that it was crucial that outage related information be accurate, authoritative and timely. The Consumer Advocate concluded that more work is needed in the area of inter-utility communications and recommended that the utilities jointly develop and report upon an improved mode of inter-utility communications as soon as possible.[50] The Consumer Advocate submitted that the reporting and monitoring process should continue until interconnection and recommended that Hydro remain subject to ongoing reporting requirements in relation to load forecasting accuracy, winter readiness and generation adequacy as well as preventative maintenance performance.[51] The Consumer Advocate also submitted that Hydro should move promptly to review the manner in which Hydro and Nalcor will be structured including the regulatory affairs function. [52]

Newfoundland Power stated in its written submission, that the Board is justified in concluding that the January 2014 outages resulted from insufficiency of generation resources and issues with the operation of Hydro's transmission equipment, and that a high risk of supply-related emergencies will continue until interconnection.[53] In relation to critical customers, Newfoundland Power explained that its priority during the January 2-8, 2014 outages was to minimize service disruption to customers whose roles are essential to health, safety and welfare of the communities it serves. [54]

The Industrial Customer Group recommended that the Board establish a continuing process to monitor Hydro's implementation of key recommendations, arguing that it was important to establish a rigorous and continuing process to assess whether there are changes, arising from load forecast increases, generation performance deterioration, delay in the interconnection or other causes. The Industrial Customer Group suggested that a substantial margin should be established in respect of the forecast generation reserve to ensure that all reasonable measures are taken to identify and avoid potential "critical level" situations. The Industrial Customer Group stated that Hydro has a responsibility to be forthright with its customers about load forecast uncertainties and the risks inherent in its aging generation infrastructure (particularly at Holyrood) during periods of anticipated peak or near peak demand in the winter months. Further, Hydro should send clear conservation messages to its customers more, rather than less, frequently, and with a greater lead time to allow customers to adapt their power usage accordingly. The Industrial Customer Group suggested that Hydro's corporate emergency response plan and other internal response measures may need to be changed. [55]

[50] Consumer Advocate Submission, April 27, 2015, pages 5-6.
[51] Consumer Advocate Submission, January 11, 2016, pages 1-2.
[52] Consumer Advocate Submission, April 27, 2015, page 4.
[53] Newfoundland Power Submission, December 23, 2015, page 2.
[54] Newfoundland Power Submission, May 6, 2015, page 2.
[55] Industrial Customer Group Submission, April 27, 2015, pages 2-3.

In his submission Mr. Dumaresque acknowledged the good work done by Hydro but submitted that there are still fundamental problems. In particular Mr. Dumaresque argued that Hydro lacked focused experienced leadership and further that there is a lack of effective regulation. Mr. Dumaresque voiced concerns in relation to ongoing communication issues, noting that during the March 2015 outage public comments by Newfoundland Power and Hydro contradicted each other and the public were not informed until hours after the issues were known.[56]

Hydro responded that its approach to load forecasting and generation performance and adequacy is appropriate and that setting a higher level of forecast reserves to trigger a graduated assessment as suggested by the Industrial Customer Group would not be productive.[57] Hydro also advised that a new President, separate from the CEO, had been appointed effective November 3, 2015 and further executive level changes were under review.[58]

5.0 LIBERTY'S PHASE ONE REPORT - NEWFOUNDLAND POWER

5.1 Liberty's Conclusions and Recommendations

Liberty reviewed Newfoundland Power's operations with respect to planning and design, asset management, power systems operations, generation, outage management, emergency management, and customer service and outage communications. Liberty confirmed that Newfoundland Power's operations and conditions did not contribute to the January 2014 outages which were the result of a generation shortfall and issues with the operation of transmission equipment on Hydro's system. Liberty stated:

> Newfoundland Power's planning and design of its system, its asset management practices, its system operations, its outage management and emergency practices and its customer communications processes all conform to good utility practices.[59]

Liberty noted that Newfoundland Power's reliability performance has been better than Canadian comparators for the past five years but did make a number of recommendations for Newfoundland Power to enhance performance in certain areas. These recommendations and Newfoundland Power's response are summarized below.

5.1.1 Planning and Design

Liberty found that Newfoundland Power has incorporated appropriate levels of redundancy in its transmission and distribution systems and its substations, and appropriate design standards, criteria and practices are employed. Liberty also found that transmission and distribution reliability has substantially improved since 1999 and has recently remained stable overall. According to Liberty, Newfoundland Power's plans to complete its SCADA replacement to incorporate all distribution feeders will bring the company into conformity with good utility practice.

[56] Mr. Dumaresque's Submission, April 29, 2015, pages 2-3.
[57] Hydro Submission, May 6, 2015, page 3.
[58] Hydro Submission, January 11, 2016, page 3.
[59] Liberty Report - Newfoundland Power, December 17, 2014, page ES-1.

Specific issues addressed by Liberty included the rebuild distribution lines initiative, efforts to address worst performing feeders, and methods used for prioritization of capital projects. Based on its review Liberty found that Newfoundland Power had recently ceased committing resources to worst performing feeders despite the fact that such feeders still exhibit disproportionately high outage metrics. Liberty also noted the minimal use of downstream feeder reclosers, which can reduce the number of customers affected by feeder faults. Liberty noted that a formal protective relay scheme criteria document explaining its protective relaying objectives, approaches and methods for each electric systems element is not used. Liberty also noted that Newfoundland Power does not formally periodically exercise its circuit breakers.

Liberty recommended that Newfoundland Power:

- Increase the emphasis on the Rebuild Distribution Lines initiative in annual capital budgets, with the goal of reducing distribution equipment failures.
- Perform a structured evaluation of the costs and benefits of reinstituting a regular annual program for addressing worst performing feeders.
- Develop a weighted analytical scoring of criteria process to support capital planning; include in this a scoring criterion that relates expected project costs to avoided numbers of customer interruptions or minutes.
- Investigate the installation of downstream feeder reclosers for the purpose of improving distribution SAIFI and SAIDI indices, in addition for reducing cold load pick up difficulties, with priorities given to feeders based on installation costs versus anticipated avoided customer interruptions.
- Document protective relay scheme objectives, criteria, and methods for protecting transmission lines, buses, and distribution feeders.
- Conduct circuit breaker operation tests from relays on a periodic basis to assure that all relay trip circuits and circuit breakers operate as intended.
- Centrally report multiple device operations.

5.1.2 Asset Management

Liberty addressed transmission and distribution asset management organization, skilled worker staffing, relay and control engineers and technicians, inspection and maintenance work completion and monitoring, substation inspection and maintenance, line programs, critical spares, rebuild strategy, substation refurbishment, and worst performing feeders.

Liberty found that Newfoundland Power's asset management operates under a program with the necessary organization and support to meet system reliability needs effectively. The only areas within the asset management program where Liberty made recommendations related to treatment and testing/replacement of aged poles.

Liberty recommended that, unless Newfoundland Power can show that fungus and insect infestation does not occur on its wood poles, it should reconsider the need to treat its transmission poles for fungus and insect infestation. Newfoundland Power should also consider conducting "sounding" tests on all older distribution poles when inspecting feeders and reconsider chemically treating distribution poles to extend their lives.

5.1.3 Power Systems Operations

Liberty addressed system control and central dispatch center operations, control center and central dispatch team staffing, power system operations' management tools, short-term forecasting, load management tools, rotating outages, coordination with Hydro, and energy management.

Liberty found that Newfoundland Power's system control center operates soundly and with an appropriate number of qualified staff and adequate measures have been taken to support continued operations should the control center be out of service. Newfoundland Power also needs to provide for operator training and enhance its ability to forecast the next one to three day demands.

Liberty recommended that Newfoundland Power include in the specification for the new SCADA system the ability to turn an operator console into a formal training system simulation console for instruction and evaluation. In addition a short-term forecasting application should be considered.

5.1.4 Generation

Liberty reviewed how Newfoundland Power operates and maintains its generating units and whether its practices are consistent with the needs of the electrical system and with good utility practice. Liberty found that Newfoundland Power has appropriately operated and maintained its generating units and has maintained a reasonable level of generating availability. Liberty did not make any recommendations in relation to generation.

5.1.5 Outage Management

Liberty examined Newfoundland Power's Outage Management System which plays a critical role in response to storm-related outages. Liberty found that Newfoundland Power's approach, organization, staffing and practices associated with outage management are effective. Liberty noted that Newfoundland Power plans to replace its Outage Management System within five years. Liberty did not make any recommendations in relation to outage management.

5.1.6 Emergency Management

Liberty reviewed Newfoundland Power's Emergency Command Center, emergency management organization, staff emergency restoration training, tracking of approaching severe storms, emergency response plan and preparation checklist, and restoration performance. Liberty found that reasonable restoration times following past severe storm events indicate that Newfoundland Power's emergency management practices for severe storms are appropriate. The only issue identified was that the System Restoration Manual does not describe actions where there is insufficient generation.

Liberty recommended that Newfoundland Power's System Restoration Manual should include a section delineating actions for loss of supply to its system, such as occurred in January 2014.

5.1.7 Customer Service and Outage Communications

Liberty reviewed Newfoundland Power's progress in relation to outage communications since the January 2014 outages. Liberty explained that Newfoundland Power and Hydro worked jointly and individually to tackle outage communications issues and improve inter-utility coordination. Liberty found that Newfoundland Power has made significant progress towards improving outage communications and inter-utility coordination but important monitoring work remained. Liberty detailed Newfoundland Power's progress as follows:

- Newfoundland Power developed an outage communications strategy to guide near and long term improvements to outage technologies.
- Newfoundland Power's customer facing technologies has been extensively stress tested and fortified and will continue to be monitored on an ongoing basis.
- Newfoundland Power was proceeding with an enhancement that will provide multi-channel communication options for customers and, following successful testing, the option will be offered to customers.
- Newfoundland Power conducted research which highlighted the need to provide additional customer education around conservation requests and indicated that business and residential customers needed more advance warning to prepare for conservation requests. In addition it revealed that customers may use more power after a request to conserve to prepare for an impending outage. Newfoundland Power and Hydro developed a coordinated customer education awareness plan and while they are not technically able to measure the conservation savings the utilities undertook to provide general feedback such that customers can understand the impact of conservation efforts. In addition Newfoundland Power was actively partnering with local business organizations to discuss conservation options and encourage future cooperation.
- Several joint Newfoundland Power and Hydro initiatives were undertaken relating to advanced notification protocols, joint customer outage expectation research, the storm/outage communications plan, a joint lessons-learned exercise and an executive level committee to guide initiatives.[60]

Liberty recommended that Newfoundland Power should monitor the "customer experience" of the new multi-channel communications services, and adjust the service offering as necessary to ensure a good customer experience.

5.2 Newfoundland Power's Response

In its response Newfoundland Power stated that it would fully evaluate Liberty's recommendations aimed at improving reliability of its distribution system, including cost effectiveness, within the context of the existing reliability management framework. Newfoundland Power noted that the Rebuild Distribution Lines project is only one of a number of recurring capital budget projects directed at distribution reliability and that applying more weight to the Rebuild Distribution Lines project would not necessarily be the most effective way to improve distribution reliability.

[60] Liberty Report - Newfoundland Power, December 17, 2014, pages 88-93. The joint initiatives are also discussed in section 4.1.8 of this report.

With respect to addressing worst performing feeders Newfoundland Power confirmed that between 2011 and 2014 it did not propose expenditures under its Distribution Reliability Initiative project because, in its view, the results of the reliability data review and engineering assessment did not justify such expenditures. Newfoundland Power advised that documentation was being developed to formally capture Newfoundland Power's approach to protection and control.

Newfoundland Power also advised that the periodic testing of circuit breakers is being incorporated into its substation maintenance activities. Newfoundland Power noted that in its 2015 Capital Budget application, additional reliability measures were proposed to assess distribution feeder reliability. Capital expenditures for 2015 of $863,000 to address two of its worst performing feeders were approved by the Board in Order No. P.U. 40(2014). In its 2016 Capital Budget Application Newfoundland Power included a report *2015 Distribution Reliability Initiative* which outlined the company's distribution system reliability management practices and provided a status update on the implementation of Liberty's recommendations

Newfoundland Power advised that it would assess the deterioration presented by fungus and insect infestation in wooden poles in its service territory to determine what changes, if any, are warranted in its existing wood pole maintenance practices. Newfoundland Power stated that it has not experienced the degree of fungal infestation or rot in its wood poles to warrant changing its inspection and maintenance practices for wood poles. Newfoundland Power explained that the chemical treatment of aged wood poles was addressed in its 2013 general rate application, where the company's evidence was that decay was not a problem encountered to date due to a combination of factors, including cool temperatures. Newfoundland Power suggested that it is not clear that chemically treating aged wood poles is consistent with good utility practice in climates similar to its service territory.

Newfoundland Power advised that the development of specifications and vendor selection for the replacement of its existing SCADA system was underway and the capabilities recommended by Liberty would be incorporated into the procurement process. In its response to Liberty's outage management recommendation Newfoundland Power advised that its System Restoration Manual has been updated to address loss of supply.

Newfoundland Power substantively agreed with Liberty's findings in relation to customer service and outage communications. Newfoundland Power submitted that based on the evidence the Board is justified in concluding that, among other things, its outage management and emergency practices and its customer communications all conform to good utility practice.[61] Newfoundland Power noted that it commenced SMS - Texting and email notification to customers in December 2014 and that it continued to monitor customer experience and feedback to ensure satisfactory performance of the service.[62]

[61] Newfoundland Power Submission, December 23, 2015, page 2.
[62] Newfoundland Power Submission, February 5, 2015, page 4.

5.3 Presentations and Submissions

The Consumer Advocate commended Newfoundland Power on Liberty's finding of good utility practice in relation to planning and design, asset management, systems operations, outage management and customer communications. The Consumer Advocate recommended that the utilities jointly develop and report on an improved mode of inter-utility communications. The Consumer Advocate also recommended a transparent means for customers with critical needs to be considered for addition to the critical customer list and that the list be updated regularly and provided to the Board.[63]

In its reply submission Newfoundland Power set out its approach in relation to critical customer lists and argued that the Board's regular reviews of its response to major electrical events and customer outages provides the appropriate transparency and accountability for ensuring the health, safety, and welfare of customers is properly managed and further regulatory process is not required.[64] Newfoundland Power stated that the Board is justified in concluding that Newfoundland Power operations or conditions did not contribute or cause the January 2014 outages and that Newfoundland Power's planning and design of its system, its asset management practices, its system operations, its outage management and emergency management practices and its customer communications processes all conform to good utility practices.[65]

6.0 LIBERTY'S REPORT ON THE MARCH 2015 OUTAGE

Liberty examined Hydro's role and effectiveness in preparing for, recognizing and responding to the unplanned outage on March 4, 2015 on the Island Interconnected system, and whether there were linkages to the underlying causes and contributing factors to the January 2014 outages.[66]

6.1 Liberty's Conclusions and Recommendations

According to Liberty, the March 2015 outage was the result of a voltage collapse on the Island Interconnected system following the failure of both Unit 1 at Holyrood and the new combustion turbine at Holyrood.

In February 2015 during a routine inspection of Unit 1 Hydro discovered oil in the brushgear housing, a component associated with the generator. Unit 1 was taken out of service on February 27, 2015 and was scheduled to return to service on the evening of March 3, 2015. However the return to service was delayed and Unit 1was not available for the March 4, 2015 morning peak. Further, when the new Holyrood combustion turbine was called upon to meet the morning peak it failed to start.

Hydro's modelling had indicated that a single contingency could have serious consequences should Unit 1 not return in time for the peak on March 4, 2015. In particular load shedding

[63] Consumer Advocate Submission April 27, 2015, page 6.
[64] Newfoundland Power Submission, May 6, 2015, page 2.
[65] Newfoundland Power Submission, December 23, 2015, page 2.
[66] Liberty Report, *Review of the Newfoundland and Labrador Hydro March 4, 2015 Voltage Collapse*, October 22, 2015.

would be needed with a delay in return to service of Unit 1 and the failure of the new combustion turbine to start. Nevertheless Holyrood personnel working on Unit 1 were not aware that the failure of Unit 1 to be available for the morning peak would make the system highly vulnerable to a single contingency that could lead to load shedding. Further Hydro's system operator was not advised until the next morning that the return to service of Unit 1 was delayed. Because the event involved a voltage issue, the advance notification protocol was not triggered and advance notification was not provided to senior leadership, Newfoundland Power or other key stakeholders.

At 7:14 a.m. on March 4, 2015 the system began to collapse and by 7:20 a.m. approximately 83,000 customers were without power. Rotating outages started at 8:05 a.m. and continued through 10:30 a.m., when power was restored to over 50,000 customers. All load was restored by 12:30 p.m.

Liberty detailed several specific factors in relation to the March 4, 2015 outage:

- System planning and system operations should have communicated the vulnerability of the system to responsible operators and managers.
- Hydro's characterization of the event was questionable and the philosophy underlying it comprised a significant contributing factor to the event and its management.
- Reliance on the combustion turbines to start when called upon was a too aggressive planning assumption and involved too great a risk.
- The system operator's lack of urgency contributed to the event:
    - Emergency notifications were not made when it was learned that Unit 1 would not be available for morning peak.
    - The emergency plan was not activated upon the failure of the new combustion turbine to start.
    - Notification of the new combustion turbine's unavailability was delayed with the system operator anticipating it would start at any moment.
    - Only 20 MW of the 60 MW available was requested from Corner Brook Pulp and Paper Limited and the request to Vale was delayed.
    - A quicker start to the load shedding may have prevented or mitigated the loss of control.
    - Holyrood diesels were not called upon until after 9:00 a.m.
- Hydro's unwillingness to declare an emergency and activate its Corporate Emergency Response Plan was not appropriate.
- Hydro was not well prepared for an emergency at a time of comparatively high probability of disruptive events and maximum adverse consequences.
- A flaw in Hydro's analytical approach has been corrected by developing an approach focusing on the Avalon Peninsula, as opposed to overall Island Interconnected system, load and reserves.
- Hydro's initial designation of the March 4, 2015 outage as a "power warning" rather than a "power emergency" does not reflect a sufficient appreciation of customer expectations. Newfoundland Power had already started load shedding at that point.

Liberty found that, while there are many lessons to be learned from the March 2015 outage, the overriding cause was the current operating culture at Hydro, which continues to adversely influence Hydro's decision making and contributes to operational incidents.[67]

Liberty noted that, in its interim report, it had discussed "a culture more tolerant of rotating outages" at Hydro and that a similar culture more accepting of shedding load and more tolerant of outages remains. Liberty explained that, in its experience, it is exceedingly rare to need to resort to rotating outages. Liberty noted an uncommon approach to reliability engineering and analysis and a less rigorous approach to emergency management and preparedness.[68] Liberty questioned whether Hydro's operating culture has adequately responded to changes in customer reliability expectations:

> Our report following the January 2014 outages found a number of examples of non-standard industry thinking associated with reliability. The March 4th incident provides another telling example. This suggests that more conventional approaches and the skills to implement them are appropriate.[69]

Liberty noted continued concerns with Hydro's approach to reliability:

> Counterbalancing these positive actions, Hydro has continued to plan for and react to contingencies less aggressively than do many other utilities. Liberty observed such an approach in our work associated with the January 2014 outages. Hydro's operating culture continues to comprise a matter of concern. With the operating culture issue identified in the aftermath of the January 2014 incidents, it nevertheless appears that Hydro has not accepted changing that culture as a priority. Liberty found that Hydro's reliability culture contributed to the causation and to the management of the March 4 event.[70]

In relation to communication and coordination, Liberty noted that the joint storm/outage communications plan was followed appropriately during the March 4, 2015 outage and that it proved to be a key success factor, enabling a prompt, coordinated response on the morning of the outage once Hydro accepted the severity of the event.[71] Further Liberty noted that, within one week of the event, Hydro and Newfoundland Power met to discuss lessons learned and identified several enhancements to the plan which have since been implemented. Liberty suggested that Hydro should ensure that the advance notification protocol addresses the full range of scenarios that could trigger a loss of power for customers. Hydro should also be more willing to activate its Corporate Emergency Response Plan, and allow for intermediate alerts.

Liberty made the following recommendations:

- Hydro should assign a team to implement a program to establish a more robust operational philosophy regarding reliability.

[67] Ibid., page 5.
[68] Ibid.
[69] Ibid., page 10.
[70] Ibid., page 2.
[71] Ibid., page 10.

- Hydro should enhance the skills and capabilities it brings to reliability engineering and analysis.
- Steps should be taken to assure situational awareness among operators and others who need the information to respond promptly and ably to adverse system conditions.
- A more robust approach to the Corporate Emergency Response Plan should be implemented.
- Advance notification protocols should be reviewed.

6.2 Hydro's Response

In its reply Hydro noted that since the March 2015 outage it has changed how it responds to adverse events, including how it dispatches and runs generating plants. Hydro advised that it had implemented improved internal and external communication protocols to ensure a robust emergency response.[72]

Hydro set out the work that was done following the March 2015 outage, including:[73]

- Undervoltage protection setting changes at Come By Chance
- Corrective action in relation to the fuel valve at the Holyrood combustion turbine
- Expanded reviews and reporting of capability and reserves to include a dedicated assessment of system conditions and updated notification protocols
- Coordination with Newfoundland Power in relation to an undervoltage load shedding protection scheme
- Review of the protection operations that occurred on March 4, 2015
- Review of the operating instructions
- Operating procedure changes so that standby generating units that support the Avalon is operated in advance rather than after an event has occurred
- Changes to its web page in relation to the communication of a system event
- Changes to the joint storm/outages communications plan
- Improvements in relation to operations at Holyrood

Hydro stated that it has enhanced its reliability foundations over the past number of years and reliability was further enhanced in the actions it took following the March 2015 outage. In Hydro's view actions taken in 2015 deepened skills and capabilities with respect to reliability engineering and analysis. Further, Hydro explained how it has improved situational awareness among operators, including additional support and oversight for operators at daily peaks during the winter season. Hydro did not accept Liberty's position that Hydro's failure to declare an emergency or activate its corporate emergency response protocol reflects a culture that considers major outages normal and easily managed but noted that additional personnel will be involved in the annual review of the protocol.[74]

[72] Hydro Letter to Board dated November 17, 2015.
[73] Hydro Submission, March 2015 Outage, December 22, 2015, pages 2-9.
[74] Ibid., page 14.

6.3 Submissions

Newfoundland Power submitted that Liberty's assessment of the March 4, 2015 events was thorough and the conclusions appeared generally sound, stating:

> The evidence before the Board is clear that severe failures on Hydro's electrical system caused outages which had dramatic customer impacts in each of the last 2 winter seasons. The evidence is equally clear that Hydro could improve its reliability focus.[75]

According to Newfoundland Power the Board should conclude:

- Improvements in Hydro's operating culture can have positive impacts on the reliability of service provided to customers on the Island Interconnected system.
- Hydro should take specific steps to improve its operating culture vis a vis its reliability focus.
- The steps taken by Hydro should respond fully to the five recommendations contained in the Liberty Report.
- Hydro should report to the Board on the specific steps planned and update the Board on a regular basis on progress made.[76]

The Consumer Advocate submitted that Hydro needs to address Liberty's recommendations in relation to reliability, stating that "it is important that Hydro fully implement the recommendations of Liberty, as these recommendations are well grounded and should, if fully implemented, improve on the reliability of service provided to customers."[77] The Consumer Advocate further submitted that Hydro should report to the Board in relation to the establishment of a team to establish a more robust philosophy regarding reliability and develop a plan as to how it will go about enhancing the skills and capabilities it brings to reliability engineering and analysis.

7.0 DISCUSSION AND CONCLUSIONS

The January 2014 outages raised significant concerns in relation to the operation of the Island Interconnected system. These concerns were heightened by the fact that it was the second consecutive winter of widespread outages and were exacerbated by the subsequent outage in March 2015. The Consumer Advocate's comments as to the significance of the outages aptly express the concerns raised during the investigation:

> The events of January, 2014 will not be forgotten by those who experienced it. These events severely shook the confidence of customers in the reliability of our electrical system in general and in Newfoundland and Labrador Hydro, in particular.
>
> The Consumer Advocate believes it will take a considerable period of time before customer confidence can be restored. Time alone will not restore it. Customers will need

[75] Newfoundland Power Submission, March 2015 Outage, December 23, 2015, page 2.
[76] Ibid., page 3.
[77] Consumer Advocate Submission, January 11, 2016, page 3.

> to actually experience solid, reliable electrical service, and where service interruptions do occur, they will need to receive first rate communications from their utilities.[78]

The investigation into the outages has been comprehensive, resulting in far-reaching recommendations and a great deal of work has been done by the utilities in response. To conclude Phase One of this investigation, this section of the report will set out the Board's views in relation to the following matters:

- The causes and contributing factors of the January 2014 outages.
- Utility response and reporting - Board's Interim Report and Liberty's Phase One Reports.
- The March 2015 outage.
- Outage communication and rotating outages.
- Adequacy and reliability on the Island Interconnected system.

7.1 Causes and Contributing Factors

The Board's Interim Report addressed the likely causes and contributing factors of the January 2014 outages on the Island Interconnected system and explained that a final determination would be made at the conclusion of the investigation and hearing. In its Interim Report the Board concluded that the number and nature of equipment failures that occurred were unusual, raising questions as to Hydro's operation and maintenance of its equipment, especially given that it was the second consecutive winter that there had been widespread outages on the Island Interconnected system.

Now that the investigation is complete, it is clear that the January 2014 outages were associated with Hydro's operation of the Island Interconnected system and that Newfoundland Power did not cause or contribute in any way to the outages. It is also clear that the outages should be considered as two distinct events on Hydro's system with two different sets of causes and contributing factors. The rotating power outages beginning on January 2, 2014 were the result of a generation shortfall which began in December 2013 associated with unavailable or de-rated Hydro generating units and higher than forecast loads. The extended outages beginning on January 4, 2014, were largely the result of multiple transmission and terminal station failures on Hydro's bulk transmission system.

7.1.1 January 2, 2014 Rotating Outages

In relation to the rotating power outages beginning on January 2, 2014, the unavailability or reduced capacity of Hydro's generating units throughout December 2013 and into January 2014 was the overriding issue. This was not a case of one or two units being de-rated or the loss of one large unit, rather Hydro had five units and 233 MW unavailable late in December. As stated in the Board's Interim Report, while the January 2014 outages were unplanned and may not have been expected by Hydro, the circumstances, including the weather, load and unit performance, were not outside of the range of outcomes for which Hydro should plan.

[78] Consumer Advocate Submission, April 27, 2015, page 2.

The Board believes that Hydro's approach to generation planning and supply led to the serious shortfall in generation in December 2013. Hydro's load forecasts did not adequately consider reserve margins or account for system losses and reflected an overly optimistic weather variable. Further Hydro did not add new generation when its own forecasts showed declining reserves which would not meet the LOLH target that it had established. The Board does not accept Hydro's position that its decision to delay new generation is an example of the cost considerations that must be taken into account in relation to system capacity reserves.

It is Hydro's responsibility to plan and operate its system so that, to the extent practicable, generation sources are adequate and available to meet the forecasted load. In the Board's view Hydro should have taken account of the low reserves in the management of its generation assets as the winter of 2013-2014 approached. The Board would expect that, in the circumstances, Hydro would have taken extra care to meet its own winter readiness target and to ensure the availability of the critical Holyrood units. Instead both the Stephenville and the Hardwoods gas turbines were not at full capacity throughout December 2013 and a spare forced draft fan motor was not available when Unit 3 at Holyrood failed on December 26, 2013.

The Board concludes that the generation shortfall in December 2013 was associated with Hydro's approach to generation planning and supply, particularly with respect to management of its generation assets. Hydro did not proactively consider all of the circumstances and potential risks in the context of its aging assets, the forecast increase in load, and the challenging winter conditions on the Island Interconnected system. The Board believes that, taken together, Hydro's generation planning and supply decisions and actions failed to appropriately assess the circumstances and account for the risks, and caused or contributed to the generation shortfall and the rotating outages beginning on January 2, 2014.

7.1.2 January 4, 2014 Extended Outages

The extended outages which began on January 4, 2014 were caused by failures of Hydro's transmission system and terminal station equipment. The outages began on the morning of January 4, 2014 with the failure of a transformer and an air-blast circuit breaker at the Sunnyside Terminal Station and were complicated and extended by the failure of an air-blast circuit breaker at the Western Avalon Terminal Station. As the Board found in Order No. P.U. 13(2016), deferred preventative maintenance caused the failure of the Sunnyside transformer and the two air-blast circuit breakers. At the time of the outages the transformer at Sunnyside was overdue for preventative maintenance by three months, the air-blast circuit breaker at Sunnyside was overdue by five months, and the air-blast circuit breaker at Western Avalon was overdue by two and a half years. In addition as noted by Liberty, Hydro had not been regularly testing the technologically dated air-blast circuit breakers.[79] In Order No. P.U. 13(2016) the Board found that the maintenance deferrals were widespread and longstanding and further that Hydro did not demonstrate that it undertook thorough analysis of the risks and consequences of these deferrals.

The impact of the transformer and breaker failures on the morning of January 4, 2014 spread beyond the Sunnyside terminal station because, contrary to good utility practice, Hydro had not installed breaker failure protection on the 230 kv breakers at Sunnyside. In addition restoration

[79] Liberty Report - Hydro, December 17, 2014, page 5.

was complicated and extended by the operator's poor knowledge of the relay protections schemes and Hydro's failure to adequately address cooling issues on its back-up generator at Hydro Place.

Two subsequent widespread outages in the days that followed were also caused by Hydro. The outage on January 5, 2014 was the result of the failure of the air-blast circuit breaker at Holyrood caused by Hydro's poor maintenance practices. The January 8, 2014 outage was caused by Hydro's failure to notify Newfoundland Power of the status of its transmission equipment.

The Board concludes that Hydro's actions and decisions in its operation of its transmission system and terminal station equipment caused or contributed to the extended outages beginning on January 4, 2014, and specifically:

- Hydro caused the failure of the Sunnyside transformer and the breakers at Sunnyside and Western Avalon on January 4, 2014 by failing to effectively execute its asset management program for its transmission and terminal station equipment.
- Hydro caused the extension of the duration of the January 4, 2014 outage by failing to have experienced personnel onsite during the restoration efforts and by failing to adequately address issues on the Hydro Place generator.
- Hydro caused the outage on January 5, 2014 by failing to ensure that maintenance on the Holyrood air-blast circuit breaker was conducted in accordance with good utility practice.
- Hydro caused the January 8, 2014 outage by failing to effectively communicate with Newfoundland Power.

It is the Board's view that Hydro's management and operation of the Island Interconnected system in the period leading up to and during the January 2014 outages did not accord with the provision of a level of service which is expected of the primary generation and transmission utility in the province. The Board does not accept that the January 2014 outages were the result of circumstances beyond the control of Hydro or that they were beyond the range of circumstances for which Hydro should plan. Further, if these events were unexpected by Hydro, then it was because of planning and management which did not fully account for the full range of circumstances which may be encountered on the Island Interconnected system. The Board concludes that the January 2014 outages on the Island Interconnected system originated on Hydro's system and were the result of Hydro's failure to effectively plan and manage its assets and that Hydro failed to meet the standard of generally accepted sound public utility practice.

7.2 Utility Response and Reporting

Throughout this investigation a number of recommendations and required actions were identified for both Hydro and Newfoundland Power in relation to various aspects of their operations. The Board's Interim Report set out a significant number of key required actions and reporting requirements to be addressed primarily by Hydro. In addition Liberty made a number of recommendations in its Phase One reports for both Hydro and Newfoundland Power. This section addresses the work that has been done in relation to these requirements and recommendations.

7.2.1 Board's Interim Report

The Board's Interim Report was issued shortly after the January 2014 outages and was intended to address the immediate measures necessary to prepare for the coming winter seasons. The Board set out required key actions for Hydro in relation to a number of areas, including load forecasting and generation planning, generation availability, transmission system and terminal stations and communications, coordination and outage response. The Board believes that the early identification of the issues and required key actions through the interim report process led to significant improvements in the operation of the Island Interconnected system over the past two winter seasons.

It is clear that both Hydro and Newfoundland Power made every reasonable effort to address the required key actions set out by the Board and to implement other changes which were identified as the work progressed. Based on the latest information available, the Board concludes that:

- Hydro made significant improvements in relation to planning and supply. Hydro improved short-term forecasting to better reflect weather conditions and varying system configurations and sensitivity analysis for long term load forecasts. The new Holyrood combustion turbine was installed and unit capacity added as of February 27, 2015 and capacity agreements were reached with industrial customers. Hydro substantively met its winter readiness target and made reasonable progress in relation to critical spare parts and its existing combustion turbines, though work in relation to critical spares was underway.
- Hydro substantively completed the transmission and distribution required actions, except that overdue testing and maintenance had not been completed on two of the eight critical transformers.
- Hydro accelerated the pace of maintenance of air-blast circuit breakers in 2014 and reported completion of deferred work on 23 breakers in early 2014 with 23 more to be completed in 2014 and 17 to be completed in 2015.[80]
- Hydro completed significant work in the areas of protection and control as well as alarms and recording devices with work ongoing in relation to both.
- Hydro completed the required work in relation to Hydro Place emergency power and lighting.
- Hydro substantively completed the required work in relation to staffing.
- Hydro reported that the recommended transmission system and terminal station safety work was ongoing.
- Hydro and Newfoundland Power made a great deal of progress towards improvements in communications, inter-utility coordination and outage response with the required key actions substantively addressed and few ongoing items.

The Board is satisfied that the required key actions set out in the Board's Interim Report have been substantively addressed but notes that Hydro's last Integrated Action Plan showed that there was some ongoing work.[81] To bring a conclusion to the outstanding matters Hydro will be

[80] Liberty Report - Hydro, December 17, 2014, page 91.
[81] Integrated Action Plan, January 15, 2015.

directed to file a final Integrated Action Plan addressing whether the ongoing work has been completed and, if not, a plan for completion.

Hydro will be directed to file a final Integrated Action Plan.

7.2.2 Liberty's Phase One Report – Hydro

Liberty completed a comprehensive review of all aspects of Hydro's operations including planning and supply, transmission and distribution, customer service and outage communications and governance and staffing issues.

In relation to planning and supply, Hydro made significant progress following the January 2014 outages. Capacity on the Island Interconnected system has been increased with the installation of the new Holyrood combustion turbine and capacity agreements with industrial customers. In addition Hydro's generation planning now considers reserve margins as well as LOLH, reflects a more conservative weather variable, and better reflects system losses. Further, Hydro made progress in relation to winter readiness, maintenance and capital work, critical spare parts and interruptible loads. However, there are two aspects of Hydro's generation planning which the Board believes require further work. While the performance of Hydro's load forecasting has improved the Board believes that continued reporting is appropriate given the significance of the issues identified and the extent of the changes that were implemented. Secondly, the Board believes that the continued use of the P50 weather variable as the base case with the P90 weather variable as a sensitivity case does not ensure a transparent and unambiguous basis for Hydro's supply planning decisions. It is the Board's view that Hydro should use the P90 weather variable as the base case for its supply planning decisions.

In relation to transmission and distribution, Hydro accepted Liberty's recommendation to complete a plan to bring maintenance backlogs to a more appropriate sustained level and explained that it had focused more attention on processes for work planning and execution to ensure that maintenance work is planned and completed in an efficient and timely manner.[82] The Board notes that Hydro's transmission and distribution equipment is advanced in age and will likely require increased levels of maintenance and replacement. The Board continues to believe that the highest priority should be given to the completion of necessary maintenance and testing and that Hydro's plan to bring maintenance backlogs to a more appropriate sustained level is of critical importance.

In relation to customer service and outage communications, Hydro and Newfoundland Power implemented significant changes and, while there are some ongoing matters, the Board is satisfied that, once all of the changes are implemented, communication with customers will be greatly improved.

In relation to governance and staffing issues, the Board has a limited role in this area since Hydro's Board of Directors and Chief Executive Officer are appointed by the Lieutenant Governor in Council on the terms and conditions established pursuant to the *Hydro Corporation Act (2007)*, RSN 1990, H-17. As such matters related to the size and composition of the Board

[82] Hydro Submission, February 6, 2015, page 48.

and the appointment and remuneration of the Directors and the Chief Executive Officer are not within the Board's jurisdiction. Further the Board notes that Liberty did not find a link between these issues and the January 2014 outages.

The Board believes that Liberty's comprehensive review of Hydro's operations and the work completed by the utilities will yield significant ongoing benefits in the operation of the Island Interconnected system in the coming years. The Board notes that Hydro recently filed information in relation to the status of Hydro's work on each of Liberty's recommendations.[83] The Board is satisfied that Hydro has substantively addressed the recommendations set out in Liberty's report.

Hydro will be directed to continue reporting in relation to its load forecasting tool and also to use the P90 weather variable as the base case in its reporting for supply planning decisions.

7.2.3 Liberty's Phase One Report – Newfoundland Power

Liberty's review of Newfoundland Power was comprehensive and confirmed that Newfoundland Power's operations conform to good utility practice and that Newfoundland Power's reliability performance has been better than Canadian comparators. Further Liberty's report confirmed that Newfoundland Power did not cause or contribute to the January 2014 outages.

The Board believes that Newfoundland Power is well positioned to effectively meet its obligations with respect to the adequate and reliable supply of power on the Island Interconnected system until interconnection with Muskrat Falls. The Board is satisfied that Newfoundland Power has substantively addressed the recommendations set out in Liberty's report.

7.3 March 2015 Outage

The March 2015 outage exacerbated concerns in relation to the operation of the Island Interconnected system. This outage was particularly concerning given the extent of the work undertaken by Hydro throughout 2014 and early 2015. Liberty's review of the outage identified a number of factors which contributed to or exacerbated the event, largely relating to planning and operational failures by Hydro. In particular Liberty explained that system operations and planning personnel knew the risks associated with the failure of the generating units at Holyrood to start on the morning of March 4, 2015 but did not effectively communicate these risks. In addition according to Liberty Hydro failed to recognize the seriousness of the circumstances and delayed declaring an emergency.[84]

The Board believes that operational and communication failures by Hydro were the primary factors in this outage. Hydro had identified the potential for voltage issues on the Island Interconnected system on the morning of March 4, 2015 but failed to take appropriate actions to address this risk. Hydro failed to proactively manage circumstances that it knew would pose a

[83] IC-NLH-023, Phase Two of the Investigation.
[84] Liberty Report, March 2015 Outage, October 22, 2015, page 8.

threat to the continued supply of power on the Island Interconnected system. Of particular concern to the Board is Liberty's finding that there are continuing issues with Hydro's operating culture and reliability engineering and analysis which it appears that Hydro does not acknowledge. While Hydro has implemented changes to address the specific circumstances which caused the March 4, 2015 outage, it is not clear that Hydro has fully addressed each of Liberty's recommendations. Hydro will be required to file a report in relation to the actions it has taken to address the issues and recommendations set out by Liberty in its March 2015 outage report, detailing specific improvements that have been made in relation to operating culture and reliability engineering.

Hydro will be directed to report in relation to:

i) the specific actions it has taken to address each of Liberty's recommendations;
ii) establishing a more robust operational philosophy regarding reliability; and
iii) enhancing skills and capabilities related to reliability engineering and analysis.

7.4 Outage Communications and Rotating Outages

While significant progress in relation to outage communications and rotating outages was documented throughout this investigation, ongoing concerns were expressed by the parties and presenters. Specifically, concerns were expressed in relation to whether there should be advance notice of rotating outages to affected customers, as to the transparency of critical customer lists and whether adequate progress had been made by Hydro in relation to outage communications.

In relation to the suggestion that advance notice be provided to the customers affected by the rotating outages, the Board notes Newfoundland Power's evidence as well as Liberty's comments that specific advance notice of the precise timing and location of rotating power outages could not be provided.[85] As Liberty explained the purpose of conducting rotating feeder outages is to prevent uncontrolled collapse of the system and to minimize the impact on customers. The Board accepts that advance notice to the customers that will be affected is not practical as utilities must be able to respond dynamically to the rapidly changing circumstances during system events.

The Board believes that every reasonable precaution should be taken to avoid the need for rotating outages and to ensure that, where they are necessary, the impact on customers is minimized. The Board notes that, since the January 2014 outages, Newfoundland Power has implemented improvements to reduce the risks and impacts of rotating outages, including increased automation and enhanced breaker maintenance focused on cold weather impact. In addition there have been improvements in utility information sharing and coordination which should reduce the need for and impact of rotating outages in the future. The Board is satisfied that the changes that have been made since January 2014 will provide benefits in managing issues on the Island Interconnected system and communication with customers so as to reduce the impact of necessary rotating outages in the future.

[85] Transcript, March 30, 2015, page 142/18-25; Liberty Report - Newfoundland Power, December 17, 2014, page 59.

In relation to the designation of critical customers, the Board is satisfied that the current approach of identifying critical customers on the basis of health, safety and welfare is reasonable. Given the dynamic and uncertain circumstances during a system event, it may not be practical to broaden the basis upon which critical customers are identified. However, the Board acknowledges the concerns expressed with respect to the level of transparency associated with the determination of critical customers and agrees that the process should be more transparent. The Board will direct Hydro and Newfoundland Power to review opportunities for improving transparency in relation to the designation of critical customers and file a report with the Board.

In relation to outage communications, concerns were raised at the March 30, 2015 hearing in relation to the March 2015 outage and whether Hydro had made sufficient progress since the January 2014 outages. The Board notes that, following the March 2015 outage, Hydro implemented improved internal and external communication protocols, updated the joint storm/outages communications plan and made changes to its website.[86] Hydro now issues public notice of a power watch, power warning, and power emergency providing customers with knowledge and information as to what to expect and the potential for outages. This type of notice provides customers the opportunity to take the appropriate steps in the event that there is a power outage, rotating or otherwise. In 2016 Hydro regularly issued power watches and power warnings to advise customers as to circumstances which may lead to interruptions. In addition beginning in 2015 the number of other advisories and notices issued by Hydro increased compared to 2013 and 2014.[87] The Board is satisfied with the improvements Hydro has made in relation to outage communication and does not believe that further specific work is required at this time. The Board believes that timely effective communication of issues on the electrical system is critical and that both utilities should continue to work together to ensure continued ongoing improvements and best practices in relation to outage communications.

Hydro and Newfoundland Power will each be directed to file a report in relation to improving the transparency associated with the designation of critical customers.

7.5 Adequacy and Reliability of the Island Interconnected System

Despite the progress that has been made throughout this investigation the Board believes that there are continuing significant risks to the adequacy and reliability of supply on the Island Interconnected system associated with Hydro's operations. The three primary issues of concern are: i) Hydro's approach to generation planning and supply, ii) Hydro's transmission asset management execution, and iii) Hydro's operating culture and reliability engineering.

7.5.1 Hydro's Generation Planning and Supply

Hydro's practices in relation to generation planning and supply were a significant issue throughout this investigation. The Board stated in its Interim Report that Hydro had forecasted shrinking reserve margins and imminent supply deficits on the Island Interconnected system for several years, noting Liberty's comment that Hydro elected to operate rather close to the edge, increasing the risk of adverse outcomes. The Board expressed concern as to whether Hydro had

[86] Hydro Letter to Board dated November 17, 2015; Hydro Submission, December 22, 2015, page 3.
[87] These notices are detailed on Hydro's website.

sufficient generation capacity to meet customer demand while maintaining adequate reserve capacity in the next few years.

The Board notes that, despite the improvements that have been made in relation to generation planning and supply, Liberty concluded that there is a continuing and high risk of supply-related emergencies until Muskrat Falls and the Labrador-Island Link come into service.[88] As well, according to Liberty, generation asset availability remains a major challenge which requires a particular focus until interconnection. Liberty noted that there have been lingering problems with the Hardwoods and Stephenville combustion turbines and suggested that, if these units become too unreliable, new generation would be required to maintain adequate reserve margins. The Board notes that both the Consumer Advocate and Newfoundland Power agree that there is a continuing and high risk of supply-related emergencies until interconnection with Muskrat Falls.[89] The Board believes that, despite the addition of significant generation and demand-side resources, the supply situation on the Island Interconnected system will remain tight until interconnection with Muskrat Falls.

The Board's concerns in relation to supply have been heightened based on recent developments in relation to the Muskrat Falls project and the performance of Hydro's generation resources. On June 24, 2016 Nalcor Energy announced that first power at Muskrat Falls is now scheduled for the fall of 2019, with full power expected by mid-2020.[90] This is a significant change from the previously planned date of full power in 2017. As well there have been ongoing issues with Hydro's thermal units at Holyrood and its older combustion turbine units over the past few months. In early 2016 all three units at the Holyrood thermal generating station were de-rated as a result of boiler tube failures, and the Hardwoods and Stephenville combustion turbines were de-rated as a result of engine failures.[91] In addition, in January 2016 Hydro advised the Board as to issues regarding low hydrology on the Island Interconnected system as a result of low precipitation and low storage levels.

Given the significant recent developments in relation to supply on the Island Interconnected system the Board directed Hydro to:

1. Complete a comprehensive report on energy supply on the Island Interconnected system to 2019.[92]
2. File bi-weekly reports on system hydrology and the thermal generation used to support the return of reservoir storage to normal levels.[93]

[88] Liberty Report - Hydro, December 17, 2014, page 3.
[89] Consumer Advocate Submission, January 11, 2016, pages 1-2; Newfoundland Power Submission, December 23, 2015, page 2.
[90] Nalcor Press Release, dated June 24, 2016.
[91] According to the Energy Supply Risk Assessment Report, filed May 27, 2016, Unit 1 and Unit 2 were de-rated from 150 MW to 120 MW, and Unit 3 from 150 MW to 140 MW. The Board approved Hydro's application to do extensive replacement of boiler tubes on Units 1 and 2 over the summer of 2016 [Order No. P.U. 19(2016)]. Hydro advised in the Energy Supply Report, August 2016, page 4, that it planned to do work on Unit 3 in the summer of 2017. The Hardwoods combustion turbine was de-rated from 50 MW to 38 MW and the Stephenville combustion turbine was de-rated from 50 to 25 MW. The Board approved Hydro's application to repair both engines with the repairs to be completed by November, 2016 [Order No. P.U. 22(2016)].
[92] Letter to Hydro, February 8, 2016.
[93] Ibid.

3. File a report by November 30, 2016 on the causes of the failures of the combustion turbine units, addressing short and longer term reliability status, as well as the implications for Hydro's overall available generation capacity.[94]

Hydro filed the energy supply report directed by the Board, setting out a comprehensive assessment of its ability to meet the energy and demand requirements of the Island Interconnected system until the interconnection with Muskrat Falls.[95] This report indicated that there is a risk of expected unserved energy in excess of planning criteria, assuming continued unavailability of the full capacity of the Holyrood units and the return to full rated capacity of the Hardwoods and Stephenville combustion turbines.[96] Hydro noted that the recent addition of the Holyrood diesels provided some additional capacity and recommended securing additional curtailable load on the Avalon Peninsula as well as the advancement of the new transmission line from Bay d'Espoir.[97]

In light of recent events, on June 9, 2016 the Board advised the parties that the issue of adequacy and reliability of supply until the interconnection with Muskrat Falls will continue to be evaluated as part of Phase Two of the investigation.

The Board notes that Liberty filed its Phase Two report on August 19, 2016 confirming that the Island Interconnected system remains vulnerable to supply related disruptions.[98] Liberty noted that continuing problems with Hydro's thermal generating units and the delayed in-service date for Muskrat Falls increase the risk of outages on the Island Interconnected system. Liberty reached this conclusion despite the fact that Hydro had advised that its engineering consultant had determined that Units 1 and 2 at Holyrood could be operated normally and Unit 3 could operate at 90% until boiler tube work was completed.[99] Also, according to Liberty, Hydro's assessment of supply adequacy indicated reliability violations which Hydro proposed to mitigate but not eliminate. In Liberty's view the supply risks are greater than suggested by Hydro's assessment. Liberty believes that new supply will be needed before interconnection and will continue to be needed after to mitigate the impact of extended outages on the Labrador Island Link. Liberty recommended that Hydro conduct a new supply review that considers all risks and that it provide a risk-based determination of the need, timing and amount, if any, for new pre-Muskrat Falls supply.[100]

In the circumstances, the Board concludes that there are significant continuing risks to the adequacy and reliability of supply on the Island Interconnected system. The Board is especially concerned about continued reliance on Hydro's aging thermal units, the announced delay in the Muskrat Falls project and Liberty's conclusions in its Phase Two report. While it was Hydro's view in 2015 that the Island Interconnected system can supply all customer demand under

[94] Order No. P.U. 22(2016).
[95] Hydro report, Energy Supply Risk Assessment Report, filed May 27, 2016.
[96] The report explained the need for continued de-ratings of the Holyrood units after the repairs depends on the results of the condition assessment of the units, page 18.
[97] Hydro report, Energy Supply Risk Assessment Report, filed May 27, 2016, page 29. In Board Order No. P.U. 17(2016) the Board granted approval for Hydro to purchase 12 MW of diesel units installed at Holyrood.
[98] Liberty Report, August 19, 2016, page 12.
[99] Hydro letter to the Board, dated August 12, 2016.
[100] Liberty Report, August 19, 2016, page 12.

multiple contingencies through to 2018, the Board notes that a delay in the Muskrat Falls project and deteriorated generation unit performance are two of the factors which Hydro had stated may impact its assessment.[101] The Board believes that further urgent work is required to fully assess the circumstances and risks with a view to determining the measures that are required in relation to supply. It is imperative that circumstances continue to be closely monitored so that immediate and decisive action can be taken where necessary to ensure adequate and reliable supply before interconnection with Muskrat Falls. The Board will continue to require daily system reports from Hydro in addition to its quarterly generation unit performance reports. The Board will also require continued winter readiness reporting to monitor planning, scheduling and execution. Given the serious ongoing issues, generation planning and supply will continue to be evaluated as part of Phase Two of this investigation. In the meantime, Hydro will be directed to immediately commence the supply review recommended by Liberty.

Hydro will be directed to:

- **i) continue to file daily system reports;**
- **ii) continue to file winter readiness reports in the fall;**
- **iii) continue to file quarterly reports in relation to generation unit performance;**
- **iv) file its generation adequacy report semi-annually rather than annually; and**
- **v) complete a supply review and provide a risk based determination in relation to need, timing and amount, if any, for new supply prior to interconnection.**

7.5.2 Hydro's Transmission Asset Management Execution

Asset management execution in relation to Hydro's transmission system was an area of focus throughout this investigation. Failures by Hydro in the execution of its asset management program resulted in multiple failures of key transmission system and terminal station equipment and led to widespread power outages for customers beginning on January 4, 2014. Liberty explained that, while Hydro's asset management plan is sound, its execution of asset management activities raises concerns. In its prudence review the Board found that Hydro's decisions and actions with respect to deferral of certain preventative maintenance were imprudent.

The Board notes that Hydro reported significant progress in relation to its maintenance planning and completion and that Hydro was confident that the changes it has made will improve the efficient execution of maintenance work.[102] Hydro provided further information in relation to the changes to its maintenance practices during its general rate application hearing, including a new target of 100% completion of annual preventative maintenance, criteria to assess whether a deferral of preventative maintenance is appropriate, and improved reporting and documentation in relation to deferrals.[103]

The Board believes that the work that has been completed in relation to Hydro's transmission system asset management execution since the January 2014 outage events has led to improvements on the Island Interconnected system which will contribute to a more robust

[101] Hydro Submission, February 6, 2015, page 16.
[102] Ibid., page 48.
[103] Transcript September 23, 2015, page 52/6-18, October 27, 2015, pages 201-203.

electrical system as it undergoes major changes in the next few years. The Board continues to believe that the highest priority should be given to the completion of maintenance and testing and that this is essential for Hydro to effectively manage its assets. The Board notes that much of Hydro's transmission equipment is advanced in age and will require substantial levels of maintenance and replacement, including comprehensive inspections, maintenance and modernization programs. The Board agrees with the Consumer Advocate's suggestion that there is a continuing need to monitor Hydro's preventive maintenance performance.[104] Given the importance of preventative maintenance, the issues identified in relation to Hydro's maintenance practices, and the age of Hydro's system, the Board believes that it is necessary to closely monitor Hydro's execution of its maintenance program to ensure that Hydro's own targets are met and ensure that its asset management execution is best practice.

Hydro will be directed to report annually in relation to asset management execution for its transmission system and terminal station assets.

7.5.3 Hydro's Operating Culture

It is now clear that the widespread outages on the Island Interconnected system in 2013, 2014 and 2015 were the result of failures by Hydro in the operation of its system. While specific issues relating to generation planning and supply and transmission asset management execution were identified, as the investigation progressed more systemic issues also began to emerge in relation to Hydro's operation of its system. Liberty raised concerns in relation to Hydro's operating culture and reliability engineering in its March 2015 outage report.[105] In testimony during Hydro's general rate application hearing, Liberty's president, Mr. Antonuk questioned whether there had been sustained and effective change at Hydro.[106] Further Liberty's Phase Two report confirmed that "many of Hydro's past issues, including the major outages in 2013 and 2014 and the voltage collapse of 2015, were as much or more due to organizational issues as they were due to system inadequacies."[107] According to Liberty, it is essential that Hydro develop a plan to address the issues previously identified in relation to Hydro's operating culture and its approaches to planning, reliability analyses, system operations and asset.[108]

The Board's findings in its prudence review also identified issues in relation to Hydro's approach to the operation of its system. The Board stated in Order No. P.U. 13(2016):

> This is the first time that the Board has undertaken a prudence review of this scope. The resulting findings by the Board of imprudence by Hydro are significant and reflect failure on the part of Hydro's management to exercise the reasonable standard of care expected in certain aspects of its operations. The consequences of this imprudence for customers are significant, both in terms of impact on service adequacy and reliability, as was shown during the outages of January 2013 and January 2014, and in terms of cost.[109]

[104] Consumer Advocate Submission, April 27, 2015, page 5.
[105] Liberty Report, October 22, 2015, page 5.
[106] General Rate Application Transcript, November 12, 2015, pages 124/18-25 and125/1.
[107] Liberty Phase Two Report, page ES-2.
[108] Ibid., page ES-4.
[109] Order No. P.U. 13(2016), page 77.

The Board found that Hydro was imprudent in relation to a majority of the matters and noted concerns in relation to several others. The Board concluded:

- Hydro's deferral of preventative maintenance was imprudent and caused the failure of the Sunnyside transformer and the Sunnyside and Western Avalon air-blast circuit breakers.
- There were a number of areas of weakness in Hydro's supply planning, including Hydro's focus on LOLH, the use of "average" weather, and Hydro's handling of atypical system losses. The Board stated that it shared Liberty's view that Hydro's supply planning processes were flawed and supply planning decisions prior to 2014 contributed to the need to procure additional generation on an urgent basis.[110]
- Hydro failed to take action in relation to black start capability at Holyrood until directed by the Board in October 2013, even though Hydro had identified it as critical.
- The widespread outage in January 2013 was associated with Hydro's failure to conduct its own testing to demonstrate that the lube oil system worked as intended and to verify that the required test was performed by its contractor and Hydro had still not addressed the ongoing risk of common mode failure of the lube oil system. [111]

It is concerning that Hydro was found to be imprudent with respect to so many of the identified projects and activities and further that the imprudence was found to have occurred over the course of a number of years. In each case there were serious shortcomings in Hydro's decision making and management of various aspects of the Island Interconnected system, including generation planning and supply, generation asset management, transmission asset management execution, and reliability engineering. The Board believes that, when considered together, these shortcomings suggest that there are serious issues associated with Hydro's approach to the management of the Island Interconnected system.

The Board is particularly concerned by Hydro's suggestion that cost considerations were factors in relation to its decision to delay the addition of new generation, its approach to black start capability and its deferral of preventative maintenance. The Board acknowledges the challenges associated with balancing cost and reliability on the Island Interconnected system; however, the circumstances and risks must be carefully considered in making these difficult choices. In the Board's view Hydro did not demonstrate that it had completed the appropriate comprehensive analyses, balancing all of the risks and costs, in making these decisions.

The Board acknowledges that Hydro has completed a significant amount of work to address the specific issues that were identified in relation to the widespread outages on the Island Interconnected system in 2013, 2014 and 2015. However, the Board believes that there are ongoing issues related to Hydro's approach to the management of its system which have not yet been addressed. As discussed earlier the Board will require Hydro to file a report setting out, among other things, the specific improvements that have been made in relation to its operational philosophy regarding reliability.[112] The Board also notes that that there have recently been significant changes in the executive at Hydro and that a process is underway to appoint new

[110] Ibid., page 60.
[111] Ibid., page 15.
[112] Section 7.3.

members to the Board of Directors.[113] The Board is hopeful that these changes will bring new and improved approaches so that, by the conclusion of Phase Two of the Board's investigation, confidence in Hydro's operation of the Island Interconnected system will be restored.

7.6 Costs

The Board began this investigation over two years ago and, while Phase One is now concluded, there are many issues which continue to be assessed and which will be finalized as a part of Phase Two. While an award of costs is not normally made until the conclusion of a proceeding, the circumstances in this case are somewhat unusual. This has been a lengthy proceeding involving important issues affecting the public interest in the provision of least cost reliable power. The Board acknowledges the considerable resources that have been devoted by the parties involved in this lengthy proceeding. In addition it is clear that it will be some time before the matter is concluded as the hearing of Phase Two is anticipated to begin in the winter of 2017. In the circumstances the Board believes that the conclusion of Phase One is an appropriate point in this proceeding to consider claims for costs in advance of the conclusion of the matter.

The Board will not address costs in this report. Any party intending to claim costs should file an application with the Board which will be addressed in a separate Order. The Board notes that Mr. Dumaresque has already filed a claim for costs which will be the subject of an Order to be issued shortly. Further applications will be addressed in due course with full opportunity for interested parties to comment.

7.7 Conclusion

The Board concludes that the widespread and extended supply disruptions on the Island Interconnected system in 2013, 2014 and 2015 were the result of multiple failures by Hydro across a number of aspects of its operation over the course of a number of years. Hydro failed to meet the standard of generally accepted sound public utility practice and failed to fulfill its obligation to provide least cost reliable service. While the Board denied recovery from customers of the costs associated with the actions and decisions found to be imprudent, these costs will ultimately be borne by the people of the province as the owners of Hydro. The Board believes that Hydro let down its customers and the people of this province, who, collectively will bear the significant financial burden associated with Hydro's failures.

Most concerning for the Board is that, despite the work that has been done, there continue to be significant risks to the adequacy and reliability of supply on the Island Interconnected system in the next few years. The Board concludes that issues related to Hydro's transmission asset execution, operating culture, generation planning and supply, and generation asset management pose a continuing threat to the adequate and reliable supply of power on the Island Interconnected system. It is imperative that Hydro acknowledge these serious ongoing issues so that it can begin the challenging work of ensuring meaningful and sustained change.

[113] IC-NLH-023, Phase Two of the investigation.

While Newfoundland Power has an important role to play in the adequacy and reliability of supply on the Island Interconnected system, at the conclusion of this investigation, the Board is satisfied that Newfoundland Power did not cause or contribute to the January 2014 outages.

APPENDIX A

BOARD'S INTERIM REPORT AND UTILITIES REPORTING AND COMPLIANCE

1. Load Forecasting and Generation Planning

The required key actions in relation to load forecasting and generation planning were:

1. By December 1, 2014 Hydro should:
   i) implement changes to its short-term forecasting process to appropriately incorporate impacts of weather conditions and any significant load changes, from losses or otherwise, resulting from varying system configurations
   ii) incorporate sensitivity analyses to weather extremes in all forecasting and supply and planning decision evaluations
2. By October 31, 2014 Hydro should file a status report in relation to the changes to its short-term forecasting and the incorporation of sensitivity analyses.

On October 31, 2014 Hydro filed the required report in relation to load forecasting concluding that weather was a factor that significantly influenced load in December 2013 and January 2014. Hydro explained that the winter peak demand occurred earlier than usual and low temperatures were more severe and sustained than normal. The report sets out the improvements that Hydro implemented in relation to its short-term forecast, medium-term forecast and long-term forecast, including:

- a new version of Nostradamus Software
- modification of the short term forecasting procedure
- adjustment to the short-term load forecast for unusual system losses for system dispatch
- Inclusion of sensitivity analyses reflecting the P90 weather variable
- transmission loss forecasts to reflect changes to system configurations
- medium term operating load forecasts reflecting the total Island system
- recalibrated historical wind chill values to be used for forecasting system peak demands
- continued research related to the system impacts of electric space heating
- regular assessment of sensitivity analysis of longer term load to key variables

Hydro explained that the effects of these improvements will be monitored and reviewed to ensure that the expected improvements in accuracy have been achieved.

2. Generation Availability

The required key actions in relation to generation availability were:

1. By December 1, 2014 Hydro should:

i) complete the work necessary to ensure winter readiness of its generation assets
ii) address the issue of critical spares of its generation assets
iii) complete negotiations in relation to interruptible load and, to the extent that it can secure economically available interruptible load, have a contract in place
iv) complete the procurement and installation of the 100 MW (nominal) gas turbine

2. By June 16, 2014 Hydro should file a report in relation to each of the following issues addressing schedule, estimated costs, the resources required, and how these requirements will be met:
i) a generation master plan for winter preparation, including a plan to implement an availability improvement program on all generating assets and its maintenance program for the Holyrood Thermal Generating Station
ii) a plan in relation to critical spares for the Holyrood Thermal Generating Station and the Hardwoods and Stephenville gas turbines
iii) a plan in relation to securing economically available interruptible loads.
3. By October 1, 2014 and December 1, 2014 Hydro should file status reports with the Board in relation to winter readiness of its generation assets.

On June 16, 2014 Hydro filed the required report in relation to generation availability which set out its generation master plan for winter preparedness, a critical spares plan, and a work plan for securing economically available interruptible loads. Hydro also advised that it was introducing a self-assessment process for the purpose of verifying winter readiness, which included completing a survey by July 30, 2014 and developing a winter readiness action plan with completion of identified activities by November 30, 2014. Hydro set out a detailed availability improvement program for its two older combustion turbines with a focus on maintenance, spare parts, repeat failures, fuel storage and winter readiness. Hydro explained that a refurbishment/life extension was completed at Hardwoods over the 2010 to 2013 period and that a similar project is being carried out at Stephenville over the 2014 to 2016 period. In addition, following the January 2014 events, Hydro implemented a protocol for performing test starts of the combustion turbines in advance of all significant weather events.

Throughout the summer and fall of 2014 Hydro filed additional reports, including:

- on August 1, 2014, its Winter Readiness Self Assessment
- on August 29, 2014, a comprehensive generation master plan for winter preparation.
- on September 30, 2014 a status report in relation to ongoing corrective maintenance for Hardwoods and Stephenville combustion turbines
- bi-weekly reports in relation to the new combustion turbine
- monthly reports in relation to generation availability, its integrated action plan, annual work plan items, capital projects, critical spares, progress on economically available interruptible loads

On October 1, 2014 Hydro filed the required winter readiness of generation assets report setting out a listing of the various operations and maintenance initiatives, a master outage schedule for generation issues, a Severe Weather Preparedness protocol and an updated winter readiness self

assessment. The planned generation outage schedule showed no planned outages after November 30, 2014.

On December 1, 2014 Hydro filed the required status report in relation to winter readiness of its generation assets, reporting completion of most but not all items. Hydro reported all generation assets available as of December 1, 2014 except the Hardwoods combustion turbine and the new combustion turbine. Hydro explained that the Hardwoods unit was undergoing an assessment and there was some delay in the schedule for the new combustion turbine. Hydro further reported that it had finalized a capacity agreement with Corner Brook Pulp and Paper Limited for 60 MW and that a further agreement with Vale Newfoundland and Labrador Limited was almost finalized. In relation to critical spares Hydro advised that in 2014 it had focused on critical spares which were the highest priority in terms of ensuring equipment readiness and availability for the 2014-2015 winter. Hydro reported that in most cases adequate spares already existed but where spares were not in stock, procurement action was initiated or planned.

On December 9, 2014 Hydro filed an update in relation to winter readiness and critical spares, reporting a high state of critical spares readiness in relation to hydraulic generation assets.

In its December 15, 2014 monthly report in relation to generation availability Hydro indicated that annual work plan activities were substantially complete. Some delays were reported in relation to protection and control activities for Hardwoods and Stephenville combustion turbines and good progress was reported in relation to critical spares.

3. Terminal Station Transformers

The required key actions in relation to terminal station transformers were:

1. By December 1, 2014 Hydro should:
   i) complete all 2014 and outstanding prior year testing and maintenance on critical transformers
   ii) take appropriate action in relation to critical transformers which have questionable levels of combustible gases
2. By June 2, 2014 Hydro should file a report in relation to the work required to be done in 2014 with regard to transformers, addressing schedule, estimated costs, the resources required, and how these requirements will be met, setting out:
   i) a list of critical transformers and an explanation as to how this determination was made
   ii) a list of all transformers showing gas analysis results for the period 1993-2013
   iii) a plan for testing in 2014 for all transformers with questionable levels of combustible gases
   iv) a plan to complete the 2014 and overdue testing and maintenance on critical transformers in 2014
   v) a plan to complete the 2014 and overdue testing and maintenance on the remaining transformers

3. By June 16, 2014 Hydro should file reports with the Board in relation to the following transformer issues:
    i) system studies in relation to the relocation of the repaired T5 transformer from Western Avalon to Sunnyside, including a plan to address potential further failures
    ii) a study in relation to the availability and necessity of a replacement transformer for T5 at Western Avalon, addressing schedule, estimated costs, the resources required, and how these requirements will be met
    iii) a plan for the study to determine if abnormal system disturbances may have caused the T5 failure at Western Avalon

On June 2, 2014 Hydro filed the required report setting out the transformer work to be done in 2014. The report explained that all preventive maintenance on critical transformers rescheduled from previous years was planned to be completed in 2014 and other preventive maintenance would be accelerated so that overdue testing and maintenance on all power transformers would be completed by the end of 2015.

On June 16, 2014 Hydro filed the required report in relation to system studies and repairs/refurbishment of the T1 transformer at Sunnyside and the T5 transformer at Western Avalon. Hydro projected that a new transformer for Sunnyside would be commissioned in November of 2014 and the repairs to T5 at Western Avalon would be complete in October 2014.

At the request of the Board Hydro filed bi-weekly status updates beginning on August 15, 2014 in relation to the Sunnyside and Western Avalon transformer work.

On December 5, 2014 Hydro reported that the Sunnyside replacement was substantially complete with only minor, non-operational tasks remaining and the Western Avalon repair work was complete.

In the integrated action plan update filed on December 10, 2014 Hydro confirmed that:

i) Transformer gas testing was completed as planned.
ii) Testing and maintenance on critical transformers was progressing as planned with six of eight critical transformers completed.
iii) System studies on the transformers were complete.
iv) The new transformer intended to replace the T1 transformer at Sunnyside was delayed in factory testing and instead a redundant transformer was moved from Holyrood to Sunnyside and the new transformer was placed in Holyrood when it was delivered. At the time of the status report the new transformer was in the process of being connected and commissioned.
v) Refurbishment of the T5 transformer at Western Avalon was complete and it was energized in October.
vi) Hydro adopted a plan to install on-line continuous gas monitors on all 22 GSU transformers in the coming years with seven being done in 2015.
vii) Formal life assessment of 30 of Hydro's most critical transformers was complete.

4. Air-Blast Circuit Breakers

The required key actions in relation to air-blast circuit breakers were:

1. By December 1, 2014 Hydro should:
   i) properly exercise all air-blast circuit breakers
   ii) complete all 2014 and outstanding prior year testing and maintenance on its critical air-blast circuit breakers
2. By June 2, 2014 Hydro should file a report in relation to the work required to be done in 2014 with regard to its air-blast circuit breakers, addressing schedule, estimated costs, the resources required, and how these requirements will be met, setting out:
   i) a plan for the proper exercise, preferably in cold weather, of all air-blast circuit breakers annually beginning in 2014
   ii) a list of critical air-blast circuit breakers and an explanation as to how this determination was made
   iii) a plan to complete 2014 and overdue testing and maintenance on critical air-blast circuit breakers in 2014
   iv) a plan to complete 2014 and overdue testing and maintenance on the remaining air-blast circuit breakers
   v) a plan to periodically operate air-blast circuit breakers from protective relays
   vi) a plan to conduct an in-depth analysis of the DC system for B1L03 to determine if any high impedance paths exist that may affect its operation
   vii) a plan to conduct a review of the annual air system leak check preventive maintenance to ensure that it is adequate in both scope and timing of execution to accurately identify leaks at the Sunnyside Terminal Station; and
   viii) a plan to review the current approach to air-blast circuit breaker re-lubrication, addressing why the DOW 55 grease was not removed during the 2007 re-lubrication.
3. By August 1, 2014 Hydro should file a report in relation to each of the following issues in relation to its air-blast circuit breakers addressing schedule, estimated costs, the resources required, and how these requirements will be met:
   i) acceleration of the preventive maintenance cycle for air-blast circuit breakers.
   ii) acceleration of the replacement of air-blast circuit breakers.
   iii) changes to internal procedures and documents addressing: the application of the protective coating to air-blast circuit breakers; false indications of the open/close state; and specific pass/fail criteria for the timing test of the air-blast circuit breaker preventive maintenance check sheet.

On June 2, 2014 Hydro filed the required report in relation to the air-blast circuit breakers, advising that it planned to exercise all 230 kV circuit breakers no later than November 30, 2014. Hydro also set out that preventive maintenance on all critical air-blast circuit breakers would be completed in 2014 and the remainder would be done in 2015. The report also set out a plan to operate air-blast circuit breakers from protective relays, to conduct an in-depth analysis of the

DC system for Sunnyside B1L03, to review the annual air system leak check preventive maintenance, and to review the current approach to air-blast circuit breaker re-lubrication.

On August 1, 2014 Hydro filed the second required report in relation to air-blast circuit breakers, advising that it would reduce its six-year preventive maintenance schedule to four years beginning in 2015 and that replacement of all air-blast circuit breakers would be accelerated from 2031 to 2020. The report also advised of changes to internal procedures and testing in relation to air-blast circuit breakers, addressing: i) the application of the protective coating, ii) false indications of open/close, and iii) pass/fail criteria for the timing test.

In the integrated action plan update filed on December 10, 2014 Hydro reported in relation to the air-blast circuit breakers:

i) The exercise of the air-blast circuit breakers was complete with 57 of the 63 breakers exercised, five replaced and one remaining breaker to be exercised during the week of December 8, 2014.
ii) A plan for testing and maintenance on critical air-blast circuit breakers was complete.
iii) A plan to do overdue testing and maintenance was in place.
iv) A procedure was adopted for periodic operation of the breakers from protective relays.
v) Analysis of the DC system for B103 at Sunnyside was complete.
vi) The maintenance manual was updated for the annual air system leak check.
vii) Breaker re-lubrication practices and procedures were amended.
viii) The preventive maintenance cycle for air-blast circuit breakers was shortened to four years.
ix) Accelerated replacement of air-blast circuit breakers would start in 2015.
x) Certain internal procedures for the breakers were updated.

5. Protection and Control Systems

The required key actions in relation to protection and control systems were:

1. By December 1, 2014 Hydro should check and modify slow trip coil connections on the air-blast circuit breakers.

2. By June 16, 2014 Hydro should file a report in relation to each of the following issues, addressing schedule, estimated costs, the resources required, and how these requirements will be met:
   i) a plan to redesign existing breaker failure relay protection schemes to provide that breaker failure will be activated with either a 138 kV or 230 kV breaker malfunction after a transformer failure
   ii) a plan for the installation of breaker failure relay protection for transformers in terminal stations where breaker failure relay protection is not in place
   iii) a plan to include experienced protection and control technologists with response teams, where appropriate beginning in 2014
   iv) a plan to eliminate the use of “slow trip” coils in 2014

v) a plan to complete work in relation to relay cards in terminal stations in 2014
vi) a plan to document its protection philosophy as a Protection and Control Engineering Standard in 2014
vii) a review of the recommendations in the previous 230 kV transmission line protection studies in light of priorities and requirements arising from the January 2014 events

On June 16, 2014 Hydro filed the required report in relation to protection and control, setting out its plan to review all terminal stations which have existing breaker failure protection and to complete a plan for the design work by September 30, 2014 with field modifications beginning in 2015. In relation to terminal stations which did not have breaker failure protection (all 138 kV and 69 kv stations) a plan was to be completed by November 30, 2014. Hydro also set out a plan for the elimination of slow trip coils and to update the protective relay maintenance procedure by November 30, 2014 and to update its protection and control standard. Hydro also set out a plan for the implementation of previous 230 kV transmission line protection studies by the end of 2015.

In the integrated action plan filed on December 10, 2014 Hydro reported in relation to protection and control:

i) All breakers with slow trip coils had been addressed.
ii) The redesign of existing breaker failure protection schemes scheduled for November 30, 2014 was delayed until December 19, 2014.
iii) Protection and control technologists will be included in response teams.
iv) Of the 60 Integrated Action Plan items in relation to protection and control, 54 were planned for completion in 2014 but, as a result of delays caused by other operational and winter readiness priorities 46 items were reported as complete and eight would be completed by January 31, 2015.
v) The repair and update of terminal station relay operation cards would be completed by December 31, 2014.
vi) A protection philosophy and protection and engineering standard had been completed.
vii) A plan for meeting substation and protection and control resources requirements had been developed.
viii) Thirteen of seventeen protection and control recommendations from the 2010 and 2011 studies had been completed and the remaining four were delayed by other operational and winter readiness priorities and would be completed by January 31, 2015.
ix) All outstanding protection and control recommendations from the 2013 winter events study were in conformity with the plan for a December 31, 2014 completion date.

6. Alarms and Recording Devices

The required key actions in relation to alarms and recording devices were:

> 1. By August 1, 2014 Hydro should file a report in relation to the following issues, addressing schedule estimating costs, the resources required, and how these requirements will be met, setting out:
>
> i) a plan to update its event and data recording devices and systems and procedures to identify the key set of priority alarms, provide for the monitoring of alarms, and address staff training and equipment repair
>
> ii) an analysis of the implementation of a program to install modern digital relays for all major equipment such as 230 kV transformers

On August 1, 2014 Hydro filed the required report in relation to alarms and recording devices, setting out that it planned to update its event and data recording devices and procedures. Hydro explained that by November 30, 2014 it would review existing digital fault recording devices, identify key priority alarms, address monitoring of alarms and staff training, and repair the digital fault recorder at Western Avalon. In relation to digital relays Hydro reported that a plan and a capital budget proposal were to be completed by October 24, 2014. In the integrated action plan filed December 10, 2014 Hydro reported that a plan had been developed for updating event and data recording devices to install modern digital relays, with implementation in future years.

7. Hydro Place Emergency Power

The required key actions in relation to Hydro Place emergency power were:

> 1. By December 1, 2014 Hydro should complete all reasonable and necessary work in relation to the emergency generation system and appropriate emergency lighting at Hydro Place.
>
> 2. By June 16, 2014 Hydro should file a report in relation to:
>
> i) the emergency generation system for Hydro Place addressing the outstanding work, availability risk, and maintenance procedures
>
> ii) a plan to ensure that there is adequate emergency lighting at Hydro Place in 2014

On June 16, 2014 Hydro filed the required report in relation to Hydro Place emergency power and lighting. Hydro reported that as of May 2014 the faulty actuators for the ventilation system louvers had been replaced and that best practices in relation to preventive maintenance for the Hydro Place emergency power system had been incorporated into an updated preventive maintenance and testing program. Hydro also reported that it had confirmed a protocol with Newfoundland Power that, in the event of a system interruption affecting the St. John's area, the feeder to Hydro Place will not be subject to a planned interruption and, in the event of an unplanned interruption, it will be restored on a priority basis. In relation to emergency lighting Hydro advised that battery powered emergency lighting had been installed in all Hydro Place

stairwells and supplemental battery powered emergency lighting has also been installed in the emergency generation system room.

In its update filed December 10, 2014 Hydro confirmed completion of the required key actions in relation to Hydro Place emergency power and lighting. Hydro explained that the preventive maintenance program for the diesel generation system is complete, a second contractor had been added, engine maintenance checks will be done twice a year rather once a year and a critical spares list for all components had been developed.

8. Staffing

The required key action in relation to staffing was:

> 1. By June 16, 2014 Hydro should file a report addressing associated costs in relation to how it will meet its substation, and protection and control system resource requirements beginning in 2014.

On June 16, 2014 Hydro filed a report in relation to terminal station and protection and control resource requirements, setting out how it would address the requirements of incremental work in relation to the preventive maintenance recovery plan for transformers and air-blast circuit breakers and the protection and control action items. Hydro explained that the incremental preventive maintenance work would be filled with a combination of contractors and temporary Hydro employees. To complete the protection and control action items Hydro advised that it would utilize temporary Hydro employees. In relation to terminal station resources Hydro explained that it planned to complete a review by July 31, 2014 to ensure that its staff complement is adequate and to determine the appropriate mix of internal and external staff to effectively meet it ongoing and future operational needs.

On August 22, 2014 Hydro reported in its Integrated Action Plan that a long term plan had been developed to ensure resource needs are met.

9. Transmission System and Terminal Station Safety

The required key action in relation to transmission system and terminal station safety was:

> 1. By December 1, 2014 Hydro should file a report in relation to transmission system and terminal station safety issues.

Hydro filed the required report on December 1, 2014 setting out:

1. A study of adding station service redundancy at all 230 kV terminal stations would be completed by March 30, 2015;
2. A new station service transfer switch was installed at the Sunnyside Terminal Station;
3. The requirement for station service transfer switches in control buildings remote from power transformers had been added to the engineering standards and the modifications in existing stations would be planned and integrated as appropriate with other work;

4. The study of transfer switches in stations without control buildings would be initiated in 2015; and
5. The PCB contents of all oil filled power transformers had been made available.

10. Communication, Coordination and Response

The required key actions in relation to communication, coordination and response were:

1. By December 1, 2014 Hydro and Newfoundland Power should make improvements in operational and customer information and communications coordination.
2. By December 1, 2014 Hydro and Newfoundland Power should file a joint report on progress towards enhancements and improvements in operational and customer information and communications coordination.

On September 3, 2014, in response to a request from the Board, Hydro provided information in relation to customer expectations research, the customer service strategy, the joint utilities meeting and the Severe Weather Reporting Protocol.
On October 6, 2014 Hydro provided copies of minutes of the 2014 joint utilities meeting.

On December 1, 2014 Newfoundland Power filed, on behalf of Newfoundland Power and Hydro, the report *Joint Utilities Coordination Report*, as required. This report set out the progress of both utilities towards joint enhancements and improvements in operational and customer information and communications coordination. Specific actions identified included:

1. Hydro is providing Newfoundland Power additional real-time electrical system data.
2. Procedures were developed related to electrical system generation reserves, generation testing, generation dispatch, rotating power outages, and cold load pickups; including:
   a. Hydro's *T-093 Island Generation Supply – Gross Continuous Unit Ratings*;
   b. Joint System Operating Instruction *T-043 Request for Newfoundland Power Generation*;
   c. changes to Hydro's *T-001 Generation Reserves* System Operating Instruction;
   d. Newfoundland Power's *SRP-001 Rotating Power Outages System Restoration Plan* and *SRP-002 Cold Load Pickup System Restoration Plan*; and
   e. Hydro's *T-042 Rotating Power Outages* System Operating Instructions.
3. Measures were developed to improve customer information and communication, including:
   a. the *Customer and Stakeholder Advance Notification Protocol*;
   b. the *Joint Storm/Outage Communications Plan*;
   c. improved customer service technologies; and
   d. new customer education materials in relation to conservation.

11. Hydro's Integrated Action Plan

The required key action in relation to Hydro's Integrated Action Plan was:

1. By June 2, 2014 Hydro should file an updated Integrated Action Plan.

As directed by the Board Hydro filed an updated Integrated Action Plan on June 2, 2014 incorporating the actions recommended by Liberty and the Board. Several updates to the Integrated Action Plan were filed by Hydro up to January 15, 2015.[114] Hydro reported in this final filing that at the time there were five outstanding action items, including:

i) Installation and commissioning of a new combustion turbine at Holyrood, which was delayed from the planned date of December 7, 2014, with first electrical synchronization to the grid planned for January 17 or 18, 2015.
ii) Implementation of eight protection and control recommendations planned for 2014 would be completed by January 31, 2015, bringing the total completed to 54, with the remaining six of the 60 set out in Hydro's Integrated Action Plan to be completed.
iii) Execution of a 2014 plan to repair and update terminal station relay cards would be complete by January 31, 2015 for all critical 230 kV stations.
iv) Thirteen of the seventeen outstanding recommendations from the 2010/11 Protection and Control studies, which were planned to be completed in 2014 were completed with expected completion of the remaining four by January 31, 2015.
v) Changes to the way customer calls are managed in an outage were delayed from December 15, 2014 to January 31, 2015.

Hydro advised it expected that items in the Integrated Action Plan and in Liberty's interim report not completed in 2014 would be incorporated into its 2015 operations plans.

[114] On July 25, 2014 an update was filed to reflect tracking and reporting changes, specifically with respect to the Board's required action items identified in its interim report. Further updates were filed on August 22, September 19, October 20, November 21, and December 10, 2014 to provide a status report on the progress of the action items.

Newfoundland & Labrador
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