Q. Please provide backup for the summary capital cost estimate in Table 9.1 of Exhibit 5d – Round Pond Hydroelectric Development Feasibility Study

A. The report filed as Exhibit 5d represents the level of detail that Hydro has for this site. No additional detail for the summary capital cost estimate in Table 9.1 is available.

Q. Please provide a project description and schedule for the systems improvements outlined in Section 2.4.3 of document DC1210_filed.pdf "HVDC Sensitivity Studies", July 2010 required to mitigate the 3 phase fault at Bay d'Espoir. The system improvements noted are a cross tripping/over frequency protection system, a new 230 kV circuit between Bay d'Espoir and Western Avalon, plus two new 230 kV circuits between Bay d'Espoir and Sunnyside.

A. Stability studies of the existing Island system under peak load conditions demonstrate that a 230 kV three phase fault at Bay d'Espoir with tripping of a 230 kV transmission line between Bay d'Espoir and Sunnyside will result in angular instability. In other words, the system does not recover from the fault and an outage will occur. To the extent that the existing AC system cannot survive a three phase fault at Bay d'Espoir during peak load conditions, the DC1210 – "HVDC Sensitivity Studies" contemplated an Island system with an HVdc interconnection having performance similar to the existing Isolated Island Scenario. This was outlined in section 2 of the study, last paragraph of page 2-1 which states:

> …It is also based on the assumption that the three-phase Bay d'Espoir fault will not be considered when determining the synchronous condenser requirements and system upgrades. This fault is not considered in this sensitivity analysis as the intent is to determine the system additions for the HVdc integration with system performance comparable to that of the existing system.

For clarification, Section 2.4.3 of DC1210 – "HVDC Sensitivity Studies" does not state that two new 230 kV circuits between Bay d'Espoir and Sunnyside are required to mitigate a 3 phase fault at Bay d'Espoir.

Section 2.4.3 states at page 2-5:

> However, if the new 230 kV circuit between Bay d'Espoir and Western Avalon is built and if this new circuit plus the two circuits between Bay d'Espoir and Sunnyside are 50% series compensated, AND if 2x300 MVAR high inertia Toshiba synchronous condensers are in service at Soldiers Pond (which means 3x300 MVAR installed to account for maintenance outages), the system is able to recover from a three-phase fault at Bay d'Espoir within criteria.

The "two circuits between Bay d'Espoir and Sunnyside" refer to the two existing circuits between these locations (i.e. TL202 and TL206).

The upgrades necessary to recover from a three phase fault at Bay d'Espoir are:

1) <u>A new 230 kV circuit between Bay d'Espoir and Western Avalon</u>

This circuit is common to both the Interconnected and Isolated scenarios, and is included in NL Hydro's 2012 capital budget submission. Construction of the 230 kV transmission line between Bay d'Espoir and Western Avalon has a five year completion schedule and includes:

- Addition of three 230 kV circuit breaker bays at Bay d'Espoir Terminal Station #2 to complete the breaker and one half arrangement on legs 1 and 2 with the new line termination on leg 3;

- Construction of 188 km of overhead 230 kV transmission line consisting of 795 kcmil ACSR "DRAKE" conductor on steel towers with overhead shield wire along the entire length; and
- Addition of a four 230 kV GIS circuit breaker ring bus arrangement at Western Avalon.

2) Three 300 MVAR high inertia synchronous condensers at Soldier's Pond. Three 300 MVAR units are currently in the Basis of Design for the Labrador-Island Transmission Link, but quantities and final rating will be determined during detailed engineering. The applicable design criteria will be to ensure that the Island system remains stable for faults under which the Island system remains stable today.

3) 50% series compensation of the two existing and one new transmission line (from (1)) between Bay d'Espoir and Sunnyside. This work is neither budgeted nor scheduled. Nalcor has not opted to install the series compensation on each of the three 230 kV transmission lines between Bay d'Espoir and the eastern portion of the system. Given the extremely low probability of the event, the increase in cost for series compensation in the HVdc scenario was deemed to unnecessarily penalize the Interconnected Scenario over the Continued Isolated Scenario from a performance perspective.

Similar to the existing Island System, there are load scenarios in the interconnected case where the system will survive the 230 kV bus fault at Bay d'Espoir. Preliminary analysis of the Interconnected System with a simplified model of the Labrador – Island HVdc Link reveals that the Island System will

remain stable following a three phase fault at Bay d'Espoir with the 230 kV transmission line between Bay d'Espoir and Western Avalon added and all synchronous condensers in service during the spring/fall intermediate load levels.

Q. Please provide project scoping documents, cost estimates, and relevant technical details of these system reinforcements referred to in MHI-NALCOR-86.

A. No additional system reinforcements are planned to mitigate a 3 phase fault at Bay d'Espoir. As a result, no documents exist.

Q. Are there any load/generation patterns on the Island where the system survives a 3 phase fault at Bay d'Espoir, and will implementing the system reinforcements listed in DC 1220, section 2.4.3 change this result?

A. DC 1210 section 2.4.3 provides the system reinforcements for the Island system specific to an interconnected Island scenario including an HVdc transmission line between Labrador and the Island portion of the province as discussed in MHI-Nalcor-83. There are two loading scenarios where the isolated Island system maintains angular stability today for a 230 kV three phase fault at Bay d'Espoir with subsequent tripping of a 230 kV transmission line between Bay d'Espoir and Sunnyside. These loading scenarios are:

- Intermediate system load levels where in service Holyrood generators are operating at 80 MW or less; and
- Summer loading conditions where there are no units in service at Holyrood.

Simulations of the isolated Island system with the proposed 230 kV transmission line addition between Bay d'Espoir and Western Avalon reveal that angular stability is maintained for a 230 kV three phase fault at Bay d'Espoir with subsequent tripping of a 230 kV transmission line between Bay d'Espoir and Sunnyside.

For the continued isolated Island system, the most severe ac system fault is a 230 kV three phase fault at Holyrood. A 230 kV three phase fault at Holyrood will result in severe voltage dips to plant auxiliaries resulting in tripping of all on line generators and subsequent loss of angular stability. The system reinforcements

proposed under DC 1210 – “HVdc Sensitivity Studies” will not improve the angular stability of the isolated system for a 230 kV three phase fault at Holyrood.

Q. Are any further system reinforcements planned or required to mitigate a 3 phase fault at Bay d'Espoir?

A. No further system reinforcements are planned to mitigate a three phase fault at Bay d’Espoir.

Q. The assumption of annual capacity factor of 40% for the 25 MW wind farm is based on the average of the two existing wind farms at St. Lawrence (44.3%), and Fermeuse (35.7%) capacity factors. Has any wind survey data been collected to validate the assumption of a 40% capacity factor at the proposed site of the 2014 3rd 25 MW wind farm? If so, please provide documentation to support the anticipated capacity factor.

A. It is assumed that the site of the proposed 2014 3rd 25 MW wind farm would be chosen through an RFP process.

Submissions from proponents other than St. Lawrence and Fermeuse through Hydro's 2005 and 2006 Wind RFP process indicated expected net annual capacity factors ranging from 35% to 43%. Accordingly, the use of an average of the capacity factors of the two existing wind farms (or the approximate midpoint of the range of capacity factors submitted in the RFP) is reasonable in comparison with the range of other prospective sites on the Island.

Q. Has a system study been performed that examines wind integration into the Newfoundland Island power system? If so, please provide this document.

A. A system study has been completed to examine wind integration into the Newfoundland Island power system. Please see Exhibit-61.

Q. What is the maximum wind capacity sustainable on the Island under both options (Muskrat Falls LIL HVDC and the Isolated Island)?

A. The 2004 NL Hydro study " An Assessment of Limitations For Non- Dispatchable Generation On the Newfoundland Island System " (Exhibit 61) established two limits regarding the possible level of wind generation integration on the Isolated Island system, an economic limit and a maximum technical limit. The study determined that for wind generation in excess of 80 MW there would be a significant increase in the risk of spill at the hydroelectric reservoirs particularly during the spring run off diminishing the economic advantage of additional wind generation. The study further determined that for wind generation above 130 MW it would not always be possible to maintain system stability particularly during periods of light load and during these periods wind generation would have to be curtailed.

The limits identified in the 2004 study are still applicable today. However, as load grows, the Isolated Island system should be able to accommodate additional wind generation. It has been suggested that the system should be able to accommodate an additional 100 MW of wind in the 2025 timeframe and a further 100 MW around 2035. Nalcor has not studied this in detail but will undertake studies prior to DG3.

Nalcor has not completed an analysis to establish the level of wind generation that could be sustained in the Muskrat Falls LIL HVDC option. However, given that this option will include at least one interconnection to the North American electrical grid and that there will be considerable hydroelectric capacity both in Labrador and on the Island to provide backup it would not be unreasonable to consider an

additional 400 MW of wind generation on the Island. Nalcor will be analysing this as part of the analysis that will be completed prior to DG3.

Q. Please provide all historical sales, generation and peak demand information for the period 1969-2010 for all sectors that are part of the Load Forecast. This would include the number of customers and energy (GW.h) for the following sectors: rural residential, NP residential, total residential, rural GS, small GS, large GS, electric heat GS, total GS, street & area lighting, industrial and total island sales.

A. Please see Exhibit -58. Peak demand information is provided in the response to MHI-Nalcor-92.