BC Hydro
Power smart

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

July 30, 2024

[redacted]

[redacted]

[redacted]

RE: CEAP IR 24 - [redacted] Project - Interconnection Feasibility Study Report

Enclosed is the Interconnection Feasibility study report for the proposed [redacted] Project 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 $102.3 M.

Major Scope of Work Identified:

- Install a new 230kV tap structure near Str. 20-05 of 2L258
- One disconnect switch structure is assumed to be required on tap line
- A fibre optic cable running between the customer POI to BC Hydro Cranbrook (CBK) substation will be required. Possible route could be the 2L258 transmission line support structures
- Wood H-Frame replacements and mid-span structures will be required on 2L258
- Install new fibre optic cables and terminate old fibre optic cables, as required
- Install Optical Transport System equipment and connect to fibre
- Supply and install protection relays and other required protection equipment
- Other Telecom and Protection work, as required

Exclusions:

- GST
- Right-of-Way
- Permits

Key Assumptions:

- Construction will be done by contractor
- Early Engineering and Procurement
- 3 years of construction
- No ground improvements will be required
- No contaminated soil will be encountered during construction
- A Certificate of Public Convenience and Necessity (CPCN) requirement will not impact the schedule

Key Risks:

- Additional right of way or acquisition of more property may be required
- Transmission routing may be different than assumed, including number of disconnect switches and structure types may change
- 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 loading costs
- Costs may be affected by market conditions and escalation
- A CPCN requirement may delay the project schedule and increase costs

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, 2030 (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 t the BC Hydro CEAP Team at ceap2024@bchydro.com.

Sincerely,

[redacted]

Senior Manager, Transmission Interconnections

BC Hydro

Encl.: CEAP2024_IR_24_[redacted]_FeS_Report_final.pdf

[redacted]

[redacted] Project

Interconnection Feasibility Study

BC Hydro EGBC Permit to Practice No: 1002449

2024 CEAP IR # 24

Prepared for: [redacted]

[redacted]

300-APR-00003
2024 Jul 30

Report Metadata

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[redacted]	[redacted]
[redacted]	[redacted]
[redacted]	[redacted]
[redacted]	[redacted]
[redacted]	[redacted]
[redacted]	[redacted]

Related Facilities:	2L258
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Revisions

Revision	Date	Description
0	2024 Jul	Initial release

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Executive Summary

[redacted] the interconnection customer (IC), requests to interconnect its [redacted] project (2024 CEAP IR # 24) to the BC Hydro system. [redacted] project has 60 [redacted] solar inverters with total installed capacity of 195 MW. The IC's proposed Point of Interconnection (POI) is on BC Hydro's 230 kV line 2L258, approx. 34 km from Cranbrook substation (CBK). The IC's project will connect to the POI via a 1.8 km 230 kV interconnection line. The proposed commercial operation date (COD) is September 30, 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 tap connection on the BCH's existing circuit 2L258 is acceptable for interconnecting the IC's generating project to the BCH system.
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. Powerflow studies under specific P2.1 contingencies reveal that voltage collapse could occur. The existing local protection schemes will need to be modified by adding an open terminal tripping logic in 2L258 line protection to address the potential voltage collapse concern. The details will need to be determined in next study stage.
4. At the POI, BCH will design and build the tap that will include a tap structure and a switch structure on the tap side. A 253 kV rated disconnect switch will be installed to isolate the IC's facilities from the BCH system. Additional Right-of-Way (ROW) may be required to accommodate the tap. Telecommunication requirements on 2L258 involve installing fiber optic cables between the POI and INV, as well as between the POI and CBK. Transmission line structure replacements and/or mid span structures may be required for this fibre addition to 2L258.
5. 2L258 line protection relays at BC Hydro's CKB and INV substations will be replaced. As part of the line protection replacement, telecommunication facilities will be required for each of the three substations.

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.

Contents

Appendices

Acronyms

The following are acronyms used in this report.

BCH	BC Hydro
CBK	Crankbrook Substation
CEAP	Competitive Electricity Acquisition Process
COD	Commercial Operation Date
DTT	Direct Transfer Trip
ERIS	Energy Resource Interconnection Service
FeS	Feasibility Study
FVO	Fraser Valley Office
IBR	Inverter-Based Resources
IC	Interconnection Customer
INV	Invermere Substation
JOE	Joseph Creek Substation
KHS	Kicking Horse Substation
LAPS	Local Area Protection Schemes
MPO	Maximum Power Output
MVL	Marysville Substation
NERC	North American Electric Reliability Corporation
NRIS	Network Resource Interconnection Service
OATT	Open Access Transmission Tariff
POI	Point of Interconnection
RAS	Remedial Action Scheme
ROW	Right of Way
SIO	South Interior Office
TIR	BC Hydro “60 KV to 500 kV Technical Interconnection Requirements for Power Generators”
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] Project	
Name of Interconnection Customer (IC)	[redacted]	
Point of Interconnection (POI)	on 2L258 at 34 km from CBK	
IC's Proposed COD	30th September 2028	
Type of Interconnection Service	NRIS ☒	ERIS ☐
Maximum Power Injection [1] (MW)	189 MW (Summer)	189 MW (Winter)
Number of Generator Units	60 x 3.25 MW Solar Inverters	
Plant Fuel	Solar	
Note 1: The maximum achievable power injection at the POI is approx. 189 MW after accounting for MW losses and service load which is lower than the IC proposed 190 MW.		

[redacted] the Interconnection Customer (IC), requests to interconnect its [redacted] project (2024 CEAP IR # 24) to the BC Hydro system. [redacted] project has 60 [redacted] solar inverters with total installed capacity of 195 MW. The IC's proposed Point of Interconnection (POI) is on BC Hydro's 230 kV line 2L258, approx. 34 km from Cranbrook substation (CBK). The IC's project will connect to the POI via a 1.8 km 230 kV interconnection line. The proposed commercial operation date (COD) is September 30, 2028.

Figure 1-1 shows the South Interior East (SIE) region 500/230/60 kV transmission system topology diagram when the proposed [redacted] project (#24) will be in-service. Three 230 kV transmission lines (2L113, 2L258, and 2L294) are originating from the Cranbrook substation (CBK). The northern part of SIE region will be supplied by two 230 kV transmission lines 2L258 and 2L259 from CBK to Invermere (INV) and Golden (GDN). The 60 kV transmission system in the same northern SIE region is supplied by three 60 kV transmission lines (60L283, 60L299, and 60L284).

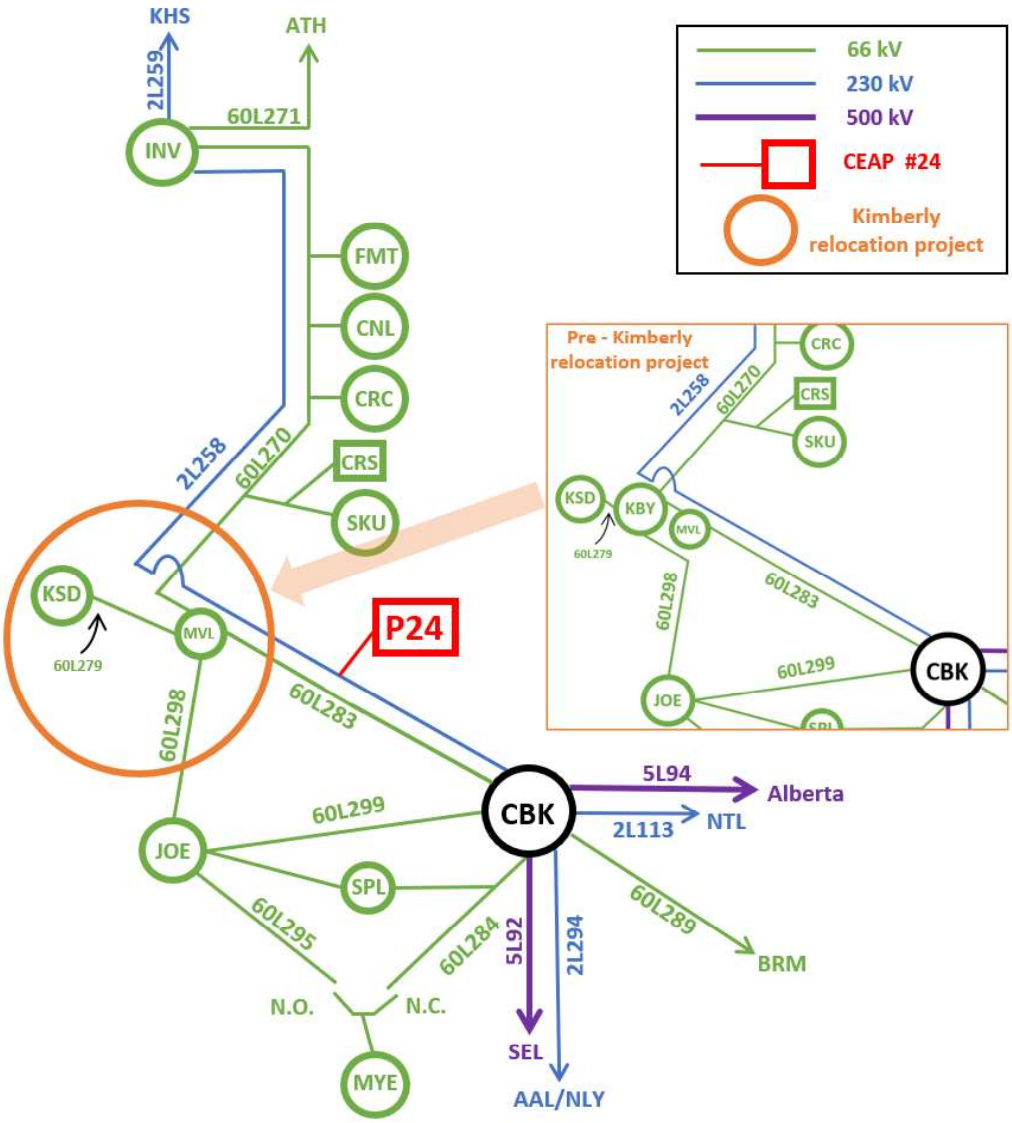

Figure 1-1: SIE region 500/230/60 kV Transmission System Topology Diagram

Prior to the [redacted] project, the existing 60 kV Kimberly (KBY) substation will be decommissioned as planned. After decommissioning KBY, the existing 60 kV circuits 60L270, 60L283 and 60L298 currently terminated at KBY will be re-terminated at the to-be-rebuilt Marysville substation (MVL), and the load at KSD will be served from the MVL via a renamed line 60L279 (MVL-KSD). An existing small solar farm Sun Mine (close to 1 MW) is currently connected to KSD.

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 process and focuses specifically on the BC Hydro regional transmission system where the proposed generating project is is proposed to be constructed. An assessment of the incremental effect on the 500kV 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) Kimberly relocation project is assumed to be completed by the time the [redacted] project #24 is in-service.

5 System Studies and Results

Based upon the IC's submitted information and the area system conditions, a tap connection on the existing 2L258 is acceptable to interconnect the IC's generating project to the BCH system.

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 Existing Operation Practice

Pre-interconnection study scenarios indicate that the following constraints are prevalent in 60 kV transmission system in the northern part of SIE region. These constraints have been addressed using the local protection schemes currently in place.

- P2.1 contingency of CBK breakers being opened on 2L258 without a fault leads to overvoltage issue at INV and surrounding area.
    - Overvoltage protection at INV under 2L258 Protection will be triggered to open entire 2L258.
    - Once 2L258 protection is triggered, the INV Extended Tripping Scheme will trip 60 kV and 230 kV breakers at INV, disconnecting 2L259 and 60L271.
    - The INV 2L258 Extended Tripping Scheme will also send a DTT signal to Kicking Horse Substation (KHS) to trip breakers to disconnect loads at KHS.

- P2.1 contingency of INV breakers being opened on 2L258 without a fault leads to system overloads at INV and its surrounding system.
    - Open terminal tripping logic at INV under 2L258 Protection will be triggered to open INV 2L259.

- Once 2L259 protection is triggered, the INV Extended Tripping Scheme will trip 60 kV breakers at INV, disconnecting 60L271.
- The INV 2L259 Extended Tripping Scheme will also send a DTT signal to KHS to trip breakers to disconnect loads at KHS.

The existing constraints have been reviewed with the new interconnection of project #24 specifically. Steady-state power flow studies have been conducted and the results are summarized in the tables within each section below.

5.1.2 Branch Loading Analysis

Table 5-1 shows a summary of branch loading analysis under system normal and single contingencies for various load conditions.

P2.1 contingency of INV breakers being opened on 2L258 without a fault could lead to voltage collapse in the 60 kV transmission system. The load north of INV would be supplied by 60 kV path from CBK to INV. These findings are comparable to those in the pre-interconnection scenarios, which can be mitigated by the existing local protection stated in Section 5.1.1 Existing Operation .

P2.1 contingency of CBK breakers being opened on 2L258 without a fault could result in voltage collapse issue. This is due to the fact that the IC's generator ouput would transfer from INV to CBK though 60 kV path.

To mitigate the post-contingency concerns, an open terminal tripping logic (local protection) at CBK is required in the line protection to open the INV end of 2L258 and isolate the project site from the grid. The further detailed mitigations will be determined in next study stage.

Table 5-1: Summary of Branch Loading Analysis Results

Case	IC's Plant Output	Contingency		Branch Loading	
				2L258	2L258
		Cat.	Description	P24POI-CBK	P24POI-INV
Winter Rating				318.7 MVA	318.7 MVA
28HW	Max	P0	System Normal	36.9 %	25.1 %
	Max	P2.1	2L258 Breakers at CBK or INV with no LAPS actions	Case Blown up (Voltage collapse)	
	Max	P2.1	2L258 Breakers CBK or INV + local protection	N/A	N/A
Summer Rating				318.7 MVA	318.7 MVA
29HS	Max	P0	System Normal	49.7 %	14.3 %
	Max	P2.1	2L258 Breakers at CBK or INV with no LAPS actions	Case Blown up (Voltage collapse)	

	Max	P2.1	2L258 Breakers CBK or INV + local protection	N/A	N/A
29LS	Max	P0	System Normal	54.7 %	17 %
	Max	P2.1	2L258 CBK or INV with no LAPS actions	Case Blown up (Voltage collapse)	
	Max	P2.1	2L258 CBK or INV + local protection	N/A	N/A

5.1.3 Steady-State Voltage Analysis

With the connection of the IC's project, the voltage performance under system normal condition is acceptable for all the three load conditions (29LS, 29HS, 28HW). Certain P2.1 contingencies lead to high/low voltage concerns or voltage collapse (study case blown up) as stated in Section 5.1.2. Table 5-2 shows a summery of steady-state voltage performance under various system conditions and contingencies.

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

Case	IC's Plant Output	Contingency		Bus Voltage (PU)		
		Cat.	Description	P24 230 HV	INV 230	CBK 230
28HW	Max	P0	System Normal	1.035	1.020	1.008
	Max	P2.1	2L258 breakers at CBK or INV with no LAPS actions	Case Blown up (Voltage collapse)		
	Max	P2.1	2L258 breakers at CBK or INV + Local Protection	N/A	1.035	0.998
29HS	Max	P0	System Normal	1.041	1.02	1.014
	Max	P2.1	2L258 breakers at CBK or INV with no LAPS actions	Case Blown up (Voltage collapse)		
	Max	P2.1	2L258 breakers at CBK or INV + Local Protection	N/A	0.983	1.010
29LS	Max	P0	System Normal	1.039	1.020	1.014
	Max	P2.1	2L258 breakers at CBK or INV with no LAPS actions	Case Blown up (Voltage collapse)		
	Max	P2.1	2L258 breakers at CBK or INV + Local Protection	N/A	1.003	1.011

5.1.4 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 proposed generating project would be capable of meeting the BC Hydro's reactive capability

requirement at the plant's maximum MW output, which is subjected to further verification in the next stage of interconnection study.

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 WTG has +/- 2.16 Mvar reactive capability at zero MW output, which meets the reactive power requirement and will need to be re-confirmed if the IC's project proceeds further.

5.1.5 Anti-Islanding Requirements

The [redacted] project is not arranged for islanded operation. The IC is required to install anti-islanding protection within their facility to disconnect the [redacted] site from the grid when an inadvertent island with the local loads 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

No station work is required.

5.4 Transmission Line Requirements

No transmission line upgrade has been identified for this project.

At the POI, BCH will design and build the tap that will include a tap structure and a switch structure on the tap side. A 253 kV rated disconnect switch will be installed to isolate the IC's facilities from the BCH system. Additional Right-of-Way (ROW) may be required to accommodate the tap.

Requirements to support Telecommunication

- A fibre optic cable running between the POI to INV will be required. Possible route could be the 60L270 and/or 2L258 transmission line support structures.

- A fibre optic cable running between the POI to CBK will be required. Possible route could be the 60L270, 60L283, and/or 2L258 transmission line support structures.

With the telecom requirements, structure replacement of 2L258 may be required. Running fibre optic on 60L270 and 60L283 are not feasible as there are existing distribution and communication underbuilt on these two circuits already.

5.5 Protection & Control Requirements

To connect the [redacted] project, line protection relays at BC Hydro's CKB and INV substations for 2L258 will be replaced. As part of the line protection replacement, telecommunication facilities will be required for each of the three substations.

The IC is to provide the followings 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) relays at the entrance of P24 to provide protection coverage for 2L258. BC Hydro P&C Planning will provide settings for these relays.
- The IC should note that 2L258 is operating with single pole tripping and auto-reclose. The IC can assess the requirements and impacts of this scheme during future study stages.
- 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 line protection relays and PPIS equipment by BCH servers.
- The IC is required to 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

- WECC Level 3 PY & SY, CBK – INV 2L258, with C37.94 interfaces.
- WECC Level 3 PY & SY, CBK – P24 2L258, with C37.94 interfaces.
- WECC Level 3 PY & SY, INV – P24 2L258, with C37.94 interfaces.

Telecontrol Requirements for Telecom

- One P24 SCADA circuit off FVO & SIO.

Other Requirements for Telecom

- PY & SY T1s between CBK-INV.
- PY & SY T1s between CBK- P24.
- PY & SY T1s between INV- P24.

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 proposed POI, this Feasibility Study has identified the following conclusions and requirements:

1. The tap connection on the BCH's existing circuit 2L258 is acceptable for interconnecting the IC's generating project to the BCH system.

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. Powerflow studies under specific P2.1 contingencies reveal that overloading, lower voltage concerns, or voltage collapse could occur. the existing local protection schemes will need to be modified by adding an open terminal tripping logic in 2L258 line protection to address the potential voltage collapse concern. The further detailed mitigations will be determined in next study stage.

4. At the POI, BCH will design and build the tap that will include a tap structure and a switch structure on the tap side. A 253 kV rated disconnect switch will be installed to isolate the IC's facilities from the BCH system. Additional Right-of-Way (ROW) may be required to accommodate the tap. Telecommunication requirements on 2L258 involve installing fiber optic cables between the POI and INV, as well as between the POI and CBK. Transmission line structure replacements and/or mid span structures may be required for this fibre addition to 2L258.

5. 2L258 line protection relays at BC Hydro's CKB and INV substations will be replaced. As part of the line protection replacement, telecommunication facilities will be required for each of the three substations.

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.

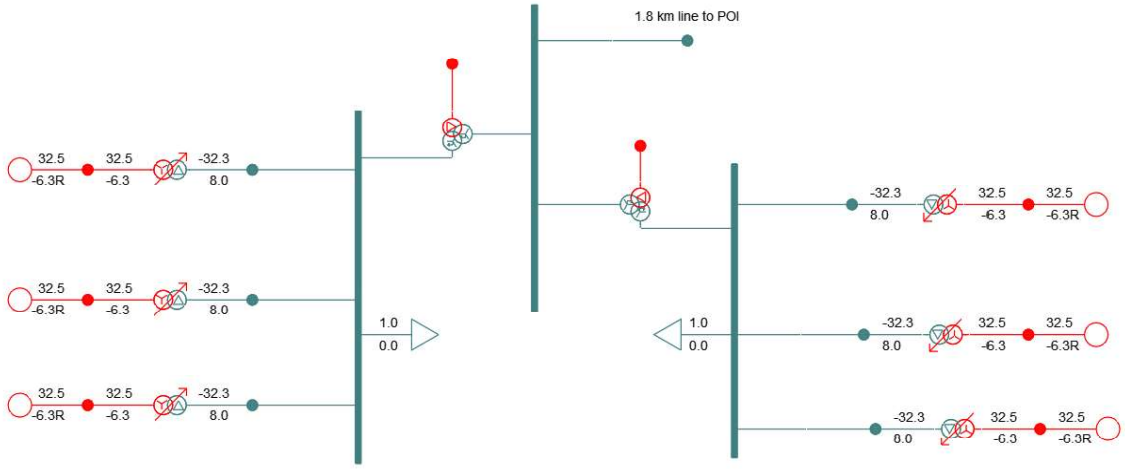

Figure A-1: [redacted] Project Single Line Diagram for Power Flow Study.

As seen in the diagram, [redacted] project has two main power transformers dividing the plant into two parts.

- Part 1 has three (3) feeders connecting 10 solar inverters to the collector station.
- Part 2 has three (3) feeders connecting 10 solar inverters to the collector station.