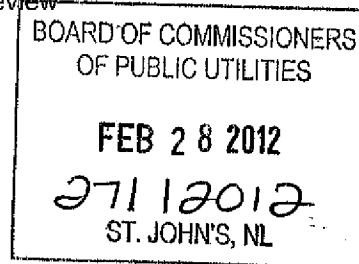


From: [REDACTED]
Sent: February 27, 2012 4:48 PM
To: PUB Muskrat Falls Review
Subject: Written Submission with respect to the Muskrat Falls Review
Attachments: Written_Submission.rtf



ATTN:

Ms. Cheryl Blundon, Board Secretary
Public Utilities Board

Good day Ms. Blundon,

Please find attached my Written Submission with respect to the Review by the Public Utilities Board of the proposed Muskrat Falls hydro electric project.

Also, please be advised that I consent fully to the public release of my Written Submission, including my name, address, phone number, email address and other information as required (and which is included on the cover page of my submission).

Also, my submission has a total of 20 pages (including the cover page) and contains several (3) coloured graphs and one table.

Please confirm by email or telephone that these have all been received OK (both in terms of content and format).

If not received OK, I can re-send and/or provide a hard copy.

Regards,
Maurice E. Adams

Written Submission

to the

Public Utilities Board

of

Newfoundland and Labrador

with respect

to the

Least-cost Analysis and Review

of the

Proposed

Muskrat Falls and Labrador/Island Transmission Link

Hydro Electric Project

Maurice E. Adams



Preamble

The Terms of Reference requires that the Board determine whether presentations and submissions, or parts thereof, are relevant to the issue before the Board.

While I had intended to comment more fully on the issue that is before the Board, the limited time frame and the Board's advance Media Release stating what is not relevant and that directed interested parties to submit only those presentations, written submissions and comments that were relevant (and which seemed therefore to place the onus on the public to determine what is relevant) has had the effect of limiting my participation in the review process, the scope of my written submission and the fullness of my comments.

Submission Topics

My submission is therefore limited to four main topics:

1. **Review Process:** the Terms of Reference (TOR) and the Reference Question (RQ) itself (guideline established by the enabling legislation, appropriateness and impact of a narrow interpretation);
2. **System Planning Assumptions:** the failure of Nalcor to provide a year by year breakdown of the costs of both options using a cost of service method, thereby making it impossible to "compare" the relative merit, the appropriateness and the effects of their 'planning assumptions' especially as they relate to Nalcor's planning assumption that an escalating supply method is the most appropriate;
3. **Forecasting Accuracy and Reliability:** Nalcor's forecasting accuracy and reliability, especially as they relate to Nalcor's load forecasting, the further magnification of risk due at least in part to the long 57-year forecasting and cost comparison period, and the actual and potential risk and impact that reliance on such high and progressively higher (magnified) risk associated with long term forecasting can and will have on the DG2-quality CPW cost calculations and CPW cost difference/preference.
4. **Margin of Error:** How Nalcor's Decision Gate 2 (DG2)-quality cost estimates (consistent with a DG2 industry standard of +50% or -30%) impacts the Reference Question and potential Board findings.

Review Process

The Terms of Reference states, in part, that:

"It has been determined that the least-cost option for the supply of power to the Island interconnected system over the period of 2011-2067

is the development of the Muskrat Falls generation facility and the Labrador-Island Link transmission line, as outlined in Schedule "A" attached hereto (the "Projects"), as compared to the isolated Island development scenario, as outlined in Schedule "B" attached hereto (the "Isolated Island Option"), both of which shall be outlined further in a submission made by Nalcor Energy ("Nalcor") to the Board of Commissioners of Public Utilities... (emphasis added)".

It is noted therefore that even before the Board could do its own due diligent investigations and evaluations, the TOR itself had already answered its own Reference Question.

Accordingly, it is submitted that in answering its own Reference Question (as shown in the Terms of Reference itself), the TOR has unduly and inappropriately prejudiced the review process and the preparation of an objectively valid report.

Furthermore, the Public Utilities Board Media Release "Backgrounder" dated February 1, 2012, under the headline "**Scope of the Review**", stated that the "*The parameters of these two options are set out in the Terms of Reference and Nalcor's Submission* (emphasis added)".

It is further submitted therefore that it is difficult if not impossible for a review process to be fair and objective where the proponent (Nalcor), who supports one option over the other, is party to determining the "scope" of the review itself by, in effect, not only determining the two options that are under review, but also (by way of "Nalcor's Submission") determining their "parameters". As the TOR and the Media Notice confirms, the 'parameters' are "set out" both in the TOR Schedules A and B and in Nalcor's Submission. These Nalcor documents thereby **improperly, unfairly and unjustly** become **key determining factors** in identifying the scope, the issues for consideration, investigation, evaluation **and relevancy** --- and they influence practically all matters where the Board is to decide what is appropriate and what is relevant to inform, or better inform the matter before it.

Notwithstanding these fundamental weaknesses and limitations with respect to the fairness and objectivity of the review process, it is noted that the Terms of Reference (TOR) and Reference Question (RQ) has nevertheless been drafted pursuant to section 5 of the *Electrical Power Control Act, 1994* (EPCA).

Sections 5. (2) of the ECPA states, in part, that:

*"A reference under this section may be general or particular in terms and may specify **criteria, factors and procedures** to **guide** the public utilities board in making its investigation, examination and report (emphasis added)".*

It is respectfully submitted therefore, as noted above, that while the TOR design itself may favour the proponent's preferred option and may therefore prejudice the review

process, the EPCA allows for the RQ to specify “*criteria, factors and procedures*” to **guide** the Board, and the RQ itself includes no “criteria” and no “procedures” that might limit or constrain the Board in the conduct of its considerations, investigations, and evaluations that “it” might consider relevant and that could bring a greater degree of balance, fairness and objectivity to the process.

And even though the RQ includes certain “factors” only, the Board is not limited to considering, investigating and evaluating **only** those factors. And furthermore, as specified in the EPCA, factors that are included are not intended to be all encompassing and are intended only to “**guide the public utilities board in making its investigation, examination and report** (emphasis added)”.

In addition to the flexibility that the EPCA provides to the Board, the Terms of Reference also states (in part) that:

*“In answering the Reference Question, the Board: **shall consider and evaluate** factors **it** considers relevant **including** NLH's and Nalcor's forecasts and assumptions for the Island load, **system planning assumptions**, and the processes for developing and comparing the estimated costs for the supply of power to Island Interconnected Customers (emphasis added)...”.*

So, while the RQ states that “*In answering the Reference Question, the Board: shall consider and evaluate factors **it** considers relevant **including**...forecasts...assumptions... (and) **processes** (emphasis added)*”, the reference question makes it clear that it is the Board that **shall consider and evaluate** not just those factors that are specified in the TOR/RQ itself (and not just those factors that Nalcor or the general public might consider relevant), but factors that “**it**” considers relevant.

And while the RQ specifies **and includes** (as a guide only) certain ‘factors’, the Reference Question does not “exclude” or limit the ‘consideration’ of other factors, or any **criteria or procedures that the Board itself determines to be relevant and that might inform or better inform the Reference Question.**

So the RQ itself makes it mandatory, that is, that “*the Board: **shall consider and evaluate** factors **it considers relevant**”, and therefore the Board must not be limited in its investigations, evaluations and review because of, or by, the fact that the RQ has included **only some factors** --- factors that are not intended for the purpose of limiting the Board’s investigations and evaluation processes, but are intended for the Board to consider --- and use --- only as a **guide**.*

Furthermore, regulatory boards are not required to adhere strictly and precisely to a process, procedures and practices standard that is normally required of courts, but instead regulatory boards are permitted to consider and apply a less formal and less rigid process, practices and procedures standard.

Accordingly, it is respectfully requested that during this more public investigative, evaluation and report preparation phase of the review, that the Board apply a TOR/RQ interpretation (and investigation, evaluation, process and procedures) standard that is at least as broad --- in scope, in parameters, and as flexible as the Board has already granted Nalcor (and as is evidenced by the broad scope and content of Nalcor's Final Submission, its responses to RFIs, and its public presentations to the Board).

System Planning Assumptions

Nalcor's own documents make it clear that one of Nalcor's key system planning assumptions is that "**supply pricing analysis**" is its chosen and considered to be Nalcor's best way to "*derive an appropriate price*" for Muskrat Falls generated power, **and** for the development of the 2-option CPW **cost calculation** comparisons.

In support of this assumption, and as outlined in Nalcor's Exhibit 36, Nalcor makes it clear that

*"(i)n order to derive an **appropriate price** for Hydro's power purchase requirements for the Island, Nalcor has undertaken a **supply pricing analysis** for MF assuming that Hydro is the only viable customer. **The objective of this analysis is to determine the "escalating supply price"** (that is, the price per MWh of power actually used by ratepayers, expressed in real dollars subject to escalation at CPI), which recovers **all costs— operating costs over time, debt service costs** (emphasis added) for the debt portion (as applicable) of the capital investment, and an equity return on the equity portion of the capital investment at a defined Internal rate of Return ("IRR") over the life of the project (emphasis added)."*

Furthermore, Nalcor (in its Exhibit 36) also argues and explains how and why it needed to "*derive (at) an **appropriate price** for Hydro's power purchase requirements for the Island* (emphasis added)", and how and why its assumption that an escalating supply method is an **appropriate** system planning assumption.

And again, in Nalcor's own documents, particularly in Nalcor's Final Submission to the Board, Nalcor demonstrates that its escalating supply price assumption is a key part of Nalcor's total "system planning assumption".

In its Final Submission, section 1.3 (Report Structure) Nalcor states that "*The structure of this report reflects the **system planning process** NLH employed to **determine the least cost option for the supply of power to the Island** (emphasis added)".*

And again in section 1.3 of Nalcor's Final Submission (at lines 4 and 5, page 10) Nalcor further states (in its **System Planning** Criteria and Need Identification section) --- that "*Section 3 of the report describes **the system planning criteria, methodology, and tools used in completing this assessment** (emphasis added)*". Nalcor then goes on to discuss, in

some detail, the system planning criteria and methodology, their escalating supply price system planning criteria, methodology, etc., which flows from Nalcor's own, earlier, foundational '**system planning assumption**' that an escalating supply method is the most **appropriate** method for developing and comparing costs for the Muskrat Falls generation station (and which is also used as the underlying principle for the CPW calculations and 2-option **cost comparison**).

It seems clear therefore (from Nalcor's own documents), that Nalcor's escalating supply price planning assumption underlies (and is used) to develop Nalcor's cost comparison calculations, that it is one of Nalcor's **key "system planning assumptions"**, and therefore, as a 'system planning assumption' it is a factor that falls within the scope of the Terms of Reference and/or Reference Question.

Not only does the Reference Question include within its scope Nalcor's 'system planning assumptions', but the Terms of Reference also requires that "(i)n answering the Reference Question, the Board: **shall consider and evaluate factors it considers relevant including (but not limited to) NLH's and Nalcor's...system planning assumptions...** (emphasis added)".

But how can the Board "evaluate" Nalcor's escalating supply price assumption, how can the Board determine the objective and relative merit of this assumption if it is not compared on an equally thorough, complex, year-by-year, analytical, cost comparison basis with an alternative cost of service assumption? Is Nalcor's key escalating supply price system planning assumption to be accepted by the Board without being thoroughly and fairly 'evaluated'? Is Nalcor's escalating supply price assumption to be evaluated only against itself? Is Nalcor's key escalating supply price assumption to be assessed in a vacuum?

Nalcor has explained, assessed, examined and presented the apparent merits of its escalating supply price assumption through its Final Submission to the Board, through numerous exhibits, through Requests For Information (RFI) responses and graphs (graphs which show the same apparent merits of its escalating supply price assumption over and over --- but only from different perspectives).

But all of these different perspectives offer (as a substitute for rational, comparative and objective analyses) only an inadequate and self-serving point of view. They are all based on the same escalating supply price system planning assumption/cost comparison method, and use repetition and changes in perspective only. They paint what is little more than the same picture, viewing the same subject matter, but only from a different perspective --- over and over (CA/KPL 27 Rev. 1 refers).

Although Nalcor has presented its escalating supply price system planning assumption to the Board through and in, many different narrative forms and through various graphs and by way of various presentations, it is respectfully submitted that since all of these rely on the same escalating supply price assumption, that therefore this does not constitute a thorough and appropriate "evaluation" as required by the TOR/RQ.

It is submitted that Nalcor's assumption that an escalating supply method is the most "appropriate" for Muskrat Falls is itself a 'system planning assumption', and therefore it falls within the scope of the TOR/RQ. Accordingly the requirement for the Board to conduct a thorough, rational, objective and relative merit evaluation of this assumption falls within the scope and parameters of the TOR/RQ.

- In support of this position it is important to note that in order to 'evaluate' the proposed Muskrat Falls project, the TOR/RQ itself requires that the Muskrat Falls option be evaluated by way of a 'comparison' --- a comparison with something else – the "Isolated Island" option.
- It is also important to note that Nalcor's Decision Gate 2 (DG 2) cost estimates are **compared**, in their degree of accuracy/reliability, against the DG 2 industry standard of +50% or -30%.
- And in order for MHI to "evaluate" Nalcor's load forecast accuracy, MHI not only '**compared**' Nalcor's 10 year, end-of-year accuracy against the industry standard of + or – 1%, MHI's load forecast accuracy evaluation was both a year-end (+17.4%) comparison and a year over year accuracy comparison over the entire 10-year accuracy comparison period (year over year, from year 1 to year 10) --- **against the + or – 1% industry standard**.
- Furthermore, in order for MHI to "evaluate" Nalcor's planned transmission reliability of 1:50, MHI 'compared' (once again) Nalcor's 1:50 reliability factor to the 1:150 and 1:500 industry standard (and also **cost-compared** it against a 1:150 reliability standard).

Accordingly, I would submit that relative merit (comparative analyses in its full sense) is an appropriate part of a thorough evaluation process and that a 'comparison' with industry standards, other options and other industry 'assumptions' year by year, over the entire relevant time period is firmly within the scope of the TOR/RQ. The Board's review process itself, by way the required TOR 2-option 'comparison' and by way of MHI's evaluations and industry comparisons, has recognized and demonstrated that comparative analyses form a key component of an evaluation process and is therefore within the scope of the TOR/RQ.

To consider and appropriately "evaluate" Nalcor's escalating supply price system planning assumption, Nalcor's assumption must be compared to a year-by-year breakdown of costs over the entire 57-year (or 50-year, as appropriate) assessment period calculated using the utility industry's "cost of service" standard --- an approach or assumption other than (and different from) Nalcor's escalating supply price assumption.

Only by providing an appropriately clear, accurate and thorough 57-year (or 50-year, as appropriate) year-over-year statement of costs using a cost of service methodology can the Board (and the public) 'consider and evaluate' the full extent to which Nalcor's

escalating supply price system planning assumption might, or might not, be as Nalcor claims, the best (the most “appropriate”) assumption for the Muskrat Falls option and CPW cost comparison calculations.

It is respectfully submitted therefore that:

- the Board require Nalcor to apply a cost of service assumption/ methodology to its analyses of both options and provide both the Board and the public a clear, accurate and thorough year-over-year breakdown of costs (including graphs) over the entire 57-year (or 50-year, as appropriate) Reference Question time period,
- the Board and the public be provided an appropriate opportunity to review the cost of service data and analyses, to make presentations and/or to provide comments, and that the Board defer submitting a final report to government until receipt, consideration and evaluation of the application, impact and merit of this alternative cost of service system planning assumption is completed and compared against Nalcor’s escalating supply price assumption, and
- such other relief as deemed appropriate by the Board.

Load and Forecast Accuracy

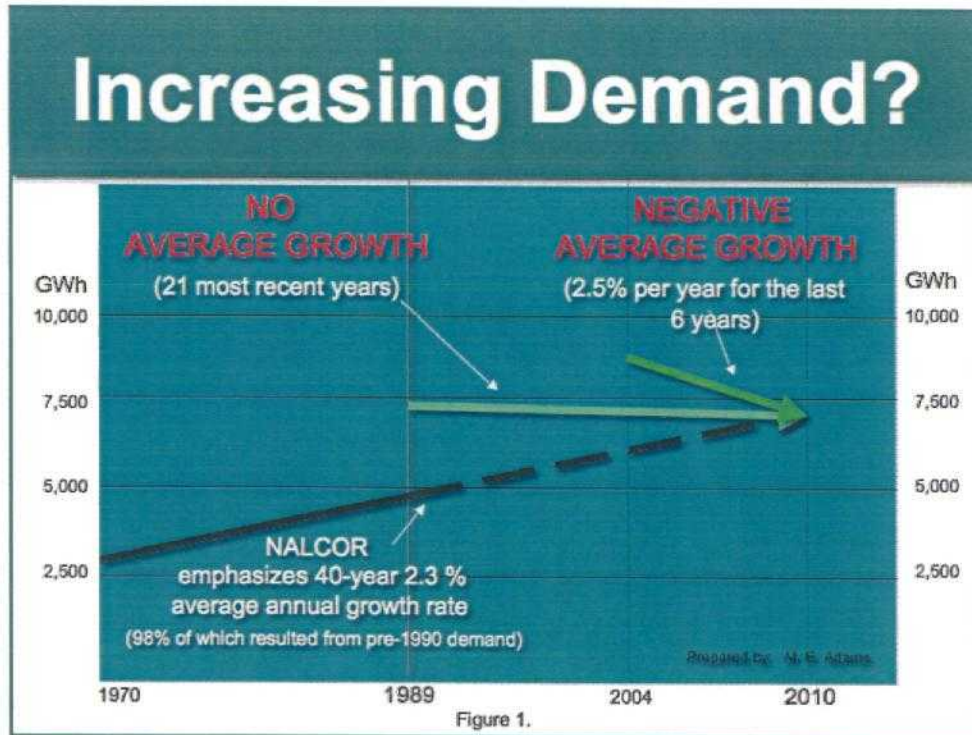
Nalcor has said repeatedly that the island’s 40-year average growth rate is 2.3% annually and that therefore, its forecast average compound annual growth rate of 0.8% is ‘conservative’.

But is it?

About 98% of that 40-year average annual growth rate of 2.3% resulted from pre-1990 demand. Clearly there has been virtually no average growth over the more recent and **more relevant** 21-year period, and furthermore, there has been on average an annual **negative growth** rate of 2.5% over the most recent and most relevant 6-year period.

So, is a 0.8% forecast average compound annual growth rate for the next 57 years really, as Nalcor claims, “conservative”, when 0.8% is 8 times more than the 0.1% average growth rate that the island has actually experienced over the most recent and most relevant 20-year period? See Figure 1 (below).

And if the forecast growth rate is reduced by 50% (from 0.8% to 0.4%) annually, as shown in Nalcor’s “sensitivity analysis”, how meaningful is that --- when a 0.4% average compound annual growth rate is still four (4) times more than the 0.1% average growth rate that the island has actually experienced over the most recent and most relevant 20-year period?



Notwithstanding the island’s historical load record, whether or not Nalcor is conservative, reasonable, or has used due diligence and applied sound methodologies in the conduct of its load and other forecasts --- **is not the issue.**

The issue is, instead, whether or not Nalcor has attained (**and demonstrated**) a consistent, reliable, and acceptable standard of energy forecast accuracy, and whether or not Nalcor’s forecasting and cost comparisons are conducted over a reasonable and foreseeable period of time.

Newfoundland and Labrador Hydro’s own legislation (the Hydro Corporation Act, 2007, section 12), under the heading “Future power demand forecasts”, requires any corporation or person receiving power from NL Hydro and requested by NL Hydro to provide “*a forecast of his or her future power requirements...(shall do so by)...covering a period...not in excess of 20 years*”.

Furthermore, while Nalcor uses a 50+ year energy/oil forecast and Cumulative Present Worth cost comparison period, Nalcor’s Final Submission refers, not to NL Hydro’s experience in conducting 30, 40, 50 or 57 year energy forecasts, but Nalcor’s Submission refers repeatedly to NL Hydro’s experience in conducting only 20 year energy forecasts.

Secondly, while Manitoba Hydro International (MHI) warns, in its recent report, that Nalcor’s very long term 50+ year forecasts may “**further magnify**” risks, MHI does not say whether 30, 40 or 50+ year forecasts and cost comparison periods are within, or outside, accepted industry standards.

What Manitoba Hydro International (MHI) does however make clear, in section 3.1.1 of its report, is that *“Experience within the industry based on the results from Manitoba Hydro and other Canadian utilities indicate that a reasonable measure for forecast accuracy is a forecast deviation of 1 percent per year into the future”*.

Accordingly, the industry standard then (what the industry considers a ‘reasonable measure for forecast accuracy’) --- is an average forecast deviation of no more than **plus or minus** 1% per year into the future. Presumably, anything outside that would generally be unreasonable.

The Manitoba Hydro report then further explains that *“this means that a 10-year-old forecast should be within plus or minus 10 percent of the actual energy load observed...”*.

Now even though Manitoba Hydro International also states, quite clearly, at page 14 of its report, that risks associated with inputs such as load forecasting *“are further magnified considering the 50+ year period (2010 – 2067) used in the preparation of the cumulative present worth analysis”*, for now let’s not look at those **magnified** risks that are caused by the 50+ year forecast period. Let’s look only at Nalcor’s most recent 10 and 6-year energy forecast accuracy record.

First of all, page 42, section 3.1.1 of MHI’s report states that over the most recent 10 year period, the forecast results for the domestic and line loss sectors were both within the accepted industry average standard deviation of plus or minus 1%.

Accordingly, MHI goes on to say that the *“forecast results for the domestic and line loss sectors were reasonable...”*

From this it would seem therefore, that **if** Nalcor’s average deviation for these sectors were **not** within the accepted industry deviation standard of 1% annually, then MHI would have found it difficult to conclude that those forecast results (for these specific sectors) were within the industry accepted *“reasonable measure for forecast accuracy”*, and MHI would also have found it hard to conclude that *“forecast results for the domestic and line loss sectors were reasonable”*.

But Nalcor’s energy forecasts for our **total island needs**, that is --- **the total energy forecasting on which the Cumulative Present Worth depends** (and on which the very viability of the Muskrat Falls project depends), is more than just the energy needs of the domestic and line loss sectors.

The domestic and line loss sectors make up only about 50% of our total island needs.

While MHI’s report emphasizes Nalcor’s forecast accuracy with respect to only a portion of the island’s energy needs, Nalcor’s Final Submission makes it clear that the energy forecast inputs and calculations used to support the options in the Reference Question, are not based on just 50% of our energy needs --- they are, **as they must be**, based on our

total island energy needs.

So the more important question is --- not whether or not, over the most recent 10 and 6-year forecast periods, Nalcor's **domestic** energy forecast, which accounts for only about 50% of the island's total energy needs, has been within acceptable industry deviation standards, but instead, **the relevant question** is whether or not Nalcor's average energy forecast accuracy and deviation record for the island's **total energy needs** have been within acceptable industry standards.

Again, MHI's Table 1, at page 42, shows that Nalcor's total "Energy Forecast Accuracy Measured in Percentage of Deviation from the Actual Load", through the most recent 10 years of history (from year 2001 through to year 2010), ranged from a +0.4% too high in year 2001 to a +17.4% too high in year 2010 --- +0.4%, +1.9%, +3.7%, +5.5%, +7.9%, +10.6%, +11.4%, +13.3%, +16.6%, and +17.4% respectively.

So, as can be seen from Nalcor's and MHI's own numbers, over the most recent 10-year forecast period, **Nalcor's total island forecast deviation has always been higher** than the island's actual load, and on average it has been 1.74% per year too high --- a full 74% higher than the industry, MHI and Canadian acceptable deviation of 1% per year.

In fact, and as can be seen from Nalcor's own numbers, over that 10 year period, Nalcor's total island energy forecasting deviation seems to have gotten --- not more accurate --- but **less accurate**.

Therefore, based on the industry, MHI and Canadian accepted deviation standard of plus or minus 1% annually, Nalcor's total island average annual forecast has not, over the last 10 years, fallen within what MHI has described as the "*accepted industry standard average deviation of plus or minus 1%*". Accordingly, by MHI's own definition, Nalcor's 10-year total island load forecast track record would not be a "*reasonable measure for forecast accuracy*".

Now, if one looked closely at the most recent 6-year (instead of the last 10-year) period, it can be seen that not only has Nalcor's total island forecasting become less accurate, but Nalcor's 6-year deviation accuracy over that 6 year period has averaged, not 1.74% higher, but 2.6% per year higher --- a shift from being on average 74% higher than the industry standard of 1% deviation per year, to 160% higher than the industry standard deviation of 1% (see Table "A" below).

TOTAL ISLAND ENERGY
(Data source: Nalcor's Exhibit 103)

6 YEAR

(ACTUAL LOAD AND FORECAST DEMAND)
(GWh)

	2004	2006	2008	2010
ACTUALS	8,637	8,088	8,103	7,608
FORECASTS				
2004	8,409	8,519	8,618	8,777
2006		8,075	8,200	8,428
2008			8,112	8,251
2010				7,585

Table "A".

As can be seen from Nalcor's own numbers, Nalcor has over-forecasted total island energy needs by 1,169 GWh (8,777 GWh minus 7,608 GWh) over the most recent 6 year period, for a deviation over a 6 year period of 15.4% (or an average annual deviation of 2.6% annually --- 160% higher than the industry deviation standard of 1% annually).

So compared to industry standards, Nalcor has **not demonstrated**, in its total island forecasting, an acceptable, industry standard of accuracy and reliability.

Therefore, while Nalcor's total island demand forecast is a major, **determining**, and very high risk --- a **key input factor** in its development of its DG2-quality Cumulative Present Worth (CPW) cost estimates and comparisons, Nalcor has not **demonstrated** ---- with any level of accuracy and reliability associated with industry standards, that its total island forecasting accuracy and reliability is reflective of the island's **actual** total island energy needs.

Given Nalcor's demonstrated and consistent failure to meet acceptable forecast deviation standards for our total island needs, it is submitted that Nalcor has failed to demonstrate that Nalcor's total island energy forecast is within an acceptable level of accuracy and reliability, that Nalcor has not demonstrated that its total island energy forecast is reflective of the island's total and actual energy needs and therefore cannot and should not be relied on and used for what MHI has described as a "major" input factor into the Cumulative Present Worth calculations.

Furthermore, as Figure 2 (below) demonstrates, Nalcor's demonstrated track record for over-forecasting the island's total energy demand appears to have been systemic.

While total island load kept going down, year over year, Nalcor's forecast kept going UP, year over year.

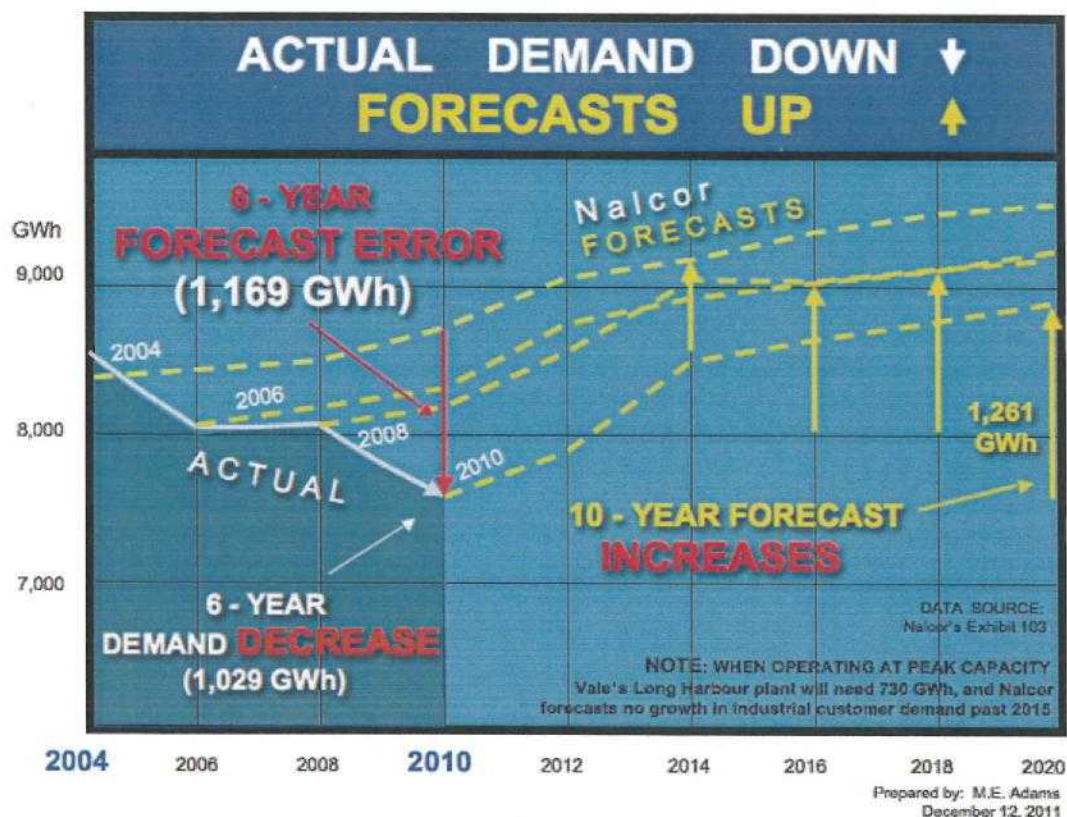


Figure 2.
Systemic Forecasting Error

(Figure 2 shows systemic error in Nalcor's/NL Hydro's forecasting. Over a 6-year period demand moved consistently DOWNWARD, while forecasts moved consistently UPWARD. **Note:** Vale's energy forecast has since been downgraded to 640 GWh. Also, only forecasts for every second year are shown for the sake of clarity)

Risk Magnification

Now let's look, not at a 10-year or a 6-year forecast deviation track record, but let's look at what forecast deviations could mean for Nalcor's 50+ year (2010-2067) forecast and cost comparison period.

Again, Manitoba Hydro International, at page 14 of its report, states clearly, and firmly,

that *“The risks associated with these inputs (inputs such as Nalcor’s energy forecasts) are **further magnified** considering the 50+ year period (2010 – 2067) used in the preparation of the cumulative present worth analysis”*.

So what does “further magnified” mean?

If we took Nalcor’s 2.6% per year, 6-year annual total island average forecast deviation level and applied only the 1.6% portion (the amount that is above the standard, acceptable 1% deviation level) not just 10 years into the future, but for the entire 57 years that the Reference Question says must be used, then by year 2067 Nalcor’s total island energy forecast would be 91.2% higher than the 1% industry deviation standard.

Reasonable?

It is noteworthy that when MHI documented that Nalcor had forecast 50% of the island’s total demand (that is, its domestic and line loss demand) at the lower end of the acceptable 1% plus or minus deviation standard, MHI emphasized the point that Nalcor should have forecasted 1% higher.

Accordingly, applying this same reasoning, going forward for the full 57-year forecast period, it seems that MHI could (and perhaps should) have also said that for total island demand (the forecast demand that is used to calculate the cumulative present worth), Nalcor should have forecasted annually 1.74% lower.

Using the same reasoning, then Nalcor’s 6-year average deviation for the full 2.6% annually would mean that over Nalcor’s full 57 year period, Nalcor’s total island forecast could therefore be 148% **too high**.

Accordingly, and clearly, with this kind of forecast deviation, it is submitted that Nalcor has failed to demonstrate (within the accepted industry deviation standard of plus or minus 1% annually) that the island has a need for the energy that has not only been forecasted by Nalcor, but has also been used as a “**cornerstone**” of Nalcor’s claim that the Muskrat Falls option has a \$2.2 billion cumulative present worth preference over the Isolated Island option.

Furthermore, when Manitoba Hydro International, at page 14 of its report, states clearly, and firmly, that *“The risks associated with these inputs (such as Nalcor’s energy forecasts) are **further magnified** considering the 50+ year period (2010 – 2067) used in the preparation of the cumulative present worth analysis”* --- what degree or numerical value can or should be placed on this “magnified”, but un-quantified risk?

Even though common sense would lead one to think that such a ‘magnified’ risk might be substantial, why did MHI not quantify it?

Can a numerical value associated with this magnified risk be determined from Nalcor’s actual 10-year forecasts?

Referring again to MHI's report at page 42 --- MHI's Table 1 shows that Nalcor's total "Energy Forecast Accuracy Measured in Percentage of Deviation from the Actual Load", through the most recent 10 years of history (from year 2001 through to year 2010), ranged from a +0.4% too high in year 2001 to a +17.4% too high in year 2010 --- +0.4%, +1.9%, +3.7%, +5.5%, +7.9%, +10.6%, +11.4%, +13.3%, +16.6%, and +17.4% respectively.

It should perhaps be noted here, that while MHI argues that Nalcor's inaccuracy in forecasting the needs of industrial customers (and therefore total island load) was due to the 'unforeseen' closure of two of the island's paper mills, Table 1, Vol. 1 (see above excerpt) of the MHI report seems to refute that argument in that even though the reduction in actual load was indeed primarily due to mill closures, at least 4 years before the closure of these mills [year 2001 (+0.4%), year 2002 (+1.9%), year 2003 (+3.7%), and year 2004 (+5.5%)] Nalcor had been forecasting increases that were all well above the deviation standard of plus or minus 1% --- averaging +1.4% per year too high.

Accordingly, I would submit that it is unreasonable, and not supported by the facts, for MHI to effectively explain away Nalcor's significant and consistently over-forecasted industrial and total island energy demand (because, it is argued, that industrial demand reductions were "unforeseeable"), and that it is even more unreasonable when MHI states that with the exception of these 'unforeseeable' closures, Nalcor's industrial demand (and therefore total island demand) would **otherwise** have been "accurate".

The facts are that Nalcor's 10-year actual total island demand forecast accuracy record has been demonstrated to be well below the industry standard of + or - 1% annually.

With respect to MHI's warning that the long, 57-year forecast period "further magnifies" risk, from Nalcor's own numbers then it can be seen that for year 1 into the future Nalcor's forecast was only +0.4% too high. But for year 10 into the future, Nalcor's forecast was 17.4% higher than the actual load. That shows that forecast error, just 10 year out, is **magnified** more than 40 times (more than 4,000%) greater than what it is for just year 1 into the future.

Even for the island's domestic demand, Nalcor's 10-year forecast record (again from MHI's Table 1, page 42) shows that while in year 1 Nalcor's forecast was only 1.3% too low, for year 10 into the future Nalcor's forecast deviation was 10% too low. Again, in this case, the actual numbers show that the further into the future you go, the greater (**the more magnified**) is the deviation --- that is, the more magnified is the forecast error.

Even in the case of domestic load forecasting, the forecast error 10 years out is 7.7 times (770%) greater than what it is just 1 year into the future.

So, these are not just mere probabilities, these are actual numbers from Nalcor's medium term forecasting itself. It shows that even just 10 years out, risks (forecast errors) were **magnified** by between 770% and more than 4,000%.

Is this then, the kind of magnified risk that MHI was getting at (but did not quantify) when it said that "*The risks associated with these inputs (such as Nalcor's energy forecasts) are **further magnified** considering the 50+ year period (2010 – 2067) used in the preparation of the cumulative present worth analysis*"?

Now if risk (if forecast error) is magnified 4,000% just 10 years into the future, what level of risk magnification can reasonably be expected for the duration of Nalcor's 57-year forecast period?

It seems to me then that over 57 years, risk could be magnified (5.7 times 4,000%), or almost 23,000%.

Or to quantify the "magnified" risk another way.

In year 2010 the island's total actual energy load was 7,608 GWh.

A +1% annual forecast deviation for year 1 (of a 57 year forecast period) would therefore be 76 GWh too high, and for year 57, the forecast error could be 57 times that amount, or 4,332 GWh too high, and such a forecast deviation would apparently still be within industry standards.

But to look further at how unrealistic 50+ year forecasting is.

Nalcor's 6-year total energy deviation track record accuracy has not been 1% per year. Instead, it has been much higher --- 2.6% per year too high. So, at Nalcor's 2.6% average annual deviation rate, year 1 forecast deviation would be 198 GWh too high, and for year 57 it would be 11,275 GWh too high.

Now how would that impact on the Cumulative Present Worth preference for the Muskrat Falls option?

It is important to note that the long term risk magnification as noted above is based on extending the first 10-year average error only out to the 57-year period. Such an approach would not appear to take into account how the error itself actually magnifies over time, but only applies the first 10-year average error (the generally more accurate forecast period) out 57 years.

Finally, while **energy forecast demand** is just one of several key factors that MHI has described as '**major**' inputs into the cumulative present worth (CPW) calculations, other major factors such as oil forecasts would also likely be subject to a similar kind of "**risk magnification**".

Perhaps **risk magnification** helps explain why NL Hydro's legislation restricts demand forecasting to 20 years, why the PIRA Energy Group only forecasts oil prices out to 15 years, why the National Energy Board only forecasts oil prices out 25 years, and why the NL government forecasts demographic estimates out to only 20 years.

Beyond 20 or 25 years, "risk magnification" is intensified --- and forecasts become not only unreliable --- but **meaningless**.

Margin of Error

The Reference Question states that:

*"The Board shall review and report to Government on **whether** the Projects represent the **least-cost** option for the supply of power to Island Interconnected Customers over the period of 2011-2067, **as compared to** the Isolated Island Option, this being the 'Reference Question' (emphasis added)".*

Clearly, the Reference Question does not ask or direct the Board to **objectively** evaluate the Infeed Option **in isolation** or to review only one option and then report that this one option, the Infeed Option, is or is not the best option, the right option or the 'lowest possible' cost option.

Instead, the Reference Question requires that the Board determine the "relative merit" (rather than the 'objective' merit) of the Infeed Option. And the relative merit is to be determined by "**compar(ing)**" the Infeed Option "to" the Isolated Island Option, and this comparison is measured primarily by way of Decision Gate 2 (DG2)-quality CPW cost calculations and cost difference.

Accordingly, since the principal measure of merit is a 'relative' (rather than an 'objective') measure of merit, the relationship between the two DG2 CPW cost estimates and the **margin of error** in the cost estimates are critical to "whether" or not the Board has rational and reasonable grounds to conclude that **either** of the two options is --- or is not --- 'least cost'.

Applying a +50% or -30% margin of error to the Isolated Island Option DG2 CPW cost estimate of \$8.810 billion produces a DG2 cost estimate ranging from as high as \$13.215 billion to as low as \$6.167 billion (for a total error spread of \$7.048 billion --- almost equal to the Isolated Island DG2-quality cost estimate itself).

Applying a +50% or -30% margin of error to the Infeed Option DG2 CPW cost estimate of \$6.652 billion produces a DG2 cost estimate ranging from as high as \$9.978 billion to as low as \$4.656 billion (for a total error spread of \$5.322 billion --- again, an amount almost equal to the Infeed Option DG2-quality cost estimate itself).

So, Nalcor's **DG2** +50% or -30% margin of error for both options ranges from \$7.048 billion for the Isolated Island Option to \$5.322 billion for the Infeed Option.

In the case of the Reference Question before the Board, both DG2-quality CPW cost estimates (\$8.810 billion and \$6.652 billion) are well within each other's DG2-quality +50% or -30% industry standard margin of error of \$7.048 billion for the Isolated Island Option and \$5.322 billion for the Infeed Option.

Since each DG2-quality cost estimate is **well within the industry margin of error (+50% or -30%) of the other**, it is submitted that the DG2-quality cost estimates are both 'statistically tied'. Figure 3 (below) refers.

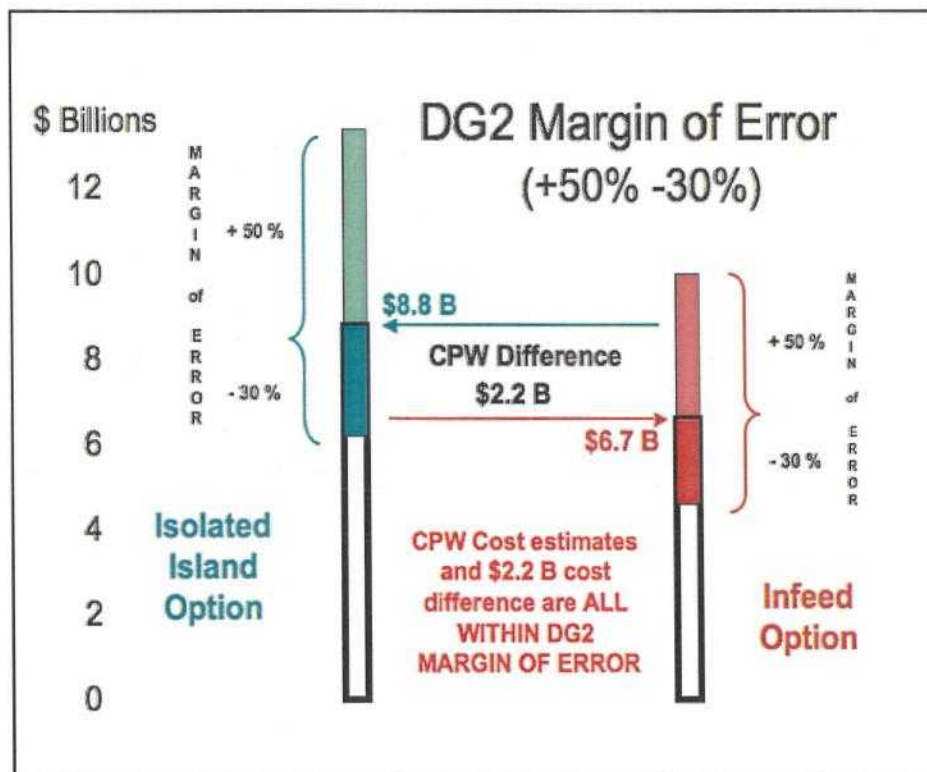


Figure 3.

[CPW DG2-quality cost estimates in relation to each other (and the difference between them) are within the DG2 margin of error]

Given therefore that the DG2-quality cost estimates that are before the Board (as well as the CPW cost difference of \$2.2. billion) are within each other's DG2 margins of error of +50% or -30%, and given that it is on the basis of this cost relationship (relative merit) that the Board is asked to base an analysis and to report "whether" the Infeed Option represents least cost "as compared to" the Isolated Island Option, it is respectfully submitted that these DG2-quality, Class 4, feasibility level estimates are in a "statistical (margin of error) tie" and therefore they provide **no prudent, rational and reliable**

grounds for a finding or a report that concludes that the Infeed Option is “least cost”.

Accordingly, since there are no rational and reliable grounds for a finding that the Infeed Option is ‘least-cost’, any such finding would not be well founded, would be fundamentally flawed --- and in error.

Accordingly, it is submitted that since the Infeed Option is within the margin of error, and in a statistical tie with, the Isolated Island Option, the Infeed Option cannot be rationally and reliably found to be --- “least-cost”.

Conclusion

The Reference Question

*“The Board shall review and report to Government on **whether** the Projects represent the **least-cost** option for the supply of power to Island Interconnected Customers over the period of 2011-2067, **as compared to** the Isolated Island Option, this being the ‘Reference Question’ (emphasis added)”.*

In answering the Reference Question, the Board should not only consider the systemic error in Nalcor’s load forecasts and should not only weigh the magnified risks associated with 57-year forecasts, but the Board should also give considerable weight to two **key factors** --- the cost estimates’ **high margin of error** (DG2, low quality, class 4, feasibility level), and **the relationship between them** (the CPW cost difference).

Both are **critical** factors that warrant careful consideration in the formulation of an answer to the reference question.

Given that the DG2 cost estimates are within each other’s margin of error and the CPW cost difference itself is also within the DG2 margins of error, it is clear that the DG2 cost estimates are in a statistical tie.

Accordingly, there are **insufficient grounds** on which the Board can reasonably, rationally and **reliably** conclude that the Infeed Option is least-cost.

While there is a lack of clear evidence that the Infeed Option is least cost, there is clear evidence (the DG2 cost estimates and CPW cost difference) that both estimates (as well as the CPW difference) are within each others margins of error and in a “statistical tie”.

The evidence therefore before the Board (the cost estimates themselves, their quality and relationship) **is not sufficient** from which an objective and reasonable conclusion can be drawn that the Infeed Option is “least-cost”.

Instead, the evidence supports the conclusion that the Infeed Option is in fact in a

“statistical tie” with the Isolated Island Option.

Accordingly, and with respect, it is suggested that the answer to the Reference Question can be found not only in the risk and error inherent in Nalcor’s 57-year magnified load forecast and cost comparison estimates, but also in Nalcor’s DG2 low reliability level cost estimates (and as evidenced in Figure 3 above) --- in their margin of error and in the relationship between them.

*“Arguments which base their demonstrations on mere probability are
deceptive, and if we are not on our guard against them
they deceive us greatly” (Plato, “The Phaedo”)*

.....