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

September 16, 2015

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

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

Dear Ms. Blundon:

Re: Recommendation 2.7: Liberty Consulting Group Supply Issues and Power Outages Review Island Interconnected System addressing Newfoundland and Labrador Hydro

In *Newfoundland and Labrador Hydro's Response to the Phase I Report by Liberty Consulting* – February 5, 2015, (page 16) Hydro proposed that each year it will file a report with the Board on Generation Adequacy. Enclosed is the report completed in September 2015.

Should you have any questions, please do not hesitate to contact the undersigned.

Yours truly,

NEWFOUNDLAND AND LABRADOR HYDRO

Tracey L. Pennell
Legal Counsel

TLP/cp

cc: Gerard Hayes – Newfoundland Power
Paul Coxworthy – Stewart McKelvey Stirling Scales
Sheryl Nisenbaum – Praxair Canada Inc.
Thomas Johnson – Consumer Advocate
Thomas O' Reilly – Cox & Palmer
Danny Dumaresque
ecc: Roberta Frampton Benefiel – Grand Riverkeeper Labrador

Investigation and Hearing into Supply Issues and Power Outages on the Island Interconnected System

Electrical
Mechanical
Civil
Protection & Control
Transmission & Distribution
Telecontrol
System Planning

A Report to the Board of Commissioners of Public Utilities On Generation Adequacy

Newfoundland and Labrador Hydro

September 2015

newfoundland labrador hydro
a nalcor energy company

1.0 Executive Summary

In its reply to the Public Utilities Board (the Board), titled *Newfoundland and Labrador Hydro's Response to the Phase I Report by Liberty Consulting (the Hydro Reply)*[1] – February 5, 2015, (page 16) Newfoundland and Labrador Hydro (Hydro) proposed:

> *As well, consistent with Liberty's recommendation 2.7, Hydro proposes that in August of each year it will file an update with the PUB providing:*
>
> 1. *The updated P90 load forecast for the period up to one year beyond the then anticipated interconnection date.*
> 2. *A summary of the previous winter's generation performance and an outlook of peak available generating capacity for each year of the load forecast.*
> 3. *The forecast generation reserves both in percentage and total MW's.*
>
> *In the event there are changes that result in the forecast reserve falling below 240 MW, Hydro will complete an assessment of the associated risks and report to the Board its recommended mitigations.*

The Labrador-Island Link and Maritime Link remain on schedule for in-service in Fall of 2017.

This report details the latest P90 forecast, the forecast of generation reserves to the end of 2018, and Hydro's generation performance over the previous year. It demonstrates that:

1. taking into account the 9.9 MW of Newfoundland Power curtailable load added to capacity at peak, the forecast peak has decreased in all years from the previous forecast peak provided in the Hydro reply.
2. reserve margins remain above 240 MW to the end of 2018. Percent Reserve Margins are slightly higher if 16 MW of Black Start Diesels remain in service and available to the system and slightly lower if they are not.
3. hydraulic Derated Adjusted Forced Outage Rates (DAFOR) are higher than planned but are trending back to 10-year rates, Holyrood's DAFORs have improved in the

[1] http://www.pub.nl.ca/applications/IslandInterconnectedSystem/files/corresp/NLH-Phase-I-Reply-Submission-re-Liberty-Group-Report-2015-02-06.pdf

current 12-month period and now stand at 10.06 percent, performance for the Holyrood CT is currently indicating higher availability than base planning assumptions[2] and while the UFOP for Hardwoods and Stephenville remains above the sensitivity rate, this can be largely attributed to an event that has occurred outside the winter season.

Analysis described in this report concludes that the generation available in the current system is adequate until the interconnections with Labrador and Nova Scotia are completed in 2017. Further, the analysis demonstrates that should the in-service date shift to 2018, current system generation continues to be adequate to meet reliability and reserve criteria.

[2] Due to in-service date of March 2015, data not available for entire period. Data provided from March through June 2015.

Table of Contents

2.0 Introduction

In *Newfoundland and Labrador Hydro's Response to the Phase I Report by Liberty Consulting (the Hydro Reply)*[3] – February 5, 2015, (page 16) Newfoundland and Labrador Hydro (Hydro) proposed:

> *As well, consistent with Liberty's recommendation 2.7, Hydro proposes that in August of each year it will file an update with the PUB providing:*
>
> 1. *The updated P90 load forecast for the period up to one year beyond the then anticipated interconnection date.*
> 2. *A summary of the previous winter's generation performance and an outlook of peak available generating capacity for each year of the load forecast.*
> 3. *The forecast generation reserves both in percentage and total MW's.*
>
> *In the event there are changes that result in the forecast reserve falling below 240 MW, Hydro will complete an assessment of the associated risks and report to the Board its recommended mitigations.*

In the following sections, this report looks at the latest P90 forecast, the forecast of generation reserves, and Hydro's generation performance to arrive at an assessment of Hydro's generation adequacy to the end of 2018, one year beyond 2017, the date of the interconnections with Labrador and Nova Scotia.

[3] http://www.pub.nl.ca/applications/IslandInterconnectedSystem/files/corresp/NLH-Phase-I-Reply-Submission-re-Liberty-Group-Report-2015-02-06.pdf

3.0 Capacity at Peak, Forecast and Reserve

This section discusses the current forecast, capacity at peak and reserve, as shown in Table 2 and Table 3. Additionally, it compares each to the figures in Table 1, which elaborates on information provided in Table 3.2 of *Newfoundland and Labrador Hydro's Response to the Phase I Report by Liberty Consulting (the Hydro Reply)*[4] – February 5, 2015.

3.1 Capacity at Peak

Capacity at peak is defined as the capacity available to the system at time of peak demand. The capacity at peak for the Island Interconnected System (IIS) was 1998 MW when Hydro completed its reply to the Liberty report, but has increased by 9.9 MW to 2008 MW, to account for the change in how NP curtailable load is treated, as described in Section 3.2. Additionally, the Holyrood Black Start Diesels are included in Table 1 at 10 MW; their capacity at the time of the Hydro Reply submission. In Table 2, the Black Start Diesel capacity has been increased to 16 MW. This reflects Hydro's current intention to submit a proposal to the Board to purchase these diesels and increase the system capacity by 16 MW. This will increase the capacity at peak to 2014 MW. Finally, in Table 3, the Black Start Diesel capacity has been reduced to 0 MW, indicating a capacity at peak of 1998 MW, if the diesels are removed from service.

Please see Table 5 for details of the Island Interconnected System capacity at peak.

3.2 Forecast and Reserve

Table 1 builds on information provided in Table 3.2 of the Hydro Reply by providing both P50 forecast information and LOLH details. LOLH information has been provided for both the base planning and sensitivity planning UFOP and DAFOR assumptions. These assumptions are described in detail in Section 4.0 Generation Performance.

- The base planning assumptions indicate the level of system reliability given a P90 forecast under normal operating conditions. The UFOP and DAFORs used in this

[4] http://www.pub.nl.ca/applications/IslandInterconnectedSystem/files/corresp/NLH-Phase-I-Reply-Submission-re-Liberty-Group-Report-2015-02-06.pdf

evaluation reflect the expected annual unavailability of each unit.

- The sensitivity planning assumptions indicate the level of system reliability given a P90 forecast under worst case operating conditions. The UFOP and DAFORs used in this evaluation reflect the maximum level of annual unavailability for all units concurrently.

Table 1: Forecast Reserve Margins Based on Current Forecast and 10 MW Capacity from Holyrood Blackstart Diesels

Winter	IIS P50 Peak[5]	IIS P90 Peak[1,5] (+57 MW)	Capacity at Peak[1,5]	w/ Voltage Reduction (+20 MW)[1]	w/ Capacity Assistance (+96 MW)[1]	Reserves (MW)[1]	% Reserve[1]	LOLH Planned UFOP/ DAFOR	LOLH Sensitivity UFOP/ DAFOR
2015 - 16	1756	1813	1998	2018	2114	301	16.6%	0.48	1.09
2016 - 17	1787	1844	1998	2018	2114	270	14.6%	0.83	1.82
2017 - 18[2]	1808	1865	1998	2018	2114	249	13.4%	1.10	2.32
2018 - 19[2]	1822	1879	1998	2018	2114	235	12.5%	1.37	2.86

1. Source: Table 3.2 the Hydro Reply
2. Assumes Isolated Island - No connection to Labrador or Nova Scotia
3. LOLH is calculated based on the P90 peak forecast
4. LOLH Sensitivity UFOP/DAFOR represents maximum
5. Does not include NP curtailable of 9.9 MW

Table 2: Forecast Reserve Margins Based on Current Forecast and 16 MW Capacity from Holyrood Blackstart Diesels

Winter	IIS P50 Peak[1]	IIS P90 Peak (+57 MW)	Capacity at Peak	w/ Voltage Reduction (+20 MW)	w/ Capacity Assistance (+96 MW[3])	Reserves (MW)	% Reserve	LOLH Planned UFOP/ DAFOR	LOLH Sensitivity UFOP/ DAFOR
2015 - 16	1758	1815	2014	2034	2127	312	17.2%	0.37	0.84
2016 - 17	1789	1846	2014	2034	2130	284	15.4%	0.64	1.43
2017 - 18[2]	1811	1868	2014	2034	2130	262	14.0%	0.87	1.87
2018 - 19[2]	1811	1868	2014	2034	2130	262	14.0%	0.87	1.87

1. Source: System Planning - Customer Winter Peak Demand Forecast
   Island Interconnected System (60 Hz) - June 30, 2015
2. Assumes Isolated Island - No connection to Labrador or Nova Scotia
3. Capacity Assistance +93 MW in 2015 - 16, reflecting 13 MW Vale Capacity Assistance.
   Vale Capacity Assistance of 15.8 MW in all other years.
4. LOLH is calculated based on the P90 peak forecast

Table 3: Forecast Reserve Margins Based on Current Forecast and 0 MW Capacity from Holyrood Blackstart Diesels

Winter	IIS P50 Peak[1]	IIS P90 Peak (+57 MW)	Capacity at Peak	w/ Voltage Reduction (+20 MW)	w/ Capacity Assistance (+96 MW[3])	Reserves (MW)	% Reserve	LOLH Planned UFOP/ DAFOR	LOLH Sensitivity UFOP/ DAFOR
2015 - 16	1758	1815	1998	2018	2111	296	16.3%	0.49	1.10
2016 - 17	1789	1846	1998	2018	2114	268	14.5%	0.85	1.84
2017 - 18[2]	1811	1868	1998	2018	2114	246	13.2%	1.14	2.38
2018 - 19[2]	1811	1868	1998	2018	2114	246	13.2%	1.14	2.38

1. Source: System Planning - Customer Winter Peak Demand Forecast
   Island Interconnected System (60 Hz) - June 30, 2015
2. Assumes Isolated Island - No connection to Labrador or Nova Scotia
3. Capacity Assistance +93 MW in 2015 - 16, reflecting 13 MW Vale Capacity Assistance.
   Vale Capacity Assistance of 15.8 MW in all other years.
4. LOLH is calculated based on the P90 peak forecast

The Labrador-Island Link and the Maritime Link will be in-service in the Fall of 2017, however for purposes of demonstrating the potential effects of a delay in the interconnections to Nova Scotia and Labrador, Tables 2 and 3 assume an Isolated Island scenario i.e. no interconnection to Labrador or Nova Scotia. The current forecast assumes the completion of the third circuit from Bay d'Espoir to Western Avalon in 2018 (TL-267) and a corresponding drop in transmission losses on peak.

The treatment of NP Curtailable has also changed in the current forecast. In the forecast provided in Table 1, it was assumed that the NP Curtailable load would be curtailed on peak, and therefore the NP load, and thus the peak demand, would be reduced by 9.9 MW. In the current forecast in Table 2 and Table 3, the NP Curtailable Load is not curtailed on peak, so the full load is shown, however, 9.9 MW has been added to the capacity at peak. To summarize, in the Table 1 forecast, both the peak demand and capacity at peak are reduced by 9.9 MW, to account for NP Curtailable Load. The Table 2 and Table 3 forecast ("current forecast") includes the NP Curtailable Load in the peak demand as well as the capacity at peak, given the nature of the curtailable load program.

Taking the current forecast and adjusting for the 9.9 MW of curtailable load provides the basis for comparison to the forecast provided in the Hydro Reply. Note that once the adjustment has been made, it clearly indicates that the forecast has decreased in all years, as indicated in the right most column of Table 4.

Table 4: Forecast Comparison

	IIS P90 Peak			
Winter	Current Forecast (MW)	Current Forecast less 9.9 MW curtailable (MW)	Previous Forecast[1] (MW)	Change in Forecast peak (MW)
2015-16	1815	1805	1813	-8
2016-17	1846	1836	1844	-8
2017-18	1868	1858	1865	-7
2018-19	1868	1858	1879	-21

1. Previous forecast refers to the forecast submitted as part of the Hydro Reply

Further analysis of Tables 1, 2 and 3 indicates that, regardless of whether the Black Start Diesels remain in service, reserves do not drop below 240 MW. If the units are removed from service, reserves decrease to 246 MW. However, if the units remain in service, reserves increase to 262 MW, increasing the buffer from 240 MW.

Hydro's current generation reliability capacity criterion is:

Capacity: The Island Interconnected System should have sufficient generating capacity to satisfy a Loss of Load Hours (LOLH) expectation target of not more than 2.8 hours per year[5].

As noted in Tables 2 and 3, the current system does not violate the LOLH criteria, regardless if the Black Start Diesels remain in service.

Please see Table 5 for current capacity at peak detail.

[5] LOLH is a statistical assessment of the risk that the System will not be capable of serving the System's firm load for all hours of the year. For Hydro, an LOLH expectation target of not more than 2.8 hours per year represents the inability to serve all firm load for no more than 2.8 hours in a given year.

Table 5

Island Interconnected System Capacity at Peak – As of August 2015	
(Assumes Holyrood Blackstart Diesels at 10 MW).	**Gross Continuous Unit Rating [MW]**
Newfoundland & Labrador Hydro	
Bay d'Espoir	613
Upper Salmon	84
Hinds Lake	75
Cat Arm	134
Granite Canal	40
Paradise River	8
Snook's, Venam's & Roddickton Mini Hydros	0
Total Hydraulic	954
Holyrood	490
Combustion Turbines	223
Diesels	24
Total Thermal	738
Total NL Hydro	**1,692**
Newfoundland Power Inc.	
Hydraulic	76
Combustion Turbine	36
Diesel	5
Curtailable	10
Total	128
Corner Brook Pulp and Paper Ltd.	
Hydraulic	99
Star Lake and Exploits Generation	
Star Lake	18
Exploits	63
Total	81
Non-Utility Generators	
Corner Brook Cogen	8
Rattle Brook	0
St. Lawrence Wind	0
Fermeuse Wind	0
Total	8
Total Island Interconnected System	**2,008**

4.0 Generation Performance

Along with peak demand and capacity at peak, generation reliability is also determined by the performance of the units. If unit forced outage rates are trending upward, indicating less reliable performance, this would be cause to reexamine the reserve margins, to determine if they remain adequate. The forced outage rates are provided for generating units at hydraulic facilities, the three units at the Holyrood Thermal Generating Station (HTGS) and Hydro's gas turbines for the current 12-month reporting period of July 1, 2014 to June 30, 2015. Generating unit data on forced outage rates for the previous 12-month period, July 1, 2013 to June 30, 2014, is also provided for comparison purposes. Further, total asset class data is presented on an annual basis for the years 2004-2013. This report provides data on outage rates for forced outages only and does not include information on planned outages.

The forced outage rates of Hydro's generating units will be presented using two measures: Derated Adjusted Forced Outage Rate (DAFOR) for the hydraulic units and the HTGS, and Utilization Forced Outage Probability (UFOP) for the gas turbines. Derated Adjusted Forced Outage Rate (DAFOR) is a metric that measures the percentage of the time that a unit or group of units is unable to generate at its Maximum Continuous Rating (MCR) due to forced outages. The DAFOR for each unit is weighted to reflect differences in generating unit sizes in order to provide a company total and reflect the relative impact a unit's performance has on overall generating performance. This measure is applied to hydraulic and thermal units. However, this measure is not applicable to gas turbines because of their nature as a standby unit and therefore low operating hours.

Utilization Forced Outage Probability (UFOP) is a metric that measures the percentage of time that a unit or group of units will encounter a forced outage and not be available when required. This metric is used for the gas turbines.

Included in the forced outage rates are outages that remove the unit from service completely, as well as instances when units were de-rated. If a unit's output is reduced by more than 2 percent, the unit is considered de-rated by Canadian Electricity Association

(CEA) guidelines. Per CEA guidelines, to take into account the de-rated levels of a generating unit, the operating time at the de-rated level is transformed into an equivalent outage time.

Hydro prepares and submits a *Quarterly Report on Performance of Generating Units* to the Board. The latest was submitted on July 17, 2015[6]. The following section contains further analysis of data provided to the Board as part of that report. For more information about specific outages that contributed materially to forced outage rates exceeding those used in Hydro's generation planning analysis, please refer to that report.

[6] http://www.pub.nl.ca/applications/IslandInterconnectedSystem/files/reports/NLH-Q2ReportontheRolling12MonthPerformanceofHydrosGeneratingUnits-2015-07-17.pdf

Table 6: Unit Performance, period ending June 30, 2015

Class of Units	July 1, 2013 to June 30, 2014 (%)	July 1, 2014 to June 30, 2015 (%)	Base Planning Assumption (%)	Sensitivity Planning Assumption (%)
Hydraulic	4.98	2.85	0.90	-
Thermal	22.99	10.06	9.64	11.64
Hardwoods and Stephenville Gas Turbines	13.32	26.98	10.62	20.62
Holyrood CT	-	1.33[7]	5.00	10.00

Table 6 provides information on performance for the current period (12-month period ending June 2015), the previous period (12-month period ending June 2014), base planning assumptions and sensitivity planning assumptions for each asset class. The hydraulic and thermal DAFOR performance improved in the current period compared to the previous period. The gas turbine UFOP performance declined in the current period compared to the previous period. For in-depth analysis of DAFOR and UFOP information for the 10-year period prior to 2014, please refer to the *Quarterly Report on Performance of Generating Units.*

Base planning assumptions are indicators used in the planning model. The DAFOR and UFOP assumptions are representative of a historic average of the actual performance of these units over the five years 2008 – 2012. Hydro also provides a "Sensitivity Planning Assumption" number for DAFOR and UFOP as part of its generation planning analysis. This number takes into account a higher level of unavailability, should it occur, to assess the impact of higher unavailability of these units on overall generation requirements. The analysis demonstrated that with the implementation of the new gas turbine generating unit at Holyrood and the capacity assistance arrangements, the LOLH reliability criterion will be met beyond 2018. If actual unit DAFORs and UFOPs are trending above the sensitivity level, this would warrant a closer look to determine if the reserve margin levels that have been set are still adequate.

[7] Due to in-service date of March 2015, data not available for entire period. Data provided from March through June 2015.

Hydraulic DAFORs are higher than planned, however are trending back towards 10-year rates. The increase in hydraulic DAFORs was largely due to issues with the unit rectifying transformers at Bay d'Espoir, which will all be replaced by the end of November 2015.

The 10.06 percent DAFOR for Holyrood thermal units is notably improved compared to the previous 12-month period when the rate was approximately 23 percent. This rate is more in line with the planned rate of 9.64 percent, and lower than the sensitivity rate of 11.64 percent.

The UFOP for the gas turbines for the 12-month period ending June 30, 2015 indicates higher unavailability due to the deration of Hardwoods to 25 MW[8] since March 1, 2015 and a forced outage on the Stephenville unit from May 1 to 27. While the UFOP remains above both the base planning rate of 10.62 percent and the planned sensitivity rate of 20.62 percent, the deration of the Hardwoods unit has occurred during the maintenance season and, given its anticipated return to 50 MW in Fall of 2015, it will be available for the Winter 2015-16 season.

The new gas turbine (Holyrood CT) has a lower expected rate of unavailability than the original gas turbines, 5 percent compared to 10.62 percent respectively, due to the fact that the unit is new and can be expected to have better availability than the older units. As the System in-service date for this unit was March 2015, data is not yet available for an entire 12-month period. The 1.33 percent UFOP presented is based on the available data at this time (March through June 2015), and currently indicates lower unavailability than the base planning assumption of 5.00 percent.

[8] The Hardwoods unit is currently derated to 35 MW and is expected to be back to 50 MW later this fall, pending approval of the application for the Hardwoods Gas Turbine Engine Refurbishment, submitted September 4, 2015.

5.0 Conclusion

This report details the latest P90 forecast, Hydro's generation performance and the forecast of generation reserves. It demonstrates that:

1. taking into account the 9.9 MW of Newfoundland Power curtailable load added to capacity at peak, the forecast peak has decreased in all years from the previous forecast peak provided in the Hydro reply.
2. reserve margins remain above 240 MW to the end of 2018. Percent Reserve Margins are slightly higher if 16 MW of Black Start Diesels remain in service and available to the system and slightly lower if they are not.
3. hydraulic Derated Adjusted Forced Outage Rates (DAFOR) are higher than planned but are trending back to ten-year rates, Holyrood's DAFORs have improved in the current 12-month period and now stand at 10.06 percent, performance for the Holyrood CT is currently indicating higher availability than base planning assumptions[9] and while the UFOP for Hardwoods and Stephenville remains above the sensitivity rate, this can be largely attributed to an event that has occurred outside the winter season.

From this analysis, it is demonstrated that the current system is adequate until the interconnections with Labrador and Nova Scotia are completed in 2017. Further, the analysis demonstrates that, should the in-service date shift to 2018, current system generation continues to be adequate to meet reliability and reserve criteria, provided the third circuit from Bay d'Espoir to Western Avalon (TL-267) is completed in 2018 to reduce losses.

[9] Due to in-service date of March 2015, data is not available for entire period. Data provided from March through June 2015.