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INFORMATION REQUEST RESPONSE

To: Manitoba Public Utilities Board Date: February 20, 2014

KP File: VA103-449/1-A.55

Needs For Alternatives To – **PUB/KP I-001 a**

SUBJECT: Capital Cost

PREAMBLE:

The KP report states that "very broadly speaking, the investment costs of large hydropower plants such as Keeyask and Conawapa range anywhere from $2 million/MW installed to $10 million/MW installed. The proposed Keeyask and Conawapa facilities are approximately $9 million/MW and $7 million/MW respectively, including all the indirect costs and inflation.

QUESTION:

What other hydropower projects in North America is KP aware of that have matched or exceeded Manitoba Hydro's cost projections and approached the $10 million/MW upper limit referenced in the report?

RESPONSE:

The projects considered under Table 2.1 of the KP IEC report offer the best direct comparison with Keeyask and Conawapa (in terms of overall cost and installed capacity).

Over the last few years, Knight Piésold has worked on a number of greenfield hydro projects in North America, many at the feasibility stage with contractor prices, and one actually constructed, where the unit price of the installed capacity has far exceeded $10 million per installed MW. Those hydroelectric endeavours were most often located in remote northern sites (Nunavut, British Columbia (off grid), Yukon, or Alaska), were not firm energy projects and were not as large as Keeyask or Conawapa. They were often attractive due to a scarcity of local resource options. One must be careful to note that the firmness and reliability of the energy source is important in the comparison.

The recently completed Mayo B project (Yukon Energy) provides an additional 10 MWs to the Mayo-Dawson electrical grid and cost around $140 million which corresponds to $14 million per installed MW.
http://www.yukonenergy.ca/energy-in-yukon/our-projects/mayo-b/

/bxf

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INFORMATION REQUEST RESPONSE

To: Manitoba Public Utilities Board Date: February 20, 2014

KP File: VA103-449/1-A.55

Needs For Alternatives To – **PUB/KP I-001 b**

SUBJECT: Capital Cost

PREAMBLE:

The KP report states that "very broadly speaking, the investment costs of large hydropower plants such as Keeyask and Conawapa range anywhere from $2 million/MW installed to $10 million/MW installed. The proposed Keeyask and Conawapa facilities are approximately $9 million/MW and $7 million/MW respectively, including all the indirect costs and inflation.

QUESTION:

Please confirm that the $1.35M/GWh number for Muskrat Falls includes HVDC transmission, while the numbers for Keeyask and Conawapa do not (i.e., they exclude Bipole III).

RESPONSE:

Confirmed, Muskrat Falls includes the HVDC transmission.

/bxf

INFORMATION REQUEST RESPONSE

To: Manitoba Public Utilities Board Date: February 20, 2014

KP File: VA103-449/1-A.55

Needs For Alternatives To – **PUB/KP I-001 c**

SUBJECT: Capital Cost

REFERENCE: KP report, pp. 7-8

PREAMBLE:

The KP report states that "very broadly speaking, the investment costs of large hydropower plants such as Keeyask and Conawapa range anywhere from $2 million/MW installed to $10 million/MW installed. The proposed Keeyask and Conawapa facilities are approximately $9 million/MW and $7 million/MW respectively, including all the indirect costs and inflation.

QUESTION:

Table 2.1 relates to other projects currently contemplated. Has KP examined any projects recently completed, aside from Wuskwatim? If so, does the range of completion costs per MW mirror the cost estimate range found in Table 2.1.

RESPONSE:

KP recently competed (as designers for the EPC contractors Graham and Flatiron) in a tender for the 126 MW John Hart Generating Station Replacement Project in British Columbia. Bids were submitted in late 2013. The project is very akin to a greenfield project despite being a replacement project and is estimated by BC Hydro to cost between 1 B$ and 1.2 B$ which roughly corresponds to between $8 million and $10 million per MW.

/bxf

INFORMATION REQUEST RESPONSE

To: Manitoba Public Utilities Board Date: February 20, 2014

KP File: VA103-449/1-A.55

Needs For Alternatives To – **PUB/KP I-002 a**

SUBJECT: Capital Cost

REFERENCE: KP report, p. 10

PREAMBLE:

In Table 2.3, KP provides its assessment of maturity levels of the project definitions for various options, including Keeyask and Conawapa.

QUESTION:

Please explain why KP offers a 45%-range for Keeyask and Conawapa (30-75%). What were the limiting factors that prevented narrowing the range?

RESPONSE:

The assessment of maturity levels are based on the AACE International Recommended Practice No. 69R-1, "Cost Estimate Classification System – As Applied in Engineering, Procurement, and Construction for the Hydropower Industry" Revision January 25, 2013. Table 3 of this reference, reproduced below, "maps the extent and maturity of estimate input information (deliverables) against five estimate classification levels". The maturity level is an approximation of the completion status of the deliverable. The range suggested by AACE is subjective, and input on a construction project can change constantly as a function of ground conditions, work conditions, ease of deployment, availability of crews and new techniques. For example, drawings issued for tender and issued for construction may have significant differences, yet both could be deemed complete.

The completion is indicated by the following letters:

- None (N): Development of the deliverable has not begun.
- Started (S): Work on the deliverable has begun. Development is typically limited to sketches, rough outlines, or similar levels of early completion.
- Preliminary (P): Work on the deliverable is advanced. Interim, cross-functional reviews have usually been conducted. Development may be near completion except for final reviews and approvals.
- Complete (C): The deliverable has been reviewed, approved and issued for design as appropriate."

	ESTIMATE CLASSIFICATION				
	CLASS 5	**CLASS 4**	**CLASS 3**	**CLASS 2**	**CLASS 1**
MATURITY LEVEL OF PROJECT DEFINITION DELIVERABLES	**0% to 2%**	**1% to 15%**	**10% to 40%**	**30% to 75%**	**65% to 100%**
General Project Data:					
Project Scope of Work Definition	S	S	P	P	C
Facility Output Profile & Nameplate Capacity	S	P	C	C	C
Site Infrastructure (Access, Construction Power, Camp etc.)	N	S	P/C	C	C

	ESTIMATE CLASSIFICATION				
	CLASS 5	**CLASS 4**	**CLASS 3**	**CLASS 2**	**CLASS 1**
MATURITY LEVEL OF PROJECT DEFINITION DELIVERABLES	**0% to 2%**	**1% to 15%**	**10% to 40%**	**30% to 75%**	**65% to 100%**
Principal Works (Location)	S	P	C	C	C
Hydraulic & Hydrology	S	P	C	C	C
Topography & Bathymetry	S	P	P/C	C	C
Geotechnical Investigation	S	P	C	C	C
Material Utilization (Borrow Sources)	S	P	P/C	C	C
Environmental Studies	S	P	C	C	C
Environmental Monitoring (During Construction & Operations)	N	N	N	S	P
Stakeholder Engagement	N	S/P	P	P/C	C
Regulatory Approval & Permitting	S	P	C	C	C
Integrated Project Plan	S	P	C	C	C
Project Schedule Baseline	S	P	P/C	C	C
Work Breakdown Structure (WBS)	P	P	C	C	C
Workforce Estimates	N	S	P	C	C
Project Code of Accounts (Control Accounts)	N	S	P	C	C
Equipment Procurement Strategy (Owner vs. Contractor)	N	S	C	C	C
Contracting and/or Outsourcing Strategy	N	S	C	C	C
Engineering Deliverables (Specifications and/or Drawings):					
General Arrangement Design & Drawings	S	S/P	P/C	C	C
Project Parameter	S	P	C	C	C
PMF and Hydraulic Design	S	P	C	C	C
Dam Design & Drawings	N	S	P	P/C	C
Intake Design & Drawings	N	S	P	P/C	C
Penstock Design & Drawings	N	S	P	P/C	C
Power House Design & Drawings	N	S	P	P/C	C
Spillway Design & Drawings	N	S	P	P/C	C
De-Silting Basins	N	S	P	P/C	C
Power Tunnel/Canal	N	S	P	P/C	C
Gates and Cranes Design & Drawings	N	S	P	P/C	C
Turbine and Generator Design & Drawings	N	S	P	P/C	C
Electrical One-Line Drawings	N	N	S	P	C
Auxiliary Mechanical Design & Drawings	N	N	S	P	C
Auxiliary Electrical Design & Drawings	N	N	S	P	C
Protection & Controls System Design & Drawings	N	N	S	P	C
Telecommunication System Design & Drawings	N	N	S	P	C
Spare Parts Spec (Commissioning & Operation)	N	N	S	P	C
Mitigation Measures (Aquatic, Terrestrial, Avian, Clearing, Heritage etc.)	N	S	P	C	C

/bxf

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INFORMATION REQUEST RESPONSE

To: Manitoba Public Utilities Board Date: February 20, 2014

KP File: VA103-449/1-A.55

Needs For Alternatives To – **PUB/KP I-002 b**

SUBJECT: Capital Cost

REFERENCE: KP report, p. 10

PREAMBLE:

In Table 2.3, KP provides its assessment of maturity levels of the project definitions for various options, including Keeyask and Conawapa.

QUESTION:

Please advise whether the 30-75% range refers to the KGS estimates prepared in 2009 and 2010, respectively, or subsequent updates to the estimates.

RESPONSE:

The maturity level evaluation was based on our appreciation for the work done for the 2012 estimate despite most of the Keeyask Generating Station Project definition being complete in 2009.

/bxf

INFORMATION REQUEST RESPONSE

To: Manitoba Public Utilities Board Date: February 20, 2014

KP File: VA103-449/1-A.55

Needs For Alternatives To – **PUB/KP I-002 c**

SUBJECT: Capital Cost

REFERENCE: KP report, p. 10

PREAMBLE:

In Table 2.3, KP provides its assessment of maturity levels of the project definitions for various options, including Keeyask and Conawapa.

QUESTION:

Why is the range for Keeyask the same as for Conawapa, despite Keeyask having progressed much further to date?

RESPONSE:

Keeyask has progressed much further to date, but since the AACE maturity range is wide and a significant portion of the engineered elements are well defined and completed for both facilities they were both deemed Class 2; however, Conawapa could arguably be considered Class 3.

As can be seen in the Table in PUB/KP I-002a the elements that are not at the same level gravitate around the indirect related elements such as: Stakeholder Engagement or Regulatory Approval & Permitting. In contrast the engineered aspects such as: General Arrangement Design & Drawings tend to be at the same level.

/bxf

INFORMATION REQUEST RESPONSE

To: Manitoba Public Utilities Board Date: February 20, 2014

KP File: VA103-449/1-A.55

Needs For Alternatives To – **PUB/KP I-002 d**

SUBJECT: Capital Cost

REFERENCE: KP report, p. 9

PREAMBLE:

KP states that "In addition KP believes the Keeyask and Conawapa hydroelectric projects are at a higher definition level than Hydro indicates despite not have [sic] an improved level of accuracy."

QUESTION:

Please explain this statement.

RESPONSE:

The accuracy range of the estimate for an AACEI Class 3 is between a low of -10% to -20% and a high of +10% to +30%. The accuracy range of the estimate for an AACEI Class 2 is between a low of -5% to -15% and a high of +5% to +20%.

In Appendix 7.2 of the Hydro submission, Hydro has classified both Keeyask and Conawapa as Class 3, yet Hydro also indicated that the Expected Accuracy Range of Cost Estimate: was -10% to +15% for Keeyask and -15% to +20% for Conawapa, a range narrower than directly prescribed by the AACEI Class 3.

KP believes that even if the definition level is higher than stated, the expected accuracy range of cost estimate does not increase beyond those stated by Hydro in Appendix 7.2.

/bxf

INFORMATION REQUEST RESPONSE

To: Manitoba Public Utilities Board Date: February 20, 2014

KP File: VA103-449/1-A.55

Needs For Alternatives To – **PUB/KP I-002 e**

SUBJECT: Capital Cost

REFERENCE: KP report, p. 10

PREAMBLE:

In Table 2.3, KP provides its assessment of maturity levels of the project definitions for various options, including Keeyask and Conawapa.

QUESTION:

Please provide a summary of the methodology used by KP to assess the maturity level of Manitoba Hydro's project definitions.

RESPONSE:

As indicated in PUB/KP I-002 a, the assessment of maturity levels is based on the AACE International Recommended Practice (RP) No. 69R-1. Completing RP Table 3 and comparing it against the five estimate classification levels, KP considered the work done to be characteristic of a Class 2 estimate.

	ESTIMATE CLASSIFICATION				
	CLASS 3	**CLASS 2**	**KIP**	**Keeyask G.S.**	**Conawapa**
MATURITY LEVEL OF PROJECT DEFINITION DELIVERABLES	**10% to 40%**	**30% to 75%**			
General Project Data:					
Project Scope of Work Definition	P	P	C	C	P
Facility Output Profile & Nameplate Capacity	C	C	NA	C	C
Site Infrastructure (Access, Construction Power, Camp etc.)	P/C	C	C	C	C
Principal Works (Location)	C	C	C	C	C
Hydraulic & Hydrology	C	C		C	C
Topography & Bathymetry	P/C	C		C	C
Geotechnical Investigation	C	C	C	C	C
Material Utilization (Borrow Sources)	P/C	C	C	C	P
Environmental Studies	C	C	C	C	P
Environmental Monitoring (During Construction & Operations)	N	S	S	S	N
Stakeholder Engagement	P	P/C	C	C	S
Regulatory Approval & Permitting	C	C	C	C	S

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	ESTIMATE CLASSIFICATION				
	CLASS 3	**CLASS 2**	**KIP**	**Keeyask G.S.**	**Conawapa**
MATURITY LEVEL OF PROJECT DEFINITION DELIVERABLES	**10% to 40%**	**30% to 75%**			
Integrated Project Plan	C	C	C	C	C
Project Schedule Baseline	P/C	C	C	C	C
Work Breakdown Structure (WBS)	C	C	C	C	C
Workforce Estimates	P	C	C	C	C
Project Code of Accounts (Control Accounts)	P	C	C	C	C
Equipment Procurement Strategy (Owner vs. Contractor)	C	C	C	C	C
Contracting and/or Outsourcing Strategy	C	C	C	C	C
Engineering Deliverables (Specifications and/or Drawings):					
General Arrangement Design & Drawings	P/C	C	C	C	C
Project Parameter	C	C	C	C	C
PMF and Hydraulic Design	C	C	NA	C	C
Dam Design & Drawings	P	P/C	NA	C	P/C
Intake Design & Drawings	P	P/C	NA	C	P/C
Penstock Design & Drawings	P	P/C	NA	C	P/C
Power House Design & Drawings	P	P/C	NA	C	P/C
Spillway Design & Drawings	P	P/C	NA	C	P/C
De-Silting Basins	P	P/C	NA	NA	NA
Power Tunnel/Canal	P	P/C	NA	C	C
Gates and Cranes Design & Drawings	P	P/C	NA	O	P/C
Turbine and Generator Design & Drawings	P	P/C	NA	C	P/C
Electrical One-Line Drawings	S	P	NA	C	P/C
Auxiliary Mechanical Design & Drawings	S	P	NA	C	P/C
Auxiliary Electrical Design & Drawings	S	P	NA	?	?
Protection & Controls System Design & DrawingS	S	P	NA	?	?
Telecommunication System Design & Drawings	S	P	NA	?	?
Spare Parts Spec (Commissioning & Operation)	S	P	NA	C	P
Mitigation Measures (Aquatic, Terrestrial, Avian, Clearing, Heritage etc.)	P	C	NA	C	?

The completion is indicated by the following letters:
None (N): Development of the deliverable has not begun.
Started (S): Work on the deliverable has begun. Development is typically limited to sketches, rough outlines, or similar levels of early completion.
Preliminary (P): Work on the deliverable is advanced. Interim, cross-functional reviews have usually been conducted. Development may be near completion except for final reviews and approvals.
Complete (C): The deliverable has been reviewed, approved and issued for design as appropriate."

/bxf

INFORMATION REQUEST RESPONSE

To: Manitoba Public Utilities Board Date: February 20, 2014

KP File: VA103-449/1-A.55

Needs For Alternatives To – **PUB/KP I-003**

SUBJECT: Capital Cost

REFERENCE: KP report, p. 13

PREAMBLE:

On page 13 of the KP report, KP refers to the preparation of cost estimates in section 2.4.4.

QUESTION:

Please confirm whether this refers to cost estimates prepared by Manitoba Hydro or KP.

RESPONSE:

This refers to cost estimates prepared by Manitoba Hydro.

/bxf

INFORMATION REQUEST RESPONSE

To: Manitoba Public Utilities Board Date: February 20, 2014

KP File: VA103-449/1-A.55

Needs For Alternatives To – **PUB/KP I-004 a**

SUBJECT: Capital Cost

REFERENCE: KP report, page 22

PREAMBLE:

The KP report states that "the difference between the P50 value and the Point Estimate is defined as the project Contingency."

QUESTION:

Please explain why a point estimate does not have a P50 value. What data that is unavailable for the point estimate is used to develop the P50 estimate?

RESPONSE:

As per Hydro's submission Appendix 2.4, the "Point Estimate is the risk-free, escalation-free (or bare) costs based on an initial set of assumptions and current market conditions (i.e. the "overnight" cost). There are no allowances for risk or uncertainty in the Point Estimate. For example, the cost in the Point Estimate to construct an earth dam will be based on average quantities and average weather with no costs included for variation from the average amounts assumed. Furthermore, interest and escalation costs are not included in the Point Estimate."

A point estimate does not have a P50 value as not every component making up the cost estimate is normally distributed. Generally there is more chance that something will require more resources than expected than less, and that the consequence of a delay will have repercussions on following elements.

The data that are unavailable for the point estimate and are used to develop the P50 estimate contain an indication of the statistical variability around each cost component as well as a link between the impact of one element on the next.

/bxf

INFORMATION REQUEST RESPONSE

To: Manitoba Public Utilities Board Date: February 20, 2014

KP File: VA103-449/1-A.55

Needs For Alternatives To – **PUB/KP I-004 b**

SUBJECT: Capital Cost

REFERENCE: KP report, pp.24/25, Table 2.9

PREAMBLE:

KP has questioned MH's use of P50 estimates for defining contingency amounts.

QUESTION:

Is KP suggesting that MH should use either a P80 or P90 estimate for Keeyask contingency amount and for Conawapa contingency amount? Explain how this would be affected by MH's contracting method(s).

RESPONSE:

The contingency is based on the decision maker's appetite for risk. MH has decided to accept the risk associated with a P50 value, where other owner/developers typically demand a higher degree of certainty i.e. less risk. KP believes that most owners would tend to use estimates nearer the P80 or P90 level. However, it should be noted that MH also has a Management Reserve in addition to the contingency built into the P50 estimate; the contingency is therefore effectively bigger and the estimate at a higher level than P50.

The contracting method could share more or less burden between Hydro and the Contractor. For example, if a contractor accepted all risk on quantities, they would include a measure of this risk in the cost and would charge more for the work. In this situation Hydro's estimate would no longer need to cater for variability around quantities, thus less contingency would be required.

/bxf

INFORMATION REQUEST RESPONSE

To: Manitoba Public Utilities Board Date: February 20, 2014

KP File: VA103-449/1-A.55

Needs For Alternatives To – **PUB/KP I-005 a**

SUBJECT: Capital Cost

REFERENCE: KP report, page 23

PREAMBLE:

KP states that "The adopted [expected value] process appears to be more akin to what KP would call a Monte Carlo simulation.

QUESTION:

Please explain what software Manitoba Hydro is using. Is it an in-house model or an off-the-shelf solution?

RESPONSE:

Manitoba Hydro is using a blended in house approach through the help of an external specialized company. No specific information was shared with KP about the software utilized.

/bxf

INFORMATION REQUEST RESPONSE

To: Manitoba Public Utilities Board Date: February 20, 2014

KP File: VA103-449/1-A.55

Needs For Alternatives To – **PUB/KP I-005 b**

SUBJECT: Capital Cost

REFERENCE: KP report, p.23, Section 2.9..2.1/2

PREAMBLE:

KP has indicated that MH's expected value modelling is akin to a Monte Carlo simulation and then cites John K. Hollman's on Monte

QUESTION:

Is it KP's view that MH's approach (expected value modelling) to systemic and specific risks has the same or similar flaws as identified by John Hollman? Explain.

RESPONSE:

It is KP's view that the intent of the approach taken by Hydro attempts to address the concerns expressed by John Hollman, but not having access to the details behind the models and their development KP is not able to confirm this.

/bxf

INFORMATION REQUEST RESPONSE

To: Manitoba Public Utilities Board Date: February 20, 2014

KP File: VA103-449/1-A.55

Needs For Alternatives To – **PUB/KP I-006 a**

SUBJECT: Capital Cost

REFERENCE: KP report, p.26, Table 2.10

PREAMBLE:

KP has indicated that MH should use a 3.4% escalation rate instead of 2.5%; NALCOR Muskrat Falls Project used 3.4%

QUESTION:

Indicate KP's revised escalation value that MH should use in CEF12 for Keeyask and Conawapa.

RESPONSE:

KP has inferred that the Hydro GS Project Composite Escalation Rate was around 3.1%, and that the Muskrat Falls Project used a 3.4% escalation rate.

It is difficult to ascertain what escalation rate is appropriate, since KP does not have the detailed make-up of the Hydro GS Project Composite Escalation Rate, but 3.1% seems to be what Hydro has itself determined.

/bxf

INFORMATION REQUEST RESPONSE

To: Manitoba Public Utilities Board Date: February 20, 2014

KP File: VA103-449/1-A.55

Needs For Alternatives To – **PUB/KP I-006 b**

SUBJECT: Capital Cost

REFERENCE: KP report, page 28

PREAMBLE:

KP concludes that Manitoba Hydro's escalation reserve is inadequate.

QUESTION:

How should the escalation rate be modelled?

RESPONSE:

By using a composite escalation rate reflective of a hydroelectric facility as opposed to Canadian CPI.

/bxf

INFORMATION REQUEST RESPONSE

To: Manitoba Public Utilities Board Date: February 20, 2014

KP File: VA103-449/1-A.55

Needs For Alternatives To – **PUB/KP I-006 c**

SUBJECT: Capital Cost

REFERENCE: KP report, page 28

PREAMBLE:

KP concludes that Manitoba Hydro's escalation reserve is inadequate.

QUESTION:

What effect would the higher escalation rate, coupled with the escalation contingency, have on the capital cost of the PDP?

RESPONSE:

The PDP would cost more than indicated with a higher escalation rate.

/bxf

INFORMATION REQUEST RESPONSE

To: Manitoba Public Utilities Board Date: February 20, 2014

KP File: VA103-449/1-A.55

Needs For Alternatives To – **PUB/KP I-007 a**

SUBJECT: Capital Cost

REFERENCE: KP report, page 29

PREAMBLE:

The KP report states that "Manitoba Hydro has not disclosed the specifics as to how the Labour Reserve was calculated."

QUESTION:

Has this information been requested by KP, or is it KP's understanding that MH will still provide this information? If so, does KP intend to address this issue if and when it receives the information from Manitoba Hydro?

RESPONSE:

KP has obtained additional confidentially emailed information on the labour reserve which shows the eight uncertain items identified when MH incorporated the Wuskwatim experience. Three of these elements addressed through the Labour Reserve for Keeyask were not completely accounted for under the P50 contingency and include:

- Increase due to poor concrete productivity,
- Schedule cumulative effects of construction delays on critical path, and
- Additional costs for a 7-12 work schedule on the GCC

Additional support confidential blue paper material is pending from Hydro.

/bxf

INFORMATION REQUEST RESPONSE

To: Manitoba Public Utilities Board Date: February 20, 2014

KP File: VA103-449/1-A.55

Needs For Alternatives To – **PUB/KP I-007 b**

SUBJECT: Capital Cost

REFERENCE: KP report, pp.29/30

PREAMBLE:

KP has not defined strategies that would reduce the need for the labour reserve.

QUESTION:

"Are there any cost reducing synergies that flow from MH's proposed in-service dates for Keeyask (2019/20) and Conawapa (2024/25)?" Explain.

RESPONSE:

KP does not have the means to assess possible project synergies in any quantifiable way. At a high level some synergies could occur if Keeyask is demobilizing at the same time as Conawapa is mobilizing. Examples might include not having to remove and then replace the camp and the retention of MH staff that is experienced with Keeyask for the construction of Conawapa. This should be beneficial, but it is not a given. It is likely that the project partners (Contractors and/or Vendors) will not be the same in both instances.

/bxf

INFORMATION REQUEST RESPONSE

To: Manitoba Public Utilities Board Date: February 20, 2014

KP File: VA103-449/1-A.55

Needs For Alternatives To – **PUB/KP I-007 c**

SUBJECT: Capital Cost

REFERENCE: KP report, pp.29/30

PREAMBLE:

KP has not defined strategies that would reduce the need for the labour reserve.

QUESTION:

"With both projects underway from 2018-2021 inclusive, will the two projects be competing for contractors/work force/other resources?" Explain.

RESPONSE:

KP compared the schedules made available as part of the Basis of Estimate documentation and found that there is no overlap in the resource requirements. It is not anticipated that the Projects will be competing for contractors/work force/other resources, save perhaps within Hydro's management team.

/bxf

INFORMATION REQUEST RESPONSE

To: Manitoba Public Utilities Board Date: February 20, 2014

KP File: VA103-449/1-A.55

Needs For Alternatives To – **PUB/KP I-007 d**

SUBJECT: Capital Cost

REFERENCE: KP report, pp.29/30

PREAMBLE:

KP has not defined strategies that would reduce the need for the labour reserve.

QUESTION:

"Would a 5 year deferral of Conawapa reduce (or increase) potential cost reduction synergies?" Explain.

RESPONSE:

KP does not have the means to assess the project synergies in any quantifiable way. At a high level some synergies could occur if MH is demobilizing one site at the same time as it is mobilizing another - as advised in PUB-KP 1-007 b). A 5 year deferral of Conawapa would tend to reduce potential cost reduction synergies because of the gap between ending one project and starting the next; MH would effectively have to start again.

/bxf

INFORMATION REQUEST RESPONSE

To: Manitoba Public Utilities Board Date: February 20, 2014

KP File: VA103-449/1-A.55

Needs For Alternatives To – **PUB/KP I-008 a**

SUBJECT: Capital Cost

REFERENCE: KP report, p. 30

PREAMBLE:

The KP report states that "In all likelihood the Management Reserve does not represent the worst case scenario of a labour cost increase beyond those observed in the Alberta oil field or the worst of the Wuskwatim productivity rates"

QUESTION:

Please comment on what the appropriate "yardstick" would be to set up a management reserve? Should it be based on worst-case scenario, 90th percentile, most likely scenario, or some other criterion? Why?

RESPONSE:

KP traditionally has not used Labour Management Reserve in its estimates but has attempted to incorporate the uncertainty associated with the productivity variability through the contingency. Hydro has done the same thing, but the low productivity and staff retention experienced at Wuskwatim went well beyond what the estimates had anticipated.

A “yardstick” could be to use labour rates throughout the estimate that are in excess of those observed or anticipated to occur elsewhere in Canada and developed by a group specialised in such forecasts.

/bxf

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INFORMATION REQUEST RESPONSE

To: Manitoba Public Utilities Board Date: February 20, 2014

KP File: VA103-449/1-A.55

Needs For Alternatives To – **PUB/KP I-008 b**

SUBJECT: Capital Cost

REFERENCE: KP report, page 30

PREAMBLE:

The KP report states that "In all likelihood the Management Reserve does not represent the worst case scenario of a labour cost increase beyond those observed in the Alberta oil field or the worst of the Wuskwatim productivity rates"

QUESTION:

What level of labour reserve and contingency reserve should be included in the economic analysis for the Keeyask and Conawapa reference case and for the "high capital" case?

RESPONSE:

In KP/MH II-026c, KP asked Hydro to relate the cost probability distribution curve to the values and assumptions used in the scenario development, namely the Capital Cost High 30%, Reference 50%, and Low 20% cases used in Chapter 10 of the NFAT submission.

In the IR response, Hydro indicated that for all capital costs, the High and Low estimates were based on the P10 and P90 levels respectively, and the Reference case on the P50. KP believes it appropriate to use a “high capital” case based on the P90 contingency with full expenditure of the remaining management reserve for the practical purpose of the economic analysis undertaken by Hydro.

KP would have preferred to forgo a management reserve and include the associated variability in a contingency. The statistical analysis could then be conducted with a probability distribution function corresponding to the cost of each Hydro Facility independently and these could be discretised in a more realistic fashion than the aggregate 3 tier system employed by Hydro.

/bxf

INFORMATION REQUEST RESPONSE

To: Manitoba Public Utilities Board Date: February 20, 2014

KP File: VA103-449/1-A.55

Needs For Alternatives To – **PUB/KP I-009**

SUBJECT: Capital Cost

REFERENCE: KP report, page 30

PREAMBLE:

The KP report states that "One aspect of the use of Management Reserves is that it is outside of a system that would allow for Performance Measurement."

QUESTION:

Please explain what KP means by this statement.

RESPONSE:

The total planned value (PV) at the end of the project serves as a key benchmark for comparison against performance management indicators such as earned value (EV). If a project has a Management Reserve, it is typically not included in the budget at completion, and, therefore, in the Performance Measurement.

For example, if the cost of steel skyrocketed overnight and the escalation reserve was called upon to fill the deficit, it would not be included in the comparison between earned value and planned value.

/bxf

INFORMATION REQUEST RESPONSE

To: Manitoba Public Utilities Board Date: February 20, 2014

KP File: VA103-449/1-A.55

Needs For Alternatives To – **PUB/KP I-010 a**

SUBJECT: Capital Cost

REFERENCE: KP report, page 40

PREAMBLE:

The KP report states that "KP identifies interface management by Manitoba Hydro as one of the most important systemic risks associated with the implementation of the preferred development plan."

QUESTION:

Please explain what KP means by interface management, and elaborate on what constitutes interface management risk with respect to Keeyask and Conawapa?

RESPONSE:

In general, Crown Corporations tend to be very process heavy and have a tendency to over specify equipment. When there are a large number of direct supply contracts, and numerous separate subcontractors, particularly if they are under Hydro's direct responsibility and not under a Contractor who is wrapping up a number of sub-contractors and taking responsibility for the overall delivery, the specific scopes of work tend to be difficult or tedious to define, and tedious to supervise. The sheer number of these interactions, if not carefully managed, can result in delays.

It is KP's understanding, that some of the negotiations presently underway with the GCC involve how to integrate more of the mechanical and electrical scopes of work into the GCC, thus decreasing the amount of interactions required through Hydro.

/bxf

INFORMATION REQUEST RESPONSE

To: Manitoba Public Utilities Board Date: February 20, 2014

KP File: VA103-449/1-A.55

Needs For Alternatives To – **PUB/KP I-010 b**

SUBJECT: Capital Cost

REFERENCE: KP report, page 40

PREAMBLE:

The KP report states that "KP identifies interface management by Manitoba Hydro as one of the most important systemic risks associated with the implementation of the preferred development plan."

QUESTION:

Please confirm whether the same or a similar level of interface management risk would still be present if Manitoba Hydro had chosen to use an external project manager / construction manager with respect to Keeyask and Conawapa?

RESPONSE:

It would depend on the roles and responsibilities of the project manager or construction manager and his leeway with the contracting strategy.

The more the scope of work can be wrapped up and managed by a single responsible entity (for example, the GCC also taking on the balance of mechanical and electrical plant) the easier the interface management process is and the less likely scopes of work will be difficult to define and administer separately.

The difficulty is striking a cost balance between sub-contractor overhead and Manitoba Hydro's interface management overhead (or an external manager's interface overhead). It is perhaps easier to anticipate the sub-contractors overhead.

/bxf

INFORMATION REQUEST RESPONSE

To: Manitoba Public Utilities Board Date: February 20, 2014

KP File: VA103-449/1-A.55

Needs For Alternatives To – **PUB/KP I-010 c**

SUBJECT: Capital Cost

REFERENCE: KP report, page 40

PREAMBLE:

The KP report states that "KP identifies interface management by Manitoba Hydro as one of the most important systemic risks associated with the implementation of the preferred development plan."

QUESTION:

Please advise whether in KP's view, having contracted with an external project manager / construction manager would have likely increased or decreased project costs compared to Manitoba Hydro acting as its own project manager / construction manager.

RESPONSE:

Contracting with an external project manager / construction manager may increase project costs as Hydro's involvement would still be required throughout the process. External unit costs also tend to be higher than in-house Hydro costs, although care needs to be taken to ensure that the latter include all the indirect costs of benefits, office space, equipment, etc. In Hydro's risk matrix they have a line item for costs associated with having to outsource project management in the event Hydro does not have the resources to do the work itself. This eventuality is already included as one of the most significant items in their Project Risk Register.

/bxf

INFORMATION REQUEST RESPONSE

To: Manitoba Public Utilities Board Date: February 20, 2014

KP File: VA103-449/1-A.55

Needs For Alternatives To – **PUB/KP I-011 a**

SUBJECT: Capital Cost

REFERENCE: KP report, page 41

PREAMBLE:

KP comments on Manitoba Hydro's early contractor involvement process.

QUESTION:

Please confirm that this early contractor involvement process is essentially an RFP process as opposed to a tendering process, and that the bidding parties will have design input.

RESPONSE:

Yes, the early contractor involvement process is an RFP process as opposed to a tendering process. The main reasons for using an RFP as opposed to a Tender is to allow the flexibility of being able to negotiate any of the terms of the eventual contract, including design input by the bidding parties. A Tender is essentially an all-or-nothing offer whose details cannot be readily changed.

/mjr

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INFORMATION REQUEST RESPONSE

To: Manitoba Public Utilities Board Date: February 20, 2014

KP File: VA103-449/1-A.55

Needs For Alternatives To – **PUB/KP I-011 b**

SUBJECT: Capital Cost

REFERENCE: KP report, page 41

PREAMBLE:

KP comments on Manitoba Hydro's early contractor involvement process.

QUESTION:

If KP confirms part (a), please comment on whether KP would expect an RFP process with early contractor involvement to lead to savings compared to a tendering process.

RESPONSE:

Yes, KP would expect an RFP process with ECI to lead to savings compared to a tendering process – because of the opportunity to identify and share risk – of geotechnical conditions, schedule, design, input costs, contract conditions, etc; all aspects of the RFP are negotiable.

/bxf

INFORMATION REQUEST RESPONSE

To: Manitoba Public Utilities Board Date: February 20, 2014

KP File: VA103-449/1-A.55

Needs For Alternatives To – **PUB/KP I-012 b**

SUBJECT: Capital Cost

REFERENCE: KP report, pp. 42-43

PREAMBLE:

KP states that "Specific DNCs have been entered into because of a preference by Hydro for particular contractors to undertake a specific work assignment."

QUESTION:

Please provide your understanding of the business reasons as to why Manitoba Hydro would enter into Directly Negotiated Contracts?

RESPONSE:

KP understands that Direct Negotiated Contracts bring local and First Nation partners to the project in a meaningful and involved way, and they help garner buy-in for the project. On occasion there may be only a select number of people that can do a task either because of location or because of specialty.

/bxf

INFORMATION REQUEST RESPONSE

To: Manitoba Public Utilities Board Date: February 20, 2014

KP File: VA103-449/1-A.55

Needs For Alternatives To – **PUB/KP I-012 c**

SUBJECT: Capital Cost

REFERENCE: KP report, pp. 42-43

PREAMBLE:

KP states that "Specific DNCs have been entered into because of a preference by Hydro for particular contractors to undertake a specific work assignment."

QUESTION:

Please provide a listing of the DNCs and indicate the reason(s) for each DNC.

RESPONSE:

The DNCs are a mechanisms aimed at increasing the numbers of First Nation members employed in the construction of the Keeyask Project and achieving the construction employment target set out in the Joint Keeyask Development Agreement (http://www.hydro.mb.ca/projects/keeyask/pdf/JKDA_090529.pdf).

The DNCs shared with KP are:

KIP contracts:

016102 North Access Road B (DNC)
016103 North Access Road A (DNC)
016104 Keeyask North Access Road Start-up Camp (DNC)
016120 Looking Back Creek Bridge (DNC)

Service Contracts

016121 Catering & Janitorial Services Part 1, 2, 3 (DNC)
016122 Maintenance (DNC)
016123 Camp Security Part 1 and 2 (DNC)
016124 Employee Retention & Support Services (DNC)
016125 Emergency Medical/Ambulance Service (DNC)

It is KP's understanding that additional DNCs may be wrapped up under the GCC.

/bxf

INFORMATION REQUEST RESPONSE

To: Manitoba Public Utilities Board Date: February 20, 2014

KP File: VA103-449/1-A.55

Needs For Alternatives To – **PUB/KP I-013**

SUBJECT: Capital Cost

REFERENCE: KP report, page 43

PREAMBLE:

KP states that Manitoba Hydro will be using a cost reimbursable contract for Keeyask but a mixture of lump sum and unit price contracts for Conawapa.

QUESTION:

Please elaborate on the business reason(s) why Manitoba Hydro would choose different approaches for Keeyask and Conawapa.

RESPONSE:

The contracting process for Conawapa has not been clearly defined as of yet. KP believes that the intent was not to commit to a process yet for Conawapa, but still include the appropriate adders associated with a methodology.

/bxf

INFORMATION REQUEST RESPONSE

To: Manitoba Public Utilities Board Date: February 20, 2014

KP File: VA103-449/1-A.55

Needs For Alternatives To – **PUB/KP I-014**

SUBJECT: Capital Cost

REFERENCE: KP report, page 47

PREAMBLE:

KP states that "Hydro considered a 65 MW "generic" wind farm for planning purposes in the NFAT, although information on a comparison 100 MW wind farm is also provided in Appendix 7.2 of the NFAT."

QUESTION:

Please advise whether Manitoba Hydro provided its reasons to KP for choosing a 65 MW wind farm rather than a 100 MW wind farm for planning purposes, and whether KP agrees with those reasons.

RESPONSE:

MH did provide their reasoning for choosing a 65 MW wind farm rather than a 100 MW wind farm for planning purposes, namely that the economies of scale are minimal for wind farms of larger sizes, i.e. that further reductions in cost $/kW are minimal as project size increases beyond this approximate size. Furthermore, MH indicated in the NFAT that a development of this size is “approximately equal to the estimated provincial load growth for energy”.

KP agrees with the reasoning for selection of the 65 MW “generic” wind farm project by MH. While site specific factors may result in larger capacity projects being optimal for a given project, selection of a 65 MW compared to a 100 MW project is unlikely to result in significant cost difference. The US Department of Energy (2013) reported no difference in capacity weighted average project costs between projects in the 50-100 MW size category compared to the 100-200 MW and >200 MW categories.

/mgp1

INFORMATION REQUEST RESPONSE

To: Manitoba Public Utilities Board Date: February 20, 2014

KP File: VA103-449/1-A.55

Needs For Alternatives To – **PUB/KP I-015**

SUBJECT: Capital Cost

REFERENCE: KP report, page 47

PREAMBLE:

KP states that "Hydro considered a 65 MW "generic" wind farm for planning purposes in the NFAT, although information on a comparison 100 MW wind farm is also provided in Appendix 7.2 of the NFAT."

QUESTION:

Please confirm that in jurisdictions that have a 100 MW cut-off in environmental legislation before a more rigorous assessment process applies (such as MB or ON), most projects are built at 100 MW. If not, please clarify.

RESPONSE:

KP cannot speculate on the reasoning for selection of a particular project capacity on a given wind project. However, it is possible that developers may have considered environmental permitting factors along with land availability, wind farm layout, transmission capacity and other such constraints in deciding on project installed capacity.

In order to assess the veracity of the statement that "*In jurisdictions… such as MB or ON, most projects are built at 100 MW*", KP reviewed the database of installed wind farms provided on the Canadian Wind Energy Association website. They found that of the 50 wind projects installed in Ontario, seven have an installed capacity between 98 to 102 MW. This represents 14% of the wind projects, and 30% of the installed capacity in Ontario. Of the two wind farms currently installed in Manitoba, neither have a capacity close to 100 MW. Of the 55 wind projects contracted or under development in Ontario, 2 have a capacity between 98 to 102 MW.

While KP cannot confirm that no projects have chosen their capacity due to environmental permitting thresholds, it appears that only a minority of the constructed projects have chosen a target capacity of 100 MW, and even fewer of the proposed projects have selected this capacity limit.

/mgp1

INFORMATION REQUEST RESPONSE

To: Manitoba Public Utilities Board Date: February 20, 2014

KP File: VA103-449/1-A.55

Needs For Alternatives To – **PUB/KP I-016**

SUBJECT: Capital Cost

REFERENCE: KP report, pp. 51-52

PREAMBLE:

KP states that "Hydro has indicated an installed overnight capital cost (P50) estimate of $427 million, $170 million and $75 million for the CCGT, industrial SCGT and aeroderivative SCGT respectively ($2014). Based on an installed project capacity of 308 MW, 209 MW and 47 MW, these costs equate to $1.30 million/MW, $0.77 million/MW and $1.51 million/MW respectively.""

KP further states that "there may be a slight economy of scale effect for larger combined cycle projects, although the data are insufficient to draw definitive conclusions."

QUESTION:

The cost per MW is based on different sizes of turbine, and Figure 5.2 of the KP report lists only project size, not turbine size. Please provide an approximate cost comparison per MW based on similar-sized turbines.

RESPONSE:

KP agrees that the size of the generating units is likely to have an effect on the overall project cost. We do not expect that this level of detail has been, or need be considered for the current stage of assessment of potential natural gas projects in Manitoba. Assessment of potential cost differences due to unit size do not result in a project base case cost outside of the margins of error already proposed in KP's report.

The data and reports previously reviewed by KP do not provide sufficient detail to allow a direct comparison of similar sized projects with similar sized generating units as proposed by MH. However, reports of gas turbine industry cost data have provided prices of gas turbine equipment for various machine output capacities (Pauschert, 2009). From this, we can infer the approximate project cost difference that would result if generating units of approximately half the size, or twice the size were installed as compared to the NFAT base case. Figure 1 indicates the resulting error bars for the NFAT combined cycle project. These error bars are illustrative, and it should be recognised that an increase in the capacity of the generating units cannot be achieved for the NFAT projects without also increasing project capacity (due to only one generating unit being proposed). Nevertheless, it illustrates that the approximate project cost difference due to generating unit size is likely smaller than the overall cost uncertainty for the natural gas projects. The dependence of cost on generating unit output is greater for smaller generating units (Pauschert, 2009), which may partly explain the higher cost ($/kW) for the smaller aeroderivative units.

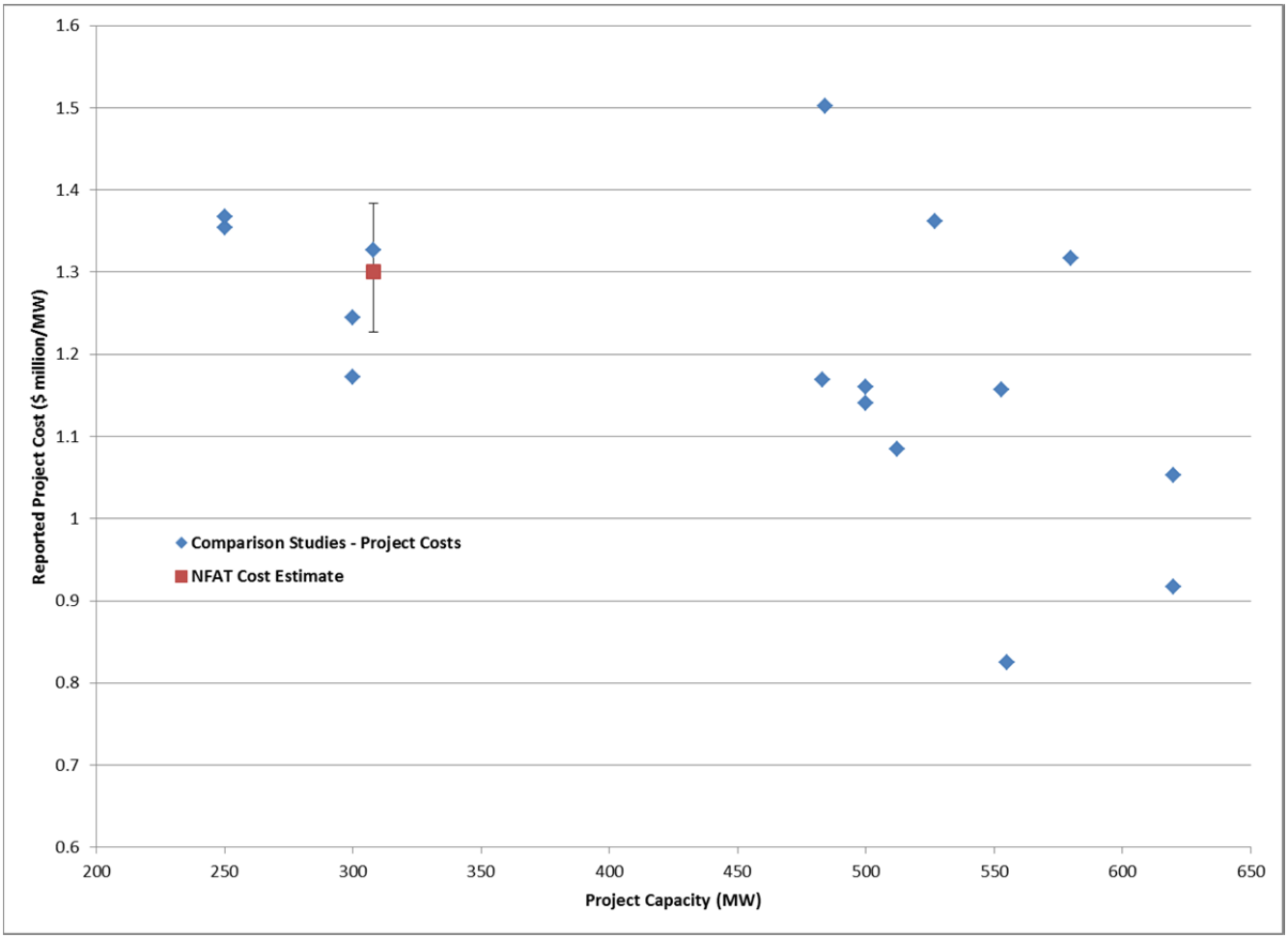

Figure 1: NFAT gas combined cycle cost estimate showing error bar for cost differences that would result from units of approximately twice the capacity and half the capacity based on publically available gas turbine unit cost data (Pauschert, 2009).

References:

Pauschert, D. (2009). *Study of Equipment Prices in the Power Sector - ESMAP Technical Paper 122/09.* Washington, D.C.: The World Bank Group - Energy Sector Management Assistance Program.

/mgp1

INFORMATION REQUEST RESPONSE

To: Manitoba Public Utilities Board Date: February 20, 2014

KP File: VA103-449/1-A.55

Needs For Alternatives To – **PUB/KP I-017 a**

SUBJECT: Capital Cost

REFERENCE: KP report, pp.55-57

PREAMBLE:

KP states that "Any planning studies undertaken by Hydro that use solar PV as part of the development plan should include sensitivity analysis on O&M costs for the entire range of costs reported in the literature to determine the impact of varying O&M costs on levelised cost of energy."

QUESTION:

Please confirm that for purposes of the current NFAT, KP agrees with Manitoba Hydro's conclusion that at Manitoba Hydro's projected capital plus OM&A cost, solar PV generation is not a cost-competitive generation source.

RESPONSE:

KP agrees with MH that solar PV generation is not cost-competitive in Manitoba in 2014. MH should continually review their development plan with respect to the continuing and rapid reduction in the cost of solar PV, which may become cost-competitive in the future.

/mgp1

INFORMATION REQUEST RESPONSE

To: Manitoba Public Utilities Board Date: February 20, 2014

KP File: VA103-449/1-A.55

Needs For Alternatives To – **PUB/KP I-017 b**

SUBJECT: Capital Cost

REFERENCE: KP report, pp.55-57

PREAMBLE:

KP states that "Any planning studies undertaken by Hydro that use solar PV as part of the development plan should include sensitivity analysis on O&M costs for the entire range of costs reported in the literature to determine the impact of varying O&M costs on levelised cost of energy."

QUESTION:

Please confirm that since KP concludes that capital and OM&A costs may be higher than assumed by Manitoba Hydro, it is KP's view that the technology is not currently cost-competitive.

RESPONSE:

It is not KP's view that capital costs are likely to be higher than assumed by Manitoba Hydro. In our view, MH's capital costs are in-line with the range of reported costs for recent Solar PV projects. This means that projects installed in 2014 could be either higher or lower than the costs proposed by MH. This will likely change quickly as Solar PV prices continue to fall.

The O&M costs proposed by MH are slightly lower than the range reported in the literature reviewed by KP. While KP recommends that sensitivity analysis be undertaken with varying O&M costs, we expect that most of the Levelised Cost of Energy (LCOE) for solar projects is likely due to the capital costs, so the differences in O&M costs are likely to have a minimal impact on LCOE.

KP agrees with MH that solar PV generation is not cost-competitive in Manitoba in 2014. MH should continually review their development plan with respect to the continuing and rapid reduction in the cost of solar PV, which may become cost-competitive in the future.

/mgp1

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INFORMATION REQUEST RESPONSE

To: Manitoba Public Utilities Board Date: February 20, 2014

KP File: VA103-449/1-A.55

Needs For Alternatives To – **PUB/KP I-018**

SUBJECT: Capital Cost

REFERENCE: KP report, page 61

PREAMBLE:

KP refers to the KGS Acres report to explain the capital cost increase between CEF09 and CEF10.

QUESTION:

Please file, or have Manitoba Hydro file, this report on the record, if necessary as CSI.

RESPONSE:

The request will be forwarded to Manitoba Hydro.

/bxf

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INFORMATION REQUEST RESPONSE

To: Manitoba Public Utilities Board Date: February 20, 2014

KP File: VA103-449/1-A.55

Needs For Alternatives To – **PUB/KP I-019**

SUBJECT: Capital Cost

REFERENCE: KP report, page 61-63

PREAMBLE:

KP refers to PUB/MH I-40 to explain the capital cost increases between CEF11 to CEF12

QUESTION:

Does KP agree with Manitoba Hydro's analysis as presented? Why/why not?

RESPONSE:

KP generally agrees with the explanation provided. Most of it was incorporating the Wuskwatim experience as detailed in Table 10.1 of the KP report.

/bxf

INFORMATION REQUEST RESPONSE

To: Manitoba Public Utilities Board Date: February 20, 2014

KP File: VA103-449/1-A.55

Needs For Alternatives To – **PUB/KP I-020**

SUBJECT: Capital Cost

REFERENCE: KP report, page 65

PREAMBLE:

KP states that escalating the costs of Long Spruce and Kettle to today's dollars would yield a cost equivalent to the cost of the turbine generators alone.

QUESTION:

Please explain, at a high level, the significant cost increase of construction since the 1970s. What are the major factors?

RESPONSE:

Construction costs have increased since the 1970s due to increasing complexity of projects; specifically, environmental constraints (both baseline and construction requirements), engineering design and construction standards, negotiation of ancillary agreements (such as northern benefit agreements) and the fact that the most cost-effective sites are always built first; later sites tend naturally to be less cost-effective. Increased productivity due to advances in construction and operating technologies has been offset by a rise in labour rates, a decline in labour productivity, an increase in safety and regulatory requirements and an increase in construction material costs. The unprecedented investment in resource projects and interconnectedness of markets is a significant factor in loss of productivity and competition for materials and skilled labour in North Western Canada.

/bxf

INFORMATION REQUEST RESPONSE

To: Manitoba Public Utilities Board Date: February 20, 2014

KP File: VA103-449/1-A.55

Needs For Alternatives To – **PUB/KP I-021 a**

SUBJECT: Capital Cost

REFERENCE: KP report, page 71

PREAMBLE:

KP states that "KP would have liked to see more of the documented information surrounding the indirect costs not related to infrastructure, and information related to the cost parametric and expected value contingency modelling method adopted by Hydro. The details behind the management labour reserve were also not made available."

QUESTION:

Please describe the difficulties in obtaining information?

RESPONSE:

The difficulties stem from obtaining the right level of information without being either overwhelmed or receiving too little. Hydro has retained the rights not to share all the information available, and only wishes to release enough information to be convincing without revealing detailed inside commercially sensitive information.

The formatting and preparation of material by Hydro also needs internal Hydro resources that are busy with a plethora of competing priorities.

Since issuing the report KP has received some additional information related to the indirects and the labour reserve.

/bxf

INFORMATION REQUEST RESPONSE

To: Manitoba Public Utilities Board Date: February 20, 2014

KP File: VA103-449/1-A.55

Needs For Alternatives To – **PUB/KP I-021 b**

SUBJECT: Capital Cost

REFERENCE: KP report, page 71

PREAMBLE:

KP states that "KP would have liked to see more of the documented information surrounding the indirect costs not related to infrastructure, and information related to the cost parametric and expected value contingency modelling method adopted by Hydro. The details behind the management labour reserve were also not made available."

QUESTION:

What additional information was KP expecting?

RESPONSE:

For the indirect costs, KP was expecting a detailed written report detailing what was included in the cost estimate and how it was determined. KP has only seen rolled up spreadsheets of the indirects.

For the cost parametric and expected value contingency modelling method KP expected to see a report detailing the methodology and assumptions and summarizing the results.

/bxf

INFORMATION REQUEST RESPONSE

To: Manitoba Public Utilities Board Date: February 20, 2014

KP File: VA103-449/1-A.55

Needs For Alternatives To – **PUB/KP I-022 a**

SUBJECT: Capital Cost

REFERENCE: KP report, p.19, Table 2.5; D. Bowen Technical Conference Presentation, p.20

PREAMBLE:

KP has carried out order of magnitude metric cost estimates for Keeyask and Conawapa which suggest MH's cost estimates in 2009 and 2010, respectively are in the correct ballpark.

QUESTION:

Confirm that KP's approximate cost estimate for Keeyask is $1.646B (w/o contingencies or reserve) which represents about 55% of MH's point estimate of $3.05B for 2012. Identify the components of the point estimate that are not included in the KP estimate.

RESPONSE:

The intent of Table 2.5 is to show the order of magnitude of the overnight direct costs and relate the overall bulk quantities to the project cost. The generic unit rates stem from numbers used by KP in the early stages of investigating greenfield projects, to compare overall concepts.

Table 2.5 does not include the development costs or the infrastructure covered in the indirects. It does cover a small fraction of contingency on directs, but not on indirects. It does not consider reserves. It does not include escalation, capitalized interest or interest on equity.

/bxf

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INFORMATION REQUEST RESPONSE

To: Manitoba Public Utilities Board Date: February 20, 2014

KP File: VA103-449/1-A.55

Needs For Alternatives To – **PUB/KP I-022 b**

SUBJECT: Capital Cost

REFERENCE: KP report, p.21, Table 2.7

PREAMBLE:

KP has carried out order of magnitude metric cost estimates for Keeyask and Conawapa which suggest MH's cost estimates in 2009 and 2010, respectively are in the correct ballpark.

QUESTION:

Confirm the KP approximate cost estimate for Conawapa is $2.828B (w/o contingencies or reserves) which represents about 62% of MH's point estimate of $4.53B for 2012.

RESPONSE:

Yes, based on the bulk overall quantities provided the direct cost are in line with Manitoba direct costs of $2.8 B.

/bxf

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INFORMATION REQUEST RESPONSE

To: Manitoba Public Utilities Board Date: February 20, 2014

KP File: VA103-449/1-A.55

Needs For Alternatives To – **PUB/KP I-022 c**

SUBJECT: Capital Cost

REFERENCE: KP report, page 21

PREAMBLE:

KP has carried out order of magnitude metric cost estimates for Keeyask and Conawapa which suggest MH's cost estimates in 2009 and 2010, respectively are in the correct ballpark.

QUESTION:

Identify the components of the point estimates that are not included in the KP estimate (contingencies?/etc.).

RESPONSE:

The order of magnitude estimate only addresses the direct costs, it does not include the development costs or the infrastructure covered in the indirects. It does cover a small fraction of contingency on directs, but not on indirects. It does not consider reserves. It does not include escalation, capitalized interest or interest on equity.

/bxf

INFORMATION REQUEST RESPONSE

To: Manitoba Public Utilities Board Date: February 20, 2014

KP File: VA103-449/1-A.55

Needs For Alternatives To – **PUB/KP I-023**

SUBJECT: Capital Cost

REFERENCE: KP report, page 30

PREAMBLE:

KP states that "Sunk costs were not included in Hydro's economic evaluations as they represented money already spent or commitments that cannot be changed relative to the decision point when choosing among plans. This creates some level of confusion as to what is included and not included in the project definition, and will create more confusion as the Keeyask Infrastructure Project progresses. KP does not recommend this practice as it obfuscates the cost estimate; strictly speaking the cost estimate should be associated with a specific project definition. The Money Spent to Date format also does not allow for an immediate measure of project performance on the money spent to date as compared to the anticipated costs."

QUESTION:

Elaborate on the sunk cost practices employed by other hydro-electric utilities specifically BC Hydro and Quebec Hydro.

RESPONSE:

KP has seen Crown Corporations expend a great deal of resources to determine the feasibility of large hydropower projects, however KP is not in a position to elaborate on the sunk cost practices employed by other hydro-electric utilities.

/bxf

INFORMATION REQUEST RESPONSE

To: Manitoba Public Utilities Board Date: February 20, 2014

KP File: VA103-449/1-A.55

Needs For Alternatives To – **PUB/KP I-031 a**

SUBJECT: Capital Cost

REFERENCE: KP report, page 6, section 1.4.5

PREAMBLE:

KP states that "Knight Piésold has provided its best effort in answering the PUBs queries in a timely manner as within the context of the NFAT procedures as the report deadline has drawn to a close and several facets could not be fully investigated with the New Generation Construction Division. These are:

- The methodology and numerical breakdown of the systemic risk calculations,
- Contingency determination on the indirects, and
- A justification for not using the Hydro Escalation factor estimated."

QUESTION:

Please indicate why KP did not assess the areas listed as "gaps" (e.g. inadequate time, inadequate resources, data non-existent, data not provided on request etc.)

RESPONSE:

Inadequate time, inadequate resources, data non-existent, and data not provided on request are all valid reasons. There has generally speaking been a lot of material covering a range of complex topics to review in a very short amount of time and it takes time to isolate and identify what information is relevant to review or in what meaningful way it can be obtained. Hydro was generally very cooperative with KPs review, but full disclosure of all information was never forthcoming as Hydro is rightfully protective of their commercially sensitive information, and the information often required internal screening and processing. In addition they are in the middle of the procurement process for Keeyask and are not prepared to release contract information until awards are made. The most significant of these is the General Civil Contract whose results and details are still awaited.

/bxf

INFORMATION REQUEST RESPONSE

To: Manitoba Public Utilities Board Date: February 20, 2014

KP File: VA103-449/1-A.55

Needs For Alternatives To – **PUB/KP I-031 b**

SUBJECT: Capital Cost

REFERENCE: KP report, page 6, section 1.4.5

PREAMBLE:

KP states that "Knight Piésold has provided its best effort in answering the PUBs queries in a timely manner as within the context of the NFAT procedures as the report deadline has drawn to a close and several facets could not be fully investigated with the New Generation Construction Division. These are:

- The methodology and numerical breakdown of the systemic risk calculations
- Contingency determination on the indirects, and
- A justification for not using the Hydro Escalation factor estimated."

QUESTION:

Please indicate the relative significance of each of the gaps listed to overall cost and schedule of the projects.

RESPONSE:

A more thorough understanding of the systemic risk evaluation process helps gain confidence in the process, but KP understands through Hydro that an external specialised firm is actively engaged through the process and as a result is reasonably satisfied that the work undertaken is comprehensive. A report attesting to this would provide additional reassurance. The relative significance relates to expected accuracy of the resulting contingency cost curve, therefore the uncertainty around a $547 million dollar line item for Keeyask.

Original 2009 estimates separated out the contingency on indirects from the contingency on directs: these represented roughly 25% of the total contingency at the time. The contingencies were lumped together later to allow for a larger pool out of which to manage the contingency. The relative significance relates to expected accuracy of roughly $120 million of the indirect costs for Keeyask.

The use of the Hydro escalation factor has a bearing on the escalation reserve and the base cost of around $140 million for Keeyask.

/bxf

INFORMATION REQUEST RESPONSE

To: Manitoba Public Utilities Board Date: February 20, 2014

KP File: VA103-449/1-A.55

Needs For Alternatives To – **PUB/KP I-031 b**

SUBJECT: Capital Cost

REFERENCE: KP report, page 6, section 1.4.5

PREAMBLE:

KP states that "Knight Piésold has provided its best effort in answering the PUBs queries in a timely manner as within the context of the NFAT procedures as the report deadline has drawn to a close and several facets could not be fully investigated with the New Generation Construction Division. These are:

- The methodology and numerical breakdown of the systemic risk calculations
- Contingency determination on the indirects, and
- A justification for not using the Hydro Escalation factor estimated."

QUESTION:

Please indicate the relative significance of each of the gaps listed to overall cost and schedule of the projects.

RESPONSE:

A more thorough understanding of the systemic risk evaluation process helps gain confidence in the process, but KP understands through Hydro that an external specialised firm is actively engaged through the process and as a result is reasonably satisfied that the work undertaken is comprehensive. A report attesting to this would provide additional reassurance. The relative significance relates to expected accuracy of the resulting contingency cost curve, therefore the uncertainty around a $547 million dollar line item for Keeyask.

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/bxf

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INFORMATION REQUEST RESPONSE

To: Manitoba Public Utilities Board Date: February 20, 2014

KP File: VA103-449/1-A.55

Needs For Alternatives To – **PUB/KP I-032**

SUBJECT: Capital Cost

REFERENCE: KP report, page 12, section 2.4.1.3

PREAMBLE:

KP states that "It is important to note that the PUB and Manitoba Hydro are making different uses of the same cost estimate (with a specific level of project definition) and as a result may have a different perspective on risks and accounting for uncertainty which are built into the relevant contingency and reserves."

QUESTION:

Since both MH and MPUB want a cost estimate in which there is confidence, please explain how differences in how each organization uses the cost estimate affects the accuracy of estimate.

RESPONSE:

KP believes that the perspective on confidence is different for both parties. In the instance of MH, KP believes it is desirable to have an estimate that is as close to what can be anticipated as possible. It is up to the MPUB to define what level of confidence they would like to see in an estimate, but KP would surmise that the MPUB would like a cost estimate that has a defined amount of certainty that it will not be exceeded.

/bxf

INFORMATION REQUEST RESPONSE

To: Manitoba Public Utilities Board Date: February 20, 2014

KP File: VA103-449/1-A.55

Needs For Alternatives To – **PUB/KP I-033**

SUBJECT: Capital Cost

REFERENCE: KP report, page 35, section 3.2.2

PREAMBLE:

KP states that "KP did not come across a clear project definition document inclusive of all indirects akin to the Basis of Cost Estimate reports used in the determination of the direct costs. KP has discussed and been witness to some of the calculations covering the Indirect Costs during teleconferences with Hydro but has not seen any complete references. The KP review would benefit from seeing such comprehensive documents."

QUESTION:

Has KP confirmed whether such documents exist and, if so, have they been requested? If they do not exist, has KP determined Manitoba Hydro's rationale for not preparing them?

RESPONSE:

An overall formal packaged documentation describing the indirect costs does not appear to exist outside the internal database system and the spreadsheets developed in 2009. Components of the baseline elements are documented and posted internally within Hydro's management tools. Manitoba Hydro feels confident that their WBS includes all elements, but has not provided a rationale for why documentation was never packaged in a comprehensive fashion. It is hoped that more detail will be presented when the GCC is awarded and Hydro is in a position to help KP complete a full reconciliation between budget and currently estimated final costs. This matter is discussed in KP's Supplemental Report of February 18, 2014.

/bxf

INFORMATION REQUEST RESPONSE

To: Manitoba Public Utilities Board Date: February 20, 2014

KP File: VA103-449/1-A.55

Needs For Alternatives To – **PUB/KP I-033**

SUBJECT: Capital Cost

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/bxf

INFORMATION REQUEST RESPONSE

To: Manitoba Public Utilities Board Date: February 20, 2014

KP File: VA103-449/1-A.55

Needs For Alternatives To – **PUB/KP I-034 a**

SUBJECT: Capital Cost

REFERENCES: KP report, page 40, section 4.4.1

PREAMBLE:

KP states that "The New Generation Construction Division of Hydro has outlined a Project Execution Plan for the Keeyask Project. The draft document seen by KP acts as a high-level guideline to manage the KIP and the KGSP."

QUESTION:

Please file, or cause Manitoba Hydro to file, the Project Execution Plan, if necessary as CSI.

RESPONSE:

The request will be forwarded to Manitoba Hydro.

/bxf

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INFORMATION REQUEST RESPONSE

To: Manitoba Public Utilities Board Date: February 20, 2014

KP File: VA103-449/1-A.55

Needs For Alternatives To – **PUB/KP I-034 b**

SUBJECT: Capital Cost

REFERENCE: KP report, page 40, section 4.4.1

PREAMBLE:

KP states that "The New Generation Construction Division of Hydro has outlined a Project Execution Plan for the Keeyask Project. The draft document seen by KP acts as a high-level guideline to manage the KIP and the KGSP."

QUESTION:

What is KP's view of the adequacy and practicality of the project execution plan?

RESPONSE:

The project execution plan is adequate; the practicality will have to be examined in its execution.

/bxf

INFORMATION REQUEST RESPONSE

To: Manitoba Public Utilities Board Date: February 20, 2014

KP File: VA103-449/1-A.55

Needs For Alternatives To – **PUB/KP I-034 c**

SUBJECT: Capital Cost

REFERENCE: KP report, page 40, section 4.4.1

PREAMBLE:

KP states that "The New Generation Construction Division of Hydro has outlined a Project Execution Plan for the Keeyask Project. The draft document seen by KP acts as a high-level guideline to manage the KIP and the KGSP."

QUESTION:

Please clarify whether the project execution plan and project budget are in alignment and are consistent with each other (i.e. cover the same scopes of work, work breakdown structures, timescales etc.). Insofar as they are not in alignment, please specify where the differences are and how significant they are to the probability that the projects will be completed according to the proposed cost and schedule.

RESPONSE:

The Project Execution Plan outlines a process - the means, methods, tools and techniques; it does not contain specifics. The project budget is determined following the Total Cost and Schedule Management Procedures which are processes within the Project Execution Plan.

/bxf

INFORMATION REQUEST RESPONSE

To: Manitoba Public Utilities Board Date: February 20, 2014

KP File: VA103-449/1-A.55

Needs For Alternatives To – **PUB/KP I-035**

SUBJECT: Capital Cost

REFERENCE: KP report, page 50, section 5.3.3

PREAMBLE:

KP states that "The NFAT assessment could consider a wind energy base cost of $1,800/kW for a total base cost of $117 million (excluding transmission) for the 65 MW wind energy projects, with a maximum cost accuracy range of -20% to +25%. This should be recognised as a conservative estimate, with continued cost reductions in the immediate future for wind energy projects considered likely."

QUESTION:

Please state KP's opinion as to the future cost of wind that should be used in the NFAT.

RESPONSE:

Background

In KP's opinion, a base cost of $1,800/kW is reasonable for a "generic" wind farm based on currently available industry databases of recently installed wind projects (reliable data is available for wind projects up to and including approximately year 2012). As mentioned in KP's report, since reported data are necessarily out of date due to the time lag inherent in processing and reporting the data, costs may have already reduced, thus possibly making the $1,800/kW a conservative estimate.

While KP did not assess future cost projections in the original report, we provide a high-level assessment herein. There is a great deal of uncertainty with respect to future cost trends on any energy technology, but there appears to be a consensus among cost trend assessments and meta-analyses that a further reduction in wind project costs is likely (IPCC, 2012; IRENA, 2012; NREL, 2012; REN21, 2013; US DoE, 2013).

Analysis

For capital cost projections, a meta-analysis of five separate sources reported an approximate reduction of 15% to 2020, and a reduction of approximately 20% by 2030 (IRENA, 2012). There is a wide variation in cost projections from the individual sources in this meta-analysis (approximately $\pm$50%).

Additional meta-analyses have reported on the projected trend in Levelised Cost of Energy (LCOE). While KP was not requested to report on future LCOE projections, it is nevertheless made a useful comparison to the studies that have assessed capital cost projections. A potential LCOE reduction between 10 to 30% by 2020, and 15 to 35% by 2030 is reported (IPCC, 2012), which is slightly higher than the projected capital cost reductions. The additional LCOE reduction as compared to capital cost can be explained by expected turbine performance improvements (which is partly offset by a reduction in the wind resource as the best sites are developed). A separate meta-analysis of 11 separate studies (NREL, 2012) projects a reduction of approximately 20-30% to 2030 for results falling between the 20th and 80th percentiles.

KP Opinion

The consensus of industry studies currently available is that wind project costs are likely to be less in both 2020 and 2030 than they are in 2014. An expected project "base case" capital cost of approximately **$1,500/kW in 2020** (range $1,400-1,700/kW) and **$1,400/kW in 2030** (range $1,300-$1,600) appears to be reasonable.

References:

IPCC. (2012). *Renewable Energy Sources and Climate Change Mitigation.* Intergovernmental Panel on Climate Change.

IRENA. (2012). *Renewable Energy Technologies: Cost Analysis Series. Volume 1: Power Sector, Issue 5/5. Wind Power.* International Renewable Energy Agency.

NREL. (2012). *IEA Wind Task 26: The Past and Future Cost of Wind Energy.* Golden, Colarado: National Renewable Energy Laboratory.

REN21. (2013). *Renewables 2013 - Global Status Report.* Paris: Renewable Policy Network for the 21st Century.

US DoE. (2013). *2012 Wind Technologies Market Report.* Oak Ridge: US Department of Energy.

/mgp1

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INFORMATION REQUEST RESPONSE

To: Manitoba Public Utilities Board Date: February 20, 2014

KP File: VA103-449/1-A.55

Needs For Alternatives To – **PUB/KP I-036**

SUBJECT: Capital Cost

REFERENCE: KP report, page 64, section 8.2

PREAMBLE:

KP states that "A meaningful assessment of historic Nelson River projects is not possible with the information made available."

QUESTION:

Please clarify whether this means that KP was unable to verify Manitoba Hydro's ability to manage a project on time and on budget with respect to an already completed project.

RESPONSE:

KP was provided with some basic information related to the layout of the facilities and a few bulleted fact sheets about these facilities. KP was not able to verify Manitoba Hydro's ability to manage projects on time and on budget with respect to the already completed historic Nelson River projects, and does not believe the information about the performance in the 1970's and 1980's would still hold relevant in todays context.

/bxf

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INFORMATION REQUEST RESPONSE

To: Manitoba Public Utilities Board Date: February 20, 2014

KP File: VA103-449/1-A.55

Needs For Alternatives To – **PUB/KP I-037 a**

SUBJECT: Capital Cost

REFERENCE: KP report, page 68, Table 10.10

PREAMBLE:

In Table 10.1, KP addresses the "lessons learned" from Wuskwatim. Several concerns that arose with respect to Wuskwatim are listed as "addressed" with respect to Keeyask and Conawapa.

QUESTION:

Please confirm whether "addressed" means that those costs would disappear completely or simply be reduced by a certain percentage. If necessary, please elaborate.

RESPONSE:

“Addressed” was intended to mean that Hydro has include additional costs to take direct measures to deal with an issue encountered at Wuskwatim so it does not occur again in Keeyask or Conawapa.

/bxf