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BY EMAIL AND RESS

March 18, 2024

Ms. Nancy Marconi
Registrar
Ontario Energy Board
Suite 2700, 2300 Yonge Street
P.O. Box 2319
Toronto, ON M4P 1E4

Dear Ms. Marconi,

EB-2023-0197 – Hydro One Networks Inc. ("Hydro One") Leave to Construct Application – K4 Reconductoring Project – Interrogatory Responses – Environmental Defence

Hydro One Networks Inc. is submitting responses to Environmental Defence interrogatories in accordance with the OEB's letter of correspondence to Hydro One dated March 12, 2024. The OEB's letter provided Hydro One an extension – to March 18, 2024, in which to file responses to Environmental Defence's interrogatories, having acknowledged that Environmental Defence were also granted an extension to submit its questions to Hydro One on March 5, beyond that established by Procedural Order No.1 in this proceeding – dated February 7, 2024.

Intervenor interrogatory response has been assigned Exhibit I and has been addressed in the following Exhibit order:

Exhibit	Tab	Intervenor
I	2	Environmental Defence

An electronic copy of these Interrogatory Responses has been filed using the Board's Regulatory Electronic Submission System.

Sincerely,

Joanne Richardson

ENVIRONMENTAL DEFENCE INTERROGATORY - 01

Reference:

Exhibit B-5-1

Interrogatory:

a) Please redo the analysis of the conductor sizing alternatives based on the line loss valuation methodology used by the IESO.

b) Please redo the analysis of the conductor sizing alternatives based on the line loss valuation methodology used by the IESO and on the assumption that electricity demand is 10% higher than planned.

c) Please file the latest line loss valuation methodology used by the IESO.

d) Please provide the latest copy of Hydro One's transmission losses guideline.

e) The settlement in Hydro One's recent rates case included the following term regarding the transmission losses guideline:

> Hydro One Transmission will continue participating in the IESO's transmission losses engagement process. Within six months of the final IESO guideline being published as part of the IESO stakeholder process, Hydro One will review and, if necessary, update its transmission line loss guideline.[1]

Please confirm whether this has taken place. If it has, please describe the outcome and the reasons therefore. If it has not, please explain when it will.

f) Please provide a table comparing Hydro One’s methodology for valuing line loses and those used by the IESO, with a column to justify why Hydro One uses a different value.

[1] Settlement Proposal for EB-2021-0110 at page 62.

Response:

a) The IESO evaluates transmission line losses in accordance with its own guideline. That guideline on page 2 states; "This guideline does not apply to transmission loss evaluations that may be conducted by a transmitter for a given transmission project."

As will be discussed in part e) to this response, Hydro One updated its Transmission Line Loss Guideline in December 2023, after the IESO published its Transmission Planning Guideline for line losses, and also after filing this Leave to Construct application. The methodology used by Hydro One in this Application is consistent with Hydro One's then-current Transmission Line Loss Guideline, which considered energy price alone in the evaluation of the cost of losses. The IESO's guideline considers the cost of capacity in addition to the cost of energy in the evaluation of losses.

Table A below shows the conductor sizing analysis as per Hydro One's updated Transmission Line Loss Guideline which considers both capacity costs and energy costs consistent with the IESO's updated line loss methodology. The assessment results in Table A support the same conclusion as reflected in Hydro One's prefiled application evidence, i.e. the most cost-effective conductor alternative is the 997.2 kcmil. (Alt. #4 in Table A)

Table A - NPV Analysis of Alternatives using Hydro One's Updated Transmission Line Loss Guideline

	Alt. #1 ***411***	**Alt. #2** ***477***	**Alt. #3** **732**	**Alt. #4** **997.2**	**Alt. #5** **1443.7**
Capital cost ($M)	13.56	13.57	13.74	13.90	14.65
Annual Losses (MWHR)[1]	1600	1399	919	680	484
Losses @ Sys Peak Hr (MW)	0.11	0.09	0.06	0.05	0.03
Capacity Price ($/MW)[2]	143640	143640	143640	143640	143640
Ann. Peak Cap. Cost Savings ($M)	0.0154	0.0135	0.0089	0.0066	0.0047
Energy Price ($/MWHR)[3]	47.3	47.3	47.3	47.3	47.3
Ann. Energy Cost Savings ($M)	0.0757	0.0662	0.0435	0.0322	0.0229
Annual Losses Cost Saving ($M)	0.0911	0.0797	0.0523	0.0387	0.0276
NPV Cost of Alternative ($M)	(13.49)	(13.2)	(12.7)	**(12.54)**	(12.90)

[1] Losses based on the average flows between 2018-2022
[2] Energy price as per IESO Losses guideline
[3] Losses calculated based on 2022 average Hourly Ontario Energy Price of $47.3/MWH.

b) The current forecast connected load for the K4 115 kV line is provided in Table B1 below.

Table B1 - Forecast Connected Load

Year	2023	2024	2025	2026	2027	2028	2029	2030	2031	2032	2033
MW Load	53	53	53	53	69	69	69	69	69	69	69

When filing this Application, the connected customers on the K4 circuit had not requested any additional capacity beyond the status quo. After the date this Application was filed to the OEB, i.e. November 13, 2023, Hydro One become aware of future forecast load increases on the K4 circuit. The forecast increases in load – from 2027 - are reflected in *Table B1 – Forecast Connected Load* above. This increase in forecast load, could also have been accommodated using Hydro One's minimum standard 411 kcmil conductor. However, given Hydro One's 2023-2027 Joint Rate Application Settlement commitment to consider the impact of line losses, Hydro One assessed the benefit of increasing the conductor size on the intended section of the K4 circuit, measuring approximately 10km.

Table B2 below shows the conductor sizing analysis as per Hydro One's updated Transmission Line Loss Guideline for 10% higher than forecast load (i.e. 69MW x 1.1 = 75.9MW). This assessment results in the same conclusion reflected in Hydro One's original Application evidence.

Table B2 - NPV Analysis using Hydro One's Updated Transmission Line Loss Guideline - 110% of Forecast Load

	Alt. #1 *411*	Alt. #2 *477*	Alt. #3 732	Alt. #4 997.2	Alt. #5 1443.7
Capital cost ($M)	13.56	13.57	13.74	13.90	14.65
Annual Losses (MWHR)[1]	2918	2552	1676	1240	883
Losses @ Sys Peak Hr (MW)	0.20	0.17	0.11	0.08	0.06
Capacity Price ($/MW)[2]	143640	143640	143640	143640	143640
Ann. Peak Cap. Cost Savings ($M)	0.0282	0.0246	0.0162	0.0120	0.0085
Energy Price ($/MWHR)[3]	47.3	47.3	47.3	47.3	47.3
Ann. Energy Cost Savings ($M)	0.1380	0.1207	0.0793	0.0587	0.0418
Annual Losses Cost Saving ($M)	0.1662	0.1453	0.0954	0.0706	0.0503
NPV Cost of Alternative (M)	-15.25	-14.77	-13.74	**-13.29**	-13.44

[1] Losses based on the 110% of planned load.
[2] Energy price as per IESO Losses guideline.
[3] Losses calculated based on 2022 average Hourly Ontario Energy Price of $47.3/MWH.

c) The IESO Transmission Losses Guideline is available via the hyperlink to the IESO's website, below.
https://www.ieso.ca/-/media/Files/IESO/Document-Library/regional-planning/Transmission-Planning-Guideline-Transmission-Losses.pdf

d) Hydro One's Transmission Line Loss Guideline is attached at Exhibit I, Tab 2, Schedule 1, Attachment 1.

e) Confirmed. Hydro One updated its Transmission Line Loss Guideline in December 2023, six months after the IESO published its Transmission Planning Guideline: *Consideration of Transmission System Losses in the Evaluation of Plan Alternatives (Version 1.0)* in June 2023.

f) As discussed in part e), above, Hydro One updated its Transmission Line Loss Guideline in December 2023. The previous guideline's methodology was based on energy price alone. Hydro One's updated guideline also now includes the cost of capacity, consistent with the IESO's transmission line loss guideline.

Filed: 2024-03-18
EB-2023-0197
Exhibit I-2-1
Attachment 1

Transmission Line Loss Guideline – R2

Purpose

The purpose of the Transmission Line Loss Guideline (the "Guideline") is to i) delineate the transmission line loss process that Hydro One will follow and is accountable for, and ii) where transmission line losses are material, describe an investment option analysis methodology for transmission line capital projects.

The Guideline is intended to satisfy the Ontario Energy Board's direction in EB-2019-0082 in respect of transmission line losses[1] and to reflect settlement commitments in EB-2021-0110[2] including to update the Guideline within six months of the IESO losses guideline being published[3].

This Guideline applies to Hydro One Transmission Planning employees (the "Planner") planning for Hydro One's transmission system.

Revision Statement

This is the second revision of this document.

R2 – December 15, 2023

- Include cost to provide capacity at system peak to cover the losses, consistent with the IESO Transmission Planning Guideline (Consideration of Transmission System Losses in the Evaluation of Plan Alternatives), Version 1.0, June 2023.
- Transmission Line Loss Option Analysis workbook updated to include removal costs.

R1 – March 31, 2023

- The process has been revised to include Net Present Value (NPV) analysis for the detailed evaluation.
- Section 6: Non-Leave-to-Construct Investments added.
  Section 10: Template to document loss evaluations.

R0 – February 26, 2021

[1] EB-2019-0082 Decision 23 April 2020, Transmission Line Loss Reduction Opportunities (Issue 8), p. 56.

[2] EB-2021-0110 Decision 29 November 2022, Schedule A (Settlement Proposal 24 October 2022, Transmission Line Losses (Issue 11), p. 62.)

[3] https://www.ieso.ca/-/media/Files/IESO/Document-Library/regional-planning/Transmission-Planning-Guideline-Transmission-Losses.ashx

Principles

- This Guideline shall be consistent with the Ontario Energy Board's direction in EB-2019-0082 in respect of developing a guideline for transmission line losses and reflects settlement commitments in EB-2021-0110.
- Transmission line losses shall be assessed for projects meeting a documented materiality threshold where transmission line investments are considered and where losses may have a material impact on the selection of alternatives.
- Transmission losses are deemed to be material if they change the relative ranking of the transmission alternatives.

Contents

1.0 Background

Line losses occur in the transmission system as power flows from the generation source to the load (i.e., energy dissipated as heat when electricity flows through the transmission system). The losses are dependent on the specific type of transmission line conductor, other transmission assets (i.e., transformers), the amount of power flowing in the line, the operating voltage, and the length of the line.

Hydro One's ability to manage line losses is limited to its role as a Transmission Owner (asset owner) in planning, selecting, maintaining, and operating its transmission equipment, subject to the inherent limitations of such equipment. Options available to manage line losses include the following:

- Upgrading the system voltage or building a new line in parallel with an existing line offers an opportunity for loss reduction. However, rebuilding transmission facilities or building new lines to reduce line losses would not be economically justifiable unless the new facilities are also required to provide capacity or ensure reliability.

- Upgrading the conductor size or using a lower loss conductor type such as the Aluminum Conductor Steel Reinforced Trapezoidal Wire (ACSR/TW) conductor[4] will reduce line losses. However, such upgrades are limited by the capability of the original tower structures, which generally can only accommodate conductors of the same or slightly larger size before costly major tower / structural reinforcements become necessary.

Hydro One historically assessed losses based on hourly energy flows multiplied by the hourly energy price, consistent with the IESO's mechanism for accounting for losses. Recently, the IESO published their Transmission Planning Guideline[3], which presented their new procedure to evaluate system losses. The IESO's new procedure includes the cost of additional system capacity to cover line losses during system peak. Hydro One has revised this Guideline's Option Analysis Methodology to include the cost of additional system capacity required to cover losses during system peak.

2.0 Scope

This Guideline shall be followed when considering transmission system investments which include:

- new customer connections
- local area supply investments
- network system reinforcement
- existing transmission system facility refurbishment

3.0 Option Analysis Methodology

Where transmission line investment alternatives are considered, the Planner shall complete an Options Analysis using the Transmission Line Loss Option Analysis workbook.

The Options Analysis for screening purposes shall be based on expected flows under normal system conditions (e.g., based on typical conditions in the last 12 months in terms of generation dispatch, reactive power dispatch, interface flows, etc.). If the flows are expected to change significantly in the future, (e.g., increase by over 25% over the next 10 years), then the 10th year forecast flows can be used. For the detailed analysis, forecast hourly flows should be used. The Option Analysis shall follow the methodology described below:

[4] The ACSR/TW conductor has the same diameter as the conductor being replaced but has more aluminum content and a 10% to 20% lower resistance. The net effect is to reduce the losses on that line by the corresponding amount.

1. The Planner shall rank the investment alternatives in ascending order by the Planner's estimated net capital investment cost of each alternative.

2. The Planner shall convert the estimated capital investment cost of each alternative to an annual revenue cost (ARC) by applying the annual cost factor (ACF)[5] to the estimated capital investment cost.

3. The Planner shall determine the annual transmission line losses (MWHR) expected to materialize under each alternative. The annual transmission line losses shall be determined by applying the losses at peak flow for 8760 hours (i.e., worst case scenario) for screening purposes.

4. The planner shall determine the Peak MW losses expected to occur at the time of the Ontario system peak demand for each alternative.

5. The Planner shall determine the cost of annual losses (CAL) for the existing system as well as each alternative as follows:

   CAL = (MWHR losses from Step 3 x energy price[6]) + MW Losses from Step 4 x capacity price[7]

6. The Planner shall determine the total annual cost by adding the ARC and CAL and rank the alternative investments to see if the ranking established at step 1 has changed.

7. If the ranking has not changed from that at step 1 (i.e., the lowest cost alternative remains unchanged) and the Total Annual Cost for all alternatives is greater than 10% of the lowest cost alternative, then no further study is required. The losses are deemed to be not material in the selection of the preferred alternative since they do not affect the ranking.

8. The expected change in MW losses compared to the current system resulting from the proposed investment will be reported in the Business Case Summary (BCS) for the preferred alternative. It is to be noted that projects involving the connection of new load and/or new generation may result in a MW loss increase whereas system reinforcement or upgrades will generally result in a MW loss reduction.

9. If the ranking has changed after including losses, or if the Total Annual Costs for any alternative is within 10% of the lowest cost alternative, then further analysis is required. Annual line energy losses and losses at the time of

[5] The Decision Support Department in Strategic Finance shall provide the ACF in the Transmission Line Loss Option Analysis workbook.

[6] The HOEP or the forecast energy price in the IESO Annual Planning Outlook will be used as appropriate.

[7] The capacity price is initially taken as $143,640/MW-year as per the IESO guideline and will be updated as per the IESO.

system peak are determined based on forecast flows[8] for each alternative in each year of the study period. The cost of losses for i^{th} year is evaluated as follows:

$$CAL_i = (\text{MWHR losses})_i \times (\text{energy price})_i + (\text{MW Loss at time of system peak})_i \times (\text{capacity price})_i$$

where i=1, 2, …..N and N is the study period typically 50 years

A Net Present Value (NPV) analysis will then be completed incorporating the CAL. Please consult with Decision Support to run this analysis.

10. The Planner shall rank the alternative investments by NPV.

11. If the ranking at step 1 has changed using the assessment in step 10, then the impact of the alternative investments on transmission line losses shall be considered when selecting the preferred alternative. A sensitivity analysis shall be carried out at different energy prices to determine the impact of energy prices on the NPV of the alternatives and to confirm the selection of the preferred alternative. The expected MW loss increase/reduction at peak load resulting from the preferred alternative will be reported in the BCS for the preferred alternative.

4.0 Examples

Example 1: Ranking of alternatives does not change.

This example shows two investment alternatives being considered to increase supply capacity to an area. The two alternatives are either to reconductor the existing circuits or build a new third circuit. Alternatives 1 and 2 cost $24M and $60M, respectively. The transmission losses under the two alternatives are 1.143MW and 1.027MW respectively and the area load peak is coincident with the Ontario peak.

The alternatives are screened using the losses at peak flow. The ranking of the alternatives does not change when considering transmission line losses. Alternative 1 remains the lowest cost. Therefore, transmission line losses are not material to the investment decision, and a NPV analysis is not required. (Please see Section 10.3 for a screen shot of the workbook for further details).

[8] Losses for future years are based on forecast loads as per the Regional Planning reports, customer information and/or the IESO. In cases where the forecast future loading is expected to see little change or where loading may be limited by equipment or network limitation (e.g., line ratings) losses may be assumed constant for the study period.

(All costs in $M)	Alt. 1 – Reconductor	Alt. 2 – Add new circuit
Planner's Estimated Net Capital Investment	24.0	60.0
Losses at Peak Flow (MW)	1.143	1.027
Losses at System peak	1.143	1.027
Ranking on capital cost	**1**	**2**
Screening		
Annual Revenue Cost (ARC)	1.82	4.54
Cost of capacity to cover losses (CAL -C)	0.16	0.15
Annual Cost of energy losses (CAL-E)	0.47	0.42
Annual cost of Losses (CAL= CAL-C + CAL-E)	0.63	0.57
Total Annual Cost (ARC + CAL)	2.45	5.11
Ranking - Screening	**1**	**2**
Ranking has not changed – Losses are not material to the investment decision. NPV analysis is not required		

Example 2: Ranking of alternatives does change

This example considers conductor selection for a new 6.5km long double circuit 230kV transmission line. Two alternative conductors may be considered: 1443 kcmil ACSR and 1780 kcmil ACSR. The transmission losses under the two alternatives are 0.538 MW and 0.449 MW respectively and the area load peak is coincident with the Ontario peak.

The alternatives are screened using losses at peak flow, which causes the ranking of alternatives to change. Alternative 2 becomes the lowest cost alternative. As the ranking of alternatives changes following the screening assessment, transmission losses are deemed material to the investment decision and a detailed NPV assessment is done.

The detailed NPV assessment shows that while Alternative 2 has a slightly higher initial capital cost than Alternative 1, factoring in the losses makes it the lowest cost and preferred alternative. In this case, transmission losses are material to the investment decision and are therefore taken into consideration for selecting the preferred alternative.

(All costs in $M)	Alternative 1 – 1443 kcmil	Alternative 2 – 1780 kcmil
Planner's Estimated Net Capital Investment	72.6	73.1
Losses at Peak Flow (MW)	0.538	0.449
Losses at System peak	0.538	0.449
Ranking on capital cost	**1**	**2**
Screening		
Annual Revenue Cost (ARC)	5.50	5.54
Cost of capacity to cover losses (CAL -C)	0.08	0.06
Annual Cost of energy losses (CAL-E)	0.22	0.19
Annual cost of Losses (CAL= CAL-C + CAL-E)	0.30	0.25
Total Annual Cost (ARC + CAL)	5.80	5.79
Ranking - Screening	**2**	**1**
Losses affect Ranking of Alternatives - Detailed NPV Analysis Required		
Detailed Assessment		
NPV	-66.7	-66.2
Ranking – Detailed	**2**	**1**

5.0 Business Case Summary (BCS)

The impact of the alternative investments on transmission line losses shall be taken into consideration and shall be documented in the BCS as follows: “This investment is expected to result in transmission line loss increase/reduction of __ MW at peak flow.”

A copy of the Transmission Line Loss Option Analysis workbook, NPV results from Decision Support and the Summary document based on the template in Appendix 10.4 shall be retained in the project folder on Sharepoint.

6.0 Non-Leave-to-Construct Investments

For material line refurbishment investments that do not require a Leave-To-Construct (Section 92) application with the OEB, the Planner will follow the same process and document the analysis. The Planner will prepare the summary at the design phase of the project and retain a copy in the project folder on SharePoint.

7.0 Accountabilities

The Transmission System Planning Division is accountable for the assessment of transmission losses and documenting the relevant findings in the BCS as appropriate.

The Transmission System Planning Division, with support from Decision Support Division for the financial factors, shall maintain the Transmission Line Loss Option Analysis workbook.

Planning is accountable for determining when a NPV analysis is required while Decision Support is accountable for preparing the NPV’s of the alternatives with inputs from the Transmission System Planning and Regulatory teams.

8.0 References

EB-2019-0082 – Decision and Order

EB-2021-0110 – Decision and Order

Hydro One Transmission Losses, EPRI Technical Report, March 2018

IESO Transmission Planning Guideline – Consideration of Transmission System Losses in the Evaluation of Plan Alternatives, Version 1.0, June 2023

9.0 Document Management

Owner/Functional Responsibility	Director, System Planning, Planning
Approver Robert Reinmuller P.Eng.	Director, System Planning, Planning December 15, 2023
Approval Date	December 15, 2023
Effective Date*	December 15, 2023
Last Reviewed Date	March 31, 2023
Next Review Date	December 2024

* Applicable to projects developed after this date.

10.0 Appendices

10.1 Rationale

In the Decision and Rate Order for EB-2019-0082 the Board accepted the settlement agreement between Hydro One and Environmental Defence, which included the development of a guideline for incorporating transmission losses into the planning process:

"3. Hydro One will prepare an internal Hydro One guideline delineating the transmission line loss process that Hydro One will follow and is accountable for. This will be developed in Q1 2020 and refined throughout the IESO stakeholder consultation as necessary.

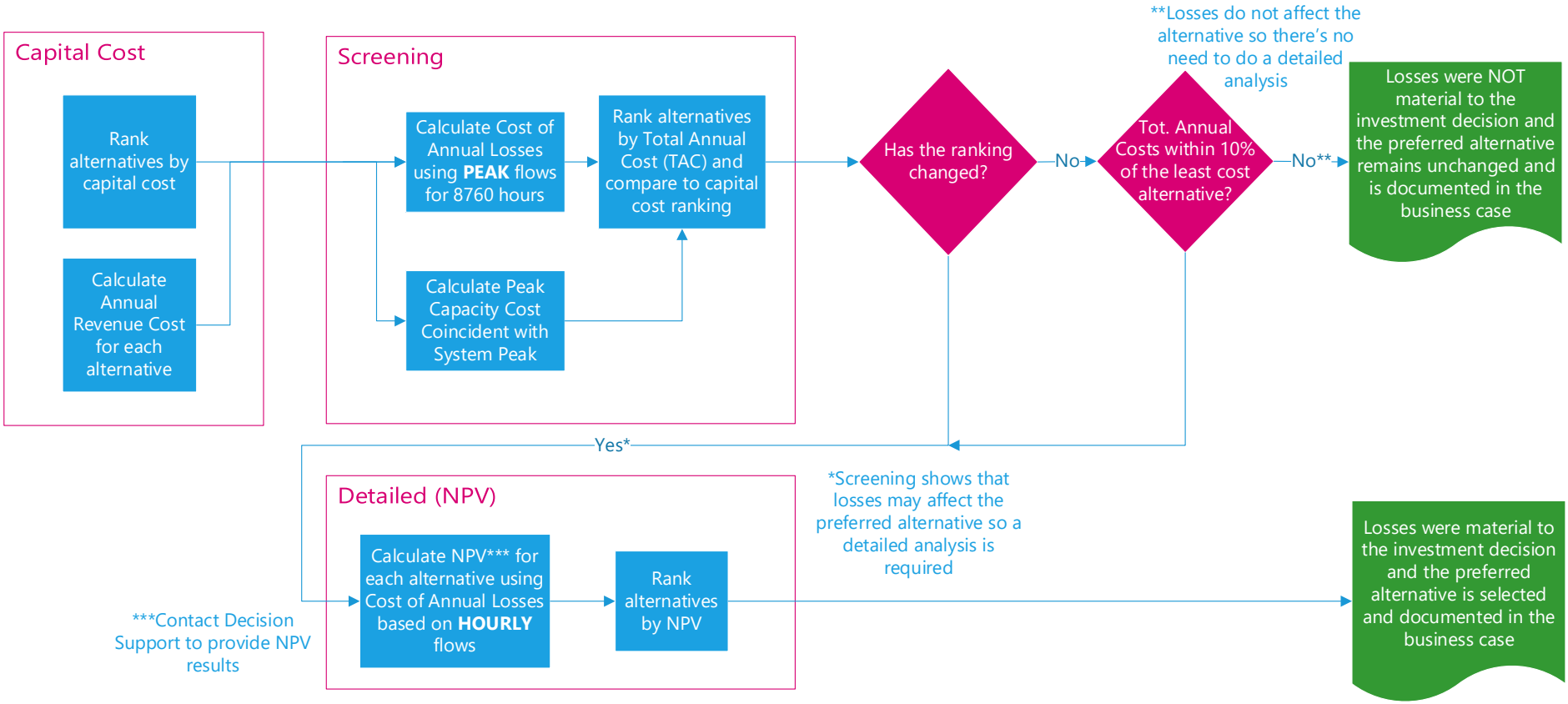
4. In business cases for projects where transmission line losses are material, Hydro One will include an option analysis and report on transmission line losses. This will be implemented over the course of 2020 for any projects meeting a documented materiality threshold."

In the Decision and Rate Order for EB-2021-0110 the Board accepted the settlement agreement between Hydro One and intervenors. The settlement agreement included the following:

a) *Transmission System Line Loss Guideline Update Hydro One Transmission will continue participating in the IESO's transmission losses engagement process. Within six months of the final IESO guideline being published as part of the IESO stakeholder process, Hydro One will review and, if necessary, update its transmission line loss guideline.*

b) *Loss Studies for Projects Not Requiring Leave to Construct Hydro One Transmission will prepare line loss assessments for material investments that do not require a leave to construct application and include such assessments in its TSP ISDs according to Hydro One's Transmission line loss guideline at the design phase of the project. The assessments will be filed as part of Hydro One Transmission's next cost-based rate application.*

10.2 Transmission Line Loss Guideline Flowchart



10.3 Transmission Line Loss Guideline Workbook Examples

10.3.1 Example 1 – Losses Not Material to Investment Decision

Date	25-Nov-23
Planner	E1
Study Title	Reinforce Area Supply - Reconductor or build new line
Comments on Study	Example 1 in Guideline Workbook

Input Data		
Energy Price	$47.30	$/MWH
Capacity Price	$143,640	$/MW

SCREENING

Note: Use actual dollars, not $k or $M

	Least Capital Option 1	Option 2
Option Name	Reconductor with Larger Size conductor	Build a new circuit
Original rank	1	2
Gross Capital Cost	$ 24,000,000	$ 60,000,000
Removals		
Net Capital Cost	$ 24,000,000	$ 60,000,000
Losses at Peak Flow (MW) (Lpf)	1.143	1.027
Losses at Time of System Peak (MW) (Lsp)	1.143	1.027
Annual Losses assuming Peak Flow for Entire Year (MWh) (Lmax)	10,010	8,997
Incremental Annual OM&A	$ -	$ -
Capacity Price ($/MW) (Pmw)	$ 143,640	$ 143,640
Energy Price ($/MWh) (Pmwh)	$ 47.30	$ 47.30
Annual Revenue Cost (ARC)	$ 1,817,635	$ 4,544,087
Cost of capacity to cover losses (CAL-C)	$ 164,141	$ 147,521
Annual Cost of energy losses (CAL-E)	$ 473,485	$ 425,545
Cost of annual losses (CAL) -	$ 637,625	$ 573,066
Preliminary Total Annual Cost	$ 2,455,260	$ 5,117,153
Less Than Option One?		False
Revised Rank	1	2

Losses do not affect Ranking - Detailed Analysis not required

10.3.2 Example 2 – Losses Material to Investment Decision

Date	25-Nov-23
Planner	E2
Study Title	New Double circuit Line - Conductor Selection
Comments on Study	Example 2 in Guideline Workbook

Input Data		
Energy Price	$47.30	$/MWH
Capacity Price	$143,640	$/MW

SCREENING

Note: Use actual dollars, not $k or $M

	Least Capital Option 1	Option 2
Option Name	Use 1443kcmil Conductor	Use 1780 kcmil Conductor
Original rank	1	2
Gross Capital Cost	$ 72,600,000	$ 73,100,000
Removals		
Net Capital Cost	$ 72,600,000	$ 73,100,000
Losses at Peak Flow (MW) (Lpf)	0.538	0.449
Losses at Time of System Peak (MW) (Lsp)	0.538	0.449
Annual Losses assuming Peak Flow for Entire Year (MWh) (Lmax)	4,713	3,933
Incremental Annual OM&A	$ -	$ -
Capacity Price ($/MW) (Pmw)	$ 143,640	$ 143,640
Energy Price ($/MWh) (Pmwh)	$ 47.30	$ 47.30
Annual Revenue Cost (ARC)	$ 5,498,345	$ 5,536,212
Cost of capacity to cover losses (CAL-C)	$ 77,278	$ 64,494
Annual Cost of energy losses (CAL-E)	$ 222,919	$ 186,042
Cost of annual losses (CAL) -	$ 300,198	$ 250,537
Preliminary Total Annual Cost	$ 5,798,542	$ 5,786,749
Less Than Option One?		True
Revised Rank	2	1

Losses affect Ranking of Alternatives - Detailed Analysis Required - See below for information to be provided for NPV analysis

Fill in Detailed section below if Losses change Ranking or if Total Annual Cost is within 10% of the least cost alternative

DETAILED

	Use 1443kcmil Conductor	Use 1780 kcmil Conductor
Option Name		
Gross Capital Cost	$ 72,600,000	$ 73,100,000
Removals	$ -	$ -
Net Capital Cost	$ 72,600,000	$ 73,100,000
Annual Losses (MWh - Detail)*	$ 3,090	$ 2,584
Losses at Time of System Peak (MW)	0.538	0.449
Incremental Annual OM&A	$ -	$ -
Capacity Price ($/MW)	$ 143,640	$ 143,640
Energy Price ($/MWh)	$ 47.30	$ 47.30

**If a forecast is available for losses and/or energy prices, provide it below. If not available assume constant losses over the study period. If not provided Energy price and Capacity will adjusted by Decision Support in line with Ontario Price escalation for future years*

			Option 1			Option 2		
Energy Price ($/MWh)	Capacity Price ($/MW)	Year	Annual Losses (MWh)	MW at System Peak	Annual Cost For NPV Study	Annual Losses (MWh)	MW at System Peak	Annual Cost For NPV Study
47.3	$143,640	1	3,090	0.538	$223,435.32	2,584	0.449	$186,717.56
47.3	$143,640	2	3,090	0.538	$223,435.32	2,584	0.449	$186,717.56
47.3	$143,640	3	3,090	0.538	$223,435.32	2,584	0.449	$186,717.56
47.3	$143,640	4	3,090	0.538	$223,435.32	2,584	0.449	$186,717.56
47.3	$143,640	5	3,090	0.538	$223,435.32	2,584	0.449	$186,717.56
47.3	$143,640	6	3,090	0.538	$223,435.32	2,584	0.449	$186,717.56
47.3	$143,640	7	3,090	0.538	$223,435.32	2,584	0.449	$186,717.56
47.3	$143,640	8	3,090	0.538	$223,435.32	2,584	0.449	$186,717.56
47.3	$143,640	9	3,090	0.538	$223,435.32	2,584	0.449	$186,717.56
47.3	$143,640	48	3,090	0.538	$223,435.32	2,584	0.449	$186,717.56
47.3	$143,640	49	3,090	0.538	$223,435.32	2,584	0.449	$186,717.56
47.3	$143,640	50	3,090	0.538	$223,435.32	2,584	0.449	$186,717.56

10.3.3 NPV Results Provided by Decision Support

	Alternative 1 – 1443 kcmil	Alternative 2 – 1780 kcmil
Net Capital Cost ($M)	**72.6**	**73.1**
Annual Losses (MWHR)	**3090**	**2584**
MW Loss at time of System Peak	**0.538**	**0.449**
Net Present Value ($M)		
Energy and Capacity Prices $47.3/MWH and $143,640/MW	**-66.7**	**-66.2**

10.4 Project Analysis Template

PROJECT ANALYSIS SUMMARY

Date:

A. INVESTMENT DESCRIPTION

Briefly outline the investment and the need that is being addressed.

B. ALTERNATIVES CONSIDERED

Describe the alternatives considered.

Alternative 1 –

Alternative 2 –

Alternative 3 –

Alternative 4 –

C. ANALYSIS AND RECOMMENDATIONS

All the alternatives listed above would address the need to (describe need for investment). An analysis to select the preferred alternative was completed according to Hydro One's Transmission Line Loss Guideline (Fill Table below from Workbook).

Table 1 - SCREENING - Analysis of Line Losses for Alternatives

(All costs in $M)	**Alt. #1**	**Alt. #2**	**Alt. #3**	**Alt. #4**
Planner's Estimated Net Capital Investment				
Losses at Peak Flow (MW)				
Losses at System peak	1	2	3	4
Ranking on capital cost				
Screening				
Annual Revenue Cost (ARC)				
Cost of capacity to cover losses (CAL -C)				
Annual Cost of energy losses (CAL-E)				
Annual cost of Losses (CAL= CAL-C + CAL-E)				
Total Annual Cost (ARC + CAL)				
Ranking - Screening				
If Ranking has not changed – Losses are not material to the investment decision. *If Ranking changes – Losses are material. Carryout NPV analysis to select preferred alternative.*				

Determine whether losses are material to the selection of the preferred alternative. If the ranking of the alternatives changes, then provide brief reasoning for selecting the preferred alternative.

If losses are material to the selection of the alternatives, then list the results of the NPV analysis.

Table 2 - NPV of Alternatives

	Alt. #1	**Alt. #2**	**Alt. #3**	**Alt. #4**
Net Capital Cost ($M)				
Incremental Annual OM&A ($k)				
Annual Losses (MWHR)				
MW Loss at time of System Peak				
Net Present Value ($M)				
Energy and Capacity Prices $47.3/MWH and $143,640/MW				
Price #2				
Price #3				

The Energy Price #1 is based on the IESO Average annual Hourly Energy price for the year of study. The Capacity Price is the cost to provide additional capacity during system peak to cover losses. Prices #2 and #3 are selected for sensitivity analysis to assess the reasonableness of selecting the preferred alternative should energy prices and capacity prices change in the future.

Briefly describe the rationale for selecting the preferred alternative based on the results of the NPV analysis. List any other criteria that may be relevant to the selection of the preferred alternative.

ENVIRONMENTAL DEFENCE INTERROGATORY - 02

Reference:

Exhibit B-5-1, Table 1

Interrogatory:

a) Please provide a table with annual figures comparing the forecast peak and annual electricity demand underlying the conductor sizing alternatives analysis with the forecast peak and annual demand that is consistent with the IESO latest overall demand forecasts.

b) Please provide a table with annual figures comparing the forecast peak and annual electricity demand underlying the conductor sizing alternatives analysis with the forecast peak and annual demand that would arise if all buildings served by the line were to have electrified heating and transportation (i.e. heat pumps and electric vehicles). Please provide all calculations and a live spreadsheet. Please make and state assumptions and caveats as necessary. A high-level analysis with high-level assumptions is sufficient.

c) Assuming Hydro One's proposed solution is implemented, would the conductor need to be replaced in the future if all of the buildings served by the line were to switch to electrified heating and transportation (i.e. heat pumps and electric vehicles)? Please make and state assumptions and caveats as necessary. A high-level analysis with high-level assumptions is sufficient.

Response:

a) There are two direct transmission connected customers connected to the 115kV line K4. The load forecast (MW) for the line is provided in Exhibit I, Tab 2, Schedule 1 part (b) and is based on the most recent information for the two customers. There is no separate IESO load forecast.

b) Please see answer to part (a) above. The two transmission-connected Customers have confirmed that they do not anticipate any further load increase.

c) Hydro One does not have the information to predict the future load requirements for the conditions specified. Hydro One does not expect the conductor will need to be replaced as the proposed conductor has adequate ampacity to supply well beyond the planned load. However, other transmission constraints (e.g. voltage drop, conductor sag) will limit the supply capacity before the ampacity of the conductor is exceeded.

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