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August 14, 2024

Patrick Wruck
Commission Secretary and Manager
Regulatory Services
British Columbia Utilities Commission
Suite 410, 900 Howe Street
Vancouver, BC V6Z 2N3

Dear Patrick Wruck:

**RE: British Columbia Utilities Commission (BCUC)
British Columbia Hydro and Power Authority (BC Hydro)
Mainwaring Substation Upgrade Project (Project)
Annual Progress Report No. 4
July 1, 2023 to June 30, 2024 (Annual Report)**

BC Hydro writes in compliance with BCUC Order Nos. C-4-22 and G-27-24A to provide Annual Report No. 4 for the Project.

Commercially sensitive and contractor-specific information has been redacted from the public version of the Report. A confidential version of the Report is being filed with the BCUC only, under separate cover. BC Hydro seeks this confidential treatment pursuant to section 42 of the *Administrative Tribunals Act* and Part 4 of the Commission's Rules of Practice and Procedure. BC Hydro requests that the information be held confidential on an ongoing basis, until otherwise determined by the BCUC.

For further information, please contact Joe Maloney at bchydroregulatorygroup@bchydro.com.

Yours sincerely,



Chris Sandve
Chief Regulatory Officer

wc/tl
Enclosure

BC Hydro Mainwaring Substation Upgrade Project

Annual Progress Report No. 4

July 2023 to June 2024

PUBLIC

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1 Background

The objective of the Mainwaring Substation Upgrade Project (the **Project**) is to maintain the reliability of Mainwaring substation, support new customer load connection requests in the Mainwaring area,¹ and address safety, environmental and reputational risks at the substation by replacing two existing power transformers T1 and T3 with two new 150 MVA transformers and replacing the existing 50/60 feeder section with four new indoor gas insulated feeder sections with a total of 28 feeder positions² and all associated equipment. The existing substation fence will be expanded within BC Hydro's property to accommodate a new gas insulated switchgear building.

The BCUC issued Decision and Order No. C-4-22, granting BC Hydro a CPCN for the Project. In Appendix A to Decision and Order No. G-27-24A,³ the BCUC directed BC Hydro to file annual progress reports as follows:

- Actual costs incurred to date compared to the Project cost breakdown table estimate provided in Table 4-2 of the Application, highlighting variances with an explanation of variances greater than 30% for any row number or line item;
- Updated forecast of costs, highlighting the reasons for costs that are forecast to have variances greater than 30% for any row number or line item; and
- The status of Project risks provided in Chapter 6 of the Application, highlighting the status of identified risks, changes in and additions to risks, the options

¹ Supporting new customer load connection requests in the Mainwaring area is an added objective that was reported in the Material Change Report filed January 17, 2024.

² The increase in the number of feeder positions from three to four, and accordingly the increase in number of feeder sections from 21 to 28, is added scope that was reported in the Material Change Report filed January 17, 2024. On May 27, 2024, BCUC issued Order No. G-149-24 to amend the CPCN granted by Order C-4-22 to include this scope change.

³ Order G-27-24A was issued in BC Hydro's Request to Amend the Capital Filing Guidelines proceeding and it amended the period and scope of annual reporting for several Major Projects, including the Mainwaring Substation Upgrade Project.

1 available to address the risks, the actions that BC Hydro is taking to deal with
2 the risks and the likely impact on the Project's schedule and cost.

3 This is Progress Report No. 4 (**Report**), which provides an update on the Project
4 covering the period from July 1, 2023, to June 30, 2024 (**Reporting Period**).

5 During the Reporting Period, a Material Change to the Project scope occurred on
6 December 20, 2023. The change to the Project scope added one more feeder
7 section, with seven feeder positions, to the Project to support customer load
8 connection requests in the Mainwaring area. This will increase the number of feeder
9 positions at the substation to 28. A Material Change report on this scope change
10 was filed on January 17, 2024. On May 27, 2024, BCUC issued Order No. G-149-24
11 to amend the CPCN granted by Order C-4-22 to include this scope change.

12 **2 Project Cost**

13 At the time of the Application, the Project had an Authorized Cost of \$143.3 million
14 with an expected in-service date of October 2026. In December 2022, BC Hydro's
15 Board of Directors approved Implementation Funding for the Project.

16 The Authorized Cost of \$156.3 million was reported in the Mainwaring Progress
17 Report No. 1 that was filed on October 14, 2022. As reported therein, an updated
18 preliminary estimate was completed on August 31, 2022, and had an updated
19 Authorized Cost of \$156.3 million, an increase of 9% of the Authorized Cost of
20 \$143.3 million presented in Table 4-2 in the Application. A Material Change report
21 was not provided for the increase in the Authorized Cost because the increase was
22 less than 10% of the Application amount. The Authorized Cost of \$156.3 million was
23 approved by the BC Hydro Board of Directors in December 2022, as the first
24 approval of these amounts for the purpose of completing the Implementation phase,
25 as reported in Mainwaring Progress Report No. 2 that was filed on February 13,
26 2023.

1 As reported in Progress Report No. 1, an updated preliminary estimate was
2 endorsed by BC Hydro’s Gate Board in September 2022. The updated preliminary
3 estimate had an Expected Cost of \$129.5 million. During the Reporting Period, the
4 approved Expected Cost increased to \$150.5 million due to the \$21.0 million draw
5 on the Project Reserve to fund the addition of one more feeder section, with seven
6 feeder positions, to the Project scope to support customer load connection requests
7 in the Mainwaring area.⁴ The Authorized Cost remains at \$156.3 million.

8 [Table 1](#) provides the actual costs incurred to the end of the Reporting Period. The
9 table also provides the Project’s forecast Expected Cost and Authorized Cost as of
10 June 30, 2024, and a comparison to the Project Cost Range Breakdown provided in
11 Table 4-2 of the Application.

12 As of the end of the Reporting Period, the actual costs incurred total \$42.3 million.
13 The forecast Expected Amount as of the end of the Reporting Period is
14 \$134.8 million.

15 Variances greater than 30% between the Project Cost Range Breakdown provided
16 in Table 4-2 of the Application ([Table 1](#), column A) and i) the Project’s forecast cost
17 as of June 30, 2024 ([Table 1](#), column B) are explained in section [2.1](#); and ii) the
18 Project’s actual costs as of June 30, 2024 ([Table 1](#), column E) are explained in
19 section [2.2](#).

⁴ This addition to the Project scope was described in the Material Change Report filed January 17, 2024. This change to the Project scope is described in section [3](#). On May 27, 2024, BCUC issued Order No. G-149-24 to amend the CPCN granted by Order C-4-22 to include this scope change.

1

Table 1 Project Cost Summary Table as of June 30, 2024⁵

Row No.	Description	A Application filed Nov 2021 (\$M)	B Current Forecast at Jun 30, 2024 (\$M)	C Current Forecast Variance to Application (\$M) B-A	D Current Forecast Variance to Application (%) C/A	E Actuals to Jun 30, 2024 (\$M)	F Actuals Variance to Application (\$M) E-A	G Actuals Variance to Application (%) F/A
1	Pre-Implementation Phase Costs							
	(Excludes Interesting During Construction and Capital Overhead)							
	Implementation Phase Costs							
	Direct Construction Costs							
2	Site Work, Temporary Work, Foundation & Steel Structure							
3	Bus Work & Grounding							
4	Major Equipment ⁶							
5	Gas Insulated Switchgear Feeder Building							
6	Gas Insulated Switchgear							
7	Protection & Control, Automation, SCADA & Telecommunication							
8	Distribution							
9	Asset Dismantle and Removal							
10	General Construction Requirements							
11	Total Direct Construction Costs							

⁵ Due to the use of rounded numbers, certain columns and rows may not calculate precisely to the numbers provided.

⁶ Includes power transformers, instrument transformers, station service transformers, current limiting reactors, neutral reactors, surge capacitors, disconnect switches, and surge arresters.

Row No.	Description	A Application filed Nov 2021 (\$M)	B Current Forecast at Jun 30, 2024 (\$M)	C Current Forecast Variance to Application (\$M) B-A	D Current Forecast Variance to Application (%) C/A	E Actuals to Jun 30, 2024 (\$M)	F Actuals Variance to Application (\$M) E-A	G Actuals Variance to Application (%) F/A
	Indirect Construction Costs							
12	General Management							
13	Engineering & Design							
14	Total Indirect Construction Costs							
15	Implementation Costs							
	(Before Contingency & Loadings)							
16	Contingency							
17	Escalation							
18	Capital Overhead							
19	Interest During Construction							
20	BC Hydro Expected Cost	114.4	134.8 ⁷	20.4	18	42.3	-72.1	-63
21	Project Reserve (Loaded)	28.9	5.8	-23.1	-80	0.0	-28.9	N/A
22	BC Hydro Authorized Cost	143.3	156.3	12.9	9	42.3	-101.0	-70
23	Project Cost Range	143.3 - 91.5 ⁸	148.9-116.6 ⁹					

⁷ In column B, rows 20 and 21 do not add up to row 22 because the forecasted expected amount at completion (column B, row 20) varies over the life of the project and can be less than the approved Expected Cost of 150.5 million. The Project Reserve and Authorized Cost (rows 21 and 22) cannot be increased without approval.

⁸ Estimating accuracy range of +25%/-20% of the Expected Cost of the Implementation phase.

⁹ Estimating accuracy range of +15%/-10% of the Expected Cost of the Implementation phase.

2.1 Project Cost Forecast Variance Explanation

[Table 2](#) below provides the reasons for the variances of 30% or greater between the costs submitted in the Application and the forecast costs as of the end of the Reporting Period as shown in [Table 1](#), column C.

Table 2 Project Cost Forecast Variance Explanation as of June 30, 2024

Row in Table 1 , Column C	Explanation	Total Variance (\$ million)
3	<ul style="list-style-type: none"> • <u>Prior Reports</u>: Increase of \$ [REDACTED] million due to more refined design resulting in increased quantities for various equipment and update to account for market condition changes between November 2021 and September 2022; and \$ [REDACTED] million of escalation when the resin impregnated paper bus Stage 2 contract was awarded. Partially offset by decrease of \$ [REDACTED] million due to lower than expected resin impregnated paper bus contract; and [REDACTED] million for design that was advanced as part of pre-Implementation activities. • <u>Current Report</u>: Increase of [REDACTED] million due to more materials (grounding conductor, support structures and insulators for the tubular bus) than the updated preliminary design estimate. 	[REDACTED]
5	[REDACTED]	[REDACTED]
6	[REDACTED]	[REDACTED]

9		
16	<ul style="list-style-type: none"> • <u>Prior Reports</u>: Decrease of \$ [REDACTED] million due to updated risk contingency quantification analysis and relatively higher completeness of maturity level of project definition deliverables during preparation of the September 2022 updated preliminary design estimate; and \$ [REDACTED] million due to contingency draws for increases to direct construction costs. Partially offset by increase of \$ [REDACTED] million reallocation from escalation (row 17). • <u>Current Report</u>: Increase of \$ [REDACTED] million due to draw on Project Reserve (row 21) to fund the addition of one feeder section to the Project scope. Partially offset by contingency draws of [REDACTED] million to fund the addition of one feeder section. Includes equipment, construction, engineering, and management costs. 	
17	<ul style="list-style-type: none"> • <u>Prior Reports</u>: Decrease of [REDACTED] million due to refined cash flow for Implementation phase, elimination of escalation for phases now complete, and reduction in contingency; \$ [REDACTED] million due to reallocation to contingency (row 16); \$ [REDACTED] million due to reduced forecast; and [REDACTED] million due to realization of escalation when contracts were awarded (rows 3, 4, 5, 6, 8, and 13). • <u>Current Report</u>: Decrease of [REDACTED] million due to realization of escalation when contracts were awarded (rows 3, 4, 6, 7, and 8). 	
19	<ul style="list-style-type: none"> • <u>Prior Reports</u>: Increase of \$ [REDACTED] million due to increased implementation costs (line 15) and interest during construction rates and extending in-service date (explained in Progress Report #1). Partially offset by decrease of \$ [REDACTED] million in forecast. 	

¹⁰ This is associated with the change to the Project scope, noted in section 1, to add one feeder section with seven feeder positions to the Project scope.

	<ul style="list-style-type: none"> • <u>Current Report</u>: Increase of █████ million due to increase in forecast Expected Cost. 	
21	<ul style="list-style-type: none"> • <u>Prior Reports</u>: Decrease of \$ █████ million due to change in the Authorized Cost. Partially offset by increase of \$ █████ million due to the addition of a special reserve for price escalation risk. • <u>Current Report</u>: Decrease of \$ █████ million due to a draw on Project Reserve to fund the addition of one feeder section to the Project scope. 	█████

1 **2.2 Actual Cost Variance Explanation**

2 [Table 3](#) below provides the reasons for the variances of 30% or greater between the
3 costs submitted in the Application and the actual costs incurred as of the end of the
4 Reporting Period as shown in [Table 1](#), column F.

5 **Table 3 Actual Costs Incurred Variance**
6 **Explanation as of June 30, 2024**

7 **3 Project Risks**

8 This section describes the material Project risks that have potential to impact the
9 Project included in Chapter 6 of the Application.¹¹ Over the life of the Project, risks
10 and associated risk treatments are and will be identified, analyzed, monitored, and

¹¹ BC Hydro defines “material” in this case to be any risk with a pre-treatment risk level in the Executive Risk zone, as identified in the Project Delivery Risk Matrix.

- 1 reviewed, in accordance with BC Hydro's project management practices and
- 2 procedures. The material Project risks are summarized in [Table 4](#), below.

1

Table 4 Summary of Material Project Risks and Treatments

From Application dated November 5, 2021 & Newly Identified Risks						Updated for Reporting Period ending June 30, 2024		
1	2	3	4	5	6	7	8	9
Section in Application	Risk Status	Description of Risk Event and Consequence	Consequence Type	Risk Level	Residual Risk Level	Risk Status	Risk Treatments (Identified in the Application or New)	Residual Risk Level
6.3.1	Identified	Risk of this Regulatory Proceeding Impacting the Project Schedule BC Hydro expects to proceed to the Implementation phase of the Project by October 2022 in order to meet the PCB removal timeline. BC Hydro is requesting a decision from the BCUC on whether to grant a CPCN for the Project no later than August 2022.	Financial Loss	10 Probability: Possible (L6) Severity: \$10M to \$100M (S4)	8 Probability: Very Unlikely (L4) Severity: \$10M to \$100M (S4)	Closed	<ul style="list-style-type: none"> Completed - Comprehensive Application Completed - Regulatory schedule allows for a decision by August 2022 Completed - Include a three-month contingency to mitigate impact from the regulatory proceeding Completed - Prepare contingency plan to remove PCB-containing equipment to meet the regulatory timeline 	Not Applicable

6.3.2	Identified	<p>Risk of Transformer Failure</p> <p>Due to the age and condition of the T1 and T3 power transformers, there is a risk of failure and loss of equipment redundancy, resulting in an increased risk of service loss.</p>	Reliability	<p>10</p> <p>Probability: Possible (L6)</p> <p>Severity: Localized load shedding (S4)</p>	<p>8</p> <p>Probability: Very Unlikely (L4)</p> <p>Severity: Localized Load Shedding (S4)</p>	Identified	<ul style="list-style-type: none"> Removed¹² - Install the new T5 transformer on a temporary pad prior to putting T4 in service. Completed - Advance design of the transformers from the Implementation phase to the Definition phase. Ongoing – Implement preventive maintenance for early warning signals of any incipient fault until the transformers are replaced. Ongoing (new) – Backup plan includes ability to transfer up to 40MW load to nearby substations if a second transformer fails during the on-going outage for replacing transformer T1 with higher capacity T5. 	<p>8</p> <p>Probability: Very Unlikely (L4)</p> <p>Severity: Localized Load Shedding (S4)</p>
6.3.3	Identified	<p>Risk of Sunk Costs Associated with Early Equipment Procurement</p> <p>In order to meet the PCB removal deadline, BC Hydro will place orders for long lead time equipment prior to BCUC's decision on whether to grant a CPCN for the Project and prior to approval from BC Hydro's Board of Directors of Full Implementation Funding. This could result in sunk costs for this equipment.</p>	Financial Loss	<p>10</p> <p>Probability: Possible (L6)</p> <p>Severity: \$10M to \$100M (S4)</p>	<p>8</p> <p>Probability: Remote (L5)</p> <p>Severity: \$1M to \$10M (S3)</p>	Closed	<ul style="list-style-type: none"> Completed - Stage the award of the long lead time equipment contracts. Completed - Include an exit clause in the Stage 1 contract. 	Not Applicable

¹² As noted in BC Hydro's response to BCUC IR 1.19.1, the updated construction staging plan no longer requires the temporary installation of T5 to maintain redundancy of supply during construction. Instead, BC Hydro will maintain redundancy of supply to all customers throughout the Project construction period by planning transformer outages during off peak seasons and using the transfer capacity available on the distribution system during those seasons.

6.4.1	Identified	<p>Risk of Missing PCB Deadline due to Schedule Delays</p> <p>There is a risk that equipment containing PCBs will not be removed by the deadline of December 31, 2025, resulting in non-compliance with PCB Regulations and fines.</p>	Reputational	<p>11</p> <p>Probability: Possible (L6)</p> <p>Severity: Loss of trust (S5)</p>	<p>10</p> <p>Probability: Remote (L5)</p> <p>Severity: Loss of Trust (S5)</p>	Closed	<ul style="list-style-type: none"> Completed - Complete critical Implementation phase work in the Definition phase. Completed - Procure long lead time equipment early. Completed - Prioritize construction work for PCB removal: schedule replacement of PCB-contaminated power transformer T1 in 2024 – removal was completed on April 26, 2024. 	Not Applicable
6.4.2	Identified	<p>Risk of Worker Injury in an Energized Substation</p> <p>There is a risk of a worker or equipment violating the Limits of Approach requirements while working in the energized substation, resulting in worker injury or fatality.</p>	Safety - Worker	<p>10</p> <p>Probability: Remote (L5)</p> <p>Severity: Fatality (S5)</p>	<p>9</p> <p>Probability: Very Unlikely (L5)</p> <p>Severity: Fatality (S5)</p>	Identified	<ul style="list-style-type: none"> Ongoing - BC Hydro maintains role of Prime Contractor. Ongoing - Require mandatory Power System Safety Protection and local component training for workers working within the substation. Ongoing - Provide workers with the proper training and work methods. Ongoing - Use mostly BC Hydro internal resources for high-risk work within the energized substation. Ongoing - Review contractor's safety management plan to ensure robust safe work procedures. Ongoing - Coordinate the sequencing of construction tasks to reduce the overlap of activities that may be hazardous. Ongoing - Use physical barriers, warning tapes and signage to isolate live equipment and only allow work in designated areas. Ongoing - Use a safety watcher to oversee work where unqualified workers distance cannot be maintained. 	<p>9</p> <p>Probability: Very Unlikely (L4)</p> <p>Severity: Fatality (S5)</p>

6.4.3	Identified	<p>Risk of Noise Level Exceeding City Bylaw Limits</p> <p>There is a risk that the noise level will be above 45 dBA after installation of the new transformers resulting in complaints from the community.</p>	Reputational	<p>11</p> <p>Probability: Possible (L6)</p> <p>Severity: Loss of Trust (S5)</p>	<p>7</p> <p>Probability: Possible (L6)</p> <p>Severity: Limited Complaints to Company or Shareholder (S1)</p>	Identified	<ul style="list-style-type: none"> • Completed - Specify and order low noise level (70/72 dBA) transformers. • Completed - Make provision for total tank sound enclosure. • Planned - If after installation, noise levels exceed the bylaw noise threshold, BC Hydro will install the total tank sound enclosure to further reduce the noise level at the substation property line. 	<p>7</p> <p>Probability: Possible (L6)</p> <p>Severity: Limited Complaints to Company or Shareholder (S1)</p>
Added in Progress Report No. 2	Identified	<p>Risk of Increased Distribution Material and Installation Effort</p> <p>Due to the need to avoid conflict with City of Vancouver underground existing and planned future services and as well as BC Hydro existing and future Transmission and Distribution infrastructure at the substation, there is a risk of the current design being more complicated and construction more challenging which may result in increased cost.</p>	Financial Loss	<p>9</p> <p>Probability: Likely (L7)</p> <p>Severity: \$1M to \$10M (S3)</p>	<p>8</p> <p>Probability: Possible (L6)</p> <p>Severity: \$100K to \$1M (S2)</p>	Active	<ul style="list-style-type: none"> • Completed - Estimate cost and schedule impact. • Completed - Review assumptions of detailed design studies. • Completed - Assess options to reduce severity. • Ongoing (new)– Consultations with the City of Vancouver • Planned (new) - Constructability reviews 	<p>6</p> <p>Probability: Very Unlikely (L4)</p> <p>Severity: \$100K to \$1M (S2)</p>

<p>Identified during Reporting Period and Added in Progress Report No. 4</p>		<p>Risk of the Fourth Feeder Section Being Added to the Project Scope Due to new customer load connection requests in the Mainwaring area, there is a risk that the fourth feeder section will be added to the project scope, which may result in a cost increase and a schedule delay that impacts the Authorized Cost.</p>	<p>Financial Loss</p>	<p>10 Probability: Possible (L6) Severity: \$10M to \$100M (S4)</p>	<p>8 Probability: Possible (L6) Severity: \$100K to \$1M (S2)</p>	<p>Active</p>	<ul style="list-style-type: none"> • Completed – Approve an increase to the Expected Amount for the cost of the fourth feeder section. • Completed - Obtain firm pricing and issue change orders to the existing equipment supply and for the fourth feeder section supply and confirm delivery schedule. • Completed – Obtain firm pricing and issue change orders to the existing equipment installation, commissioning, and testing contracts for the fourth feeder section equipment. • Ongoing – Follow up with vendors for equipment delivery with the main order and completion of detailed design to ensure remobilization of the contractor is not needed for the fourth feeder sections' installation, commissioning, and testing. 	<p>8 Probability: Possible (L6) Severity: \$100K to \$1M (S2)</p>
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BC Hydro Mainwaring Substation Upgrade Project

Annual Progress Report No. 4

Appendix A

Record of Material Changes

1 Record of Material Changes

2 This Appendix provides a summary record of the material changes that have been
 3 reported to the BCUC.

4 Record of Material Changes Due to Schedule Delay

5 **Table A-1** Reported Material Changes Due to
 6 Schedule Delay

Description of Major Milestone	Date of Material Change Report	Reported Forecast Date	Variance to Application (Section 4.5.1)
PCB Equipment Removal Complete	October 14, 2022 ¹³	July 2025 ¹⁴	6 months
Asset In-Service Date - T5 Transformer	October 14, 2022 ¹³	October 2025	7 months
Project Complete	October 14, 2022 ¹³	June 2028	8 months
Gas Insulated Switchgear Feeder Building Contract Award	August 11, 2023	May 2023	7 months
Asset In-Service Date - T4 Transformer	August 11, 2023	October 2025	13 months

7 Record of Material Changes Due to Project Cost Increase

8 **Table A-2** Reported Material Changes Due to
 9 Project Cost Increases

Description	No. and Date of Material Change Report	Reported Authorized Cost (\$M)
BC Hydro Authorized Amount	N/A	None

¹³ This Material Change Report was filed as part of Progress Report No. 1 on October 14, 2022.

¹⁴ Subsequent to this Material Change being reported in Progress Report #1 on October 14, 2022, the milestone was achieved on April 26, 2024.

1 **Record of Material Changes Due to Change to the Project**
2 **Scope**

3 **Table A-3 Reported Material Changes Due to**
4 **Project Scope Changes**

Application Section No. and Heading	No. and Date of Material Change Report	Reported Explanation of Scope Change
4.2.1 Project Scope	January 17, 2024	The change to the Project scope is to add one more feeder section with seven feeder positions to the Project to support customer load connection requests in the Mainwaring area, thereby increasing the number of feeder positions to 28.