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Joanne Richardson
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BY COURIER

January 25, 2018

Ms. Kirsten Walli
Board Secretary
Ontario Energy Board
Suite 2700, 2300 Yonge Street
P.O. Box 2319
Toronto, ON M4P 1E4

Dear Ms. Walli:

EB-2017-0194 – Hydro One Networks Inc.'s Section 92 – East West Tie Station Project – Interrogatory Responses

Please find attached Hydro One Networks Inc.'s ("Hydro One") Interrogatory Responses regarding the East West Tie Station Project.

An electronic copy of these responses has been filed through the Ontario Energy Board's Regulatory Electronic Submission System (RESS).

Sincerely,

ORIGINAL SIGNED BY JOANNE RICHARDSON

Joanne Richardson

OEB Board Staff Interrogatory # 1

Reference:

EB-2017-0194: Exhibit B, Tab 1, Schedule 1, page 3 of 5 and Exhibit B, Tab 2, Schedule 1, Attachment 1, page 4 of 18: "Updated Transmission Cost Estimates"

Interrogatory:

Preamble:

The IESO in its "Assessment of the Rationale for the East-West Tie Expansion – Third Update Report", dated December 15, 2015 (IESO's 3rd update) noted that Hydro One provided a revised estimate of approximately $150 million for the station work for the 650 MW East-West Tie expansion, up from the previous planning estimate of $100 million, reflecting more detailed design work than was previously available. This estimate accounts only for costs directly attributable to the East-West Tie project.

In addition, the IESO's 3rd update noted that costs associated with a portion of the station upgrade work that would be required to enable the existing system to meet the new NERC standards, while maintaining system capability and operational requirements, regardless of whether the East-West Tie expansion goes ahead, was deducted from the station cost estimates.

Hydro One in EB-2017-0194 provided that the proposed East-West Tie station project work includes:

- Installing new facilities at each of the three terminal stations, i.e. Wawa TS, Marathon TS and Lakehead TS for connecting the new 230 kV circuits of the East-West Tie Line project;
- Reconfiguring the existing facilities at Wawa TS and Marathon TS and installing new facilities at all three terminal stations to enable 450 MW power transfer capability, while respecting the NERC and ORTAC criteria and bringing the station layouts in compliance with the ORTAC guidelines; and
- Installing additional reactive compensation at Lakehead TS to mitigate the existing high voltage issue.

Questions:

a) Please provide the cost for the detailed design work referred to in the IESO update.

b) Please describe in detail the changes in planned station work prompted by the more detailed design work, and please provide the incremental cost attributable to each such change.

c) Were there any other factors that led to the increased cost estimate? Please describe and quantify any such factors.

d) Please provide the cost associated with a portion of the station upgrade work needed in all three terminal stations that would be required (to meet NERC and ORTAC criteria) regardless of whether the East-West Tie expansion goes ahead.

e) Please provide the cost associated with mitigating the existing high voltage issue, i.e. installing additional reactive compensation at Lakehead TS.

f) Please confirm Hydro One has not already accounted for the costs in (d) and (e), referred to above in its latest electricity transmission rate proceeding (EB-2016-0160).

g) Who would the beneficiaries be for the cost associated with the portion of the station upgrade work that would be required, regardless of whether the East-West Tie expansion goes ahead? Would this cost be paid for by the network pool, through Uniform Transmission Rates (UTR)?

Response:

a) In 2015, Hydro One prepared a detailed cost estimate for the connection of the EWT Line to the three terminal stations, the reconfiguration and installation of the new facilities at these stations, the re-termination of some of the existing transmission lines, and all the required protection, control and telecommunication (PC&T) facilities, to achieve 650 MW east-west transfer capability while meeting the requirements of the NERC reliability standard and ORTAC. That estimate was based on the detailed design of the single stage alternative at that time. Hydro One also prepared a high-level cost estimate for an assumed staged approach, which was based on the detailed design of the single stage

alternative, and assumed an initial twinned stage. This estimate, used as the basis in the 3rd update report, introduced the concept of staging the station facilities to manage costs.

The estimated total cost (including interest, overhead and 15% contingency) to complete all station work, including enablement of the existing station to meet new NERC standards at 650 MW transfer limit, was $217 million for the single-stage (multi-circuit) alternative and $227 million for the multi-stage (twinned in the first stage) alternative.

b) The main changes in the planned station work in 2015 were the following

I. Addition of a 115 kV, 40 MVAr, shunt reactor at Marathon TS. This resulted in the need to reconfigure the 115 kV ring bus and the addition of new 115 kV circuit breakers.

II. The requirement to design the 230 kV side of the three stations to meet the criteria for NPCC Bulk Power System (BPS) facilities (since the SIA indicated that at 650 MW transfer, the stations could be classified as BPS). This, in particular, impacted the PCT design. Also since the existing relay rooms and cable trenches at the three stations could not accommodate the new and revised PC&T equipment and cables, new relay rooms were also required.

III. Detailed design work, including assessment of the existing station facilities, layout and limitations, identified details of the full engineering and construction work, including the required upgrades to the existing bus work.

The cost estimate was revised based on this updated scope of work.

In contrast, the previous planning estimates, were based on high-level review of the connection requirements (e.g. number of new circuit breakers, the SVC at Marathon TS and the shunt capacitor bank at Lakehead TS), without sufficient conceptual design and detailed estimation of material and labour cost. The planning estimates were prepared by comparing the new station work to that of an earlier East-West Tie project (one of the Green projects), for which Hydro One had prepared a cost estimate in 2009-2010. Therefore, it is not possible to directly compare the previous planning estimates with the detailed cost estimate, and to attribute the incremental cost to each change in the detailed design work.

Additional changes to the required station facilities have occurred since the IESO's 3rd update report and are outlined in the IESO's evidence in Exhibit B, Tab 3, Schedule 2 and are reflected in the latest Hydro One's cost estimate of $157 M (excluding the SVC).

c) The revised cost estimates were based on the full scope of work at the time of the 3rd update report, including the original twinned circuit staging approach, to achieve 650 MW east-west transfer capability while meeting the requirements of the NERC reliability standard and ORTAC, as well the expectation that the 230 kV side of the three stations could be classified as BPS in the future.

d) For the IESO's 3rd update report, the cost associated with the station reconfiguration work required to the meet NERC and ORTAC criteria, regardless of whether the East-West Tie expansion goes ahead, was estimated (at high-level) to be $45 million.

The scope of work included:
Wawa TS:

i. Reconfiguration of the 230 kV buses and addition of three new breakers (two on a new diameter, one on the existing diameter) and associated disconnect switches
ii. Re-termination of the existing circuits W21M and W23K and transformer T2
iii. Addition of new, and revision of the existing, PC&T facilities, including the new Northwest SPS 2, as required with the above work

Marathon TS:

i. Addition of two new breakers (on a new diameter) and associated disconnect switches
ii. Re-termination of the existing circuit W21M
iii. Addition of new, and revision of the existing, PC&T facilities, including the new Northwest SPS 2, as required with the above work

The above scope of work was based on the IESO's recommendations for reconfiguration of the stations.

e) In the IESO's 3rd update report, $25 M of the proposed SVC's cost was removed from the estimated cost of the EWT station facilities to account for the fact that the SVC would also be used to address the existing high voltage issue in the Lakehead area, and therefore be required even if the E-W Tie project were to not go ahead.

Following the publication of the 2015 need update report, the scope of the required station facilities was updated to include a new 230 kV shunt reactor at Lakehead TS. This reactor addresses the high voltage issue in the Lakehead area, no longer requiring the

SVC to meet this near-term need and allowing the full cost of the SVC to be deferred. The estimated cost of this shunt reactor is $10 M.

f) Hydro One's transmission rate application (EB-2016-0160, Exhibit B1, Tab 3, Schedule 1, Investment Summary Document #D04) forecast $166 million cost for the EWT Station Project ($33 million in capital expenditures in 2017 and 2018) with a 2020 in-service date. This included project costs as described in the evidence as filed in EB-2017-0194.

g) The work required regardless of whether the East-West Tie expansion goes ahead benefits the overall bulk transmission system and, as such, will be pool-funded. Since the work involves network assets, the costs will be recovered through the network pool.

OEB Board Staff Interrogatory # 2

Reference:

EB-2017-0194: Exhibit B, Tab 3, Schedule 2, page 6-12

Interrogatory:

Preamble:

The IESO recommends staging the East-West Tie Station work due to its lower overall cost. The IESO states that the first stage will provide 450 MW east to west transfer capability and cost $157 million. The second stage will enable the full 650 MW of east to west transfer capability and is expected to be required in 2024 at an additional cost of $60 million.

Questions:

a) Please describe why the full 650 MW of capability is not required at this time. What circumstances are expected to materialize in 2024 to warrant needing this additional capability?

b) Please advise how the second stage will be triggered.

c) Will additional approvals be required to undertake the second stage?

d) Will Hydro One be undertaking the second stage of work?

e) Please illustrate how the $10 million of cost savings for deferring stage 2 was calculated.

Response:

a) The IESO's evidence provided in Exhibit B, Tab 3, Schedule 2, states that based on the December 2015 Need Update Report (Exhibit B, Tab 2, Schedule 1, Attachment 1), the 650 MW transfer capability is not required until the end of 2024. The full 650 MW of E-W Tie capability was linked to a capacity need that was expected to materialize in 2024 as a result of expiring supply contracts in the Northwest (Figure 5, Exhibit B, Tab 2, Schedule1, Attachment 1).

On December 1, 2017, the IESO published an updated need assessment which indicated that for the reference outlook, the second stage of the station facilities (enabling the 650 MW transfer capability) would not be required within the study period (2018-2035)

b) The IESO will continue to monitor the supply and demand outlook in the Northwest as part of its normal planning process and will trigger the second stage of the station facilities when required based on lead time for the required reactive compensation (typically 2-3 years).

c) Yes, additional approvals will be required to complete the 650 MW transfer capability. Hydro One will seek that approval when the need materializes which is not currently expected to materialize in the study period (2018-2035) as per the latest IESO Need Assessment.

d) Yes.

e) The $10 million of cost savings is the difference between the net present value (NPV) in the year 2015 of the costs of the second stage stations facilities with an in-service date of Q4 2020 and the NPV of those same facilities with an in-service date of Q4 2024 [(NPV of associated costs for second stage station facilities 2015) less (NPV of associated costs for second stage facilities 2024)].

The NPV analysis was based on the following assumptions, which included operating costs and the annual revenue required to cover the project's capital cost (e.g., return of capital, return on equity, interest paid, and taxes paid based on earnings after interest and the declining balance capital cost allowance):

- $60 M capital cost ($2014 CAD)
- A construction period of 2 years
- OM&A estimated to be 1% of the capital cost
- Escalation rate of 2%
- Real social discount rate of 4%
- Nominal corporate income tax rate of 26.5%
- Nominal return on equity after tax of 9.3%
- Nominal interest rate of 4.77%
- Debt ratio of 60%
- Nominal CCA rate of 8%

- Indexing factor of 100%
- Asset life of 45 years
- Study period extends to 2050.

OEB Board Staff Interrogatory # 3

Reference:

EB-2017-0194: Exhibit B, Tab 2, Schedule 1, Attachment 1, page 4 of 18: "Staging of Station Facilities" and Exhibit B, Tab 5, Schedule 1: "Cost-Benefit Analysis and Options"

Interrogatory:

Preamble:

The IESO in its 3rd update, dated December 15, 2015 noted that the IESO has identified a potential opportunity to defer costs by staging the installation of station facilities and that this approach would allow for approximately $100 million of station facility costs to be deferred.

Hydro One's evidence noted that Hydro One and the IESO have investigated the options for staging the station facilities and two alternatives were compared:

1. The twinned alternative, and
2. The multi-circuit alternative

Hydro One noted that comparison of the two alternatives showed that the multi-circuit alternative is the lowest cost option and that it avoids technical challenges and implementation risks of the twinned alternative.

Questions:

a) Please provide the studies that the IESO relied upon, which concluded that the multi-circuit alternative maximizes savings and cost deferrals ($100 millions) for the station facility work.

b) Please provide the studies that Hydro One relied upon, which demonstrated the technical challenges and implementation risks of the twinned alternative, and demonstrated the lower cost, reduced technical challenges and reduced implementation risks of the multi-circuit alternative.

c) Please provide at least two examples of any similar electricity transmission projects in Ontario, where the twinned alternative (i.e. formation of a super-circuit) was selected as the preferred option.

Response:

a) The IESO and Hydro One examined the connection configuration and station facilities required for the twinned (super-circuit) alternative. The IESO identified the connection configuration at the three terminal stations. Hydro One identified the station requirements, including the need to upgrade the existing facilities to allow 450 MW flow on one super-circuit. Based on these assessments, a high-level scope of work for the two stages of the twinned alternative was developed and a cost estimate was prepared by Hydro One. The assumed schedule and cost estimate of the two alternatives, at the time when the alternatives were being assessed, were:

Twinned Alternative:

Stage 1:	In-service date: 2020	Cost Estimate: $132 M
Stage 2:	In-service date: 2025	Cost Estimate: $64 M

Multi-Circuit Alternative:

Stage 1:	In-service date: 2020	Cost Estimate: $154 M

The $42 M cost difference between the two alternatives translates to a saving of $19 million NPV (2015) from the Multi-Circuit alternative.

Note that Stage 2 of the Multi-Circuit alternative includes the installation of the SVC and upgrades to sections of the 115 kV circuits A5A and T1M (to increase their thermal ratings to 500 Amp) which will increase the east-west transfer capability to 650 MW in the future. Since this work and its cost were identical in Stage 2 of both alternatives, it was not included in the above cost estimates

The IESO 3rd update report stated that “The interim stage [of the Twinned alternative] would allow for approximately $100 million of the station facility costs to be deferred”. This included the cost of the SVC and A5A and T1M upgrades.

b) Hydro One reviewed the capability of the existing station facilities and identified the required new facilities, and upgrades to the existing facilities, to allow 450 MW flow on one super-circuit (when the second super-circuit is out of service, as per NERC reliability standard).

The scope of work in the Twinned alternative was identified as:

Stage 1:

- Join the two circuits of the existing (Hydro One's) double-circuit lines between the above stations to form one super-circuit
- Similarly join the two circuits of the new (NextBridge's) double-circuit lines between the above stations to form one super-circuit
- Add new breakers and reconfigure the three stations to connect the two super-circuits
- Install shunt reactors and capacitor bank for voltage control
- Add/revise protection and control for the new and modified facilities and connections
- Revise the Northwest Special Protection Scheme (SPS) to add the super-circuit contingencies, revise other contingencies according to the new station configurations, and to trip new shunt reactors and capacitor bank.

Stage 2 (excluding the SVC):

- Separate the two circuits of the super-circuits, so each returns back to its original double-circuit configurations
- Add new breakers and reconfigure the three stations to connect the individual single-circuits
- Add/revise protection and control for the new and modified facilities and connections
- Revise the Northwest SPS to remove the super-circuit contingencies, revise other contingencies according to the new station configurations, and to trip new shunt reactors and capacitor bank.

In comparison, Stage 1 of the Multi-Circuit alternative (before the SVC in Stage 2) would include:

- Add new breakers and reconfigure the three stations to connect the new circuits and change the connection of the existing circuits (as proposed in the Feasibility Study and System Impact Assessment reports)
- Install shunt reactors and capacitor bank for voltage control
- Add/revise protection and control for the new and modified facilities and connections

- Revise the Northwest Special Protection Scheme (SPS) to add the new circuit contingencies, revise other contingencies according to the new station configurations, and to trip new shunt reactors and capacitor bank.

Although, on one hand, delaying the completion of Stage 2 of the Twinned alternative would defer some of the investment (with associated cost saving), on the other hand, it would result in increased overall cost and technical challenges. The main issues causing increased cost and technical complexity are the following:

1. For the protection schemes to function correctly, the super-circuits need to be connected to each other at several locations along the line. This might require new structures for the existing EWT Line and additional or modified structures for the new EWT Line.

2. With two circuits joined together, the maximum current that could follow through line terminations, e.g. switches, wavetraps, etc., can be twice as much as today's maximum current (considering outage situations). Many of the existing equipment do not have sufficient capability to carry this increased current and need to be replaced.

3. With two circuits joined together, the size of charging current will double. The existing breakers do not have the capability of switching the super-circuits. These circuits need to be terminated on new breakers. This requires installing four new breakers in Stage 1, which otherwise would not be needed until Stage 2, moving the location of one of these breakers in Stage 2, changing the termination of the super-circuit in Stage 1 and changing the termination of separated circuits again in Stage 2.

4. Two halves of Greenwich Wind farm are connected separately to the existing two circuits between Marathon TS and Lakehead TS. Joining these two circuits together can cause technical issues for the wind farm and increase the incidents of losing the two circuits by a single fault at the wind farm.

5. Changing the station configurations and line terminations in Stage 1 and again in Stage 2, in addition to increasing the cost, increases the required outages during construction, resulting in more operational challenges.

The Multi-Circuit alternative avoids the above challenges and, as described in the answer to 5a above, results in cost saving of $19 M (NPV).

c) Examples of previous electricity transmission projects in Ontario involving twinned circuits includes:

a. Cherrywood TS - Claireville TS: Four 500 kV circuits were twinned to form two super-circuits in 1992. In 2010, to respect the contingency of the loss of one circuit when another circuit or station facility is out-of-service (as required by the reliability standards) and still maintain sufficient transfer capability, the two super-circuits were separated into four individual circuits.
b. Hanmer TS – Martindale TS: Four 230 kV circuits are twinned to form two super-circuits.
c. Pinard TS - Hunta TS: Four 115 kV circuits are twinned to form two super-circuits.

OEB Board Staff Interrogatory # 4

Reference:

EB-2017-0194: Exhibit B, Tab 7, Schedule 1, page 1-2 of 4: "Apportioning Project Costs & Risks"

Interrogatory:

Preamble:

Hydro One, in Exhibit B, Tab 7, Schedule 1, Table 1 set out the costs of East-West Tie station work.

Hydro One noted that based on past experience, the estimate for the station work includes allowances in the contingencies to cover a number of potential risks, including outage availability risk and mismatch between NextBridge's dead-end structure design and Hydro One's clearance standards.

Questions:

a) Please confirm the costs of station work, set out in Exhibit B, Tab 7, Schedule 1, Table 1 are still accurate and whether the total amount (i.e. $157,315,000) includes all costs, such as land acquisition, that is needed for Wawa TS and Marathon TS.

   - Please identify any anticipated costs that are not currently accounted for in the current estimate.

b) What cost management and control measures is Hydro One using to mitigate/contain any further increases in estimates?

c) What are Hydro One's actual costs to date broken down by category listed in Table 1?

d) Does Hydro One have monthly or quarterly cost estimates including major components? Please provide those current estimates and, if different, the estimates as of the July 2017 application.

e) Please provide any previous Hydro One estimates for the station work including a breakdown into the various categories listed in Table 1.

f) Hydro One states that $19,227,000 has been allocated to contingencies. Please show how this amount was calculated and any previous projects that were considered at arriving at this number? Have there been any changes to the contingency estimate since July 31, 2017, when Hydro One filed its application?

g) Hydro One estimates an overhead cost of $13,367,000. Please show how this amount was calculated and the major components that make up this amount.

h) Please provide in detail any direct or indirect impacts of Hydro One's station work on Ontario Power Generation (OPG) operations and outages.

i) What have Hydro One and NextBridge done to date to ensure NextBridge's dead-end structure is designed to Hydro One's clearance standards? In NextBridge and Hydro One's view, how can this potential risk be mitigated?

Response:

a) The estimated station work costs as provided in Exhibit B, Tab 7, Schedule 1, Table 1 are still accurate. The total cost of $157,315,000 includes everything required to perform the work outlined in the Application. At this time, there are no anticipated costs that are not included in this cost estimate.

b) Hydro One has various processes in place that monitor and review costs on a regular basis to mitigate cost and labour variances, as needed. These processes are performed by a dedicated 'Project Controls' group that provide monthly updates and work in tandem with 'Project Management' and the rest of the field team. Schedules are reviewed and updated on a monthly basis. Contingencies have been built into the project to address risks that may occur and is considered a part of the overall budget. In the event a cost risk does occur, that portion of the contingency is released to the planned work budget and provides funding to address that cost. Also a 3-week look ahead document is provided to ensure the schedule is sustainable in the upcoming near future.

c) Hydro One's actual costs to date are provided in the table below

Hydro One Actual Cost	
Category	Actual cost
Materials	$339,532
Labour	$4,748,495
Equipment Rental & Contractor Costs	$1,402,284
Sundry	$85,631
Contingencies	$0
Overhead	$667,907
Allowance for Funds Used During Construction	$0
Total Station Work	**$7,243,849**

These costs are currently captured in Hydro One's East-West Tie Deferral account.

d) The latest estimate still stands at $157M with no changes. Provided as Attachment 1 of this interrogatory response are the current quarterly estimates that would align with achieving the necessary deliverable to complete the proposed schedule provided in Exhibit B, Tab 11, Schedule 1.

e) As noted in response to Board Staff interrogatory 1, Hydro One provided a previous estimate to the IESO. The estimate was provided in 2014, for a scope of work which included the SVC and A5A-T1M upgrades to achieve 650 MW transfer capability. The estimate, broken down into the various categories listed in Table 1, is provided below.

Hydro One Cost of Station Work Estimate ($000s)	
Category	Estimated Cost
Materials	91,952
Labour	56,084
Equipment Rental & Contractor Costs	10,123
Sundry	1,933
Contingencies	22,846
Overhead	27,459
Allowance for Funds Used During Construction	6,137
Total Station Work	**$216,534**

f) The contingencies were calculated by using Hydro One's risk model that was introduced in late 2016. The project team identifies project risks and the probability of the occurrence of those risks by relying on their previous experience with similar type projects. The model then uses that information as initial inputs into a simulation, along with a "Probability Ranking Matrix" and a "Cost Impact Matrix" to come up with the end result.

The project risks are continually monitored by the Project Manager and team for any changes/update to the contingency forecast. Any necessary changes to the risk register (i.e., close off any risks that did not materialize and have since passed, add any new risks that were not originally identified, make any changes to the probabilities of each risk given new information available, etc.) will be re-run through the model to come up with a revised contingency forecast figure. A copy of the Risk Review Model for the EWT Station Project is provided as Attachment 2 to this Exhibit.

The model broke down the total contingency between the project's sub-parts as follows: Wawa TS $7,153,481; Marathon TS $6,676,712; Lakehead $5,397,287.

As noted in response to subsection a) of this interrogatory, there is no update to the Project estimate.

g) The calculated $13,367,000 in overhead costs is based on the direct costs forecast each month multiplied by the annual overhead rate. The direct costs include: Project Management, Real Estate, Engineering, Procurement, Construction and Commissioning

Below are the annual rates that were used in the forecast:

Year	Interest (%)	Overhead (%)
2017	4.6	13
2018	4.5	12
2019	4.6	11
2020	4.5	11
2021	4.6	10
2022	4.7	10
2023	5.3	10
2024	5.3	10
2025	5.3	10

As per EB-2016-0160 Exhibit B1, Tab 4, Schedule 1 rates used in forecasting capitalized interest represent the effective rate of Hydro One Transmission's forecast average debt portfolio during the year. Despite the forecast, actual rates will be utilized in the year in which the capitalized interest is incurred (i.e. if the actual rate is 5.1% in 2023, that rate will be applicable, not the 5.3% forecast used to construct the estimate).

h) Any outage in the northwest will have some impact to connected customers, including on OPG operations both economically and environmentally. The preliminary outage requirements and timelines have been identified both internally and externally to OPG. Although OPG is aware of the outage plan, until we get closer to the date of the outage itself, the impact on their operations cannot be fully understood. The impact is largely dependent on the environmental conditions (water level/flow) at that time of the outage. At that point in time, Hydro One will work closely with OPG to mitigate impacts on their operations which may include adjusting the date of the outage or bundling various tasks together in one outage to minimize the outages themselves. Once the project is released and the required outage schedule gets closer, timelines can be discussed and agreed to with OPG.

i) In discussions between Hydro One and NextBridge, cable run clearance design standards between NextBridge's 230kV towers and the Hydro One's line entrance structures were identified, discussed and addressed in the design of both parties. As an outcome from the design, the towers and line entrance structures were placed accordingly. Even though the positions of the towers and line entrance structures have been established, there is always a possibility that they could move slightly.

Quarterly Estimate ($000s)

	2017	2018				2019				2020				2021				2022				Total
		Q1	Q2	Q3	Q4	Q1	Q2	Q3	Q4	Q1	Q2	Q3	Q4	Q1	Q2	Q3	Q4	Q1	Q2	Q3	Q4	
Materials	323			1,328	1,328	4,885	5,684	5,046	4,128	3,211	3,432	3,255	3,255	3,725	3,769	3,769	2,220	495	495	495	495	51,337
Labour	4,524	1,182	1,095	1,420	1,420	4,639	5,403	4,721	3,774	2,543	2,880	2,691	2,691	3,603	3,651	3,651	1,894	1,278	1,278	1,278	1,278	56,895
Equipment Rental & Contractor	1,300			221	221	748	881	775	634	435	472	443	443	446	454	454	195	199	199	199	199	8,920
Sundry	82			31	31	104	172	169	87	60	66	62	62	76	77	77	41	28	28	28	28	1,305
Contingencies	-												9,615				9,612					19,227
Overhead	636	232	116	245	245	960	1,150	1,000	785	649	685	660	1,710	625	635	650	1,304	270	270	270	270	13,367
AFUDC	342	87	308	150	150	212	356	500	633	679	667	755	578	198	200	203	246					6,264
Total	7,208	1,501	1,519	3,395	3,395	11,548	13,646	12,211	10,042	7,578	8,202	7,865	18,353	8,673	8,785	8,803	15,512	2,270	2,270	2,270	2,270	157,316

LET'S GET GREAT

hydroOne

REPORT ON

Risk Review Board Meeting

SUBMITTED TO

HYDROONE PROJECT DELIVERY TEAM

For Project

AR 19927| East-West Tie Connection

Mar 06, 2017

BURNS McDONNELL

List of attendees

Invitees Name	Company	Participation
Tom Meta	HydroOne	Attended
Danoush Taef	HydroOne	Attended
Joe Ly	HydroOne	Attended
Rana Zoora	HydroOne	Attended
Zeljko Grasic	HydroOne	Attended
Amelia Arcaina	HydroOne	Attended
Chris Minhas	HydroOne	Attended
Pasquale Catalano	HydroOne	Attended
Robyn Oldewening	HydroOne	Attended
Hemant Barot	HydroOne	Attended
Ahmed Al-Tamimi	HydroOne	Attended
Flavia Redshaw	HydroOne	Attended
Dan Fudge	HydroOne	Attended
Edward Marttunen	HydroOne	Attended
Doug Dupuis	HydroOne	Attended
Jimjiahengjim Tu	HydroOne	Attended
Tibor Kertesz	HydroOne	Attended
Sergey Legatov	HydroOne	Attended
Arnold Brakel	HydroOne	Attended
Kevin Bros	HydroOne	Attended
Mike Johnson	HydroOne	Attended
Gregory Wing	HydroOne	Attended
Anthony Pellecchia	HydroOne	Regrets
Alex Meekhoff	HydroOne	Regrets
David Eckensweiler	HydroOne	Regrets
Garry Landon	HydroOne	Regrets
Aaron Fair	HydroOne	Regrets
Hamid Hamadanizadeh	HydroOne	Regrets
Randy Lundmark	HydroOne	Regrets
Robert Newton	HydroOne	Regrets
Dave Dormer	HydroOne	Regrets
Jonathon Bradley	HydroOne	Regrets
Clifford Anstey	HydroOne	Regrets
Christine Brown	HydroOne	Regrets
Roch Galipeau	HydroOne	Regrets
Robert Savard	HydroOne	Regrets
Joanne Richardson	HydroOne	Regrets
Daniel Charbonneau	HydroOne	Regrets
Mike Keski-Pukkila	HydroOne	Regrets
Maja Shkolnik	HydroOne	Regrets
Vishal Verma	Burns & McDonnell	Attended
Tushar Meshram	Burns & McDonnell	Attended

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1. INTRODUCTION

The primary objective of the Risk Management process is to identify, mitigate and track all foreseeable risks (threats and opportunities) in a manner that is proactive and effective. This will enhance the project's chances of success and help maintaining risk exposure at an acceptable level. This process will also document the collaborative relationship between Project Management and the PMO by identifying scope of work and responsibilities related to risk management. The objective of this process was to set expectations related to the implementing and execution of Project AR 19927 East-West Tie Connection in compliance with the HONI Enterprise Risk Management principles and guidelines.

2. RISK REVIEW BOARD MEETING PROCESS OVERVIEW

The purpose of Risk Review Board (RRB) is to ensure management receives all necessary information from all the lines of business experts to make timely and effective decisions on contingency. This will allow for coordination of actions by the risk team, allocation of resources, and a consistent, disciplined approach. Periodic risk review at all critical stages of the project will be carried out to identify new risks and release unmaterialized risks. The risk review board supports the PM by giving them an effective early warning of developing threats on their project. Initial identification is carried out at the estimate preparation stage prior to final PDR submission.

A detailed communication was sent to all the PMs with a standard risk register template and a risk reference database file prior to the meeting.

- The risk reference database showed a list of generic risks and various functional areas commonly affecting transmission and distribution project.
- Assumptions and possible risks identified in the PDR by the planners during estimating phase were populated in a standard risk register template and were used to kick start the meeting.
- The planners and the PMs introduced the scope of the project and started the discussion on some of the primary threats on the project.
- LOB leads were asked to determine schedule impacts of risks to their activities and evaluate the possibilities of not hitting their milestone dates.
- Based on the discussion and identified issues throughout the meeting, the PM, in coordination with the Risk Manager populated potential risks, probabilities and associated cost impacts in the risk register

- The PMs' review of risks associated with this project were based on the DETL estimate prepared for PDR submission

Following additional assumptions were made to facilitate the Risk Review meeting:

1. RISK REGISTER

- Probable risks for the project are identified by the Line of Business Managers and Subject Matter Experts.
- The PMs were asked to refer to the risk reference database to get an idea of typical transmission and substation risks.
- While discussing each risk, the PMs identified schedule delays, interest charges, and construction charges, with equipment and labor overages and calculated the cost impact based on their best estimation technique.
- The Cost Impact and Probability Ranking evaluated in this meeting for each risk items, are based on the current estimation, knowledge and project understanding.

2. RISK DATABASE

- In addition to specified risks in the draft PDR report, a high level Risk Reference database file was used (Shown in Table B below) to kick start the risk discussion.
- Based on the information provided by the PMs for each project and lessons learned, the risk reference database will be improved and standardized to meet Hydro One's future project needs.

3. WAWA PACKAGE

I. TOP PROJECT RISK

The top 4 project risks are shown in the table below. These risks are the major contributors to the total contingency suggested for this project.

Top Project Risks

Risk Title	Probability Impact	Cost Impact
The risk - if we get a full release and there are delays due to design changes & regulatory	EVEN ODDS 50% - 74%	$ 2,000,000
The risk is that HONI's may not be able to acquire an outage for the 1 year window	EVEN ODDS 50% - 74%	$ 3,050,000
Protection and Controls Drawing issues/Staging of cutover from the old to the new - Currently Wawa has shown issues applied to all three SS	LIKELY 75% - 94%	$ 2,400,000

The risk is if we have one set of engineers - we may miss the package at the execution phase - impact the schedule. This may be contracted out which introduces inherent risks	VERY LIKELY 95% -100%	$ 592,920

During the RRB meeting the PM anticipated a risk of delays in design changes and regulatory approvals after a full funding release for the project. A standard 5% as the carrying cost per year was used to calculate the risk estimate and a delay of one year was assumed if this risk occurs. The full funding release amount was estimated to be $40M for Wawa package. Any delay beyond one year due to delay in regulatory approvals would fall under the category of IROV. The risk was considered to have 50% to 74% probability of occurrence.

The PS planners have estimate a 1 year construction period for Wawa work. There is a risk that HydroOne may not get an outage window to during the construction period and the project may get delayed for one additional year to accommodate outages. The PM assumed a fully funded project carrying cost for this risk. Also it was decided to use the carrying cost of the project with largest funding approval. Based on these assumptions, the PM estimated a risk impact of $ 3,050,000, with Likely (75% - 94%) probability of occurrence.

During the RRB discussion a known risk for staging of cutover from old to new lines was identified. This risk with Protection and Control issue was estimated to be 20% of the total protection and control package of $12M for Wawa station. The PM has estimated a risk impact of $ 2,400,000 with a probability of Likely (75% - 94%).

At the estimation stage of AR 19927 only one set of engineers were allocated for all three sites (Wawa, Marathon and Lakehead). The estimate assumes that additional resources will be made available to all three stations simultaneously to meet the deadline of Dec 2020 ISD. The estimating process for all three packages has been challenging for engineers so far as they have divided the allotted time for the three sites in order to meet estimate submission date resulting in reduced detail engineering. There is a risk that limited engineering resources will be available at the execution stage. The PM anticipated one month delay per year due to this issue for three years assuming partial funding release and construction delay assuming 12 person crew at a rate of $100 an hour for three months. The estimated risk for Wawa station was calculated to be $ 592,920 and was placed at high probability (95% - 100%) of risk occurrence.

A. RISKS ASSOCIATED WITH SCHEDULE DELAYS:

The following risks were identified to have a possible impact on schedule during project execution phase:

- Partial release for this project is required in the first quarter of 2017. Any delays due to section 92, building specification & tendering of reactors, breakers & capacitor banks can cause significant delays to the ISD.

- The PM identified a major risk associated with not having a detailed schedule available during risk review board meeting and estimate preparation. An unrealistic detailed schedule may lead to an IROV and possible delay of the project by up to 1 year.
- The timber construction of the bridge connecting the Wawa station and access road is known to be rotten. The component access and replacement work would require load calculations, repair work etc. This is considered as a major schedule risk for Wawa station.
- Steel structural design and fabrication defects identified on site may lead to rework and onsite fabrication. This is likely to delay the construction schedule by 20 days.
- The PM identified a possibility of forced outage due to aging equipment and equipment failure. Based on recent trends, HONI has seen two cases of breaker failure and a subsequent Switch failure on projects. A Schedule delay of 2 weeks was considered for this risk.
- Missing of critical equipment manufacturer drawings such as basic layout of reactors or capacitor bank during construction stage is a high impact schedule delay risk.
- Control building delays may impact the outage plan and lead to shuffling of the crews, mob-demob. etc. this may result in overall Schedule delays of a month (based on historic trend).

B. RELATION OF TOP PROJECT RISKS WITH CORPORATE/ENTERPRISE RISK MANAGEMENT

N/A

II. METHOD AND SIMULATION RESULTS

Burns & McDonnell with the help of Hydro One's Subject Matter Experts (SMEs) used the cost estimate file and draft PDR report as initial inputs into the risk model. The RRB allowed for the collection of additional information to improve the model. A Monte Carlo simulation ran 10,000 iterations for each risk value and related probability to come up with the most likely P95 value (95% Confidence level) that represents all identified risks associated with this project. The P95 value denotes a 95% confidence in the model if all the risks were to materialize at the risk estimate and probability level identified in the RRB. All the uncertain parameters were assumed to have equal likelihood of occurrence in order for the simulation to run.

The Probability Ranking Matrix used to do this analysis is shown below:

PROBABILITY RANKING MATRIX	LOWPROB	HIGHPROB
VERY LIKELY 95% - 100%	95%	100%
LIKELY 75% - 94%	75%	94%
EVEN ODDS 50% - 74%	50%	74%
UNLIKELY 25% - 49%	25%	49%
REMOTE 0% - 24%	0%	24%

The Cost Impact Ranking Matrix used to do this analysis is shown below:

COST IMPACT RANKING MATRIX	*LOW_IMP*	*HI_IMP*
CATASTROPHIC > 99%	> 99%	
SEVERE 51% TO 99%	51%	99%
SIGNIFICANT 34% TO 50%	34%	50%
MAJOR 9% TO 33%	9%	33%
MODERATE 3% TO 8%	3%	8%
MINOR 1% TO 2%	1%	2%

Based on the assumptions and method stated above, Oracle Crystal Ball came up with the following range of contingency values for "AR 19927- Wawa Package"**:**

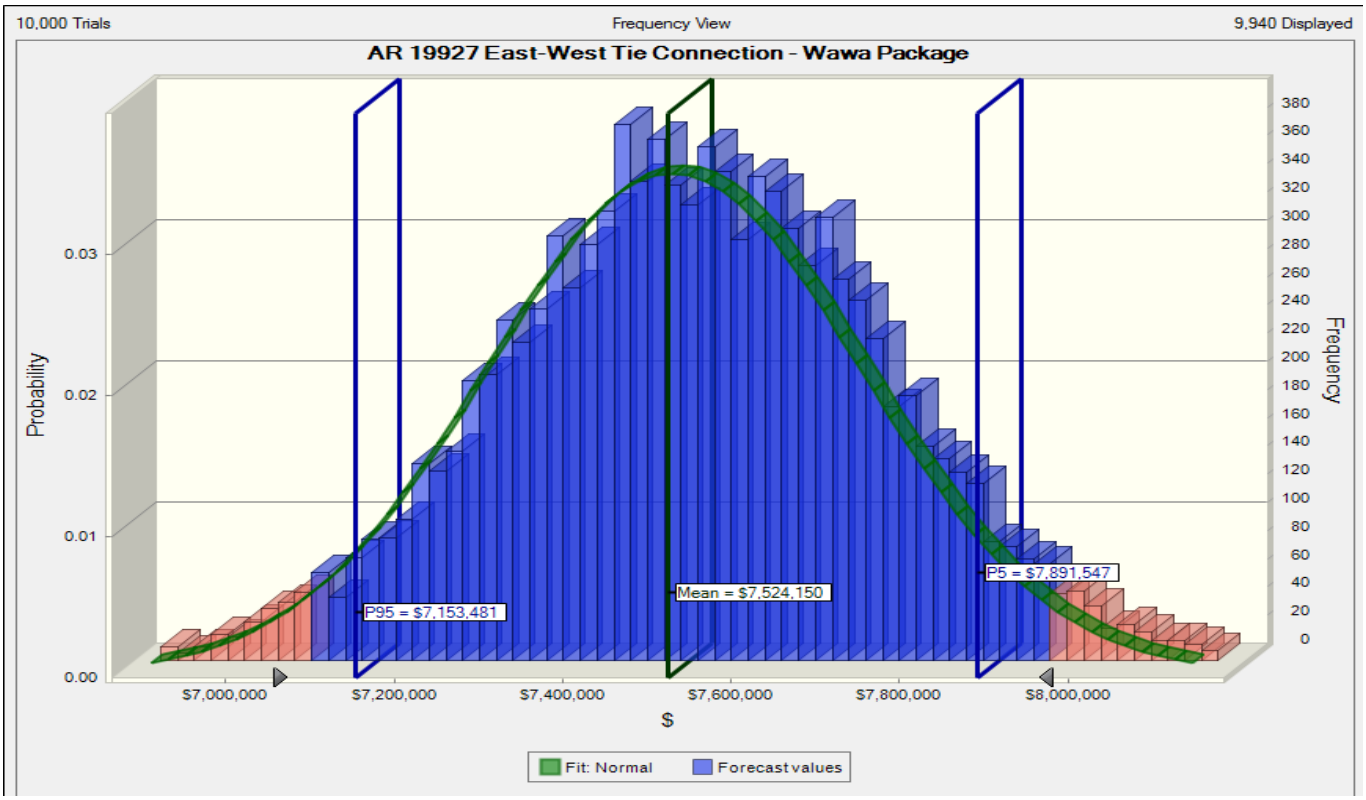
Full Value of Risk Cost Impact identified in the meeting	Un-modelled	$10,689,714
Percentage Confidence contingency level value	P 5	$7,891,547
	P 10	$7,809,837
	P 80	$7,335,409
	P 95	**$7,153,481**

All risks identified in the risk register were assigned a level 1 WBS distribution line of business category. Based on the statistical output of Monte Carlo analysis, the risk results were assigned to the corresponding level 1 WBS category as shown in the table below:

AR	PID NUMBER	ESTIMATE DISTRIBUTION	LEV1DES (LEV1)	BASE COSTS	OTHER COSTS	RISK OUTPUT
19927		Project Management	Project Management (PM)	$ 1,236,376		$ 1,695,241
19927		Engineering	Engineering (EN)	$ 3,305,076		$ 609,297
19927		Procurement	Procurement (PR)	$12,127,762		$ 82,308
19927		Customer Operations	Real Estate (RE)	-		
19927		Construction	Construction (CN)	$ 7,756,848		$ 2,796,989
19927		Construction	Commissioning (CM)	$ 3,564,603		$ 1,969,645
19927		Removals	Others*		$ 704,043	
19927		Past Cost	Others*		$ 380,000	
19927		CAP OH	Others*		$ 5,010,719	
19927		CAP INT	Others*		$ 1,542,639	
TOTAL				**$ 27,990,665**	**$ 7,637,455**	**$ 7,153,481**

*Note that interest and overhead (other costs) are based on the original estimated and will be recalculated based on additional contingency amount (total of risk output amount)

The figure below shows a fitted normal distribution curve for "AR 19927- Wawa Package" risk calculation which confirms the validity of this simulation.



Frequency Forecast and the normal distribution fit for results generated from Monte Carlo Simulation

A. QUARTERLY CONTINGENCY DRAWDOWN FORECAST

Following a detailed risk review, a follow up session was held to identify the spread of contingency over the duration of "AR 19927- Wawa Package". Due to the unavailability of a detailed project schedule at this point, the PM needed to manually spread the drawdown triggers for each risk. Based on a cumulative total weighting for all risks, a percentage spread was mathematically calculated to show the risk distribution over the period of the project on a quarterly basis.

RISK FORECAST / QUARTERS	Q1 2018	Q2 2018	Q3 2018	Q4 2018	Q1 2019	Q2 2019	Q3 2019	Q4 2019	Q1 2020
RISK DISTRIBUTIONS	$325,158	$1,840,396	$500,744	$705,539	$341,416	$513,750	$341,416	$650,316	$286,139
	Q2 2020	Q3 2020	Q4 2020	Q1 2021	Q2 2021	Q3 2021	Q4 2021	Total	
	$637,310	$221,108	$182,089	$221,108	$263,378	$81,290	$42,271	**$7,153,481**	

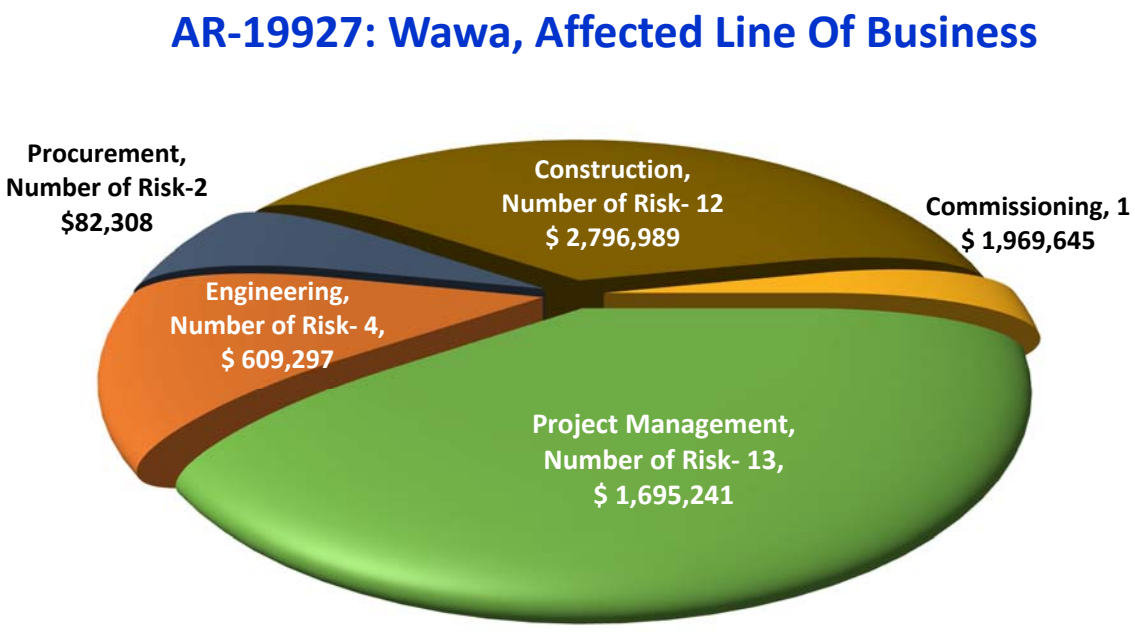
Note that due to the unavailability of the detailed schedule, the above manual methodology was used.

III. CONCLUSION

The recommended total contingency amount for project "AR 19927- Wawa Package" East-West Tie Connection is $ 7,153,481. This is 25% of the base cost estimate. It is recommended that the risk register is reviewed periodically (See Table A below) during each phase to ensure the successful completion of AR 19927 within budget and on schedule.

A. TOP LOB ELEMENT AFFECTED ON THE PROJECT

Risks were categorized under a list of various Lines of Business / WBS categories following the Risk Review Board meeting. This categorization was purely based on the WBS allocation given to each risk in the meeting and may get modified as periodic risk reviews take place during various phases of the project. Based on this categorization, the risks associated with Project Management is more than its base cost estimate and can be considered as the top LOB element affecting the project.



4. MARATHON PACKAGE

I. TOP PROJECT RISK

The top 5 project risks are shown in the table below. These risks are the major contributors to the total contingency suggested for this project.

Top Project Risks

Risk Title	Probability Impact	Cost Impact
The risk - if we get a full release and there are delays due to design changes & regulatory	EVEN ODDS 50% - 74%	$ 3,050,000
The risk is that HONI's may not be able to acquire an outage for the 1 year window	EVEN ODDS 50% - 74%	$ 3,050,000
2 Units for Marathon TS shunt reactor requires tender. The price provided is based on quotation. It is subject to change and also tied to currency exchange rate at the time of actual purchase	LIKELY 75% - 94%	$ 680,000
The risk is if we have one set of engineers - we may miss the package at the execution phase - impact the schedule. This may be contracted out which introduces inherent risks	VERY LIKELY 95% -100%	$ 587,017
Risk is Geo Tech reports are not done outside the station area. Potential of more money based on differing soil conditions across expansion area.	VERY LIKELY 95% -100%	$ 1,100,000

During the RRB meeting the PM anticipated a risk of delays in design changes and regulatory approvals after a full funding release for the project. A standard 5% as the carrying cost per year was used to calculate the risk estimate and a delay of one year was assumed if this risk occurs. The full funding release amount was estimated to be $61M for Marathon package. Any delay beyond one year due to delay in regulatory approvals would fall under the category of IROV. The risk was considered to have 50% to 74% probability of occurrence.

The PS planners have estimate a 1 year construction period for Marathon work. There is a risk that HydroOne may not get an outage window to during the construction period and the project may get delayed for one additional year to accommodate outages. The PM assumed a fully funded project carrying cost for this risk. Based on these assumptions, the PM estimated a risk impact of $ 3,050,000, with Likely (75% - 94%) probability of occurrence.

Marathon TS requires tendering on 2 units of shunt reactor. The price provided in the estimate is based on quotation. This quote is subject to change and to fluctuations due to currency exchange and rates. In the past trends have shown this fluctuation to be in between 10% to 15% of the quotation price. In the case of Marathon package, the PM assumed a risk that the shunt reactors may tender 20% the price used in the estimate with a Likely (75% - 94%) probability of occurrence. The shunt reactors are forecasted to be on site in the 3rd and 4th quarter of 2018.

At the estimation stage of AR 19927 only one set of engineers were allocated for all three sites (Wawa, Marathon and Lakehead). The estimate assumes that additional resources will be made available to all three stations simultaneously to meet the deadline of Dec 2020 ISD. The estimating process for all three packages has been challenging for engineers so far as they have divided the allotted time for the three sites in order to meet estimate submission date resulting in reduced detail engineering. There is a risk that limited engineering resources will be available at the execution stage. The PM anticipated one month delay per year due to this issue for three years assuming partial funding release and construction delay assuming 12 person crew at a rate of $100 an hour for three months. The risk estimate for Marathon station was calculated to be $ 587,017 and was placed at high probability (95% - 100%) of risk occurrence.

Soil conditions across expansion areas on Marathon TS have been assumed identical to the ones specified in the existing soil report. Geotechnical investigation for the expansion area is currently outstanding and shall be conducted to confirm the subject assumption. The PM considered a 40% change in the cost of foundations if the soil conditions are seen to not agree with the soil report. The risk estimate for Marathon station was calculated to be $ 1,100,000 and was placed at likely probability (75% - 94%) of risk occurrence.

A. RISKS ASSOCIATED WITH SCHEDULE DELAYS:

The following risks were identified to have a possible impact on schedule during project execution phase:

- Partial release for this project is required in the first quarter of 2017. Any delays due to section 92, building specification & tendering of reactors, breakers & capacitor banks can cause significant delays to the ISD.
- The current schedule for Environmental permitting and sequencing with the new EA process is aggressive. Any delay will impact overall schedule delay by six months.
- The PM identified a major risk associated with not having a detailed schedule available during risk review board and estimate preparation. An unrealistic detailed schedule may lead to an IROV and possible delay of the project by up to 1 year.
- Steel structural design and fabrication defects identified on site may lead to rework and onsite fabrication. This is likely to delay the construction schedule by 20 days.
- The PM identified a possibility of forced outage due to aging equipment and equipment failure. Based on recent trends, HONI has seen two cases of breaker failure and a subsequent Switch failure on projects. A Schedule delay of 2 weeks was considered for this risk.
- Missing of critical equipment manufacturer drawings such as basic layout of reactors or capacitor bank during construction stage is a high impact schedule delay risk.

- There is a risk that materials and equipment delivery may get delayed which could push the construction by approximately 20 days.
- As this project has a direct impact to OPG, there is a risk that OPG may cancel outages based on historic trend. The PM considered a total of 8 outages for this project and assumed a delay of 5 construction days per outage. This is likely to push the schedule by 40 days in addition to the challenges faced during mobilization and demobilization of the construction crew.
- Control building delays may impact the outage plan and lead to shuffling of the crews, mob-demob. etc. this may result in overall Schedule delays of a month (based on historic trend).

B. RELATION OF TOP PROJECT RISKS WITH CORPORATE/ENTERPRISE RISK MANAGEMENT

N/A

II. METHOD AND SIMULATION RESULTS

Burns & McDonnell with the help of Hydro One's Subject Matter Experts (SMEs) used the cost estimate file and draft PDR report as initial inputs into the risk model. The RRB allowed for the collection of additional information to improve the model. A Monte Carlo simulation ran 10,000 iterations for each risk value and related probability to come up with the most likely P95 value (95% Confidence level) that represents all identified risks associated with this project. The P95 value denotes a 95% confidence in the model if all the risks were to materialize at the risk estimate and probability level identified in the RRB. All the uncertain parameters were assumed to have equal likelihood of occurrence in order for the simulation to run.

The Probability Ranking Matrix used to do this analysis is shown below:

PROBABILITY RANKING MATRIX	LOWPROB	HIGHPROB
VERY LIKELY 95% - 100%	95%	100%
LIKELY 75% - 94%	75%	94%
EVEN ODDS 50% - 74%	50%	74%
UNLIKELY 25% - 49%	25%	49%
REMOTE 0% - 24%	0%	24%

The Cost Impact Ranking Matrix used to do this analysis is shown below:

COST IMPACT RANKING MATRIX	*LOW_IMP*	*HI_IMP*
CATASTROPHIC > 99%	> 99%	
SEVERE 51% TO 99%	51%	99%
SIGNIFICANT 34% TO 50%	34%	50%
MAJOR 9% TO 33%	9%	33%

MODERATE 3% TO 8%	3%	8%
MINOR 1% TO 2%	1%	2%

Based on the assumptions and method stated above, Oracle Crystal Ball came up with the following range of contingency values for "AR 19927- Marathon Package":

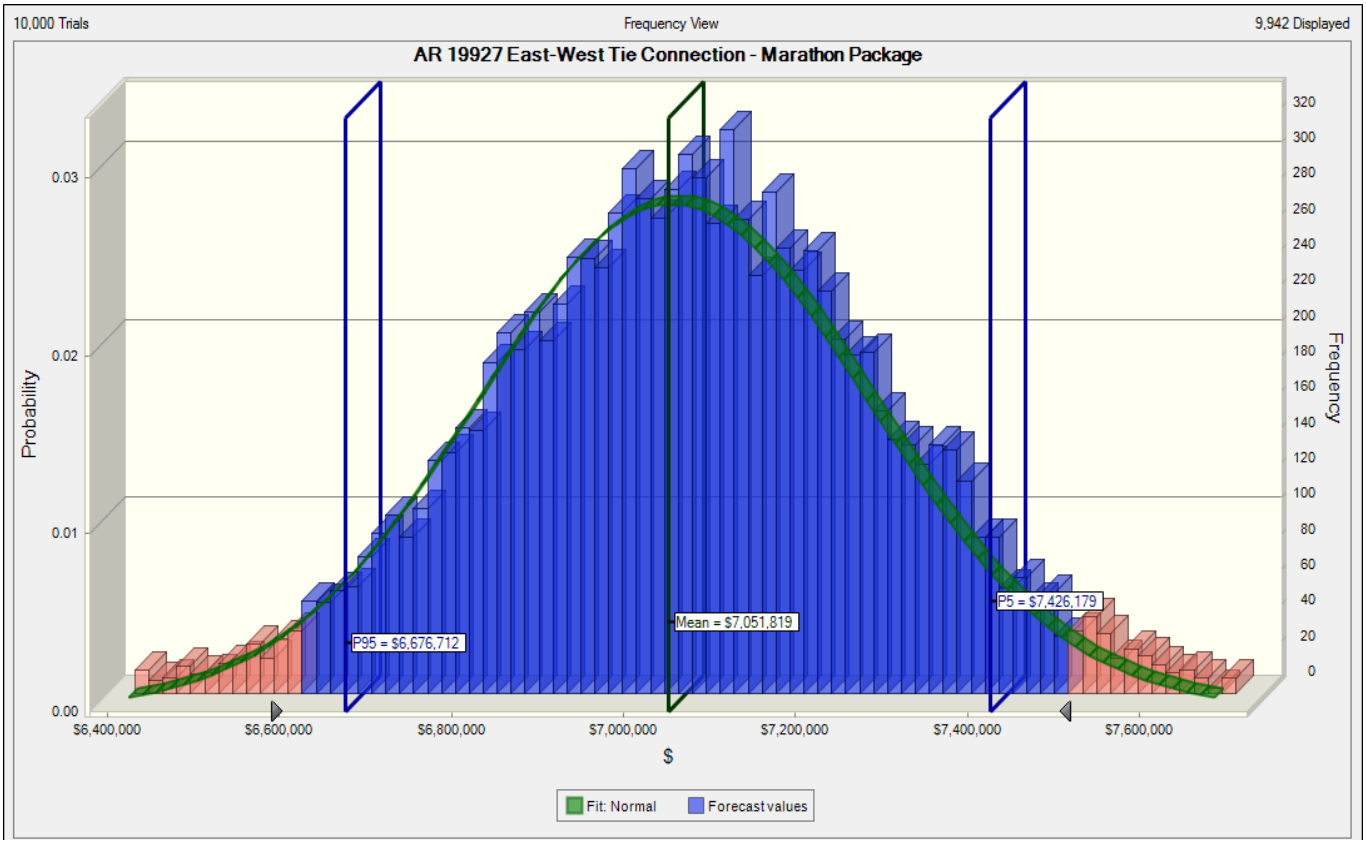
Full Value of Risk Cost Impact identified in the meeting	Un-modelled	$10,500,023
Percentage Confidence contingency level value	P 5	$7,426,179
	P 10	$7,345,641
	P 80	$6,859,104
	P 95	**$6,676,712**

All risks identified in the risk register were assigned a level 1 WBS distribution line of business category. Based on the statistical output of Monte Carlo analysis, the risk results were assigned to the corresponding level 1 WBS category as shown in the table below:

AR	PID NUMBER	ESTIMATE DISTRIBUTION	LEV1DES (LEV1)	BASE COSTS	OTHER COSTS	RISK OUTPUT
19927		Project Management	Project Management (PM)	$ 1,585,744		$ 3,395,404
19927		Engineering	Engineering (EN)	$ 4,742,554		$ 1,150,030
19927		Procurement	Procurement (PR)	$ 22,591,044		$ 82, 299
19927		Customer Operations	Real Estate (RE)			
19927		Construction	Construction (CN)	$ 12,134,035		$ 2,048,366
19927		Construction	Commissioning (CM)	$ 4,591,262		
19927		Removals	Others*		$ 442,547	
19927		Past Cost	Others*		$ 370,000	
19927		CAP OH	Others*		$ 7,991,074	
19927		CAP INT	Others*		$ 2,747,664	
TOTAL				**$ 45,644,639**	**$ 11,551,285**	**$ 6,676,099**

*Note that interest and overhead (other costs) are based on the original estimated and will be recalculated based on additional contingency amount (total of risk output amount)

The figure below shows a fitted normal distribution curve for "AR 19927- Marathon Package" risk calculation which confirms the validity of this simulation.



Frequency Forecast and the normal distribution fit for results generated from Monte Carlo Simulation

A. QUARTERLY CONTINGENCY DRAWDOWN FORECAST

Following a detailed risk review, a follow up session was held to identify the spread of contingency over the duration of "AR 19927- Marathon Package". Due to the unavailability of a detailed project schedule at this point, the PM needed to manually spread the drawdown triggers for each risk. Based on a cumulative total weighting for all risks, a percentage spread was mathematically calculated to show the risk distribution over the period of the project on a quarterly basis.

RISK FORECAST / QUARTERS	Q1 2017	Q2 2017	Q3 2017	Q4 2017	Q1 2018	Q2 2018	Q3 2018	Q4 2018	Q1 2019	Q2 2019
RISK DISTRIBUTIONS	$50,870	$50,870	$54,050	$292,504	$839,358	$1,379,854	$333,836	$769,412	$254,351	$317,939
	Q3 2019	**Q4 2019**	**Q1 2020**	**Q2 2020**	**Q3 2020**	**Q4 2020**	**Q1 2021**	**Q2 2021**	**Q3 2021**	**Q4 2021**
	$413,320	$451,473	$260,710	$413,320	$187,584	$149,341	$187,584	$149,431	$79,485	$41,332
	Total									
	$6,676,712									

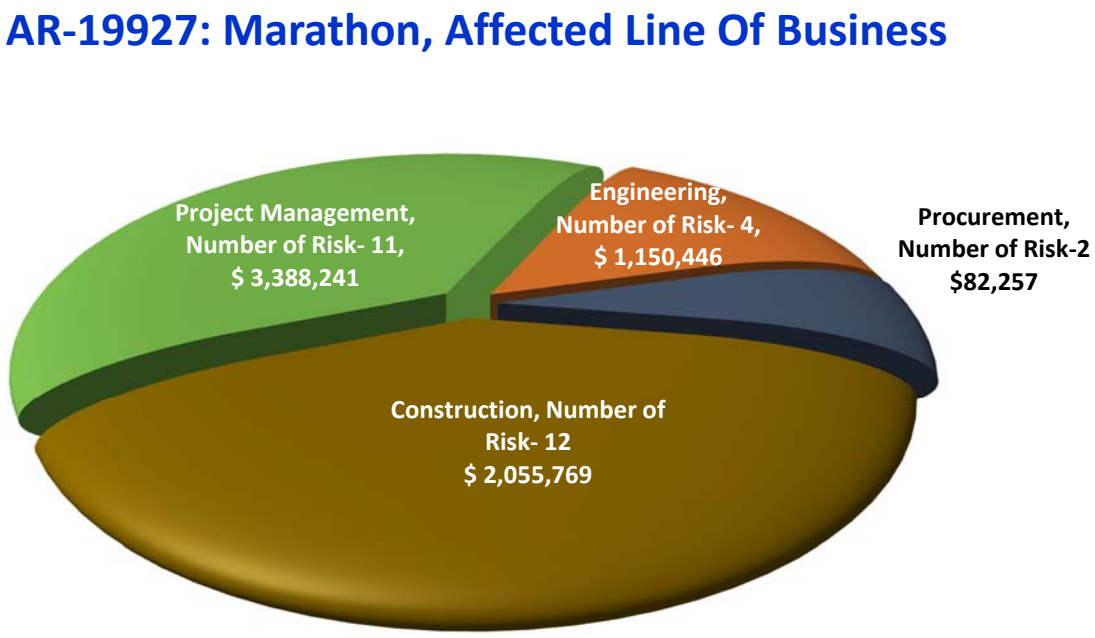
Note that due to the unavailability of the detailed schedule, the above manual methodology was used.

III. CONCLUSION

The recommended total contingency amount for project "AR 19927- Marathon Package" East-West Tie Connection is $ 6,676,712. This is 14.4% of the base cost estimate. It is recommended that the risk register is reviewed periodically (See Table A below) during each phase to ensure the successful completion of "AR 19927-Marathon Package" within budget and on schedule.

A. TOP LOB ELEMENT AFFECTED ON THE PROJECT

Risks were categorized under a list of various Lines of Business / WBS categories following the Risk Review Board meeting. This categorization was purely based on the WBS allocation given to each risk in the meeting and may get modified as periodic risk reviews take place during various phases of the project. Based on this categorization, the risks associated with Project Management is approx. double than its base cost estimate and can be considered as the top LOB element affecting the project.



5. LAKEHEAD PACKAGE

I. TOP PROJECT RISK

The top 3 project risks are shown in the table below. These risks are the major contributors to the total contingency suggested for this project.

Top Project Risks

Risk Title	Probability Impact	Cost Impact
The risk - if we get a full release and there are delays due to design changes & regulatory	EVEN ODDS 50% - 74%	$ 2,550,000
The risk is that HONI's may not be able to acquire an outage for the 1 year window	EVEN ODDS 50% - 74%	$ 2,550,000
The risk is if we have one set of engineers - we may miss the package at the execution phase - impact the schedule. This may be contracted out which introduces inherent risks	VERY LIKELY 95% -100%	$ 579,378

During the RRB meeting the PM anticipated a risk of delays in design changes and regulatory approvals after a full funding release for the project. A standard 5% as the carrying cost per year was used to calculate the risk estimate and a delay of one year was assumed if this risk occurs. The full funding release amount was estimated to be $51M for Lakehead package. Any delay beyond one year due to delay in regulatory approvals would fall under the category of IROV. The risk was considered to have an Even Odds (50% to 74%) probability of occurrence.

The PS planners have estimate a 1 year construction period for Lakehead work. There is a risk that HydroOne may not get an outage window to during the construction period and the project may get delayed for one additional year to accommodate outages. The PM assumed a fully funded project carrying cost for this risk. Based on these assumptions, the PM estimated a risk impact of $ 2,550,000 with an Even Odds (50% to 74%) probability of occurrence.

At the estimation stage of AR 19927 only one set of engineers were allocated for all three sites (Wawa, Marathon and Lakehead). The estimate assumes that additional resources will be made available to all three stations simultaneously during execution phase to meet the deadline of Dec 2020 ISD. The estimating process for all three packages has been a challenging for engineers so far as they divided the allotted time for the three sites in order to meet estimate submission date resulting in reduced detail engineering. There is a risk that limited engineering resources will be available at the execution stage. The PM anticipated one month delay per year due to this issue

for three years assuming partial funding release and construction delay assuming 12 person crew with at $100 an hour for three months. The risk estimate for Lakehead station was calculated to be $ 579,378 and was placed at high probability (95% - 100%) of risk occurrence.

A. RISKS ASSOCIATED WITH SCHEDULE DELAYS:

The following risks were identified to have a possible impact on schedule during project execution phase:

- Partial release for this project is required in the first quarter of 2017. Any delays due to section 92, building specification & tendering of reactors, breakers & capacitor banks can cause significant delays to the ISD.
- The PM identified a major risk associated with not having a detailed schedule available during risk review board and cost estimation. An unrealistic detailed schedule may lead to an IROV and possible delay of the project by up to 1 year.
- Steel structural design and fabrication defects identified on site may lead to rework and onsite fabrication. This is likely to delay the construction schedule by 20 days.
- The PM identified a possibility of forced outage due to aging equipment and equipment failure. Based on recent trends, HONI has seen two cases of breaker failure and a subsequent Switch failure on projects. A Schedule delay of 2 weeks was considered for this risk.
- Missing of critical equipment manufacturer drawings such as basic layout of reactors or capacitor bank during construction stage is a high impact schedule delay risk.
- There is a risk that materials and equipment delivery may get delayed which could push the construction by approximately 20 days.
- As this project has a direct impact to OPG, there is a risk that OPG may cancel outages based on historic trend. The PM considered a total of 8 outages for this project and assumed a delay of 5 construction days per outage. This is likely to push the schedule by 40 days in addition to the challenges faced during mobilization and demobilization of the construction crew.
- Control building delays may impact the outage plan and lead to shuffling of the crews, mob-demob. etc. this may result in overall Schedule delays of a month (based on historic trend).

B. RELATION OF TOP PROJECT RISKS WITH CORPORATE/ENTERPRISE RISK MANAGEMENT

N/A

II. METHOD AND SIMULATION RESULTS

Burns & McDonnell with the help of Hydro One's Subject Matter Experts (SMEs) used the cost estimate file and draft PDR report as initial inputs into the risk model. The RRB allowed for the collection of additional information to improve the model. A Monte Carlo simulation ran 10,000 iterations for each risk value and related probability to come up with the most likely P95 value (95% Confidence level) that represents all identified risks associated with this project. The P95 value denotes a 95% confidence in the model if all the risks were to materialize at the risk estimate and probability level identified in the RRB. All the uncertain parameters were assumed to have equal likelihood of occurrence in order for the simulation to run.

The Probability Ranking Matrix used to do this analysis is shown below:

PROBABILITY RANKING MATRIX	LOWPROB	HIGHPROB
VERY LIKELY 95% - 100%	95%	100%
LIKELY 75% - 94%	75%	94%
EVEN ODDS 50% - 74%	50%	74%
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REMOTE 0% - 24%	0%	24%

The Cost Impact Ranking Matrix used to do this analysis is shown below:

COST IMPACT RANKING MATRIX	*LOW_IMP*	*HI_IMP*
CATASTROPHIC > 99%	> 99%	
SEVERE 51% TO 99%	51%	99%
SIGNIFICANT 34% TO 50%	34%	50%
MAJOR 9% TO 33%	9%	33%
MODERATE 3% TO 8%	3%	8%
MINOR 1% TO 2%	1%	2%

Based on the assumptions and method stated above, Oracle Crystal Ball came up with the following range of contingency values for "AR 19927- Lakehead Package":

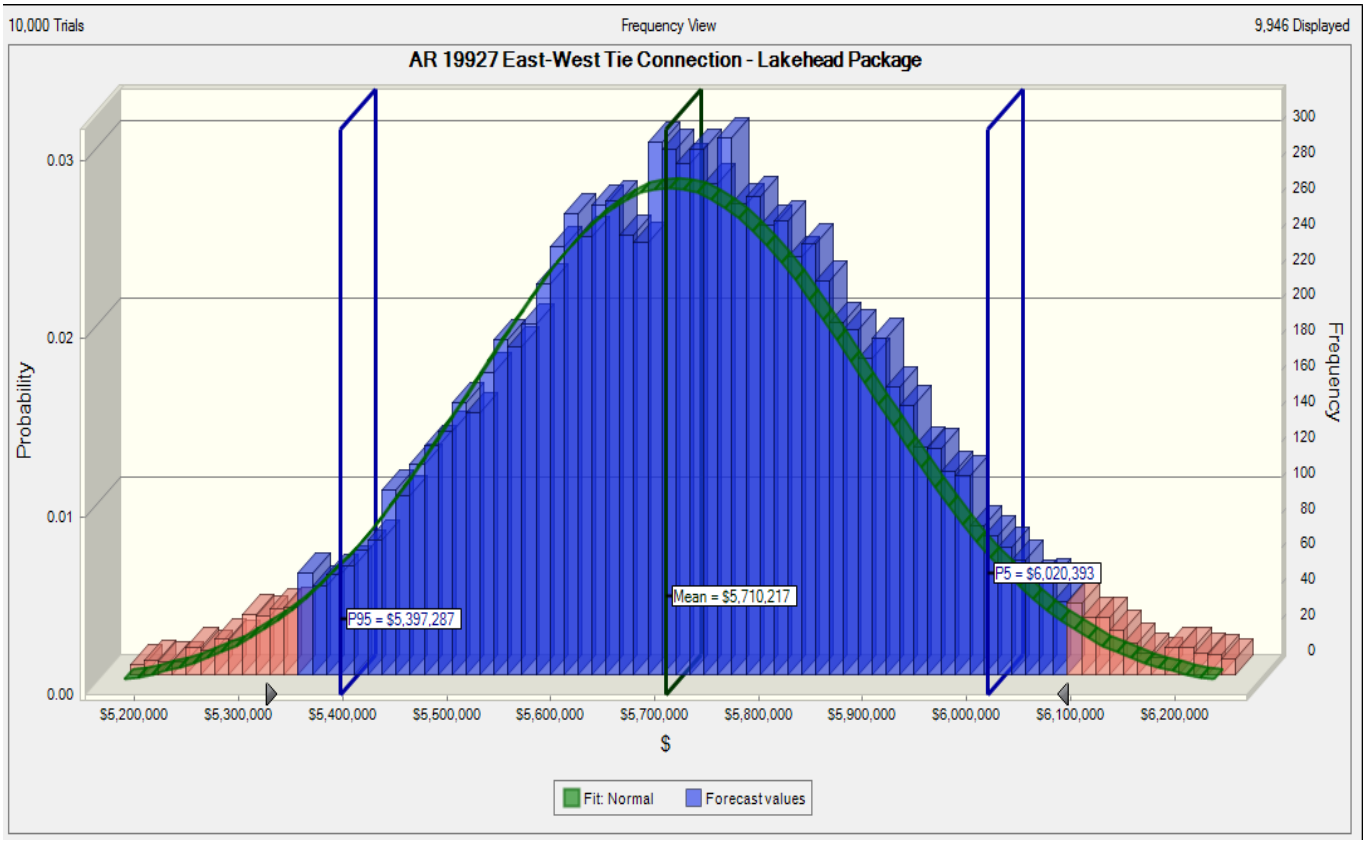
Full Value of Risk Cost Impact identified in the meeting	Un-modelled	$8,838,111
Percentage Confidence contingency level value	P 5	$6,020,393
	P 10	$5,952,722
	P 80	$5,551,157
	P 95	**$5,397,287**

All risks identified in the risk register were assigned a level 1 WBS distribution line of business category. Based on the statistical output of Monte Carlo analysis, the risk results were assigned to the corresponding level 1 WBS category as shown in the table below:

AR	PID NUMBER	ESTIMATE DISTRIBUTION	LEV1DES (LEV1)	BASE COSTS	OTHER COSTS	RISK OUTPUT
19927		Project Management	Project Management (PM)	$ 1,348,446		$ 2,038,578
19927		Engineering	Engineering (EN)	$ 3,960,463		$ 870,058
19927		Procurement	Procurement (PR)	$ 17,145,012		$ 82,451
19927		Customer Operations	Real Estate (RE)	-		
19927		Construction	Construction (CN)	$ 11,671,734		$ 2,406,200
19927		Construction	Commissioning (CM)	$ 3,516,564		
19927		Removals	Others*		$ 827,550	
19927		Past Cost	Others*		$ 370, 000	
19927		CAP OH	Others*		$ 6,705, 000	
19927		CAP INT	Others*		$ 2,203,780	
TOTAL				**$ 37,642,219**	**$ 10,106,385**	**$ 5,397,287**

*Note that interest and overhead (other costs) are based on the original estimated and will be recalculated based on additional contingency amount (total of risk output amount)

The figure below shows a fitted normal distribution curve for “AR 19927- Lakehead Package” risk calculation which confirms the validity of this simulation.



Frequency Forecast and the normal distribution fit for results generated from Monte Carlo Simulation

B. QUARTERLY CONTINGENCY DRAWDOWN FORECAST

Following a detailed risk review, a follow up session was held to identify the spread of contingency over the duration of "AR 19927- Lakehead Package". Due to the unavailability of a detailed project schedule at this point, the PM needed to manually spread the drawdown triggers for each risk. Based on a cumulative total weighting for all risks, a percentage spread was mathematically calculated to show the risk distribution over the period of the project on a quarterly basis.

RISK FORECAST / QUARTERS	Q4 2017	Q1 2018	Q2 2018	Q3 2018	Q4 2018	Q1 2019	Q2 2019	Q3 2019	Q4 2019	Q1 2020
RISK DISTRIBUTIONS	$183,998	$287,038	$1,238,923	$961,698	$257,598	$306,664	$257,598	$471,036	$196,265	$377,810
	Q2 2020	**Q3 2020**	**Q4 2020**	**Q1 2021**	**Q2 2021**	**Q3 2021**	**Q4 2021**	**Total**		
	$144,745	$115,306	$144,745	$176,638	$ 126,666	$93,226	$61,333	**$5,397,286**		

Note that due to the unavailability of the detailed schedule, the above manual methodology was used.

III. CONCLUSION

The recommended total contingency amount for project “AR 19927- Lakehead Package” - East-West Tie Connection is $ 5,397,286. This is 14% of the base cost estimate. It is recommended that the risk register is reviewed periodically (See Table A below) during each phase to ensure the successful completion of “AR 19927- Lakehead Package” within budget and on schedule.

A. TOP LOB ELEMENT AFFECTED ON THE PROJECT

Risks were categorized under a list of various Lines of Business / WBS categories following the Risk Review Board meeting. This categorization was purely based on the WBS allocation given to each risk in the meeting and may get modified as periodic risk reviews take place during various phases of the project. Based on this categorization, the risks associated with Project Management is approx. 1.5 times more than its base cost estimate and can be considered as the top LOB element affecting the project.

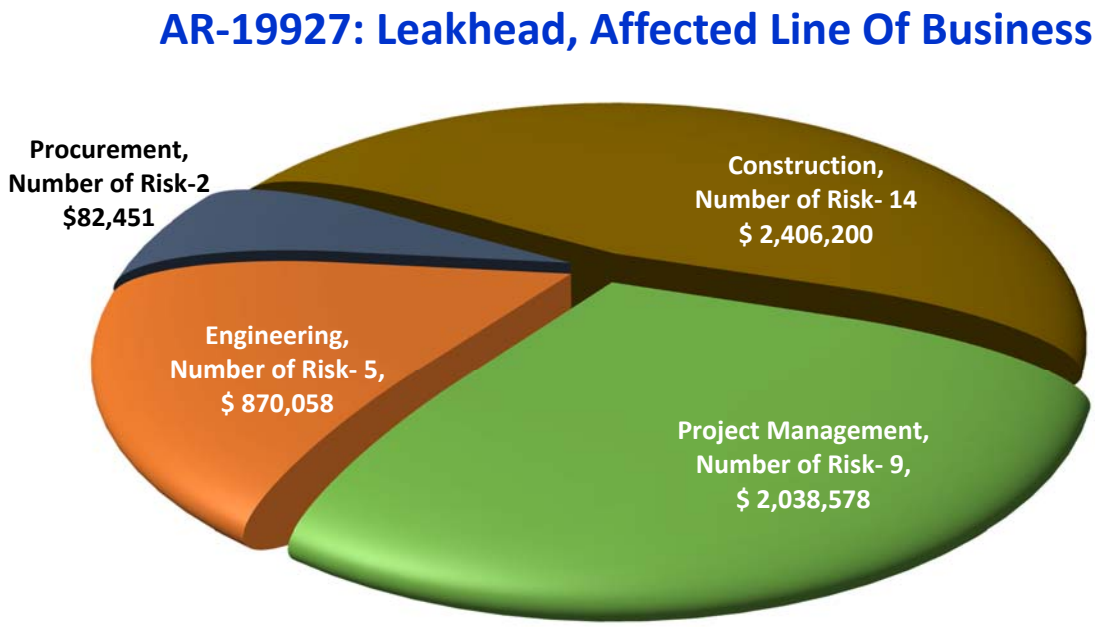


Table A
AR 19927| East-West Tie Connection
Risk Register

AR 19927 East-West Tie Connection Wawa Package
Risk Register

AR	AR Description	Lev1 Description	Risk Title	Risk Type	Probability Ranking	Risk Impact Estimate	Cost Impact related to Base cost	Comments
19927	East-West Tie Connection	Project Management (PM)	The risk is of getting a partial release and encountering delays due to property acquisition, environmental approvals, specification & tendering, confirm/lock basic layout, building specification & tendering of reactors, breakers & capacitor banks and Section 92.	Threats	VERY LIKELY 95% - 100%	$ 67,680	MINOR 1% to 2%	All three Projects (Per site) potential Schedule delay to tendering as this is a new components -may not get a partial release; Partial release required by 1st quarter of 2017 for the following to meet required I/S date If this is beyond 12 months - it may lead to an IROV (potential 12 month delay) Carrying cost for 9 months ? Carrying cost $1,353,607 *.05
19927	East-West Tie Connection	Project Management (PM)	The risk is of getting a full release and encountering delays due to design changes & regulatory approvals	Threats	EVEN ODDS 50% - 74%	$ 2,000,000	MODERATE 3% to 8%	If this is beyond 12 months - it may lead to an IROV (potential 12 month delay) Carrying cost for 9 months ? Carrying cost $150M *.05 ; ($61M for Marathon) = $61 X 5% ; Wawa $40M X 5%; Lakehead $51 X 5% used this cost instead of whole $150M
19927	East-West Tie Connection	Project Management (PM)	Risk is Geo Tech reports are not done outside the station. Potential of more money based on differing soil conditions	Threats	LIKELY 75% - 94%	$ 200,000	MINOR 1% to 2%	Marathon and Wawa - Wawa TS & Marathon TS - Soil conditions across expansion area have been assumed identical to the ones specified in the existing soil report. Geotechnical investigation for the expansion area is outstanding; shall be conducted to confirm the subject assumption. (Cost of foundations - Marathon $2.2M X 20% as change in foundation cost; Wawa TS $1M X 20%)
19927	East-West Tie Connection	Construction (CN)	The risk is that the cost of control building may go higher than the estimate. Wawa, Marathon & Lakehead - The cost for building is based on previous project – AR22279 Holland TS PO#4500506828; building specification is unavailable at time of estimate preparation	Threats	LIKELY 75% - 94%	$ 478,872	MINOR 1% to 2%	Taken the average of the scenario; Assumed Per Sq M $9,633 X (Wawa 27X12M; Marathon 22X15; Lakehead 24X10) ; Higher limit Per Sq M $11,111 (Difference between assumed and higher limit)
19927	East-West Tie Connection	Engineering (EN)	The risk is if we have only one set of engineers for all packages at the execution phase - we may miss the package at the execution phase - impact the schedule. This may be contracted out which introduces inherent risks	Threats	VERY LIKELY 95% - 100%	$ 592,920	MODERATE 3% to 8%	Additional resource requirements if only one set of engineers are available for all three sites at the execution phase - Resources are assumed available for each TS in execution phase to meet required I/S date; during estimate preparation there is only one set of engineers working for three site - Wawa, Marathon & Lakehead estimates have been a challenging situation to engineers, they divided the allotted time for the three sites in order to meet estimate submission date resulting to a reduced detail engineering. The proposed plan in execution phase is to have different set of engineers for each site to meet required Dec 2020 I/S date - This is still carrying cost delay assumed 3 months (1 Month per year) + carrying cost assuming partial funding = Average Crew per site 12 person X $100 X 40 Hrs X 4 Weeks X 3 Months (per station)
19927	East-West Tie Connection	Project Management (PM)	Risk of not getting documents and temporary access on time - Partial release (Real Estate/ Environmental) - not the quickest process to get approval/release from MNR (May go from 1 year to 18 months) Long lead time	Threats	EVEN ODDS 50% - 74%			Expand Marathon - started to purchase land for Marathon - potential schedule delay (if the release is delayed) we will need funds at the time of purchase. Wawa - owners may not look at the expansion based on HONI market value 20% of fair market value. (Wawa will be mitigated as owner has been cooperative) Marathon - Carrying cost for 6 months or overtime will be required. (Overtime - 20% X 3 months of overtime of construction cost)
19927	East-West Tie Connection	Engineering (EN)	Risk of getting Partial release (Engineering)	Threats				Covered in other engineering risks - No additional information
19927	East-West Tie Connection	Project Management (PM)	The risk of Section 92 delay - Filing joint application with NextBridge - first time filing this with NextBridge - Delay to the start of construction	Threats	LIKELY 75% - 94%	$ 203,041	MINOR 1% to 2%	Potential 2 to 3 years delay All three projects (Carrying cost) + Might have to go through the process for environmental again. $3M X 5% interest per year X 3 years (typical max delay for S-92)
19927	East-West Tie Connection	Project Management (PM)	Schedule delays associated with Tight schedule for Environmental permitting and sequencing with the new EA process	Threats	EVEN ODDS 50% - 74%			Marathon schedule - assuming we start on Jan 2017 - EA approval by Jan 2018 - tree cutting - geo tech (assuming no first nations issues general public issues) Carrying Cost We are already beyond January 2017 and have not received a partial release yet. This could introduce schedule delays (e.g. the EA consultant cannot be retained until funds are released)
19927	East-West Tie Connection	Construction (CN)	Construction permits for access to the sites (Road access permit) Covered Above	Threats	LIKELY 75% - 94%			Historic delay of 2 years on Burwash for access roads - issues with MTO
19927	East-West Tie Connection	Construction (CN)	The risk of Bridge repair - Wawa Bridge - timbers are rotten - impact on component replacement - identify the loads to be going across the bridge	Threats	VERY LIKELY 95% - 100%	$ 375,840	MINOR 1% to 2%	Schedule and cost risk - assuming the bridge repair starts after full fund release and construction start (May have to cover the assessment fee for Bridge inspection) - Construction crew 1 month inactive + Carrying cost 6 months + Assessment fee ($150K)
19927	East-West Tie Connection	Project Management (PM)	Wawa Transformer replacement is in the top 20 advanced readiness list	Threats	VERY LIKELY 95% - 100%	$ 67,680	MINOR 1% to 2%	Potential schedule impact due to potential high priority projects - next five years 600M of capital spend - reassessment risk- Transformer and breaker replacement program may impact ISD. As partial release is aimed for Jan 2017, there is a very good chance that sustainment cost will have to be added (This is going to be separate AR) = We will have carrying cost - partial release 1 year
19927	East-West Tie Connection	Construction (CN)	Winter - Weather additional Heating and hoarding cost (not estimated when winter work is starting)	Threats	REMOTE 0% - 24%	$ 360,000	MINOR 1% to 2%	Marathon and Lakehead (3 months) - Wawa working from April to Dec (Not on site in winter months); Historically the outage delays have pushed such projects into the colder months. $120k (renting ground heaters is 5k/week + fuel - just for the heater) X 3 years on winter

AR 19927 East-West Tie Connection Wawa Package
Risk Register

AR	AR Description	Lev1 Description	Risk Title	Risk Type	Probability Ranking	Risk Impact Estimate	Cost Impact related to Base cost	Comments
19927	East-West Tie Connection	Construction (CN)	Differed outages or cancelled outage particularly with OPG if there is not coordination. Only tie between North Ontario and South Ontario	Threats	EVEN ODDS 50% - 74%	$ 280,000	MINOR 1% to 2%	Marathon-Lakehead and Marathon-Wawa 3 months construction delays; time of the year (weather etc.) will have to work 3 months more to reassess the outage. Difficult to take an outage in spring time. Opportune time is the Fall time for outages. If we don't get an outage in Fall time we may have to wait for the whole season to get another outage. Mob Demob cost (IESO, OPG, Weather, windfarm etc. primary factors); Due to direct impact to OPG - economic concerns, weather. Construction day = 6 FTEs = $85*10hrs/day+ $120*6= $5820/day+ Equipment (lift, truck..)1000 = $7000/day. Approx. 3 circuit outages/year = 8 days per year. Since we are only working with breakers and light switches - it may not be easy to reassign crews quickly +Mob and Demob. Assume 5 total outages missed for the project. Historically dealing with OPG has been an issue. It is quite possible that we may miss all outages - 8 total outages at 5 days an outage = 40 construction days
19927	East-West Tie Connection	Construction (CN)	The risk is that HONI's may not be able to acquire an outage for the 1 year window	Threats	EVEN ODDS 50% - 74%	$ 3,050,000	MAJOR 9% to 33%	The current estimate assumes 3 years of construction. Also note associated PM costs. The carrying costs will be impacted by this delay. The carrying cost for XX spent @5%. This may not be significant as the crew can be utilized on other projects. Using the highest of all three stations ($61M for Marathon) = $61 X 5% ; Wawa $40M X 5%; Lakehead $51 X 5%
19927	East-West Tie Connection	Engineering (EN)	Installation of additional temporary wave trap	Threats	REMOTE 0% - 24%			will be included in the estimate
19927	East-West Tie Connection	Construction (CN)	Risk of Control Building delayed - Outages planned will be scrapped - associated overtime cost to meet the schedule	Threats	LIKELY 75% - 94%	$ 56,000	MINOR 1% to 2%	Historic trend 1 month or more; schedule delays due to shuffling crews, outages, mob-demob etc. Productivity could be affected by upto 8 days. Outage delays have been captured above.
19927	East-West Tie Connection	Procurement (PR)	Risk of missing equipment - material delays	Threats	LIKELY 75% - 94%	$ 50,000	MINOR 1% to 2%	All three projects generally 20 days construction delay if the material is not procured on time 2,500 per day
19927	East-West Tie Connection	Procurement (PR)	The risk of material fabrication defects (quality control) rework - or sending material back	Threats	LIKELY 75% - 94%	$ 50,000	MINOR 1% to 2%	All three projects Steel - lightning towers - structures 20 days average delays - (e.g. not matching with foundation)
19927	East-West Tie Connection	Construction (CN)	The risk of additional Aggregate cost; There is a risk of cost overrun on gravel and Equipment in NW Ontario. For PCB area	Threats	LIKELY 75% - 94%	$ 10,000	MINOR 1% to 2%	Current issue in NW Ontario. Delivery charge is currently 100-300% higher. 200 tonnes. Cost @ $60/tonne per project
19927	East-West Tie Connection	Construction (CN)	The risk of soil contamination; The risk is that there may be contaminated soil associated with PCB	Threats	REMOTE 0% - 24%	$ 24,000	MINOR 1% to 2%	Expansion Geo-tech studies; Cost associated with digging, waste management and transportation. Waste management - $600 tipping fee + transportation =$1200/load. 20 loads - per project
19927	East-West Tie Connection	Project Management (PM)	Endangered species vegetation management. Triggering EA. Having to compensate for the lost of Habitat	Threats	UNLIKELY 25% - 49%	$ 200,000	MINOR 1% to 2%	All three projects.
19927	East-West Tie Connection	Project Management (PM)	The risk is that we don't get a approval within 1 year. First MNRF approval is required before EA consideration for MNRF requirements	Threats	UNLIKELY 25% - 49%	$ 50,000	MINOR 1% to 2%	By Acquiring their land we are automatically triggering this risk - Three month delay possible. Impact the ISD. Construction cost and carrying cost
19927	East-West Tie Connection	Project Management (PM)	The risk of encountering Bed Rock - final decision based on the results of GEO tech report	Threats	UNLIKELY 25% - 49%			Marathon and Wawa
19927	East-West Tie Connection	Project Management (PM)	Section 92 delay - external interveners covered above	Threats	VERY LIKELY 95% - 100%			
19927	East-West Tie Connection	Engineering (EN)	The risk of missing Manufacturer drawing - basic layout of reactor and capacitor bank	Threats	EVEN ODDS 50% - 74%	$ 67,680	MINOR 1% to 2%	Schedule delay to construction start 6 months construction delay for all three projects; Carrying cost % by each substation - partial release
19927	East-West Tie Connection	Project Management (PM)	External Contractor issues ; see control building risk above	Threats				
19927	East-West Tie Connection	Construction (CN)	The risk of Ailing equipment's - Old equipment - forced outages; Forced outages due to aging equipment and equipment failure (Historic trend)	Threats	LIKELY 75% - 94%	$ 56,000	MINOR 1% to 2%	We just had two failures- breaker fail and a subsequent switch fail. This may impact the project schedule. 2 weeks (8 days)
19927	East-West Tie Connection	Commissioning (CM)	The risk is Protection and Controls Drawing may have issues/Staging of cutover from the old to the new - Currently Wawa has shown issues applied to all three SS	Threats	LIKELY 75% - 94%	$ 2,400,000	MAJOR 9% to 33%	add 20% of the time from P&C perspective $12M More risks at Wawa
19927	East-West Tie Connection	Construction (CN)	OGCC outage risks; Covered under outages	Threats				
19927	East-West Tie Connection	Construction (CN)	A risk of strong opposition to NextBridge's EW Tie project/EA may carry over into our work at the stations associated with that project	Threats	REMOTE 0% - 24%	$ 50,000	MINOR 1% to 2%	Potential delays will be considerable. Show Stopper. Based on historic trend in Barwick. Opposition will be from First Nations or Public. Possible start for EA for our project will be end of July. Schedule impact. Delay in carrying cost.
19927	East-West Tie Connection	Project Management (PM)	Ultimate Stage layout - proximity to the lake bank - transformers banks will be positions 15 to 20 meters away from the banks	Threats				Identified and mitigated

AR 19927 East-West Tie Connection Marathon Package
Risk Register

AR	AR Description	Lev1 Description	Risk Title	Risk Type	Probability Ranking	Risk Impact Estimate	Cost Impact related to Base cost	Comments
19927	East-West Tie Connection	Engineering (EN)	The risk of increase in price for 2 Units for Marathon TS shunt reactor and 1 unit for Lakehead as they require tender. The price provided is based on quotation. It is subject to change and also tied to currency exchange rate at the time of actual purchase, (forecast 3rd to 4th quarter of 2018).	Threats	LIKELY 75% - 94%	$ 680,000	MINOR 1% to 2%	Added into the tender - may go higher or lower (generally 10% to 15% higher or lower) Price =2X 1.7 = $3.34M (20%) for Marathon
19927	East-West Tie Connection	Project Management (PM)	The risk is of getting a partial release and encountering delays due to property acquisition, environmental approvals, specification & tendering, confirm/lock basic layout, building specification & tendering of reactors, breakers & capacitor banks and Section 92.	Threats	VERY LIKELY 95% - 100%	$ 50,000	MINOR 1% to 2%	Potential Schedule delay to tendering as this is a new components -may not get a partial release; Partial release required by 1st quarter of 2017 for the following to meet required I/S date If this is beyond 12 months - it may lead to an IROV (potential 12 month delay) Carrying cost for 12 months for Marathon based on partial release of $881,324 Carrying cost $1,000,000 *.5%
19927	East-West Tie Connection	Project Management (PM)	The risk is of getting a full release and encountering delays due to design changes & regulatory approvals	Threats	EVEN ODDS 50% - 74%	$ 3,050,000	MODERATE 3% to 8%	If this is beyond 12 months - it may lead to an IROV (potential 12 month delay) Carrying cost for 12 months of full fund release: Carrying cost $150M *.05 ; ($61M for Marathon) = $61 X 5% ; Wawa $40M X 5%; Lakehead $51 X 5% used this cost instead of whole $150M
19927	East-West Tie Connection	Project Management (PM)	Risk is Geo Tech reports are not done outside the station. Potential of more money based on differing soil conditions	Threats	LIKELY 75% - 94%	$ 1,100,000	MODERATE 3% to 8%	Marathon and Wawa - Wawa TS & Marathon TS - Soil conditions across expansion area have been assumed identical to the ones specified in the existing soil report. Geotechnical investigation for the expansion area is outstanding; shall be conducted to confirm the subject assumption. (Cost of foundations - Marathon $2.2M + Cost of Blasting = 40% as change in foundation cost; Wawa TS $1M X 20%)
19927	East-West Tie Connection	Project Management (PM)	The risk is that the cost of control building may go higher than the estimate. Wawa, Marathon & Lakehead - The cost for building is based on previous project – AR22279 Holland TS PO#4500506828; building specification is unavailable at time of estimate preparation	Threats	LIKELY 75% - 94%	$ 487,740	MINOR 1% to 2%	Taken the average of the scenario; Assumed Per Sq M $9,633 X (Wawa 27X12M; Marathon 22X15; Lakehead 24X10) ; Higher limit Per Sq M $11,111 (Difference between assumed and higher limit)
19927	East-West Tie Connection	Engineering (EN)	The risk is if we have only one set of engineers for all packages at the execution phase - we may miss the package at the execution phase - impact the schedule. This may be contracted out which introduces inherent risks	Threats	VERY LIKELY 95% - 100%	$ 587,017	MINOR 1% to 2%	Additional resource requirements if only one set of engineers are available for all three sites at the execution phase - Resources are assumed available for each TS in execution phase to meet required I/S date; during estimate preparation there is only one set of engineers working for three site - Wawa, Marathon & Lakehead estimates have been a challenging situation to engineers, they divided the allotted time for the three sites in order to meet estimate submission date resulting to a reduced detail engineering. The proposed plan in execution phase is to have different set of engineers for each site to meet required Dec 2020 I/S date - This is still carrying cost delay assumed 3 months (1 Month per year) + carrying cost assuming partial funding = Average Crew per site 12 person X $100 X 40 Hrs X 4 Weeks X 3 Months (per station) (Construction cost (25 resources + 6 additional commissioning crew) = average of 12 in total = rate at $100 an hr X 40 hrs a week)
19927	East-West Tie Connection	Project Management (PM)	Risk of not getting documents and temporary access on time - Partial release (Real Estate/ Environmental) - not the quickest process to get approval/release from MNR (May go from 1 year to 18 months) Long lead time	Threats	EVEN ODDS 50% - 74%	$ 115,200	MINOR 1% to 2%	Expand Marathon - started to purchase land for Marathon - potential schedule delay (if the release is delayed) we will need funds at the time of purchase. Wawa - owners may not look at the expansion based on HONI market value 20% of fair market value. (Wawa will be mitigated as owner has been cooperative) Marathon - Carrying cost for 6 months or overtime will be required. (Overtime - 20% X 3 months of overtime of construction cost)
19927	East-West Tie Connection	Engineering (EN)	Risk of getting Partial release (Engineering)	Threats	EVEN ODDS 50% - 74%			Covered in other engineering risks - No additional information
19927	East-West Tie Connection	Project Management (PM)	Risk of Section 92 delay - Filing joint application with NextBridge - first time filing this with NextBridge - Delay to the start of construction	Threats	LIKELY 75% - 94%	$ 150,000	MINOR 1% to 2%	Potential 2 to 3 years delay All three projects (Carrying cost) + Might have to go through the process for environmental approval again. $3M X 5% interest per year X 3 years (typical max delay for S-92)
19927	East-West Tie Connection	Project Management (PM)	The risk is that we don't get a approval within 1 year. First MNRF approval is required before EA consideration for MNRF requirements	Threats	UNLIKELY 25% - 49%	$ 50,000	MINOR 1% to 2%	By Acquiring their land we are automatically triggering this risk - Three month delay possible. Impact the ISD. carrying cost
19927	East-West Tie Connection	Project Management (PM)	Endangered species vegetation management. Triggering EA. Having to compensate for the lost of Habitate	Threats	UNLIKELY 25% - 49%	$ 200,000	MINOR 1% to 2%	All three projects.
19927	East-West Tie Connection	Project Management (PM)	Schedule delays associated with Tight schedule for Environmental permitting and sequencing with the new EA process Covered in the MNRF and EA species Veg Mgmt risks	Threats	VERY LIKELY 95% - 100%			Marathon schedule - assuming we start on Jan 2017 - EA approval by Jan 2018 - tree cutting - geo tech (assuming no first nations issues general public issues) Carrying Cost for 6 months We are already beyond January 2017 and have not received a partial release yet. This could introduce schedule delays (e.g. the EA consultant cannot be retained until funds are released) Potential one to two years for EA. Delay of cost and schedule delays to be considered
19927	East-West Tie Connection	Construction (CN)	Construction permits for access to the sites (Road access permit) Same as Item 9	Threats	LIKELY 75% - 94%			Historic delay of 2 years on Burwash for access roads - issues with MTO

AR 19927 East-West Tie Connection Marathon Package
Risk Register

AR	AR Description	Lev1 Description	Risk Title	Risk Type	Probability Ranking	Risk Impact Estimate	Cost Impact related to Base cost	Comments
19927	East-West Tie Connection	Construction (CN)	Winter - Weather additional Heating and hoarding cost (not estimated when winter work is starting)	Threats	REMOTE 0% - 24%	$ 360,000	MINOR 1% to 2%	Marathon and Lakehead (3 months) - Wawa working from April to Dec (Not on site in winter months); Historically the outage delays have pushed such projects into the colder months. $120k (renting ground heaters is 5k/week + fuel - just for the heater) X 3 years on winter
19927	East-West Tie Connection	Construction (CN)	Differed outages or cancelled outage particularly with OPG if there is not coordination. Only tie between North and South Ontario	Threats	EVEN ODDS 50% - 74%	$ 280,000	MINOR 1% to 2%	Marathon-Lakehead and Marathon-Wawa 3 months construction delays; time of the year (weather etc.) will have to work 3 months more to reassess the outage. Difficult to take an outage in spring time. Opportune time is the Fall time for outages. If we don't get an outage in Fall time we may have to wait for the whole season to get another outage. Mob Demob cost (IESO, OPG, Weather, windfarm etc. primary factors); Due to direct impact to OPG - economic concerns, weather. Construction day = 6 FTEs = $85*10hrs/day+ $120*6= $5820/day+ Equipment (lift, truck..)1000 = $7000/day. Approx. 3 circuit outages/year = 8 days per year. Since we are only working with breakers and light switches - it may not be easy to reassign crews quickly +Mob and Demob. Assume 5 total outages missed for the project. Historically dealing with OPG has been an issue. It is quite possible that we may miss all outages - 8 total outages at 5 days an outage = 40 construction days
19927	East-West Tie Connection	Construction (CN)	The risk is that HONI's may not be able to acquire an outage for the 1 year window	Threats	EVEN ODDS 50% - 74%	$ 3,050,000	MODERATE 3% to 8%	The current estimate assumes 3 years of construction. Also note associated PM costs. The carrying costs will be impacted by this delay. The carrying cost for XX spent @5%. This may not be significant as the crew can be utilized on other projects. Using the highest of all three stations ($61M for Marathon) = $61 X 5% ; Wawa $40M X 5%; Lakehead $51 X 5%
19927	East-West Tie Connection	Construction (CN)	Control Building delayed - Outages planned will be scrapped - associated overtime cost to meet the schedule	Threats	LIKELY 75% - 94%	$ 56,000	MINOR 1% to 2%	Historic trend 1 month or more; schedule delays due to shuffling crews, outages, mob-demob etc. Productivity could be affected by upto 8 days. Outage delays have been captured above.
19927	East-West Tie Connection	Procurement (PR)	Risk of missing equipment - material delays	Threats	LIKELY 75% - 94%	$ 50,000	MINOR 1% to 2%	All three projects generally 20 days construction delay if the material is not procured on time 2,500 per day
19927	East-West Tie Connection	Procurement (PR)	The risk of material fabrication defects (quality control) rework - or sending material back	Threats	LIKELY 75% - 94%	$ 50,000	MINOR 1% to 2%	All three projects Steel - lightning towers - structures 20 days average delays - (e.g. not matching with foundation)
19927	East-West Tie Connection	Construction (CN)	The risk of additional Aggregate cost; There is a risk of cost overrun on gravel and Equipment in NW Ontario. For PCB area	Threats	LIKELY 75% - 94%	$ 10,000	MINOR 1% to 2%	Current issue in NW Ontario. Delivery charge is currently 100-300% higher. 200 tones. Cost @ $60/tone per project
19927	East-West Tie Connection	Construction (CN)	The risk of soil contamination; The risk is that there may be contaminated soil associated with PCB	Threats	REMOTE 0% - 24%	$ 24,000	MINOR 1% to 2%	Expansion Geo-tech studies; Cost associated with digging, waste management and transportation. Waste management - $600 tipping fee + transportation =$1200/load. 20 loads - per project
19927	East-West Tie Connection	Project Management (PM)	The Risk of encountering Bed Rock - final decision based on the results of GEO tech report (Covered in GEO tech above)	Threats	UNLIKELY 25% - 49%			Marathon and Wawa
19927	East-West Tie Connection	Project Management (PM)	The risk of section 92 delay - external interveners (covered above)	Threats	VERY LIKELY 95% - 100%			
19927	East-West Tie Connection	Engineering (EN)	The risk of missing Manufacturer drawing - basic layout of reactor and capacitor bank	Threats	EVEN ODDS 50% - 74%	$ 44,066	MINOR 1% to 2%	Schedule delay to construction start 6 months construction delay for all three projects; Carrying cost % by each substation - partial release
19927	East-West Tie Connection	Project Management (PM)	The risk of external Contractor issues ; see control building risk (covered above)	Threats				
19927	East-West Tie Connection	Construction (CN)	The risk of ailing equipment's - Old equipment - forced outages; Forced outages due to aging equipment and equipment failure (Historic trend)	Threats	LIKELY 75% - 94%	$ 56,000	MINOR 1% to 2%	We just had two failures- breaker fail and a subsequent switch fail. This may impact the project schedule. 2 weeks (8 days)
19927	East-West Tie Connection	Commissioning (CM)	The risk of issues with protection and Controls Drawing /Staging of cutover from the old to the new - Currently Wawa has shown issues applied to all three SS	Threats	LIKELY 75% - 94%			add 20% of the time from P&C perspective $12M More risks at Wawa
19927	East-West Tie Connection	Construction (CN)	OGCC outage risks; Covered under outages	Threats				
19927	East-West Tie Connection	Construction (CN)	A risk of strong opposition to NextBridge's EW Tie project/EA may carry over into our work at the stations associated with that project	Threats	REMOTE 0% - 24%	$ 50,000	MINOR 1% to 2%	Potential delays will be considerable. Show Stopper. Based on historic trend in Barwick. Opposition will be from First Nations or Public. Possible start for EA for our project will be end of July.
19927	East-West Tie Connection	Construction (CN)	Ultimate Stage layout - proximity to the lake bank - transformers banks will be positions 15 to 20 meters away from the banks	Threats				Identified and mitigated

AR 19927 East-West Tie Connection Lakehead Package
Risk Register

AR	AR Description	Lev1 Description	Risk Title	Risk Type	Probability Ranking	Risk Impact Estimate	Cost Impact related to Base cost	Comments
19927	East-West Tie Connection	Engineering (EN)	The risk of increase in price for 2 Units for Marathon TS shunt reactor and 1 unit for Lakehead as they require tender. The price provided is based on quotation. It is subject to change and also tied to currency exchange rate at the time of actual purchase, (forecast 3rd to 4th quarter of 2018).	Threats	LIKELY 75% - 94%	$ 340,000	MINOR 1% to 2%	Added into the tender - may go higher or lower (generally 10% to 15% higher or lower) Price =2X 1.7 = $3.34M (20%) Marathon and Lakehead
19927	East-West Tie Connection	Project Management (PM)	The risk is of getting a partial release and encountering delays due to property acquisition, environmental approvals, specification & tendering, confirm/lock basic layout, building specification & tendering of reactors, breakers & capacitor banks and Section 92.	Threats	VERY LIKELY 95% - 100%	$ 13,513	MINOR 1% to 2%	All three Projects (Per site) potential Schedule delay to tendering as this is a new components -may not get a partial release; Partial release required by 1st quarter of 2017 for the following to meet required I/S date If this is beyond 12 months - it may lead to an IROV (potential 12 month delay) Carrying cost for 9 months ? Carrying cost $1.5M *.05
19927	East-West Tie Connection	Project Management (PM)	The risk is of getting a full release and encountering delays due to design changes & regulatory approvals	Threats	EVEN ODDS 50% - 74%	$ 2,550,000	MODERATE 3% to 8%	If this is beyond 12 months - it may lead to an IROV (potential 12 month delay) Carrying cost for 9 months ? Carrying cost $150M *.05 ; ($61M for Marathon) = $61 X 5% ; Wawa $40M X 5%; Lakehead $51 X 5% used this cost instead of whole $150M
19927	East-West Tie Connection	Project Management (PM)	The risk is that the cost of control building may go higher than the estimate. Wawa, Marathon & Lakehead - The cost for building is based on previous project – AR22279 Holland TS PO#4500506828; building specification is unavailable at time of estimate preparation	Threats	LIKELY 75% - 94%	$ 354,720	MINOR 1% to 2%	Taken the average of the scenario; Assumed Per Sq M $9,633 X (Wawa 27X12M; Marathon 22X15; Lakehead 24X10) ; Higher limit Per Sq M $11,111 (Difference between assumed and higher limit)
19927	East-West Tie Connection	Engineering (EN)	The risk is if we have only one set of engineers for all packages at the execution phase - we may miss the package at the execution phase - impact the schedule. This may be contracted out which introduces inherent risks	Threats	VERY LIKELY 95% - 100%	$ 579,378	MINOR 1% to 2%	Additional resource requirements if only one set of engineers are available for all three sites at the execution phase - Resources are assumed available for each TS in execution phase to meet required I/S date; during estimate preparation there is only one set of engineers working for three site - Wawa, Marathon & Lakehead estimates have been a challenging situation to engineers, they divided the allotted time for the three sites in order to meet estimate submission date resulting to a reduced detail engineering. The proposed plan in execution phase is to have different set of engineers for each site to meet required Dec 2020 I/S date - This is still carrying cost delay assumed 3 months (1 Month per year) + carrying cost assuming partial funding = Average Crew per site 12 person X $100 X 40 Hrs X 4 Weeks X 3 Months (per station)
19927	East-West Tie Connection	Construction (CN)	The risk is - we are assuming a unit cost for replacing 1.6 Km of sky wire - Grounding study on the old measurement - impact on material cost - more copper will required - more digging (Labor and material additions) slight chance that the ground resistivity may change. Modifications/upgrade to the structures is not included.	Threats	LIKELY 75% - 94%	$ 264,500	MINOR 1% to 2%	Lakehead - Skywire and Structure upgradation Unit cost of 6 spans total of 1.6 Km (Modifications of 6 towers) = $529,000 X 50% - only for 2021 scope
19927	East-West Tie Connection	Engineering (EN)	Risk of getting Partial release (Engineering)	Threats				Covered in other engineering risks - No additional information
19927	East-West Tie Connection	Engineering (EN)	Drawing Modifications due to temperory configurations covered in Sec 92 delay filing joint application		EVEN ODDS 50% - 74%			In the event that NextBridge are not on schedule for installing the lines. Temperory measures will have to be done to mitigate this risk
19927	East-West Tie Connection	Project Management (PM)	Risk of Section 92 delay - Filing joint application with NextBridge - first time filing this with NextBridge - Delay to the start of construction	Threats	LIKELY 75% - 94%	$ 150,000	MINOR 1% to 2%	Potential 2 to 3 years delay All three projects (Carrying cost) + Might have to go through the process for environmental again. $3 M X 5% interest per year X 3 years (typical max delay for S-92)
19927	East-West Tie Connection	Construction (CN)	Construction permits for access to the sites (Road access permit) Covered Above	Threats	LIKELY 75% - 94%			Historic delay of 2 years on Burwash for access roads - issues with MTO
19927	East-West Tie Connection	Construction (CN)	Access road issues for lakehead - we may have to go around the site	Threats	EVEN ODDS 50% - 74%	$ 800,000	MODERATE 3% to 8%	Substantial cost for installation of access road.
19927	East-West Tie Connection	Construction (CN)	Winter - Weather additional Heating and hoarding cost (not estimated when winter work is starting)	Threats	REMOTE 0% - 24%	$ 360,000	MINOR 1% to 2%	Marathon and Lakehead (3 months) - Wawa working from April to Dec (Not on site in winter months); Historically the outage delays have pushed such projects into the colder months. $120k (renting ground heaters is 5k/week + fuel - just for the heater) X 3 years on winter
19927	East-West Tie Connection	Construction (CN)	Differed outages or cancelled outage particularly with OPG if there is not coordination. Only tie between North and South Ontario: Upto 2020	Threats	EVEN ODDS 50% - 74%	$ 70,000	MINOR 1% to 2%	Marathon-Lakehead and Marathon-Wawa 3 months construction delays; time of the year (weather etc.) will have to work 3 months more to reassess the outage. Difficult to take an outage in spring time. Opportune time is the Fall time for outages. If we don't get an outage in Fall time we may have to wait for the whole season to get another outage. Mob Demob cost (IESO, OPG, Weather, windfarm etc. primary factors); Due to direct impact to OPG - economic concerns, weather. Construction day = 6 FTEs = $85*10hrs/day+ $120*6= $5820/day+ Equipment (lift, truck..)1000 = $7000/day. Approx 3 circuit outages/year = 8 days per year. Since we are only working with breakers and light switches - it may not be easy to reassign crews quickly +Mob and Demob. Assume 5 total outages missed for the project. Historically dealing with OPG has been an issue. It is quite possible that we may miss all outages - 8 total outages at 5 days an outage = 40 construction days * 25% in the year 2020

AR 19927 East-West Tie Connection Lakehead Package
Risk Register

AR	AR Description	Lev1 Description	Risk Title	Risk Type	Probability Ranking	Risk Impact Estimate	Cost Impact related to Base cost	Comments
19927	East-West Tie Connection	Construction (CN)	Differed outages or cancelled outage particularly with OPG if there is not coordination. Only tie between North and South Ontario: Upto 2021	Threats	EVEN ODDS 50% - 74%	$ 210,000	MINOR 1% to 2%	Marathon-Lakehead and Marathon-Wawa 3 months construction delays; time of the year (weather etc.) will have to work 3 months more to reassess the outage. Difficult to take an outage in spring time. Opportune time is the Fall time for outages. If we don't get an outage in Fall time we may have to wait for the whole season to get another outage. Mob Demob cost (IESO, OPG, Weather, windfarm etc. primary factors); Due to direct impact to OPG - economic concerns, weather. Construction day = 6 FTEs = $85*10hrs/day+ $120*6= $5820/day+ Equipment (lift, truck..)1000 = $7000/day. Approx 3 circuit outages/year = 8 days per year. Since we are only working with breakers and light switches - it may not be easy to reassign crews quickly +Mob and Demob. Assume 5 total outages missed for the project. Historically dealing with OPG has been an issue. It is quite possible that we may miss all outages - 8 total outages at 5 days an outage = 40 construction days * 75% in the year 2021
19927	East-West Tie Connection	Construction (CN)	The risk is that HONI's may not be able to acquire an outage for the 1 year window	Threats	EVEN ODDS 50% - 74%	$ 2,550,000	MODERATE 3% to 8%	The current estimate assumes 3 years of construction. Also note associated PM costs. The carrying costs will be impacted by this delay. The carrying cost for XX spent @5%. This may not be significant as the crew can be utilized on other projects. Using the highest of all three stations ($61M for Marathon) = $61 X 5% ; Wawa $40M X 5%; Lakehead $51 X 5%
19927	East-West Tie Connection	Project Management (PM)	Control Building delayed - Outages planned will be scrapped - associated overtime cost to meet the schedule	Threats	LIKELY 75% - 94%	$ 56,000	MINOR 1% to 2%	Historic trend 1 month or more; schedule delays due to shuffling crews, outages, mob-demob etc. Productivity could be affected by upto 8 days. Outage delays have been captured above.
19927	East-West Tie Connection	Procurement (PR)	Risk of missing equipment - material delays	Threats	LIKELY 75% - 94%	$ 50,000	MINOR 1% to 2%	All three projects generally 20 days construction delay if the material is not procured on time 2,500 per day
19927	East-West Tie Connection	Procurement (PR)	Material fabrication defects (quality control) rework - or sending material back	Threats	LIKELY 75% - 94%	$ 50,000	MINOR 1% to 2%	All three projects Steel - lightning towers - structures 20 days average delays - (e.g. not matching with foundation)
19927	East-West Tie Connection	Construction (CN)	additional Aggregate cost; There is a risk of cost overrun on gravel and Equipment in NW Ontario. For PCB area	Threats	LIKELY 75% - 94%	$ 10,000	MINOR 1% to 2%	Current issue in NW Ontario. Delivery charge is currently 100-300% higher. 200 tons. Cost @ $60/tone per project
19927	East-West Tie Connection	Construction (CN)	Soil contamination; The risk is that there may be contaminated soil associated with PCB	Threats	REMOTE 0% - 24%	$ 24,000	MINOR 1% to 2%	Expansion Geo-tech studies; Cost associated with digging, waste management and transportation. Waste management - $600 tipping fee + transportation =$1200/load. 20 loads - per project
19927	East-West Tie Connection	Construction (CN)	encountering Bed Rock - final decision based on the results of GEO tech report	Threats	UNLIKELY 25% - 49%			Marathon and Wawa
19927	East-West Tie Connection	Project Management (PM)	Section 92 delay - external interveners covered above	Threats	VERY LIKELY 95% - 100%			
19927	East-West Tie Connection	Project Management (PM)	Endangered species vegetation management. Triggering EA. Having to compensate for the lost of Habitate	Threats	UNLIKELY 25% - 49%	$ 200,000	MINOR 1% to 2%	All three projects.
19927	East-West Tie Connection	Project Management (PM)	The risk is that we don't get a approval within 1 year. First MNRF approval is required before EA consideration for MNRF requirements	Threats	UNLIKELY 25% - 49%	$ 50,000	MINOR 1% to 2%	By Acquiring their land we are automatically triggering this risk - Three month delay possible. Impact the ISD. Construction cost and carrying cost
19927	East-West Tie Connection	Engineering (EN)	Missing Manufacturer drawing - basic layout of reactor and capacitor bank	Threats	EVEN ODDS 50% - 74%	$ 50,000	MINOR 1% to 2%	Schedule delay to construction start 6 months construction delay for all three projects; Carrying cost % by each substation - partial release - Revisit amount
19927	East-West Tie Connection	Project Management (PM)	External Contractor issues ; see control building risk above	Threats				
19927	East-West Tie Connection	Construction (CN)	Ailing equipment's - Old equipment - forced outages; Forced outages due to aging equipment and equipment failure (Historic trend)	Threats	LIKELY 75% - 94%	$ 56,000	MINOR 1% to 2%	We just had two failures- breaker fail and a subsequent switch fail. This may impact the project schedule. 2 weeks (8 days)
19927	East-West Tie Connection	Construction (CN)	OGCC outage risks; Covered under outages	Threats				
19927	East-West Tie Connection	Construction (CN)	Ultimate Stage layout - proximity to the lake bank - transformers banks will be positions 15 to 20 meters away from the banks	Threats				Identified and mitigated
19927	East-West Tie Connection	Construction (CN)	A risk of strong opposition to NextBridge's EW Tie project/EA may carry over into our work at the stations associated with that project	Threats	REMOTE 0% - 24%	$ 50,000	MINOR 1% to 2%	Potential delays will be considerable. Show Stopper. Based on historic trend in Barwick. Opposition will be from First Nations or Public. Possible start for EA for our project will be end of July. Schedule impact. Delay in carrying cost.

Table B
Risk Reference Database

Risk Reference Database

	Level 1	Level 2	Prob. Ranking	Risks Relevent to your project
Potential Risks - Hydro One Project	**Stake Holder Initiation** (Risk associated with Initiation phase of the Project)	Business Case due diligence	VERY LIKELY 95% - 100%	
		Internal Approval	LIKELY 75%-94%	
		Funding Approval	EVEN ODDS 50%-74%	
	External Stakeholder Management & Outreach (Risks associated with public involvement and Stake Holder Management)	Municipal Outreach	UNLIKELY 25%- 49%	
		Residential Outreach	REMOTE 0%- 24%	
		Key Stakeholders Outreach (NGO's, Business Groups etc.)		
		Real Estate acquisition / Right of Way		
	Environmental and Permitting (Impacts due to environmental assessment and permitting)	Environmental Surveys		
		Licensing and Permitting		
		Impact Caused Due to Non-Compliance		
		Regulatory Citation/Notice of Violation		
		Rare, Threatened, & Endangered Species		
		Vegetation Management		
		Unanticipated subsurface discovery		
	Technical (Risks associated with the technical aspects of the Project)	Preliminary Design & Technology		
		Issued for Construction		
		As Builts		
	Procurement (Risks associated in the Procurement phase of the Project)	Material Management		
		PO Management		
		Vendor Management		
	Outage	Outage Issues		
	Construction	General Construction Issue (Geological/ Resources/ Compliance)		
		T- Line Above Grade		
		T- Line below Grade		
		Substation Above Grade		
		Substation Below Grade		
		Commissioning & Closeout		
	Program Management (Risks associated with aspects of execution of the project which require management)	Project Management		
		Resources Management		
		Safety		
	Project Controls (Risks associated with commercial aspects and financial terms of the project)	Cost Management		
		Accrual/ Invoice Management		
		EVM		
		Risk Management		
		Change Control		
	External/ Unplanned Risk	Nature		
		Other (Misc.)		
	Opportunities			

OEB Board Staff Interrogatory # 5

Reference:

EB-2017-0194: Exhibit B, Tab 7, Schedule 1, page 1-2 of 4: "Apportioning Project Costs & Risks"

Interrogatory:

Question:

a) Please confirm that the costs for station work would be identical regardless of which company was granted leave to construct the East-West Tie line. If this is not the case, please quantify any cost differences that would arise and explain in detail how the costs would vary with the company granted leave to construct.

Response:

a) The costs for station work, with the same scope and schedule described in the Hydro One application (EB-2017-0194), would be identical regardless of which company was granted leave to construct the East-West Tie line.

It should be noted that, regardless of which company was granted leave to construct, delays in the approval process could impact the project completion dates and the cost, since the working environment, availability and mobilization of resources, and availability of outages are seasonal and dependent on the schedule.

OEB Board Staff Interrogatory # 6

Reference:

EB-2017-0194: Exhibit B, Tab 7, Schedule 1, page 3 of 4: "Cost of Comparable Projects"

Interrogatory:

Preamble:

Hydro One noted that the OEB Filing Requirements for Electricity Transmission Applications, Chapter 4 requires the applicant to provide the cost of similar projects constructed by the applicant or by other entities for baseline cost comparisons covering:

- in-service year of the comparator project; and,
- similarities and differences in terms of voltage level, type of towers, type of terrain, etc.

Hydro One provided the details of Orangeville TS.

Questions:

a) Please provide details of other similar projects that were used by Hydro One in deriving the proposed costs of East-West Tie station work with the actual costs of those comparable station projects.

Response:

a) In addition to the details provided in Table 2 of Exhibit B, Tab 7, Schedule 1, regarding Orangeville TS, Hydro One has updated Table 2 in this interrogatory response to provide another station project, Holland TS as a comparable station project to help illustrate the reasonableness of Hydro One's estimate to complete the EWT Station Project.

Project	**Orangeville TS Station Reconfiguration (actual)**	**Holland TS - Holland TS - Add Breakers and Re-terminate Lines**	**Wawa TS Station Expansion (Estimate)**	**Marathon TS Station Expansion (Estimate)**	**Lakehead TS Station Expansion (Estimate)**
Technical	Replace existing (6) 230kV air blast breakers with SF6 and add (3) 230kV circuit and reconfigure 230kV switchyard, AC/DC station service	Add (6) 230kV overhead circuits with (3) line entrance structures + (2) 230kV SF6 circuit breakers + (4) circuit breaker isolation switches + (6) line disconnect switches + (12) CVTs + AC/DC station service + (2) 250kV underground circuits of 120m each	Add (6) 230 kV circuit breakers + 2 new diameter, 12 disconnect switches, New Relay building	Add (10) 230 kV circuit breakers + 2 new diameter, 20 disconnect switches, New Relay building, (2) 230kV shunt reactors	Add (5) 230 kV circuit breakers + 1 new diameters, 10 disconnect switches, New Relay building, (1) 230kV shunt reactor, (1) 230kV cap bank
Length (km)	N/A	N/A	N/A	N/A	N/A
Project Surroundings	Mostly rural	Mostly rural	Mostly rural	Mostly rural	Mostly rural
In-Service Date	2014-12	2017-12	2021-11	2021-11	2021-11
Total Project Cost	$35,000k	$34,000k	$44,850k	$61,530k	$50,935k
	Less: Non-Comparable Costs				
Underground cable work		$1,700k			
Special protection scheme			$1,378k	$836k	$1,205k
230kV line connection to NextBridge			$633k	$358k	$231k
Shunt reactors/cap bank cost				$11,877k	$12,607k
New relay building			$3,200k	$3,200k	$2,300k
	Add: Escalation				
Escalation Adjustment (2%/year)	$4,900k	$2,700k			
Total Comparable Project Costs	$39,900k	$35,000k	$39,639k	$45,259k	$34,592k

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OEB Board Staff Interrogatory # 7

Reference:

EB-2017-0194: Exhibit B, Tab 9, Schedule 1, page 1 of 6: "Transmission Rate Impact Assessment – 1.0 Economic Feasibility"

Interrogatory:

Preamble:

Hydro One noted that the initial cost of $157.3 million includes $155 million of up-front costs plus $2.3 million cost of removal. $113.4 million will be in-service in 2020 and additional $41.5 million will be in-service in 2021.

Questions:

a) Please provide the specifics of the $41.5 million that will go in to service in 2021.

b) Given the above arrangement ($113.4 in 2020 and 41.5 million in 2021), please confirm that Hydro One will meet the in-service date of December 2020 for 450 MW of capacity.

Response:

a) All the work in regards to the $41.5M spend is related to the work in 2021 for which the details are listed below for each station:

For Wawa TS,

Task	**Facilities / Work**
Bus Work	Uprate the existing buses to 3000 A and uprate the existing diameters in Bay I to III to 2000 A
Breakers	Install three (3) more new breakers and associated six (6) disconnect switches in Bay I and Bay III, as shown in Fig. 2
Line Work	Connect HV terminal of transformer T2 to the main bus (renamed H-Bus), as shown in Fig. 2
	Swap termination of W21M and W23K at Bay II and III, as shown in Fig. 2

Switches	Replace the existing line disconnect c/w ground switches at termination of W22M with motor operated disconnect and motor operated ground switch
	Install a kit on the existing disconnect c/w ground switch 14-W23K (which becomes the new 14-W21M after re-termination of circuits W21M) to motorize its ground switch
PCT, etc.	Complete the PC&T, station service, SCADA, Nomenclature and Database, Facility Registration and other related work described in the Planning Specification and Appendix E
Station Grounding	Enhance station grounding to meet the GPR standards for 20 kA (or less) short-circuit level

For Marathon TS,

Task	**Facilities / Work**
Bus Work	Uprate the existing buses to 3000 A and uprate the existing diameters in Bay I to IV to 2000 A
Shunt Reactor	Install the second new shunt reactors R4 (or R3), with associated switching breaker/switcher, surge arrester, surge capacitor and disconnect switch, as shown in Fig. 4
Breakers	Install three (3) more new breakers and six (6) associated disconnect switches for termination of M23L and shunt reactor R4 (or R3), in Bay IV and in Bay V, VI, VII or VIII (which doesn't have two breakers), as shown in Fig. 4
Line Work	Re-terminate W21M and M23L in Bay III and IV as shown in Fig. 4
Switches	Replace the existing line disconnect c/w ground switches of W21M and W22M with new motor operated disconnect switches and motor operated ground switches
	Replace the existing line disconnect c/w ground switches of M23L and M24L with new motor operated disconnect switches and interrupter-type ground switches
PCT, etc.	Complete the PC&T, station service, SCADA, Nomenclature and Database, Facility Registration and other related work described in the Planning Specification and Appendix E
Station Grounding	Enhance station grounding to meet the GPR standards for 20 kA (or less) short-circuit level

For Lakehead TS,

Task	Facilities / Work
Bus Work	Uprate the existing buses to 3000 A and uprate the existing diameters to 2000 A
Shunt Reactor	Install the new shunt reactor R1, with associated switching breaker/switcher, surge arrester, surge capacitor and disconnect switch, as shown in Fig. 6
Shunt Cap Bank	Install the new shunt capacitor bank, with associated primary and back-up breakers, surge arrester, surge capacitor, series reactor and disconnect switch, as shown in Fig. 6
Breakers	Install one (1) new breaker and two (2) associated disconnect switches in Bay IX (or X) for the shunt reactor (L37R1 or L38R1) Install one (1) new breaker and two (2) associated disconnect switches in Bay XIV for the shunt capacitor bank (L24SC21)
Switches	Replace the existing line disconnect c/w ground switches of M23L and M24L with motor operated disconnect switches (2) and motor operated ground switches (2)
PCT, etc.	Complete the PC&T, station service, SCADA, Nomenclature and Database, Facility Registration and other related work described in the Planning Specification and Appendix E
Station Grounding	Enhance station grounding (possibly replacing sections of skywires) to meet the GPR standards for 20 kA (or less) short-circuit level

b) The 450 MW transfer capacity will be achieved after completing all the station work for connection of the new EWT Lines, reconfigurations of Wawa TS and Marathon TS and re-termination of the existing lines, and installation of the new shunt reactors and capacitor bank, in order to meet the requirements of the NERC reliability standard (refer to the SIA (Attachments 1 and 2 of Exhibit F, Tab 1, Schedule 1). This will be completed in 2020 with a forecast cost of $113.4 million.

Once the new EWT lines are energized in 2020, this will facilitate the remaining station reconfiguration work (to be completed in 2021) as outages will be required on the existing EWT Line making scheduled outages easier.

OEB Board Staff Interrogatory # 8

Reference:

EB-2017-0194: Exhibit E, Tab 1, Schedule 1: "Land Matters"

Interrogatory:

Preamble:

Section 97 of the *Ontario Energy Board Act, 1998* (OEB Act) stipulates the following:
"*In an application under section 90, 91 or 92, leave to construct shall not be granted until the applicant satisfies the Board that it has offered or will offer to each owner of land affected by the approved route or location an agreement in a form approved by the Board.*"

Hydro One filed the following forms of agreement it has to obtain to acquire land rights and/or permits to locate, construct, own, operate and maintain the East-West Tie station project:

- Agreement of Purchase and Sale
- Temporary Access and Temporary Access Road
- Temporary Construction Licence
- Damage Claim Agreement and Release Forms

Questions:

a) Please confirm the agreements are in the form specified in the OEB's Filling Requirements.

b) Which of the forms Hydro One filed in its evidence has been previously approved by the OEB? If so, in which proceedings?

c) Please update the status of negotiations between Hydro One and parties from which the land rights and/or permits need to be acquired.

Response:

a) The OEB Filing Requirements specifically address the form of an easement agreement and stipulates guidelines regarding the types of clauses that should be included within the agreement. Hydro One's filing for the East West Tie Station Project does not

contemplate an easement taking, and rather the Fee Simple purchase of the additional station lands. The standard form Agreement of Purchase and Sale included as Exhibit E, Tab 1, Schedule 1, Attachment 2 reflects Hydro One's intention to purchase the lands required for station expansion. The Agreement of Purchase and Sale template does have similarities to the easement requirements. The owner's property is defined in the Agreement of Purchase and Sale, as is the portion of the property being purchased, similar to defining the easement area, and clearly defines provisions for both the Purchaser and the Vendor regarding inspection periods and insurance requirements. The Agreement of Purchase and Sale specifically outlines that the Purchaser will cover the Vendors reasonable legal fees associated with the transaction which provides the Vendor with the opportunity for independent legal advice, as stated in the easement guidelines.

b) The temporary agreements for a construction workspace and off corridor access, as well as the damage claim form submitted are standard forms Hydro One utilizes for constructions projects that may have land requirements outside the permanent easement acquisition or fee simple purchase of property for the duration of the construction. These forms have been filed in most s.92 applications made by Hydro One; recent examples are the Supply to Essex County Transmission Reinforcement Project (EB-2014-0213) and the Leaside x Main cable refurbishment (EB-2017-0161).

c) The following is a summary of the current negotiations with parties from which land rights need to be acquired for each station.

Marathon TS: Hydro One has received a Land Use Permit and Tree Cutting Permit from the MNRF over the proposed expansion area on the east side of Marathon TS. Subsequent to receiving the Land Use Permit for station expansion, Hydro One submitted an application for Crown Patent to purchase a Fee Simple interest in the lands. To date, Hydro One has received appraisal and survey instructions and Terms of Reference from the MNRF and is in the process of contracting services to complete an appraisal and land survey to facilitate the final purchase of the expansion lands from the MNRF. The appraisal and survey will be used to determine the exact area of the land purchase and a purchase price will be determined according to the market value land rate determined by an Appraisal Institute of Canada appraiser.

Wawa TS: Hydro One has acquired a temporary licence from the property owner to facilitate pre-construction activities on the expansion lands. Negotiations with the Property Manager for Grant Lake Forest Resources are ongoing. An Agreement of

Purchase and Sale will be coordinated with the Property Manager to bring to the owners for final approval and execution. Hydro One will contract a surveyor to complete the final purchase of land to expand Wawa TS.

OEB Board Staff Interrogatory # 9

Reference:

Evidence EB-2017-0182 Exhibit C, Tab 1, Schedule 1, page 5 and Exhibit C, Tab 2, Schedule 1, Attachment 4

Interrogatory:

Preamble:

In its application (EB-2017-0182), NextBridge notes that it is working with Hydro One to address the feasibility of crossing Hydro One transmission infrastructure in certain locations, or, in the alternative, moving the Hydro One transmission structures.

Also included in the evidence is an email from Hydro One to NextBridge expressing its concern over the number of crossing and the impact on reliability of the transmission system and connected customers.

Questions:

a) Please advise as to the current status of discussions with NextBridge on this issue.

b) Are there any potential cost impacts on Hydro One's application (i.e. EB-2017-0194), if Hydro One's infrastructure has to be moved.

c) Please describe the reliability impacts for customers and anything Hydro One/NextBridge intends to do to mitigate these impacts.

Response:

a) Hydro One is currently exchanging final information with NextBridge on the specifics of their proposed line at the two locations. With this information, Hydro One will be able to determine the scope and requirements for the relocation (including if new land rights are required) of the existing T1M structures. This information will be used to prepare the cost estimation/recovery agreement with NextBridge.

b) Since the relocation of two short sections of T1M is unrelated to EWT Station work and is not included in the Hydro One application, there is no cost impact on the Hydro One application. Any Hydro One cost related to the relocation of T1M will be recovered from NextBridge.

c) The NextBridge proposed EWT Line will cross the existing 115 kV transmission lines W2C, M2W, T1M, A5A, 56M1, 57M1, A6P, A7L, A8L, R1LB and R2LB from Wawa to Thunder Bay, which supply Hydro One customers at 23 delivery points, at ten crossings. They will also cross the existing 230 kV transmission lines A21L and A22L between Thunder Bay and Atikokan at one crossing. Any failure of the new EWT Line components (mechanical break of insulators, conductors, hardware and towers) at these crossings could potentially result in a fault on Hydro One's existing lines and interruptions to customers. Because of the proximity of conductors where the lines cross, future maintenance of the EWT Line and its right-of-way at the crossings may also require outage of the existing lines. During the construction of the EWT Line at the crossings, outage of the existing lines will be required. For the radial supplies (W2C, M2W, 56M1 and 57M1), the crossings could potentially increase both the frequency and total duration of outages. For non-radial supplies, the frequency of outages could potentially increase, while the total duration of outages might not increase significantly where the lines can be sectionalized and customers be supplied from one end of the line.

To manage and mitigate the concern for reliability of supply to the customers, Hydro One recommended to NextBridge to reduce the number of crossings from the original 23 crossings to 11 by a) re-routing EWT Line where feasible and, b) relocating two sections of the existing transmission line T1M. For the 11 crossings that still remain, Hydro One has specified design requirements, including minimum vertical clearance between the transmission lines, quality of the material, and 70% maximum utilization for towers, insulators and hardware. The stronger design at the crossings will reduce the probability of failures and mitigate the impact on the supply to the customers of the existing 115 kV circuits and the supply to the Thunder Bay and West of Thunder Bay areas. As a result of the design measures and all the reconfigurations and facility additions at the three terminal stations, the EWT Line and Station projects are expected to improve the overall reliability for all customers in the affected area.

School Energy Coalition Interrogatory # 1

Reference:

B-07-01, Page: 4

Interrogatory:

With respect to the Orangeville TS reconfiguration project, what was the original budged cost and what is that amount if it was similarly escalated to be comparable with the proposed station project.

Response:

The original budgeted cost, in 2010, was $30.7M. Escalated to 2020, the comparable budgeted cost would be approximately $37.5M, using a 2% escalation rate.

School Energy Coalition Interrogatory # 2

Interrogatory:

Please provide a table showing, for each project Hydro One Networks Inc. (transmission and distribution) has completed within the last 10 years that was budgeted to cost at least $100M, the

i) name of the project,
ii) type of project,
iii) budgeted cost at a similar point in time as the proposed station project,
iv) actual cost,
v) explanation of variance (if material),
vi) forecast in-service data at a similar point in time as the proposed station project,
vii) actual in-service date,
viii) explanation of variance (if material).

Response:

The table below contains investments that have been completed in the last 10 years (2009-18) that were budgeted to cost at least $100M at the time of approval. The assumed cost, at a similar point in time as the East-West Tie Station Expansion, is noted as either the cost included in the project's Section 92 Leave to Construct application, the cost included in the rates application filed or internal estimates.

$million			Internal Approval for Execution (Original)				Actual		Variance vs. Similar Time			Assumptions at Similar Point in Time			
Project (i)	Project Type (ii)		Approval Year	Gross Cost	In-Service		Gross Cost (iv)	In-Service (vii)	Cost (%)	In-Service (Years)		Gross Cost (iii)	In-Service (vi)	Reference	Estimate Vintage
Claireville TS - 230kV GIS Replacement	Station		*2006*	120	2009		107	2009	-11%	-		120	2009	EB-2006-0501 - 2007/08 Tx Rates - Project S4	*2005/06*
Claireville x Cherrywood: Unbundle 500kV Circuits	Lines		*2007*	107	2009		115	2010	7%	1		107	2009	EB-2006-0501 - 2007/08 Tx Rates - Project D17	*2005/06*
Hydro One-Hydro Québec 1,250MW Interconnection	Lines		*2007*	124	2009		122	2009	26%	6		97	2003	RP-2000-0068 - S92	*1999/00*
Northeast Transmission Reinforcement (SVCs at Porcupine/Kirkland Lake)	Station		*2008*	109	2010		103	2010 /11	3%	-/1[a,b]		100[c]	2010	EB-2006-0501 - 2007/08 Tx Rates - Project D6	*2005/06*
Southwest Ontario SVCs (Nanticoke/Detweiler)	Station		*2009*	165	2011		114	2011	-23%	-		149	2011	EB-2008-0272 - 2009/10 Tx Rates - Project D13/14	*2007/08*
New 500kV Bruce to Milton Double Circuit Transmission Line	Lines		*2010*	696	2012		697	2012	10%	1		635	2011	EB-2007-0050 - S92	*2006/07*
Midtown Transmission Reinforcement: Leaside x Bridgeman	Lines		*2010*	115	2013		115	2016	10%	3		105	2013	EB-2009-0425 - S92	*2008/09*
Hearn Rebuild	Station		*2011*	104	2013		97	2013	14%	1		85	2012	EB-2010-0002 - 2011/12 Tx Rates - Project D11	*2009/10*
Guelph Area Transmission Reinforcement	Lines/Station		*2014*	103[d]	2016		88	2016	-	1		88	2015	EB-2013-0053 - S92	*2012/13*
Cornerstone Phase 2 [e]	IT		*2008*	183	2009		157	2009	-14%	-		183[e]	2009	EB-2008-0272 - 2009/10 Tx Rates - Project IT1	*2007/08*
Cornerstone Phase 4: CIS [f]	IT		*2011*	180	2012		169	2013	-14%	-1		197	2014	*Internal Estimates*	*2010*
Smart Meter Deployment [g]	Meters		*2006*	670	2010		684	Various	-7%	N/A		733	Various	*Internal Estimates*	*2005/06*

Notes

a) Porcupine: 2010 In-Service
b) Kirkland Lake: 2011 In-Service
c) Initial forecast of $67M excluded the installation of Series Capacitors at Nobel SS ($33M) for a total planned cost of $100M.
d) Costs include the Line/Station component as well as the relocation of an Operating Centre
e) Cornerstone Phase 2 cost includes OM&A and Capital
f) Cornerstone Phase 4: CIS cost includes OM&A and Capital
g) Smart Meter Deployment cost includes OM&A and Capital

Hydro One has included the following projects in the table (Cornerstone Phase 2/4, Smart Meter deployment) but highlights that these projects are not comparable to the facilities related project contemplated by this Application.

The table below contains material variance explanations relative to the originally approved internal budget and schedule for line and station projects.

Material Variance Explanation vs. Assumptions at Similar Point in Time for Lines and Stations Projects

Project	Cost Variance	Schedule Variance
Claireville TS - 230kV GIS Replacement	Lower material and contract costs and unused contingency.	No material variance
Claireville x Cherrywood: Unbundle 500kV Circuits	Higher costs due to material cost escalation, fluctuations in the foreign exchange rate and additional interest expenses as a result of an extended schedule.	Extended implementation schedule as a result of a change in delivery approach from EPC to material supply as a result of no responses to the initial tender request.
Hydro One-Hydro Québec 1,250MW Interconnection	Deferral of in-service date from 2003 to 2009. Installation of 36 steel poles vs. lattice towers as recommended by the OEB	Legal and political issues deferred the commencement of construction until Nov. 2006.
Northeast Transmission Reinforcement (SVCs at Porcupine/Kirkland Lake)	No material variance	The Kirkland Lake SVC in-service date was delayed as a result of the discovery of contaminated soil, and delays in the submission of the Certificate of Approval engineering package to the Ministry of the Environment.
Southwest Ontario SVCs (Nanticoke/Detweiler)	Lower EPC contract costs and unused contingency.	No material variance
New 500kV Bruce to Milton Double Circuit Transmission Line	Increased cost related to line clearing and civil construction costs the result of land acquisition process; construction costs related to delay in attaining EA	4-month in-service delay the result of 15-month delay in attaining EA (resulting in construction start delay), offset by staged construction and favourable weather.
Midtown Transmission Reinforcement: Leaside x Bridgeman	Installation of a new ventilation building, tunnel ventilation, discharge system and project delays.	Challenges with construction of the main tunnel shaft at Mt. Pleasant Road, the learning curve with the use of new technology (ground freeze for excavation of shafts), outage constraints during the summer months, and increased scope of ventilation.
Hearn Rebuild	Higher costs for GIS station and protection and control modification and facilities.	Property acquisition for new switchyard.
Guelph Area Transmission Reinforcement	No material variance.	Due to some unforeseen delays in the delivery of certain equipment and conflicting outages required to install protection equipment.

School Energy Coalition Interrogatory # 3

Interrogatory:

Please provide the full Hydro One business case for the proposed station project.

Response:

There is no approved full business case for this Project at the current time.