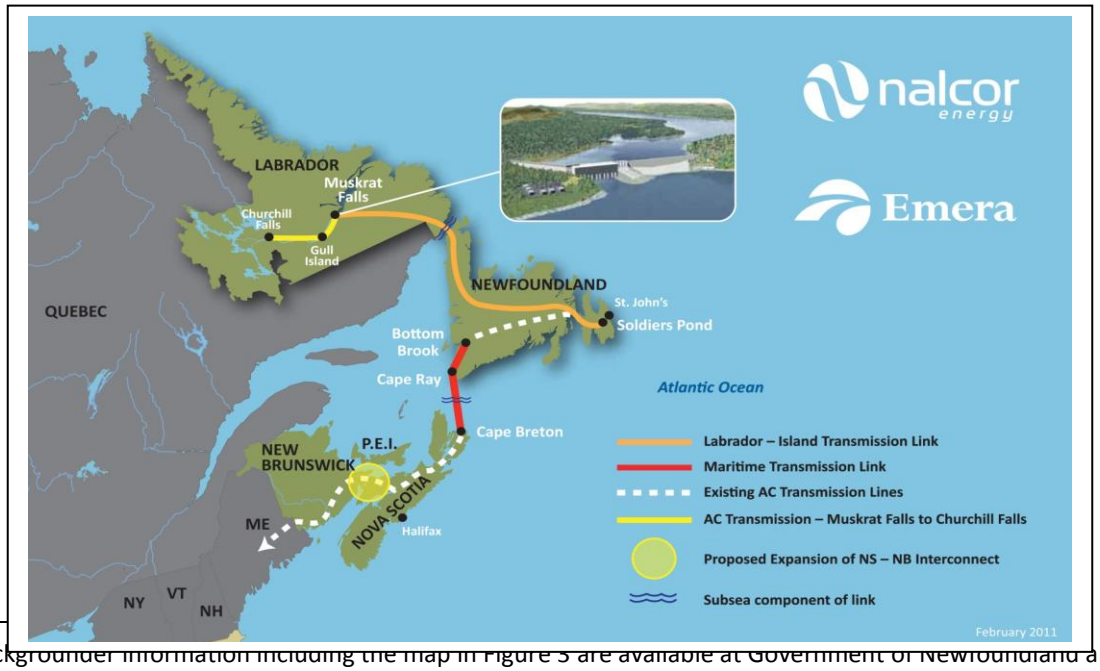
The Lower Churchill Project

Overview

The Lower Churchill project[1] is a two phase development of the 2250 MW Gull Island hydro generating station, the 824 MW Muskrat Falls hydro generating station and transmission lines to connect the stations together and to the existing grids in Labrador, Newfoundland and the Maritimes. A Term Sheet, signed in November 2010 between Nalcor Energy[2] (Nalcor) and Emera Inc.[3] (Emera), deals with the first phase which is the subject of this paper. It includes the Muskrat Falls station in Labrador combined with transmission to deliver electricity to and from the existing Churchill Falls station (Labrador Transmission), to the St. John's area on the Island of Newfoundland via a high voltage direct current (HVDC) line (Island Link), and to Cape Breton in Nova Scotia also via an HVDC line (Maritimes Link). The component pieces of the development are illustrated in Figure 1.

Figure 1 – Lower Churchill Projects



[1] Backgrounder information including the map in Figure 3 are available at Government of Newfoundland and Labrador web site, www.gov.nl.ca/lowerchurchillproject/default.htm

[2] Nalcor Energy is the "Energy Corporation of Newfoundland and Labrador" and parent company of various provincial crown energy corporations including Newfoundland and Labrador Hydro, www.nalcorenergy.com

[3] Emera Inc is parent of several energy corporations including Nova Scotia Power Inc, www.emera.com

The projects are supported by a business arrangement between Nalcor and Emera that details financial ownership rights and obligations that will see delivery of electricity for long term firm supply to Newfoundland, a 35 year firm supply to Nova Scotia and surplus electricity for the regional market. This paper defines each of the project components including their contractual terms, discusses the value of the firm supplies for each counter party, and considers the potential impact that the overall project and its surplus energy may have on the regional Atlantic and New England markets.

Muskrat Falls and the Labrador Transmission

Muskrat Falls is an 824 MW hydro electric generating station located on the lower end of the Churchill River in Labrador. It will span a narrow gorge in the river with a two section concrete dam that is 32 meters high and 757 meters long. It has a targeted in service date of late 2016 and combined with the AC transmission to Churchill Falls will cost $2.9 Billion to construct.

The average energy production will be 4.9 TWh per year which is an annual capacity factor of 68%. The station is considered to be a "run of river" plant in that it has a limited head pond storage area of only 101 square kilometres. However, because of legal requirements, the water resources of the large Churchill Falls station up river (with its vast storage area of 6527 square kilometres) will be operated to optimize energy production on the entire Churchill River. This will enable the Muskrat Falls station to be able to deliver firm power scheduled in the on peak periods 16 hours per day.

The AC transmission connection to Churchill Falls will serve two purposes. It will enable 300 MW of recall electricity from Churchill Falls to be used by Nalcor to support energy flows to Newfoundland and the Maritimes. It also will provide a path for electricity from Muskrat Falls to flow back to Churchill Falls where it could supply loads in Labrador or be exported to, or through, Quebec. This will be of significant value during a maintenance outage or a forced deration of one of the HVDC links.

HVDC Transmission Links

The Island Link is an 1100 km long HVDC transmission line from Muskrat Falls to the Solders Pond terminal station near St. John's. It has a transfer capacity of 900 MW and includes a 30 km submarine cable across the Strait of Belleisle plus overhead HVDC lines on the land portions of the route. The project cost of the Island Link including AC system upgrades to accept its output is estimated to be $2.9 Billion.

The Maritime Link is composed of overhead AC transmission to connect with the existing Nalcor transmission system and an HVDC connection from Bottom Brook NL (near Stephenville) to Lingan in Cape Breton. The HVDC system will be overhead to Cape Ray and

then submarine cable across the 180 km Cabot Strait. Its transfer capacity will be 500 MW and its estimated cost is $1.2 Billion.

Contract Terms

The business deal between Nalcor and Emera, as set out in the November 2010 Term Sheet[4], has three main components. Firstly, it provides for shared financing, 80% by Nalcor and 20% by Emera, to complete the projects; secondly, it defines a power purchase arrangement for the delivery of 20% of the Muskrat Falls output to Nova Scotia Power Incorporated (NSPI) for a period of 35 years (Nova Scotia Block); and lastly, it specifies the associated rights, obligations and ownership terms of the parties. The Term Sheet is subject to Newfoundland and Labrador law and expires on the earlier of conclusion of formal agreements or November 30, 2011.

Nalcor are to build and own 100% of the Muskrat Falls generating station and the Labrador Transmission. The Island Link transmission is to be built by Nalcor but owned jointly 71 % by Nalcor and 29% by an Emera subsidiary company which will be a regulated Newfoundland and Labrador public utility. This arrangement will enable a regulated return on Emera's investment in the transmission. All transmission rights on the Labrador Transmission and the Island Link will be held by Nalcor.

The Maritime Link is to be jointly built by Nalcor and Emera but is to be owned 100 % by Emera through its subsidiary NSPI. Emera will also pay the costs of operating and maintaining the Maritime Link to a maximum of 20% of the operating and maintenance costs of the entire project. Transmission rights to deliver the Nova Scotia Block will be held by NSPI with the remaining rights held by Nalcor.

The Nova Scotia Block will provide NSPI with approximately 165 MW of capacity and about 1000 GWh of energy delivered in the on peak hours for a period of 35 years. Emera (or NSPI) may seek to extend the Nova Scotia Block agreement beyond 35 years and Nalcor must negotiate in good faith to reach an agreement on extension. If an agreement can not be reached, then Nalcor may sell to third parties. At the termination of the Nova Scotia Block, ownership of the Maritime Link will revert back to Nalcor for a price of $1.

Greenhouse gas (GHG) credits associated with the Nova Scotia Block will be owned by NSPI but they must be used solely for NSPI obligations and not sold. Nalcor is to own any remaining GHG credits generated by the project.

In addition to the transmission rights to be held by Nalcor on the Island and Maritime Links, Emera will provide Nalcor with transmission rights from Cape Breton to the Nova Scotia/New

[4] Nalcor Energy and Emera Inc Term Sheet, November 18, 2010, www.nalcorenergy.com/muskrat-falls-agreement.asp

Brunswick border up to Nalcor's capacity on the Maritime Link. Nalcor will pay the Nova Scotia transmission tariff for these rights. Nalcor will be provided use of Emera's transmission rights to transmit power through New Brunswick with Nalcor paying the associated transmission tariff when used by Nalcor. If these rights cannot be acquired or extended, Emera will purchase the power Nalcor would have sold through New Brunswick. Alternatively, at Nalcor's option, Emera will provide Nalcor with the opportunity to acquire or use 300 MW of firm transmission if the proposed new Nova Scotia-New Brunswick transmission line is constructed.

Future opportunities are provided for Emera to increase its investment in the Island Link to a maximum of 49% and Nalcor are to have similar investment opportunities in future Emera infrastructure. Also, both parties can seek to expand the Maritime link together or separately if the other decides not to participate.

Value of the Project to Newfoundland and Labrador

Prior to making the decision to proceed with the Lower Churchill project Nalcor, through its subsidiary Newfoundland and Labrador Hydro (NL Hydro), completed a broad Integrated Resource Planning study. Details of the analysis were submitted in a Generation Planning Issues report[5] to the Board of Commissioners of Public Utilities and most of the information considered in the study is set out in various information documents on the Lower Churchill Project section of the Nalcor web site.

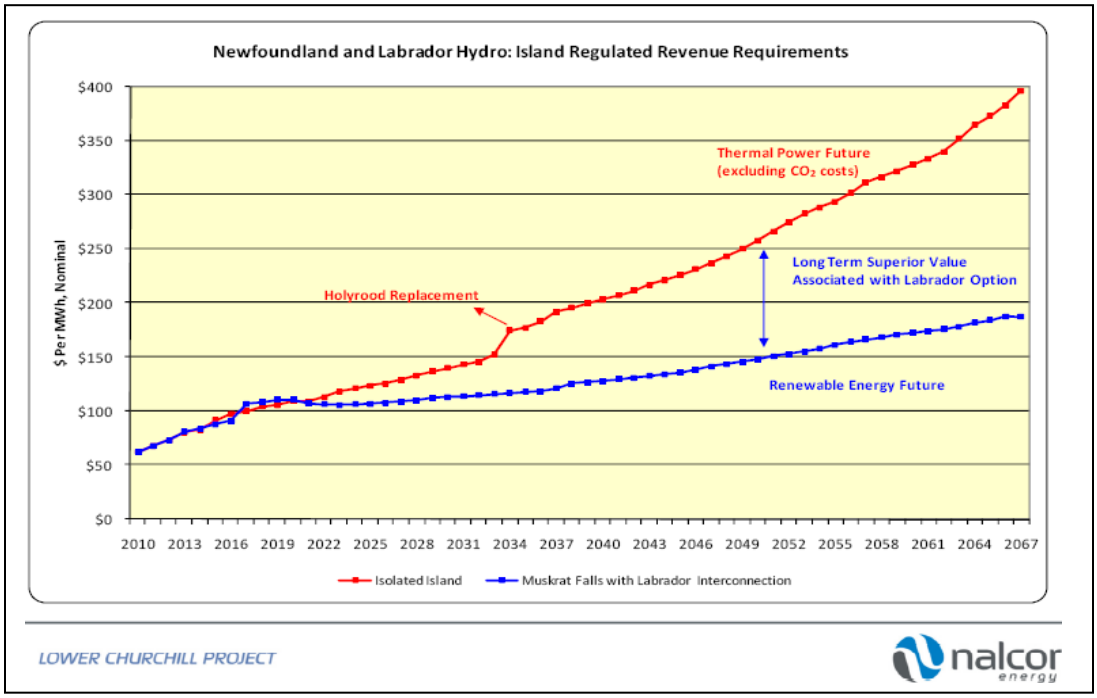
The report indicated that a decision on new generation resources must be made by the end of 2010 in order to be able to construct new generation in time to meet future demand. To this end NL Hydro evaluated all practical supply options for generation sources to meet the Island's long-term electricity needs and determined that Muskrat Falls, with a transmission link to the Island, was the least cost and most environmentally friendly solution.

Currently, the 500 MW Holyrood oil fired generating plant provides for winter capacity and about 1000 to 1500 GWh of energy each year. The NL Hydro report indicated that, with the Muskrat Falls plant delivered to the Island, the Holyrood oil-fired generation would be replaced. That replacement will virtually eliminate acid gas emissions, will reduce GHG emissions by more than one million tonnes per year, will eliminate the province's dependence on the imported supply of high priced fuel oil, and will provide for stable electricity prices. The project will also eliminate the requirement for additional fossil-fuel generation on the Island in the future and avoid associated emissions.

[5] Generation Planning Issues 2010 Report, NLHydro, www.nlh.nl.ca/hydroweb/nlhydroweb.nsf/0/979399918E1A1521A32577E4004EA20B/$File/GenerationPlanningIssues2010Report20100716.pdf

A comparison of the value of the Muskrat Falls supply to the Island versus a thermal power future was provided in the background information[6] at the time of the project announcement in November 2010. It is shown in Figure 3. The increase in fuel oil prices over the last six months is much higher than that used in the analysis so at this point in time the economics of the project for Island supply would be even better than that shown.

Figure 3 – Comparison of Generation Futures



The development of Muskrat Falls will also meet the energy requirements for Labrador as well as the Island and provide sufficient capacity for future industrial developments throughout the province. However, the power and energy of generation at Muskrat Falls will be initially greater than what is required for the domestic market and the related surplus presents an opportunity for Nalcor to export power. To monetize the value of the surplus power, Nalcor has partnered with Emera, to develop the Maritimes Link so that the Nova Scotia Block can be delivered to NSPI and that up to 335 MW of additional surplus can be sold into the regional market.

Overall, the development of Muskrat Falls is financially attractive, generates a positive rate of return, ensures long-term price stability, and will make the NL Hydro generation 98% GHG emission free. The agreement with Emera for transmission access enables the sale of additional power to export markets, further enhances the viability of the development and makes this

[6] "Comparative Electricity Analysis – Muskrat Falls vs Isolated Island Cases", Lower Churchill Project backgrounder information, www.gov.nl.ca/lowerchurchillproject/default.htm

approach the most economic solution over time. It also creates further export opportunity in the future for the other significant renewable hydro and wind resources throughout Newfoundland and Labrador.

Value of the Nova Scotia Block

NSPI regularly reviews its plans to meet forecast future load and environmental emission requirements. The 2009 Integrated Resource Plan Update[7] that was filed and reviewed by the Utilities Review Board sets out a future within which the Nova Scotia Block will fit. Key findings of that report are:

- There is certainty today regarding provincial renewable energy targets and emissions limits for carbon dioxide (CO_2), sulphur dioxide (SO_2), nitrogen oxide (NO_x) and mercury (Hg) from now to 2020.
- Aggressive demand side management (DSM), more wind generation and enhanced biomass usage are appropriate to meet load and environmental targets for the short term future to 2015.
- Towards the end of the decade material investment is likely required in a renewable or low-emitting supply resource that will require a lead time of several years to plan, permit, engineer and construct.
- Beyond 2020 uncertainty in emission limits remains, though further physical reductions are expected, and NSPI will continue to explore opportunities for a large (300MW) non-emitting Power Purchase Agreement (PPA) as an option to respond to the larger-scale future need.

The Nova Scotia Block of the Muskrat Falls project, as a 165 MW non-emitting PPA, addresses the supply resource needs for the end of the decade. It will enable displacement of about 1000 GWh of fossil generation and reduction of about 1 million tonnes of CO_2 emissions and 5,000 to 10,000 tonnes of acid gas emissions. In combination with the aggressive DSM, planned new wind resources and the 60 MW biomass plant[8] at the NewPage Port Hawksbury plant, it will enable NSPI to meet all projected requirements for 2020.

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[7] 2009 Integrated Resource Plan Update, Nova Scotia Power Inc www.nspower.ca/en/home/aboutnspi/ratesandregulations/regulatoryinitiatives/irp2009.aspx

[8] "Port Hawksbury Biomass Co-Generation Project Proceeding", Press Release by NSPI, November 1, 2010, www.nspower.ca/en/home/aboutnspi/mediacentre/NewsRelease/2010/biomasscogen.aspx

The delivered cost of the power is comparable to any potential alternative but it also comes with additional capabilities. Its flexibility to be dispatched via the fast acting HVDC controls provides a frequency control and balancing resource that can help optimize intermittent wind generation in Nova Scotia. The contract size of 165 MW is similar to existing unit sizes in Nova Scotia so it does not increase the operating reserve obligations of NSPI. Beyond 2020, there is an opportunity to contract for additional resources from the 335 MW of surplus energy destined for the regional market.

Surplus Energy Available for Regional Market

Initially there will be up to 335 MW of Muskrat Falls generation targeted for sales by Nalcor into the regional market. Over time the quantity will diminish as it is used to supply growing load in Newfoundland and Labrador but for several years it will add competition to the Maritimes and New England markets. What will be its impact?

The energy could be wheeled through to New England where it would be a small supply in a large market. As such it would essentially be a price taker in this market which is dominated by natural gas fired generation. Alternatively, it could be purchased in the Maritimes for displacement of fossil generation. This is an expected action for NSPI and less so for NB Power. Maritime Electric on the other hand will likely invite Nalcor to bid firm power for supply to PEI. This will add competition to NB Power for the extension of current and future supply contracts to PEI.

Energy pricing today in the Maritimes is driven by the New England market[9] to the extent that energy is accessible to the region. It could be energy from New England or from Hydro Quebec sold into the Maritimes at New England prices. Adding the Muskrat Falls surplus to the mix will add supply but should have little affect on the prices other than transmission cost differences between the market segments.

Nova Scotia – New Brunswick Interconnection Upgrade

The first interconnection between the provincial utilities was a 138 kV line constructed in the late 1950's that enabled shared reserves, economic energy trading and improved reliability for both provinces. A second 138 kV line was installed in the late 1960's and a 345 kV line between the Salisbury terminal (near Moncton) and the Onslow terminal (near Truro) was completed a year or so prior to the Point Lepreau nuclear unit coming on line in February 1983. The transfer capacities set out in the 1983 interconnection agreement between NB Power and NS Power were 350 MW towards NB and 300 MW towards NS. At that time, these transfer capacities represented about 20-25% of peak load for each utility and provided significant sharing and

[9] ISO New England real time market prices available at www.iso-ne.com/index.html

trading opportunities. Normally about half of the transfer capacity in each direction was held in reserve for reliability purposes but that still left 10 % or more of each systems load available for economic trading.

No upgrades to the interconnection have been done yet loads have increased by about 70% since 1983. While the transfer capacities are still posted as 350/300 MW they are now under study by NBSO and it is expected that they will be reduced. How much reduction, and for what periods of the year, are not known. But a large reduction under peak load conditions is not unreasonable. This means that most, if not all, of the transfer capacity will be required for reliability and little or no capacity will be available for economic trading. To add to the challenge, the generation mix on both sides of the interconnection has increasing amounts of wind generation that with its intermittent nature makes load balancing in each province more difficult. This, at times, pushes the interconnection to its operating limit. As such, a potential upgrade to the interconnection has been referenced in past studies[10,11,12] and it is the subject of joint interest by NB Power and NSPI in the past year[13].

An interconnection upgrade will have benefits throughout the Maritimes and especially for Nova Scotia regardless of the success of the Lower Churchill project. But with the project the upgrade is necessary. Even if the current 350 MW transfer capacity to NB is maintained after the NBSO study, half is needed for reliability margin leaving only half for power transactions. Without an upgrade Nalcor will be limited in its ability to get the 335 MW of surplus capacity to market. Hence, the requirement for Emera (or NSPI) to purchase the power Nalcor is not able to get through New Brunswick should the interconnection upgrade not occur.

NB Power and NS Power have agreed to consider the interconnection upgrade and have completed preliminary analysis of several approaches to that end. Apparently different transfer capacities with different associated costs are being considered but no details of the analysis are yet publicly available. It is likely that the benefits of the upgrade will favour Nova Scotia and it may be a challenge to achieve an acceptable cost sharing arrangement. As yet there is no public commitment for the project to proceed and there is no public indication of a business arrangement through which upgrades could occur. The only known business arrangement at this time is the opportunity being provided by Emera to Nalcor to acquire or use 300 MW of firm transmission if the proposed interconnection upgrade is completed.

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[10] "Nova Scotia Wind Integration Study", by Hatch Corporation for NS Department of Energy, 2008, www.gov.ns.ca/energy/publications/NS-Wind-Integration-Study-FINAL-(Sep-1-2009)-(RE-WEN-RP).pdf

[11] "Transmission and System Operator Options For Nova Scotia, by SNC Lavalin for the NS Department of Energy, December 2009, www.gov.ns.ca/energy/publications/NS_DOE_TSO_2009_12_07__R2_Final_Submitted-r1-(Dec-1-2009)-(EL-ELE-RP).pdf

[12] "A Discussion Paper on Potential Generation and Transmission Developments", New Brunswick System Operator, December 2008, www.nbso.ca//Public/_private/NBSO%20Discussion%20Paper%20Final%20Pre-release%20Dec%2012,%2020.pdf

[13] "New Energy Partnerships Possible Between New Brunswick and Nova Scotia", Press Release, July 20, 2010, www.nbpower.com/html/en/about/media/media_release/pdfs/Emera%20-%20release.pdf

The NS-NB transmission upgrade is not necessarily tied to the Lower Churchill project. It has value in its own right for improved economic trading between provinces, increased reliability, and easier integration of expected intermittent wind generation additions. It also has future value to enable greater exports to Nova Scotia should NB Power proceed with conversion of Coleson Cove to natural gas and/or the addition of a second nuclear unit at Point Lepreau.

Operational Opportunities

The proposed Lower Churchill project provides several opportunities to enhance and benefit the operation of the Atlantic power grids. Four such opportunities are discussed below.

1. **Sharing of Operating Reserve Capacity –** Operating reserve capacity is fast acting generation that is required to maintain system reliability in the event of a major loss of supply. The North American Electric Reliability Corporation (NERC) standard requires each area to recovery from a loss of supply contingency and reset its interchange schedules to the pre-contingency values within 15 minutes.

   For the Maritimes the largest contingency has been the Point Lepreau generating unit which requires 680 MW of operating reserve capacity to offset its loss[14] and the interface that must be reset is that between New England and New Brunswick. After the Muskrat Falls project is completed the largest contingency in the Atlantic region could be the 900 MW Island Link under full load conditions[15]. This will be much more than the Island system can handle so the 500 MW flow to the Maritimes will need to be curtailed. Even so, this would increase the Island's largest contingency to 400 MW from the current situation where loss of a Holyrood unit at 170 MW is the requirement. A 500 MW contingency passed on to Nova Scotia will be almost three times its current reserve obligation of about 170 MW.

   Because electricity travels extremely fast the instantaneous effect on New Brunswick will be a swing on its New England interconnection of 500 MW that will pass through the province to Nova Scotia. Such is the physics of electricity which is different than the economic obligation. Normally the entity that causes the increase in operating reserve requirement is responsible to provide the increase in reserves. Alternatively it could be the entity that contracts for the power. Given that NB Power does not contract for a firm component of the project and that the Nova Scotia Block of 165 MW is smaller than its

[14] The 680 MW is required to supply the net maximum generation output of the 635 MW plus station service loads of about 45 MW to handle cooling systems so the unit can be safely shut down if needed. Under the current Maritimes Area reserve sharing arrangement NSPI provides about 170 MW, PEI and Northern Maine provide about 30 MW and NB power provides the remaining 480 MW.

[15] The actual size of the Island Link contingency is not publicly known as yet. If the line is a bi-pole HVDC it may be only 450 MW but there also could be circumstances that make it 900 MW. Detailed technical study is required.

current largest contingency that increased responsibility could fall to Nalcor. Yet Nalcor is not in a position to physically provide the required reserves so there is a need for reserve procurement or sharing in some way. If the obligation is passed through to the contracting party then it would reduce the market value of the energy. Either way there is an impact on Nalcor.

This issue of operating reserves is a complex technical matter that is a reliability requirement that must be met for the region. But, it is also an opportunity for some economic gains if the requirements can be optimally determined based on changing system conditions throughout the region and shared. For example, the Maritime Link could possibly be reversed to supply the Island if conditions in the Maritimes warrant it and the Maritime Link could assist a Point Lepreau trip if unused capacity on the link is available. A final arrangement will only be achieved after significant study followed by detailed negotiations between utilities.

2. **Balancing of Wind Generation Variability –** According to NBSO in their adequacy submission to the Northeast Power Coordinating Corporation (NPCC)[16] there is 759 MW of wind generation that is operational in the Maritimes Area systems today. Relative to system load it is 14% of the area peak load of 5445 MW and one third of the estimated low load of 2200 MW. At these levels the variability of the wind generation can be much more than load variation and the balancing of loads and generation in real time and hour to hour becomes much more difficult. This difficulty is expected to increase as more wind generation comes on line and after the Point Lepreau unit returns to service because there will be less opportunity to schedule more flexible generation.

   The best generation resources to provide balancing are hydro units like those at the Mactaquac and Wreck Cove stations which can rapidly increase or decrease output under automatic generation controls (AGC) that electronically respond to the imbalance at the New England interface. In the spring with high river flows the hydro units lose there flexibility and balancing must be done by switching the AGC to slower reacting thermal units. With lower loads and high hydro output there may be little room for the more expensive thermal generation and some hydro may have to be dumped to accommodate the balancing.

   Balancing is not coordinated as a single exercise throughout the Maritimes, rather, it is done separately for Nova Scotia and separately by NBSO for the remaining systems. Because of Nova Scotia's location and its single interconnection with New Brunswick, any imbalances there automatically get passed back to New Brunswick and NBSO must

[16] "Maritimes Area Comprehensive Review of Resource Adequacy", New Brunswick System Operator, Sept 2010, www.npcc.org/documents/reviews/Resource.aspx

address it along with its imbalances to maintain the scheduled transactions with New England.

One of the benefits of the Muskrat Falls project is that it adds much more hydro to the Maritimes systems. The 500 MW injection into Nova Scotia via fast acting HVDC will provide significant more balancing capability for Nova Scotia. The Nova Scotia Block will be scheduled by NSPI and certainly should have AGC capability. The 335 MW of surplus energy which is destined for market is open for negotiation and could be a major balancing resource for the rest of the Maritimes systems. It could be a driver to create a single balancing area for the Maritimes or even a single area for the entire Atlantic region. Either way, it will make balancing easier and enable integration of additional world class wind generation[17] in Atlantic Canada. This AGC balancing potential of the project could be negotiated by Nalcor to offset some of its operating reserve requirement.

3. **Economic Dispatch of Supply Resources -** Today the real time hourly dispatch of generation resources to meet load obligations is done separately for Labrador, the Island of Newfoundland, Nova Scotia and the New Brunswick areas. If progress is made on regional reserve sharing and coordinated balancing as previously discussed, then a regional economic dispatch is a logical next step.

   The economic dispatch could take different market forms but need not be a complete day ahead and hourly market as is done in New England. A much more simple approach with each utility providing a bilateral contract schedule to meet its load obligations and pricing on its resources would suffice. It could be a regional dispatch done centrally by a designated utility with benefits shared similar to the operation of the New England Power Pool (NEPool) prior to implementation of the ISO-NE market. Alternatively, it could be an hourly re-dispatch balancing energy market similar to that operated in New Brunswick by NBSO. Either way would enable optimization of transmission losses, improved use of marginal units and minimization of emissions as well as fuel costs.

   Some people argue that such an opportunity exists today yet has not been pursued because the complexity out weighs the benefits. This may be true. While there could be benefits today the transmission constraints between NB and NS limit their achievement. Addition of the Muskrat Falls project with the HVDC links is a game changer that should encourage greater cooperation. As we discussed previously, negotiation of regional reserve sharing is a must for optimal reliability. It opens the door for consideration of balancing, economic dispatch and greater regional coordination of operations. It presents an opportunity that should not be ignored.

[17] "Maritimes Area Wind Power Integration Study Summary Report", New Brunswick System Operator, April 2007, www.nbso.ca/

4. **Implementation of Enhanced System Operations –** Achieving any of the operational considerations discussed requires coordination of system operations across the Atlantic region. This coordination requires one central party to be directing operations for the entire region with the agreement of all the parties. The issue is how to empower that party?

   As a minimum it will be continuation and enhancement of the bilateral coordination agreements that exist today. In the Maritimes Area at present NBSO is the NERC sanctioned Reliability Coordinator for the entire area. These duties plus other operational issues (such as reserve sharing and balancing) are set out in separate bilateral Coordinating Agreements between NBSO and each of the operating entities in NS, PEI and Northern Maine[18]. With completion of the Muskrat Falls project and associated transmission there will be a need for new Coordination Agreements between NLHydro and NSPI and most likely between NLHydro and NBSO as well if any reserve sharing is to be achieved. Under this arrangement the agreements will need to set out in detail the role and responsibilities of NBSO in relation to each of the other parties. The advantage of this approach is that it is doable under current legal and regulatory structures in each province. The disadvantage is that it will be difficult to achieve all of the possible benefits.

   An alternative arrangement would be to create a new independent organization that oversees and directs the operation of all systems in the region. Such an undertaking with associated market rules for the Atlantic region could achieve the greatest benefits by optimizing all the system requirements for the region. But it has regulatory and legislative complexity that may not be seen as warranted. A more reasonable approach may be to start with the coordinating agreements and identifiable benefits. By demonstrating some initial success additional benefits could then be identified and pursued. In the end a regional independent operator could be the outcome.

Government Policy Considerations

While there are the operating opportunities for utilities as discussed above, there are also policy directions that governments should consider to enhance grid operations and bring benefits to the region. Four such opportunities are discussed in the following sections.

1. **Review Renewable Portfolio Standards –**

   Generally, throughout North America, Renewable Portfolio Standards (RPS) are a state/provincial requirement to procure a certain amount of the electricity sales to end use

[18] The operating entities in each province/state are NSPI for NS, Maritime Electric Company Limited for PEI and the Northern Maine Independent System Administrator for Northern Maine.

customers from "new" and "low-impact" renewable generation sources. The "new" has usually been set as after a certain date[19]. The criteria for "low-impact" may vary slightly but for Canadian provinces has been the federal EcoLogo standard that includes wind, solar, biomass, land fill gas, wave, tidal stream and low head run of river hydro, etc.

There has been opposition to this approach because it ignores pre-existing renewable resources and it does not include large hydro. Regulations regarding RPS requirements have started to change. Quebec includes large hydro and through its export contract to Vermont got that state to accept large hydro it its definition. More importantly for Atlantic Canada, in October 2010 Nova Scotia enhanced its future RPS requirements[20] for 2015 and beyond to include "heritage renewable electricity" and "imported renewable electricity". Both include electricity which are "in the opinion of the Minister generated from renewable sources" so it is understood to include existing hydro and the Nova Scotia Block of Muskrat Falls power. The New Brunswick Energy Commission has followed Nova Scotia's lead and has recommended a similar approach for New Brunswick. PEI is expected to follow so it may be possible to coordinate RPS definitions and standards throughout Atlantic Canada. If so, trading of Renewable Electricity Credits (RECs) could also be supported.

2. Consider Regional Emission Trading For SO_2 –

Today each Atlantic province sets a cap on SO_2 emissions for its thermal generating stations that has to be met within the province. There is no opportunity for emissions trading between provincial utilities. This lack of a trading opportunity is economically and environmentally inefficient.

In order for NLHydro to meet its SO_2 cap it reduced the sulphur content in the oil fuel at the Holyrood station from 2.5% S to 1.0% S and again to 0.7% S for which a premium must be paid. NSPI on occasion must alter its dispatch to employ greater natural gas generation rather than higher emission but less costly coal generation. Meanwhile NB Power has flue gas desulphurization scrubbers that enable it to perform well below its emission cap such that it does not push the scrubbers to their maximum emission removal. There is capability left in the NB Power scrubbers to remove more SO_2 very efficiently with the simple use of additional limestone. Additional emission reductions could be achieved in NB at a much lower cost than is being done in NS and NL.

With the Lower Churchill project and the expected need for greater system operations coordination there is an opportunity to gain additional environmental and economic

[19] "New" in the Nova Scotia Renewable Electricity regulation is after December 31, 2001

[20] Nova Scotia Renewable Electricity Regulations under the Electricity Act, NS Department of Energy, www.gov.ns.ca/just/regulations/regs/elecrenew.htm

savings through coordination of emissions regulations across Atlantic Canada. While it is understood that this is under the jurisdiction of Departments of Environment in each province its achievement needs to be championed by Energy Departments.

3. Coordinate Utility Regulation –

There are two areas of regulation that should be considered – reliability regulation through NERC and transmission tariff regulation through provincial utility regulatory boards.

Electricity in Canada is a provincial jurisdiction so there has been a need for provincial recognition of NERC as the Electric Reliability Organization (ERO) for North America. This was done in New Brunswick through NBSO who has jurisdiction over reliability through the Electricity Act and who has entered an agreement with NPCC and NERC for compliance with NERC standards. In Nova Scotia the Utilities Review Board has signed agreements with NERC for similar recognition. Implementation of standards within the Maritimes is done by NBSO who is certified by NERC as the Reliability Coordinator for the Area. Currently Newfoundland and Labrador is not a participant with NERC and is noticeably absent from all NERC maps. With completion of the Lower Churchill project the province will become much more interconnected with the other NERC member systems and an arrangement to acknowledge NERC as the ERO is expected to become necessary. The need for a Reliability Coordinator to be responsible for the NL systems will also be required. This will either require certification of NLHydro as RC or expansion of the NBSO RC footprint. There are likely opportunities for some economic savings by coordination of the NERC regulation through NBSO or its successor.

The difficulty associated with coordination of transmission tariff regulation throughout the Atlantic region is very dependent on the nature of changes to the current tariffs. Elimination of rate pancaking or creation of a single common tariff for the region will be extremely difficult to achieve and quite difficult to regulate because it could create large cost shifts between the provinces. It will require serious inter-provincial negotiations and a joint regulatory review that likely would need legislative changes. However, incremental changes to the current tariffs that simply allow for efficient hourly re-dispatch of generation could be done through the existing regulatory structures and yet would eliminate some pancaking. Either way, before altering the regulation structure governments have to agree to pursue some operational changes.

4. Encourage Coordinated Regional System Operations -

As we have discussed achievement of benefits through greater regional cooperation involves all four provinces plus Northern Maine plus all the utilities. These will require multilateral agreements to implement that fall outside the scope of normal utility business which is done through bilateral agreements. There is a role for provincial governments to take policy directions that will encourage (or even coerce) the utilities to move in some instances. Achieving coordinated operation of the regional power grid is one that requires government leadership.

Conclusion

The Lower Churchill project is a game changer for Atlantic Canada. It provides industrial development opportunities for Labrador, guarantees a clean stable and competitively priced electricity supply for Newfoundland, enables Nova Scotia to meet its looming environmental obligations, and provides additional clean energy that could displace fossil generation and improve the mix in Nova Scotia, New Brunswick and PEI.

It is a catalyst for greater regional cooperation through

- Region sharing of operating reserves,
- Improved balancing of intermittent wind generation,
- An optimal economic dispatch of resources
- Implementation of enhanced system operations and an Atlantic regional market,
- Coordination of renewable energy standards between the provinces, and
- Regional approaches to environmental emissions regulation.

But that cooperation faces challenges because the benefits and the costs are not evenly distributed among the regional players. There are significant negotiations yet to come if the project is to achieve its complete potential.

Epilogue

This paper has considered the Lower Churchill project connected to the existing Atlantic region power systems. There has been no consideration of the future requirements beyond 2020 when significant MWs of aging thermal generation infrastructure must be replaced. What are the future building blocks of a least cost Atlantic supply - wind, biomass, tidal, gas, nuclear? How is their integration enhanced or hindered by the Lower Churchill project? What is the optimal transmission required? Answers to these questions are needed if negotiations on the potential benefits considered in this paper are to be successful.

About us

The Atlantica Centre for Energy is an industry association dedicated to the sustainable growth and economic development of the regional energy sector. Originally centered in southwestern New Brunswick, the Centre's board has expanded to include leading energy professionals and national professional services companies in Maine, Nova Scotia, Newfoundland & Labrador and Ontario.

The Centre serves as a bridge between corporations and the community to help realize the opportunities associated with the energy sector in Atlantic Canada and the American Northeast. It provides a meeting ground for government, the education and research sectors, and the community at large to foster partnerships and engagement in energy-related issues and policy development.