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CONSULTING

NFAT REVIEW OF KEEYASK AND CONAWAPA GS

KNIGHT PIESOLD INDEPENDENT EXPERT CONSULTANT HEARING PRESENTATION

CONSTRUCTION MANAGEMENT AND CAPITAL COSTS

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April 14, 2014

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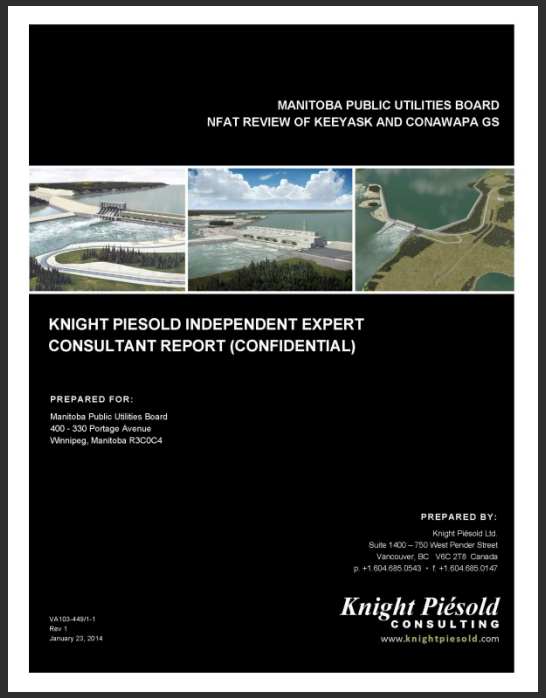
Documents

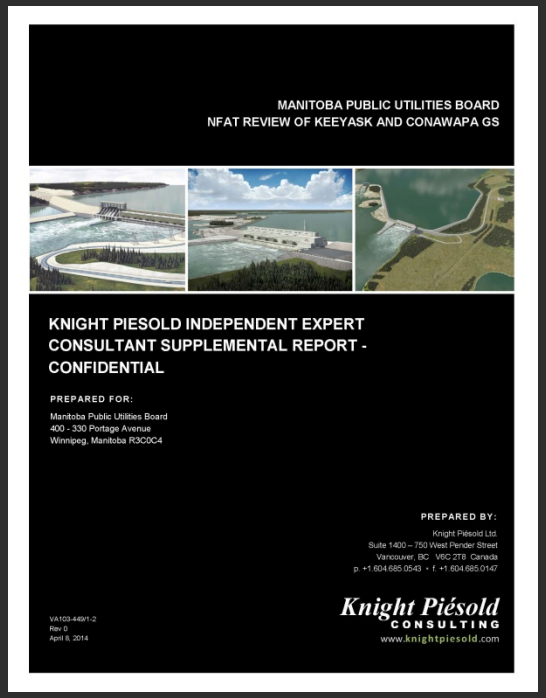
- Documents and Materials
  - KP Report VA103-449/1-1 Rev 1 of Jan 23, 2014 (CSI).
  - KP Report VA103-449/1-1 Rev 1 of Jan 23, 2014 (Redacted).
  - KP Report VA103-449/1-2 Rev 0 of April 8,2014 (CSI).
  - KP Report VA103-449/1-2 Rev 0 of April 8,2014 (Redacted).
  - KP IRs to Hydro.
  - KP responses to IRs (a few contain CSI).
  - References quoted in those reports (but not separately provided).
  - Information provided by MH (mostly CSI in hard blue paper copy and some emails).
- KP reports produced by me and Boris Fichot and other KP engineers under my supervision and control. Versions quoted are final (no revisions, updates or corrections). (Note CSI version of second report erroneously still labelled Rev A of February 18, 2014). CSI content will be provided tomorrow

Scope

- Scope of work provided by a number of questions posed by PUB. Answered in two reports – first had 9 questions (#1 to #9), second had a further 8 (#S1 to #S8).

- Some data in first 9 is updated/changed in second 8.

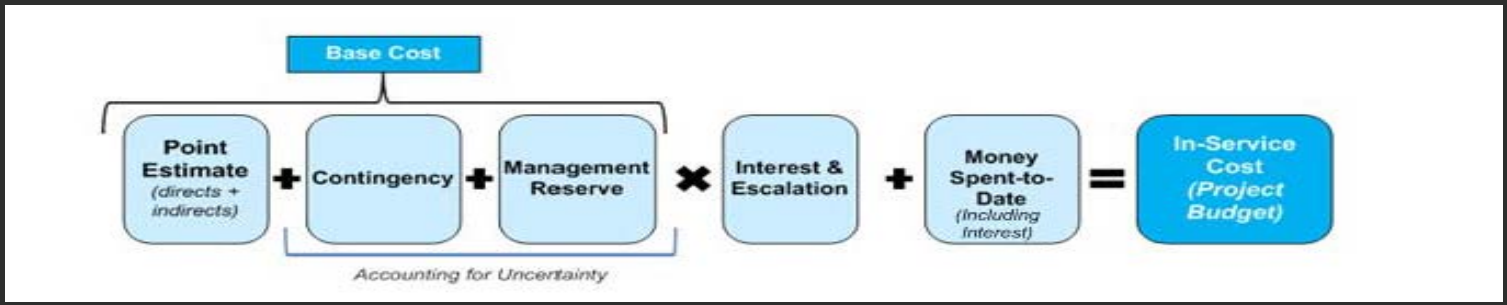




Question 1

"Review and assess Manitoba Hydro's capital and operation and maintenance (O&M) cost estimates for Conawapa GS and Keeyask GS, including the adequacy of management reserves for the projects."

General Methodology for Capital Cost Estimate **(p.11 of KP Report)**:



"Point Estimate" is essentially "Best Estimate". Comprises Direct and Indirect Costs:

- **"Direct Costs**" are those directly related to doing the generating station work e.g. labour, materials and equipment.
- **"Indirect Costs"** are all other capital costs e.g. provision of site infrastructure and services, engineering and project management and environmental activities (see detail in Question 2).

Question 1

Allowances are made for the Uncertainties (in the Point Estimate) through Contingency which includes:

- Systemic Risks (Systemic risk relates to items resulting from the project "system").
- Project Specific Risks (uncertainties specific to Keeyask and Conawapa (e.g.). Latter includes: foundation conditions, northern weather, delivery delays, Constructability, resource availability, and quality issues.

Assessed at the P50 level i.e. there is 50% probability that the final project cost will be less than the chosen number and 50% probability that it will be more (**p.24**).

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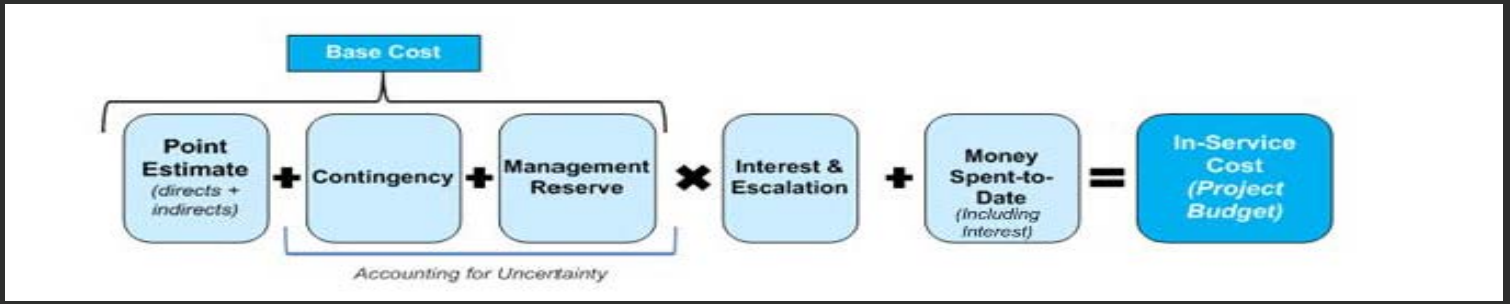
Question 1

- "Management Reserve" – Two specific risks included:
  - Escalation Reserve. Escalation at CPI is included in the Point Estimate. The reserve makes provision for escalation in excess of this amount.
  - Labour Reserve. A special pool of money has been set aside to cater for the possibility of labour costs and/or productivity being different from assumed (in the Point Estimate).

  These reserves set up as a direct result of the Wuskwatim experience (see Question 9).

"Contingency" usually includes Management Reserve but MH have chosen to split them up, if only because the two allowances are managed differently within MH.

Question 1



Point Estimate + Contingency + Management Reserve = **"Base Cost".** Base Cost is expected final cost before adding:

- the effects of interest on borrowed capital and escalation, and
- money spent to date.

Adding these to the Base Cost provides the **"In-Service Cost".**

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Question 1

High Level Comparison of Capital Cost Estimates of Similar Projects in Canada (p.8)

Name	Prov.	Proposed Installed Capacity (MW)	Estimated Average Annual Energy (GWh)	Total Estimated Capital Cost	M$ / MW	M$ / GWh	Source:
Muskrat Falls	NL	824	4,600	6.2 B$	7.5	1.35	Muskrat Falls Review
Site C	BC	1,100	5,100	7.9 B$	7.2	1.55	Site C information fact sheet.
Petit Mecatina Projects	QC	1,200	5,500	not available for review			
La Romaine	QC	1,550	8,000	6.5 B$	4.2	0.80	www.aecom.com
Keeyask	**MB**	**695**	**4,400**	**6.2 B$**	**8.9**	**1.40**	**NFAT Filing**
Conawapa	**MB**	**1,485**	**7,000**	**10.2 B$**	**6.9**	**1.45**	**NFAT Filing**
Wuskwatim	MB	200	1,520	1.78 B$	8.8	1.17	Actual Final

Question 1

Operation and Maintenance Costs have been estimated by MH as follows (**p.32**):

	Average Lifetime Fixed O&M Cost (2012$)/kW/year	Installed Capacity (MW)	Average Fixed O&M Cost (M 2012$)/year
Keeyask G.S.	17.86	695	12.4
Conawapa G.S.	10.28	1,485	15.3

Costs include:

- Wages, salaries and benefits and training in initial years.
- Insurance.
- Partnership expenses.
- Internal administrative costs.
- Internal and external (consulting) environmental services.
- Accommodation.
- Capital maintenance (in later years) – upgrades, replacements and refurbishments as required.

Question 1

Conclusions on Question 1 regarding capital cost estimates:

- MH's estimating process has been thorough, based on detailed design, estimation of quantities, initial bottom-up approach to unit rates (2009/2010), major updating to 2012 based on results of Wuskwatim, inclusion of allowances for uncertainty.
- There is more clarity in the MH process over direct costs than indirect (see Question 2).
- Many jurisdictions use higher value than P50 estimate to establish contingency (but a significant number of others do not: use P50).

Regarding Operation and Maintenance Costs:

- Estimated costs are commensurate with similar hydro projects elsewhere in Canada.

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Question 2

"Review and assess Manitoba Hydro's construction indirect costs including access roads, campsites, and off-site mitigation costs for Conawapa GS and Keeyask GS"

- Indirect Costs include all temporary and permanent items not directly associated with the primary structures but still required to successfully implement the project **(p.34)**:
  - Preconstruction costs.
  - Site infrastructure including access roads and campsites.
  - Site services.
  - Engineering and project management.
  - Environment and mitigation activities.
  - General expenses including consultants, travel, site office, insurance.
  - First Nation participation payments.
- Much of the construction work provided in the Keeyask Infrastructure Project, KIP. KP found the information provided by MH to be sensible but could not offer an opinion on costs like internal MH project management and other costs and general expenses.
- Indirect costs exclude related costs to date (or money spent).

Indirect costs stated by MH to form approx. one third of the Point Estimate.

Question 3

"Review and assess Manitoba Hydro's construction management, schedule, and contracting plans for the design, engineering, procurement, construction, start up, commissioning, testing, and commercial operation of Conawapa GS and Keeyask GS"

MH have created a Project Execution Plan (PEP) for the Keeyask Project (**p.40**). It is a high-level management guideline which:

- Describes the means, methods, tools and techniques used to manage the KIP and the KGSP.
- Serves as a record of the planning effort undertaken by MH for the construction phase of the project.
- Serves as a resource for staff to ensure the project is managed consistently.

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Question 3

The PEP is backed by MH Corporate Policies and Standards:

- Total Cost and Schedule Management (TCSM) Standard.
- Monitor and Control of Engineering Consultants Standard.
- Preparation of Project Dashboards and Trend Analysis Standard.
- Project Change Authorization (PCA) Process.
- Work Package Change Management Process.
- Consultant Communication Plans.
- Division Plan for Managing the Consultants, and
- Engineering Work Package Scope Sheets (EWPSS).

KP is able to see that Hydro has good procedures in place for the management of the projects despite the PEP presently being in draft form only.

Question 3

Contracting methods considered by MH for the various contracts included (**p.42**):

- Fixed Price Contract (FPC) (or EPC – Engineer, Procure, Construct).
- Cost Reimbursable Contract (CRC).
- Direct Negotiated Contract (DNC).
- Unit Price Contract (UPC).
- Supply Only Contracts (LS).

For contracts seen by KP, apparent that MH has made appropriate choices for different contracts e.g. FPC for turbine generating equipment and CRC for main civil works.

Main civil works contract (GCC) also utilising Early Contractor Involvement (ECI) process to obtain input from chosen contractor to refine design, construction technique, schedule and risk sharing.

Question 3

The Preferred Development Plan includes an implementation schedule. Schedules are also provided in the Basis of Cost Estimate documents. The schedules are consistent with the described developments and the anticipated work breakdown structures.

A more detailed and complete schedule for Keeyask was included with the Tender Package for the GCC. All tenderers essentially confirmed the schedule as part of their bids. The construction schedule is being refined as part of the ECI process.

The schedules do not include details of time needed for input by MH, such as reviews by themselves or independent engineers.

The PEP for Keeyask states that execution will follow the Hydro Cost and Schedule Standard (CSS) for schedule management.

Question 4

"Review and assess Manitoba Hydro's capital cost and O&M cost estimates for wind, natural gas combined cycle gas turbines, and solar facilities."

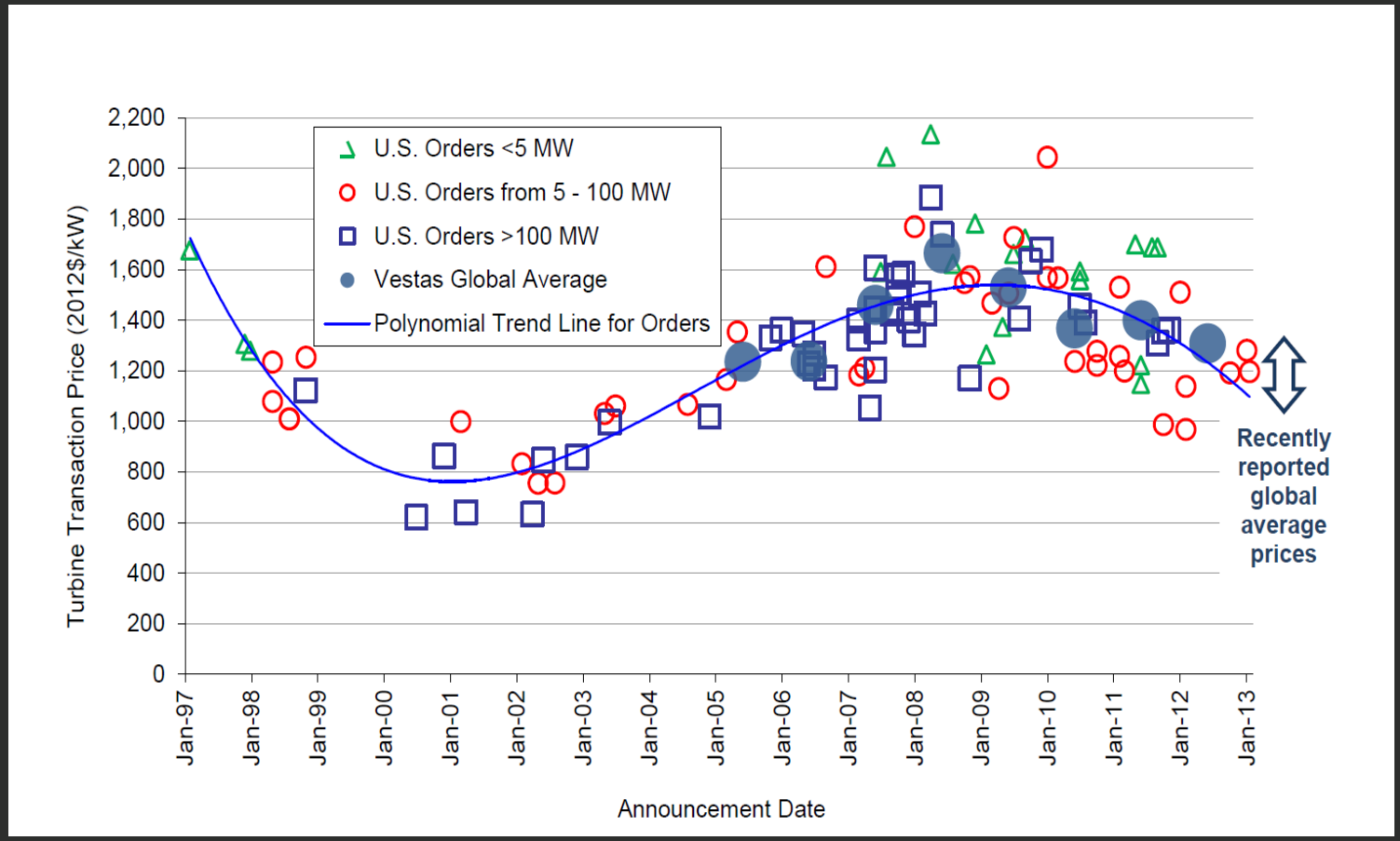
Wind (**p.50**)

Capital cost: MH has assumed an overall capital cost of $2,100/kW (excluding transmission) in the comparative exercises they have undertaken. From the data in next slide and data from other jurisdictions, $1,800/kW is deemed to be more appropriate and sufficiently conservative

O&M cost: MH's assumption of an O&M cost of $39.55/kW is deemed appropriate, with a recommended range of $35-55.

Question 4

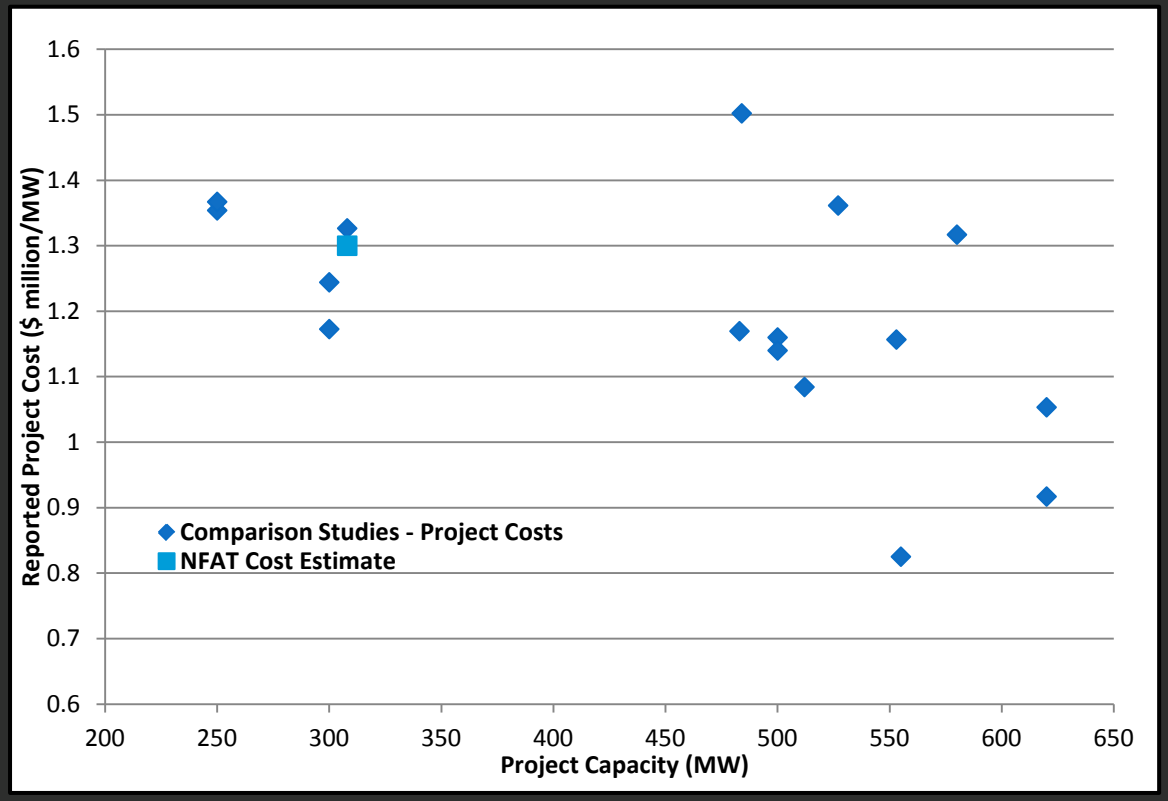
Wind Turbine Cost Trends



Question 4

Natural Gas Combined Cycle (CCGT) **(pp.53,54)**

MH's assumed capital cost of $1.3 million/MW is deemed appropriate



MH's assumed O&M costs of $20/kW/yr and $3.50/kWh are also deemed reasonable, with a recommended range of $6.30-22/kW/yr.

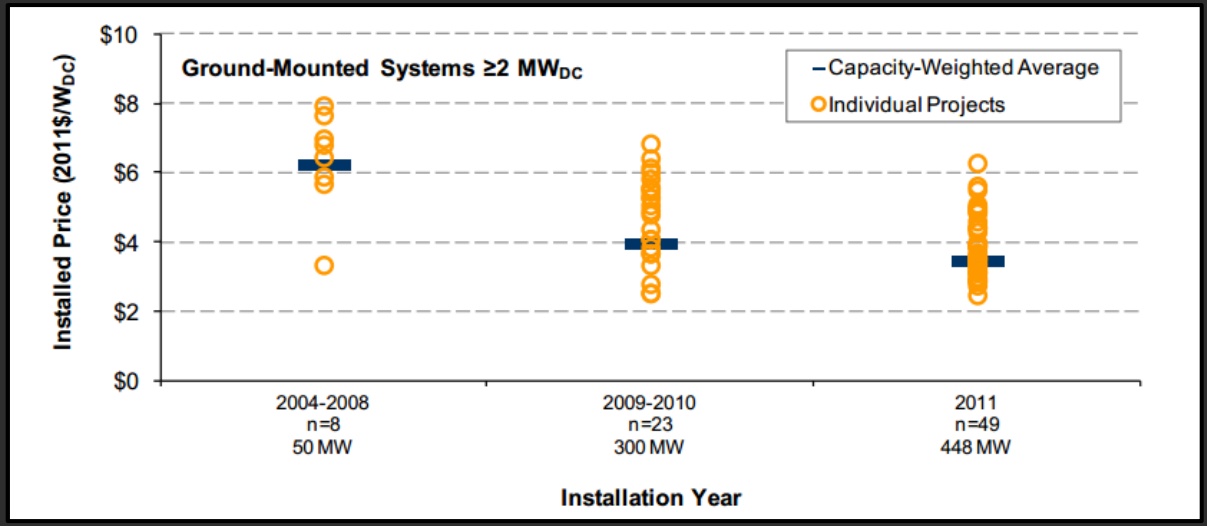
Question 4

Solar (pp.55-57)

MH's present assumptions on capital cost are deemed appropriate – but solar costs have been reducing significantly in recent years

PV System Type	NFAT Capital Cost ($/kW)	Comparison Capital Cost ($/kW)
Fixed Tilt	3,750	3,400-4,300
Single-Axis Tracking	4,500	3,900-4,700
Dual-Axis Tracking	5,000	5,100-5,500

PV System Type	NFAT O&M Cost ($/kW-year)	Comparison O&M Cost ($/kW-year)
Fixed Tilt	19.70	22-50
Single-Axis Tracking	21.10	22-50
Dual-Axis Tracking	24.60	25-50



Question 5

"Review and assess Manitoba Hydro's construction management plans, schedule, and contracting methods for the design, engineering, procurement, construction, start up, commissioning, testing, and commercial operation for wind, natural gas combined cycle gas turbines, and solar facilities."

Wind (**p.58**)

- MH assume wind power projects will be developed in-house (whereas existing Manitoba farms have been developed by IPPs)
- Time frame assumed 3 – 5 years, including resource assessment.
- Asset life ~20 years.
- No further details from MH: will be developed only if and when wind becomes cost competitive.

Question 5

Natural Gas Combined Cycle (CCGT) (**p.58**)

- NFAT assumes development by MH and construction through EPC contract.
- Time frame assumed 3 – 5 years reasonable but might be shorter (2 – 4 years, depending on turbine supply time).
- No further details from MH: will be developed as preferred development plan proceeds.

Solar (**p.59**)

- MH assume time frame of 3 years for development and construction of generic 20 MW facility. Could be reduced if/when solar perceived to be key energy resource in future.

Question 6

"Review Manitoba Hydro's capital expenditure forecasts CEF 13/CEF 12/CEF 11/CEF 10/CEF 9 and explore any significant factors that led to cost increases over successive forecasts."

Progression of Project Costs ($ Millions) **(p.60)**

	CEF09	CEF10	CEF11	CEF12	CEF13
Conawapa GS	6,325	7,771	7,771	10,192	10,492
Keeyask GS	4,592	5,637	5,637	6,220	6,220

Significant Factors in Cost Increases **(p.61)**:

- Delay of In-Service Dates (adds PM, interest and escalation costs).

	CEF09	CEF10	CEF11	CEF12	CEF13
Conawapa GS	May 2022	May 2023	May 2024	May 2025	May 2026
Keeyask GS	Dec 2018	Nov 2019	Nov 2019	Nov 2019	Nov 2019

- CEF09 to CEF10 shift due to updated detailed cost estimates by KGS-Acres.
- CEF11 to CEF12 attributed to inclusion of management reserve, increased actual escalations and changing interest rates in light of Wuskwatim experience (details in Question 9).

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Question 7

"Provide a historical perspective on the construction cost components of other Lower Nelson River hydraulic generating stations (Limestone/Long Spruce/Kettle) and analyze the major components of direct cost, including (a) Spillways/dams/dikes, (b) Powerhouses, and (c) Turbines and generators, and compare these to the Keeyask and Conawapa GS costs for these components."

Meaningful assessment not possible with information made available. MH provided total but not individual component costs. MH did provide major quantities.

Significant differences between then (1992/1979/1973) and now (Wuskwatim 2012 and Keeyask/Conawapa future) **(p.64)**:

- MH now engaged in partnership framework with FNs.
- Significant increase in rigour of environmental process (came into force after Limestone). Lack of regulatory capacity in Manitoba to follow new requirements.
- Labour costs and productivity.

Question 7

Limestone example (**p.65**):

- Completed in 1992, on time and within budget ($1.43 billion)
- Ballpark direct capital estimate would be $2.2 billion

	MH Quantity[1]	Unit	KP Unit Cost ($)	Cost ($)
Excavation (assuming 50/50 split of reported total quantity)				
Unclassified	1,600,000	m^3	20	32,000,000
Rock	1,600,000	m^3	100	160,000,000
Coffer Dam removal	3,500,000	m^3	20	70,000,000
Earth Fill	2,900,000	m^3	40	116,000,000
Concrete	650,000	m^3	1,200	780,000,000
Capacity (Generating Plant)	1,350	MW	500,000	675,000,000
				1,833,000,000
+20 % for miscellaneous items				471,380,000
				2,199,600,000

- However, escalating $1.43 billion @2.5% for 11 years yields only $1.88 billion which is short of direct costs alone let alone in-service cost which includes indirect and other costs.
- Capacity of 1,340 MW gives $1.07 million / MW (cf. 8.9 Keeyask, 6.9 Conawapa).

Question 7

Long Spruce (**p.65**):

- Constructed 1971 to 1979 for cost of $508 million.
- Capacity of 1,010 MW gives $0.50 million / MW (~cost of turbine generators alone today).
- No information provided re schedule and cost performance.

Kettle (**p.65**):

- Commissioned 1974 for cost of $240 million.
- Capacity of 1,220 MW gives $0.20 million / MW.
- No information provided re schedule and cost performance.

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Question 8

"Analyze Manitoba Hydro's justifications for increasing direct costs and for increasing indirect costs with respect to (a) Labour productivity and shortages, (b) Competition with other large civil projects in Canada, (c) Remote location, (d) Northern and First Nation jobs, and (e) Other contractual hiring constraints."

(a) Labour productivity and shortages **(p.66)**:

- Labour productivity in construction industry documented to have decreased since a peak in the 1970s, mainly due to reduction in skill level.
- Other factors include decline in # of employees, capital-labour ratio, percentage union and average age of workers.
- Canada has experienced at least a decade of labour shortages.
- MH have attributed lack of productivity to difficulties hiring and/or retaining staff and use of inexperienced staff. As a result of the low productivity experienced at Wuskwatim, MH has, for Keeyask and Conawapa, adjusted contracting methods, added staff and invested in better camp facilities. These are deemed reasonable measures.

Question 8

(b) Competition with other large civil projects in Canada (**p.66**):

- 40% of overall project workforce for Wuskwatim were out of province: 60% for generating station structure.
- Keeyask demand greater and situation likely to be even worse.
- Eastern labour had to be imported for recent KP hydro projects in BC.
- MH is relying on offering competitive wages and an attractive camp environment.

(c) Remote location (**p.66**):

- Location is remote but is known and therefore factored in to cost estimates already – should be no surprises. Is factored in to estimated staff rotations.

(d) Northern and First Nation jobs (**p.67**):

- Remote northern projects always been part of Canada's non-residential construction outlook.
- Natural resource development and mining projected to grow significantly through 2020.

Question 8

(e) Other contractual hiring constraints (**p.67**):

- Burntwood Nelson Agreement (BNA) sets out terms for "hands-on-tools" workers (including FN) on hydro projects in N Manitoba. Collective agreement between Hydro Projects Management Association (representing Contractors) and Allied Hydro Council of Manitoba (Unions).
- GCC tenders had to include compliance with BNA requirements.
- GCC tenders will reveal large contractors' assessments of labour availability (see Question S7).

Question 9

"Please provide a high level assessment of the construction planning and management of the construction costs of the new Preferred Development Plan projects, including the experience gained from the Wuskwatim project."

See Question 3 re construction planning and management of construction costs (and also Question S1).

Experience Gained from Wuskwatim (Costs) **(p.68)**:

- Wuskwatim witnessed lower than expected labour productivity, occurred during a period of international commodity escalation, and suffered a 3 year delay of In-Service Date.
- Cost went from $988 million in CEF03 to $1,771 million in CEF12 (79% increase, details on next slide).
- Keeyask and Conawapa Cost Estimates updated for Wuskwatim labour, material and equipment rates as well as labour productivity.

Question 9

Integration of Lessons Learned at Wuskwatim (Costs) (p.69)

Cost Breakdown	Increase in Cost 2003-2012 (M$)	Explanation for change by Manitoba Hydro In Undertaking # 47	KP Designated Implications for Keeyask and Conawapa
Pre-construction 2003 to 2006	224	Extended duration of federal and provincial approvals as well as PDA and NCN ratification resulting in the deferral of the construction start date, extended duration of construction, and the 3-year in-service date deferral.	Addressed through the separation of the KIP. Project definition for pre-construction work could still be refined.
General civil contract	178	Lower trade labour productivity, higher labour rates, increased bedrock overbreak, and increased engineering	Awareness of the issue, inclusion of different staffing requirements included. Similar Risks still exist, but are addressed in part (through Labour Management Reserve)
Turbines & generators	19	Higher labor rates, extra work, claims due to schedule delays.	Considered
Site preparation	32	Increased quantities (primarily rock) due to unknown site conditions, increased camp accommodations and operation and maintenance costs.	Remain
Catering	22	Higher camp occupancy and higher offsets required for work performed through a direct negotiated contract.	Addressed through projected increased staff requirements in the 2009 and 2010 estimates.
Electrical & Mechanical	38	Additions to scope of work and engineering, and contractor cost claims due to schedule and access delays.	Risk remains due to Hydro contracting technique.
Gates, Guides & Hoists	20	Extra work and contractor cost claims due to schedule delays.	Gate guides addressed in 2009 Estimate, marginal impact.
(continued ….)			

Question 9

Integration of Lessons Learned at Wuskwatim (Costs, Continued)

Cost Breakdown	Increase in Cost 2003-2012 (M$)	Explanation for change by Manitoba Hydro In Undertaking # 47	KP Designated Implications for Keeyask and Conawapa
Staff house	30	Addition of staff house to meet staffing requirements	Addressed through projected increased staff requirements in the 2009 and 2010 estimates.
Transmission	109	Increases in market costs experienced for labour, materials and contracts partially offset by reductions in contingency, project management and contract costs nearing construction completion.	Not investigated but should be part of escalation.
Other	47	Actual escalation in excess of original estimated inflation and other cost increases	Predictable, low CPI still included in escalation rate, addressed partially with escalation reserve
Interest allocated to construction capital	64	Due to increases in costs and deferral of in-service date partially offset by lower interest rates	Justified
Total Increase	**783**		

Question 9

Experience Gained from Wuskwatim (cont'd):

Access and FN Engagement (**p.70**):

- Advancing infrastructure work ahead of GS benefits FN through increased and advanced employment, training and capacity building opportunities. Also reduces financial risks to FN joint venture partners.
- Pursued on Keeyask to avoid repetition of difficulties experienced with FN JV partner at Wuskwatim.
- Allows developer to focus on engagement of GCC.

Question 9

Experience Gained from Wuskwatim (cont'd):

Changes to Construction Planning and Management (**p.70**):

- Wuskwatim originally bid as UPC in 2007 but only one bid received.
- Four bids received for subsequent CRC, with better prices.
- Provision of better camp conditions for Keeyask.
- Evidence that process review has resulted in changes:
  - Target Price contracts used for Keeyask to improve alignment with prevailing market and to share cost escalation risk.
  - Market research into craft labour and heavy construction costs and productivity and development of strategies for labour recruitment and retention.
  - Earlier scheduling for development arrangements, agreements and adverse effects and careful management through integration of engineering, regulatory and procurement processes.
  - Inclusion of Management Reserves for escalation and labour costs (on top of contingency).

Question 9

Cost Estimate Appreciation **(p.71)**:

A high quality cost estimate satisfies four characteristics:

- *Credibility* – In the case of Keeyask and Conawapa the direct point estimate is credible as it has been prepared by a reputable engineering firm with a wealth of recognised hydropower expertise (KGS-Acres).
- *Documentation* – layout and design of GSs well documented, as is makeup of direct cost estimates. Indirect cost estimates not as well documented (or not provided to KP). Project management processes and standards are well documented.
- *Accuracy* – current estimates likely as accurate as they can be prior to GCC award (see Questions S7 and S8).
- *Comprehensiveness* – KP believes estimate to be comprehensive. Includes all perceivable possible project costs and is structured in sufficient detail to insure that costs are not omitted or duplicated. Has been formulated by a suitably experienced estimating team.

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Question S1

"Review MH's overall management strategy and scheduling for the tendering of contracts for the Keeyask Generating Station and the procurement of other major facility components such as spillways, dams, dykes, powerhouse, turbines, intake gates, generators, controls etc. Comment on the effectiveness of this management approach for minimizing capital costs, securing competitive bids, and managing construction and procurement cost escalation and construction risks."

Management Strategy for Tendering (**p.2**)

- MH's Project Execution Plan (PEP) is high level guideline to manage KIP and KGSP. Provides means, methods, tools and techniques used by MH to manage the projects. Serves as record of planning effort for construction phase and as resource for staff to ensure consistent project management.

Question S1

- Process of procurement of contracts detailed in PEP. KP has seen:
  - Total Cost and Schedule Management.
  - Engineering Consulting Contract Monitoring and Controls.
  - Construction Contract Monitoring and Controls.
  - Contract Change Management.
  - Risk Management.
  - Project Contingency Management.
  - Project Change Authorisation.
- Total Cost and Schedule Management (TCSM) **(p.3)**
  - PDCA Process.
  - Plan – Establish project baseline schedule and budget.
  - Do – Implement project controls on contracts and internal labour.
  - Check – Retrieve actual costs (from SAP) and latest schedule and budget forecasts from project leads.
  - Act – Assess performance and manage change and contingency.

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Question S1

- Overall Tendering and Procurement Management Strategy (**p.3**)
  - Work divided into Work Packages.
  - Hydro Project Controls Coordinator responsible from contract drafting to early periods of the contract execution.
  - For each contract awarded contract value compared to base estimate and relevant amount of contingency allocated from contingency pool (see Question S2).
  - PDCA iterative management approach ensures project estimate and schedule are updated accordingly.
- Tendering mixture of methods, tailored to individual contracts. Supply and installation of turbine-generating equipment essentially fixed price whilst main civil works essentially design-bid-build but with target price and ECI process. KP deems overall approach appropriate in principle. Question 3 gives details of various forms of contract used by MH.

Question S1

- In GCC Early Contractor Involvement (ECI) process, selected contractor engaged early (2 years before major construction) so involved in helping finalise contract details. Main objectives:
  - Ensure contractor construction knowledge incorporated in design.
  - Refine delivery schedule.
  - Secure necessary labour.
  - Form alliances with Manitoba suppliers and sub-contractors.

Question S1

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Scheduling for Tendering **(p.4)**

- PEP requires project execution to follow the Hydro Cost and Schedule Standard (CSS) for schedule management. Schedule performance one of key performance indicators tracked by MH.
- Overall schedule anticipates construction starting in July 2014 and being complete in January 2021. Procurement of long lead time items of equipment already under way, in order to ensure delivery to site in time for incorporation in the works.
- Detailed schedules for KGSP included in 2009 Cost Estimate and in GCC RFP. No details of MH contributions. GCC tenderers all confirmed schedule. First Stage Coffer Dam Aggressive.

Question S1

Procurement of Major Facility Components **(p.5)**

- Long lead time items (e.g. TG supply) procured early.
- Wrapped most mechanical and electrical equipment supply into GCC to minimise interface issues (lesson from Wuskwatim). Also included excavation, cofferdams and draft tube forms.

Question S1

Effectiveness of Tendering and Procurement Management Approach (**p.4**)

- MH using appropriate approach to minimising capital costs by sharing risk with contractors and suppliers through advancing design prior to procurement, identifying and managing risks, and detailed management of the construction process.

- Most significant contracts have been or are being procured through competitive bid process (GCC and Equipment Supply). Number of projects procured through non-competitive DNCs because of preference by MH for particular contractors to undertake specific work assignments - Wuskwatim experience.

- Internal MH costs may not be deemed competitive but KP has insufficient data to offer opinion on this issue.

Question S1

(p.5)

- Difficult to measure MH effectiveness managing construction and procurement cost escalation as current process relatively new and significantly different from the old.

- Project team and risk engineer execute the construction risk management process and the contingency management process during construction (see Question S2).

- As an overall assessment of effectiveness, KP able to see MH is following well-documented process (despite the PEP presently being in draft form only). The project generally appears to be on schedule.

Question S2

"Review Manitoba Hydro's construction risk management strategy and comment on its effectiveness"

Confidential copies of following documents made available to KP (**p.6**):

- Risk Management Procedure. Purpose is to *"detail the activities of planning, identifying, evaluating, responding, and monitoring for effective risk management as well as detailing the standard risk reporting templates..."*
- Project Contingency Management Procedure.
- (Keeyask) Project Risk Register.
- Project Risk Report (showing contingency drawdown, schedule, one year look-ahead of project-specific risks based on project schedule, project risk profile, top 5 global and top 5 specific risks, and risk by phase of implementation).

Question S2

Risks in the Risk Management Procedure assessed as product of Probability and Impact, in following categories:

- Technical (Requirements, Technology, Complexity and Interfaces, Performance and Reliability, Quality).
- Organisational (Project Dependencies, Resources (MH Staff), Funding, Prioritisation, Customer (Internal)).
- Project Management (Estimating, Scheduling, Controlling, Communication).
- External (Regulatory, Market Intelligence, Performance and Reliability, Weather, Stakeholders).
- Safety (Design Standards, Qualifications, Training and Awareness).

Question S2

(p.8)

Probability Factor	>70% (5)	5	10	20	40	80
	50%-70% (4)	4	8	16	32	64
	30%-50% (3)	3	6	12	24	48
	10%-30% (2)	2	4	8	16	32
	<10% (1)	1	2	4	8	16
		Very Low (1)	Low (2)	Medium (4)	High (8)	Very High (16)
		Impact Factor				

Combined Risk Factor Range	Risk Level	Response for NGC
1 to 4	Minor	Acceptable level of risk. Mitigation of risks are optional.
5 to 15	Moderate	Borderline level of acceptable risk. Must be mitigated to minor in stage 5.
>15 High	Critical	Unacceptable level of risk, must be mitigated to moderate in stage 4, or low in stage 5.

Question S2

Major risks in the Risk Register (total risk score of 80) were perceived in August / September 2013 to be **(p.9)** :

- Cost of labour and other associated labour issues.
- Increased costs for project management as a result of insufficient capacity in MH and consequent need to hire consultants.
- Escalation / market conditions (leading to higher tender prices).
- Inexperienced craft labour work force (leading to increased time and cost to perform construction).

MH proposes to deal with these risks by mitigation, through the Contingency and/or the Management Reserve.

Question S2

Apparent that new procedures and systems set up for Keeyask and Conawapa are direct result of lessons learned on Wuskwatim and reflect genuine MH concern to manage the whole process better. Risk management strategy appears to be well set up and being followed.

Appreciation of present risks:

- Can be assumed at this stage of project that most significant *technical risks* have been addressed (reputable experienced designers of large hydropower facilities in Northern Canada and extensive geotechnical investigations).
- A significant *financial risk* has been removed with the award of the GCC, but others still remain.

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Question S2

- *Environmental risks* remain – contractor activities and impacts and remediation and/or compensation. KP has not examined Adverse Effects Agreement that has led to increase in indirect costs in successive cost estimates.
- Having chosen suitable, reputable and experienced contractors, *construction risks* are associated with contractor performance, in terms of quality, cost and schedule. MH carries some risk like quantities and to some degree impacts of inclement weather. Portions of the contingency have been added to each contract, to cover unknowns.

Whole issue ultimately comes down to cost. Discussed further in Questions S7 and S8.

Question S3

"Review contract documents prepared by Manitoba Hydro for the major Keeyask components and comment on how such documents have been designed to secure cost effective bids from suppliers and contractors and where Manitoba Hydro may be for vulnerable for cost increases, schedule changes etc. Comment on the overall thoroughness of the contract documents and drawings." **(p.11)**

- Question 3 details forms of contracts typically used to procure works like KIP and KGSP. KP confirms, based on contracts seen, MH has made appropriate choices for Keeyask contracts – contracts designed to secure most cost effective bids from suppliers and contractors.
- All contracts except FPC vulnerable to cost increases but MH has attempted to mitigate by sharing risk. Remaining risks and possible increases in cost have been acknowledged and accounted for in professional and competent manner – through contingency and management reserves; see Questions S2 and S8.

Question S3

- Non FPC contracts also have possible implications on schedule. Process of schedule changes has been defined. Costs associated with schedule risks are included in contingency and management reserve.
- Contract documents seen by KP clearly drawn up by competent, experienced engineers, from MH and reputable consultants.
- GCC contract involves ECI (to maximise benefit of Contactor input) and Target Price. Variations from Initial Target Price shared between MH and Contractor, generally to greater benefit of MH (80%) than Contractor (20%).

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Question S4

"Review construction and equipment procurement bonding and any liquidated damage requirements and comment on the appropriateness of such bonding and cost implications to the project."

"Bonding" either **(p.14)** :

- Performance Bond provides assurance that the work will be done (normally used for civil site construction works).
- Letter of Credit provides assurance that MH will not be out of pocket (used to procure equipment manufactured off-site).

MH has used both, different for each contract.

KP believes MH process to be appropriate, including the required amounts - reasonable balance between protecting MH interests and paying excessive premium for this insurance.

MH have also handled Liquidated Damages appropriately.

Question S5

"Review Manitoba Hydro's Quality Assurance and Quality Control (QA/QC) requirements for Keeyask construction and comment on the effectiveness and costs." (**p.17**)

Most common arrangement in hydropower construction has Contractor responsible for Quality Control (QC) and Owner (or his Engineer) responsible for Quality Assurance (QA). MH is conforming to this practice

Quality Management in MH specified at high level in PEP with more detail in New Generation Construction Division (NGCD) standard. Also include third main activity, Quality Planning (QP). MH made available to KP copies of:

- Quality Management Section 5 of PEP.
- NGCD Standard #204 Quality Management (effect. 2012 07 17).
- QA/QC Requirements for Turbine Generator Contract 016321.
- QA/QC Requirements for the General Civil Works Contract 016203.

Question S5

Wrt Turbine Generator Contract:

- Contractor's own Quality Management System must "*conform fully to the spirit and intent of* (the international quality management system) *ISO 9001 2000*".)
- Contractor also obliged to have a Project Quality Plan, a Quality Team and various Inspection and Testing Plans (ITPs).
- The document is deemed to be detailed, comprehensive and appropriate for its purpose.

Wrt General Civil Works Contract:

- Document confirms QC is responsibility of Contractor and QA responsibility of Engineer. Details not made available to KP but likely to be appropriate.

Costs of QA/QC not expressly shown – part of MH and Contractor overheads.

Question S6

"Review the overall civil contract(s) project management approach; comment on its effectiveness and what project management controls are in place to minimize cost escalations." (**p.19**)

- GCC being managed with all procedures, processes and standards mentioned in earlier questions. Financial activities part of SAP, MH's system-wide accounting system. Some processes new and still not finalised.
- Details provided to KP by MH in conference call:
  - "PCA"s (Project Change Authorizations) used to transfer funds to and from the project contingency, in real time.
  - There is a person in MH responsible only for managing the contingency. All significant Network #s have portion of overall contingency allocated to them and actuals and revisions to forecast are tracked.
  - MH keep a "CRR" (Contract Revision Register) that records budget changes like PCAs.

Question S6

- Also have "Dashboards" - reports tailored to present information to particular audiences. Example of dashboard included in KP report .
- Estimates of future expenditure adjusted in real time by adding inflation and deducting money spent to date. Check made at same time on expected final cost of each item i.e. budget still appropriate. Changes also recorded in other parts of estimate, to keep overall In-Service cost the same. Overall reconciliation done annually, with quarterly reports in interim. MH presently working to make this reconciliation possible more in real time.
- Schedule management correctly perceived to be as important as cost.

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Question S7

"Critically review Manitoba Hydro's pre-tender construction estimates and compare with actual tender prices. Define where significant differences are noted and rationalize the specific differences." (**p.21**)

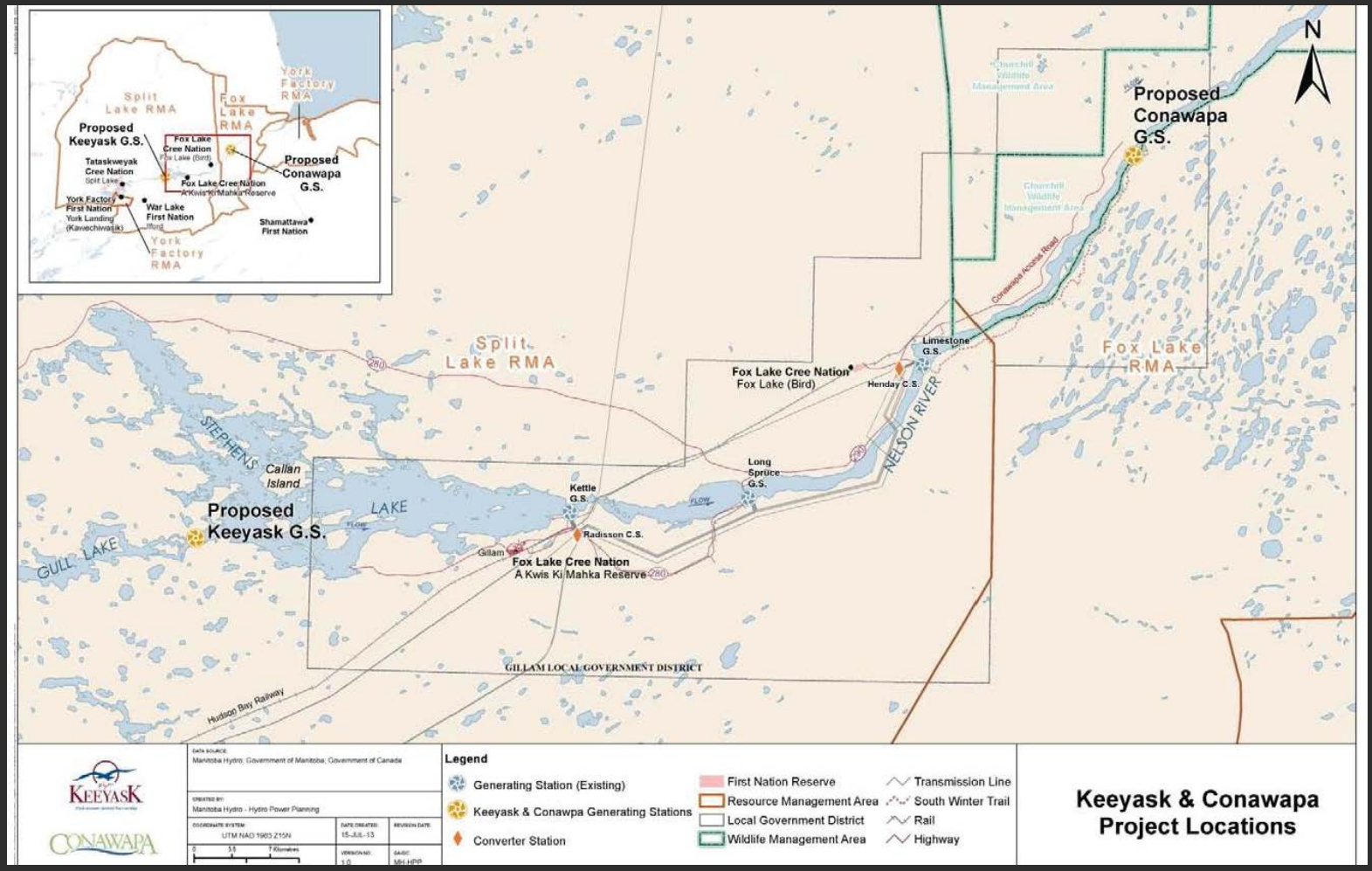
MH has provided KP with summary presentation material and Bills of Quantities comparing the GCC proposals, the independent estimators estimate (by Chant), and an escalated original Engineers Estimate by KGS Acres. KP believes that MH has been diligent in their internal comparison between the GCC tenders, their Engineers estimate and the independent Third Party Estimate. The tenderers have built into their bids their assessment of labour availability, productivity and costs.

Question S8

"Provide an opinion as to the expected in-service capital cost for Keeyask once all work has been completed." (**p.23**)

KP essentially confirms MH expected in-service capital cost of 6.5 B$ but is of the opinion that a more risk averse decision maker would incorporate a higher Contingency (e.g. P80 as opposed to P50) and a Management Reserve that incorporates greater allowances for labour and escalation, plus an allowance for schedule delay (primarily 2014 start date not achieved).

Conclusion


Split Lake RMA
Fox Lake RMA
York Factory RMA
Proposed Keeyask G.S.
Fox Lake Cree Nation
Fox Lake (Bird)
Tataskweyak Cree Nation
Split Lake
Fox Lake Cree Nation
A Kwis Ki Mahka Reserve
Proposed Conawapa G.S.
York Factory First Nation
York Landing (Kawechiwasik)
War Lake First Nation
Ilford
Shamattawa First Nation
York Factory RMA
Split Lake RMA
Fox Lake Cree Nation
Fox Lake (Bird)
Limestone G.S.
Henday C.S.
Fox Lake RMA
Proposed Conawapa G.S.
N
Conawapa Access Road
NELSON RIVER
STEPHENS LAKE
Callan Island
Proposed Keeyask G.S.
GULL LAKE
Kettle G.S.
Long Spruce G.S.
Radisson C.S.
Gillam
Fox Lake Cree Nation
A Kwis Ki Mahka Reserve
GILLAM LOCAL GOVERNMENT DISTRICT
Hudson Bay Railway
KEEYASK
CONAWAPA
Manitoba Hydro, Government of Manitoba, Government of Canada
Manitoba Hydro - Hydro Power Planning
UTM NAD 1983 Z15N
15-JUL-13
Legend
Generating Station (Existing)
Keeyask & Conawpa Generating Stations
Converter Station
First Nation Reserve
Resource Management Area
Local Government District
Wildlife Management Area
Transmission Line
South Winter Trail
Rail
Highway
Keeyask & Conawapa Project Locations