



Construction Cost Consultants and Quantity Surveyors Manitoba Hydro Capital Expenditure Review

January
2018





Powerhouse Complex July 2017 photograph provided by Manitoba Hydro

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The Company

MGF Project Services is a Quantity Surveying and Construction Cost Consultancy firm with its origins in Europe and Australia.

MGF operates from project inception to close-out in the Resources, Infrastructure, Oil & Gas and Commercial sectors.

The collective experience gained from projects completed in North America, Australia, Europe and Africa, places MGF in a strong position to deliver cost consultancy services to the construction sector throughout Canada.



Manitoba Hydro Capital Expenditure Review



What is a Quantity Surveyor

A Quantity Surveyor (QS) is a construction industry professional with expert knowledge on construction costs and contracts throughout the entire life cycle of a project from inception to post-completion.

They act in liaison with Architects, Consulting Engineers and Contractors to safeguard the Client's interest. They are independent experts who operate in the major capital projects space across multiple industrial sectors.

The services offered by Quantity Surveyors include:

- Cost estimating
- Cost planning
- Property development advice
- Advice on contract strategy, tendering and contractual arrangements
- Financial control over contracts
- Valuation of work in progress
- Cash flow budgets
- Final Account preparation and negotiation
- Dispute Avoidance, Minimisation and Resolution
- Claims Management
- Project Management

THE KEEYASK HYDROELECTRIC DAM

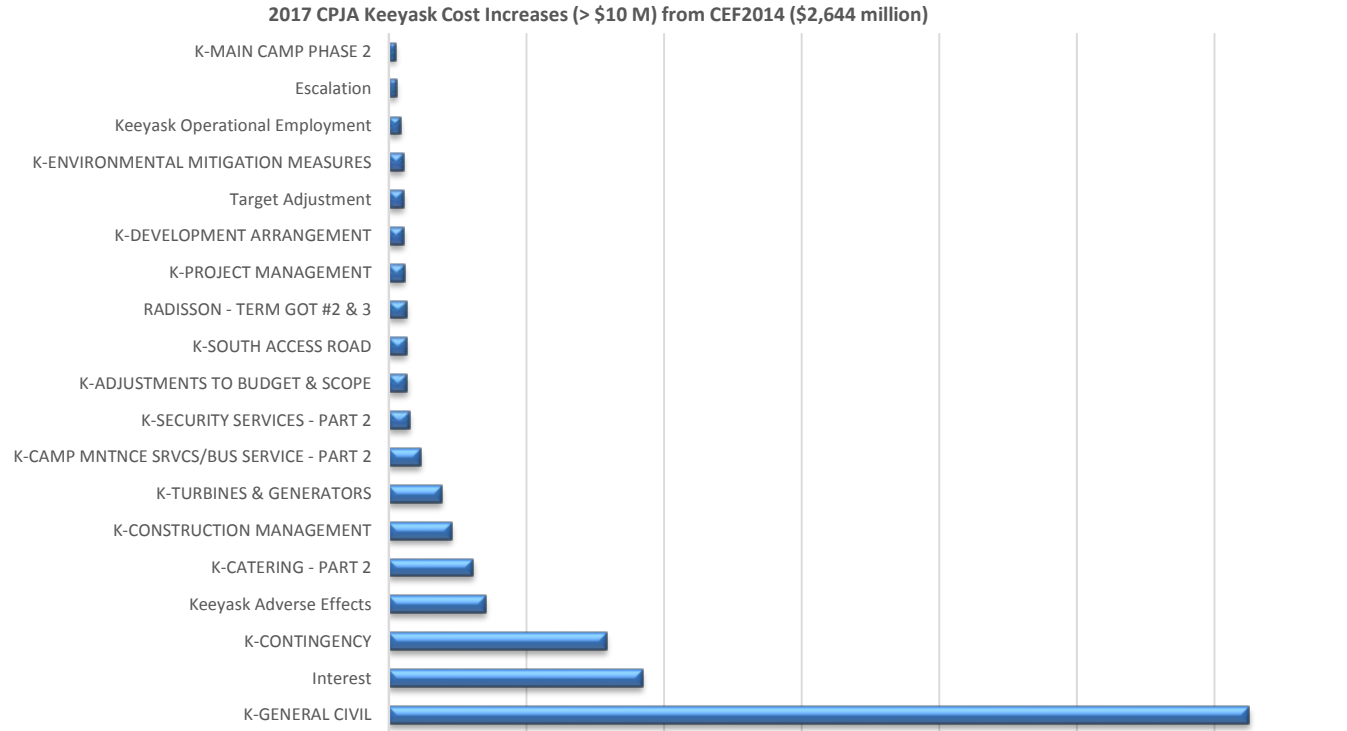


Spillway October 2017 photograph provided by Manitoba Hydro

Keeyask Hydroelectric Dam - MH Revised Budget

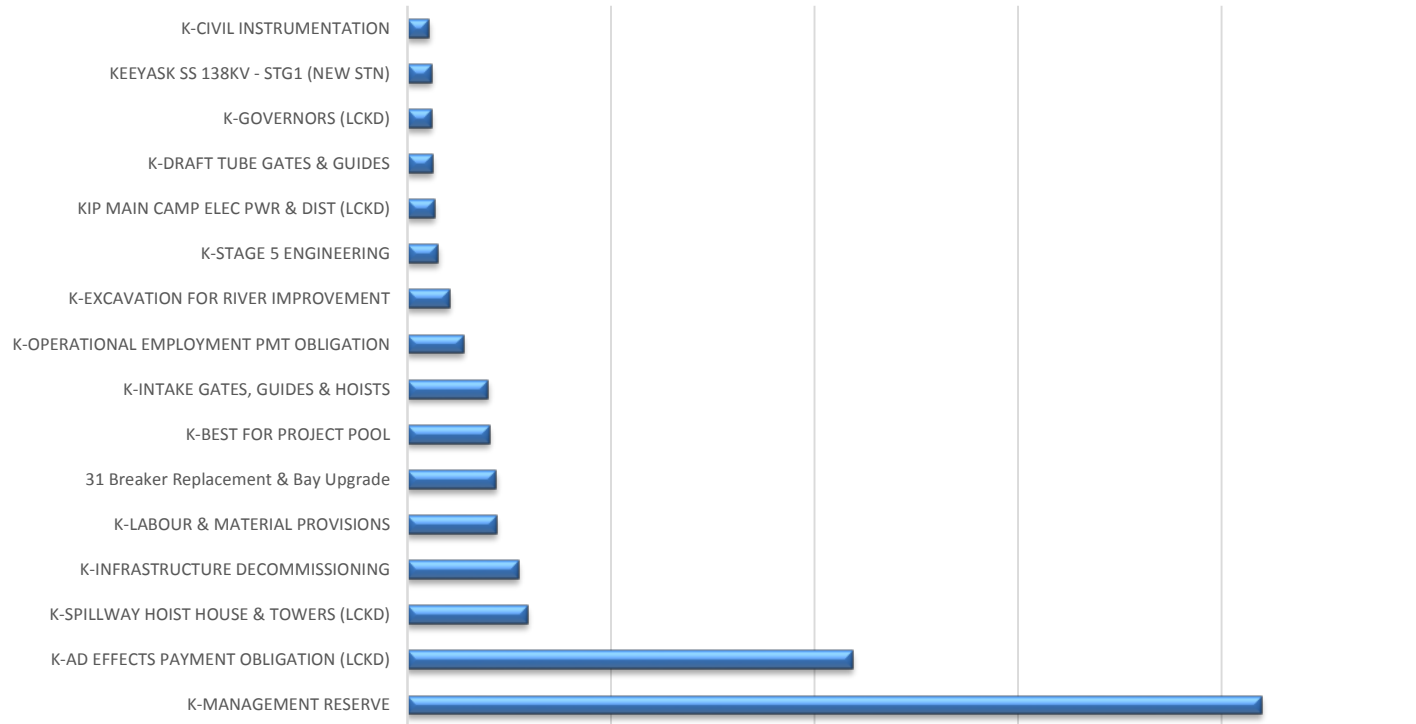
- Final Pre-Construction Budget \$6,496,076,546
- Additions \$2,783,971,637
- Omissions (\$ 554,009,510)
- Total Manitoba Hydro Budget **\$8,726,038,673**
- \$2,229,962,127 net increase
- The increase to GCC Work Package following Amending Agreement No. 7 from Original Contract due to:
 - Revised unit prices and higher productivity rates for construction activities
 - Increased man-hours to perform the GCC

Keeyask Hydroelectric Dam - Cost Increases



Keeyask Hydroelectric Dam - Cost Reductions

2017 CPJA Keeyask Cost Reductions (> \$5 M) from CEF2014 (\$521 million)



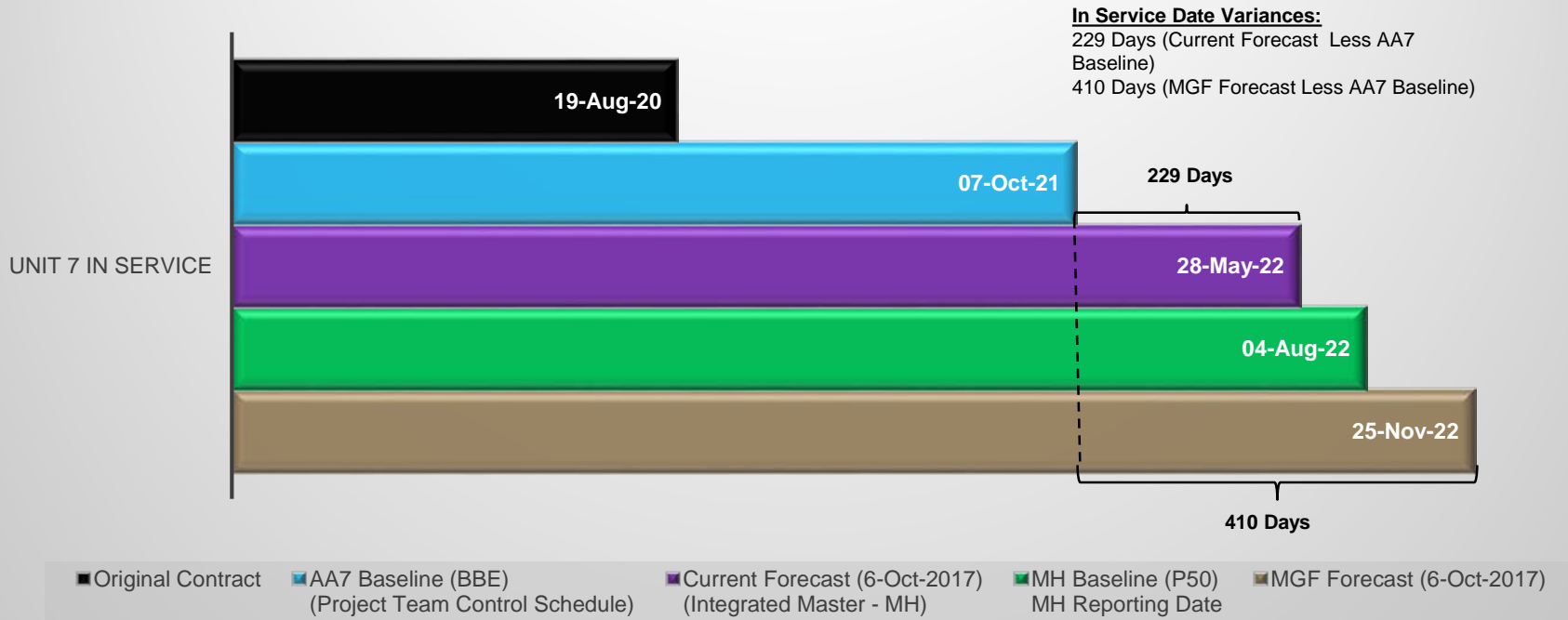
Keeyask - GCC pricing mechanism

- Cost reimbursable pricing mechanism
- GCC contractor reimbursed its actual costs irrespective of the quantity of work performed or the time it takes to perform the work
- Places the following risks on Manitoba Hydro:
 - Labour costs
 - Labour availability
 - Material costs
 - Escalation
 - Productivity
 - Final contract costs
 - Indirect costs
 - Schedule
 - Time and cost impacts on other contractors caused by the GCC contractor

Keeyask - BBE Forecast Completion Dates

- 8th October 2021 – planned completion date
- 23rd January 2022 – BBE's forecast completion date
- 4th August 2022 – Manitoba-Hydro's In-Service Date for Turbine-Generator Unit 7, including 10 month contingency
- 25th November 2022 –
 - MGF's projected completion date due to BBE's poor concreting productivity
 - 4 months later than Unit 7 In-Service Date
- 410 days – order of magnitude delay from 8th October 2021 to 25th November 2022.

Keeyask Generating Station - Schedule History



Keeyask – 229 Day order of magnitude delay for Unit 7

- 8th October 2021 – planned completion date
- 23rd January 2022 – BBE’s forecast completion date
- 28th May 2022 – Manitoba Hydro Integrated Master Schedule forecast completion date
- 229 days – Order of Magnitude delay from 8th October 2021 to 28th May 2022

Keeyask - Basis of Schedule for Integrated Master Schedule

- Manitoba Hydro rejected BBE's Basis of Schedule
- Since 23rd October 2017, BBE has not re-submitted a more detailed and acceptable Basis of Schedule
- MGF recommends BBE corrects this by developing a Basis of Schedule with which to guide and manage the contract, that is acceptable to Manitoba Hydro

Keeyask - BBE Negative Float

- Negative Float indicates that the activity cannot finish by its scheduled finish date
- BBE's contract stipulates that the Contract Schedule shall *“not have any negative float”*
- BBE's schedule contains 1,030 activities with negative float, of which 97 are in the critical path
- Each day a critical path activity is delayed, it has the potential to delay the schedule by the amount of such delay or longer
- Manitoba Hydro should not accept this and instruct BBE to correct the Contract Schedule

Keeyask - Earthworks Productivity

- Budgeted man-hours per cubic metre for earthwork is X
- Actual average productivity to September 2017 is Y man-hours per cubic metre
- Earthworks productivity is $Y-X=Z$ man-hours per cubic metre worse than planned
- This lower productivity will result in:
 - Increased direct costs
 - Increased indirect costs
 - Longer schedule
- Applying the Z difference in earthworks productivity results in an increase in earthworks cost in the order of \$88,400,000

Keeyask - Concrete Placement

- Week ending 6th October 2017:
 - 2017 Year to Date Plan – 61,172 cubic metres
 - 2017 Year to Date Placed – 48,834 cubic metres
 - 2017 Year to Date concrete placement is down 12,338 cubic metres or 20%
- BBE failed to meet its schedule in 2016 and continues miss the 2017 schedule, even after the Amending Agreement No. 7 and renegotiation of target price and schedule
- Raises concerns with BBE's optimistic productivity rates and its ability to plan and execute concreting activities.
- Recommendation:
 - BBE to revise its schedule with productivity rates it can realistically achieve
 - With a realistic and achievable schedule, revise the forecast cost at completion estimate
 - Use the revised schedule to plan and sequence other contractors e.g. Voith who interface with BBE to avoid potential delay and disruption claims

Keeyask - Concrete Productivity

- The Cost and Schedule of Amending Agreement No. 7 is based on an average concrete productivity rate of X man-hours per cubic metre
- Actual average productivity achieved to date is Y man-hours per cubic metre
- The delta between forecast and actual productivity is Y-X man-hours per cubic metre
- This productivity is likely to worsen as BBE has more complicated structures to pour and potentially three further winter seasons to work through
- The impact of this lower concrete productivity to the end of the contract results in an Order of Magnitude additional cost of \$136,500,000

Keeyask - Tender & Contract Management

- Tender Management
 - The standards, procedures and processes supporting Contracting Strategy, Contractor Prequalification, Individual Contract Plans and Tender, Evaluate, Negotiate & Award are sufficient and well documented
- Contract Management
 - Contract Management process appears comprehensive although there are concerns with BBE's non-compliance
 - Recommendation is for Manitoba Hydro to initiate periodic contract compliance reviews, assessing both the contractor and itself, to promote and assure compliance

Keeyask - BBE Indirect Costs

- As per September 2017 Construction Monthly Report:
 - Physical construction progress achieved is 24%
 - Actual indirects spend is 30.4%
 - Indirect budget is \$X
 - 6.4% cost variance
 - If trend continues, the Indirects Budget will require additional funding

Keeyask - Estimated Final Cost Range

- Current Manitoba Hydro Estimated Final Cost is \$8.7 billion
- Issues that may impede this cost being achieved:
 - Productivity
 - Schedule
 - Costs
 - Indirect costs expenditure
 - Cost reimbursable pricing mechanism of the GCC
 - Delay and disruption to other contractors
- MGF Order of Magnitude final cost range is \$9.5 billion to \$10.5 billion
- The final cost within the range will depend on how Manitoba Hydro addresses current issues

Keeyask - Construction Management

- In cost reimbursable priced contracts *“Time is the Owner’s Money”*
- All construction decisions directly affect Manitoba Hydro financially
- BBE thus far appears to be inefficient:
 - Planned productivity not being achieved
 - Working from a schedule with 1,030 activities with negative float
 - Not meeting planned schedule
 - Spending more of the Indirect Costs budget for less construction progress
- These reflect inadequate supervision and construction management
- Recommendation:
 - closer collaboration on execution planning and oversight of BBE’s construction management by Manitoba Hydro
 - Use of GCC to manage BBE’s performance

Summary - Keeyask Generating Station

- The General Civil Contract (GCC) and performance of BBE presents greatest risk to planned cost and schedule being met
- BBE is not meeting revised productivity factors for concreting and earthworks in Amending Agreement No. 7, dated 28th February 2017
- \$XXX billion added to original GCC on account of:
 - BBE's poor productivity
 - Increased indirect costs as GCC would take longer to perform
- BBE is paid its Actual Costs rather than quantities times unit prices for actual construction work done
- Current contingency is likely to be insufficient
- Final Project Cost range is \$9.5 billion to \$10.5 billion

HVDC CONVERTER STATIONS



HVDC - Cost Estimating Methodologies

- Cost estimating methodology is consistent with industry standard for the class of estimate and the estimate's intended purpose
- BPIII 2014 Basis of Estimate is well written and closely aligns with best practice
- The use of estimating templates has promoted consistency, however details supporting summaries in some instances were insufficient

HVDC - Tender and Contracting

- Approach to market:
 - Appropriate use of competitively tendered and single sourced directly negotiated contracts
 - HVDC converter equipment was competitively tendered; and
 - Keewatinohk Camp Operations Services was a single sourced directly negotiated contract
- Contract types:
 - Appropriate use of contract types and allocation of risks
 - HVDC equipment on a design, supply, construct, install and commission contract
 - Keewatinohk Camp Operations Services scope on a services based contract
- Pricing mechanism:
 - Appropriate choices of pricing mechanisms relative to contract scope, the degree of scope definition and associated risks:
 - HVDC Converter Stations paid on achieving key lump sum milestones
 - Keewatinohk Camp Operations Services paid on a cost reimbursable pricing mechanism, comprised of reimbursement of actual costs incurred plus a management fee

HVDC - Cost Control

- The choices of contract pricing mechanisms has promoted predictability in forecasted final cost and schedule.
- There is approximately \$320 million of spend to completion in August 2018:
 - 83% is lump sum
 - 4% is unit rate
 - 13% is cost reimbursable
- Variations to date have not had a significant cost impact
- The potential for cost over-runs on the HVDC Converter Station scopes is low

Summary - HVDC Converter Station

- Well managed project
- Basis of Estimate document is well written
- Potential for cost over-run is low
- Effective use of fixed price compensation mechanisms such as lump sum and unit rates, placing the following risks on its contractors:
 - Productivity
 - Cost
 - Schedule

BIPOLE III TRANSMISSION LINE



photograph provided by Manitoba Hydro

Bipole III Transmission Line - Cost Estimating Methodologies

- Final pre-construction estimate based on “*using quantities and historical project unit rates dependent on design criteria*”
- The approach is consistent with industry standard for the Class of Estimate and for the intended purpose of the estimate
- Estimating team is a knowledgeable and capable group
- Potential areas for improvement:
 - More supporting back-up and transparency of costs included in summaries
 - Ensure that values carried in Estimate Summaries aligns with the values used in the Work Breakdown Structure

Bipole III Transmission Line - Contracting

- Lump sum priced contracts:
 - Transmission Line Clearing
- Unit rate priced contracts:
 - Transmission Line Construction Package
- Cost reimbursable or “Service Release Order” contracts:
 - Inspection Services
- Manitoba Hydro has made appropriate use of lump sum, unit rate and cost reimbursable pricing mechanisms

Bipole III Transmission Line - Rokstad Power Corporation(RPC)

- RPC has not progressed work to plan in sections N1, N4, C1 and C2
- Many activities are slipping from the November 2016 approved baseline dates
- Manitoba Hydro is reviewing RPC's recovery plan and has also removed scope from RPC effective 9th November 2017
- If RPC's remaining scope is not progressed as per the schedule, work will need to be performed in another construction season, with a schedule impact of one year

Bipole III Transmission Line - Project Cost Overruns

- Pre-construction control budget was \$1.66 billion
- Overall project cost has increased by \$302 million
- Key contributing factors to increased cost:
 - 500 kV HVDC Transmission Line
 - Transmission Line Property
 - Transmission Line Vehicles
 - Transmission Line Contingency

Summary - Bipole III Transmission Line

- Project is well organized and managed
- Effective use of fixed price compensation mechanisms such as lump sum and unit rates, placing the following risks on its contractors:
 - Productivity
 - Cost
 - Schedule
- Project on schedule for 31st July 2018 completion, although some critical path activities on contractors' schedules are slipping
- Rokstad Power Corporation (RPC)
 - Performance of RPC is the key risk to 31st July 2018 completion
 - Manitoba Hydro is aware and taking mitigation measures

MANITOBA – MINNESOTA TRANSMISSION PROJECT (MMTP)



photograph provided by Manitoba Hydro

MMTP - Cost Estimating Methodologies

- Cost estimate is \$453 million
- Best practices
 - Appropriate level of project definition with which to develop quantities
 - Use of historical project unit rates and recent pricing is reasonable
 - Use of project estimate templates
- Short-comings
 - Basis of Estimate not prepared

MMTP - Schedules Generally

- Using a common template for schedules is good for consistency across schedules
- Once construction activities commence, schedules should be reviewed and updated more frequently than every two months
- Schedules with high logic density, should be reviewed with goal of reducing potential complexity
- Schedules identified with 'missing logic' or 'inaccurate logic' need review as the correct critical path may not be identified
- Schedules with High Duration and insufficient detail is a concern; however as construction contracts are awarded, then these long duration activities can be decomposed into more detail

MMTP - Estimate reasonableness

- Estimated cost is \$453 million
- MGF/Stanley analysis focused on the transmission line and related scope, representing a significant percentage of the estimated project cost
- Benchmark comparison suggests the MMTP cost estimate is lower than similar industry projects
- MGF/Stanley identified activities whose costs are lower and higher than similar industry projects
- Detailed Tower Design had not started at time of Estimate
- Station Design is underway
- Recommendation is that Manitoba Hydro performs a review of these costs to determine the reasonableness of these prior to Execution Phase

Summary - Manitoba Minnesota Transmission Line

- Project on schedule
- Estimating methodology is consistent with industry standard
- Recommendation to update subsequent cost estimates using:
 - Estimate Preparation Plan
 - Basis of Estimate

GREAT NORTHERN TRANSMISSION LINE (GNTL)



photograph provided by Manitoba Hydro

GNTL - Capital Cost Comparison

- The transmission line estimate appears high
- Total USD/mile cost comparisons:
 - Stanley Consulting BM - \$2,467,000
 - MMTP - \$1,863,545
 - GNTL – Commercially Sensitive Information (CSI)
- Further review is required to establish the reasonableness of the cost estimate
- The review should be accompanied by a Basis of Estimate to address those items considered lower than and higher than expected
- Implementing an industry project stage gate process is recommended

GNTL - Construction Management Agreement

- The Construction Management Agreement is:
 - Comprehensive
 - Is operationally well drafted
 - Identifies and manages likely risks appropriately
 - Protects Manitoba-Hydro's business interests
- Manitoba-Hydro's key personnel have a common and shared understanding of how it operates

GNTL - Forecast at Completion

- USD \$677 million cost estimate in 2013
- Cost estimate in May 2016 is CSI
- Minnesota Power's cost estimating methodology is consistent with industry standard
- The level of project definition is reasonable to develop quantities and unit prices with which to build the cost estimate
- A summary of 'cost assumptions' was provided; but a detailed Basis of Estimate was not
- The overall cost is considered high and an updated estimate is recommended

GNTL - Schedules Generally

- Schedules have been generally assessed as ‘medium quality’
- Improvements would comprise:
 - Breaking down activities into greater detail
 - High duration activities generally indicate that a plan is too high level for adequate planning and control purposes; such activities should be reviewed and broken down in to more detail
 - Missing logic impacts the quality and reliability of a schedule; MGF recommends Manitoba Hydro perform a schedule review to address missing logic issues

Summary - Great Northern Transmission Line

- Project is well organized and managed
- The Construction Management Agreement:
 - Meets acceptable commercial business practice
 - Protects Manitoba-Hydro's interests
- Estimating methodology is consistent with industry standard
- The Cost Estimate appears high when benchmarked with other similar projects

Thank You



Manitoba Hydro Capital Expenditure Review

