newfoundland labrador
hydro
a nalcor energy company

Hydro Place. 500 Columbus Drive.
P.O. Box 12400. St. John's. NL
Canada A1B 4K7
t. 709.737.1400 f. 709.737.1800
www.nlh.nl.ca

March 30, 2017

The Board of Commissioners of Public Utilities
Prince Charles Building
120 Torbay Road, P.O. Box 21040
St. John's, NL A1A 5B2

Attention: **Ms. Cheryl Blundon**
Director Corporate Services & Board Secretary

Dear Ms. Blundon:

Re: Investigation and Hearing into Supply Issues and Power Outages on the Island Interconnected System -- Directions further to the Board's Phase One Report

Further to the Board's correspondence dated October 13, 2017, attached please find:

1. A report entitled "*Establishing a Robust Operational Philosophy and Enhancing Skills and Capabilities Relating to Systems Reliability and Analysis*" outlining the actions taken in response to each of Liberty's recommendations in its report dated October 22, 2015 on the March 2015 Outage; and

2. A report entitled "*Improving the Transparency of the Designation of Critical Customers*" detailing improvements to the transparency of the designation of critical customers.

We trust the foregoing is satisfactory. If you have any questions or comments, please contact the undersigned.

Yours truly,

NEWFOUNDLAND AND LABRADOR HYDRO

Tracey Pennell

Tracey L. Pennell
Senior Counsel, Regulatory

TLP/bs

cc: Gerard Hayes – Newfoundland Power
Paul Coxworthy – Stewart McKelvey Stirling Scales
Roberta Frampton Benefiel – Grand Riverkeeper Labrador
Dennis Browne, Q.C. – Consumer Advocate
Danny Dumaresque

ecc: Denis Fleming- Vale Newfoundland & Labrador Limited
Larry Bartlett – Teck Resources Ltd.

Establishing a Robust Operational Philosophy and Enhancing Skills and Capabilities Relating to Systems Reliability and Analysis

March 30, 2017

A Report to the Board of Commissioners of Public Utilities

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1.0 Introduction

On October 13, 2016, the Board of Commissioners of Public Utilities (the Board) requested Newfoundland and Labrador Hydro (Hydro) provide a report on the actions taken in response to each of Liberty's recommendations in its report dated October 22, 2015, on the March (2015) outage, including all actions and plans to establish a more robust operational philosophy regarding reliability and to enhance the skills and capabilities of Hydro's employees related to reliability engineering and analysis.

This report details the actions that Hydro has taken to establish a more robust operational philosophy and its plans to establish a more reliability-centric culture. This report also discusses the actions taken by Hydro to improve the skills and capabilities of its employees related to reliability engineering and analysis.

It must be recognized that changing an organization's culture takes time. It is a large-scale undertaking that requires the organization to first change its behaviours knowing that the mindset of its employees will follow. Hydro has implemented many changes since the outages in 2014 and more following March 2015 events. The company is more risk focused and strives to remove known risks in addition to mitigating and managing those it cannot fully remove. Today, Hydro's new leadership has set expectation that the approach to the overall system management is to be customer focused with a goal of continually improving reliability as well as transparency with our customers on system conditions. There is also an expectation of a heightened and urgent response to system events to ensure that any outages or customer impacts are minimized to the extent possible. This has been achieved by implementing a number of changes in practises and processes which are directly benefiting customers and fundamentally resetting the utility focus of Hydro.

Hydro has made significant progress since 2014 and has a fundamental strategy of renewing the focus of Hydro and its employees to its core business of supplying its customers with a safe and reliable power supply. Hydro has demonstrated to the Board and its customers improved operational philosophy and an increased focus on service continuity for the customer. Hydro also acknowledges that this work and the improvements to culture, processes, practices will continue with appropriate urgency, driven by the current leadership but supported across the company. Some examples of where Hydro's approach has ensured service continuity include:

- In 2016, Hydro experienced boiler tube issues at the Holyrood Thermal Generating Station (HTGS) and took deliberate actions to ensure minimal customer outages. The thermal generating units were run at lower loads and the gas turbines were started in advance to ensure service continuity. There was no visibility to cost recovery for the operation of the gas turbines; Hydro took this action solely to ensure reliability of the system for customers.
- Starting in 2016, Hydro leased a spare engine that provides redundancy for its gas turbines. Hydro believes that the need for reliability of the gas turbine generation warrants the additional leasing costs and will continue to lease the spare engine.
- In 2017, Hydro entered a long-term maintenance contract with Siemens for the Holyrood combustion turbine (CT). The Holyrood CT is an important component of the Avalon contingency reserves and securing a long-term service provider will improve access to parts inventories, improve service response times and contribute to the overall reliability of the grid.
- In 2017, Hydro experienced air flow issues with the generating units at HGTS that have caused de-ratings to each unit. Due to the importance of the HTGS to the Island Interconnected System (IIS) and Avalon Peninsula, and rather than leave both units de-rated until the summer maintenance season, Hydro is planning an outage in April to restore capacity to one unit as quickly as possible.
- The March 11, 2017, windstorm shows an improved operational philosophy for Hydro and demonstrates many of the improvements discussed in this report. The impending weather conditions (extreme wind; up to 180 km/hr) were recognized early and it was decided during the daily system status meeting that a storm preparation would be

required. During the storm preparation meeting, Hydro created a plan to respond to the impending weather event and it was decided that crews would be placed on standby in advance of the weather for quick mobilization to areas requiring attention. Once the storm hit and outages were experienced, Hydro staff was able to respond quickly, thus minimizing the outages. Internal communications kept all stakeholders informed of the status and progress of unplanned outages and Hydro was in direct communication with Newfoundland Power and the general public. Hydro staff reacted appropriately and quickly to minimize the impact of the storm, with engagement of all levels of the organization. Hydro's system was exposed to design specification wind loading and experienced damage that was not extensive during this event. Hydro is reporting to the Board separately on the March 11, 2017, windstorm.

The above are a few examples only. Each of the changes outlined in this document directly influences the organization's philosophy and culture, moving ever-further in its evolution as a reliability-focused organization. Hydro will continue to learn, grow and evolve its operational philosophy while continuing to improve service continuity.

2.0 Establishing a More Robust Operational Philosophy

2.1. Overview

Liberty recommended that "Hydro should assign a team to implement a program to establish a more robust operational philosophy regarding reliability."[1] Hydro regards service continuity as being critical to its customers and seeks to continually improve its service reliability. Reliability has been enhanced over the past several years through a series of strategic operational and system improvements undertaken by Hydro.

[1] The Liberty Consulting Group, "*Review of the Newfoundland and Labrador Hydro March 4, 2015 Voltage Collapse,*" October 22, 2015, at page 10. Available at: http://www.pub.nf.ca/applications/March4thPowerOutage/files/reports/Liberty-Report-Oct22-15.pdf

In response to its customers, the Board, and Liberty's recommendations, Hydro has taken a number of actions, as explained below, to secure a reliable power system and to support a more robust operational philosophy.

2.2. Corporate Reorganization

Changes to both the Nalcor and Hydro organizational structures have improved executive focus on the principal functions associated with the delivery of service. These changes position Hydro to operate as an autonomous business entity within the Nalcor group of companies focused solely on its mandate of delivering safe, reliable, least-cost power to industrial, utility and residential customers in Newfoundland and Labrador.

2.2.1 Strategic Organizational Transformation

Since the power outage events of 2014, Hydro has implemented organizational changes that have transformed the company and improved its focus on core power generation and transmission operations, but through the lens of its customers. In its response to Liberty's Phase I report in early February 2015, Hydro acknowledged that its executive structure, as it existed 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. [2]

Hydro noted that the arrangement under which two Hydro vice presidents reported to the CEO was implemented in 2013 as a transitional structure that would ensure the required focus on ongoing operations, while at the same time enabling the Company to give the required attention to the future integration of Muskrat Falls with existing electricity operations. Hydro indicated that it would not maintain this structure in its longer term steady state operating environment, and further indicated that the manner in which Hydro and Nalcor Energy (Nalcor) would be structured for longer term electricity operations was actively under review.

[2] This report dated December 14, 2014 outlined various conclusions and recommendations by Liberty Consulting, specific to Hydro, as part of the *Review of Supply Issues and Power Outages on the Island Interconnected System* conducted by the Board.

Hydro also acknowledged that the regulatory affairs function in a regulated utility is a critical function. In its response, Hydro indicated its intention to fully consider Liberty's recommendation as part of Hydro's determination of its long term structure for electricity operations.

In November 2015 the position of President for Hydro was created to be ultimately responsible and accountable for all aspects of Hydro operations. Following the appointment of a new President and CEO for Nalcor in May 2016, a number of further organizational changes were instituted. The direction provided by Nalcor's CEO as part of his overall reorganization of Nalcor was that Hydro was to be operationally independent from Nalcor and its other lines of business. The goal was to ensure organizational separation and simplicity for Hydro as it relates to operations management, budgeting and financial management, performance accountability, and regulatory oversight.

Organizational changes were made with the intention of creating clear separation between Hydro as Nalcor's established regulated utility. A new President for Hydro was appointed in June 2016. Following this appointment, Hydro reviewed its organizational structures and subordinate organizational structures for all areas of operations. Figure 1 presents the high level executive structure for Nalcor that was announced by Nalcor's President and CEO in June 2016.

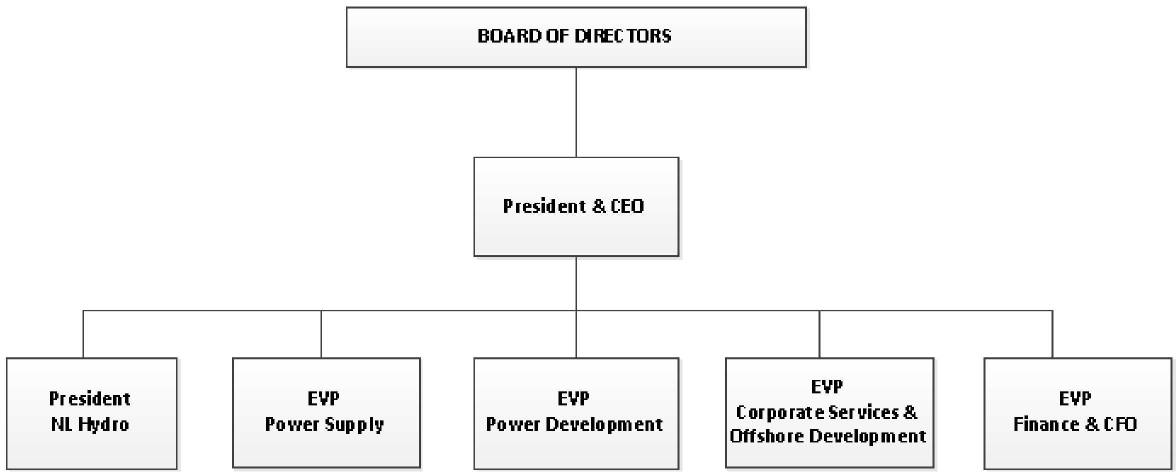

Figure 1: Executive Structure – Nalcor Energy

2.2.2 Hydro's Organizational Structure

Hydro's new executive structure reflects a more encompassing organizational model that ensures that core functions required to operate the company as an operationally independent, stand-alone organization have clear accountability within the new structure.

Hydro's new executive structure reflects a more encompassing organizational model that internalizes the core functions required to operate the company as an operationally independent, stand-alone organization. All functions have clear accountability within the new structure. The new divisions include:

- **Production –** The Production Division encompasses all aspects of power generation within Hydro, including hydroelectric, thermal, diesel, and gas turbine generation, as well as generation planning. Exploits Generation, which was previously managed as part of Hydro's non-regulated operations, is now managed by Production Operations, under its hydraulic generation group.
- **Transmission, Distribution, and NL System Operations –** The Transmission, Distribution, and NL System Operations Division also includes transmission planning and is

responsible for the transmission and distribution of power throughout the Island and Labrador. The incorporation of System Operations, transmission planning and the Energy Control Center optimizes the operation and planning of the core provincial power system.

- **Engineering Services –** The Engineering Services Division includes asset management, project execution and technical services employees. The division also includes an Information Systems and Operations Technology group that are focused on ensuring that Hydro's has the core systems required for the business as well as maintaining the company's Energy Management System, Network Services and other critical IT infrastructure utilized in the Energy Control Center.
- **Regulatory Affairs and Corporate Services –** The Regulatory Affairs and Corporate Services Division consolidates and strengthens Hydro's organizational focus on regulatory affairs, including a dedicated legal resource, and integrates Customer Service, Energy Efficiency, Safety, Health, Environment and Corporate Communications.
- **Financial Services –** The Financial Services Division provides financial oversight and support to Hydro in the areas of Commercial Management, Treasury, Tax, Risk, Insurance, Supply Chain, Administration, and other financial services.
- **Corporate Secretary and General Counsel –** The Corporate Secretary and General Counsel Division provides core legal oversight to the company as well as Board Secretarial functions.

Figure 2 presents the executive level structure for Hydro announced by the President of Hydro in September 2016.

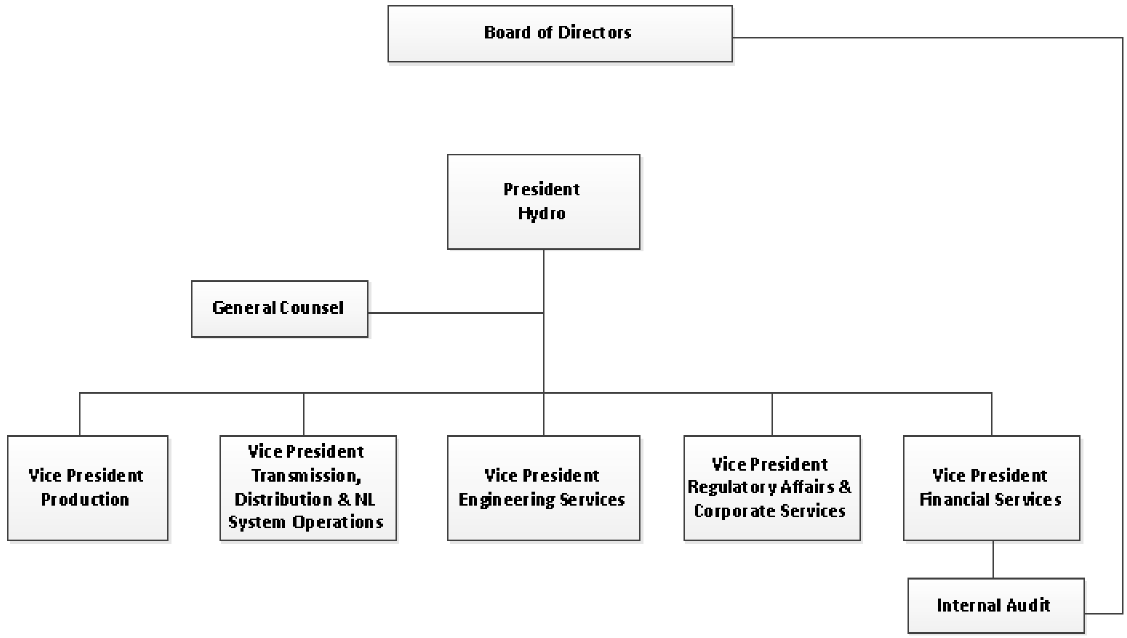

Figure 2: Executive Structure – Hydro

2.3. System Operations Improvements

Since the outages in 2014, Hydro's System Operations Department has made significant improvements that demonstrate meaningful change in its operational philosophy regarding system reliability. Hydro now takes a more holistic view of customers when assessing system conditions and is more focused on the end-consumer of its power, rather than being focused on the end-point of its power delivery.

This change in philosophy and practise has led to enhanced communications between System Operations and the rest of the organization through the addition of daily system status meetings, storm preparation meetings, and improvements in communication to Executive and Management to ensure awareness of both planned and unplanned outages. The Company has also increased its focus on the Avalon Peninsula supply, and has changed its approach for placing standby generating units into operation. Each of these improvements is described in detail in the following sections.

2.3.1 Daily System Status Meetings

Hydro's System Operations Department hosts a daily system status meeting where participants discuss power supply capability and reserves and other conditions that could impact the reliability of the Island Interconnected System and/or the Avalon Peninsula.

Traditionally, power system discussions were held internally within the System Operations Department and had an internal focus to the Energy Control Center (ECC). Stakeholders within Hydro were engaged with respect to any concerns related to their area's assets. This meeting has since evolved into a very structured process that includes key individuals throughout Hydro with primary responsibilities tied to the reliability of the Island Interconnected System, including participation from Hydro Executive and Management representatives from

Production, Transmission, Distribution, System Operations, Communications, and Regulatory Affairs.[3]

The increased scope and structure of the daily system status meeting has improved the reliability culture at Hydro by improving internal communications within Hydro as well as a broader system status understanding for a large group of people involved in various aspects of system management and monitoring. All stakeholders are engaged and aware of the various factors that might impact the power system. As part of these meetings, system reliability assessments, based on load forecasts for the current day and for the next seven days, are reviewed and discussed for both the Island Interconnected System and the Avalon Peninsula. These assessments outline the expected reserves based on the load forecast and the availability of assets which include primary generation, standby generation and in the case of the Avalon, transmission availability.

There is a review of weather warnings and special weather statements issued by environment Canada that can impact the Island Interconnected System. An additional storm preparation meeting is held if participants decide it is warranted (see Section 2.3.2). A review of the 14-day weather outlook is also reviewed. Hydro's internal load forecasting application (Nostradamus) generates a load forecast for seven days. The 14 day forecast outlines the expected temperatures beyond the seven day load forecast so there is a better understanding of potential high load days outside the immediate seven day window.

The previous day's power system events are also discussed to understand any outages or equipment issues. This activity gives participants a better understanding of the current state of

[3] The only days in 2016 that this meeting did not occur were Christmas Day and New Year's Day. It was determined on Christmas Eve and New Year's Eve, respectively, that the following days meeting was not required as the system and weather conditions indicated that there were no impending risks. All representatives remained on call for these days in the event of a system issue.

the power system and can serve as a lessons-learned activity for meeting participants. Existing and planned equipment outages are also reviewed to assess their impacts on short and long term and can lead to cancelling planned outages or implementing contingency plans if the load forecast warrants this action. After each meeting, summary notes are prepared and distributed to the meeting participants. An example of these meeting notes is located in Appendix B.

2.3.2 Storm Preparation Meetings

Storm preparation meetings are held when Environment Canada posts special weather warnings related to wind, rain, freezing rain, and/or snow that have the potential to negatively impact the Island Interconnected System. The decision to hold this meeting is at the discretion of System Operations and the Executive Team and depends on the scope and severity of the weather event. This practice began in January 2016 and these meetings provide a structured review of the current state of the system, the preparedness of each operational area, and ultimately improve system reliability by ensuring that each operational area is ready to respond quickly and effectively to any severe weather impacts.[4]

The meeting includes a review of the weather warnings and the areas of concern. Representatives from the impacted area will review their severe weather checklists, referenced in Appendix C, to confirm they are prepared to address storm impacts. Equipment and generation capacity is also reviewed so that system risks can be identified and subsequently accounted for in system preparation action plans. If the weather event is considered severe, Hydro may proactively staff terminal stations and generation sites to reduce travel time, help troubleshoot any issues, and ultimately respond faster to incidents and reduce outage durations.

[4] If the meeting is warranted, System Operations will notify each operational area. The operational areas of the organization all have severe weather checklists that will be completed and forwarded to System Operations in advance of the meeting. The storm preparation meeting includes the same invitees as daily system status meeting.

For example, it was determined during the daily system status meeting that a storm preparation meeting would be required for the windstorm that was forecasted for March 11, 2017. During the storm preparation meeting, Hydro reviewed the weather warning, its impact on each region, and then created a plan to respond to the storm. It was also decided that crews would be placed on standby for quick response to where the issues were experienced.

2.3.3 Improved Internal Outage Communication

Hydro has improved its internal communications during maintenance activities for both planned and unplanned outages. If an outage is time sensitive, for example a unit trips off line, then the asset owner proactively communicates during the outage to Executive and Management.[5]

This communication includes updates on work progress, expected return to service of equipment, and other details that are important for the safe and reliable return to operation. These updates ensure timely information is communicated to all internal stakeholders and allows for proactive management and additional actions, when necessary, including external updates to customers and other stakeholders.

As an example, Hydro has set clear expectations for how the Holyrood Control Room communicates with the Energy Control Center during times when a unit is down for a planned outage. If the unit is going to be delayed, they are to inform the ECC and the ECC will notify the system on call[6] and System Operations personnel. The system on call will notify the Hydro Executive Team. This is required as a review of both the Island Interconnected System and

[5] Includes representatives from the various functional areas, including Production, Transmission, Distribution, System Operations, Communications and Regulatory Affairs as included in the daily system status meeting.

[6] The system on call is the on call person that is responsible for issues related to the entire power system. The individual is intended to be the communication liaison for large scale system wide issues which require more analysis (i.e. reserves levels) or to coordinate support. It can also be used for technical advice as required.

Avalon reserves would need to be completed to ensure reserve levels will be maintained and if there are any requirements for alert level notification.

2.3.4 Increased focus on the Avalon Peninsula Reserves

Over fifty percent (50%) of the customer load is located on the Avalon Peninsula and System Operations has a requirement to safeguard against the worst case contingency on the transmission system into the Avalon Peninsula. To this end, system operating instruction "Avalon Capability and Reserves (T-096)" (see Appendix D) was created to provide a method of assessing capability and reserves specific to the Avalon Peninsula. This instruction was approved internally at Hydro on June 26, 2015, and submitted to the Board for information on October 14, 2015.

Since April 8, 2015, system reliability assessments for the Avalon Peninsula have been performed daily, based on current load forecasts for the next seven days. These assessments determine the reserves for the Avalon Peninsula for the next seven days given the availability of the assets, which includes primary generation, standby generation, and sources of reactive support, such as capacitor banks.

T-096 provides clear instruction to operators that reserves equal to the single largest contingency, plus an additional reserve of 35 MW must be maintained for the Avalon Peninsula. If the reserves are expected to go below this contingency factor, then the policy provides clear instructions of the steps required to restore the appropriate reserves.

In addition, System Operations will monitor Avalon contingency reserves in real-time. This takes into account transmission line capability and generation asset capabilities. This real-time analysis allows operations to monitor the Avalon reserves and make decisions to maintain these reserves, as per operating instruction T-096.

For example, on March 27, 2017, based on the load flow analysis, [7] a Power Watch was issued for the Avalon Peninsula and no warning was issued for the Island Interconnected System. There has not been any power alerts issued for the Island Interconnected System since 2014. All of the alerts issued have been related to the Avalon.

It is important to note that when level 2 (Power Watch) situations are experienced, Hydro analyzes the reserves more frequently and updates interested parties, often having more frequent system calls than the daily norm. Depending on the time of the issue, 6 am and 9 pm calls may be held to ensure the right people are informed and ready to respond. While being highlighted as part of the analysis of reserves, this is a significant situational awareness and communication improvement illustrating the behavioural and cultural shift within the organization.

2.3.5 Island Spinning Reserves

Spinning reserve is the extra generating capacity that is available by increasing the power output of either hydro or thermal generators that are already connected to the power system.

Operators use operating instructions to operate the power system in an efficient manner. Operating instructions look at system-wide impact. The operating instruction "[IIS] Generation Reserves (T-001)" (see Appendix E) determines the amount of spinning reserves to maintain on the Island Interconnected System. T-001 provides direction to the Energy Control Center to take appropriate action to maintain a minimum spinning reserve level equal to 70 MW. This operating instruction applies to the entire Island Interconnected System. Maintaining appropriate spinning reserves covers performance uncertainties in generating units, especially wind and other variable generation and unanticipated increases in demand. It can also allow for quicker restoration times on outages. As an example, if a generator trips, it could cause an

[7] **Load flow analysis** is used to determine if system voltages will remain within specified limits under normal and emergency operating conditions, and whether equipment is overloaded during these conditions.

under frequency load shed event with loss of customers. The ECC can quickly request to restore customers using the online spinning reserve. In this example, the ECC will also make calls to senior management and on-call personnel to ensure that all stakeholders are aware of the situation.

2.3.6 Operation of Standby Units

In its process of improving system reliability, Hydro has started to operate standby generation in advance to cover generation or transmission outages equal to the worst case contingency (for either Island or Avalon) and to maintain Island spinning reserves. Based on reserve requirements, the Energy Control Center will operate the Hardwoods gas turbine, Holyrood combustion turbine, and Holyrood diesel standby generating units (or a combination thereof) in advance of the single largest Avalon contingency, rather than starting them after the event has occurred. This maintains the Avalon reserve. This practice results in lower risk of customer impact and unserved energy in the event of a contingency.[8]

For the Island, standby generation is started in advance to maintain appropriate spinning reserves. In addition to the standby generation mentioned previously, the ECC will operate the Stephenville gas turbine and the Hawkes Bay and St. Anthony diesel generators for Island spinning reserves.

To support this improvement, Hydro's ECC operators now receive daily standby generation requirements from System Operations, supporting both the Island Interconnected System and the Avalon Peninsula transmission, which allows operators to understand predicted changes to the load forecast and better plan for system continuity. The standby generation requirements are sent each morning as part of the daily system status meeting notes to the daily system status meeting participants. There is also a standby generation group email created that

[8] An example of a contingency would be the loss of a major 230 kV transmission line that supplies the Avalon with power generated off of the Avalon. The contingency may occur in the future and therefore must be prepared for. http://www.nerc.com/files/concepts_v1.0.2.pdf

receives these notifications. The requirements are monitored throughout the day and if there are any changes due to load forecast changes, System Operations will send a revised standby requirement.

2.4. Integrated Annual Work Plan (IAWP)

The Operations and Engineering divisions within Hydro prepare an annual work plan (AWP) to schedule and plan maintenance activities critical to providing customers with safe, reliable electricity. These activities include capital projects, preventative maintenance, corrective maintenance, non-maintenance, and operating project work. Once finalized, these plans form the baseline for each division’s work plan for the year.

Traditionally, each division prepared their plan in the first quarter of the year and then executed that plan throughout the year, mostly in isolation from other regions. When outages were required for work in that region, the regions would deal directly with System Operations, who would then coordinate any conflicting work being scheduled across the regions.

Since 2014, Hydro has taken a more holistic approach to the work planning function and now creates an integrated annual work plan (IAWP) that includes all capital and maintenance work plans for all regions. The IAWP allows planners to get a full view of the annual resource requirements, including peaks and valleys. The planners can then reschedule work so that the peaks are reduced and valleys levelled, leaving the organization with a more realistic and balanced work plan for the year. Any peaks that exist after this process are reviewed again and external contractors are then engaged for critical pieces of work. This integration of work plans has improved the coordination of equipment outages and improved communications between Operations and Engineering Services.

Many of the maintenance items included in the IAWP are outage dependent and System Operations have the final decision for planned outages. System Operations are engaged early in the planning process and review with a holistic view of all required outages which allows them to proactively detect any conflicts in the IAWP that would not be acceptable for system continuity. System Operations will then adjust the outage schedule and eliminate conflicts to maintain the integrity of the system. The IAWP is subsequently adjusted, thus improving accuracy of scheduled equipment outages.

These integrated work planning processes have improved intra-company communications and accuracy of the IAWP. The integrated annual work plan has become a core process for work, outage and resource planning and has a direct impact on customer reliability.

2.4.1 Winter Readiness Plan

The winter period is a critical time period for Hydro. Newfoundland and Labrador winters exhibit significant variability in temperature and other weather conditions. Winter will bring below freezing temperatures, snowfall, freezing rain, high winds and other extreme weather conditions, such as blizzards. Hydro recognizes that power system reliability over these months requires assets to be in peak condition so that they can perform optimally in these extreme conditions.

The Winter Readiness Plan is a subset of the IAWP and was created to ensure system reliability during the winter months. It includes those preventative maintenance, corrective maintenance, and capital project work items that are considered necessary to ensure that Hydro has the generation, transmission, and distribution equipment ready for the upcoming winter season. The deadline for completing these items is December 1 of each year and Hydro reports its progress of winter readiness items to the Board on September 30, October 30, and November 30 for the upcoming winter season.

The creation of the Winter Readiness Plan helps Hydro set priorities and create work plans that focus on being ready for the upcoming winter season. If it is anticipated that winter readiness items will not be completed by November 30, Hydro completes a risk assessment of each item and a recovery plan to complete the necessary work, or develops risk mitigation strategies, as required.

2.4.2 Maintenance Tracking Report

Hydro regularly measures and tracks its progress towards the completion of its IAWP, down to the level of individual work plan items. Traditionally, regions tracked the progress of their individual work plans using traditional project management software. In March 2016, following the completion of the baseline IAWP, a maintenance tracking system was implemented using Hydro's enterprise project portfolio management software. The tracking system includes the annual work plans for each division that collectively create the IAWP.

The planners within each division track progress towards completion of their work plan and progress is then reported bi-weekly in the maintenance tracking report. The report shows progress within each division and then for Hydro as a whole. As maintenance progresses and plans need to be adjusted, the planners within each division adjust their original plans. These adjustments may include the removal of non-critical activities, the addition of activities, or rescheduling of activities. The Maintenance Tracking Report tracks these adjustments.

This report is delivered to Hydro Management bi-weekly and improves management's visibility to IAWP progress. If issues have been encountered, management are made aware promptly, thus giving them time to enact mitigation strategies and host risk-based discussions for any items not completed or that are impacted by changes.

Hydro has also developed an outage tracker with a look ahead on equipment outage readiness. This provides visibility on factors that can affect upcoming maintenance or capital work, such as permitting or resource availability. Any areas that may prove a risk to readiness are flagged and addressed in advance of outages to ensure the plan can proceed (see section 2.5).

2.5 Equipment Outage Management Tracker

In February 2016, Hydro implemented an Equipment Outage Management Tracker, displayed in Appendix F, to minimize impact on customers, improve the efficiency of work planning, manage the duration of planned outages, and improve overall system reliability. The outage management tracker was reviewed twice weekly at the daily system status meeting leading up to and during maintenance and construction season and was reviewed more frequently by the regions completing the work. It is a risk management tool that is linked to the IAWP and captures all upcoming planned outages for generation, transmission and stations. The outage tracker has become an essential tool for Operations in ensuring that planned outage durations are minimized and do not introduce an unacceptable level of risk to customers on the Island Interconnected System.

Each planned outage can require a number of mandatory permits, involve a number of internal and external stakeholders, and consist of various levels of complexity. The outage tracker formally documents requirements that are critical to the outage and ensures their preparedness before any outage will proceed, thus ensuring outage time is minimized to just the essential tasks. The tracker ensures work is ready to proceed.

The Planned Outage Database gives the Energy Control Center a single-view of all upcoming planned outages. This single-view allows the operators to review all of the planned outages for that day and make a reliability assessment. If too much risk is introduced to the power system by the planned outages due to system conditions (i.e. other equipment out of service, weather, etc.) then an outage will not proceed and modifications to the planned outage schedule will be required to reduce the level of risk. The outage tracker provides a status update for each planned outage and all items must be checked in the outage tracker before being approved in the Planned Outage Database. This updated status in the Outage Management Tracker is used in conjunction with the Planned Outage Database to give the ECC and Operations a clear picture of the upcoming planned outage requests, and a better line of sight for managing system risks.

2.6 Reintroduction of Hot Line Work

Hot line work, also referred to as live-line work, refers to the maintenance and upgrade of electrical equipment, often at high voltage, while the equipment is still energized. Hot line work techniques can be used in a variety of maintenance activities, including changing and testing of insulators, replacing damaged sections of conductors, replacing transmission poles, and other maintenance activities.

Performing maintenance on energized electrical equipment can be dangerous as one mistake can result in fatalities. As a result, hot line work requires line crews to be trained in live-line work techniques and use specialized equipment and procedures that prevent potentially hazardous voltage differences across the worker's body. Hydro stopped utilizing live-line techniques after two incidents resulting in fatalities occurred during the maintenance of energized equipment. At the time, there were concerns of further incidents so system outages became the preferred method for performing maintenance activities.

Safety standards and specialized training exist that together allow live-line work to be completed safely. There are many advantages to utilizing hot line work techniques. It allows a utility to complete maintenance activities with fewer planned outages, thus maintaining continuity of service for customers, and provides greater flexibility for maintenance activities, allowing for efficiency of operations. Overall, hot line maintenance techniques improve system reliability and stability for customers.

Recognizing the advantages that hot line techniques deliver, Hydro has begun to reintroduce this maintenance approach and now utilizes contractors trained in hot line work techniques to perform live-line maintenance activities. In 2016, Hydro utilized hot line work to repair a damaged splice on one of its Avalon Peninsula 230 kV transmission lines and to also replace insulators on the Bottom Waters system. Both the 230 kV transmission line and Bottom Waters work were critical to providing reliable power and Hydro was able to complete necessary maintenance to ensure the integrity of the system, while avoiding any disruption of power to customers.

Hydro is currently finalizing recommendations to further introduce and utilize hot line techniques to both transmission and distribution work activities over the coming years.

3.0 Improving Reliability Engineering and Analysis Skills and Capabilities

Liberty recommended that "Hydro should enhance the skills and capabilities it brings to reliability engineering and analysis."[9] Hydro is committed to the development of its personnel and will continue to look for opportunities to improve staff's training and knowledge in the fields of reliability engineering and analysis.

As detailed throughout this report, Hydro has enhanced its reliability foundation over the past number of years and increased medium to long term capital investment planning. As outlined in Section 2.3.4 of this report, Hydro has introduced capacity assessment criteria for the Avalon Peninsula that are used to make decisions from both an operational and communications perspective.

The sections below outline other actions that have provided improvements in these areas.

3.1 Energy Control Center Operator Training

Hydro recognizes the importance that ECC operator training has in regards to improving its skills and capabilities of ECC operators for system reliability.

Hydro has an Operating Training Simulator (OTS) training facility for the Energy Control Center operators. Previously, the training space was a shared space with the Corporate Emergency

[9] The Liberty Consulting Group, "*Review of the Newfoundland and Labrador Hydro March 4, 2015 Voltage Collapse,*" October 22, 2015, at page 10.

Operations Center (CEOC) and consisted of one trainee console and a console for the trainer. In 2016, Hydro created a dedicated OTS Training Facility for operators. This facility includes training consoles for operators, a separate console for the trainer, and has its own training digital video wall display. It can simultaneously train up to 3 operators.

The Operator Training Simulator is used to train the system operators in both normal and emergency operation of the power system. Scenarios are developed which simulate various generation and load configurations. The OTS simulates real-time operation, allowing system operators to see the impact of contingencies, learn how to respond to events, and complete restorations.

OTS training is scheduled three times each year. Many different scenarios have been developed to simulate contingencies on the Interconnected Island System, including scenarios on the Avalon Peninsula. These scenarios have components of monitoring power system elements such as acceptable voltage levels, transmission line loadings, and frequency. As the system operators go through the simulation of restoration, they learn how load restoration impacts system voltages. The system operators must maintain these voltages within acceptable levels. As well, there are system operating instructions that are relevant to these scenarios that are used as part of the training. These instructions are procedures for restoration and maintaining acceptable operating criteria. In essence, the OTS training also keeps the system operators up to date on these operating instructions.

System operators have also been given training in alarm monitoring and management. This was completed as part of an OTS training session and was developed to ensure the system operators identify critical terminal station alarms and understand the appropriate response to the alarm. Essentially, before restoration can commence, if there are alarms at the station, a discussion with the asset owner needs to take place. The alarms would need to be cleared or permission given to the Energy Control Center to proceed depending on the nature of the alarm.

System Operations uses the OTS to continually improve the knowledge of operators. The simulator can be programmed with different contingencies based on real world learnings. For example, an OTS session was also developed that simulates the events of March 4, 2015. All of Hydro's Energy Control Center operators participated in this simulator training session, where they experienced declining voltages on the Avalon power system and acted accordingly to stabilize and restore the system.

The new training facility will be critical to System Operations as the Maritime Link (ML) and Labrador Island Link (LIL) are commissioned and operators are trained to manage these new assets and interconnectivity with the North American power grid.

3.2 Corporate Reorganization of System Operations

Hydro has completed organizational changes that demonstrate the importance of a structured and focused system operation's function. Some of the changes are being made to support the creation of the Newfoundland Labrador System Operator (NLSO) and other changes are part of continuous improvement initiatives. Section 7.1 provides an overview of the changes being made in advance of the creation of the NLSO. This section outlines current organizational changes that have added to the department's capabilities, and the removal of peripheral tasks has increased staff's focus on their primary responsibilities, ultimately leading to improved system reliability.

The Transmission Planning Department has been integrated with the System Operations Department. Collocated in the same office space, the transmission planning and system operation's staff are now able to work closer together. This change has helped to improve communications and cohesion between operations and transmission planning.

To improve focus on primary functions, the tasks of industrial customer billing and invoicing and meter validation have moved to Customer Service. Water management has been moved from System Operations to Production (December 2016) and fuel/power purchase forecasting and budgeting is currently being transitioned to Production. The requirement for System Operations to report on asset failures has now been transitioned to Regulatory Affairs. Asset owners now send their outage reports to Regulatory Affairs, who subsequently send to the Board. System Operations are no longer tasked with submitting outage reports on behalf of the organization.

Traditionally, the industrial customer relationships were managed inside System Operations. In 2016, Hydro created a Manager, Key Accounts position within Customer Service that is now accountable for the overall relationship between Hydro and its key industrial and general service customers across the Province. This Manager is the single point of contact for all services and communications provided by Hydro to its industrial customers and leads the resolution of electricity-related issues impacting key customers. This allows the Energy Control Centre Operators and System Operations to focus on the power system. For the customer, the Manager, Key Accounts has a much deeper understanding of the customers' business operations and can advocate on their behalf when planned outages and other pertinent matters are being discussed. The Manager, Key Accounts is the single point of contact for their interactions with Hydro and keeps industrial customers informed of planned outages, meets with them on a regular basis to understand their short-term and long-term needs, and navigates the internal Hydro organization for resolution to their questions, issues, and concerns. Understanding a customer's long-term plans allows Hydro to be more proactive and adjust its capital plans, if it is foreseen that improvements and/or enhancements will be necessary to meet customer requirements.

Hydro has also improved it after hours support for customers. Previously, the Energy Control Center was tasked with answering customer inquiries during planned and unplanned outages.

This was distracting and prevented the Energy Control Centre from focusing on issue resolution and power system management. A third party vendor was engaged to provide first-line response to customer inquiries for both planned and unplanned power interruptions that occur after business hours. The vendor was trained in Hydro's processes for dealing with power interruption inquiries and can engage on-call staff as required to follow-up with customers on resolution of issues after business hours. This change in process has been well received by both customers and staff.

All of these changes allow System Operations to focus their efforts on the primary goal of maintaining a stable and reliable Island Interconnected System. This focused structure also allows the System Operations staff to plan for the integration of new assets that will be introduced as part of the Muskrat Falls Project and plan for the creation of the NLSO.

3.3 Supply Planning and Risk Assessment

In 2016, in an effort to improve its transparency, Hydro conducted a comprehensive energy supply risk assessment of its ability to meet Island Interconnected System energy and demand requirements until the expected interconnection with the North American grid.

The Energy Supply Risk Assessment is an in-depth review of all of Hydro's assets and includes load forecast analysis methodology for assessing Hydro's ability to meet the demands of the Island Interconnected System and the Avalon Peninsula major load center. This assessment represents a significant milestone in Hydro's evolution towards improving its system planning techniques and reliability engineering.

The purpose of the Energy Supply Risk Assessment is to:

- Analyse the reliability of Hydro's existing generation assets, including: a) the thermal generation assets at the Holyrood Thermal Generating Station, b) the gas turbines at Hardwoods and Stephenville, and c) Hydro's hydraulic generating facilities;

- Determine Hydro's ability to meet its demand requirements given the projected reliability of these assets;
- Determine expected reliability for these assets through to the interconnection period;
- Analyse and determine Hydro's ability to meet its energy requirements for a range of unit reliabilities in consideration of the historical dry sequence;
- Consider alternative load growth scenarios and Hydro's ability to meet the associated change in forecast demand; and
- Provide alternatives and options to mitigate exposure, if required.

Hydro filed its energy supply risk assessment with the Board on May 27, 2016,[10] and submitted an updated copy of the report on November 30, 2016.[11]

This review provided Hydro staff with focus on the critical asset components that must be addressed within the IWAP. Hydro's asset reliability is a critical component in determining its ability to meet its generation and transmission planning and load forecasting criteria.

Based on the findings of the November 2016 energy risk assessment, Hydro is confident in its ability to meet Island Interconnected System requirements from an energy and capacity perspective. Hydro also concluded that until interconnection to the North American grid is achieved, for the sensitivity cases only, there is some risk of minimal unserved energy in excess of planning criteria for the current winter of 2016-17. [12]

[10] Newfoundland and Labrador Hydro, "*Energy Supply Risk Assessment –May 2016.*" Available at: http://pub.nl.ca/applications/IslandInterconnectedSystem/phasetwo/files/reports/From%20NLH%20-%202015-2019%20Energy%20Supply%20Risk%20Assessment%20-%202016-05-27.PDF

[11] Newfoundland and Labrador Hydro, "*Energy Supply Risk Assessment –November 2016.*" Available at: http://pub.nl.ca/applications/IslandInterconnectedSystem/phasetwo/files/reports/From%20NLH%20-%20Energy%20Supply%20Risk%20Assessment%20Report%20-%20UPDATED%20November%202016%20-%20Revision%201%20-%202017-01-26.PDF

[12] In one case, the load that is forecast to decline actually stays stable, and in the other case, the industrial load is assumed to increase compared to forecast.

The following sections outline the methodology and planning criteria used to make this determination and the strategies that Hydro is using to mitigate this risk. An updated Energy Supply Risk Assessment will be submitted to the Board in May 2017 that includes updated system demand forecast, updates to new asset deliverables, and other changes based on Hydro's assessment of current system realities. Hydro will also review Liberty's assessment of the November 30, 2016, Energy Supply Risk Assessment and make updates or additions where appropriate.

3.3.1 Demand Forecast Analysis

Hydro bases its generation supply planning decisions for the Island Interconnected System on a P90[13] peak demand forecast.[14] The P90 peak demand forecast reflects the associated increase in demand over the normalized (P50) peak demand forecast resulting from instances of severe wind and temperature. The development of the P90 peak demand forecast is an extension of Hydro's regularly prepared system operating load forecast and allows Hydro to assess its ability to reliably supply customers in instances of extreme weather conditions.

Hydro prepares its initial demand forecast in the spring of each year subsequent to receiving Newfoundland Power's load forecast update and the available industrial customer demand forecast updates. Hydro will subsequently revise its demand forecast in the fall, taking account of industrial customer's power requirement plans which are set in the fall for the following year and allowing for any revisions to Newfoundland Power's demand requirements. These demand forecasts are then used in the creation of the yearly Energy Supply Risk Assessment.

[13] A P90 forecast is one in which the actual peak demand is expected to be below the forecast number 90% of the time and above 10% of the time.

[14] In accordance with direction in the Board's letter to Hydro regarding Investigation and Hearing into Supply Issues and Power Outages on the Island Interconnected System - "Directions further to the Board's Phase One Report", received October 13, 2016.

As part of the 2016 Energy Supply Risk Assessment, Hydro updated its peak demand forecasts to reflect the latest available customer and system information available. The revised forecast was then used to review reliability of generation assets.

Hydro studied its demand forecasts with two planning criteria including:

a) An Expected Case,[15] and

b) A Fully Stressed Case for three different demand forecast projections,[16] including:

   1) Sensitivity Load Projection I (the stable utility demand case), [17]

   2) Sensitivity Load Projection II (the high industrial coincidence), [18] and

   3) Sensitivity Load Projection III (the high utility coincidence). [19]

Based on the projected asset reliability and demand forecasts listed in the November 2016 Energy Supply Risk Assessment, neither the Expected Case nor the Fully Stressed Reference Case result in Expected Unserved Energy (EUE)[20] in excess of planning criteria beyond the current winter of 2016-17 for either of the three sensitivity load projections. Both Sensitivity Load Projection II (the high industrial coincidence) and Sensitivity Load Projection III (the high utility coincidence) estimated a demand forecast result in EUE in excess of planning criteria for the winter 2016-17, only. This EUE in excess of planning criteria is observed for these cases despite having a relatively low increase in demand forecast for winter 2016-17 over the base case forecast, 9 MW and 12 MW, respectively.

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[15] The Expected Case reflects Hydro's anticipated system capability and the P90 demand forecast with scheduled in-service of the Labrador Island Link and Maritime Link.

[16] The Fully Stressed Reference Case is a conservative analysis reflecting Hydro's anticipated capacity in consideration of the P90 peak demand forecast should no interconnection to the North American grid be established through winter 2019-20.

[17] Sensitivity Load Projection I - Stable utility demand: Assumes that in spite of the current forecast, which is for reduced energy requirements relative to 2015, demand requirements remain stable (i.e. lower load factor).

[18] Sensitivity Load Projection II - High industrial coincidence: Includes increased industrial load requirement over Hydro's base case expectation assuming less diversity in industrial customer demand requirements at island Interconnected system peak.

[19] Sensitivity Load Projection III - High utility coincidence: Includes increased utility load requirement over Hydro's base case expectation assuming less diversity in utility customer demand requirements at Island Interconnected system peak.

[20] Expected Unserved Energy (EUE) is the summation of the expected number of MWh of load that will not be served in a given year as a result of demand exceeding available capacity.

To mitigate this risk, Hydro has undertaken initiatives to secure additional curtailable Avalon Peninsula load to reduce the identified transmission exposure (see Section 3.3.3) and has accelerated the in-service of the third 230 kV transmission line from Bay d'Espoir to the Avalon Peninsula (TL267). The in-service of TL267 for winter 2017-18 more than mitigates any additional exposure for EUE in excess of planning criteria (see Section 3.3.2).

3.3.2 Accelerated Construction of Transmission Line TL267

On April 30, 2014, Hydro filed an application for approval to construct a 230 kV transmission line between Bay d 'Espoir Hydroelectric Generation Station and Western Avalon Terminal Station at Chapel Arm, including upgrades at both stations to accommodate the new infrastructure.

The transmission line project, now known as TL267, will increase Hydro's capability to deliver power to the major load centre on the Avalon Peninsula and will ensure the continued stability and reliability of the Island Interconnected System, particularly during faulting events. TL267 will help Hydro meet the long-term power requirements of the Island Interconnected System by providing additional capacity, enhancing resiliency to system faults, and relieving congestion on the existing transmission system.

Accelerating the in-service date of TL267 to October 31, 2017, will increase Hydro's capability to deliver power to the major load centre on the Avalon Peninsula and transmission constraints on the Avalon Peninsula will be eliminated to the extent that the loss of two Holyrood units will not result in transmission system violations.

As requested by the Board on July 19, 2016, Hydro has been filing monthly reports since September 15, 2016, that provides a status of this project. As stated in the March 12, 2017, report, the construction of TL267 is on schedule and Hydro is working aggressively to deliver this project on schedule for the 2017-2018 winter season.

3.3.3 Capacity Assistance Agreements

Capacity assistance agreements with industrial customers are used by many utilities as a way to reduce peak load by having large customers interrupt their operations. Hydro's capacity assistance arrangements are considered an appropriate utility practice and have been negotiated as an instrument of insurance for system reliability. The capacity assistance agreements allow for the purchase or curtailment of power from industrial customers.[21] For multiple reasons, demand can exceed Hydro's capability to generate and/or distribute the required power to meet the need. Usually there is a hierarchy of customers, in which some may be required to partially or totally reduce their power consumption. Industrial users, for example, are usually curtailed before service to residential users is reduced.

Hydro presently has capacity assistance agreements in place with the following industrial customers:

- 60 MW of capacity assistance from Corner Brook Pulp and Paper Limited (CBPP), as per Board Order P.U. 49(2014). CBPP interrupts its production activities to provide this capacity assistance to Hydro.
- 30 MW of capacity assistance from CBPP through a further interruption of mill operations, via the Supplemental Capacity Assistance Agreement.
- 7.6 MW of capacity assistance from Vale Newfoundland & Labrador Limited (Vale) to be provided to the Island Interconnected System from Vale's standby diesel generating facilities.[22]
- In December 2016, a 5 MW interruptible agreement was reached with Praxair Canada Inc. (Praxair), as per Board Order P.U. 55(2016).
- In January 2017, as per Board Order P.U. 3(2017), a 6 MW interruptible agreement was reached with Vale.

[21] Curtailment is the reduction of power delivery to a customer due to a shortage of supply.
[22] The agreement allows for up to 15.8MW of capacity assistance, with a test of Vale's diesel generating facilities each year. The test completed in 2016 confirms 7.6MW of capacity assistance for winter 2016-2017.

Hydro can also request Newfoundland Power to utilize its Curtailable Service Option to reduce its load requirements. The amount of curtailable load that is forecasted to be available for winter 2016-2017 by Newfoundland Power is 11 MW.

These capacity assistance agreements help to maintain generation reserves on both the Island Interconnected System and Avalon Peninsula systems and, in the case of significant system events, help to lessen the impact on residential customers. These agreements proved to be prudent actions, as capacity assistance requests were issued during the winter of 2014-2015, winter of 2015-2016, and winter of 2016-2017. These agreements have provided Hydro with operational flexibility during times of higher demand and/or unforeseen system events and were a core element in the company's pursuit of increased reliability and system continuity.

3.4 Equipment Failure Review Enhancements

Hydro has improved its new model for investigating equipment failures. Traditionally, individuals from the immediate operational area worked to primarily fix the issue and subsequently look for the root cause of the equipment failures.

In the new model, a broader focus to find the root cause of equipment failure is mandatory and frequently involves internal experts from across the organization, addressing issues with increased urgency. Lessons learned from previous equipment failures are also captured and incorporated into the current investigation so that insights learned during previous equipment investigations can be applied to the current review.

The investigation of the unit trip issue at Paradise River is one such example of the improved and more inclusive equipment review model. Paradise River is a hydroelectric generating plant that generates 8 MW of electrical power. The plant had been experiencing an increasing number of unit trips through 2016 in comparison to previous years. From January to mid-November 2016, the plant experienced almost 30 unit trips, compared to 4 in 2014 and 11 in

2015. No cause could be determined for a high proportion of the trips in 2016, despite a thorough review and inspection by staff at the plant.

Hydro expanded the review team, incorporating expertise from across the organization, to complete a more extensive review to determine the cause of the repeated trips.[23] The cross-departmental team developed a set of actions to structure the investigation. Following the cross-departmental investigation plan led Hydro to work with Newfoundland Power to replace a recloser[24] in their Monkstown substation. Since the installation, there have been no trips of the plant with an undetermined cause. This is a significant improvement over the frequency experienced prior to replacement.

This model is now being rolled out across the organization with the mandate of more consistent investigation and reporting, ultimately improving equipment reliability.

3.5 Membership in the Center for Energy Advancement through Technological Innovation

Hydro joined the Centre for Energy Advancement through Technological Innovation’s (CEATI’s) Power System Planning & Operations program to gain access to additional technical expertise and support Hydro’s broad-based focus on system reliability.

The CEATI Program Model provides electrical utilities with a cost-effective vehicle for sharing experiences and addressing issues pertinent to their day-to-day operations, maintenance, and planning. The Power System Planning & Operations program’s areas of focus include: a) planning and operations practices, including high-voltage direct current planning solutions, b)

[23] It has been hypothesized that the distribution line into which the plant is connected may be experiencing some system disturbances. Paradise River plant is connected to the Island Interconnected System via a distribution line, as opposed to a dedicated transmission line.

[24] A recloser is a protection device for electrical distribution networks. It combines a circuit breaker that trips if an overcurrent is detected with an electronically-controlled reclosing function that automatically restores power to the affected line if the fault clears itself quickly.

methods for increasing capacity and security, and c) modern simulation and modelling tools and techniques. The strategic direction of Power System Planning & Operations program is "…to enable the use of new technologies, including FACTS[25], to enhance the use of existing and new transmission facilities while continuing to maintain a high level of reliability. This includes exploring and developing tools and techniques for planning and operating transmission systems in a reliable, secure and cost-effective manner."[26]

4.0 Improving Situational Awareness

Liberty recommends that "Hydro should take steps to assurance situational awareness among operators and others who need the information to respond promptly and ably to adverse system conditions."[27] Situational analysis refers to the methods that staff utilize to analyze Hydro's environment with the goal of better understanding the organization's capabilities, constraints, customers, and other operational influences.

Hydro now places a greater focus on the end-consumer of power, rather than its end-point of power delivery. This change in operational philosophy has led to multiple enhancements, one being its improved situational awareness. Key personnel within Hydro are better informed of system's vulnerabilities and are better prepared to react to system events.

4.1 Internal and External Communications

Improving situational awareness starts with improved communications. Hydro has taken many actions to improve both its internal and external communications. The Daily System Status Meeting hosted by System Operations described in section 2.3.1 provides participants with daily updates on Hydro's supply capability and reserves and other conditions that could impact

[25] Flexible Alternating Current Transmission System (FACTS) are electronic devices that allow for quick adjustments to control the electrical system. The benefits they offer include improved stability of the grid, control of the flow of active and reactive power on the grid, loss minimization, and increased grid efficiency.
[26] https://www.ceati.com/collaborative-programs/transmission-distribution/pspo-power-system-planning-operations
[27] The Liberty Consulting Group, "*Review of the Newfoundland and Labrador Hydro March 4, 2015 Voltage Collapse,*" October 22, 2015, at page 10.

the reliability of the Island Interconnected System and Avalon Peninsula. Hydro Executive and Management representatives from the various functional areas, including Production, Transmission, Distribution, System Operations, Communications, and Regulatory Affairs all participate, which has improved internal communications and system status understanding within Hydro.

If Environment Canada has posted special weather statements related to wind, rain, freezing rain, and/or snow, that have the potential to negatively impact the Island Interconnected System or the Avalon Peninsula, then Hydro will host a Storm Preparation Meeting, as described in section 2.3.2. These meetings provide a structured review of the current state of the system, the preparedness of each operational area, and ultimately improve situational awareness and system reliability by ensuring that each operational area is ready to respond quickly and effectively to any severe weather impacts.

Maintenance of Hydro's systems and equipment often require planned power outages to complete. Hydro uses the Planned Outage Database and the Equipment Outage Management Tracker, described in section 2.5, to provide staff with a complete picture of existing and upcoming planned outages. The Planned Outage Database gives the ECC a single-view of all upcoming planned outages. It allows operators to see the impacts of concurrent outages and if too much risk to the system is introduced by multiple planned outages, the planned outages will be modified to reduce the level of risk to the Island Interconnected System.

The Equipment Outage Management Tracker provides a current status update for each planned outage listed in the Planned Outage Database. The outage management tracker is linked to the IAWP and captures all upcoming planed outages for generation, transmission and stations. The status in the outage management tracker is used in conjunction with the outage database to give operations a clear picture of the status of upcoming planned outage requests.

Hydro has also improved its communications with external stakeholders, including Newfoundland Power, its industrial customers, end consumers (residential), and the Board. Hydro's General Manager of System Operations will contact their Newfoundland Power counterpart to review any noteworthy items that came out of the meeting. The General Manager will also follow-up with a weekly report to Newfoundland Power. The Hydro ECC Supervisor will also follow-up with their counterpart at Newfoundland Power to discuss noteworthy items with a more detailed technical scope. This is done on a regular basis to discuss any upcoming planned outages to ensure common understanding.

The Advance Notification Protocol (see section 6.0) was developed to proactively communicate important information to customers, with clear direction on actions required, based on forecasted supply shortages and Hydro's ability to supply customers on the Island Interconnected System. Recognizing the importance and intricacies of power delivery to the Avalon Peninsula, the operating instructions and Advance Notification Protocol were updated after March 2015 to include additional protocols specific to the Avalon Peninsula.

Finally, since January 10, 2014 Hydro has prepared a daily supply and demand report for the Board, based on their reporting guidelines. The report gives the Board visibility to the current state of the Island Interconnected System. It includes the amount of electricity being generated to meet the needs of customers, the amount electricity needed by residential and business customers, the current state of generation facilities and the current and forecasted weather conditions. Hydro also produces and provides several other regular reports for the Board, including Power Outage and Incident Reports, 12 Month Rolling Generation quarterly reports, monthly Energy Supply Reports, and a semi-annual Nostradamus Report. These reports serve to provide regular updates on system status and maintain open communication and accountability of the system. Hydro's Manager, Regulatory Engineering also provides regular updates to the Board whenever there is an active or pending system issue, which could include weather events, unplanned outages, or other event impacting the integrity of the system.

All of these communication improvements make Hydro and its stakeholders more observant of the risks and current constraints facing the Island Interconnected System and Avalon Peninsula.

4.2 Improved Strategic Focus of System Operations

Changes to Hydro's organizational structure have improved Executive focus on Hydro's core mandate to provide customer with safe, least cost, reliable power and the principal functions of generation and transmission. As described in section 3.2, Transmission and Planning was merged into the System Operations organization which has helped to improve the interface between operations and planning. This change facilitates and stronger working relationship, leading to improved cooperation and outcomes.

Strategic organizational changes have also been made within System Operations. The tasks of billing, invoicing, and meter validation have moved to Customer Service. Water management has been moved from System Operations to Production and fuel/power purchase forecasting and budgeting is currently being transitioned to Production. The requirement for System Operations to report asset failures has been transitioned to Regulatory Affairs.

All of these changes allow System Operations and Transmission Planning to focus their efforts on the primary goal of maintaining a stable and reliable Island Interconnected System. This focused structure also allows the System Operations staff to plan for the creation of the NLSO (see section 7.2) and the integration of new assets that will be introduced as part of the Muskrat Falls Project.

4.2.1 Early Engagement of System Operations in IAWP

As described in section 2.4, the IAWP includes all capital and maintenance work plans for all regions for the given year. One noted improvement in the creation of the 2016 IAWP was the involvement of system operations staff in the development process. Engaging System

Operations in the planning phase allowed for proactive system balancing of generation and transmission outages.

With a view to all required outages, System Operations proactively detects conflicts and eliminates them during planning, rather than taking reactionary measures later in the maintenance season to ensure system continuity. Engaging System Operations early in the IAWP process has improved the accuracy of scheduled equipment outages.

4.2.2 Improvements to the Energy Control Center

Hydro has made extensive improvements in its Energy Control Center that provide operators with improved visibility and an enhanced holistic view of the Provincial power grid. The physical space has been reconfigured to improve operator focus on the grid and the enhanced situational awareness tools added to the ECC allow operators to proactively monitor the power grid and identify and respond to system events quickly. These improvements include:

1. **Installation of Digital Video Wall**

   Commissioned in November 2016, the new digital video wall provides flexibility and an improved holistic view of the provincial power grid than its static wall predecessor. The video wall consists of two components: a) the One Line Display and b) the Geographic Display.

   - The **One Line Display** shows the single line version of the provincial grid. It includes all power sources, transmission lines and status of each line.
   - The **Geographic Display** is part of the digital display wall and includes a digital map of Newfoundland and Labrador, and the tip of Nova Scotia.

Figure 3: ECC Display (Pre Upgrades)

Figure 4: ECC One Line Display (Post Upgrade)

2. **Situational Awareness Tool**

The existing situational awareness tool has been integrated with the video wall to provide operators with:

- A single-view of alarms for transmission lines approaching limits;
- A single-view to transmission line outages; and,

- Graphical indicators of the megawatts and directional flow of power on each transmission line.

These changes provide the operators with better visibility and awareness of the power grid and highlight potential issues of which they should be aware. Previously, the transmission line views were spread over multiple screens and operators only had visibility to one screen at a time. Using the new video wall, the operators get a full system view of the transmission lines without having to navigate through multiple screens.

The video wall will highlight any transmission line reaching pre-defined threshold limits for the operator and will dynamically change the color of any transmission lines outages, either planned or unplanned. Newly added directional flow indicators will become critical once the Labrador Island Link (LIL) and Maritime Link (ML) are commissioned.

3. Lightning Graphic System

The lightning graphic system is now part of the geographic display. This system provides the operator with a visual representation of the power grid, including Labrador, overlaid with lightning weather systems. Previously, this system was available on the operator's desktop screen and was not visible to the operator at all times.

Integrating the lightning graphic system with the geographic display gives operators better visibility of potential lightning strikes and allows them manage the grid while maintaining visibility to such events.

Figure 5: ECC One Line and Geographic (highlighted in red) Displays

Figure 6: ECC Geographic Display

4. Contingency Analysis Tool

The contingency analysis (CA) tool was installed on the ECC Display Wall in February 2017 and is being developed with an expected completion date in April 2017. The CA tool defines contingency violations for regional areas (zones) based upon a predetermined set of transmission line and bus violations and provides a visual means of quickly identifying where a contingency violation could potentially occur. For example, this application indicates to the system operators the single worst-case contingency on the power system at the time the application runs. CA has a number of equipment outages defined and will run a load flow for each contingency. The application then ranks each contingency in the order of severity and the results are displayed to the system operators. The severity is rated both from a voltage and thermal overload perspective. CA runs on the EMS automatically and is updated every five minutes.

Hydro has identified nine regional areas within the CA tool, five of these areas have been defined with CA rules and four others will be expanded upon once new assets come on line. Three warning levels have been developed for these regional areas including: Normal (0% CA Violation), Yellow (<5% CA Violation) and Red (<10% CA Violation). The CA warnings will be displayed as a highlighted border around each area that has a violation. This will prompt operators to drill deeper into the system to determine cause and potential solution to the CA violation.

5. Spinning Reserves Display

The spinning reserves are charted for operators to visually see spinning reserves on a real-time basis. This running chart provides operators with a visual target for monitoring and feedback. This is further enhanced by an audible alarm should the spinning reserve drop below the pre-determined target.

6. Addition of Electronic Notes to Video Wall

The use of electronic notes now takes advantage of the video wall and notes can now be added to any part of the grid, giving operators constant visibility to them. These notes are not shift-dependent and allow operators to leave notes of current system interactions/events visible on the video wall. Previously, notes could be added to a screen and were only visible on that single view of the operator's screen. This reduced the visibility of the notes across the grid for operators when focused on other screen views. The enhanced functionality of electronic notes improves communication and knowledge transfer between operators during shift changes. The type of information contained in a note would include name and contact number of a lead person on site, estimated completion time, etc. This information would be especially useful during an operator shift change if work on site transitions between shifts.

7. Creation of a Breakout Room in ECC

A breakout/meeting room was added to the ECC that allows System Operations Staff to meet and discuss ongoing issues without disturbing the on-shift operators. This additional room will allow operators to maintain their focus on management of the power grid.

8. Relocation of the Corporate Emergency Operations Center

The Corporate Emergency Operations Center (CEOC) was moved out of the ECC to a new dedicated center. This change reduces the number of individuals that would be present in the ECC during an emergency and reduces the number of person interactions with the operators, which will allow them to focus on power grid management with minimal interruption.

Moving the CEOC out of the ECC has the added benefit of giving System Operations a dedicated training facility for operators (see Section 5.0).

4.3 Staffing in Advance of Issues

Since 2016, Hydro has adopted the policy of staffing its offices and generation and transmission facilities in advance of certain system conditions to provide additional support and oversight, and improve Hydro's response time to system events.

The daily systems status meetings references upcoming weather events and provides an opportunity for those managing and monitoring the system to take proactive measures should the circumstances warrant. Depending on the severity of weather events Hydro will:

- Staff terminal stations in advance of weather impacts,
- Mobilize transmission crews closer to impacted areas, or areas that may be impacted, and,
- Mobilize operators and technical support staff to the gas and combustion turbine facilities, based on the potential of running this equipment in the event of issues with transmission or generating equipment as a result of the weather event.

All of these actions reduce travel time and gives ECC operators on-site support to help troubleshoot issues, ultimately respond faster to incidents, and reduce outage durations.

As noted in Section 6.0, since the March 4, 2015, events, the Communication Department adds staff to provide coverage during peak periods, typically 6-8am and 5-8pm in the winter months, and during any public power alerts (Power Watch, Power Warning or Power Emergency) to ensure that communications personnel are on-site and have full and immediate access to system operations information and the tools necessary to communicate effectively with the public.

Each of these preventative measures is costly but Hydro deems them important to the supply of reliable power.

4.4 A Strategy for Customer Service Excellence

Recognizing a desire to improve customer service and the customer experience, Hydro developed a Customer Service Strategy, with the purpose of creating a strategic roadmap for delivering customer service at Hydro. The purpose of the Customer Service Strategy is to outline a strategic roadmap for customer service at Hydro from 2015 - 2017. The report, entitled "*Customer Service Strategic Roadmap 2015 – 2017,*" filed with the Board on September 30, 2014, describes a vision for improving service to Hydro's industrial, utility, and retail customers. The report also identifies the vision, supporting strategies, and guiding principles to meet Hydro's current business needs and support long-term customer service strategies.

Hydro continues the execution of its Customer Service Strategy and has seen a number of improvements to software, hardware, and process and procedures. Based on survey feedback from Hydro's customers, Hydro strategy is working and Hydro looks forward to continuing to improve the service it provides to its customers. In 2017, the strategic plan will be reviewed and refreshed to take Hydro into 2020. New strategies will continue to focus on enhancing the customer experience through continuous improvement and the implementation of new technology to support processes where needed.

4.4.1 Development of an Account Management Framework

An essential requirement identified in Hydro's Account Management Framework was the creation of a dedicated account manager within Hydro's Customer Service Department to support Hydro's industrial and identified commercial customers, as well as Hydro's utility customer Newfoundland Power.

In 2016, Hydro created a Manager, Key Accounts position. The Manager, Key Accounts act as the single point of contact for its key customers, and focuses on enhancing these individual customer relationships. This allows all interactions to be managed via a single channel and be filtered throughout the Hydro organization in an efficient manner. Once a customer request is received by the Manager, Key Accounts, it is their responsibility to advocate on behalf of the customer within Hydro and pursue a resolution.

4.4.2 Implement New Customer-Focused Mobile Application

Figure 7: MyHydro Application

In April 2016, Hydro launched a new mobile and web portal platform called *MyHydro*. *MyHydro* keeps things simple and provides customers with unlimited access to their account anytime, anywhere and on any device. Users can easily and conveniently:

- View account balance, payment history, and set up payment options online,
- Subscribe to text and email notifications for planned and unplanned power outages,
- View and report power outages online,
- Subscribe to payment reminders via text and email notifications,
- Sign up for paperless e-billing and equal payment plan,
- Track and manage electricity usage in easy-to-read charts, set budget goals, compare power usage year over year, or against the average usage of residents in their neighborhood, and
- Submit service requests.

4.4.3 Improve Customer Interaction Though Phone System

Hydro implemented a new Interactive Voice Response (IVR) telephone system to better support its customers. Hydro's new enhanced IVR outage system replaces an older, unsupported system. The new system removes risk as both software and hardware components are vendor supported. The new phone system provides enhanced functionality such as automated billing and outage information. It also links the phone system and our online customer outage notification application.

4.4.4 Structured After Hours Support

Hydro established a formal after hours support arrangement with a third party vendor, TeleLink. TeleLink provides power outage handling and reporting service for after business hours customer calls related to outages. TeleLink has been trained and provided with Hydro's process for dealing with outage calls and engages on-call staff when required to follow-up with our customers to resolve an individual and widespread unplanned outage.

Hydro has seen positive results from this service and has increased the visibility into Hydro's after-hours customer calls though reporting provided by TeleLink. Hydro's customers, as well as Hydro's Energy Control Center, have experienced the benefit of this new process as it removes responsibility from the operators in the Energy Control Center for managing outage calls and allows them to focus on supporting the power system. In addition, it allows Hydro to provide customer focused service 24 hours per day.

4.4.5 Implement Transactional Customer Surveys

Hydro has implemented a transactional survey process to receive timely feedback on the service that Hydro's call center staff provides to customers. Transactional surveys are conducted through an automated outbound call service where customers are asked five questions about their most recent experience with Hydro staff in relation to the reason of their call. The survey focuses on the quality of service received, staff's knowledge, and measuring first contact satisfaction.

5.0 Improving the Corporate Emergency Response Plan

Liberty has recommended that "Hydro should implement a more robust approach to the CERP."[28]

Hydro has taken ownership of its own Corporate Emergency Response Plan(CERP) and fully staffs its Corporate Emergency Operations Center Response Team with Hydro Executive and Management personnel. Hydro's Corporate Emergency Response Plan provides clear and concise guidelines for actions to be taken by Hydro's Management Team during emergency situations. Its purpose is to ensure an effective corporate response to all emergency situations and provide guidance on all necessary emergency support actions required to reduce the probability of emergency events escalating in severity.

As part of its corporate management review process, Hydro reviews CERP on an annual basis. Since March 2015, improvements and necessary changes have been identified and are being implemented in a phased approach. These changes improve Hydro's response to emergency situations and reflect the ongoing organizational changes taking place as Hydro prepares for integration into the North American grid, and include:

1. CERP has been updated to provide dedicated resources and focus for events related to Hydro operations. CERP now includes a dedicated Hydro Executive on Call (EOC) and Hydro Corporate Emergency Operations Center (CEOC) Response Team. These individuals have autonomy for making decisions related to events impacting Hydro and would have direct knowledge of Hydro Operations resulting in quicker focused responses for Hydro events.

[28] The Liberty Consulting Group, "*Review of the Newfoundland and Labrador Hydro March 4, 2015 Voltage Collapse,*" October 22, 2015, at page 10.

2. The on-call and delegation of authority process has been streamlined. The Executive on Call now assumes the roles of Incident Commander, determines the level of response required by CERP, and assumes responsibility for managing the emergency response. Prior to this amendment, there was a dedicated Incident Commander and Deputy Incident Commander and EOC would notify the Incident Commander (or Deputy Incident Commander). The new process allows for quicker decision-making and response times.

3. The Corporate Emergency Operations Center has been moved to its own dedicated location, outside of the Energy Control Center. Previously, the CEOC was a shared location within the ECC's training facility.

4. CERP has improved the clarity of the notification and mobilization protocol. Hydro's Advance Notification Protocol Levels have been incorporated into the CERP Alert and Emergency Criteria. The EOC will be alerted when the EEC has moved into a Power Warning and will mobilize (either fully or partially) when the ECC has moved into a Power Emergency.

   CERP has also added definitions for minor and major outages to its notification protocols. These definitions are used by the EOC as part of criteria for determining whether mobilization of CERP, either full or partial mobilization.

5. CERP has updated its process for notifying and mobilizing the CERP Team. The CERP team is now notified by a third party call center vendor. The pager-system has been replaced with a third party vendor that is contracted to make contact with members of CERP. Prior to this improvement, the CERP members were contacted via pager and there was no assurity that the individual received the page. CERP members are now notified via text and required to respond. If no response is received within five minutes,

then the third party vendor will follow-up by phone call, ensuring the CERP members receive notification of the emergency.

6.0 Improvements to External Communications Processes

Following the supply disruptions in January 2014, several robust protocols and processes were developed to ensure clear and timely external communications with customers and key stakeholders. Liberty recommended the development of a Joint Storm/Outage Communication Plan with Newfoundland Power as well as the development of Advance Notification Protocols that appropriately identify potential impact in terms of the loss of power to customers.

Newfoundland and Labrador Hydro, along with Newfoundland Power, have developed a joint storm/outage communication plan that clearly outlines the roles and responsibilities of each utility along with expected timelines for communications, as well as tactics, messaging and approval processes. In addition, the utilities developed three levels of alerts to advise customers of the status of the power supply in the province. [29] The goal of the Advance Notification Protocol is to provide early information to customers when there is potential for a supply shortage, to advise on specific actions required of customers and to better prepare customers for any potential impacts.

Communications tools (including videos and infographics) were developed, along with clear messaging for each alert level, to ensure that time is not wasted during the activation of an alert aligning on appropriate messaging. In addition, during a power alert, Hydro's website is activated with a screen pop-up with clear information for customers who visit the site. Figure 7 displays the infographic developed to explain the Advance Notification Protocol.

[29] https://www.nlhydro.com/winter/advance-notification-protocol/

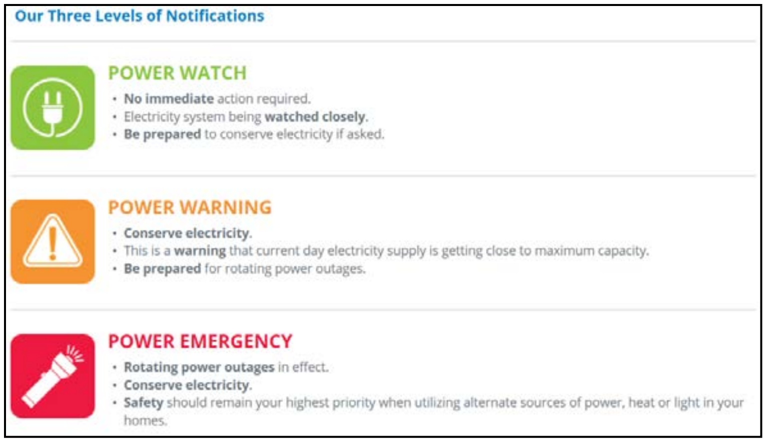


Figure 8: Advanced Notification Protocols – Levels of Notification

The original Advance Notification Protocol was developed after the supply issues experienced in January 2014 to communicate important information to customers, in advance, based on forecast generation shortages and Hydro's ability to supply customers on the Island Interconnected System.

Because the events in March 2015 were specific to the Avalon Peninsula, the Island Advance Notification Protocol was not triggered. In retrospect, power customers on Avalon Peninsula should have been notified in advance of the March 4 event. As referenced in section 2.3, Hydro is now focused on the end-consumer of power, rather than being focused on the end-point of its power delivery. This change in philosophy has led to several important enhancements. The Advance Notification Protocol and system operating procedures were expanded in April 2015 to ensure reserves are analyzed daily, from both an Island (IIS) and Avalon Peninsula perspective, to trigger any supply shortages (reference system operating instructions "Avalon Capability and Reserves (T-096)" in Section 2.3.4).

The Advance Notification Protocol public communication alerts (Power Watch, Power Warning and Power Emergency) are now able to be executed for either the Island or the Avalon Peninsula, allowing for advance communication and messaging to the appropriate customers.

As an improvement to its operational philosophy and improved communication protocols, Hydro communicates any equipment failure or system vulnerability significant in nature to its stakeholders. After the March 4 (2015) event, an additional communication process was developed to help better inform customers when major pieces of equipment are offline. The Equipment Advisory Process outlines the communications activities that will take place when major generation equipment[30] or major transmission equipment[31] is offline and unavailable to the system. Public equipment advisories are posted on Hydro's website – www.nlhydro.com/projects under the maintenance and repairs section.

Hydro has recognized the importance of educating customers and stakeholders on their provincial electricity system and is working hard to keep customers better informed about the inner workings of the provincial electricity grid. To that end, since 2014 the Hydro Communications Team has been working to develop relevant and easily understood information for customers to help them understand the overall system as well as outage and event-specific information. For example, videos, infographics and web content have been developed on the following topics;

- how to conserve energy
- power outage safety
- the Advance Notification Protocol
- how the system works
- restoring power after a distribution outage
- restoring power after a generation outage
- communications during outages
- under frequency load shedding
- how outages are planned
- power line safety

[30] Limited to generating units greater than 80MW and stand-by units
[31] 138 kV or 230 kV transmission lines

- cold load pickup

All of this customer education material can be found on Hydro's website –www.nlhydro.com and is regularly shared on Hydro's social media channels throughout the year and during specific events and/or outages.

Finally, an additional change made to communications processes after the March 4, 2015, event includes staffing of peak periods (typically 6-8am and 5-8pm in winter months) during any public power alerts (Power Watch, Power Warning or Power Emergency). This allows communications personnel to be on-site and have full and immediate access to system operations information and the tools necessary to communicate effectively with the public.

7.0 Future Improvements

In addition to the enhancements that have been detailed in this report, Hydro continues to seek improvements in support of its goal of delivering safe, reliable and least cost supply electricity to the consumer. The following items will help improve Hydro's operational reliability and will prepare Hydro for the integration of the Maritime Link, the Labrador Island Link, and the Muskrat Falls assets into the provincial electricity system.

7.1 Improving Equipment Reliability and Preventative Maintenance Programs Based on Lessons Learned

Changing the operational philosophy of Hydro involves creating a learning environment where continuous improvement is achieved by learning from the past projects and experiences. Hydro is taking an approach to learn from known operational issues and react conservatively, meaning to put plans in place to reduce risk as much as is practicable. This may involve additional operational maintenance, operational monitoring, or capital investment. For example:

1. Hydro has experienced penstock failures and generating unit seal issues at the Bay d'Espoir hydro generation facility. In review of these items, Hydro felt it important to look at the Preventative Maintenance (PM) program and ensure we are identifying these types of issues earlier. To identify issues, the PM program needs to be reviewed to ensure it is appropriate. Therefore, in 2016, Hydro contracted an external consultant to review its PM programs related to surge tanks, penstocks and generating station transformers. In an effort to continually improve its programs and long-term reliability, Hydro has asked the consultant to identify if there are gaps in the maintenance programs for these assets. Hydro will update its PM programs based on the findings of the consultant. Hydro will review the outcomes of the engagement with the outside consultant and ascertain if the external review approach provides the improvement sought for the asset management program.

2. As referenced in section 7.3, Hydro is also increasing its focus on its gas turbine units with the goal of improving their reliability. Hydro has engaged another external consultant to review all aspects of gas turbine operation and control and provide Hydro with recommendations which will further improve the reliability of these units going forward. This is being reported to the Board through a separate process.

3. Hydro also recognizes the importance of reliability at the Holyrood Thermal Generating Station until decommissioning and has refocused its maintenance efforts here. Condition assessments and inspections, along with operational experience, will dictate when Hydro requests to move ahead with investments to address reliability risks, such as the exciter controls replacement at Holyrood in the supplemental application filed with the Board February 28, 2017. This is a known reliability risk and Hydro's perspective is to remove as many such risks as is reasonable. The approach to address the risks is conservative as we are not waiting until the risk becomes so significant that it becomes an impact on the ability to serve customers.

Hydro recognizes the need to proactively improve its condition assessments, asset management programs, and ultimately, its system reliability, and will continue engage consultants for external review of its preventative maintenance programs for other corporate assets.

7.2 Creation of Newfoundland Labrador System Operator

The creation of the Newfoundland Labrador System Operator (NLSO) is an important step in the integration of the Muskrat Falls assets into the provincial electricity system, and the island's interconnection with the North American electricity market.

Industry recognized standards, such as those developed by the Federal Energy Regulatory Commission (FERC), require that electricity entities maintain a clear functional separation between the system operator and any other functions of that entity that are concerned with power production and/or marketing. [32] The purpose of this requirement is to ensure that there is no collaboration or exchange of information between affiliated business units which could impair non-discriminatory, open system access within the wider electricity market.

The NLSO will continue to exist within Hydro but will also be the system operator for the transmission and distribution system in Newfoundland and Labrador. The NLSO will represent all interests on the transmission and distribution network and will be governed by a set of rules and regulations that ensures fair and equitable treatment of all entities seeking access to the network.

The NLSO will be created by making structural and resourcing changes needed to enable the System Operations Division to function as the NLSO. Although the NLSO will reside inside

[32] The Federal Energy Regulatory Commission (FERC) is an independent agency, based in Washington, D.C., which regulates the inter-state transmission of electricity, natural gas, and oil. In the United States, and in neighboring Canadian jurisdictions, wholesale sales of electricity are typically governed by FERC's Open Access Transmission Tariff which sets out standards and other requirements governing market access and system reciprocity.

Hydro, it will act as the independent system operator[33] (ISO) for the province. It will operate the facilities owned by Hydro and Nalcor Power Supply along with interconnections with Emera's Maritime Link assets on the island.

Hydro is in the process of identifying the structural, process, and other changes required to be compliant with applicable open access obligations, including those pertaining to tariff transparency, system access, and reciprocity with jurisdictions where Nalcor takes transmission service. Section 3.2 outlines substantial organization changes that have already been made to improve the efficiency and focus of System Operations and to prepare for the creation of the NLSO. In addition to these changes, Hydro is in the process of making the following changes to support the creation of the NLSO:

1. From an operational readiness standpoint, Hydro is adding and training five System Operators to support the integration of the ML and the LIL with the IIS. This is required in order to address the new work scope assumed by the NLSO as the province's independent system operator to meet the requirements related to the standards of interchange scheduling and interconnection system reliability.Hydro's Energy Control Centre will continue to be staffed on a 24/7 basis. It will also transition to a complement of three Energy Control Center staff per shift, versus the current complement of two.

2. To meet the requirements related to the standards of interchange scheduling and interconnection system reliability, Hydro will hire:
    a) **Reliability Coordinator** – This individual has the highest level of authority and has responsibility for the grid. Reliability Coordinators have the authority, plans, and agreements in place to immediately direct reliability entities within their jurisdiction

[33] An independent system operator (ISO) is an organization that is formed at the recommendation of the Federal Energy Regulatory Commission (FERC). It coordinates, controls, and monitors the operation of the electrical power system.

to re-dispatch generation, reconfigure transmission, or reduce load to mitigate critical conditions to return the system to a reliable state.

b) **Transmission Operator** – This individual ensures the real time operating reliability of the transmission assets and manages the power system in real time and coordinates the supply of and demand for electricity in a manner that avoids fluctuations in frequency or interruptions of supply.

c) **Balancing Authority** – This individual maintains load-resource balance through the collection of generation, transmission, and load data within its metered boundaries.

7.3 Improved Standards for Measuring Gas Turbine Performance

Hydro currently uses industry standard metric Utilization Forced Outage Probability (UFOP) for measuring its gas turbines performance.[34]

While UFOP is an industry standard, as Hydro has been reviewing system reliability, Hydro determined this metric does not capture all of the necessary aspects of gas turbine asset reliability. In the "*Gas Turbine Failure Analysis Final Report*"[35] submitted to the Board on January 11, 2017, Hydro recognized and stated that an additional metric that measures the availability of its gas turbine assets is required. Material steps have been taken to identify this measure and the final selection is nearing completion. This new measure will be discussed in the May 2017 Energy Supply Risk Assessment update.

In the January 11, 2017 report, and discussed in section 7.1, Hydro also stated that it is increasing its focus on the gas turbine units with the goal of improving their reliability. To this end, Hydro has engaged external consultant Performance Improvements Ltd. (PI) to review all

[34] UFOP is defined as the probability that a generation unit will not be available when required. It is used to measure performance of standby units with low operating time such as gas turbines.

[35] Available at: http://www.pub.nf.ca/applications/IslandInterconnectedSystem/phasetwo/files/reports/From%20NLH%20-%20Hardwoods%20and%20Stephenville%20Gas%20Turbine%20Failure%20Analysis%20-%20Final%20Report%20-%20%202017-01-11.PDF

aspects of gas turbine operation and control and to provide recommendations which will further improve the reliability of these units going forward.

7.4 Review and Adoption of NERC Reliability Standards

The North American Electric Reliability Corporation (NERC) is a not-for-profit international regulatory authority with a mission is to assure the reliability and security of the bulk power systems in North America. NERC Reliability Standards define the reliability requirements for planning and operating the North American bulk power system and are developed using a results-based approach[36] that focuses on performance, risk management, and entity capabilities.[37]

Hydro recognizes the benefits that the NERC reliability standards provide and is in the preliminary stages of reviewing and assessing these standards for adoption into the Island Interconnected System. Hydro is also reviewing the impacts that the NERC reliability standard will have on Hydro's reliability and the approach it would use to implement applicable NERC reliability standards.

7.5 Service Level Agreements

Service level agreements (SLA) are contracts between a service provider and end-user that define the level of service that is expected from the service provider. The purpose of the SLA is to define what the customer will receive.

Hydro currently has SLAs in place with many of its suppliers to ensure that Hydro can get timely support and service when issues arise. Through the issues experienced in the past several

[36] Results based standards are standards that focus on required actions or results (the "what") and not necessarily the methods by which to accomplish those actions or results (the "how").
[37] http://www.nerc.com/pa/Stand/Pages/Default.aspx

years, Hydro believes that its SLAs need to be reviewed and a high level of support is required from some of its suppliers to ensure a more timely and substantial response.

One improvement in this area includes Hydro's recent long-term maintenance contract with Siemens for the Holyrood combustion turbine (CT). The Holyrood CT is an important component of the Avalon contingency reserves and securing a long-term service provider will improve access to parts inventories, improve service response times and contribute to the overall reliability of the grid.

Hydro will continue to review its SLAs with a view to renegotiating those for critical assets that are viewed as having insufficient SLAs.

7.6 Requirement for Additional Generation

In its report titled "*Review of Newfoundland and Labrador Hydro Power Supply Adequacy and Reliability Prior to and Post Muskrat Falls*", [38] Liberty recommended that "Hydro should expedite efforts to determine (a) the availability of dependable reserves from Nova Scotia or elsewhere and (b) the competitiveness of those reserves versus new Island Interconnected System generation."[39]

In order for Hydro to do a complete evaluation of the competitiveness of new sources of Island Interconnected System generation, Hydro requires an accurate estimate of each reasonable generation alternatives. One proposed Island Interconnected System generation alternative is the construction of a new hydroelectric generation turbine unit at the Bay d'Espoir Power Plant.

The new hydroelectric generation turbine (unit 8) would be identical to unit 7 and would add 154.4 MW of capacity to the Island Interconnected System. It could also be started quickly and

[38] http://www.pub.nf.ca/applications/IslandInterconnectedSystem/phasetwo/files/reports/TheLibertyConsultingGroup-PhaseTwoReport-2016-08-19.pdf
[39] Recommendation V-1

could be put on-line when coming into high load periods or kept on-line for extended periods. Given improvements in technology, a new turbine could also be more efficient than the existing turbines at Bay D'Espoir. Bay D'Espoir unit 8 is one candidate for the least-cost source of additional capacity.

Hydro is currently completing more detailed feasibility studies and cost estimated for this alternative. The results of this analysis will be used as input to the evaluation of the competitiveness of new sources of Island Interconnected System generation. The construction schedule for a new unit is estimated to be approximately 3.5 years, so Hydro is taking action to attain the required information for its review.

8.0 Conclusion

Hydro remains committed to the provision of safe, reliable and least cost supply of electricity to its customers. This report outlines the many changes that Hydro has taken since 2014 to improve its operational philosophy and reliability culture. Hydro understands that changing an organization's culture takes time and it is a large-scale undertaking that requires the organization to first change its behaviours. The current leadership and employees throughout the company are fully committed to delivering stronger service to Hydro's customers and delivering on the company's mandate.

Appendix A

Glossary of Terms

Glossary of Terms

ANP - Advanced Notification Protocols

AWP - Annual Work Plan

CEOC - Corporate Emergency Operations Center

CERP - Corporate Emergency Response Plan

ECC - Energy Control Center

EMS - Energy Management System

EOC - Executive on Call

ESRA – Energy Supply Risk Assessment

EUE - Expected Unserved Energy

HTGS – Holyrood Thermal Generating Station

IAWP - Integrated Annual Work Plan

IIS – Island Interconnected System

kV - Kilovolt

LIL - Labrador Island Link

ML - Maritime Link

MW – Megawatts

NERC - North American Electric Reliability Corporation

NLSO - Newfoundland Labrador System Operator

OTS - Operator Training Simulator

UFOP - Utilization Forced Outage Probability

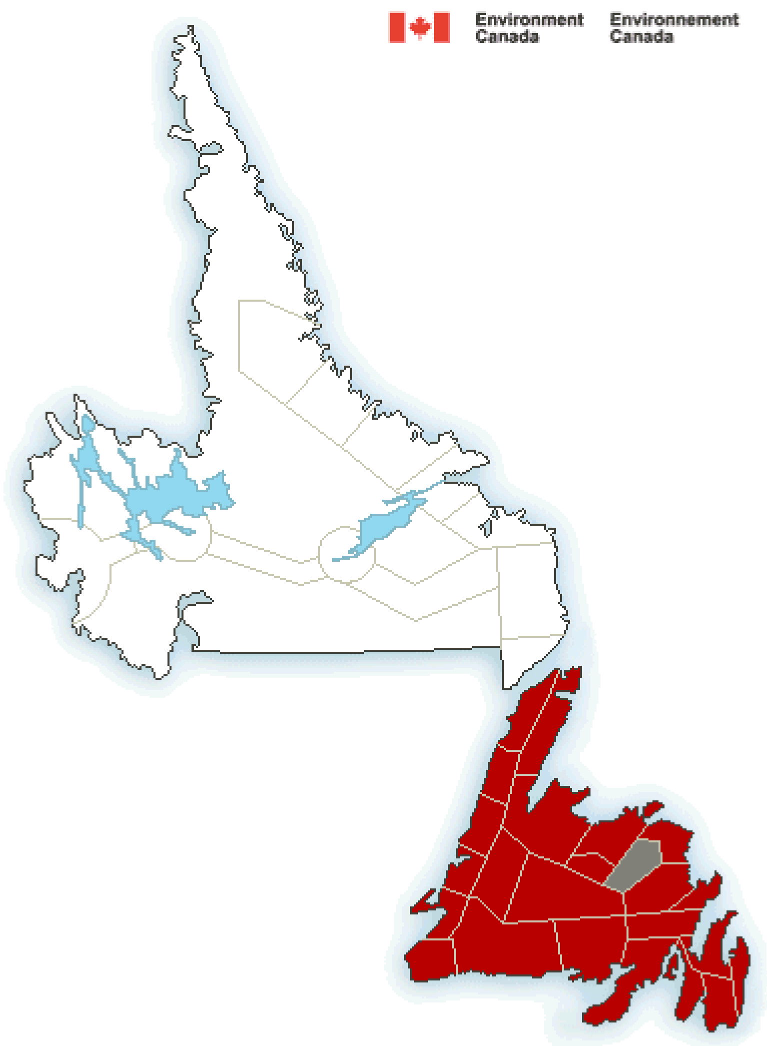
Appendix B

Daily System Status Meeting Notes

	Daily System Status Meeting - Notes		
	Topic	**Lead**	**Notes**
1	**Safety Moment and Key Messages**		http://www.nlhydro.com/winter/power-outage-safety Move towards our gaps as immediate opportunities to improve our performance and resiliency Open and honest discussion on risks and how we mitigate them Visible leadership supporting awareness and demonstrating a heightened sense of urgency
2	**System Risk/Watch**		HRD Unit #2 to come offline for cell replacement on VFD B Phase. **Water Management** Thermal generation to follow the guidelines below based on current outlook of low reservoir storage, low snowpack, and low inflows. When 2 units are available at Holyrood, the total Holyrood + Standby output shall be 400 MW. When 3 units are available at Holyrood, the total Holyrood + Standby output shall be 460 MW. *Note:* 3 units considered available when Unit 2 is available at 70 MW. **Hydrology position as of Thursday, February 4:** Total system energy storage is at 48% and all reservoirs are continuing to decline Exploits Generation is currently at 55% of normal, Red Indian Lake is 45% full and continuing to decline

			Fall/winter Inflows fourth lowest in 65 years Inflows year to date at 26% average Snowpack is at 30 - 50% of typical end of winter maximums Thermal generation has been increased for water management Holyrood generation is at maximum Standby generation increased for reliability and energy Holyrood plus standby generation averaged 431 MW over last 7 days The Avalon peak for today is 655 MW in the evening. Based on this forecast and maintaining current wind generation (2 MW) the Avalon reserves for this evening would be 265 MW with no alert. Western Avalon T5: Please see notes below in section 6b.
3	**Previous Day's Events**	System On-Call / Sys Ops	VBN T1 was taken out of service at 1732 hour due to due to burnt CT block. CBC C1 was taken out of service as the 487 relay is showing failed.
4	**Labrador Operations**	System Operations	Unit G7 HVY will be returned to service today at approximately 6pm. The unit in Postville (573) is unavailable for operation due to white smoke coming from the stack yesterday afternoon. The unit was shut down immediately and tagged out. They are currently arranging for a crew to get into Postville today from Nain where there is currently a Mechanical crew. Update Feb 03: The unit in Postville will require a partial

			dismantle to assess the issue. They are suspecting a broken liner so want to ensure they have enough time to assess the problem this week and order the repair parts by before weeks end. If damage is not too significant the unit should be up and running sometime next week depending on delivery of parts.
5	**Weather Outlook and Notifications**	Sys Ops/ Corp Relations	**Wind warning in effect for:** Avalon Peninsula North Avalon Peninsula Southeast Avalon Peninsula Southwest Boniest Peninsula Bay of Exploits Clareville and vicinity St. John's and vicinity Terra Nova Strong winds that may cause damage are expected or occurring. A low pressure system is forecast to track through central Newfoundland early on Saturday. Northwesterly winds gusting up to 110 km/h are expected along parts of the coast on Saturday behind this system. **Rainfall warning in effect for:** Avalon Peninsula Southeast Burgeo-Ramea Burin Peninsula Rain, heavy at times is expected. A low pressure system is expected to approach from the southwest



today and will cross central Newfoundland early on Saturday. Rain ahead of this system will begin near noon today and will persist into Saturday morning. Total rainfall accumulations of 25 to 35 millimetres are expected before the rain tapers off by noon on Saturday.

Winter storm warning in effect for:
Corner Brook and vicinity
Deer Lake -Humber Valley
Green Bay-White Bay
Gros Morne
Northern Peninsula East
Parson's Pond-Hawke's Bay
Port Saunders and the Straits

Hazardous winter conditions are expected. A low pressure system is forecast to track across central Newfoundland early on Saturday. Snow ahead of this system will spread northward across western Newfoundland this afternoon into this evening becoming heavy at times tonight. Total snowfall accumulations of up to 35 centimetres are expected before the snow tapers off on Saturday.
In addition, strong northerly winds are expected to develop early Saturday morning. These winds will combine with the freshly fallen snow to give reduced visibilities in blowing snow. Conditions are expected to improve Saturday afternoon.

Special weather statement in effect for:
Gander and vicinity

			A low pressure system is forecast to track through central Newfoundland early on Saturday. This system will bring warm temperatures and rain to northeastern Newfoundland tonight into Saturday morning. Total rainfall amounts are expected to be near 20 mm before the rain tapers off on Saturday.
6a	**Equipment Outages and Notifications - <u>Planned</u>**	Sys Ops/ Corp Relations	Outage is required to remove two of the mobile diesels from HRD. HRD to review and send in a detailed plan to system operations. This work will wait until HRD Unit #2 is back online.
6b	**Equipment Outages and Notifications - <u>Ongoing</u>**	Sys Ops/ Corp Relations	BDE Unit #2: It has been requested by P&C engineering that this unit not be shut down due to a start/stop relay. TL 227 remains out of service from BHL to SCV due to a landslide in the area. Section of line was taken out to be proactive and prevent possible outages and equipment damage. No customers were lost. Area assessment, extent of damage and recovery plan will be further developed when weather conditions permit and it is safe to access area. Corporate communications have been talking to parks Canada. Update Feb 05: Stantec has completed the geotechnical assessment for Parks Canada and will provide the assessment today. This will confirm the safe distance for the relocation. A detailed work plan and resources are being developed. The work will be coordinated with system operations to minimize impact to customers. Engineering design is ongoing, with surveying crews in the field, materials acquisition. All activities are being coordinated

			with Parks Canada. Western Avalon T5 still out of service. Work will be rescheduled next week based on the performance of HRD Unit#1.
7	**Island Capability / Reserves and Notifications**	Sys Ops/ Corp Relations	Island reserves are adequate at 515- 705 MW for the next 7 days. Continue to watch for Frazil ice at GCL, USL and HLK. Exploits are generating at 39 MW. Exploits generation will be adjusting output to 40 MW through discussions with System Operations. Also watching situation at Badger Wesleyville GT is out of service. There is a bearing issue and it has to be replaced. It will be out for about 6 weeks NP reported 70 MW of total hydraulic capability.
8	**Avalon Capability / Reserves and Notifications**	Sys Ops/ Corp Relations	Avalon reserves are at 235- 350 MW for the next 7 days. Three HRD units are available and unit# 2 will go offline tonight. HWD GT and HRD CT are available NP reported 41 MW of Avalon hydraulic capabilities.
9	**Standby Unit Staffing / Operation Requirements**	System Operations	This outlook reflects: Three HRD units are available and unit #2 will go offline tonight. HWD GT and HRD CT are available All Avalon transmission lines are in service.
10	**Communications - Stakeholders and Public**	Corporate Relations	
11	**Other**		

Appendix C

Severe Weather Checklist

Severe Weather Preparedness Checklist

Date:	**Location:**
Current and Forecasted Weather:	

Things to think about before preparing

- ☐ Do workers know and understand the tasks?
- ☐ Have all workers been given orientations? (Is there an orientation or training for working in severe weather?)
- ☐ Ensure Tailboards are completed prior to start of work
- ☐ Communicate forecasted weather conditions to all employees. Keep employees updated on changing conditions
- ☐ Are all proper tools available for job?
- ☐ Ensure employees have Proper PPE for working in extreme weather conditions
- ☐ Will employees be working alone? If yes, circulate the working alone procedure for review.
- ☐ Have environmental aspects been considered?

Emergency Information

Emergency response plan(s) in place? ☐ **Yes**

Has it been communicated to all required personnel? ☐ **Yes**

Nearest medical facility:

Emergency Contact Numbers

1.	**3.**
2.	**4.**

Severe Weather Preparedness

Safety	**Trucks**

☐ Consider holding safety briefings with available staff
☐ Ensure workers are familiar with the safety tools and procedures associated with severe weather
    ☐ Tailboard
    ☐ Step Back 5x5
    ☐ Proper PPE for Weather conditions
	☐ Fuel all vehicles
	☐ Ensure Distribution line trucks are stocked with critical spare parts and consumables
	☐ Equip trucks with special tools and equipment as required
	☐ Ensure distribution line workers and distribution front line supervisors have company vehicles at home
	☐ Provide on call supervisors with a company vehicle
	☐ Consider having other staff take company vehicles home
	☐ Ensure truck radios are working

Tools and Equipment	**Buildings**
☐ Test portable generators, standby duiesels and gas turbines ☐ Test tools as required ☐ Ensure fuel supply available	☐ Schedule additional snow removal ☐ Consider renting portable generators for buildings not equipped with a backup ☐ Check ability to alter temperature controls in buildings to override normal after-hour temperature settings
Substation and Generation	**Stores – Not sure this applies to us (or maybe diff name)**
☐ Consider location and availability of portable generation and portable substations. Re-deploy as required ☐ Ensure fuel Supply for system generators	☐ Ensure all stores have proper staffing levels ☐ Check stock levels for items likely needed during storms ☐ Consider confirming the supply of poles on the island

Operations Staff	Transportation
☐ Notify Staff of forecasted storm. Consider scheduling staff to work outside of normal working hours to ensure quick response ☐ Equip Supervisors with up to date staff listings and contact information ☐ Consider re-deploying staff to areas most likely impacted by the severe weather ☐ Put technical staff on notice of pending storm ☐ Ensure support and costumer service staffs are aware if the forcasted weather ☐ Consider enhancing staff levels at ECC and other control rooms ☐ Ensure IS support team is in place ☐ Ensure Protection and Control Engineering are aware of the pending weather and that contact information is available	☐ Where possible, put a rush on maintenance or repair work for any company vehicle ☐ Complete inspections of additional equipment and vehicles (four wheel drive trucks, snowmobiles, ATVs and specialized vehicles) ☐ Notify garages and mechanics of forecasted storm ☐ Confirm after hour contacts with government departments in the event that permits are required to re-locate portable equipment, or obtain permits in advance ☐ Confirm the availability of tractors or other equipment to relocate portable equipment ☐ Arrange for any necessary escorts
Communications	**System Security**
☐ Hold a pre-event coordination call to coordinate response activities ☐ Consider additional communication with on-call personnel to ensure rediness to respond ☐ Contact NF Power for generation Status ☐ Check availability of Satellite Phones, ensure they are charges and working ☐ Ensure appropriate staff have cell phones. Ensure adequate cell phone chargers and spare batteries are available ☐ Charge and test portable radios ☐ Test area office base station radios	☐ Make extra effort to correct any adnormal system conditions ☐ Where practical consider suspending construction on capital jobs to return the system to normal ☐ Consider developing a contingency plan for any abnormal conditions that cannot be corrected ☐ Consider protection changes above normal settings
Contractors	**Customer Service and Communications Hub**
☐ Put contractors on notice of pending storm and ask that they prepare ☐ Confirm Contractor's emergency contact information ☐ Confirm their available resources and their ability to assist ☐ Ensure Snow clearing contractors are on alert and available	☐ Confirm area connections to the communications hub. Ensure an area person is assigned to communicate with the hub ☐ Consider assigning a communications hub member to the ECC ☐ Communicate with Customer Service to determine their requirement for remote ☐ Check the availability of local Costumer Service Staff
Accommodations	**Finance**
☐ Contact local hotels to determine availability of rooms in the event that crews are moved into the area. Consider reserving a block of rooms.	☐ Arrange for numbers to be used for charging the storm. Communicate to staff
Government	**Other Utilities**
☐ Prior to the storm, confirm contacts for emergency snow clearing with the Department of Transportation ☐ Ensure updates contact lists are available for surrounding municipalities ☐ Prior to the storm, confirm ferry schedules and contact information	☐ Coordinate response with Newfoundland Power

Appendix D

Avalon Capability and Reserves (T-096)

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SYSTEM OPERATING INSTRUCTION

STATION:	GENERAL	**Inst. No.**	T-096
TITLE:	AVALON CAPABILITY AND RESERVES **	**Page** 1	**of** 5

INTRODUCTION

In order to ensure that customer service is maintained, the Energy Control Centre (ECC) shall exercise its authority to reduce risks to the Avalon capability and maintain sufficient Avalon reserves to meet current and anticipated customer demands. The ECC shall be prepared to deal with reserve deficiencies and take appropriate actions in order to maintain the reliability of the Avalon system.

Avalon reserve is required to replace generation or transmission capacity lost due to equipment forced outage, to cover performance uncertainties in generating units or to cover unanticipated increases in demand. Sufficient reserve is required to meet current and forecasted demands under a worst case contingency.

PROCEDURE

A. Calculation of *Total Avalon Capability and Available Avalon Reserve*

Total Avalon Capability is determined using load flow analysis[1] and is based on the availability of equipment on the Avalon for each day. This would include the following:

1. Generation on the Avalon (Holyrood thermal units, Hardwoods GT, Holyrood CT, Holyrood Diesels, Newfoundland Power hydro, Newfoundland Power standby, Fermeuse Wind[2] and Vale Capacity Assistance[3])
2. Transmission Availability (230 kV transmission lines on the Avalon, 138 kV transmission lines from Stony Brook – Sunnyside and Western Avalon - Holyrood)
3. Reactive resources (capacitor banks in Oxen Pond, Hardwoods and Come By Chance)

Available Avalon Reserve shall be calculated for the current day and the following six days in the manner as indicated below:

Available Avalon Reserve for each day =
Total Avalon Capability ; *less*
Forecasted Avalon Peak Load (adjusted for Voltage Reduction[4] when applicable)

[1] Base case load flows will be used to determine the Avalon Capability.
[2] Included for the current day based on actual wind output, but assumes no wind generation for the following six days.
[3] *Capacity Assistance* (when available) from Vale through operation of standby diesel units with a combined capacity of up to 15.8 MW.
[4] Up to 10 MW of Avalon load reduction (on peak) is expected to be achieved through the *Voltage Reduction* strategy. This is approximated as one-half the total Island reduction.

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PROCEDURE (cont'd.)

B. Assessment and Notification of Available Avalon Reserve

The available Avalon reserve will be calculated for the current day and the following six days and an assessment will be made against the criteria in the table below and a notification will be issued to stakeholders when available Avalon reserve is below the stated thresholds.

Available Avalon Reserve	Expected Action	Level
> Impact of largest contingency + min reserve[5]	none	0
< Impact of largest contingency + min reserve	Prepare for potential Load Reduction	1
< Impact of largest contingency	Load Reduction	2
< Impact of ½ largest contingency	Conservation	3
Zero/deficit	Rotating Outages	4

Based on the assessment above, perform the following:

- Level 0 - If the available Avalon reserve is anticipated to be greater than the impact of the largest contingency plus min reserve, the ECC are not expected to perform any further actions, other than to advise the on-call Executive member (Exec On-call) of NLH's Corporate Emergency Response Plan (CERP), Corporate Relations and Newfoundland Power's Control Centre that the available Avalon reserve has returned to normal following a prior Level 1, 2, 3 or 4 notice.
- Level 1 - If the available Avalon reserve is anticipated to be <u>less than the impact of the largest contingency plus min reserve</u>, the ECC will notify Newfoundland Power's Control Centre, advising of possible requirements for load reduction to maintain sufficient Avalon reserve, if the available Avalon reserve should decrease.
- Level 2- If the available Avalon reserve is anticipated to be <u>less than the impact of the largest contingency</u>, the ECC will notify Exec On-call (CERP)[6] Corporate Relations[7] and Newfoundland Power's Control Centre[8], advising of load reduction strategies to maintain sufficient Avalon reserve, if the capability shortfall is not corrected.

[5] Min reserve is 35 MW.
[6] As part of the CERP, the Exec On-Call makes the decision to activate the Corporate Emergency Operations Centre (CEOC) and issues alert notifications. If activated, a partial mobilization is recommended consisting of Deputy Incident Commander, Operations Liaison and Communications Support.
[7] Corporate Relations is responsible for activating the joint communication plan between NLH and Newfoundland Power.
[8] ECC will advise the NP Control Centre once internal alignment is achieved on the alert level through the CERP process.

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PROCEDURE (cont'd.)

- Level 3- If the available Avalon reserve is anticipated to be less than the impact of half the largest contingency, the ECC will notify Exec On-call (CERP), Corporate Relations and Newfoundland Power's Control Centre, advising of customer conservation strategies to help maintain sufficient Avalon reserve, if the capability shortfall is not corrected.
- Level 4 - If the available Avalon reserve is anticipated to approach zero or fall into a deficit, the ECC will notify Exec On-call (CERP), Corporate Relations and Newfoundland Power's Control Centre, advising of rotating outages in order to maintain supply point voltages and transmission line loadings within acceptable ranges.

The following is the standard message that will be communicated if it is anticipated that a notification is to be made under Level 1, 2, 3 or 4; or a return to Level 0:

"System Operations is advising that the available Avalon reserve is at a notification level [0-4] for [insert date here]. The available Avalon reserve is expected to be [insert reserve amount in MW], calculated from the total Avalon capability of [insert available capacity in MW] and a peak Avalon load forecast of [insert peak forecast in MW]."

C. Operational requirements to cover largest contingency

The ECC shall maintain sufficient Avalon reserve to cover performance uncertainties in generating units and transmission equipment and unanticipated increases in demand. Such actions include the following: placing in service all available generating and transmission capacity, cancelling outages to generating units and transmission equipment that have a short recall, deploying all available standby resources, including Vale Capacity Assistance, cancelling Avalon industrial interruptible load and reducing Avalon load, through procedures such as public conservation notices, voltage reductions, curtailing interruptible loads and non-essential firm loads.

The ECC shall use the following guideline in the sequence outlined in order to cover the largest contingency, maintain the reliability of the Avalon and minimize service impacts to customers:

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PROCEDURE (cont'd.)

Normal Sequence

1. Determine the Avalon capability under worst case contingency and the Avalon load threshold for operating standby units.
2. Based on this threshold and expected loads, determine requirements for staffing and potential operation for standby generation on the Avalon and notify appropriate personnel of standby staffing requirements.

To position the Avalon power system in order to cover off the single largest contingency, perform the following:

3. Ensure all NLH static reactive resources are in service (i.e. capacitor banks).
4. Request Newfoundland Power to maximize Avalon hydro generation.
5. Increase Holyrood real and reactive power up to the maximum Holyrood capability.
6. Start and load (to minimum) standby generators on the Avalon, both Hydro's and Newfoundland Power's, to cover the largest contingency once the Avalon load threshold for operation is exceeded. (At this point in time it is important to notify Avalon customers taking non-firm power and energy that if they continue to take non-firm power, the energy will be charged at higher standby generation rates.)
7. Request Newfoundland Power to curtail its interruptible loads on the Avalon (typically up to 10 MW and can take up to 2 hours to implement).
8. Request Vale for Capacity Assistance (7.6 MW) and to put all its available capacitor banks in service.
9. Request Praxair for Capacity Assistance (5 MW).

Load Reduction

10. Cancel all non-firm power delivery to customers and ensure Avalon industrial customers are within contract limits.
11. Inform Newfoundland Power of Hydro's need to reduce supply voltage at Hardwoods and Oxen Pond to minimum levels to facilitate load reduction. Implement voltage reduction (if not already in a reduced voltage condition).
12. Request Avalon industrial customers to shed non-essential loads, informing them of system conditions.

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PROCEDURE (cont'd.)

Rotating Outages

If the Avalon reserve continues to decrease below the minimum level, the Avalon voltages and transmission line loadings should be watched closely. Delivery point voltages at CBC (212 kV) and Hardwoods and Oxen Pond (62.5 kV) need to be maintained. Transmission line loadings need to be kept to within thermal ratings. If voltages or line loadings deviate outside of acceptable operating ranges, perform the following:

13. Request Newfoundland Power to shed load by rotating feeder interruptions.

** Part of the Emergency Response Plan

REVISION HISTORY

Version Number	Date	Description of Change
0	2015-06-26	Original Issue
1	2016-12-22	Added Praxair Capacity Assistance

PREPARED: J. Tobin	**APPROVED:**

Appendix E

Generation Reserves (T-001)

SYSTEM OPERATING INSTRUCTION

STATION:	GENERAL	**Inst. No.**	T-001
TITLE:	GENERATION RESERVES *, **	**Page** 1	**of** 5

INTRODUCTION

In order to ensure that customer service is maintained, the Energy Control Centre (ECC) shall exercise its authority to reduce risks to the generation supply and maintain sufficient generation reserves to meet current and anticipated customer demands. The ECC shall be prepared to deal with generation shortages and take appropriate actions in order to maintain the reliability of the Island Interconnected System.

Generation reserve[1] is required to replace generation capacity lost due to an equipment forced outage, to cover performance uncertainties in generating units or to cover unanticipated increases in demand. Sufficient generation reserve is required to meet current and forecasted demands under a contingency of the largest generating unit.

PROCEDURE

A. Calculation of *Available Generation Reserve*[2]

Available generation reserve shall be calculated for the current day and the following six days in the manner as indicated below:

Available Generation Reserve for each day =
Available Generation of NLH (Hydro + Thermal + *Standby*[3] + *Purchases*[4]); *plus*
Available Generation of NP (Hydro + Standby); *plus*
Available Generation of DLP (60 Hz Hydro); *plus*
Capacity Assistance of Vale (Standby)[5]; *less*
Forecasted Island Peak Load (adjusted for CBPP Capacity Assistance[6] and Voltage Reduction[7])

A plot is provided on the EMSView – Production - Load Forecast page for reference.

[1] *Generation Reserve* is defined as the quantity of available generation supply that is in excess of demand, and includes spinning reserve[8]. It is equal to Available Generation Supply less Current / Forecasted Demand.
[2] *Available Generation Reserve* is associated with generation that is in service or standby generation that can be placed in service within 20 minutes. NP's mobile generation may take up to 2 hours to place in service.
[3] *Standby* generation includes combustion turbine / diesel generation, including the new CT at Holyrood.
[4] *NLH Purchases* includes wind for the current day based on actual wind output, but assumes no wind generation for the following six days.
[5] *Capacity Assistance* (when available) from Vale through operation of standby diesel units with a combined capacity of 10.8 MW.
[6] *Capacity Assistance* (when available) from CBPP through load interruption in 20, 40 or 60 MW blocks.
[7] Up to 20 MW of load reduction (on peak) is expected to be achieved through the *Voltage Reduction* strategy.
[8] *Spinning reserve* is defined as unloaded generation that is synchronized to the power system and ready to serve additional demand.

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<u>PROCEDURE</u> (cont'd.)

B. Assessment and Notification of Available Generation Reserve

The available generation reserve will be calculated for the current day and the following six days and an assessment will be made against the criteria in the table below. A notification will be issued to stakeholders when available generation reserve is below the stated thresholds for anytime within the next week.

Available Reserve	Expected Action	Level
> Largest Generating Unit + min. spinning reserve	none	0
< Largest Generating Unit + min. spinning reserve	Prepare for Potential Load Reduction	1
< Largest Generating Unit	Load Reduction	2
< ½ Largest Generating Unit	Conservation	3
Zero/deficit; hold f=59.8 Hz	Rotating Outages	4

Based on the assessment above, perform the following:

- Level 0 - If the available reserve is anticipated to be greater than the largest available generating unit capacity plus minimum spinning reserve, the ECC are not expected to perform any further actions, other than to advise the on-call Executive member (Exec On-call) of NLH's Corporate Emergency Response Plan (CERP), Corporate Relations and Newfoundland Power that available reserve has returned to normal following a prior Level 1, 2, 3 or 4 notice.
- Level 1 - If the available reserve is anticipated to be <u>less than the largest available generating unit capacity plus the minimum spinning reserve</u>, the ECC will notify Newfoundland Power's Control Centre, advising of possible requirements for load reduction to maintain sufficient spinning reserve, if the available generation reserve should decrease.
- Level 2 - If the available reserve is anticipated to be <u>less than the largest available generating unit capacity</u>, the ECC will notify Exec On-Call (CERP)[9], Corporate Relations[10] and Newfoundland Power, advising of load reduction strategies to maintain sufficient spinning reserve, if the generation shortfall is not corrected.

[9] As part of the CERP, the Exec On-Call makes the decision to activate the Corporate Emergency Operations Centre (CEOC) and issues alert notifications.
[10] Corporate Relations is responsible for activating the joint communication plan between NLH and Newfoundland Power.

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PROCEDURE (cont'd.)

- Level 3 - If the available reserve is anticipated to be less than half of the largest available generating unit capacity, the ECC will notify Exec On-call (CERP), Corporate Relations and Newfoundland Power, advising of a requirement for customer conservation strategies to help maintain sufficient spinning reserve, if the generation shortfall is not corrected.
- Level 4 - If the available reserve is anticipated to approach zero or fall into a deficit, the ECC will notify Exec On-call (CERP), Corporate Relations and Newfoundland Power, advising of a requirement for rotating outages to help maintain frequency near the 60 Hertz standard, if the generation shortfall is not corrected.

The following is the standard message that will be communicated if it is anticipated that a notification is to be made under Level 1, 2, 3 or 4; or a return to Level 0:

> *"System Operations is advising that the available Island generation reserve is at a notification level [0-4] for [insert date here]. The available generation reserve is expected to be [insert reserve amount in MW], calculated from an available generation capacity of [insert available capacity in MW] and a peak load forecast of [insert peak forecast in MW]."*

C. Maintaining Spinning Reserve

The ECC shall maintain sufficient spinning reserve to cover performance uncertainties in generating units, especially wind and other variable generation, and unanticipated increases in demand. The ECC will take appropriate action to maintain a minimum spinning reserve level equal to 70 MW. Such actions include the following: placing in service all available generating capacity, cancelling outages to generating units that have a short recall, deploying all available standby resources, including CBPP and Vale Capacity Assistance, cancelling industrial interruptible load and reducing system load, through procedures such as public conservation notices, voltage reductions, curtailing interruptible loads and non-essential firm loads.

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PROCEDURE (cont'd.)

The following guideline shall be followed by the ECC Shift Supervisor and System Operator in the sequence outlined in order to maintain sufficient spinning reserve, maintain the reliability of the Island Interconnected System and minimize service impacts to customers:

Normal Sequence

1. Place in service all of Hydro's available hydroelectric generation.
2. Request Newfoundland Power to maximize their hydroelectric generation.
3. Make a Capacity Request of Deer Lake Power to maximize their hydroelectric generation.
4. Request Non-Utility Generators to maximize their hydroelectric and wind generation.
5. Maximize Holyrood thermal generation.
6. Start and load standby generators, both Hydro and Newfoundland Power units, in order of increasing average energy production cost with due consideration for unit start-up time, while holding the least efficient NLH standby combustion turbine unit in reserve. (At this point in time it is important to notify customers taking non-firm power and energy that if they continue to take non-firm power, the energy will be charged at higher standby generation rates.)
7. Request Newfoundland Power to curtail its interruptible loads (typically up to 10 MW and can take up to 2 hours to implement).
8. Request Corner Brook Pulp and Paper for Capacity Assistance (20, 40 or 60 MW).
9. Request Vale for Capacity Assistance (7.6 MW).
10. Request Praxair for Capacity Assistance (5 MW).
11. Start and load the remaining NLH standby combustion turbine unit.

Load Reduction

12. Cancel all non-firm power delivery to customers and ensure all industrial customers are within contract limits.
13. Inform Newfoundland Power of Hydro's need to reduce supply voltage at Hardwoods and Oxen Pond and other delivery points to minimum levels to facilitate load reduction. Implement voltage reduction.
14. Request Newfoundland Power to implement voltage reduction on its system.

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PROCEDURE (cont'd.)

Load Reduction (cont'd)

15. Request industrial customers to shed non-essential loads, informing them of system conditions.
16. Request Corner Brook Pulp and Paper Supplemental Capacity Assistance (to a maximum of 30 MW). Note that this is above the Capacity Assistance request and a request for the full 30 MW will likely reduce CBPP Mill load to that required for essential services. Upon request for Supplemental Capacity Assistance, arrangements should be made with TRO-Central to close the load break bus tie switch B2B4-1 at Massey Drive.

Rotating Outages

If the spinning reserve continues to decrease below the minimum level, the system frequency should be watched closely. In order to minimize outages to customers, utilize the reserve as much as possible and maintain the system frequency at 59.8 Hz.

17. Request Newfoundland Power to shed load by rotating feeder interruptions. At the same time, shed load by rotating feeder interruptions in Hydro's rural distribution areas. Follow instruction for rotating outages, T-042.

* Part of the Environmental Plan
** Part of the Emergency Response Plan

REVISION HISTORY

Version Number	Date	Description of Change
0	1992-07-16	Original Issue
13	2016-12-22	Added Praxair Capacity Assistance
PREPARED: J. Tobin		**APPROVED:**

Appendix F

Outage Readiness Tracker

Equipment Outage	MOS Outage #	Customer Outage		PETS		Baseline %	Start	Finish		Outage Request Submitted? Submitted	System Outage #	Approved	WPC Requirements Reviewed? None	TAWP	OAWP	PC1 Submittal (7 Days Prior)	Submitted	Approved	Field Isolation Plan Required? Required Y	N	Plan Finalized (7 Days Prior)	Approved	Energization/Start-Up Plan Required? Required Y	N	1st Draft (28 Days Prior)	Received	Plan Finalized (14 Days Prior)	Approved	Extra Outage Required Y	N	System Outage #	Commissioning Plan & Procedures Plan Required Y	N	Plan Prepared (1 Day Prior)	Approved	Resource Confirmation Internal External Manpower (7 Days Prior)	Confirmed	Equipment Parts Deliverables (7 Days Prior)	Confirmed
BDE B3T6	T-C024	No	☐	PETS	☑	100%	9-May-16	25-Jun-16	☐	☑	9533	☑	☐	☐	☑	2-May-16	☑	☑	☑	☐	2-May-16	☑	☑	☐	28-May-16	☑	11-Jun-16	☑	☑	☐	9689	☑	☐	8-May-16	☑	2-May-16	☑	2-May-16	☑
BDE B2T3	T-C021	No	☐	PETS	☑	92%	6-Jun-16	23-Jul-16	☐	☑	9535	☑	☐	☐	☑	30-May-16	☑	☑	☑	☐	30-May-16	☑	☑	☐	25-Jun-16	☐	9-Jul-16	☐	☑	☐		☑	☐	5-Jun-16	☑	30-May-16	☑	30-May-16	☑
BUC L05L33 Breaker PM	T-C164	No	☐		☐	100%	21-Jun-16	24-Jun-16	☐	☑	9627	☑	☐	☑	☐		☐	☐	☐	☑		☐	☐	☑		☐		☐	☐	☐		☐	☑		☐	14-Jun-16	☑	14-Jun-16	☑
BDE T3 Transformer Protection	T-C211	No	☐	PETS	☑	100%	6-Jun-16	23-Jul-16	☐	☑	9676	☑	☑	☐	☐		☐	☐	☑	☐	30-May-16	☑	☐	☑		☐		☐	☐	☐		☑	☐	5-Jun-16	☑	30-May-16	☑	30-May-16	☑
HWD B7B8 breaker replacement	T-C015	No	☐	PETS	☑	96%	30-May-16	14-Jul-16	☐	☑	9649	☑	☐	☑	☐		☐	☐	☑	☐	23-May-16	☑	☑	☐	16-Jun-16	☑	30-Jun-16	☐	☐	☑		☑	☐	29-May-16	☑	23-May-16	☑	23-May-16	☑
HRD B12L42 Breaker replacement	T-C013	No	☐	PETS	☑	96%	28-May-16	14-Jul-16	☐	☑	9602	☑	☐	☑	☐		☐	☐	☑	☐	21-May-16	☑	☑	☐	16-Jun-16	☑	30-Jun-16	☐	☐	☑		☑	☐	27-May-16	☑	21-May-16	☑	21-May-16	☑
TL203 Insulator Replacements, Outage #1	T-C048	No	☐	PETS	☑	100%	13-Jun-16	11-Jul-16	☐	☑	9650	☑	☐	☐	☑	6-Jun-16	☑	☑	☐	☑		☐	☐	☑		☐		☐	☐	☐		☐	☑		☐	6-Jun-16	☑	6-Jun-16	☑
TL242 Replace Protection Systems	T-C006	No	☐	PETS	☑	100%	6-Jun-16	29-Jun-16	☐	☑	9603	☑	☑	☐	☐		☐	☐	☐	☑		☐	☑	☐	1-Jun-16	☑	15-Jun-16	☑	☑	☐		☑	☐	5-Jun-16	☑	30-May-16	☑	30-May-16	☑
TL242 reconfiguration around soldiers pond	T-C007	No	☐		☐	100%	6-Jun-16	29-Jun-16	☐	☑	9604	☑	☐	☐	☑	30-May-16	☑	☑	☐	☑		☐	☐	☑		☐		☐	☐	☐		☐	☑		☐	30-May-16	☑	30-May-16	☑
BDE T4 Transformer Protection Replacement	T-C269	No	☐	PETS	☑	100%	13-Jun-16	8-Jul-16	☐	☑	9722	☑	☑	☐	☐		☐	☐	☐	☑		☐	☐	☑		☐		☐	☐	☐		☑	☐	12-Jun-16	☑	6-Jun-16	☑	6-Jun-16	☑
MDR T2 A-B phase PT replacement	T-C188	No	☐	PETS	☑	92%	29-Jun-16	30-Jun-16	☐	☑	9710	☐	☐	☑	☐		☐	☐	☐	☑		☐	☐	☑		☐		☐	☐	☐		☐	☑		☐	22-Jun-16	☑	22-Jun-16	☑
BUC L05L33-1, B1L05-2, L05G disconnect PMs	T-C166	No	☐		☐	100%	20-Jun-16	20-Jun-16	☑	☑	9728	☑	☐	☐	☑	13-Jun-16	☑	☑	☐	☑		☐	☐	☑		☐		☐	☐	☐		☐	☑		☐	13-Jun-16	☑	13-Jun-16	☑
MDR B5L11-2, L11G disconnect PM, doble CTs	T-C191	No	☐		☐	92%	17-Jun-16	17-Jun-16	☐	☑	9714	☐	☐	☐	☑	10-Jun-16	☑	☑	☐	☑		☐	☐	☑		☐		☐	☐	☐		☐	☑		☐	10-Jun-16	☑	10-Jun-16	☑
WAV B4 outage. L64G CM, PT doble	T-C134	No	☐		☐	100%	20-Jun-16	21-Jun-16	☑	☑	9661	☑	☐	☐	☑	13-Jun-16	☑	☑	☐	☑		☐	☐	☑		☐		☐	☐	☐		☐	☑		☐	13-Jun-16	☑	13-Jun-16	☑
HRD TS T3 Oil Replacement	T-C221	No	☐	PETS	☑	100%	20-Jun-16	1-Jul-16	☐	☑	9769	☑	☐	☐	☑	13-Jun-16	☑	☑	☐	☑		☐	☐	☑		☐		☐	☐	☐		☐	☑		☐	13-Jun-16	☑	13-Jun-16	☑
BBK L400T2 Breaker Replacement	T-C027	No	☐	PETS	☑	92%	20-Jun-16	5-Aug-16	☐	☑	9543	☑	☐	☑	☐		☐	☐	☑	☐	13-Jun-16	☑	☐	☑		☐		☐	☐	☐		☑	☐	19-Jun-16	☐	13-Jun-16	☑	13-Jun-16	☑
WAV B2T1 Breaker Replacement	T-C028	No	☐	PETS	☑	92%	21-Jun-16	5-Aug-16	☐	☑	9652	☑	☐	☑	☐		☐	☐	☑	☐	14-Jun-16	☑	☐	☑		☐		☐	☐	☐		☑	☐	20-Jun-16	☐	14-Jun-16	☑	14-Jun-16	☑
BDE B3 outage. To install new B3T6 breaker	T-C253	No	☐	PETS	☑	100%	21-Jun-16	21-Jun-16	☑	☑	9689	☑	☑	☐	☐		☐	☐	☐	☑		☐	☐	☑		☐		☐	☐	☐		☐	☑		☐	14-Jun-16	☑	14-Jun-16	☑
BDE Unit #7, T7 replacement	T-C010	No	☐	PETS	☑	79%	26-Jun-16	19-Aug-16	☐	☑	9545	☑	☐	☐	☑	19-Jun-16	☑	☐	☑	☐	19-Jun-16	☑	☑	☐	22-Jul-16	☐	5-Aug-16	☐	☐	☑		☑	☐	25-Jun-16	☐	19-Jun-16	☑	19-Jun-16	☑
BDE B9B10 breaker PM. B9B10-1 & B9B10-2 PM CTs	T-C101	No	☐		☐	92%	27-Jun-16	28-Jun-16	☐	☑	9745	☐	☐	☑	☐		☐	☐	☐	☑		☐	☐	☑		☐		☐	☐	☐		☐	☑		☐	20-Jun-16	☑	20-Jun-16	☑
HRD B3L18 complete auxiliary contacts	T-C251	No	☐	PETS	☑	100%	21-Jun-16	24-Jun-16	☐	☑	9777	☑	☑	☐	☐		☐	☐	☐	☑		☐	☐	☑		☐		☐	☐	☐		☐	☑		☐	14-Jun-16	☑	14-Jun-16	☑
MDR B2 doble PTs	T-C187	No	☐		☐	92%	28-Jun-16	28-Jun-16	☐	☑	9766	☐	☐	☐	☑	21-Jun-16	☑	☑	☐	☑		☐	☐	☑		☐		☐	☐	☐		☐	☑		☐	21-Jun-16	☑	21-Jun-16	☑
BDE B1B2 Breaker Replacement	T-C045	No	☐	PETS	☑	83%	30-Jun-16	16-Aug-16	☐	☑	9179	☑	☐	☑	☐		☐	☐	☑	☐	23-Jun-16	☑	☑	☐	19-Jul-16	☐	2-Aug-16	☐	☑	☐		☑	☐	29-Jun-16	☐	23-Jun-16	☑	23-Jun-16	☑
BDE T7 Transformer Protection Replacement	T-C215	No	☐	PETS	☑	83%	4-Jul-16	19-Aug-16	☐	☑	9545	☑	☑	☐	☐		☐	☐	☑	☐	27-Jun-16	☑	☐	☑		☐		☐	☐	☐		☑	☐	3-Jul-16	☐	27-Jun-16	☐	27-Jun-16	☑
OPD B1L36 Breaker Replacement	T-C019	No	☐	PETS	☑	58%	4-Jul-16	20-Aug-16	☐	☑	9767	☑	☐	☑	☐		☐	☐	☑	☐	27-Jun-16	☐	☑	☐	23-Jul-16	☐	6-Aug-16	☐	☑	☐		☑	☐	3-Jul-16	☐	27-Jun-16	☐	27-Jun-16	☐
BDE B13T12 replacement. T12 outage (TL220 to be feed via T10)	T-C069	No	☐	PETS	☑	83%	4-Jul-16	18-Jul-16	☐	☑	9785	☐	☐	☐	☑	27-Jun-16	☐	☐	☐	☑		☐	☐	☑		☐		☐	☐	☐		☐	☑		☐	27-Jun-16	☑	27-Jun-16	☑
IRV B1L24 overhaul	T-C168	No	☐		☐	67%	4-Jul-16	11-Jul-16	☐	☐		☐	☐	☑	☐		☐	☐	☐	☑		☐	☐	☑		☐		☐	☐	☐		☐	☑		☐	27-Jun-16	☐	27-Jun-16	☐
BDE B9 outage. Install Mobile Sub (to bypass T11, T-C232), split B13, Isolate T12.	T-C237	YES	☑	PETS	☑	33%	4-Jul-16	4-Jul-16	☐	☑	9784	☐	☐	☐	☑	27-Jun-16	☐	☐	☐	☐		☐	☐	☐		☐		☐	☐	☐		☐	☐		☐	27-Jun-16	☑	27-Jun-16	☑
TL233 Replace Crossarm on Structure #386	T-C270	No	☐		☐	83%	5-Jul-16	5-Jul-16	☐	☐	9656	☑	☐	☐	☑	28-Jun-16	☐	☐	☐	☑		☐	☐	☑		☐		☐	☐	☐		☐	☑		☐	28-Jun-16	☑	28-Jun-16	☑
CRV TS L20T1 PM	T-C174	YES	☑		☐	33%	5-Jul-16	5-Jul-16	☐	☑	9784	☐	☐	☐	☑	28-Jun-16	☐	☐	☐	☐		☐	☐	☐		☐		☐	☐	☐		☐	☐		☐	28-Jun-16	☑	28-Jun-16	☑
CRV TS T1 PM	T-C272	YES	☑		☐	33%	5-Jul-16	5-Jul-16	☐	☑	9784	☐	☐	☐	☑	28-Jun-16	☐	☐	☐	☐		☐	☐	☐		☐		☐	☐	☐		☐	☐		☐	28-Jun-16	☑	28-Jun-16	☑
OPD B5 outage. B2B5-2, B5C1-1, B5T3-1 Disconnect PMs. PTs	T-C128	No	☐		☐	92%	6-Jul-16	8-Jul-16	☐	☑	9663	☑	☐	☐	☑	29-Jun-16	☐	☐	☐	☑		☐	☐	☑		☐		☐	☐	☐		☐	☑		☐	29-Jun-16	☑	29-Jun-16	☑
OPD B2B5 doble	T-C127	No	☐		☐	92%	6-Jul-16	8-Jul-16	☐	☑	9663	☑	☐	☐	☑	29-Jun-16	☐	☐	☐	☑		☐	☐	☑		☐		☐	☐	☐		☐	☑		☐	29-Jun-16	☑	29-Jun-16	☑
IRV B1L23 overhaul	T-C169	No	☐		☐	17%	11-Jul-16	18-Jul-16	☐	☐		☐	☐	☑	☐		☐	☐	☐	☐		☐	☐	☐		☐		☐	☐	☐		☐	☐		☐	4-Jul-16	☐	4-Jul-16	☐
HWD Bus 2 outage, B2L42-1,B2T4, B2T3 disconnect PMs, B2 PT Doble. Will take T242 out of service.	T-C092	No	☐		☐	33%	12-Jul-16	12-Jul-16	☐	☑	9605	☐	☐	☐	☑	5-Jul-16	☐	☐	☐	☐		☐	☐	☐		☐		☐	☐	☐		☐	☐		☐	5-Jul-16	☑	5-Jul-16	☑
CBFC 129/129GR/129SP/229/229GR/29MB disconnect PMs	T-C177	No	☐		☐	92%	12-Jul-16	15-Jul-16	☐	☑	9575	☐	☐	☑	☐		☐	☐	☐	☑		☐	☐	☑		☐		☐	☐	☐		☐	☑		☐	5-Jul-16	☑	5-Jul-16	☑
HWD T3 PM	T-C110	No	☐		☐	42%	13-Jul-16	14-Jul-16	☐	☑	9782	☐	☐	☑	☐		☐	☐	☐	☐		☐	☐	☐		☐		☐	☐	☐		☐	☐		☐	6-Jul-16	☑	6-Jul-16	☑
WAV T3 tap changer leak test	T-C137	No	☐		☐	25%	13-Jul-16	17-Jul-16	☐	☑	9290	☐	☐	☑	☐		☐	☐	☐	☐		☐	☐	☐		☐		☐	☐	☐		☐	☐		☐	6-Jul-16	☐	6-Jul-16	☐
HWD B7T1 replacement	T-C014	No	☐		☐	17%	15-Jul-16	31-Aug-16	☐	☐		☐	☐	☑	☐		☐	☐	☐	☐		☐	☐	☐		☐		☐	☐	☐		☐	☐		☐	8-Jul-16	☐	8-Jul-16	☐
OPD B5C1 replacement	T-C129	No	☐		☐	17%	16-Jul-16	30-Aug-16	☐	☐		☐	☐	☑	☐		☐	☐	☐	☐		☐	☐	☐		☐		☐	☐	☐		☐	☐		☐	9-Jul-16	☐	9-Jul-16	☐