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February 13, 2023

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

Dear Sara Hardgrave:

**RE: Project No. 1599273
British Columbia Utilities Commission (BCUC)
British Columbia Hydro and Power Authority (BC Hydro)
Mainwaring Substation Upgrade Project (Project)
CONFIDENTIAL Semi-Annual Progress Report No. 2
July 1, 2022 to December 31, 2022 (Semi-Annual Report)**

BC Hydro writes in compliance with BCUC Order Nos. C-4-22 and G-243-22 to provide its confidential Semi-Annual Report for the Project. Pursuant to Order C-4-22, which states, in part, that BC Hydro file a Material Change Report as soon as practicable and in any event within 30 days of the date on which a material change occurs, BC Hydro confirms that during the reporting period there were no material changes to the Project.

BC Hydro is providing the confidential Semi-Annual Report to the BCUC only. A public version of the Semi-Annual Report is being filed under separate cover redacting commercially sensitive and contractor-specific information. 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.

February 15, 2023
Sara Hardgrave
Acting Commission Secretary and Manager
Regulatory Services
British Columbia Utilities Commission
Mainwaring Substation Upgrade Project (Project)
CONFIDENTIAL Semi-Annual Progress Report No. 2
July 1, 2022 to December 31, 2022 (Semi-Annual Report)

For further information, please contact Joe Maloney at 604-623-4348 or by email at bchydroregulatorygroup@bchydro.com.

Yours sincerely,



Chris Sandve
Chief Regulatory Officer

jm/kl

Enclosure

BC Hydro Mainwaring Substation Upgrade Project

Semi-Annual Progress Report No. 2

Six Month Period

July 1, 2022 to December 31, 2022

PUBLIC

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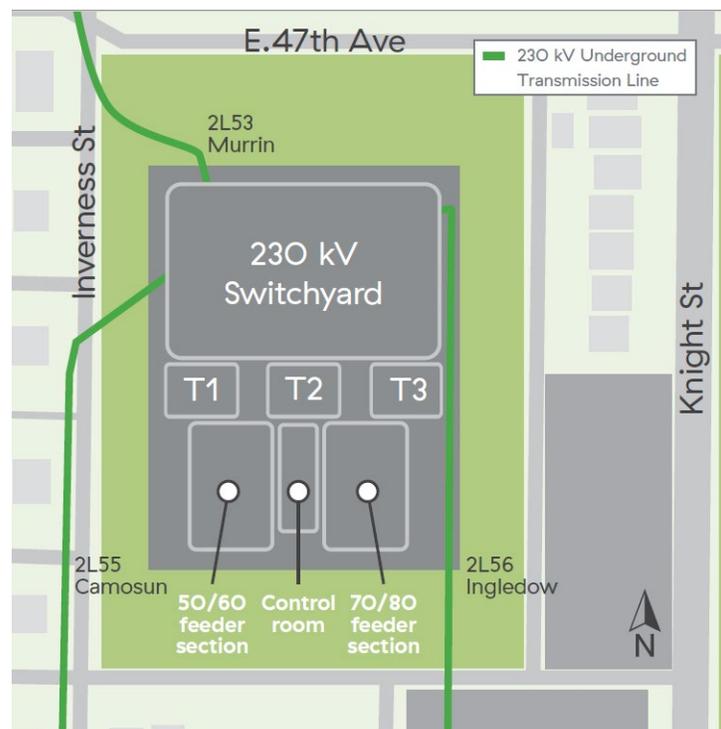
Appendix A Site Photographs

1 Background

1.1 Project Overview

The Mainwaring substation is centrally located within the Metro Vancouver Burnaby sub-region, which comprises 16 substations. The Metro Vancouver Burnaby sub-region has the largest load in the BC Hydro system. Based on peak demand, the Mainwaring substation is the seventh largest distribution substation in the BC Hydro system. The Mainwaring substation is a high criticality substation with a normalized criticality score of 83/100 (with zero being the least critical and 100 being the most critical substation). The Mainwaring substation layout is shown in [Figure 1](#) below.

Figure 1 Mainwaring Substation Layout



The Mainwaring Substation Upgrade Project (**the Project**) addresses significant reliability, safety, environmental and reputational risks due to the deteriorated condition of the T1 and T3 power transformers and the 50/60 feeder section in the

substation. Both the T1 and T3 power transformers have a “Poor” Asset Health Rating (**AHR**) and are reaching their end-of-life. Most of the equipment in the 50/60 series feeder section also have a “Poor” or “Very Poor” AHR. The deterioration of these key assets increases the likelihood of equipment failure, which can cause unplanned outages and impacts to customers, and poses safety risks to workers and the public. Additionally, the presence of Polychlorinated Biphenyls (**PCBs**) in equipment needs to be removed to comply with federal PCB Regulations.¹

The Project will replace the T1 and T3 power transformers with two new 150 MVA transformers and replace the existing 50/60 feeder section with three new indoor gas insulated feeder sections with a total of 21 feeder positions and all associated equipment. The existing substation fence will be expanded within BC Hydro’s property to accommodate a new gas insulated switchgear building.

1.2 Certificate of Public Convenience and Necessity Application and Decision

In November 2021, British Columbia Hydro and Power Authority (**BC Hydro**) filed an application with the British Columbia Utilities Commission (**BCUC**) seeking a Certificate of Public Convenience and Necessity (**CPCN**) for the Project (**Application**). At the time of the Application, the Project had a total cost estimate range from \$91.5 million to \$143.3 million, with an expected in-service date of October 2026. The Project schedule planned for all required PCB-containing equipment to be removed from the site before the federal PCB Regulations compliance deadline of December 31, 2025.

On August 16, 2022, the BCUC issued Order No. C-4-22 granting a CPCN to BC Hydro for the Project. In the Order, the BCUC directed BC Hydro to file semi-annual progress reports and also a Material Change report in the event of a

¹ The PCB Regulations are issued under the *Canadian Environmental Protection Act, 1999*, and are intended to protect the health of Canadians and the environment by preventing the release of PCBs to the environment, and by accelerating the phasing out of these substances.

change to BC Hydro’s plan as set out in the Application that would reasonably be expected to have a significant impact on the Project (i.e., a schedule delay of greater than six months, the total Project cost exceeding 10% of the estimated Project cost, or a change to the Project scope).

BC Hydro files the Progress Report No. 2 (**Report**), which provides an update on the Project covering the period ending December 31, 2022 (**Reporting Period**). The Report complies with project reporting requirements for semi-annual progress reports as set out in Appendix A to Order C-4-22. During the Reporting Period, BC Hydro did not report any material changes pursuant to Order C-4-22, and there were no material changes to report in the Report pursuant to Order C-4-22.

Commercially sensitive numbers and content have been redacted. Public disclosure of the redacted information would harm our negotiating position with suppliers and contractors, and ultimately harm our customers.

2 Project Status

2.1 General Project Status

The [Table 1](#) below provides a high-level status update for the Project.

Table 1 Project Status Dashboard²

🟢 Green: No Concerns; 🟡 Amber: Some Concerns but in Control; 🔴 Red: Serious Concerns

Status as of:	December 31, 2022	
Project Status	🟡	The Project is in Implementation phase. The Project completed all Definition Phase deliverables, obtained approval from the BC Hydro Board of Directors to proceed to Implementation phase in December 2022 and met the end-of-Definition phase milestone date. The overall Project status is amber because the Project is forecast to miss BC Hydro's internal PCB removal deadline of March 31, 2024, but complete PCB removal before the Federal PCB Regulations deadline of December 31, 2025. The forecast PCB removal date remains July 2025.
Safety	🟢	Constructability and design measures were considered during Preliminary Design to address potential safety issues during construction, operation, and maintenance. Construction Services will be the Prime contractor for the site preparatory work. The Prime responsibility will be transferred to BC Hydro Construction Management before the general contractor mobilizes in July 2023.
Scope	🟢	Delivery of approved scope and expected performance or functionality is on track.
Schedule	🟡	The Project progressed on schedule and met the End of Definition milestone in December. The schedule is amber because the Project is forecast to miss BC Hydro's internal PCB removal deadline of March 31, 2024, but complete PCB removal before the Federal PCB Regulations deadline of December 31, 2025. The forecast PCB removal date remains July 2025.
Cost	🟢	The forecast Expected Amount is within the BC Hydro-approved Expected Amount.
First Nations	🟢	The Project has minimal or no incremental adverse impacts on Aboriginal rights or Aboriginal title. Potentially affected First Nations were updated on the Application approval and upcoming site work.
Public Engagement	🟢	No new issues. Contact is maintained with the City of Vancouver and other external stakeholders, including nearby residents. A virtual Open House was held in September 2022.
Environment	🟢	There have been no environmental incidents and no archaeological incidents.

2.2 Major Accomplishments and Work Completed

2.2.1 Procurement Activities

BC Hydro initiated the procurements for long lead time equipment (new power transformers, resin impregnated paper bus, and gas insulated switchgear) in the Definition phase to avoid delayed equipment delivery and schedule impacts.

² The presented key performance indicators are BC Hydro's internal indicators of project health that reflect performance against BC Hydro-approved scope, schedule, and cost.

Specifically, BC Hydro committed to Original Equipment Manufacturer Design (Stage 1) work of \$████ million in the Definition phase for the aforementioned long lead time equipment. Supply and/or installation work (Stage 2) will be awarded in the Implementation phase. These contracts are summarized in section [5.2](#).

In November 2022, BC Hydro initiated the Indigenous procurement opportunity for site preparation and gas insulated feeder building construction by sending the request for proposal to the designated businesses of a First Nation whose traditional territory includes Mainwaring substation.

2.2.2 Contract Management Activities

All contracts are progressing well with no issues. Stage 1 work for the transformer contract is complete. Stage 1 work for the resin impregnated paper bus and gas insulated switchgear reached substantial completion during the Reporting Period.

2.2.3 Engineering and Design

During the Reporting Period, the following engineering and design works were advanced:

- The updated Preliminary Design Estimate (+15% / -10%) was completed on August 31, 2022, and was provided in Progress Report No.1 for the BCUC's information;
- The civil, electrical, and mechanical designs of the new gas insulated switchgear feeder building and the site preparation (e.g., expansion of the substation ground) were progressed from 65% completion towards 95% completion;
- The design of the switchyard, distribution scope, and protection and controls and supervisory control and data acquisition were progressed from 35% completion towards 65% completion; and

- The construction requirements document and drawings have been issued to Construction Services for the early construction work scheduled to start in January 2023.

2.2.4 Construction Activities

There have been limited site construction activities undertaken to date. The following is a list of the key construction activities completed during this Reporting Period:

- Utility survey and utility locates of the north and south quadrants of the substation (see [Figure A-1](#) and [Figure A-2](#) in [Appendix A](#));
- Further refinement of the construction schedule and outage staging plan;
- Issuance of the construction requirements document for early site preparatory works to Construction Services; and
- Engagement of a First Nations designated business, which is also a BC Hydro-approved vegetation management contractor, for tree removal to facilitate site preparation work.

2.2.5 Environment and Archaeology

There are no reportable environmental incidents and no archaeological finds or issues.

During the Reporting Period, soil testing was undertaken outside the existing substation fence within BC Hydro's property to determine the quality of the soil that will be removed to support the development of a Soil Management Plan for off-site disposal.

2.2.6 First Nations

During the Reporting Period, a Project update was shared with First Nations and included the Decision and Order from the BCUC granting a CPCN for the Project. BC Hydro also provided an overview of the upcoming Project activities, including site preparation and tree removal work. No concerns were raised by First Nations.

BC Hydro will share the Soil Management Plan and continue to engage with First Nations on current and upcoming potential procurement opportunities.

2.2.7 Public Engagement

No new issues were identified during the Reporting Period. Work is ongoing to address issues raised to date as summarized in Table 5-2 of the Application. Regular contact is maintained with the City of Vancouver and other external stakeholders, including nearby residents. Some specific activities are summarized below.

During the Reporting Period, discussions continued with the City of Vancouver regarding upcoming construction work to support the work proceeding on schedule. The discussions to date have been productive.

A public open house was held on September 21, 2022. Invitations to the open house were mailed to 245 local residents and commercial businesses on September 8, 2022. The invitations also notified recipients that the BCUC has granted a CPCN for the Project. The MLA for Vancouver-Kensington, Sir Sanford Fleming Elementary School, Sunset Community Center, and those who attended the last open house on September 15, 2021, were notified via e-mail. The September 2022 open house was also advertised on the Project website. Three people attended the open house. Those who registered for the open house and did not attend were contacted to see if they had questions or comments. No issues or concerns were raised as a result of the open house.

Residents and businesses immediately surrounding the Mainwaring substation property were notified by hand-delivered flyers in November 2022 that soil testing activities would be undertaken outside the existing substation fence within BC Hydro's property later in the month. No feedback was received.

A letter advising that construction would be starting at the Mainwaring substation in January 2023 was mailed to 244 stakeholders on December 16, 2022. The MLA for Vancouver-Kensington, Sir Sanford Fleming Elementary School, and Sunset

Community Center were provided e-mail notification of the upcoming construction work.

2.2.8 Regulatory, Permits, and Authorizations

There were no permitting requirements during the Reporting Period.

2.3 Project Challenges

There have been no material project challenges during the Reporting Period.

During the Reporting Period, the Project did not progress the design of all discipline deliverables to the expected 95% completion as more effort and time than expected was required for the development of vendor designs. The design of the distribution scope is requiring more time and effort and may result in an increase in the forecast cost and schedule for the distribution scope. This risk of needing increased distribution material and installation effort is discussed in section [6](#) of this Report.

2.4 Plans for Next Six Months

The Project plans to undertake the following activities from January 2023 to June 2023:

- Construction Services mobilize on site in January 2023, followed by completion of the following site preparation works:
 - ▶ Install a temporary 2.4-metre-high metallic fence on the substation property;
 - ▶ Demolish the existing microwave tower structure and tower foundation;
 - ▶ Remove PCB-contaminated circuit breaker 12CB56;
 - ▶ Construct a temporary parking area in the north quadrant of the substation property; and
 - ▶ Remove approximately 20 trees that are within the footprint of the new gas insulated switchgear feeder building on the south-west side of the substation property.

- Advance the design of all disciplines to 95% completion;
- Issued-for-construction drawings for the gas insulated switchgear feeder building and power transformers work;
- Finalize the vendor design for the gas insulated switchgear and resin impregnated paper bus;
- Award the contract for the gas insulated switchgear feeder building;
- Release the Stage 2 Contract change orders for supply of power transformers, and supply and installation of gas insulated switchgear and resin impregnated paper bus, as summarized in [Table 5](#);
- Award equipment contracts for current limiting reactors, station service transformer and surge arrestors;
- Evaluate opportunities for advancing the PCB Equipment Removal Complete milestone from July 2025 to an earlier date, including replacing the PCB-contaminated low side bushings of power transformer T1; and
- Hold a virtual open house in May 2023, before the mobilization of the civil general contractor.

3 Scope Change Summary

There was no approved change in scope during this reporting period.

4 Project Schedule

As of the end of this Reporting Period (December 31, 2022), the forecast Project in-service date remains as December 2026. As explained in Progress Report No. 1, this is a two-month delay from the in-service date of October 2026 stated in the Application. There is no change to the forecast Project in-service date as compared to the prior report's forecast of September 16, 2022.

[Table 2](#) below provides the forecast dates for the Project’s Major Milestones as of December 31, 2022, and a comparison to the estimated dates provided in Table 4-4 of the Application and the prior report’s forecast of September 16, 2022.³ Variances are explained in section [4.1.1](#).

**Table 2 Project Major Milestones as of
December 31, 2022**

Row No.	Description of Major Milestone	Estimated Date in Application dated Nov 5, 2021	Prior Report’s Forecast as of Sep. 16, 2022	Actual / Current Forecast as of Dec. 31, 2022	Status vs Estimated Date in Application and Comments
1	Stage 1 Contract Award - Transformers	July 2021	July 2021	July 2021	Complete
2	Application Filed with BCUC	November 2021	November 2021	November 2021	Complete
3	Requested BCUC Decision Date	August 2022	August 2022	August 2022	Complete
4	Stage 2 Contract Award – Transformers	October 2022	December 2022	February 2023	Forecasting delay
5	Gas Insulated Switchgear Feeder Building Contract Award	October 2022	March 2023	April 2023	Forecasting delay
6	Construction Services Mobilization	November 2022	January 2023	January 2023	Forecasting delay
7	Contractor Mobilization	January 2023	June 2023	June 2023	Forecasting delay
8	Asset In-Service Date - T4 Transformer	September 2024	October 2024	October 2024	Forecasting delay
9	PCB Equipment Removal Complete	January 2025	July 2025	July 2025	Forecasting delay
10	Asset In-Service Date - T5 Transformer	March 2025	October 2025	October 2025	Forecasting delay
11	Project In-Service Date	October 2026	December 2026	December 2026	Forecasting delay
12	Project Complete	October 2027	June 2028	June 2028	Forecasting delay

³ Of the two forecasts that were provided in the prior report (a forecast as of June 30, 2022, and a forecast as of September 16, 2022), the most recent forecast is presented here.

4.1.1 Schedule Variance Explanation for Forecast as of December 31, 2022

[Table 3](#) below provides the reasons for the variances between the Application dated November 5, 2021, and the Actual / Current Forecast as of December 31, 2022.

Table 3 Schedule Variance Explanation for Forecast as of December 31, 2022

Row in Table 2	Explanation	Variance to Application
4	<ul style="list-style-type: none"> Progress Report No. 1: forecasting delay of two months due to needing more time to complete the Preliminary Design estimate; and Progress Report No. 2: forecasting delay of additional two months due to more time required to assess the sequencing of the replacement transformers and negotiate the price for the Stage 2 Contract. 	4 months
5	<ul style="list-style-type: none"> Progress Report No. 1: forecasting delay of five months due to needing more time to prepare the specifications for the site preparation and gas insulated switchgear building request for proposal; and Progress Report No. 2: forecasting delay of additional one month to extend the bid period to accommodate the year-end holiday season. 	6 months
6	<ul style="list-style-type: none"> Progress Report No. 1: forecasting delay of two months due to needing more time to complete the Preliminary Design estimate; and Progress Report No. 2: no change. 	2 months
7	<ul style="list-style-type: none"> Progress Report No. 1: forecasting delay of two months due to needing more time to complete the Preliminary Design estimate; and Progress Report No. 2: forecasting delay of additional three months due to delay in contract award and time needed by the contractor to complete pre-mobilization submissions. 	5 months
8	<ul style="list-style-type: none"> Progress Report No. 1: forecasting delay of one month due to the timing of available outage window for replacing the transformer; and Progress Report No. 2: no change. 	1 month
9	<ul style="list-style-type: none"> Progress Report No. 1: forecasting delay of six months due to the timing of available outage window for replacing the transformer and due to leaving the T1 power transformer in place longer to eliminate the temporary installation of the T5 power transformer.⁴ While the July 2025 PCB removal completion date still meets the December 31, 2025 deadline as required by federal regulation, BC Hydro is implementing the risk treatments listed in section 6 to be in compliance; and Progress Report No. 2: no change. 	6 months ⁵

⁴ As noted in BC Hydro’s response to BCUC IR 2.27.1, during review of the construction outage staging plan with Transmission & Distribution System Operations, BC Hydro identified that the temporary installation of the T5 power transformer could be eliminated if the sequence was modified. By leaving the T1 power transformer in place longer and removing the T3 power transformer first, the remaining transformer capacity is higher, and BC Hydro is able to rely on Distribution circuit ties for the remaining supply redundancy.

⁵ Variance was reported as a “material change” to the Project schedule in Progress Report No.1.

Row in Table 2	Explanation	Variance to Application
10	<ul style="list-style-type: none"> Progress Report No. 1: forecasting delay of seven months due to the timing of available outage window for replacing the transformer and due to leaving the T1 power transformer in place longer to eliminate the temporary installation of the T5 power transformer;⁴ and Progress Report No. 2: no change. 	7 months ⁵
11	<ul style="list-style-type: none"> Progress Report No. 1: forecasting delay of two months due to needing more time to complete the Preliminary Design estimate; and Progress Report No. 2: no change. 	2 months
12	<ul style="list-style-type: none"> Progress Report No. 1: forecasting delay of two months due to needing more time to complete the Preliminary Design estimate, plus delay of six months to allow more time after the in-service date to prepare and review the Project Completion and Evaluation Report, including providing a briefing to BC Hydro's Board of Directors, before filing the Project Completion and Evaluation Report with the BCUC; and Progress Report No. 2: no change. 	8 months ⁵

5 Project Costs

5.1 Project Cost Summary as of December 31, 2022

As reported in Semi-Annual Progress Report No. 1, an updated preliminary estimate was endorsed by BC Hydro's Gate Board on September 16, 2022. The updated preliminary estimate has an Expected Amount of \$129.5 million, Authorized Amount of \$156.3 million, and estimating accuracy range of +15%/-10% around the Expected Amount of the Implementation phase. The Expected Amount and Authorized Amount were approved by the BC Hydro Board of Directors in December 2022; this is the first approval of these amounts for the purpose of completing the Implementation phase.

As of the end of the Reporting Period (December 31, 2022), the actual costs incurred total \$10.9 million. The forecast Expected Amount as of December 31, 2022, is \$128.7 million, a decrease of \$0.8 million from the prior report's forecast of September 16, 2022.

[Table 4](#) below provides the actual costs incurred to December 31, 2022. The table also provides the forecast Expected Amount and Authorized Amount as of December 31, 2022, and a comparison to the Project Cost Range Breakdown

provided in Table 4-2 of the Application and the prior report's forecast of September 16, 2022.⁶

Variances greater than \$1.0 million, between the Project Cost Range Breakdown provided in Table 4-2 of the Application (Table 4, column A) and the Project's forecast cost as of December 31, 2022 (Table 4, column E) are explained in section [5.1.1](#).

⁶ Of the two forecasts that were provided in the prior report (a forecast as of June 30, 2022, and a forecast as of September 16, 2022), the most recent forecast is presented here.

Table 4 Project Expenditure Summary - Application, Forecast and Actual Cost as of December 31, 2022⁷

Row No.	Description	Estimate Analysis			Forecast Analysis					Actuals Analysis		
		A	B	C	D	E	F	G	H	I	J	K
		Project Cost Range in Application dated Nov. 5, 2021 (\$M)	Implementation Approval ⁸ (\$M)	Variance to Application [B-A]	Prior Report's Forecast of Sep. 16, 2022 ⁹ (\$M)	Current Forecast as of Dec. 31, 2022 (\$M)	Variance to Prior Report (\$M) [E-D]	Variance to Application (\$M) [E-A]	Variance to Application % [G/A]	Actuals to Dec. 31, 2022 (\$M)	% of Current Forecast [I/E]	% of Application [I/A]
1	Pre-Implementation Phase Costs Excluding Interest 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 ¹⁰	█	█	█	█	█	█	█	█	█	█	█
5	Gas Insulated Switchgear Feeder Building	█	█	█	█	█	█	█	█	█	█	█
6	Gas Insulated Switchgear	█	█	█	█	█	█	█	█	█	█	█
7	Protection & Control, Automation, SCADA & Telecommunication	█	█	█	█	█	█	█	█	█	█	█
8	Distribution	█	█	█	█	█	█	█	█	█	█	█

7 Numbers may not add up due to rounding

8 Implementation Approval refers to cost breakdown for the Expected Amount and Authorized Amount that are approved by the BC Hydro Board of Directors, as of the end of the Reporting Period. The basis for the Implementation Approval shown here is the updated preliminary estimate as of September 16, 2022.

9 Updated Preliminary Estimate as of Sep 16, 2022

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

Row No.	Description	Estimate Analysis			Forecast Analysis					Actuals Analysis		
		A	B	C	D	E	F	G	H	I	J	K
		Project Cost Range in Application dated Nov. 5, 2021 (\$M)	Implementation Approval ⁸ (\$M)	Variance to Application [B-A]	Prior Report's Forecast of Sep. 16, 2022 ⁹ (\$M)	Current Forecast as of Dec. 31, 2022 (\$M)	Variance to Prior Report (\$M) [E-D]	Variance to Application (\$M) [E-A]	Variance to Application % [G/A]	Actuals to Dec. 31, 2022 (\$M)	% of Current Forecast [I/E]	% of Application [I/A]
9	Asset Dismantle and Removal	█	█	█	█	█	█	█	█	█	█	█
10	General Construction Requirements	█	█	█	█	█	█	█	█	█	█	█
11	Total Direct Construction Costs	█	█	█	█	█	█	█	█	█	█	█
	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 Amount	114.4	129.5	15.1	129.5	128.7	-0.8	14.3	12	10.9	8	10
21	Project Reserve (Loaded)	28.9	26.8	-2.1	26.8	27.6	0.8	-1.3	-4	0.0	0	0
22	BC Hydro Authorized Amount	143.3	156.3	13.0	156.3	156.3	0.0	13.0	9	10.9	7	8
23	Project Cost Range	143.3 - 91.5 ¹¹	148.9 - 116.6		148.9 - 116.6							

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

5.1.1 Project Cost Variance Explanation

The table below provides the reasons for the variances between the Application dated November 5, 2021, and the forecast as of December 31, 2022, for variances greater than \$1.0 million.

Cost Variance Explanation for Forecast as of December 31, 2022

Row in Table 4	Explanation	Variance to Application (\$M)
1	<ul style="list-style-type: none"> • <u>Progress Report No.1</u>: \$ [REDACTED] million decrease due to Definition phase contingency not being spent/utilized, and engineering design underspent. Reflected in updated preliminary design estimate of September 16, 2022; and • <u>Progress Report No.2</u>: \$ [REDACTED] million decrease due to further Definition phase engineering design underspent. 	[REDACTED]
2	<ul style="list-style-type: none"> • [REDACTED] • [REDACTED] 	[REDACTED]
3	<ul style="list-style-type: none"> • [REDACTED] • [REDACTED] 	[REDACTED]

¹² While preparing this Report, we noticed that the cost variance explanation provided in Report No. 1 was not clear and could be misleading. In this Table, we have amended the explanation and clarified that the Report No. 1 explanations correspond to the updated preliminary estimate of September 16, 2022.

Row in Table 4	Explanation	Variance to Application (\$M)
5	<ul style="list-style-type: none"> • [REDACTED] • [REDACTED] 	[REDACTED]
6	<ul style="list-style-type: none"> • [REDACTED] • [REDACTED] 	[REDACTED]
8	<ul style="list-style-type: none"> • [REDACTED] • [REDACTED] 	[REDACTED]
9	<ul style="list-style-type: none"> • [REDACTED] • [REDACTED] 	[REDACTED]
10,12	<ul style="list-style-type: none"> • [REDACTED] • [REDACTED] 	[REDACTED]

¹³ BC Hydro recently completed the installation of new gas insulated switchgear feeders at Barnard substation in Burnaby. The gas insulated switchgear building types for the Barnard project and the Mainwaring project are similar.

Row in Table 4	Explanation	Variance to Application (\$M)
17	<ul style="list-style-type: none"> Progress Report No. 1: \$ [REDACTED] million decrease due to Project progression, primarily: refined cash flow for Implementation phase, elimination of escalation for Definition phase as it is now complete, and reduction in contingency. Reflected in updated preliminary design estimate of September 16, 2022; and Progress Report No. 2: \$ [REDACTED] million decrease due to reallocation to contingency (row 16) and \$ [REDACTED] million decrease due to reduced forecast. 	[REDACTED]
19	<ul style="list-style-type: none"> Progress Report No. 1: \$ [REDACTED] million increase due to increased implementation costs before contingency and loadings (line 15), extended in-service date, and increased interest during construction rates; and Progress Report No. 2: \$ [REDACTED] million decrease due to decrease in forecast Expected Amount. 	[REDACTED]
21	<ul style="list-style-type: none"> Progress Report No. 1: \$ [REDACTED] million decrease due to Project progression resulting in a decrease in the P90-P50 estimate. Partially offset by a \$ [REDACTED] million increase due to the addition of a special reserve for price escalation risk; and Progress Report No. 2: \$ [REDACTED] million increase due to decrease in forecast Expected Amount. 	[REDACTED]

5.2 Summary of Individual Contracts Exceeding \$3.0 million

There is no change to the values in [Table 5](#) below as compared to the prior report.

Table 5 Summary of Contracts Exceeding \$3.0 million¹⁴

Description Supplier and Scope of Supply	Initial Contract Value ¹⁵ (\$M)			Expected Equitable Adjustment (\$M)	Expected Forecast Contract Cost (\$M)	Actuals to end of Reporting Period (\$M)
	Stage 1 (Design)	Stage 2 (Supply and/or Installation)	Total			
Hyundai Electric Energy System Co c/o Hyundai Electric America Corp. Power Transformer	████	████	████	████	████	████
ABB Inc. Medium Voltage Gas-Insulated Switchgear	████	████	████	████	████	████
MindCore Technologies Inc. 25kV Resign Impregnated Paper Bus	████	████	████	████	████	████
Total	████	████	████	████	████	████

6 Project Risks

This section describes the material¹⁶ Project risks that have potential to impact the Project. Over the life of the Project, risks and associated risk treatments are and will be identified, analyzed, monitored, and reviewed, in accordance with BC Hydro’s project management practices and procedures.

¹⁴ Numbers may not add up due to rounding.

¹⁵ Estimated value at the time the contract was awarded.

¹⁶ 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, which was provided in Appendix O of the Application.

Table 6 Summary of Material Project Risks and Treatments

From Application dated Nov 5, 2021						Updated for Reporting Period ending December 31, 2022			
1	2	3	4	5	6	7	8	9	10
Section in Application	Risk Status ¹⁷	Description of Risk Event and Consequence	Consequence Type	Risk Level	Residual Risk Level	Risk Status	Risk Treatments (Identified in the Application or New)	Treatment Status	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)	Treated	Comprehensive Application	Complete	8 Probability: Very Unlikely (L4) Severity: \$10M to \$100M (S4)
							Regulatory schedule allows for a decision by August 2022	Complete	
							Include a three-month contingency to mitigate impact from the regulatory proceeding	Complete	
							Prepare contingency plan to remove PCB-containing equipment to meet the regulatory timeline	Complete	
6.3.2	Identified	Risk of Transformer Failure 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.	Reliability	10 Probability: Possible (L6) Severity: Localized load shedding (S4)	8 Probability: Very Unlikely (L4) Severity: Localized load shedding (S4)	Identified	Install the new T5 transformer on a temporary pad prior to putting T4 in service	Removed ¹⁸	8 Probability: Very Unlikely (L4) Severity: Localized load shedding (S4)
							Advance design of the transformers from the Implementation phase to the Definition phase	Complete	
							New: Implement preventive maintenance and enhanced surveillance for early warning signals of any incipient fault until the transformers are replaced	In progress	
6.3.3	Identified	Risk of Sunk Costs Associated with Early Equipment Procurement 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.	Financial Loss	10 Probability: Possible (L6) Severity: \$10M to \$100M (S4)	8 Probability: Remote (L5) Severity: \$1M to \$10M (S3)	Treated	Stage the award of the long lead time equipment contracts	Complete	8 Probability: Remote (L5) Severity: \$1M to \$10M (S3)
							<ul style="list-style-type: none"> Include an exit clause in the Stage 1 contract 	Complete	

¹⁷ Instances of "Active" risk status in the Application were errors because "Active" means that the risk event had occurred, and the consequence may or may not have occurred. The correct risk status is "Identified" because the risk event had been identified and had not occurred and treatment plans may still have been in development.

¹⁸ 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.

From Application dated Nov 5, 2021						Updated for Reporting Period ending December 31, 2022			
1	2	3	4	5	6	7	8	9	10
Section in Application	Risk Status ¹⁷	Description of RiskEvent and Consequence	Consequence Type	Risk Level	Residual Risk Level	Risk Status	Risk Treatments (Identified in the Application or New)	Treatment Status	Residual Risk Level
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>	Identified	<ul style="list-style-type: none"> Complete critical Implementation phase work in the Definition phase Procure long lead time equipment early Prioritize construction work for PCB removal Prepare a contingency plan for removal of PCB-containing equipment to meet the regulatory timeline 	<p>Complete</p> <p>In progress</p> <p>In progress</p> <p>Complete</p>	<p>10</p> <p>Probability: Remote (L5)</p> <p>Severity: Loss of trust (S5)</p>
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 (L4)</p> <p>Severity: Fatality (S5)</p>	Identified	<ul style="list-style-type: none"> BC Hydro maintains role of Prime Contractor Require mandatory Power System Safety Protection and local component training for workers working within the substation Provide workers with the proper training and work methods Use mostly BC Hydro internal resources for high-risk work within the energized substation Review contractor's safety management plan to ensure robust safe work procedures Coordinate the sequencing of construction tasks to reduce the overlap of activities that may be hazardous Use physical barriers, warning tapes and signage to isolate live equipment and only allow work in designated areas Use a safety watcher to oversee work where unqualified workers distance cannot be maintained 	<p>Planned</p> <p>Planned</p> <p>Planned</p> <p>Planned</p> <p>Planned</p> <p>In progress</p> <p>Planned</p> <p>Planned</p>	<p>9</p> <p>Probability: Very Unlikely (L4)</p> <p>Severity: Fatality (S5)</p>

From Application dated Nov 5, 2021						Updated for Reporting Period ending December 31, 2022			
1	2	3	4	5	6	7	8	9	10
Section in Application	Risk Status ¹⁷	Description of Risk Event and Consequence	Consequence Type	Risk Level	Residual Risk Level	Risk Status	Risk Treatments (Identified in the Application or New)	Treatment Status	Residual Risk Level
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>	7	Identified	<ul style="list-style-type: none"> Specify and order low noise level (70/72 dBA) transformers Make provision for total tank sound enclosure¹⁹ 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>Complete</p> <p>Complete</p> <p>Planned</p>	<p>7</p> <p>Probability: Possible (L6)</p> <p>Severity: Limited Complaints to Company or Shareholder (S1)</p>
New		<p>Risk of Increased Distribution Material and Installation Effort</p> <p>Due to the results of more detailed design studies during the Reporting Period, there is a risk of needing additional duct banks and inspection holes. This increase in distribution material and effort may result in increased cost and schedule.</p>	Financial Loss	<p>9</p> <p>Probability: Likely (L7)</p> <p>Severity: \$100K to \$1M (S2)</p>		Identified	<ul style="list-style-type: none"> Estimate cost and schedule impact Review assumptions of detailed design studies Assess options to reduce severity 	<p>Planned</p> <p>Planned</p> <p>Planned</p>	<p>9</p> <p>Probability: Likely (L7)</p> <p>Severity: \$100K to \$1M (S2)</p>

¹⁹ The cost of the total tank sound enclosure is included as part of the Project contingency, consistent with BC Hydro's response to RCIA IR 1.22.2.1.3.

BC Hydro Mainwaring Substation Upgrade Project

Semi-Annual Progress Report No. 2

Appendix A

Site Photographs

Figure A-1 Locating Utilities, North End of Substation Property, November 2022



Figure A-2 Exposing a Duct Using Hydrovac, North End of Substation Property, November 2022

