BC Hydro
Power smart

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

July 30, 2024

[redacted]

RE: CEAP IR 62 - Klo Wind Project - Interconnection Feasibility Study Report

Enclosed is the Interconnection Feasibility study report for the proposed Klo Wind 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 $10.2 M.

Major Scope of Work Identified:

- Add one 138kV line position with the associated substation equipment at BC Hydro Telkwa (TKW) substation
- Supply and install protection relays and other required protection / telecom equipment

Exclusions:

- GST
- Right-of-Way or Property costs
- Permits

Key Assumptions:

- Construction will be done by contractor
- 2 years of construction
- Early Engineering and Procurement
- No piles or ground improvements will be required
- No contaminated soil will be encountered during construction
- No expansion of existing stations or control buildings to accommodate new equipment

Key Risks:

- 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 4 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,

Senior Manager, Transmission Interconnections

BC Hydro

Encl.: CEAP2024_IR_62_Klo Wind_FeS_Report_final.pdf

[redacted]

Klo Wind Project

Interconnection Feasibility Study

BC Hydro EGBC Permit to Practice No: 1002449

2024 CEAP IR # 62

Prepared for: [redacted]

[redacted]

Report Metadata

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Revisions

Revision	Date	Description
0	2024 Jul	Initial release

[redacted]

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Executive Summary

[redacted], the interconnection customer (IC), requests to interconnect its Klo Wind Project (2024 CEAP IR # 62) to the BC Hydro (BCH) system. Klo Wind Project has forty-seven (47) [redacted] 4.2 MW type-4 wind turbine generators with a total installed capacity of 197.4 MW. The Proposed Point of Interconnection (POI) is at the 138 kV bus of BC Hydro's Telkwa (TKW) substation. The IC's project will interconnect the POI via a new customer-built 47.62 km long 138 kV transmission line. The IC's proposed commercial operation date (COD) is Nov 1, 2029.

To interconnect the Klo Wind 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 138 kV line position at TKW is required to interconnect the IC's generating project to the BC Hydro system.
2. The connection of the Klo Wind 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 the Klo Wind Project will cause an overload on one of the two TKW 230/138 kV transformers (T4 or T5) under single contingencies (P2). If an overload on the TKW transformer is detected, Operating Procedures will be required to shed or curtail the IC's generation.
4. An Anti-islanding transfer trip scheme is required to isolate the IC's wind farm at the IC's substation to avoid potential islanding operations with BC Hydro loads. In addition, 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 Klo Wind Project is required to participate in the existing North Coast Generation Shedding RAS to maintain system reliability under 500 kV line contingency operating conditions.
6. The IC shall provide the 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

Appendices

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
ERIS	Energy Resource Interconnection Service
FeS	Feasibility Study
FVO	Frase Valley Office
IBR	Inverter-Based Resources
IC	Interconnection Customer
LAPS	Local Area Protection Schemes
MPO	Maximum Power Output
NERC	North American Electric Reliability Corporation
NRIS	Network Resource Interconnection Service
OATT	Open Access Transmission Tariff
POI	Point of Interconnection
RAS	Remedial Action Scheme
SIO	South Interior Office
TIR	BC Hydro “60 KV to 500 kV Technical Interconnection Requirements for Power Generators”
TKW	Telkwa Substation
WECC	Western Electricity Coordinating Council
WTG	Wind Turbine Generator

1 Introduction

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

Table 1-1 Summary of Project Information

Project Name	Klo Wind Project	
Name of Interconnection Customer (IC)	[redacted]	
Point of Interconnection (POI)	Telkwa Substation 138 kV bus	
IC's Proposed COD	1st November 2029	
Type of Interconnection Service	NRIS ☒	ERIS ☐
Maximum Power Injection [1] (MW)	185.45 MW (Summer)	185.45 MW (Winter)
Number of Generator Units	47x4.2 MW WTGs	
Plant Fuel	Wind	

[redacted] the interconnection customer (IC), requests to interconnect its Klo Wind Project (2024 CEAP IR # 62) to the BC Hydro system. Klo Wind Project has forty-seven (47) [redacted] 4.2 MW type-4 wind turbine generators with a total installed capacity of 197 MW. The IC's proposed Point of Interconnection (POI) is at the 138 kV bus of BC Hydro's Telkwa (TKW) substation. The IC's project will connect to the POI via a customer-built 47.62 km long 138 kV transmission line. The proposed commercial operation date (COD) is Nov 1, 2029.

Figure 1-1 shows the Telkwa region transmission system diagram. Telkwa substation is a major substation in this area with two existing 500/230 kV transformers (TKW T2 & T3) and two 230/138 kV transformers (TKW T4 & T5). TKW presently supplies two 138 kV transmission lines — 1L385 to BC Hydro's Smithers substation (SRS) and 1L396 to BC Hydro's Houston substation (HUS).

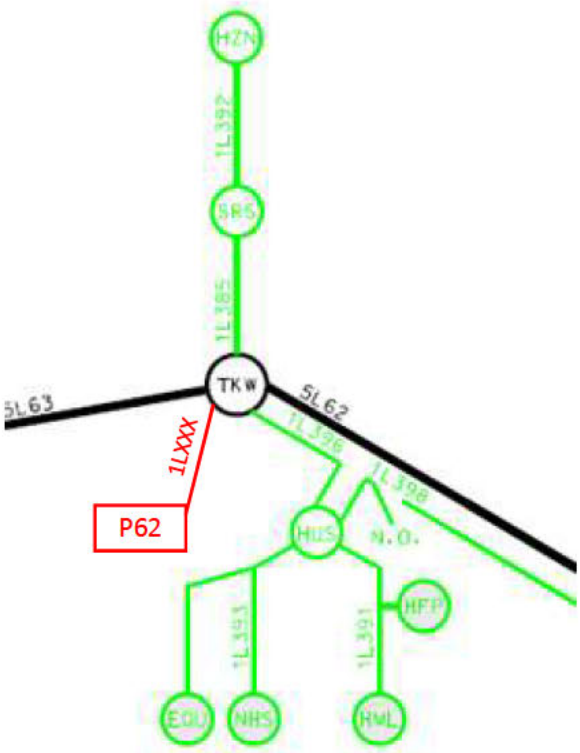

Figure 1-1: Telkwa Region 138/500 kV Transmission System Diagram in 2024

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 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.

5 System Studies and Results

The new line from P62 to the TKW substation, temporarily named 1LXXX, will become an IC's Bulk Electric System (BES) line, and the IC will be responsible for the compliance with applicable MRS requirements

5.1 Power Flow Study Results

Power flow studies were performed to evaluate whether the IC's generating project would cause 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 2030 light summer (30LS) 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 2030 heavy summer (30HS) and 2029 heavy winter (29HW) 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 various load conditions.

The study finds no transformer or line overload under system normal conditions for all three load conditions studied. For single contingencies, the connection of the Klo Wind Project could cause transformer overloading in the summer light load conditions (30LS).

If the TKW 230/138kV transformer (T4 or T5) is overloaded (power flow direction is from 138 kV to 230 kV) during the system summer off-peak operating period under single contingencies (P2), the Operating Procedure shall be required to open the new dedicated 138 kV line at TKW substation or cutail IC's generation.

Table 5-1: Summary of Branch/Transformer Loading Analysis Results

Case	IC's Plant Output	Contingency		Branch Loading	
		Cat.	Description	TKW T4	TKW T5
Summer Rating				168 MVA	168 MVA
30LS	Max	P1	TKW T3 and T5	103%	
	Max	P1	TKW T2 and T4		103%

	Max	P2	TKW 1CB6 internal fault		108%
	Max	P2	TKW 1CB9 internal fault	104%	

5.1.2 Steady-State Voltage Analysis

With the connection of the IC's project, the voltage performance under system normal conditions (P0) and single contingencies (P1 and P2) is acceptable for all three load conditions (30LS, 30HS, 29HW).

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 the full MW operating range including at zero MW output level. According to the IC-provided reactive capability curve, the proposed WTG has +2.55/-2.2 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 the new 138 kV transmission line connected to IC's project is islanded with 1L385 (or 1L396) during various operation conditions or under system contingency operation conditions, an anti-islanding transfer trip scheme is required to isolate the IC's project at the IC's entrance circuit breaker to avoid potential islanding operations with BC Hydro loads.

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.

The Klo Wind Project is required to participate in the existing North Coast Generation Shedding RAS to maintain system reliability under 500 kV line

contingency operating conditions. North Coast regional transmission system including the Klo Wind Project will form an island operating condition when loss of major North Coast 500 kV transfer cut-plane between Wiliston substation and Skeena substation.

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

To interconnect this customer, the following are the station work required at the Telkwa substation:

- Add one 138kV line position with the associated substation equipment. Refer to the one-line diagram in Appendix B.
- Terminate the Klo Wind customer line.

Other associated station work.

5.4 Protection & Control Requirements

For the new IC to be successfully integrated, new line protection relays will need to be installed at BC Hydro's TKW and at the new IC station to protect the new line 1LXXX. Telecommunication facilities will also be required at both TKW and the new IC station.

The IC, Klo Wind, to provide the following for the interconnection of the IC's 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 the IPP station to provide protection coverage for the new line 1LXXX from TKW to the IC station. BC Hydro P&C Planning will provide settings for these relays.
- The IC is responsible for NERC PRC-related tasks and setting 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.
- Provide anti-islanding protection as per Regional System Planning requirements.

The runback schemes or RAS requirements, if required in Section 5.1, are mainly to address the overloading concerns under contingencies, which are preliminary. These RAS requirements may utilize the communication channels required for protection purposes included in the cost estimate. If the proposed project proceeds through the CEAP process, subsequent System Impact Studies may identify additional RAS requirements for this interconnection. These RAS functional requirements will include initiating events, control actions, and latency times. Depending on these supplementary requirements, additional telecommunication facilities may be needed to facilitate signal transmission between the BC Hydro substations and customer facilities.

5.5 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 TKW and P62 for “TKW-P62 1LXXX PY DIGITAL TELEPROT” and “TKW-P62 1LXXX SY DIGITAL TELEPROT” with C37.94 interfaces.

Telecontrol Requirements for Telecom

- Provide P62 SCADA circuit off FVO & SIO.

Other Requirements for Telecom

- Provide PY & SY aggregate T1’s over separate OC3s between P62-TKW. Provide MPLS links and LSPs for new TKW MPLS nodes.

Certain assumptions were made to determine a potential telecom solution. Details of the telecom solution (e.g., assumptions made, alternatives investigated, and work required for BCH and the IC) will 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 Klo Wind 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 138 kV line position at TKW is required to interconnect the IC's generating project to the BC Hydro system.
2. The connection of the Klo Wind 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 the Klo Wind Project will cause a thermal overload on one of the two TKW 230/138 kV transformers (T4 or T5) under single contingencies (P2). If an overload on the TKW transformer is detected, Operating Procedures will be required to shed or curtail the IC's generation.
4. Anti-islanding transfer trip scheme is required to isolate the IC's wind farm at P62 to avoid potential islanding operations with BC Hydro loads. In addition, 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 Klo Wind Project is required to participate in the existing North Coast Generation Shedding RAS to maintain system reliability under 500 kV line contingency operating conditions.
6. The IC shall provide the 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 Klo Wind Project single line diagram used for power flow study.

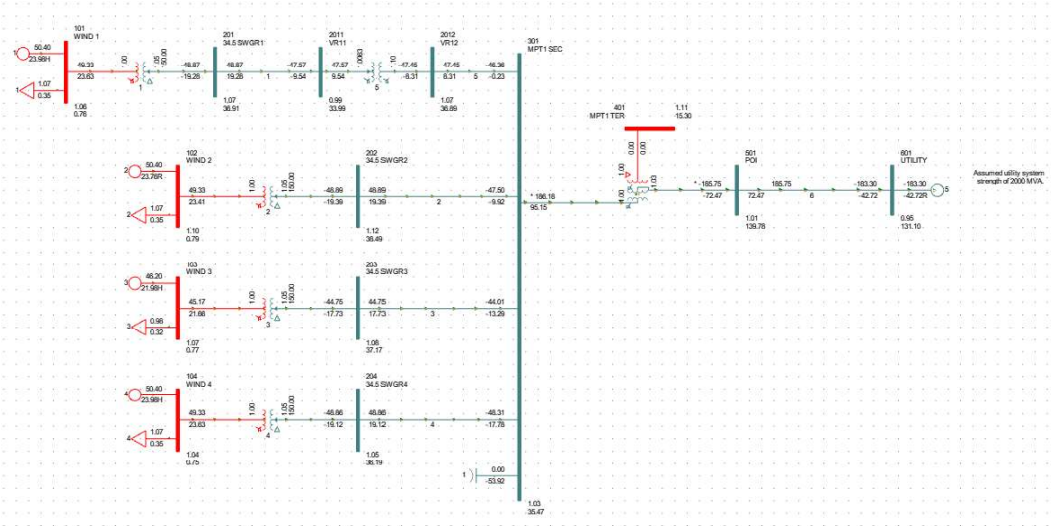

Figure A-1: Klo Wind Project Single Line Diagram for Power Flow Study.

Appendix B
One-Line Sketch for TKW Station with New Line Position

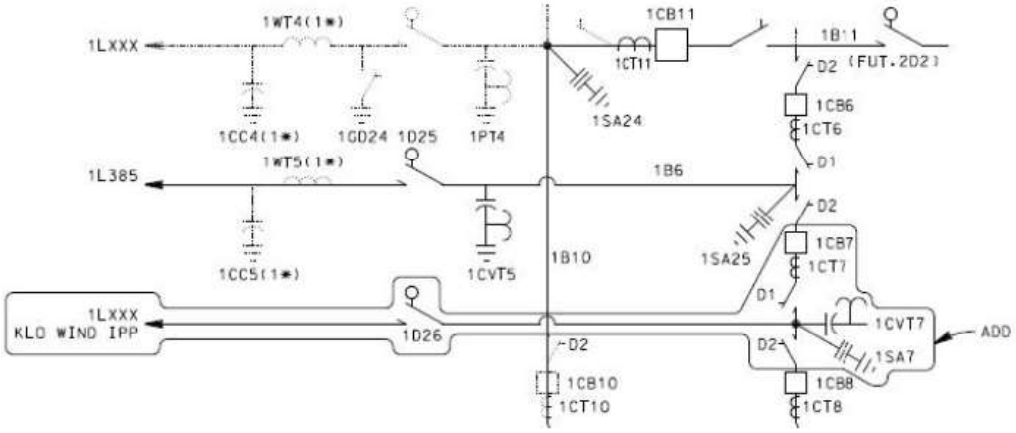

Figure B-1: Stations Planning One-Line Sketch for the TKW Substation with the new line position.