5 Technical Review – Isolated Island Option

The Isolated Island Option is largely a thermal generation plan, with the addition of seven CCCT units of 170 MW each and nine CT units of 50 MW each, totalling 1,640 MW of thermal, three new hydro plants totalling 77 MW, and one new wind farm of 25 MW, which when combined total 1,742 MW of new generation. Over the course of the review period, the two existing wind plants are replaced in 2028 and 2048; and the new wind plant is replaced twice in 2034 and 2054. All generation associated with the Isolated Island Option is contained on the island, with no interconnections to the mainland.

Table 9 describes the timing, size, and type of new generation sources added to the island as well as required upgrades and replacements in the Isolated Island Option.

Table 9: Isolated Island Option Generation Expansion Plan

Year	Isolated Island Option	Additional Capacity (MW)	Type
2010			
2011			
2012			
2013			
2014	25 MW Wind farm	25	Wind
2015	Holyrood ESP and Scrubbers		Thermal
	Island Pond	36	Hydroelectric
2016	Holyrood Life Extension (5-yr $20 M /yr)		Thermal
2017	Holyrood Low Nox Burners		Thermal
2018	Portland Creek	23	Hydroelectric
2019	Holyrood Upgrades		Thermal
2020	Round Pond	18	Hydroelectric
2021			
2022	170 MW CCCT (Greenfield)	170	Thermal
2023			
2024	50 MW CT (Greenfield)	50	Thermal
	Holyrood Upgrades		Thermal
2025			
2026			
2027	50 MW CT (Greenfield)	50	Thermal
2028	Replace 2 existing wind farms (~54 MW)		Wind
2029	Holyrood Upgrades		Thermal
2030	50 MW CT (Greenfield)	50	Thermal
2031			
2032			
2033	Holyrood U1 and U2 Replacement - 170 MW CCCT		Thermal
2034	Replace 2014 wind farm (~25 MW)		Wind
2035			
2036	Holyrood U3 Replacement - 170 MW CCCT		Thermal
2037			
2038			
2039			
2040			
2041			
2042	50 MW CT (Greenfield)	50	Thermal
2043			
2044			
2045			

Year	Isolated Island Option	Additional	Type
2046	50 MW CT (Greenfield)	50	Thermal
2047			
2048	Replace 2 existing wind farms (~54 MW)		Wind
2049	50 MW CT (Greenfield)	50	Thermal
2050	170 MW CCCT (Greenfield)	170	Thermal
2051			
2052	170 MW CCCT (Greenfield)	170	Thermal
2053			
2054	Replace 3rd Wind farm (~25 MW)		Wind
2055			
2056	170 MW CCCT (Greenfield)	170	Thermal
2057			
2058			
2059			
2060			
2061			
2062			
2063	50 MW CT (Greenfield) - 2 Units	100	Thermal
	170 MW CCCT (Greenfield)	170	Thermal
2064	50 MW CT (Greenfield)	50	Thermal
2065			
2066	170 MW CCCT (Greenfield)	170	Thermal
2067	170 MW CCCT (Greenfield)	170	Thermal

5.1 Thermal Generating Plants

Future utilization of the Holyrood Thermal Generating Station is very different for each of the two options. Also, both options make extensive use of combustion turbines and combined cycle combustion turbines as part of their generating expansion plan. Reviews of the various assessments of the thermal assets are summarized in Section 6 of this report, and covered in greater detail in Volume 2 – Section 10.

5.2 Small Hydroelectric Plants

The Isolated Island Option requires the addition of three small hydroelectric generation projects at Round Pond, Portland Creek, and Island Pond. Portland Creek is also required in the Infeed Option, but not until 2036.

Table 10: Small Hydroelectric Plant Summary

Plant	Capacity (MW)	Firm Energy (GWh)	Base Estimate (2010$ M)
Round Pond	18	108	$142
Portland Creek	23	99	$90
Island Pond	36	172	$166
Total	77		

Each of the plants has been the subject of one or more studies, including those that are presented as feasibility level studies. The studies were conducted by consulting engineering firms with extensive experience in the engineering of hydroelectric projects. Nalcor relied on the findings of these studies for inputs to the Strategist model it used to produce CPW analyses for the Isolated Island and Infeed Options.

The basis for Nalcor's capacity, capital cost, schedule, and availability inputs to the Strategist tool for CPW analyses was reviewed for reasonableness. The reviews of the three plants generally focused on the most recent and advanced studies made available by Nalcor. The required level of review was judged in the context of the relatively small scale of the three plants relative to the overall expenditures and the large difference in CPW between the Isolated Island and Infeed Options.

For additional information on the review of the small hydroelectric generating stations at Island Pond, Round Pond, and Portland Creek, please refer to Volume 2 – Section 9.

5.2.1 Small Hydroelectric Plant Key Findings

The following key findings from the small hydroelectric plant reviews are as follows:

- A review of the capital cost estimates for the three small hydroelectric plants indicated that the level of engineering and investigations were consistent with a feasibility study. Considering the age of some of the studies, the review also indicated that the development schedules and cost estimates used as inputs to Strategist for the three projects were optimistic in light of current, more stringent environmental processes.
- It is expected that resolution of these uncertainties would generally result in increases rather than decreases in the CPW of the three projects. However, the magnitude of any changes would not be expected to significantly alter the difference in CPW between the Isolated Island and Infeed Options. It is therefore concluded that Nalcor's Strategist inputs for the capacity, direct capital costs, schedule, and outage rates for the three small hydroelectric projects provide a reasonable basis for comparing the two expansion options when considered against the significantly larger expenditure for fuel in the Isolated Island Option.

5.3 Wind Farms

In the Isolated Island Option, a new 25 MW wind farm is proposed and scheduled for in-service in 2014. This is in addition to the 27 MW wind farms already in operation at St. Lawrence and Fermeuse. The latter two wind farms have a 20-year Power Purchase Agreement (PPA) with NLH. Once the contract period ends, there is a build-own-operate-transfer clause that allows transfer of ownership of the wind farm assets to NLH at no cost[48]. For the CPW calculation, it is assumed that the wind farms have a 20-year operating life[49], and that after this period, the entire wind farm would be replaced by NLH. The replacement cost of each of the wind farms was factored into the CPW calculation.

[48] Exhibit 6a, Nalcor, "PPA Listing and Rates".
[49] Exhibit 7, Nalcor, "Service Life-Retirements"

The review of the wind farms included the following objectives:

- Assess related planning and cost estimates for the wind farm and verify the estimates are reasonable.
- Examine related studies or assumptions such as wind survey, annual capacity factor and assessment of allowable non-dispatchable wind capacity in the island grid.

The review was conducted in sufficient detail to ensure that the wind assessment had been performed with due diligence.

5.3.1 Cost Estimates and Capacity Factors

The existing price structure used in the evaluation for a new wind farm in 2014 is based on NLH's current wind PPA structure as outlined in Exhibit 25[50]. Capital costs for the replacement of wind famrs is based on the 2007 Ontario Power Authority Integrated Power System plan. Operations and maintenance costs for these new wind farms are based on information from NLH recent requests for proposals. MHI considers that the estimated capital and operating costs used by Nalcor in the CPW analysis are representative of projects of this type and are appropriate for use at DG2.

An annual capacity factor of 40% is assumed for the 25 MW wind farm, based on the average capacity factor between the two existing wind farms at Fermeuse (44.3% capacity factor) and St. Lawrence (35.7% capacity factor). No specific site and wind survey data has been collected for the proposed new wind farm to validate the 40% annual capacity factor. According to Nalcor, the proposed site for the new 25 MW wind farm would be selected through a wind RFP process[51]. Nalcor added that from previous 2005 and 2006 wind RFPs, submissions from other proponents (excluding Fermeuse and St. Lawrence wind proponents) indicated expected net annual capacity factors ranging from 35%-43%. In MHI's opinion, a 40% annual capacity factor appears to be a reasonable assumption for a planning estimate.

5.3.2 Assessment of Non-Dispatchable Capacity

From the analysis performed in 2004, an upper limit of 80 MW was recommended by Nalcor for wind generation on the Isolated Island system for the following reasons:

1. Water management: Additional wind generation beyond 80 MW would result in less load being supplied by hydroelectric generation. This would result in wasteful spillage of water from reservoirs. For example, by adding 20 MW to the upper limit of 80 MW, the annual water spill energy equivalent would approximately double from the existing 9 GWh to 19 GWh.
2. Transmission grid security: Non-dispatchable generation could displace the demand for hydroelectric generation and cause the transmission network to be lightly loaded in certain

[50] Exhibit 25, Nalcor, "Board Letter July 12th 2011: Q5: A report on the information and data collected for wind farms", July 2011.
[51] Response to RFI MHI-Nalcor-87

areas, resulting in an overvoltage condition. A small disruption to the system could then cause widespread system disturbances.

3. Regional transmission voltage: The study notes a possible overvoltage condition due to limited voltage control provided by wind generation installations.

These reasons, identified in the 2004 study, still apply today as the power system has not substantially changed[52].

5.3.3 Wind Farms Key Finding

The key finding from the wind farms review is as follows:

- The capacity factor of 40% used by Nalcor is reasonable for a planning study. The estimated capital and operating costs used in the analysis are appropriate. Nalcor's assessment of an 80 MW limit for wind generation under the Isolated Island Option appears reasonable. Additional wind power could be installed beginning in the 2025 timeframe as the system capacity grows.

[52] Response to RFI MHI-Nalcor-89