Q: Reference: *Review of Newfoundland and Labrador Hydro Power Supply Adequacy and Reliability Prior to and Post Muskrat Falls Final Report,* page ES-3.

"Adequate backup capacity will be new combustion turbines or firm, dependable capacity from Nova Scotia via the Maritime Link."

Given that Liberty has performed services for the Nova Scotia Utility and Review Board, is Liberty aware of any existing transmission constraints in the Maritime Provinces that may limit Hydro's ability to acquire firm capacity that can be delivered via the Maritime Link? If so, please explain.

A. Liberty addressed transmission constraints in its latest report to the Nova Scotia Utility and Review Board (NS UARB), "Audit of Nova Scotia Power, Inc.'s Fuel Adjustment Mechanism for 2014-2015", which was issued on August 12, 2016. This report is available on the NS UARB website. Liberty has included, as Attachment 1, a redacted copy of an extract from Chapter X of that report, which includes discussions of transmission limitations.

In addition, Newfoundland and Labrador Hydro, Nova Scotia Power, and New Brunswick Power are jointly studying this topic. Selected results regarding transfer limits are included on Page 103 of Liberty's report.

X. Power Purchases and Sales

A. Background

NS Power has traditionally relied predominantly on its own generation to serve its load, depending much less on power purchases. However, a current transition for the Company will increase its power purchases to almost 47 percent of total energy requirements within the next three to four years. Its Audit Period purchases fell into three principal categories:

- Long-term contracts from solicitations for independent or renewable power, undertaken in response to provincial renewable requirements
- Short-term purchases from the power markets to the west and from New England, when management can buy on a real-time (hourly) basis at a delivered price lower than the marginal cost to generate with its own units.
- Term imports of market power acquired through RFP solicitations that seek economic replacement of Company generation.

NS Power conducted several competitions for independent or renewable power over the years prior to 2010. A 2007 solicitation focused on the acquisition of substantial amounts of renewable energy required to meet Nova Scotia's renewable energy standard ("RES") of five percent of energy production in 2010 and 10 percent in 2013. Deliveries from these projects began in 2010, and continued through 2015, with 361.8 MW of contracted wind production operating at the end of 2015. NS Power is a joint venture minority owner in some of the wind projects, which it joined to stabilize projects experiencing financing difficulties. The South Canoe Partnership (102 MW) and the Sable Wind project (13.8 MW) joint ventures came online in 2015. The Company also owns 100 percent of two wind projects totaling 80 MW, and operating Community-Based Feed-In Tariff ("COMFIT") projects of 107.4 MW brought total wind on the system to 549 MW at the end of 2015.

In previous FAM audits, Liberty concluded that management should improve the identification, solicitation, pursuit of transmission issues, and evaluations of opportunities for term power purchases. NS Power began regular solicitations for monthly power purchases in the spring of 2011. Management has continued issuing regular RFPs for term power through November 2015. The Company established term import procedures in 2011 and updated them in December 2013.

B. Findings

The following table presents the power quantities and costs associated with power purchases and power exports for each of the two years of the Audit Period. The table also provides 2013 information for comparative purposes.

(The following chart is confidential)

				Production (MWh)					
				Actual	Budget *	CF	Actual	Budget **	CF
	Counterparty	Location	Capacity	2014			2015		
#	COMFIT								
	[redacted]								
	Total Other IPPs								
	Total IPP / COMFIT Renewables								

* 2014 Budget: 2014 Compliance (GRA)
** 2015 Budget: 2015 FAM Refresh (Nov. 2014)

c. Non-Wind IPPs

NS Power's non-wind IPPs originally resulted from a solicitation required following the construction of Point Aconi Unit 1. NS Power has contracts with six IPPs, with only the Brooklyn project large enough to produce substantial amounts of energy. The contracts for these IPPs do not fix production volumes; NS Power buys whatever they produce (but see Chapter Nine, which discusses an alternate arrangement that has existed for Brooklyn). The Company prepares internal forecasts of production from each project, using the most recent three years of production data.

2. Term Imports

NS Power has historically made most import power purchases on an hourly basis, employing 24-hour block purchases occasionally. Maintenance outages have occasionally led to one- or two-week purchase opportunities. Management further explored the markets for economic term purchases from two weeks to two years or more, and established regular solicitations through RFP processes.

Management began issuing written RFPs for month-long power supplies in March 2011. Regular RFP processes followed through the Audit Period, with increasing variety in the energy products requested and in the terms for import purchases made. RFPs in 2014 and 2015 went to five active suppliers: [redacted] beginning in July 2015. [redacted] marketing agent prior to 2015. [redacted] did not receive RFPs starting in March 2015, when [redacted] with NS Power. In 2013, [redacted] replaced [redacted] as NS Power's agent in the ISO-New England power market, buying power in ISO New England and delivering it to NS Power at the U.S.-Canada border.

a. 2014 RFP Processes

NS Power conducted four 2014 RFP processes for term-purchase imports. The first, in October 2013, requested seasonal delivered purchase offers for December 2013 and January and February 2014. Three subsequent RFPs made solicitations for two months of energy: April/May, July/August and September/October. Management issued no RFPs for March, November or December, expecting ample coal-fired generation and little likelihood that import markets would offer lower term pricing.

Each RFP requested a standard purchase volume of up to 100 MW, delivered at the Nova Scotia/New Brunswick intertie. The RFPs requested peak weekday energy (5 by 16) or peak energy for all days of the week (7 by 16). The RFPs stated a preference for a fixed-price product, but made clear that NS Power would consider other volumes, delivery locations, hours and days of delivery, and pricing methods.

Management recognized in these RFP's the lack of available firm transmission through New Brunswick, which precluded the delivery of firm energy to NS Power. Inability to deliver firm energy to Nova Scotia on a term basis due to transmission constraints in New Brunswick has comprised a problem area for some time, continuing through 2014 and 2015.

NS Power's 2014 RFPs resulted in one economic term import purchase for two months - - a purchase of 100 MW from [redacted] for September and October. The purchase covered seven days per week, 24 hours per day, with sourcing from the [redacted]. The Company's analysis estimated a financial advantage of [redacted] per megawatt hour from this purchase, when compared with internal generation as an alternative.

The other three 2014 RFPs did not produce economic alternatives. Two offers (from one counterparty) came in the RFP process for December, January and February. No offers came in response to the April/May process, with management citing Quebec interconnection maintenance and generation maintenance in New Brunswick as disrupting factors. The July/August RFP process generated only two offers, both from [redacted], and both evaluated as uneconomic. Potential term suppliers have learned that the absence of firm transmission through New Brunswick makes term firm energy delivery to Nova Scotia impossible, which has likely discouraged offers. Using non-firm transmission through New Brunswick results in curtailments of actual purchases made in the term RFP processes, reducing benefits to NS Power significantly.

b. 2015 RFP Processes

NS Power conducted four RFPs for term-purchase power products during 2015. The first, for January and February 2015, requested offers for three products of up to 100 MW: 7 days by 16 hours, 5 by 16 and 7 by 24. [redacted] made three offers: 50 MW for 7 by 24 for January only, and 100 MW for 7 by 16 and for 7 by 24 for both January and February. Management's analysis determined that the landed price offered by [redacted] exceeded forecasted costs of internal solid-fuel and natural-gas generation costs. Offer pricing well exceeded the costs of coal-fired generation for off-peak hours, with coal units available during the winter months. The offered pricing also exceeded forecasted costs of natural gas generation used during peak hours in the winter.

NS Power did not issue RFPs for the months of March through July 2015. [redacted]

Management later resumed solicitations, issuing an RFP for the months of August and September 2015. [redacted] received the term RFP directly for the first time, and [redacted] was eliminated from the list. The RFP requested pricing for up to 100 megawatts of three products for the two months: (a) Product 1 for 7 days by 16 hours for August only, (b) Product 2 for 7 by 16 for September only, and (c) Product 3 for 7 by 16 for August and September. The RFP went to [redacted], [redacted] and [redacted]. [redacted] indicated interest in submitting an offer. [redacted] both indicated interest, but expressed concern about getting the energy to the NB/HQ interface, due to the lack of available firm transmission in Québec. Firm transmission in New Brunswick was also not available in volumes greater than 20 MW.

One offer came from [redacted] and two offers came from [redacted] [redacted] offered 100 MW for 7 days by 16 hours, contingent on [redacted], for September only. [redacted] offered 20 MW for 7 by 16 for both August and September, to be delivered to the Hydro-Québec/New Brunswick interface. [redacted] did not offer delivery to Nova Scotia. Management evaluated the [redacted] product as economic for both August and September. NS Power purchased 20 MW of firm transmission through New Brunswick, from HQ to Nova Scotia to support delivery on a firm path, not subject to curtailment.

Term RFPs went to the same supplier group for the one-month delivery periods of October and November. [redacted] and [redacted] made offers of [redacted] and [redacted] MW, respectively, for October. Management found the pricing of both offers above NS Power's marginal generation costs, and chose not to purchase.

Management received one offer from [redacted] in the November RFP process. The offer was for 30 MW for 7 by 16, delivered to Nova Scotia. The price included non-firm transmission purchased by [redacted] to New Brunswick to Nova Scotia. Management evaluated this offer as beneficial and made the purchase, providing benefits of [redacted] per MWh, but expected transmission curtailments to reduce the benefit.

c. NS Power Term Power Import Procedures

Management drafted "Term Power Import Procedures" in September 2011, updating them in September 2013. At that time, FERM managers performed a review of certain of the procedures, considering market-related observations from the RFP processes. One conclusion found that the current target size for monthly power imports of 100 MW, or about one-third of the Nova Scotia/New Brunswick intertie when fully available, had worked well previously. Market responses to the target size level appeared favorable. NS Power continued with 100 MW as the requested level for term purchases during 2014 and 2015. Management has also expressed the desire to preserve flexibility for short-term purchases, [redacted].

The 2013 review of energy product firmness considered the New Brunswick system operator's reduction of firm transmission availability to zero. Management decided that this reduction required a change to the firmness categorization of its purchases from firm to non-firm. Non-firm imports impose additional operating-reserve requirements on NS Power, requiring maintenance of one MW of reserve for every MW of non-firm energy purchased. This requirement does not present problems at times when the turbines operate only occasionally (*e.g.*, March, April and May), but presents challenges during periods of high demand. Further, the unavailability of firm transmission through New Brunswick has discouraged potential suppliers of larger volumes of term energy, which require a firm transmission path.

3. Short-Term Purchases and Sales

The day-ahead and real-time traders continually compare the cost of on-system generation to market counterparty pricing to assess the economy of power imports and exports. Short-term purchases cover from one hour to several hours, to as much as one week, depending on the season, market pricing and the incremental cost of the Company's system generation. Short-term purchases have traditionally been made from [redacted] and from the Massachusetts energy Hub.

The following tables show the number of short-term purchase and sale transactions and related volumes by counter-party for 2014 and 2015

Short-Term Import Volumes (MWh) and Transactions

Company	2014	2015	Total	2014	2015	Total
	Volume			Transactions		
[redacted]						
Total	**355,751**	**426,521**	**782,272**	**753**	**1,277**	**2,030**

Short-Term Export Volumes (MWh) and Transactions

Company	2014	2015	Total	2014	2015	Total
	Volume			Transactions		
[redacted]						
Total	**9,611**	**32,813**	**42,424**	**42**	**153**	**195**

Power Imports, Peak and Off-Peak (MWh)

Period	2014		2015	
	Monthly	Short-Term	Monthly	Short-Term
On-Peak	63,450	123,612	20,051	189,993
Off-Peak		104,801	10,705	205,772

[redacted] was by far the largest-volume counterparty for NS Power, accounting for about [redacted] of short-term imports in 2014, increasing to about [redacted] in 2015. [redacted] also accounted for [redacted] of short-term exports in 2014 and 2015, but export volumes were small. [redacted] is NS Power's [redacted], given geographic proximity and the availability of short-term transmission paths between [redacted]. In 2013, NB Power generation replaced PPL Power Plus as NS Power's trader for hourly transactions at the Massachusetts Hub, [redacted].

While firm transmission has been severely constrained, the New Brunswick System Operator has made transmission (beyond that offered on a firm basis) available to the market on a day-ahead basis. These short-term offerings make the potential for hourly or daily imports greater than exists for the weekly, monthly, seasonal or long-term purchases more suited for firm transmission. NS Power classified about [redacted] of the import volumes as "monthly" in 2014, with that amount decreasing to [redacted] in 2015, leaving [redacted] to short-term purchases.

The preceding table shows that on-peak purchases comprised a majority of power imports in 2014, with on-peak and off-peak purchases nearly equal in 2015. Greater opportunities for economic power imports occur during peak periods, when NS Power's marginal generation costs become higher, and therefore more likely to be displaced by lower-priced market alternatives.

4. Transmission Limitations

The New Brunswick/Nova Scotia intertie currently provides NS Power's only connection to other electric systems, operating as the only path for power flows in and out of Nova Scotia. The intertie consists of one 345 kV line and two 138 kV lines, which have a combined physical transfer capability of 550 MW. NS Power sets its import limit at 300 MW, and the export limit at 350 MW. The NS Power import limit actually operates as the lesser of 300 MW or 22 percent of the Company's load, in order to limit the amount of load shedding due to under-frequency following

contingencies. This self-imposed NS Power limit protects system reliability, but more severe transmission limits actually constrain import capability. A load pocket in the Moncton area and the inability to transmit power regularly across New Brunswick from Québec causes these more severe limits. The New Brunswick transmission constraints for which the New Brunswick System Operator has applied operating limits have resulted in recurring and very substantial barriers for NS Power in arranging term power purchases with economics that would lower overall fuel costs.

a. Interconnection as a Source for Balancing Wind

NS Power has to date been able to handle the balancing requirements of wind-powered generating facilities on its system with current resources, primarily through the use of its hydroelectric facilities and combustion turbines, which have an ability to start quickly. Management also employs the flexibility inherent in its generating fleet to shut off some of its generating units during low-load periods, and restart them in advance of higher-load periods. These resources alone may not be sufficient for balancing the additional wind expected on the system in the next few years, however.

Connections to neighboring systems can provide important sources of balancing capability. Simulations performed for the GE Renewable Energy Integration Study suggested that ties to neighboring systems have significant value as a source of balancing. Those studies suggest that most balancing transactions would involve flows of less than 100 MW. Management has observed that combining NS Power's own-system balancing resources with the current tie would prove adequate to handle the incremental balancing requirements for up to 600 MW of wind capacity.

b. Limits to Power Imports

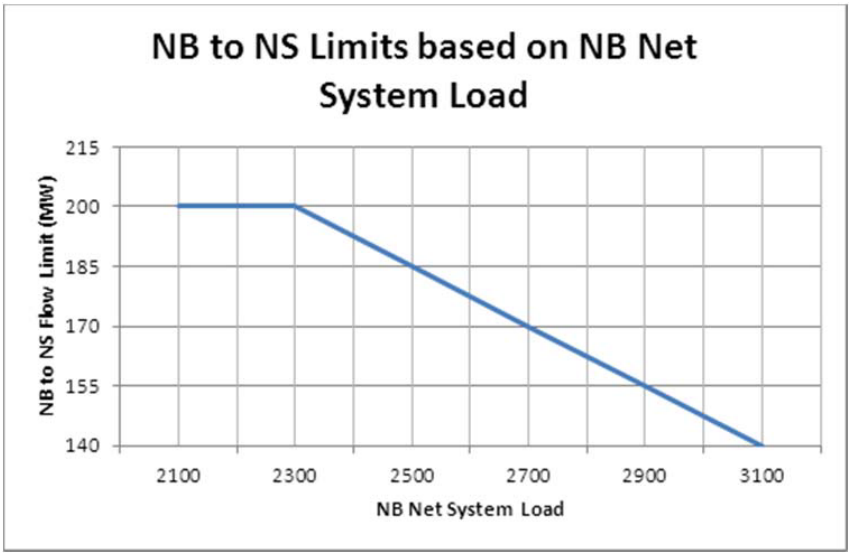
The NB system operator has a posted value of 405 MW for the total transfer capacity (TTC) on the intertie between New Brunswick and Nova Scotia. New Brunswick must maintain firm transmission capacity of 105 MW in both summer and winter to facilitate a reserve-sharing agreement with NS Power, leaving 300 MW of available transmission and transfer capability into Nova Scotia.

The firm and non-firm transfer capabilities from New Brunswick into Nova Scotia have fallen drastically during the past five years. The following chart demonstrates transfer capacity revisions that have served to reduce firm transfer capability to Nova Scotia from 300 MW to zero in the winter months (20MW in the summer months), and non-firm transfer capability from 550 MW to 200 MW, dependent on events in New Brunswick.

New Brunswick to Nova Scotia Transfer Capability Changes, 2009-2015

Date	Firm Transfer Capability (MW)	Non-firm Transfer Capability (MW)	Total Transfer Capability (MW)
10/1/2009	300	550	550
10/1/2010	250	480	480
10/1/2011	0	405	405
10/1/2012	0	405	405
10/1/2013	0	100	405
12/31/2014	0	200	405
12/31/2015	0	200	405

When New Brunswick system load levels exceed 2,300 MW in New Brunswick, non-firm transfer capability available falls further, as shown below.



A recent internal study completed by the New Brunswick System Operator in January 2016 suggests that firm transfer capability to Nova Scotia and PEI could be increased to 200 MW, for a relatively low cost. The New Brunswick System Operator issued a report that addressed firm and non-firm transmission restrictions to Nova Scotia and Prince Edward Island. The objectives of the study were to address optimizing the transmission system to take advantage of opportunities, and to address NB Power Marketing's request for an additional 50 MW firm export capability to PEI.

NS Power representatives have also reported a current technology assessment of the NB transmission system, which could lead to increasing transfer capability to Nova Scotia. The firm of SNC Lavalin began this study in September 2015, seeking to evaluate new solutions for increasing transfer capability with minimal capital investments. Such solutions might include controls and limitations on the transmission system, or the installation of reactive power devices (such as NS Power uses in the Halifax area to allow system operation without using Tufts Cove for voltage support). Such devices provide reactive power to counter contingencies, and could have the potential for solving the Moncton New Brunswick congestion at fairly low cost. NS Power reports that SNC Lavalin finished the study, delivering a final report to NB Power in April 2016. NB Power apparently plans additional studies to improve system reliability there, thus making the report interim. NB Power has not provided the report to NS Power.

The pending arrival of power from Labrador, delivered via Newfoundland and Nova Scotia complicates the existing situation. The Maritime Link generally has been considered to have a positive impact on the ability to import power to Nova Scotia through the NB/NS interties. Power flowing from Nova Scotia to New Brunswick "off-loads" NB Power's transmission system, by supplying Moncton partially from the east, instead of completely from the west. Such east-to-west flows envision Nalcor's power exports to markets beyond Nova Scotia, after the Maritime Link enters service. The "unloading effect" of Nalcor/Maritimes Link power can positively affect

simultaneous transmission constraints, but it will not cause the return of any firm transfer capability from New Brunswick into Nova Scotia. The Maritime Link can actually decrease import capability from New Brunswick in some cases.

Management at NS Power observed that, absent NB Power reinforcements in the Moncton area, imports from New Brunswick will have simultaneous import limits. When the Maritime Link operates at its full capacity of 475 MW net to Nova Scotia, NS Power's ability to import simultaneously from New Brunswick will face restrictions. Availability will be a function of the load in the Moncton area, producing different summer and winter relationships. For example, with the Maritime Link operating at 300 MW in the winter, NS Power would be able to import 200 megawatts from New Brunswick on a non-firm basis. In contrast, with the Maritime Link operating at 475 MW in the winter, NS Power would not be able to import any energy from New Brunswick simultaneously.

These relationships resulted from work NS Power has done on its own, based on management's understanding of New Brunswick circumstances and restrictions. A joint planning study currently underway by NB Power, NS Power and Newfoundland and Labrador Hydro appears likely (or at least possibly) to shed further and more definitive light on this issue. In any event, one possible outcome appears to be even greater restrictions on importing energy from New Brunswick during winter months.

c. Costs of Addressing Transfer Capability

Several studies have addressed the cost of addressing the New Brunswick transfer problem. A 2010 study for Emera Energy, NB Power Transmission Corporation, and NS Power estimated the cost of "larger transfer capability" to Nova Scotia at $411 Million. A later study for Nalcor Energy came to the same conclusion. Both studies, however, examined a very large (800 MW) transfer capability.

The recent internal study performed by the New Brunswick System Operator suggests that fairly low costs can produce material, but smaller improvements in transfer capability. The SNL Lavalin study recently submitted to NB Power also sought options for improving transfer capability at lower cost. We also understand that NB Power's study efforts include examining how much increase would result from various levels of expenditure. The potential that results of this study could have important implications for firm and non-firm transfer capabilities for Nova Scotia make it important for NS Power to urge completion and use in looking at specific alternatives as soon as practicable.

As noted earlier, NS Power currently sets its import limit at 300 MW or 22 percent of the Company's load, to protect its system. How that limit might change with various levels of flow from Labrador and Newfoundland also awaits further study.

C. Conclusions

1. NS Power has continued its progress in integrating greatly increased wind resources into its power supply mix.

NS Power currently has about 549 MW of operating wind resources on its system (IPPs of 361.8 MW, Digby and Nuttby at 80 MW, COMFIT of 107.4 MW). Management estimates a future level of 622 MW of wind resources, including the Company-owned wind projects. Integrating the variable wind resources presents significant challenges, which are being addressed appropriately. Management has been able to balance variable wind resources to date, primarily through the use of its Wreck Cove hydroelectric resource.

Management has properly prepared for recent high growth in wind resources. For example, changes in operating procedures provide for two-shifting Lingan coal-fired units, thus improving balancing capability. Management is also modifying the Burnside 4 unit to provide fast-acting generation. Wind forecasting tools are being implemented with AWS True Power and management is updating the New Brunswick inter-tie tariff for hourly imbalances.

The Maritime Link and Muskrat Falls energy from Nalcor will become key assets for balancing wind resources in future years.

2. Management has performed effectively in budgeting and forecasting wind resources.

NS Power's performance in forecasting and budgeting for its wind resources has been accurate, ranging within a moderate, five percent band in 2014 and 2015. When considering the uncertainty of timing of IPP and COMFIT wind projects and operational issues, the budgeting performance has been effective.

The 4.6 percent 2014 production variance resulted primarily because three of the larger projects (Glen Dhu North, Dalhousie and Amherst) produced greater-than-budgeted volumes, with a partial offset from under-production by Lingan and Point Tupper 3. Actual 2015 production from wind projects ran about 5.5 percent less than budgeted amounts. The variance resulted from late start-up of the 115 MW capacity of the South Canoe and Sable projects, whose production volume the project developers had estimated.

Management has also been diligent in developing and upgrading its forecasting methods for wind resources. Using AWS forecasting services helps to produce ongoing improvement in wind forecasting.

3. NS Power's short-term economic import purchases from NB Power have increased very substantially.

NB Power has become by far the largest volume counterparty for NS Power, representing over [redacted] of short-term imports by 2015. NB Power also accounts for [redacted] of short-term exports during the Audit Period. NB Power also acts as NS Power's agent for transactions at the Massachusetts Hub, further increasing import volumes associated with this counterparty.

The New Brunswick system operator makes additional transmission available to the market on a day-ahead basis. Transmission availability in New Brunswick is greater on a day-ahead basis, making the possibilities for hourly or daily economic purchase imports greater than those for weekly, monthly, seasonal or long-term purchases.

4. Management operates under reasonable procedures, and uses effective evaluation techniques and recommendation formats when soliciting term power imports.

Management has appropriately followed sound procedures. The determination of economic import requirements and the details of RFP solicitation documents (*e.g.*, size, product firmness, and contract duration) undergo occasional review by FERM managers, who have made adjustments based on market feedback and learning from the solicitations. The reviews of the procedures have resulted in RFP processes that have appropriately tested power markets with regard to several product variables.

Management has improved the evaluation of proposals generated by the RFPs by including economic analysis of transmission curtailments on term-purchase opportunities, as recommended by Liberty in the 2014 FAM Report. NS Power has also maintained sufficient solicitation documentation, which includes the RFP documents, bidder lists, counterparty conversation logs, proposals received, financial evaluations of alternatives, recommendation memos, and deal documentation.

5. Audit Period market solicitations for term power produced weak response, largely because New Brunswick transfer capability restrictions failed to support the acquisition of firm transmission capacity to support delivery.

NS Power conducted four RFP processes covering eight months of 2014 for two-month purchases of up to 100 MW. One bidder offered in response to the RFP for January and February delivery; none made offers in response to the RFP for April and May, and one party offered in response to the RFP for July and August. None of these offers proved economic. NS Power conducted six RFP processes covering eight months of 2015 for term purchase power products. NS Power purchased 20 MW from [redacted] for August and September 2015. NS Power also purchased 30 MW from [redacted] for November, delivered to Nova Scotia with firm transmission provided by the seller.

It has become clear to the market that an absence of firm transmission through New Brunswick makes term firm energy delivery to Nova Scotia largely impossible. The alternative, non-firm transmission through New Brunswick, risks curtailments in deliveries, discouraging offers and threatening the economics of purchases that NS Power might otherwise find useful in reducing costs to customers.

6. Assessments of the ability to import power through New Brunswick have not reached a satisfactory conclusion. *(Recommendation #1)*

Since 2011, the New Brunswick System Operator has changed transfer capability between New Brunswick and Nova Scotia frequently, with the net effect being very low availability of firm import capability. This parameter has been and may continue to prove very valuable to NS Power's customers, making continuing certainty, and the failure to complete underlying studies a matter for immediate attention.

It is clear from the available studies and information that, despite no change in physical facilities, much of the variability has to do with factors that appear to include: (a) reservations for required reserves, (b) commitments to Prince Edward Island, (c) loads in both Nova Scotia and New Brunswick, (d) and the configurations of generating units running in each province. The latest

study (NB Power ECC Operations Engineering) appears to suggest that transmission-system settings make a big difference. Moreover, it appears to offer a reasonable basis for considering relatively low-cost reinforcement methods a serious possibility. Flows from Labrador and Newfoundland through Nova Scotia will soon add another dimension of complexity, further heightening an already present need to study alternatives and their costs and benefits forthwith.

Moreover, NS Power needs to develop its own capability to evaluate transfer capabilities under a broad range of operating conditions. NS Power's dispatch-modeling capability would benefit generally from an extension of its ability to address neighboring systems, such as that of NB Power. That such extension may assist in identifying sources of constraints and their elimination, adds to the importance of the matter.

7. It is not clear when a consensus understanding of the costs and benefits of transfer capability will be forthcoming. *(Recommendation #2)*

NS Power's loss of transfer capability over recent years has proved harmful. The Company has lost much of its access to energy markets that could provide a source of firm term purchases. Longer-term purchases rely on vanishing firm transmission. NS Power's term purchase power RFPs have been significantly impeded by transmission restrictions in New Brunswick. Suppliers are discouraged by the lack of firm transmission, especially for seasonal, long-term and larger (greater than 50 MW) purchases. Transmission curtailments on power purchases delivered with non-firm transmission discourages sellers, whose product is diminished as a result. The curtailments make purchases less beneficial for NS Power as well.

Moreover, the loss of transmission capability also diminishes NS Power reliability incrementally. Management has observed on numerous occasions that it meets NERC reliability requirements, satisfying contingencies with NS Power generation and with a 105 MW reliability contract with NB Power. NS Power becomes incrementally less reliable with lower transfer capability from New Brunswick than with full transfer capability.

Finally, reduced transfer capability reduces management's options for balancing wind resources. NS Power wind resources requiring balancing reached almost 550 MW at year-end 2015. Since the GE study of 2012, management has observed that balancing wind becomes difficult when wind saturation approaches 600 MW. NS Power projects that it will reach 622 MW of wind in the next two years. Less than full transfer capability thus incrementally diminishes NS Power's ability to balance.

Study suggests the potential for cost effective solutions, but no clear conclusions have resulted.
A New Brunswick System Operator report in January 2016, for one example, discussed very low cost means for making increases in transport capacity to Prince Edward Island, and cited opportunities including "increased firm and non-firm limits east to NS Power and MECL" (the Fortis subsidiary serving electricity customers on Prince Edward Island). The analysis identified an additional 120 MW of firm capacity eastward (above the 80 MW listed as currently available), and reported additional non-firm transfer limit increases. The report cited an estimate of $75,000 in total investment for the changes associated with the studies performed. NS Power and MECL share a common transmission path from New Brunswick.

D. Recommendations

1. Management should extend NS Power's *Plexos* modeling capability into New Brunswick. *(Conclusion #6)*

Liberty believes that there is broad agreement about the benefits of dispatch coordination with NB Power. As that coordination extends forward, NS Power will increasingly need to model NB Power's system as well as its own. The benefits of cooperative dispatch are substantial; therefore, management's forecasting models must match the way their new "real world" operates. Currently they do not, as *Plexos* remains configured to model NS Power as an isolated dispatch area with boundary parameters reflecting the "outside world," one key component of which is NB Power's system.

Accordingly, *Plexos* is not yet capable of producing a true forecast of the combined NB/NS system. Only by creating a *Plexos* data set that models the generators, loads, and transmission systems of both companies can this be the case. As such, the current *Plexos* implementation lacks the ability to forecast coordinated dispatch in the best manner.

While this enhancement will be important for forecasting, it will also enable NS Power to examine the operation of NB Power's system under a variety of conditions. NS Power's ability to deal with NB Power over a variety of issues, including the Moncton problem, should be much enhanced by improvements in NS Power's analytical capabilities in this area.

2. Management should develop a strategy for increasing access to power resources from the west, and report to the NSUARB. *(Conclusion #7)*

The Maritimes Link will complete a transmission loop that encompasses Quebec and Atlantic Canada. Unless power through the Maritime Link has to compete with power from New Brunswick – either generated there or transmitted through there – NS Power will not realize the full benefit of the loop. Thus, NS Power must develop a strategy to improve access to power ties with the west.

Deepening the cooperative dispatch relationship with NB Power comprises one aspect of such a strategy, but there should be others:

- Completing work apparently now underway in New Brunswick to identify the costs and benefits of various alternatives for improving transfer capability with Nova Scotia
- Examining what it would take to improve access to Hydro Quebec, Nalcor and Ontario Power Generation – and other sources, as well – at capacity levels below 800 MW
    - Identifying whether "inflection points" below 800 MW cause costs to drop dramatically
    - Determining the costs and benefits of each level of transfer capability to Nova Scotia, in 100 MW increments
    - How different levels of flow from Labrador and Newfoundland via Nova Scotia change these costs
- Determining how costs and flows change with
    - Increasing requirements for renewable power, in New Brunswick, as well as Nova Scotia
    - Actual and potentially increasingly stringent emissions limits.

It does not appear that the completed New Brunswick study work provides an adequate foundation for making such assessments. NS Power will have to upgrade its system-simulation capabilities as recommended above, secure as promptly as possible a far more clear understanding of reinforcements that will increase transfer capabilities with New Brunswick, and examine possibilities under a variety of load and power-flow conditions. The relationship developing with NB Power will hopefully provide a basis for fully cooperative efforts where common interests and concerns lie. Should that not be the case, NS Power nevertheless must secure answers based on sound, comprehensive study and analysis in very short order.

Liberty believes that a sustained effort over some period of time is likely to be required. To ensure that such an effort receives the proper priority and resources, we recommend that NS Power develop and present a plan for it to the NSUARB. The plan should be presented no later than the end of 2016.