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BY EMAIL AND RESS

March 1, 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

Hydro One Networks Inc. is submitting responses to OEB Staff Questions in accordance with Procedural Order ("PO") No.1 issued February 7, 2024.

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

Exhibit	Tab	Intervenor
I	1	OEB Staff

As described in interrogatory response Exhibit I, Tab 1, Schedule 1 part a), this Project's success is dependent on Hydro One being able to execute certain construction tasks during the limited outage window available for the K4 circuit, currently scheduled and approved by both the line-connected customers and the IESO, for the period starting May 29, 2024. To take advantage of this scheduled outage, we respectfully request this application approval proceed as expeditiously as possible.

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

Sincerely,

Joanne Richardson

OEB STAFF INTERROGATORY - 01

Reference:

Exhibit C-1-1, Page 2

Preamble:

Reference 1 describes the physical design for the proposed K4 circuit refurbishment. Hydro One divides the project into two main parts: Section 1 involves sustaining existing transmission facilities by replacing end-of-life assets, while Section 2 entails constructing new facilities parallel to the existing end-of-life assets. Hydro One has proposed this construction methodology in lieu of the option of refurbishing in-situ due to limited outage windows in the second section of the line.

Interrogatory:

a) Please provide more details regarding the limited outage windows on the second section of the line.

b) Please describe any alternative construction methods or strategies evaluated to address the limited outage windows on the second section of the line.

c) Please provide more details to support the necessity of the proposed construction methodology.

Response:

a) The limited outage window, as approved by the two line-connected industrial customers and the IESO is scheduled for the period starting May 29, 2024, the timing of which is driven by the customer's businesses, their needs and preferences. These customers are connected along the second section of the K4 circuit. If outages occur longer than half a day, they will incur operating stoppages and have cost consequences to their business. Historically, these customers have not been able to accommodate more than two interruptions to power supply in any calendar year. This line is located in Northern region of Ontario, and during cold weather conditions, there is risk that if power supply is interrupted, that the hydraulic equipment may seize and not restart due to accumulation of condensation. This would result in operating stoppages and potential damage to the equipment of those customers.

The proposed construction methodology and the associated proposed construction schedule, including the timing of the proposed outage, avoids disruption to power during cold weather months. As such it is critical for Hydro One to be prepared, and have the approvals it needs, to proceed with project execution.

b) Hydro One explored an in-situ "live line" replacement construction methodology. Performing the in-situ "live line" construction methodology in a safe, timely and cost-effective manner requires all structures to be of a similar configuration, however, section 2 utilizes a mixture of structure configurations. If Hydro One were to safely construct an “in-situ replacement, it would require four or more outages, which could not be tolerated by the connected customers (see response in part a, above). Therefore, an in-situ "live line" replacement construction methodology was deemed impractical.

c) As per the justifications outlined in parts (a) and (b) above, refurbishment of the second section of the circuit, via the construction of a new facility situated parallel to the existing facility, enables appropriate work safety, limited customer interruptions (both in terms of the number of outages and the durations of those outages), reduced project cost, and the ability to execute the energization of the project during the available outage windows.

OEB STAFF INTERROGATORY - 02

Reference:

Exhibit B-2-1, Page 1

Preamble:

Hydro One states that the total length of the K4 transmission line is 97 km, with Hydro One owning and managing 64 km, while the remaining portion is customer-owned. The sections of the K4 transmission line owned and operated by Hydro One, not covered in this application, underwent refurbishment in 2011 and are currently deemed to be in good operational condition.

Interrogatory:

a) Please confirm whether Hydro One sought approval from the Board for the refurbishment of the Hydro One-owned K4 transmission line, which was addressed in 2011.

b) Please provide the docket number if applicable.

Response:

a) The K4 circuit's partial refurbishment, of approximately 47 km, as undertaken in 2011 was a like for like conductor replacement, resulting in the installation of a conductor size of 211.6 kcmil[1], which in today's terms is below Hydro One's minimum standard conductor size and rating for 115 kV circuits. As such, this scope of work did not require leave of the OEB under section 92.

   Hydro One is not proposing to refurbish/replace the 2011 refurbished K4 circuit section because it still has significant remaining useful life, and the electrical configuration of the circuit remains sufficient to supply the needs of the customers connected to it.

b) Not Applicable, please refer to part a), above.

[1] The conductor used is more commonly know in the industry as – 4/0 ACSR.

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OEB STAFF INTERROGATORY - 03

Reference:

Exhibit E-1-1, Page 3

Preamble:

Hydro One has applied for approval of the forms of the agreement offered or to be offered to affected landowners pursuant to s.97 of the OEB Act, for permanent land rights and temporary construction rights for access or staging areas required for the duration of the construction period. Hydro One states that there are two privately held properties it requires new land rights for.

Interrogatory:

a) Please confirm the current status of the land rights for both privately held properties.

b) Please confirm that all impacted landowners will have the option to receive independent legal advice regarding the proposed land agreements.

c) Please confirm if there is still a possibility of expropriation as identified in the application risks and contingencies.

Response:

a) Current Status of Property A – Since filing its s.92 Application for this project, Hydro One has secured the property rights required for this Property (PIN # 612280691).

Current Status of Property B – Hydro One has yet to secure the property rights required for Property (PIN # 612280472), however, activities to acquire those rights remain underway and Hydro One expects to be able to secure those rights in a timely manner that will maintain the Project's in-service date[1].

At the date of filing these interrogatory responses, Hydro One has secured Option Agreements on 19 of 20 properties where easements are required.

b) Confirmed.

c) At the time of filing these interrogatory responses to the OEB, Hydro One considers the likelihood of expropriation for the final outstanding property rights to be low. As outlined above, Hydro One expects to be able to obtain voluntary property rights to the

[1] This property is currently registered to a deceased person and therefore requires title rectification from the Ministry of Mines.

one property (PIN # 612280472) where rights remain outstanding, once the issues relating to that property's title, as discussed in Exhibit E, Tab 1, Schedule 1, Section 1.0, Pgs. 3-4 have been rectified.

OEB STAFF INTERROGATORY - 04

Reference:

Not Applicable

Preamble:

Hydro One has applied for leave to construct approval pursuant to s.92 of the OEB Act. The OEB typically imposes a set of standard conditions of approval (Schedule 1) as part of its leave to construct approvals. As stated in the OEB's Filing Requirements for Electricity Transmission leave to construct applications, applicants should expect to meet those standard conditions. If an applicant believes that a condition should be modified, the applicant must request any proposed changes and provide supporting rationale in its application.

Interrogatory:

a) Please comment on the OEB's standard conditions of approval for electricity transmission leave to construct applications noted above. If Hydro One does not agree with any of the specific draft conditions of approval noted below, please identify the specific conditions that Hydro One disagrees with and explain why. For conditions in respect of which Hydro One would like to recommend changes, please provide the proposed changes.

Response:

a) Hydro One takes no issue with the OEB's form of standard conditions of approval for this Project.

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OEB STAFF INTERROGATORY - 05

Reference:

Exhibit B-5-1, Pages 1-3

Preamble:

Hydro One considered five incrementally larger conductor options as part of its cost benefit analysis. Alternative 4 the preferred option, provided additional incremental scope and cost and is analyzed in the table below.

Table 1 - Peak Flow Analysis of Line Losses for Alternatives

	Alt. #1 411 kcmil	Alt. #2 477 kcmil	Alt. #3 732 kcmil	Alt. #4 997 kcmil	Alt. #5 1443 kcmil
Capital Cost ($M)	13.56	13.57	13.74	13.90	14.65
Losses at Peak Flow (MW)[1]	0.31	0.27	0.18	0.13	0.09
Annual Revenue Costs ($M)	1.03	1.03	1.04	1.05	1.11
Annual Cost of losses[2] ($M)	0.13	0.11	0.08	0.06	0.04
Total Annual Cost ($M)	1.16	1.14	1.12	1.11	1.15

Interrogatory:

a) Please explain how Hydro One calculated “Annual Cost of Losses in the table above”.

b) Please explain how Hydro One calculated “Losses at Peak Flow” in the table above.

Response:

a) The annual cost of losses in *Table 1 - Peak Flow Analysis of Line Losses for Alternatives*[1] are calculated on the assumption that the peak flow, and therefore peak losses, occurred every hour of the year. The equation is given below:

Annual cost of losses = Losses at Peak Flow (MW) * Avg. Hourly Ontario Energy price * 8760 (number of hours in year)

Table A, below, shows the calculation for the various conductor sizes using the equation above.

[1] Exhibit B, Tab 5, Schedule 1, Pg. 4.

Table A - Calculation of the Annual Cost of Line Losses

	Description	Annual Cost of Losses				
		411 kcmil	**477 kcmil**	**732 kcmil**	**997 kcmil**	**1443 kcmil**
A	Losses at Peak	**0.3137**	**0.2744**	**0.1803**	**0.1334**	**0.0950**
B	Energy Cost ($/MWHR)	47.3	47.3	47.3	47.3	47.3
C=A*B*8760	Annual Cost of losses ($)	129,983.39	113,703.55	74,697.38	55,272.66	39,354.36
$D=C*10^{-6}$	Annual Cost of losses ($M)	0.13	0.11	0.07	0.06	0.04

b) The general transmission line loss formula used for “Losses at Peak Flow” is given below;

$$\textit{Line Losses} = 3 * I^2 * R$$

where:
- I is the current flowing in the line section in Amperes, and
- R is the line resistance in ohms.

The formula provides the resulting line losses in watts and is multiplied by 10^{-6} to convert to MW.

The portion of the K4 line being upgraded is shown in single line diagram given in Exhibit B, Tab 2, Schedule 1, Attachment 1, and has effectively three sections as follows:

1. Kirkland Lake to Macassa Mill Jct.
2. Macassa Mill Jct. to Macassa #3 Jct.
3. Macassa #3 Jct. to 93K4-89 Jct.

The peak current flow and the resistance of each section are used to calculate the line losses as per the line loss formula above. Details of the “Losses at Peak Flow” calculation are shown in Table B, below.

Table B - Calculation of Line Losses at Peak Flow

Line Section	*I* Peak Flow Current (Amps)	*R* - Resistance (ohms)					Line Losses = $3 * I^2 * R$ (MW)				
		411 kcmil	477 kcmil	732 kcmil	997 kcmil	1443 kcmil	411 kcmil	477 kcmil	732 kcmil	997 kcmil	1443 kcmil
Kirkland Lake to Macassa Mill Jct.	281.4	1.10384	0.968368	0.636168	0.470735	0.335166	0.2622	0.2300	0.1511	0.1118	0.0796
Macassa Mill Jct. to Macassa #3 Jct.	223.01	0.259111	0.223335	0.14672	0.108566	0.077299	0.0387	0.0333	0.0219	0.0162	0.0115
Macassa #3 Jct. to 93K4-89 Jct.	157.24	0.172845	0.14898	0.097872	0.072421	0.051564	0.0128	0.0111	0.0073	0.0054	0.0038
Total MW Losses							**0.3137**	**0.2744**	**0.1803**	**0.1334**	**0.0950**

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OEB STAFF INTERROGATORY - 06

Reference:

Exhibit B-7-1, Page 6

Preamble:

Hydro One provided the costs of similar projects for baseline cost comparisons. Hydro One cites industry changes since project completion, driven by global factors like supply chain issues, interest rate hikes, and inflation, as significantly impacting cost comparability.

Interrogatory:

a) Please provide the unit cost/per km for all incremental conductor sizes.

b) Please explain further why the unit cost is almost double compared to Circuit H9K Reinforcement Project as shown in the application.

Response:

a) Table A, below, provides the unit cost/per km for all incremental conductor sizes considered.

Table A - Unit costs per Km for Incremental Conductor Sizes Considered

	Alt. #1 411 kcmil	Alt. #2 477 kcmil	Alt. #3 732 kcmil	Alt. #4 997 kcmil	Alt. #5 1443 kcmil
Capital Cost ($M)	13.56	13.57	13.74	13.90	14.65
Kilometres Addressed	10.0	10.0	10.0	10.0	10.0
Unit Cost per Kilometres ($k)	1.36	1.36	1.37	1.39	1.47

b) Table B, below, provides comparative rationale for the increased cost factors of Hydro One's K4 and H9K projects. As mentioned in Exhibit B, Tab 7, Schedule 1 of the application, the K4 Line Refurbishment Project requires more complex construction methods that were not required by the line comparator projects, resulting in more cost. These items include rock drilled foundations for structure installation, rentals of off-road vehicles and other specialized construction equipment vehicle rentals, rider pole installation and removal, existing line facilities removal costs, and the need for real estate acquisitions.

Table B - Cost Comparative Factors

Project Cost Factor	Circuit H9K	Circuit K4	Comment
Year of in-service	2020	2024 (planned)	
Line length	32 km	10 km	Economies of scale and efficiencies gained from longer transmission lines like the H9K line have the potential to produce lower cost per km, compared to similar voltage transmission circuit projects of a shorter length. The efficiencies arise from the ability to spread a transmission project's fixed costs (i.e. those that are not linear in nature, such as; design, engineering, project management, permitting and regulatory approvals, site mobilization and demobilization) over a larger number of units (in this case km).
Tower Structure	Single pole structures	Double pole and H-frame structures	Comparatively, the K4 Project requires a larger and more complex variety of pole structure types, as described and shown in the Exhibit C, Tab 1, Schedule 1, Attachment 1 of the Application. The pole structures designed for the K4 Project include double pole structures and H-frame structures, used to carry a larger size conductor than what was used for H9K Project[1]. In addition to the procurement cost of the poles, the installation of these structure types will require additional time and labour, compared to a single pole structure. The double pole structures, (i.e. those that require 2 holes and 2 vertical structures to be installed simultaneously) require additional complexity/adjustments when constructing. For H-frame structures, the frame is assembled on the ground before being elevated and placed into the drilled holes. This additional complexity requires more time and equipment to complete.

[1] K4 Project will use 997 kcmil (more than double the size) and H9K used 411 kcmil.

Project Cost Factor	Circuit H9K	Circuit K4	Comment
Topography	Flat – no elevation changes	Changes in elevation from structure to structure by +/-10 meters	K4 topography is not flat, so there is additional time required for work crews and equipment to physically access and transport materials to the areas where structures will be installed (i.e. challenging rocky and uneven terrain). Comparatively, H9K's terrain was substantially flatter and less challenging to access, and the movement of equipment, such as a bucket trucks on wheels, were able to assist crews in the installation of the line's structures. Comparatively, some sections of the K4 Project will require a helicopter to place structures where access is challenging. Accessing those areas by road-going equipment is not possible.
Access	The H9K circuit right of way is adjacent to a highway, making site access far easier.	The K4 right of way is several hundred meters removed from existing roadways, requiring new access road construction	The H9K circuit required only 0.2 km access road construction. The K4 Project requires construction of 6 individual access roads (totaling approximately 0.55km) to accommodate equipment and vehicles.
Labour and Material Escalation beyond the OEB-issued inflation factors used in the Escalation Adjustment in Table 2 of B-7-1			While OEB-approved inflation factors have been applied to provide a cost comparable price escalation of the H9K circuit to the K4 circuit replacement, this level of cost increase does not reflect true inflation. Hydro One has utilized the OEB-approved inflation factor to maintain a conservative escalation adjustment. The post COVID-19 inflationary environment has continued to impact project costs by increasing inflationary trends and global supply chain issues. Additionally, the price of essential commodities has a significant impact on project costs.

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