April 11, 2014

NFAT-Manitoba Hydro's Preferred Development Plan

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PE Scope of Work(SOW)

Today's presentation will cover the following topics:

- SOW 1 – 6: Transmission Line Construction and Management
  - Glenn Davidson
- SOW 7: MH Transmission Reliability
- SOW 10 – 12: Transmission Constraints and Need for new Transmission
  - Paul Arnold
- SOW 8 – 9: Transmission Losses
  - Brian Furumasu

Scope of Work items 1 – 6 with PE Report Page References

1. Assess completeness and reasonableness of AC Transmission line capital cost and O & M estimates: (PE Report pages 1 – 7)

2. Review and assess the completeness and reasonableness of Manitoba Hydro's AC Transmission line construction indirect costs, including access roads, campsites, and off-site mitigation costs. (PE Report page 8)

3. Assess construction management, schedule, and contracting plans for the design, engineering, procurement, construction, start up, commissioning, testing, and commercial operation of the AC transmission system. (PE Report page 8)

4. Review and assess Manitoba Hydro's cost estimating risks and risk management practices, sensitivity analysis in construction cost estimates, contingencies, and construction cost indices for the AC Transmission system. (PE Report page 9)

5. Provide comparable estimates of costs for each of the forgoing new transmission projects, including Bipole III as suggested by Manitoba Hydro. (PE Report page 10)

6. Review and assess Manitoba Hydro's estimate for the cost of construction of U.S. transmission infrastructure to facilitate sales into MISO. (PE Report page 10)

Scope of Work items 7 – 12 with PE Report Page references

7. Review and assess the completeness and reasonableness of the technical aspects of Manitoba Hydro's existing and proposed AC & DC transmission system. (PE Report pages 10 – 15)

8. Define the average energy flow and transmission losses from Keeyask and Conawapa G.S. to Southern Manitoba for domestic load during peak and off-peak times with a) BP I and II only and b) BP I, II, and III (PE Report pages 15 – 18)

9. Define the average energy flow and incremental transmission losses for exports into MISO during peak and off peak time with a) Bipoles I and II plus AC to the US Border; and b) Bipoles I, II, and III plus AC to the US border. PE Report pages 18 – 19)

10. Provide an assessment of MISO transmission constraints that require new interconnections and/or require Manitoba Hydro's financial participation in US transmission project(s). (PE Report pages 20 – 24)

11. Provide an analysis and justification of Manitoba Hydro's need for additional North-South AC transmission when Conawapa comes on-line. (PE Report pages 24 – 28)

12. Review and assess Manitoba Hydro's technical need for the cost of construction of U.S. transmission infrastructure to facilitate sales into MISO. (PE Report pages 29 – 31)

Summary of Key Conclusions

- MH's capital estimates are complete and reasonable and within an accuracy tolerance of ± 20%
- The Existing MH System is Reliable and meets NERC Standards, as demonstrated in the 2012 System Performance Assessment report
- The Proposed System Reliability meets NERC Standards using existing BPIII model, as demonstrated in the Integrated Transmission Plan for Keeyask and Conawapa report, *however*,
  - The proposed maximum operating limit for the combined three-Bipole system should be verified when a new BPIII model becomes available from the vendor

SOW 1 – A Word About Construction Cost Estimating

- AACE (Association for the Advancement of Cost Engineering) expects accuracy tolerance of ± 50% for budgetary level estimates for projects not yet designed and known only in conceptual terms.

- PE uses historic cost data from similar projects to achieve an expected accuracy tolerance of ±20%.

- PE used the ± 20% accuracy tolerance as the criterion for evaluating the reasonableness of the MH estimates.

SOW 1 – Cost Estimating Methodology

- PE Estimating Procedure: (PE Report page 1, line 8)
  - Incorporated construction data provided by MH in NFAT filing and responses to IRs (PE/MH II 015)
  - PE filled in gaps based on PE's design and estimating experience
  - Used PE's proprietary estimating tools and procedures
    - Continually updated
    - Used on projects worldwide

    *Note: PE estimates are calculated in US dollars

SOW 1 – Cost Estimating Methodology

- Manitoba Hydro (MH) Estimating procedure: (PE Report page 1, line 25)
  - Unit pricing from recent tenders for similar projects in similar environmental conditions
  - Unit prices include indirect costs, interest, contingency, management reserve, and escalation
    - The cost impacts of environmental protection, ground conditions, indirect costs, and construction timing are embedded in the unit rates bid by contractors for similar work.

SOW 1 – Comparison of MH & PE Estimates of Capital Cost for Keeyask Transmission Lines

- MH Estimate for Keeyask Transmission Project (PE Report page 3, lines 15 and 27)
  - $727,272/km
  - Total($-2012) $ 86 Million
- PE Estimate for Keeyask Transmission Project (PE Report page 3, line 39)
  - $738,000/km
  - Total($-2012) $ 84.5 Million
- MH Estimate and PE estimate are within 5%
- We conclude that the MH estimate is reasonable

SOW 1 – Comparison of MH & PE Estimates of capital cost for Conawapa Transmission Lines

- MH Estimate for the Conawapa Transmission Lines (PE Report page 5, line 9)
  - 2012 Dollars $286,000/km
- PE Estimate for the Conawapa Transmission Lines (PE Report page 5 line 18)
  - 2013 Dollars $344,000/km
- Conclusion:
  - The MH Estimate is at the very low end of our expected ± 20% accuracy tolerance

SOW 1 – MH & PE Estimates of Capital Cost for N-S Transmission Lines

- MH Estimate for North-South Transmission Lines (PE Report page 5, line 44)
  - MH based estimates on a $300,000/km historical cost for similar lines in similar terrain
- PE Independent estimate for the lines in 2013 Dollars is $344,000/km (PE Report page 6, line 19)
- Conclusion – MH's & PE's estimates are within 13% which is within our 20% accuracy tolerance.

SOW 1 – MH Capital Cost and Estimate for MMTP

- MH Estimate for MMTP Lines (PE Report page 7, lines 38 and 39)
  - $739,668/km (2012); $925,000/km (const year)
- PE Estimate for MMTP Lines (PE Report page 8 lines 11 and 13)
  - $663,500/km (2012); $831,000/km (const year)
- Conclusion:
  - MH estimate is about 11% higher than PE estimate, but within our ± 20% accuracy tolerance

SOW 1 – MH Transmission Line Operation and Maintenance (O & M) Estimates

- O & M for a transmission system includes functions directly related to maintaining the line in proper, safe condition, and for the overall operation of the system, including administration and the system operations center
  - MH provided their historic per-km cost for the direct O & M cost
  - The cost provided is lower than PE has seen for other comparable transmission systems

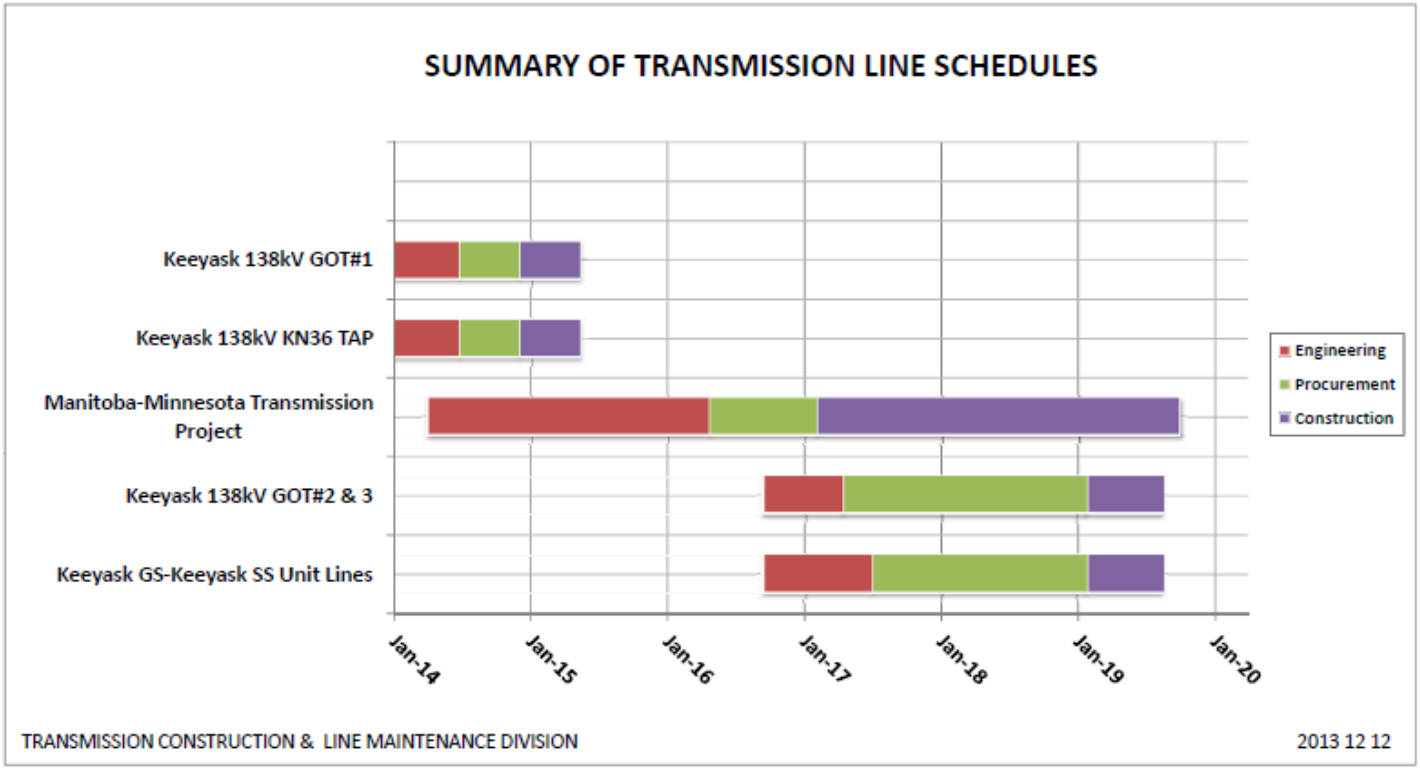
SOW 2 – MH AC Transmission Line Construction Indirect Costs

- MH Estimates (PE Report page 8, line 19)
  - Indirect costs were not broken out separately in MH estimates
  - MH indicated that the unit costs from contractors included all their indirect costs

- PE Estimates (PE Report page 8, line 25)
  - PE's estimates included indirect costs

- Conclusion
  - PE estimates and MH estimates (SOW 1) were within our expected accuracy tolerance
  - PE concludes that the MH allowances for indirect costs are reasonable

SOW 3 – MH Schedule, Construction Management, and Contracting Plans (PE Report Appendix F)



SOW 3 – MH Schedule, CM, and Contracting Plans

- Schedule: (PE Report page 8, line 28)
  - The schedule is dependent on Winter construction for the northern sections of the project. Weather is the major schedule risk factor.
  - PE's review of the schedule showed reasonable time allotments for the design, procurement, and construction activities
  - MMTP and Keeyask Transmission construction periods overlap, putting manpower pressure on Keeyask transmission (Small projects are not as attractive to contractors as large projects)

SOW 3 – MH Schedule, Construction Management, and Contracting Plans

- Contracting Plan: (PE Report page 9, line 1)
  - MH typically uses the design, procure, and bid plan. They provide construction management and inspection

- PE Conclusion:
  - This contracting plan is widely used and offers the potential for lowest cost and highest quality

SOW 4 – MH Cost Estimating Risks, Risk Mgmt, Sensitivity Analysis, and Contingencies

- MH follows a formal risk management analysis program (PE Report page 9, line 20)
  - Contingency is included in estimates to allow for unforeseen events during construction. All or part of contingency funds are expected to be spent.
  - Management reserve is set aside to cover "global" issues that affect labor or material costs. Management reserves are to cover events that are not project related, such as increased inflation rates

SOW 4 – MH Cost Estimating Risks, Risk Mgmt, Sensitivity Analysis, and Contingencies

- PE Conclusions (PE Report page 9, line 37)
  - MH estimates are based on similar lines constructed in similar terrain and ground conditions
  - Lines are mostly on Crown Lands avoiding private landowner issues
  - Appropriate contingencies have been included in all estimates
  - A sensitivity analysis was performed by MH and showed the transmission line cost variances have a minor impact on the overall project.

SOW 5 – Comparable Cost Estimates

- PE prepared independent cost estimates of comparable lines (PE Report page 64, Appendix E)
- Specific input provided by MH was used when available
- PE filled in gaps based on PE's design and estimating experience
- PE believes our estimates have an accuracy tolerance of ± 20%
- PE concludes that MH's estimates are complete and reasonable
  - Summaries of all estimates are in PE's report

SOW 6 – Review and Assess MH's Estimate for the Cost of Construction of U.S. Transmission Facilities

- All US transmission facilities were estimated by Minnesota Power. The U.S. facilities cost estimates were not the responsibility of MH.

SOW 7 – Reliability of Existing System (PE Report Page 10, Line 37)

- Manitoba Hydro's 2012 System Performance Assessment Report
  - MH Study Scope and Results
    - MH looked out 10 Years and included BPIII and Keeyask
    - System compliant with NERC TPL-001 thru TPL-004
    - Updated Annually
  - PE Recommend inclusion of all NFAT Preferred Plan facilities including Conawapa at next opportunity (PE Report page 10, Line 37)

SOW 7 – Reliability of Proposed System

- Manitoba Hydro's Integrated Transmission Plan for Keeyask and Conawapa report demonstrates compliance with NERC Planning Standard, using the currently available Bipole III model.
  - PE recommends further analysis and verification of the proposed maximum DC operating limit when a new model becomes available.(PE Report page 15, Line 6)

SOW 10 – MISO Transmission Constraints

- Existing Interconnection
  - Letellier to Drayton 230 kV (L20D) 467.7 MVA
  - Glenboro to Rugby 230 kV (G82R) 335.0 MVA
  - Richer to Moranville 230 kV (R50M) 229.9 MVA
  - Dorsey to Forbes 500 kV (D602F) 1732.0 MVA

- 2175 MW Existing Rating with all facilities in service
  - 1950 MW Export Limit
  - 75 MW TRM
  - 150 MW MISO Contingency Reserve Obligation

- (PE Report page 20, lines 27 – 35)

SOW 10 – MISO Transmission Constraints

MISO transmission constraints that require new interconnections

- Why not just Upgrade existing 500 kV line?
  - Would require upgrading Series Capacitor Rating beyond existing 2000A limit
  - Increases HVDC reduction for loss of a single line
  - Increases MISO largest single contingency
  - (PE Report page 20, lines 37 - 41)

SOW 10 – MISO Transmission Constraints

MISO Transmission Constraints require MH Financial Participation in US Transmission

- Cost Sharing spread among committed participants
- Minnesota Power Commitment 250 MW
- MH funding 2/3 of 750 MW Interconnection Upgrade
- Future commitments would reduce MH funding
- (PE Report page 23, lines 19 - 34)

SOW 11 – Need for Additional N-S Transmission when Conawapa Comes On Line

- Impacts of providing additional 100 MW N-S Transmission
  - Allows one Kettle generation unit (102 MW) to be added to the AC Transmission system and offloads the three-Bipole HVDC System
  - Provides 100 MW margin for the HVDC maximum loading limit
  - Improves DC on line valve group sparing which reduces non-firm transmission by 102 MW
  - Adds 85 MW additional firm transmission for Kelsey and Wuskwatim generation
  - (PE Report pages 27, lines 18 – 20 and footnote 15 on page 28)

SOW 12 – Technical Need for Cost of Construction of US Transmission Infrastructure

Facilities needed in the US consist of two parts (PE Report pages 29 – 31)

- New 500 kV Facilities in the US to interconnect with 500 kV facilities in Manitoba
  - As discussed in SOW 10, MH proposes to fund two thirds of these facilities, because MP is currently the only committed project participant in the US.
- Underlying System Upgrades in US required to fulfill Transmission Service Requests.
  - PE covered needed US system upgrades because it assumed it was part of its work scope
  - MH Rebuttal explains they are not responsible for the construction or cost of these upgrades

SOW 8 – Transmission Losses Within Manitoba

- PE based it's loss analysis on 21 MH power flow cases provided at PE's request (PE Report page 16, line 43)
  - 2020 winter peak and summer off-peak cases adjusted for load and export
  - Existing System means no BPIII and No New US Tie Line
  - Proposed System means adding BPIII and New US Tie plus Keeyask and Conawapa generation

SOW 8 – Comparing Generation to Load Losses with Existing and Proposed System

	Total System Losses (AC + DC) Generation to Load							
Season	Summer Off-Peak		Summer On-Peak			Winter Peak		
US Exports	0	2175	0	2175	2975	0		
Proposed System	112	239	177	329	423	267		
Existing System	101	343	170	374	N/A	308		

SOW 8 – Average Energy Flow

- Using NFAT Appendix 4.2, System Firm Winter Peak Demand & Capacity Resources Table K19/C25/250:
  - BPIII peak loss savings are 90 MW
  - When Conawapa comes on line, peak loss savings are reduced to 18 MW
  - Reference (PE Report page 18, lines 11 – 16)

SOW 9 – Incremental Export Losses for Existing and Proposed System

Combined Data from Table 8 & 9 of PE Report Page 19	Incremental Transmission Export losses (MW) for Proposed System and Existing System				
Season	Summer Off-Peak		Summer On-Peak		
MH – US Flows	0	2175	0	2175	2975
Proposed System with BPIII and New US Tie Line					
Export losses	0	127	0	152	246
Existing System No BPIII, No New US Tie Line					
Export Losses	0	242	0	204	N/A

SOW 9 – Average Energy Flow - Exports

- Using NFAT Appendix 4.2, MH System Firm Energy Demand and Dependable Resources Table
  - Projected Net Energy to Load over the calendar year is 27,762 GWHrs for 2020/21, which is equivalent to an hourly average load of 3,163 MW.
  - Exports for this same year are estimated at 2,012 GWHrs or 230 average MW
  - (PE Report page 19, lines 20 – 27)