BC Hydro
Power smart

6911 Southpoint Drive (B03)
Burnaby, BC
V3N 4X8

July 30, 2024

[redacted]

RE: CEAP IR 118 - [redacted] - Interconnection Feasibility Study Report

Enclosed is the Interconnection Feasibility study report for the proposed [redacted] submitted under Attachment M-2: Transmission Service and Interconnection Service Procedures for Competitive Electricity Acquisition Process (CEAP) of the Open Access Transmission Tariff (OATT). This letter provides a non-binding good faith estimate of the cost and time to construct the facilities required to interconnect your project to BC Hydro's Transmission System, being the Network Upgrades, based on the findings of the Interconnection Feasibility study.

Open Access Transmission Tariff

The OATT defines Network Upgrades as additions, modifications, and upgrades to BC Hydro's Transmission System required at or beyond the Point of Interconnection to accommodate the interconnection of the Generating Facility to the BC Hydro's Transmission System. Pursuant to the OATT, BC Hydro will design, procure, construct, install, and own the Network Upgrades. While BC Hydro will pay the costs for the Network Upgrades, the Interconnection Customer provides security for such costs.

Cost Estimate

Based on the Interconnection Feasibility study, the non-binding good faith estimated cost (typical accuracy range of +150%/-50%) for Network Upgrades required to interconnect your project is $92.4 M.

Major Scope of Work Identified:

- Acquire adequate property for a new switching station close to the existing transmission line 1L10
- Construct a new outdoor 132 kV, 3- circuit breaker ring bus switching station
- Construct a new control building and other required facilities and infrastructure
- Supply and install 15 mid-span structures and reinforce 40 structures for telecommunication ADSS cable (Option 1)
- Supply and install microwave tower, waveguides, antennas, and other required telecommunications equipment
- Supply and install protection relays and other required protection equipment

Exclusions:

- GST
- Right-of-ways
- Permits

Key Assumptions:

- The transmission cost of Option 1 is used in the cost estimate (Costs for Option 1 and Option 2 are similar)
- Construction will be done by contractor
- 3 years of construction is considered
- No expansion of existing stations or control buildings to accommodate any new equipment
- Early Engineering and Procurement
- No piles or ground improvements will be required
- No contaminated soil will be encountered during construction

Key Risks:

- Additional Right of Way or acquisition of more property may be required
- No defined supply chain strategy, construction costs may increase depending on delivery method
- Cost of construction may increase based on geotechnical condition of the actual project site
- Project schedule may be longer than expected, leading to increase costs
- Cost of materials and major equipment may be affected by market conditions and escalation

Please note that the Revenue Metering requirements and associated costs required to interconnect your project have not been determined at this stage and, therefore, not included in the above estimate. Revenue Metering costs that are attributable to the Interconnection Customer are to be paid in cash. For more details on Revenue Metering requirements and responsibilities, please refer to:

https://www.bchydro.com/content/dam/BCHydro/customer-portal/documents/distribution/standards/ds-rmr-complex-revenue-metering.pdf.

Schedule

Based on the Interconnection Feasibility study, the non-binding good faith estimated in-service date for your project's Network Upgrades is Quarter 3 2031 (calendar year). To achieve this timeline, we may need to expedite certain activities, including engineering design and procurement of long-lead equipment.

Timely actions required from you to minimize risks to the schedule:

- Submission of additional technical data required for the System Impact Study and Facilities Study
- Submission of any required information or document such as demonstration of Site Control
- Execution of Combined Study Agreement and Standard Generator Interconnection Agreement
- Financial commitments and securities

Please note that changes to your interconnection request, delays in data submission, or financial commitments may also impact the target in-service date.

Next Steps

In September 2024, we will issue a final invoice for the Feasibility Study costs. This invoice will reflect the total amount due, taking into account the $15,000 Feasibility Study deposit you have already paid and any remaining amount on the non-refundable $15,000 Interconnection request deposit that we did not spend in reviewing and validating your interconnection request.

If you have any questions, please contact the BC Hydro CEAP Team at ceap2024@bchydro.com.

Sincerely,

Senior Manager, Transmission Interconnections

BC Hydro

Encl.: CEAP2024_IR_118_[redacted]_FeS_Report_final.pdf

[redacted]

Interconnection Feasibility Study

BC Hydro EGBC Permit to Practice No: 1002449

2024 CEAP IR # 118

Prepared for: [redacted]

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Executive Summary

[redacted] the interconnection customer (IC), requests to interconnect its [redacted] (2024 CEAP IR # 118) to the BC Hydro (BCH) system. [redacted] project has Eight (8) [redacted] central inverter and PV collector units with total capacity of 40 MW. The proposed Point of Interconnection (POI) is at a new switching station on BC Hydro's 132 kV line 1L10, approximately 12.45 km from Shawnigan substation (SHA). The IC's project will connect to the POI via a 4.48 km customer-built 132 kV interconnection line. The IC's proposed commercial operation date (COD) is Oct 16, 2028.

To interconnect the [redacted] project and its facilities to the BCH Transmission System at the proposed POI, this Feasibility Study has identified the following conclusions and requirements:

1. A new 132 kV switching station (referred to as "P118T") on 1L10 is required at the proposed POI for interconnecting the IC's generating project to the BCH system. With the new switching station P118T, 1L10 will be segregated into two new lines, temporarily referred to as: 1L10_A (VIT-P118T), 1L10_B (P118T-GOW). The customer-built 132 kV line from switching station P118T to their site substation P118 will be designated as 1L10_C. The temporary line designations will be replaced by permanent designations at a later stage of interconnection study.

2. The connection of [redacted] project does not cause any performance violation (i.e. thermal overload, voltage performance violation or voltage stability concern) under system normal conditions.

3. The connection of [redacted] project will cause a potential backflow issue on SHA transformer T1 under single contingencies. If a backflow at SHA T1 is measured, a Direct Transfer Trip scheme at IC's substation will be initiated to shed or curtail generation at the IC's facility.

4. The IC is required to install anti-islanding protection within their facility to disconnect the IC's wind farm from the grid when an inadvertent island with the local loads forms.

5. The IC's project does not fully satisfy the BC Hydro's reactive capability requirement.

6. A fibre optic cable of approximately 11.5 km running between the new switching station P118T to SHA will be required. With the fibre addition, Structure replacements & reinforcements and mid span structures maybe required due to fibre addition.

7. The new lines 1L10_A and 1L10_B will remain as part of BC Hydro BES and need to be compliant with applicable NERC MRS requirements. The new line 1L10_C (P118T-P118) will be a non-BES line.

8. BC Hydro will provide line protections for 1L10_A, 1L10_B and 1L10_C (BCH end only) protections. As part of the line protection replacements for each of the three lines, telecommunication facilities will be required to accommodate the new protection schemes. The IC shall provide required relays, telecom facility and associated equipment at its facilities to accommodate the new protection schemes.

The above conclusions are made based on the IC's input data and study assumptions listed in Section 4, which represent the best available information on May 22, 2024.

A non-binding good faith estimated cost and time to construct the Network Upgrades required to interconnect the proposed project will be provided in a separate letter to the IC.

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Appendices

Appendix A Plant Single Line Diagram Used for Power Flow Study

Appendix B One-Line Sketch for New Switching Station

Acronyms

The following are acronyms used in this report.

BCH	BC Hydro
CEAP	Competitive Electricity Acquisition Process
COD	Commercial Operation Date
CLD	Colwood substation
DTT	Direct Transfer Trip
EDM	Edmonds Office
ERIS	Energy Resource Interconnection Service
FeS	Feasibility Study
FVO	Fraser Valley Office
GOL	Goldstream substation
GOW	Goward substation
IBR	Inverter-Based Resources
IC	Interconnection Customer
MPO	Maximum Power Output
NERC	North American Electric Reliability Corporation
NRIS	Network Resource Interconnection Service
OATT	Open Access Transmission Tariff
PIK	Pike Lake substation
POI	Point of Interconnection
RAS	Remedial Action Scheme
SIO	South Interior Office
SHA	Shawnigan substation
SVI	South Vancouver Island
TIR	BC Hydro “60 KV to 500 kV Technical Interconnection Requirements for Power Generators”
VITRC	Vancouver Island – Transmission Reinforcement Completion
WECC	Western Electricity Coordinating Council

1 Introduction

Table 1-1 below summarizes the project reviewed in this Feasibility Study.

Table 1-1 Summary of Project Information

Project Name	[redacted]	
Name of Interconnection Customer (IC)	[redacted]	
Point of Interconnection (POI)	At a new switching station on 1L10, 12.45 km from Shawnigan substation	
IC's Proposed COD	16th October 2028	
Type of Interconnection Service	NRIS ☒	ERIS ☐
Maximum Power Injection [1] (MW)	40 MW (Summer)	9 MW (Winter)
Number of Generator Units	8 x 5 MW	
Plant Fuel	Solar	

[redacted] the interconnection customer (IC), requests to interconnect its [redacted] (2024 CEAP IR # 118) to the BC Hydro system. [redacted] project has Eight (8) [redacted] central inverter and PV collector units, adding a total capacity of 40 MW into the BC Hydro system. The proposed Point of Interconnection (POI) is a new switching station on BC Hydro's 132 kV line 1L10, approx. 12.45 km from Shawnigan substation (SHA).

Figure 1-1 shows the South Vancouver Island (SVI) region 132/230 kV transmission system diagram. The SVI region 132/230 kV system has pre-existing branch overload and voltage stability concerns under system contingencies during heavy load conditions. The SVI region 1L10/1L11/1L14 Overload Remedial Action Scheme (RAS) and 2L142 RAS are relied on to address these overload and voltage stability concerns.

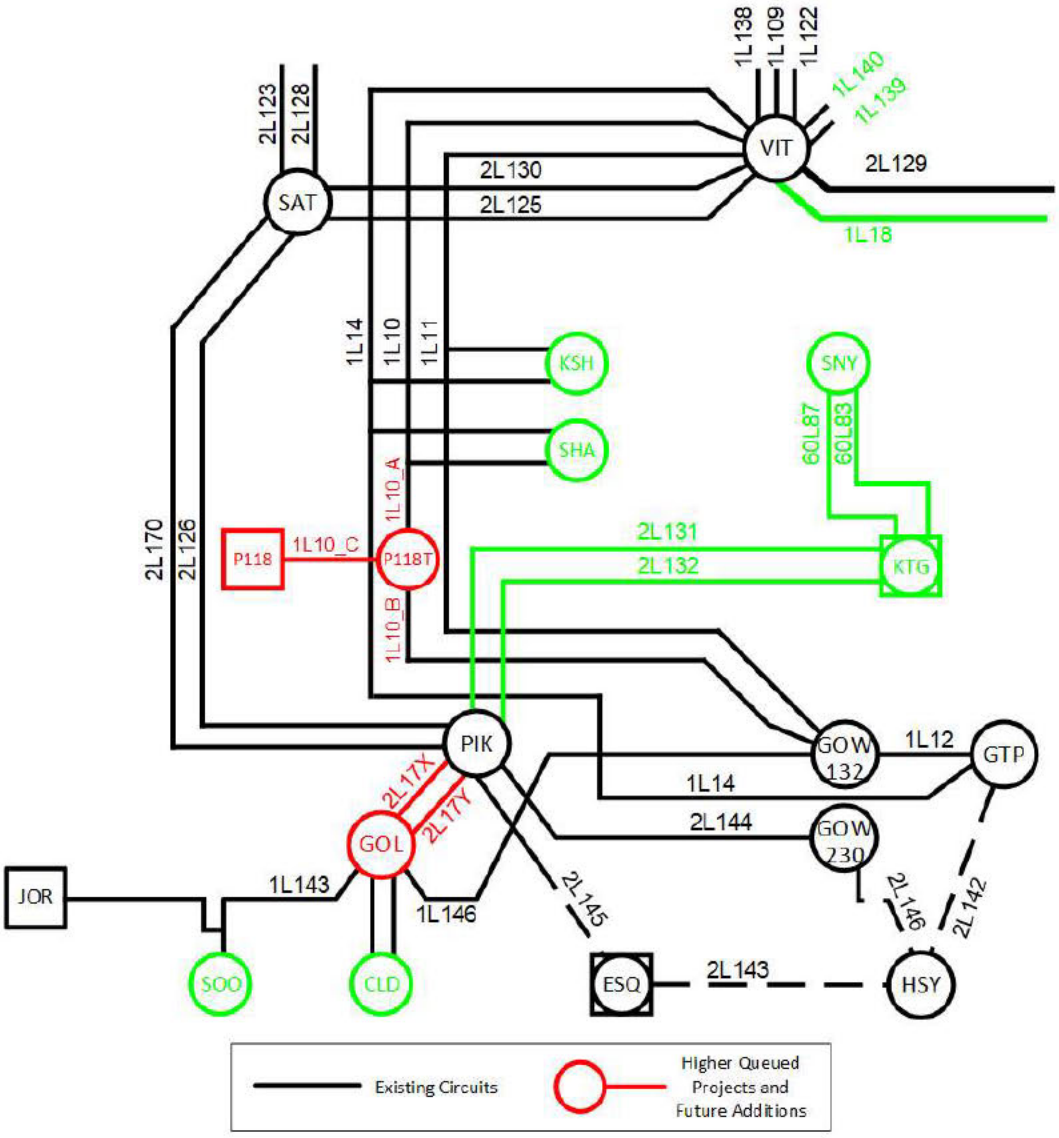

Figure 1-1: South Vancouver Island 132/230 kV Transmission System Diagram with Proposed [redacted] Interconnection and Other Projects

There are two major capital projects in Vancouver Island system planned as follow:

- Vancouver Island – Transmission Reinforcement Completion (VITRC) project in identification phase with target ISD of 2029. This project is scoped to upgrade 1L18 (Vancouver Island Terminal substation – Arnott substation) to 230 kV and redesignate to 2L124.

- CLD (Colwood) Area Study project in identification phase with target ISD of 2029. This project is scoped to build a new 230/132/25kV Goldstream Substation (GOL) in the northwest area of city of Langford to offload existing Colwood Substation (CLD). The transmission component of this project includes two 230 kV parallel line from GOL to Pike Lake substation (PIK) and loop the existing 132 kV transmission circuits 1L143 and 1L146 in-and-out the GOL substation.

2 Purpose and Scopes of Study

This Feasibility Study is a preliminary evaluation of the system impact of interconnecting the proposed project to the BC Hydro system based on power flow and short circuit analysis in accordance with BCH's Open Access Transmission Tariff (OATT). A non-binding good faith estimated cost of required Network Upgrades and estimated time to construct will be provided.

Per OATT, the Feasibility Study is performed individually for each of the participating projects in the CEAP and focuses specifically on the BC Hydro regional transmission system where the proposed generating project is proposed to be constructed. An assessment of the incremental effect on the 500 kV bulk transmission system is beyond this study scope.

This is a "limited scope" study which is restricted to power flow studies of P0, P1 and P2 planning events as defined in TPL-001-4 and short circuit analysis. The study does not address other technical aspects such as transient stability and switching transients and impact of multiple contingencies. These subjects would be addressed in subsequent System Impact Study if the project is a Successful Participant of the CEAP.

In case impact to the adjacent external systems to BC Hydro is observed, such impact would be addressed in subsequent detailed and coordinated studies with the relevant adjacent entities if the proposed interconnection proceeds further.

3 Standard and Criteria

The Feasibility Study is performed in compliance with the North American Electric Reliability Corporation (NERC) and Western Electricity Coordinating Council (WECC) reliability standards, and the BCH interconnection requirements in the TIR, and upon the ratings of the existing BCH transmission facilities described in Operating Orders, specifically:

- NERC standards: TPL-001-4 and FAC-002-3 relevant to the scope of this Feasibility Study.
- WECC criteria TPL-001-WECC-CRT-4 Transmission System Planning Performance, July 1, 2023.
- BC Hydro's 60 kV to 500 kV Technical Interconnection Requirements for Power Generators.
- BC Hydro Operating Order 5T-10, Ratings for All Transmission Circuits 60 kV or Higher, April 16, 2024.
- BC Hydro Operating Order 5T-14, Ratings for All Transmission and Distribution Transformer, November 8, 2022.
- BC Hydro System Operating Order 7T-22 System Voltage Control, September 19, 2023.

4 Assumptions and Conditions

This Feasibility Study is performed based on the IC's submitted data and information available to BC Hydro on May 22, 2024 for the study purpose. Appendix A shows the plant single line diagram for the IC's project used in the study model. Certain assumptions were, as set out below, made to the extent required.

The power flow study cases used in this Feasibility Study are established based upon the BC Hydro's base resource plan and load forecasts available at the time of performing the study, which includes existing and future generations, transmission facilities, and loads in addition to the subject interconnection project in this study. Applicable seasonal conditions and the appropriate study years for the study planning horizon are also incorporated.

Additional assumptions are listed as follows.

1) The regional generation are dispatched to the patterns that stress the transmission system in the study area. In these patterns, the regional generations are typically set to their Maximum Power Outputs (MPO) unless otherwise specified.

2) Vancouver Island – Transmission Reinforcement Completion Project is included in the Feasibility Study model, as the target in-service date for this capital project is March 2029 at the time of performing this study.

3) CLD Integrated Area Study is include in the Feasibility Study model, as the target in-service date for this capital project is March 2030 at the time of performing this study.

5 System Studies and Results

Based upon the IC's submitted information and the area system conditions, a new switching station (referred to as "P118T") on 1L10 is proposed as the POI to interconnect the IC's generating project with the BCH system. There are multiple terminals and multiple sources on the existing line 1L10. The new switching station would help to maintain reliability and adequate protection performance to serve the existing customers and the new addition.

With the new switching station P118T, the existing line 1L10 will be segregated into two new lines, temporarily referred to as: 1L10_A (VIT-P118T) and 1L10_B (P118T-GOW). The proposed customer-built 132 kV line (P118T-P118) will be designated as 1L10_C. The temporary line designations will be replaced by permanent designations at a later stage of interconnection study.

5.1 Power Flow Study Results

Power flow studies were performed to evaluate whether the IC's generating project would cause any unacceptable system performance (e.g. equipment overloads, steady-state voltage violation and voltage instability) and to determine the reinforcement requirement based on steady state performance analysis.

The study focuses on the 2029 light summer (29ls) system load condition which is typically a stressed condition for a generation interconnection project, taking into considerations of factors such as load conditions, seasons and generation patterns. The 2029 heavy summer (29hs) and 2028 heavy winter (28hw), cases are also checked at a high level to capture any possibility of performance violations under high load conditions.

5.1.1 Branch Loading Analysis

Table 5-1 shows a summary of branch loading analysis under system normal and single contingencies (P1, P2) for light summer condition load conditions.

For all the studied load conditions (28hw, 29hs, 29ls), there is no branch overload identified under system normal (P0) and single contingency conditions (P1, P2).

Under the light summer condition (29ls), the study finds current backflows from 25 kV to 132 kV in SHA T1 under contingency of Goward substation (GOW) 1CB3 internal fault (loss of 1L10_B, 1L12, 2L142, and GTP T11). A DTT scheme is

required to curtail or shed the IC's generations at the IC's substation if backflow is observed at SHA.

Table 5-1: Summary of Branch Loading Analysis Results

Case	South Vancouver Island Regional Generation/ Load	IPP's Generator Output	Contingency Identified		Branch Loading		
					1L10_A	SHA T2	SHA T1
			Cate-gory	Description	P118T-SHA	1L10-SHA	1L14-SHA
29LS	306.57 MW /203.8 MW	40 MW	P0	System Normal	85.2 Amps 15.0 %	11.1 MVA 14.8 %	5.1 MVA 6.8 %
			P2	GOW 1CB3[1] internal fault	173.9 Amps 30.6 %	19 MVA 25.3 %	-2.8 MVA 3.8 %
Note 1: This is single contingency causing loss of multiple elements, including 1L10_B, 1L12, 2L142 and GTP T11.							

5.1.2 Steady-State Voltage Analysis

With the connection of the IC's project, the voltage performance under system normal condition and single contingencies is acceptable for all the three load conditions (29ls, 29hs, 28hw). Table 5-2 shows a summery of steady-state voltage performance under system normal conditions.

Table 5-2: Summary of Steady-State Voltage Study Results

Case	South Vancouver Island Regional Generation/ Load	IPP's Generator Output	Contingency		Bus Voltage (P.U.)		
			Cate-gory	Description	GOW 230	HSY 230	ESQ 230
29LS	306.57 MW /203.8 MW	40 MW	P0	System Normal	1.03	1.03	1.03

5.1.3 Reactive Power Capability Evaluation

The BC Hydro TIR requires IBR power plant to have the dynamic reactive power capability at a minimum of +/- 33% of its MPO at the high voltage side of the IC's switchyard over the full MW operating range.

Based on the PSS/E power flow data submitted by the IC, the study finds that the proposed generating project does not fully satisfy the BC Hydro's reactive capability requirement at the plant's maximum MW output.

Furthermore, the BCH TIR requires the IC's project to provide sufficient reactive power capability over full MW operating range including at zero MW output level. According to the IC-provided reactive capability curve, the proposed Solar Plant would be capable of meeting the BC Hydro's reactive capability requirement at the plant's zero MW output, which needs to be re-confirmed if the IC's project proceeds further.

5.1.4 Anti-Islanding Requirements

The IC is required to install anti-islanding protection within its facility to disconnect the IC's wind farm from the grid when an inadvertent island with the local load forms.

5.2 Fault Analysis

The short circuit analysis in the FeS is based upon the latest BC Hydro system model, which includes the generating facility information and associated impedance data provided by the IC. A more detailed study will be performed at the system impact study stage if needed.

5.3 Stations Requirements

A new outdoor 132 kV, 3-circuit breaker ring bus switching station will be built at POI, close to the existing 132 kV transmission line 1L10. The existing transmission line 1L10 will be cut and looped in to, and 132 kV line of [redacted] will be terminated at the new substation.

The station upgrade scope at the new switching station P118T is as follows.

- Acquire adequate property for a new switching close to the existing transmission line 1L10.
- Construct a new outdoor 132 kV, 3-circuit breaker ring bus switching station. Refer to the one-line diagram in Appendix B for details. The designation of the new station and the new line connecting to the customer and the two new lines derived from 1L10 will be assigned in next stage. The Installation location of the metering kits will be decided in later stage.
- Construct a new control building and other required facilities and infrastructures.
- Cut the existing 1L10 and loop into the new switching station.
- Terminate 132 kV line of [redacted] at the new switching station.

5.4 Transmission Line Requirements

Limited transmission line scope of work is identified for this project.

A fibre optic cable of approximately 11.5 km running between the new switching station P118T to SHA will be required. Possible route could be the 1L10/1L11/1L14 transmission line support structures.

With the fibre addition, Structure replacements & reinforcements and mid span structures maybe required due to fibre addition.

5.5 Protection & Control Requirements

BC Hydro will provide line protections for 1L10_A (VIT-P118T), 1L10_B (P118T-GOW) and 1L10_C (P118T-P118) protections.

The IC is to provide the following for the interconnection of [redacted] project.

- Entrance protection that complies with the latest version of the “60 kV to 500 kV BC Hydro Technical Interconnection Requirements for Power Generators.”
- Provide two SEL-411L-1 relays (firmware and options specified by BC Hydro) at the entrance of P118 to provide protection coverage for 1L10_C. BC Hydro P&C Planning will provide core protection settings for these relays to protect transmission line 1L10_C during a transmission line fault. Non-core protection such as local breaker failure, auto-reclosing, backup protection for station elements will not be provided by BC Hydro P&C Planning.
- The IC is responsible for NERC PRC-related tasks, settings to compliance standards within their facilities.
- The IC is responsible for providing a communications link for remote interrogation of the PPIS equipment by BCH servers.
- Provide anti-islanding protection as stated in Section 5.1.

5.6 Telecommunications Requirements

BC Hydro performed a high-level feasibility assessment of a telecom solution to meet the following requirements.

Teleprotection Requirements for Telecom

- Provide WECC Level 3 64 kbps synchronous circuits between VIT and P118T for “VIT – P118T 1L10_A PY DIGITAL TELEPROT” and “VIT - P118T 1L10_A SY DIGITAL TELEPROT”. Physical interface shall be C37.94 optical over multimode fibre using ST connectors.
- Provide WECC Level 3 64 kbps synchronous circuits between VIT and SHA for “VIT – SHA 1L10_A PY DIGITAL TELEPROT” and “VIT - SHA 1L10_A SY DIGITAL TELEPROT”. Physical interface shall be C37.94 optical over multimode fibre using ST connectors.
- Provide WECC Level 3 64 kbps synchronous circuits between SHA and P118T for “SHA – P118T 1L10_A PY DIGITAL TELEPROT” and “SHA – P118T 1L10_A SY DIGITAL TELEPROT”. Physical interface shall be C37.94 optical over multimode fibre using ST connectors.
- Provide WECC Level 3 64 kbps synchronous circuits between P118T and GOW for “P118T -GOW 1L10_B PY DIGITAL TELEPROT” and “P118T - GOW 1L10_B SY DIGITAL TELEPROT”. Physical interface shall be C37.94 optical over multimode fibre using ST connectors.
- Provide WECC Level 3 64 kbps synchronous circuits between P118T and P118 for “P118T – P118 1L10_C PY DIGITAL TELEPROT” and “P118T – P118 1L10_C SY DIGITAL TELEPROT”. Physical interface shall be C37.94 optical over multimode fibre using ST connectors.

Telecontrol Requirements for Telecom

- Provide P118T SCADA circuit off FVO & SIO.
- Provide P118 SCADA circuit off FVO & SIO.
- Provide P118T REMACC circuit off EDM.

Other Requirements for Telecom

- Provide PY & SY T1s over separate OC3s between P118T-P118
- Provide TMS circuit for P118T (end point TBD)
- Provide MPLS links and LSPs for new GOW, P118T, SHA, and VIT MPLS nodes.

Certain assumptions were made for determining a potential telecom solution. Details of the telecom solution (e.g. assumptions made, alternatives investigated and work required for BCH and the IC) would be provided at the next study stage.

6 Cost Estimate and Schedule

The non-binding good faith estimated cost and time to construct the Network Upgrades required to interconnect the proposed project will be provided in a separate letter to the IC.

7 Conclusions

To interconnect the [redacted] project and its facilities to the BCH Transmission System at the POI, this Feasibility Study has identified the following conclusions and requirements:

1. A new 132 kV switching station (referred to as "P118T") on 1L10 is required as the proposed POI for interconnecting the IC's generating project to the BCH system. With the new switching station P118T, 1L10 will be segregated into two new lines, temporarily referred to as: 1L10_A (VIT-P118T) and 1L10_B (P118T-GOW). The proposed customer-built 132 kV interconnection line (P118T-P118) will be designated as 1L10_C. The temporary line designations will be replaced by permanent designations at a later stage of interconnection study.

2. The connection of [redacted] Project does not cause any performance violation (i.e. thermal overload, voltage performance violation or voltage stability concern) under system normal conditions.

3. The connection of [redacted] Project will cause a potential backflow issue on SHA T1 under single contingencies. If a backflow at SHA T1 is measured, [redacted] is required to be shed or curtailed at the IC's facility.

4. The IC is required to install anti-islanding protection within their facility to disconnect the IC's wind farm from the grid when an inadvertent island with the local loads forms.

5. The IC's project does not fully satisfy the BC Hydro's reactive capability requirement.

6. A fibre optic cable of approximately 11.5 km running between the new switching station P118T to SHA will be required. With the fibre addition, Structure replacements & reinforcements and mid span structures maybe required due to fibre addition.

7. The new lines 1L10_A and 1L10_B will remain as part of BC Hydro BES and need to be compliant with applicable NERC MRS requirements. The new line 1L10_C (P118T-P118) will be a non-BES line.

8. BC Hydro will provide line protections for 1L10_A, 1L10_B and 1L10_C (BCH end only) protections. As part of the line protection replacements for each of the three lines, telecommunication facilities will be required to accommodate the new protection schemes. The IC shall provide required relays, telecom facility and associated equipment at its facilities to accommodate the new protection schemes.

Appendix A
Plant Single Line Diagram Used for Power Flow Study

Figure A-1 shows [redacted] Project single line diagram used for power flow study.

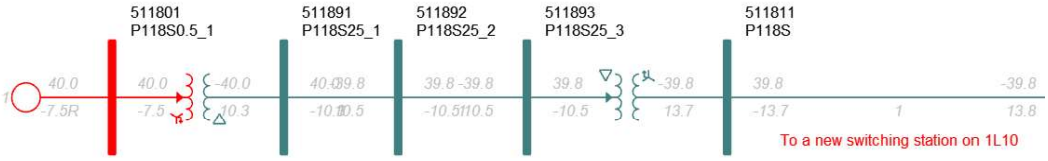

Figure A-1: [redacted] Project Single Line Diagram for Power Flow Study.

Appendix B
One-Line Sketch for New Switching Station

Figure B-1 shows the Stations Planning One-Line Sketch for the New Switching Station P118T.

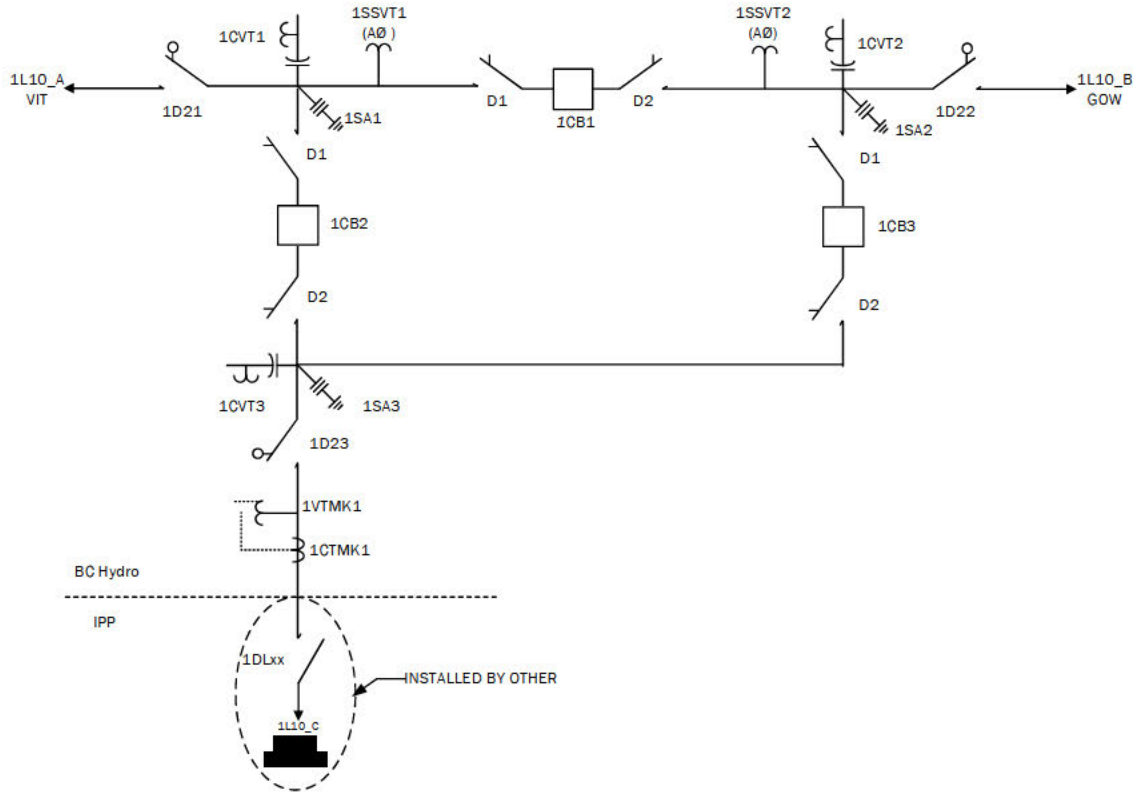

Figure B-1: Stations Planning One-Line Sketch for the New Switching Station P118T.