Review of Muskrat Falls, Labrador Island Transmission HVdc Link & Isolated Island Options by Manitoba Hydro International

OCTOBER 30, 2012

Newfoundland Labrador

Objectives

- Department of Natural Resources retained MHI to review work completed by Nalcor Energy since Decision Gate 2 in preparation for Decision Gate 3.
- The review included an assessment of the Cumulative Present Worth Analysis of the various components for each of the two options, including a reasonableness assessment of all inputs into that analysis

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Objectives

- A CPW analysis is an accepted analytical method to measure the present value of alternative options and it focuses on all future costs including capital, operating and maintenance, fuel, financing costs and power purchase agreements. The preferred option is the one with the lowest CPW over the project life.
- Reasonableness was defined as following: a) good project management and execution practises; b)good utility practises while recognizing the uniqueness of the NL electricity system; and c) to ensure work was performed with the degree of skill, care and due diligence required

Terms

- Contract signed May 22, 2012
- Building on work completed by MHI on DG2
- MHI assembled a team of specialists in:
  - Load Forecasting,
  - Project Management
  - Hydroelectric Generation
  - Thermal Generation
  - HVdc Engineering
  - AC Integration and Planning Studies
  - Submarine Cables and Marine Crossings
  - Financial Analysis
  - Additional subject matter experts as needed from the parent company

Methodology: Technical Perspective

- Examined the schedule and cost estimates for
  - Generation stations
  - HVdc and AC transmission lines
  - SOBI
  - Converter Stations and associated equipment
  - Thermal and wind plants
- Reviewed Load Forecasts for both options
- In - depth examination of:
  - AC integration studies (previously not available at DG2)
  - HVdc drawings and specifications (not available at DG2)

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Methodology: Financial Perspective

- Reviewed CPW Analysis
  - Capital and Operating Costs
  - Fuel Price Forecasts
  - Escalation Rates
  - Discount Rates
  - Debt and Equity Components
  - Examined and tested the Sensitivity Analyses

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Key Findings

- MHI found Nalcor's work to be skilled, well-founded and in accordance with industry practices.
- MHI noted that the total costs for both generation supply options increased from the prior estimates released in November 2010.
- The Muskrat Falls option continues to have the lower present value. MHI supports Nalcor's finding that Muskrat Falls is the least cost option.

Interconnected Island Option

- *Load Forecasting*: New load forecasts were prepared for DG3. MHI noted that the demand for electricity was higher due to higher economic growth. MHI found that the load forecast was well founded and appropriate as an input into the Decision Gate 3 process.
- *AC Integration*: MHI noted that Nalcor's work on integrating Muskrat Falls into the Island electrical system was in compliance with good utility practices. They also found that there is an opportunity, during detailed design, to optimize final configurations that may enhance system reliability.

Interconnected Island Option

- *HVdc Converter Stations*: MHI concluded that the technical work completed by Nalcor on the converter stations and electrode lines was reasonable as an input to the DG3 process. They also noted some project improvements to Nalcor that could be integrated in the detailed design while having little impact the CPW result.
- *Transmission Systems*: MHI noted that the approach Nalcor used in the design and engineering of the HVDC transmission line from Labrador to Soldiers Pond was diligent and appropriate and able to withstand many unique and severe climatic loading conditions over the length of the line. MHI continues to support a 1:150 return period due to the criticality of the line.

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Interconnected Island Option

- *Strait of Belle Isle Crossing*: MHI found the Nalcor's concept and design definition for the Straits crossing to be well founded and viable. MHI noted that there is a likelihood that the costs could decrease and that crossing can be completed on schedule.
- *Muskrat Falls Generating Station*: MHI reviewed the costs, schedules and design work for the generating station and found that the schedule was appropriate and consistent with best utility practices and the cost estimate is reasonable for a DG3 sanction decision. The Labrador transmission has also been appropriately designed and scheduled and the cost estimate is consistent with good utility practice.

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Isolated Island Option

- *Holyrood Thermal Generating Station*: Actual vendor costs were included in the estimates and fuel prices were updated to reflect the 2012 PIRA estimates. The studies completed on the pollution control equipment and life extension were appropriate for use at DG3.
- *Wind Farms*: Further study was completed and additional wind generation (279MW) was incorporated into the Isolated Island to reduce fuel costs. Costs included were reasonable as inputs to the analysis.

Isolated Island Option

- *Simple and Combined Cycle Combustion Turbines*: Costs were upgraded for the DG3 analysis to reflect current market prices.
- *Small Hydro Plants*: Costs for the three small hydro plants were updated to current costs and one additional study was completed on one site. Estimates were suitable for input to the DG3 analysis.

Determining the least cost option

- Both electricity supply options were updated to reflect current market conditions and cost inputs for the DG3 analysis.
- MHI noted that the costs have increased proportionately on both options as a result of increased project definition and cost escalation.
- Using an accepted analytical method called Cumulative Present Worth or CPW, the current value of all future costs for both supply options were compared to determine which option has the lowest cost in today's dollars.

CPW Results

- The analysis concluded that there is a **$2.4 billion advantage** for Muskrat Falls over Holyrood and therefore it is the least cost option.
  - Interconnected Island (Muskrat Falls): CPW is $8.4 billion in 2012 dollars.
  - Isolated Island (Holyrood): CPW is $10.8 billion in 2012 dollars.

Sensitivities or Stress Tests

- MHI also performed a number of important sensitivities or "stress tests" on Muskrat Falls including:
  - changes in fuel prices,
  - capital costs,
  - interest rates
  - potential for carbon pricing.
- After reviewing these potential changes and the impact on the overall costs, MHI concluded that Muskrat Falls is still the preferred option.

Final Recommendation

- MHI recommends that Nalcor pursue the Interconnected Island (Muskrat Falls) option as the least cost alternative to meet future generation requirements to meet the expected electrical load in Newfoundland and Labrador.