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

July 30, 2024

[redacted]

[redacted]

[redacted]

RE: CEAP IR 11 – [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 $23.0 M.

Major Scope of Work Identified:

- Supply and install tap structures on the existing 138 kV transmission line 1L243
- Supply and install disconnect switches with the associated structures
- Supply and install microwave towers, waveguides, antennas, and other required telecommunications equipment
- Supply and install passive reflector
- Add and upgrade Protection, Control and Telecom

Exclusions:

- GST
- Permits
- Right of Way

Key Assumptions:

- Construction by contractor
- 3 years of construction
- Early Engineering and Procurement

Key Risks:

- Transmission routing may be different than assumed, including number of disconnect switches and structure types may change
- Additional right of way or acquisition may be required to accommodate equipment
- No defined supply chain strategy, construction costs may increase depending on delivery method
- Project schedule may be longer than expected, leading to increased costs
- Costs 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 2029 (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,

[redacted]

Senior Manager, Transmission Interconnections
BC Hydro

Encl.: CEAP2024_IR_11_[redacted]_FeS_Report_final.pdf

[redacted]

[redacted] Project

Interconnection Feasibility Study

BC Hydro EGBC Permit to Practice No: 1002449

2024 CEAP IR # 11

Prepared for: [redacted]

[redacted]

300-APR-00005
2024 Jul 30

[redacted]

Report Metadata

Header:	[redacted] Project
Subheader:	Interconnection Feasibility Study
Title:	[redacted] Project
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Prepared for: [redacted]

[redacted]

Related Facilities:	1L243
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Revisions

Revision	Date	Description
0	2024 Jul	Initial release

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[redacted]

Executive Summary

[redacted] the Interconnection Customer (IC), requests to interconnect its [redacted] Project (2024 CEAP IR # 11) to the BC Hydro (BCH) system. [redacted] Project has twenty-one (21)[redacted] type-3 wind turbine generators with total installed capacity of 142.8 MW. The IC proposed Point of Interconnection (POI) is on the BC Hydro owned 138 kV transmission line 1L243, about 22 km from Nicola Substation (NIC). The IC owned station is connected through an IC owned 4 km, 138 kV transmission line to the POI. The project's 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 (FeS) has identified the following conclusions and requirements:

1. A tap connection is acceptable for interconnecting [redacted] Project. To maintain reliability of the 1L243 after the project interconnection, the IC would be required via the SGIA to build and maintain their transmission line per BC Hydro's requirements.
2. At the POI, BCH will design and build the tap connection that will include a tap structure and up to three switch structures. A 152 kV rated disconnect switch will be installed to isolate the IC's facilities from the BCH system. Two 152 kV rated disconnect switches will be installed to isolate the trunk circuit on both sides.
3. 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 (N-0) and single countingence (N-1) conditions.
4. In addition to the entrance protection and 1L243_C line protections, the IC is required to install anti-islanding protection within its facility to detect and disconnect itself from the BC Hydro transmission system if an inadvertent island with the local loads forms. In addition, a direct transfer trip (DTT) from NIC to the project is required by opening the entrance circuit breaker to facilitate disconnecting the wind farm from the system.

The 1L243 line protection relays at BC Hydro's NIC and HLD substations will be replaced. As part of the line protection replacement, telecommunication facilities will be required for NIC, HLD and the IC's station. 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.

Contents

Appendix

Acronyms

The following are acronyms used in this report.

BCH	BC Hydro
CEAP	Competitive Electricity Acquisition Process
COD	Commercial Operation Date
DTT	Direct Transfer Trip
EDM	Edmonds Office
ERIS	Energy Resource Interconnection Service
FeS	Feasibility Study
FVO	Fraser Valley Office
HAM	Hamilton Microwave Repeater
HLD	Highland Substation
IBR	Inverter-Based Resources
IC	Interconnection Customer
KCH	Kwoiek Creek Generating Station
LAPS	Local Area Protection Schemes
MIG	Merritt Green Energy Ltd
MPO	Maximum Power Output
NERC	North American Electric Reliability Corporation
NIC	Nicola Substation
NRIS	Network Resource Interconnection Service
OATT	Open Access Transmission Tariff
POI	Point of Interconnection
QYS	quA-ymn Solar Farm
RAS	Remedial Action Scheme
SGIA	Standard Generation Interconnection Agreement
SIC	South Interior Control
SIO	South Interior Office
STM	Stump Lake Substation
TIR	BC Hydro “60 KV to 500 kV Technical Interconnection Requirements for Power Generators”
WECC	Western Electricity Coordinating Council
WTGs	Wind Turbine Generators

1 Introduction

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

Table 1-1Summary of Project Information

Project Name	[redacted] Project		
Name of Interconnection Customer (IC)	[redacted]		
Point of Interconnection	On 1L243, about 22 km (conduct length) from Nicola Substation		
IC's Proposed COD	September 30, 2028		
Type of Interconnection Service	NRIS	☒	ERIS ☐
Maximum Power Injection (MW)	139 (Summer)		139 (Winter)
Number of Wind Turbines	21, each rated at 6.8 MW/ 7.7 MVA		
Plant Fuel	Wind		

[redacted] the Interconnection Customer (IC) requests a feasibility study for [redacted] Project (2024 CEAP IR # 11) with total installed capacity of 142.8 MW. The maximum power injection into the system is 139 MW. The IC proposed Point of Interconnection (POI) is on the BC Hydro owned 138 kV transmission line 1L243, about 22 km (conductor length) from Nicola Substation (NIC). The IC owned station is connected through an IC owned 4 km, 138 kV transmission line to the POI. The project's Commercial Operation Date (COD) is September 30, 2028.

In the project, there are 21 [redacted] type 3 wind turbines (WTGs), each rated at 6.8 MW/ 7.7 MVA. The total power from all WTGs will be collected, via four 34.5 kV feeders, at a 34.5 kV buses. Then the power is stepped up to 138 kV through two 166 MVA, 138/34.5 kV (high side Y-gnd/Delta) transformers. Refer Appendix A for power flow modelling details of this project.

Figure 1-1 below shows 138 kV line 1L243 and the local transmission system where the [redacted] Project is interconnected. There is one industrial facility, Stump Lake Substation (STM – Trans Mountain pipeline pump station), currently taped on the circuit 1L243.

In the Highland area, there are two existing generating stations, Kwoiek Creek Generating Station (KCH) and Merritt Green Energy Ltd (MIG). KCH's maximum power injection to BCH system is 55.0 MW and MIG's maximum power injection to BCH system is 37.6 MW.

There is also one higher-queued generating project quA-ymn Solar Farm (QYS) to be connected on 1L55. QYS has the installed capacity of 15 MW and the project is currectly under construction.

NIC is one of BCH major transmission substation, and presently has two 500/230 kV transformers, and two 230/138/12 kV transformers.

There are several high-queued load interconnections and their associated network upgrades in the study area. The relevant network upgrades being planned in the study region are included in the Assumptions and Conditions Section.

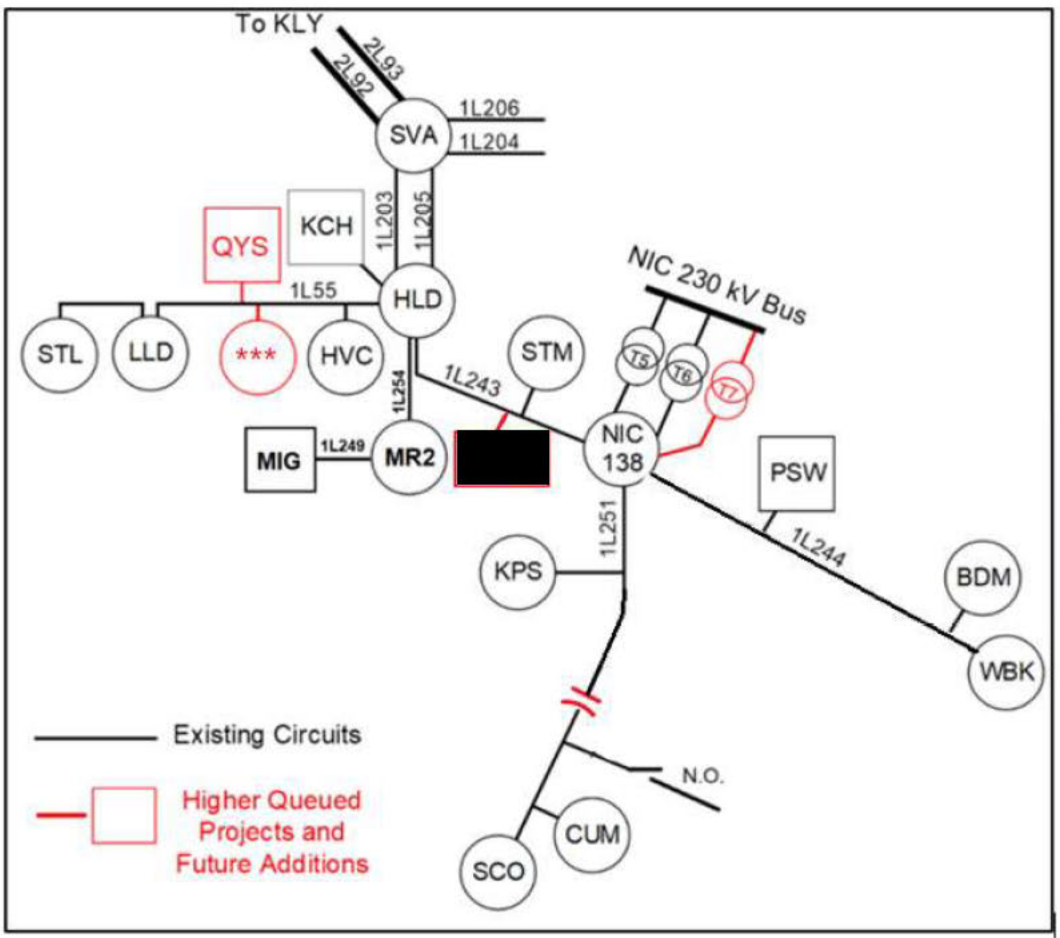

Figure 1-1: Nicola-Highland region 138/230 kV Transmission System Diagram

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 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. For the purpose of performing this study, Nicola Substation Transformation Capacity Reinforcement project (i.e. addition of NIC T7) is assumed completed by the time the IC's generating project enters service. .
3. 1L243 reconductoring is assumed to be completed by the time the IC's generating project enters service. 1L243 after reconductoring is assumed to have a conductor rating of 1145 A (summer) and 1388 A (winter).
4. Line 1L251 is assumd to be series compensated to accommodate an industrial load increase on 1L251.

5 System Studies and Results

Based upon the IC's submitted information and the area system conditions, a tap connection at the proposed POI on 1L243 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 Branch Loading Analysis

Power flow analyses under system normal (N-0 or P0) and contingency conditions (N-1 or P1 and P2) were performed to evaluate whether [redacted] Project would cause any adverse impacts in the transmission system.

In Table 5-1, Case 1 illustrates the loadings impacts of [redacted] Project on the listed transmission elements under system normal condition. Cases 2 to 4 show the impact of [redacted] Project under N-1 contingence conditions. Cases 5 to 11 demonstrate adequate system performance under P0 and P1/P2 contingence conditions in heavy summer and heavy winter cases.

This study has concluded that with [redacted] Project connected to the system, under system normal (N-0 or P0) and the contingency conditions (N-1 or P1 and P2.1), there will be no overloading identified in the transmission system under the studied load and generation conditions.

This study also checked the 1L243 line loading against the existing line thermal rating. No overloading condition was identified due to the interconnection of the [redacted] Project.

Table 5-1 Power Flow Study Results

Base Cases	IC's Plant Out-put	Contingencies		Line / Equipment Loading (percentage of the line/equipment rating)				
		Cat.	Cases & Description	1L243 uprated line Note 1	1L243 existing line Note 1	NIC T5	NIC T6	NIC T7
Summer Rating (MVA)				273.7	168.7	286.8	286.8	300
2029 LS	Max	P0	1. System normal	34	55.1	5	5	6
		P1	2. 1L55 (HLD-HVC)	32	51.9	2	1	2
			3. 1L57 (HLD-KCH)	43	69.7	6	6	7
			4. NIC T6 (isolates T2),	35	56.7	6	N/A	7
2029 HS	Max	P0	5. System normal	37	60.0	11	11	12
		P1	6. 1L57 (HLD-KCH)	45	72.9	13	13	15
			7. KCH 0 MW output, MIG tripped.	52	84.3	15	15	17
			8. KCH and MIG 0 MW output, 1L203 tripped.	50	81.0	14	14	17
Winter Rating (MVA)				331.8	213.2	286.8	286.8	300
2028 HW	Max	P0	9. System normal	29	45.2	9	9	10
		P1	10. 1L57 (KCH-HLD)	36	56.1	11	11	13
			11. KCH 10 MW output, MIG tripped.	40	64.8	12	12	14

Note 1: Power injection of the [redacted] Project is split to two directions on 1L243. The heavier Side power flow is reported in this table.

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 various system conditions and contingencies.

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

Base Cases	IC's Plant Output	Contingencies		138 kV Bus Voltage (pu)		
		Cat.	Cases & Description	NIC 138 kV	[redacted] POI	HLD 138 kV
2029 LS	Max	P0	1. System normal	1.02	1.04	1.03
		P1	2. 1L55 (HLD-HVC)	1.02	1.04	1.02
			3. 1L57 (HLD-KCH)	1.02	1.04	1.00
			4. NIC T6 (isolates T2),	1.02	1.04	1.02
2029 HS	Max	P0	5. System normal	1.02	1.03	1.02
		P1	6. 1L57 (HLD-KCH)	1.02	1.03	1.02
			7. KCH 0 MW output, MIG tripped.	1.02	1.03	1.01
			8. KCH and MIG 0 MW output, 1L203 tripped.	1.02	1.03	1.01
2028 HW	Max	P0	9. System normal	1.02	1.03	1.03
		P1	10. 1L57 (KCH-HLD)	1.02	1.03	1.03
			11. KCH 10 MW output, MIG tripped.	1.02	1.03	1.02

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 proposed generating project would be capable of to meet 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 +/- 3.75 Mvar reactive capability at zero MW output, which needs to be re-confirmed if the IC's project proceeds further

5.1.4 Anti-Islanding Requirements

If 1L243 between NIC and HLD is tripped, the IC's project may be inadvertently islanded with the proposed generators and the BC Hydro loads, which is not allowed. A direct transfer trip (DTT) from NIC to [redacted] Project is required to trip off the wind farm for protective and unintentional tripping of 1L243.

In addition, 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 stage of system impact study if needed.

5.3 Stations Requirements

No station work is identified.

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 connection that will include a tap structure and up to three switch structures. A 152 kV rated disconnect switch will be installed to isolate the IC's facilities from the BCH system. Two 152 kV rated disconnect switches will be installed to isolate the trunk circuit on both sides. Additional Right-of-Way may be required to accommodate the tap.

5.5 Protection & Control Requirements

To reliably connect the [redacted] Project into the system via a line tap, the line protection relays at BC Hydro's NIC and HLD substations for 1L243 will be replaced. As part of the line protection replacement, telecommunication facilities will be required for NIC, HLD and the IC's station.

The IC, [redacted] [redacted], is required to provide the followings for the interconnection of their 138/34.5 kV station:

- 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 [redacted] Project Substation to provide protection coverage for 1L243. BC Hydro P&C Planning will provide core settings for these relays.
- Provide instantaneous protections for transformers, buses and lines between its 138kV entrance breakers to unit step-up transformer HV buses.
- Main transformer T1 and T2 should not operate in parallel at 34.5 kV. The tie breaker of 34.5 kV buses should be normally open.
- 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.

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 PY & SY, NIC-HLD, with C37.94 interfaces.

- Provide WECC Level 3 PY & SY, [redacted] to NIC, with C37.94 interfaces.
- Provide WECC Level 3 PY & SY, HLD to [redacted] with C37.94 interfaces.
- Remove four signals, NIC-HLD 1L243 L/R.
- Remove two circuits, channel authorizations 9742 and 9743.

Telecontrol Requirements for Telecom

- One [redacted] SCADA circuit off FVO & SIO.

Other Requirements for Telecom

- None identified.

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 tap connection on line 1L243 is acceptable for interconnecting [redacted] Project. To maintain reliability of the 1L243 after the project interconnection, the IC would be required via the SGIA to build and to maintain their transmission line per BC Hydro's requirements.

2. At the POI, BCH will design and build the tap connection that will include a tap structure and up to three switch structures. A 152 kV rated disconnect switch will be installed to isolate the IC's facilities from the BCH system. Two 152 kV rated disconnect switches will be installed to isolate the trunk circuit on both sides

3. 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 (N-0) and single countingence (N-1) conditions.

4. In addition to the entrance protection and 1L243_C line protections, the IC is required to install anti-islanding protection within its facility to detect and disconnect itself from the BC Hydro transmission system if an inadvertent island with the local loads forms. In addition, a direct transfer trip (DTT) from NIC to the project is required by opening the entrance circuit breaker to facilitate disconnecting the wind farm from the system.

   The 1L243 line protection relays at BC Hydro's NIC and HLD substations will be replaced. As part of the line protection replacement, telecommunication facilities will be required for NIC, HLD and the IC's station. 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 21, 2024.

A non-binding good faith cost for required network upgrades and estimated schedule for construction are included in a separate letter to the IC.

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.

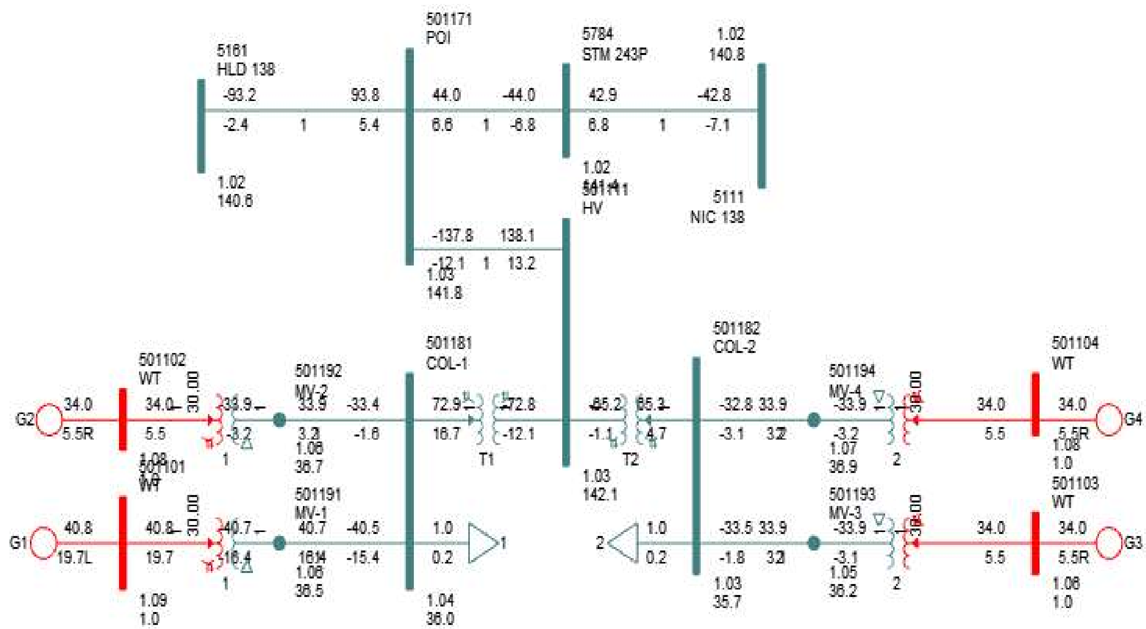

Figure A-1: [redacted] Project Single Line Diagram for Power Flow Study.

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

- Part 1 has two (2) feeders connecting two equivalent WTGs and two equivalent step-up transformers to the collector station.
- Part 2 has two (2) feeders connecting two equivalent WTGs and two equivalent step-up transformers to the collector station.