BC Hydro
Power smart

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

[redacted]

[redacted]

[redacted]

[redacted]

RE: CEAP IR 64 - Sinkut Wind Project - Interconnection Feasibility Study Report

Enclosed is the Interconnection Feasibility study report for the proposed Sinkut 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 $54.4 M.

Major Scope of Work Identified:

- Supply and install four 230kV circuit breakers together with the associated substation equipment to create a 4-circuit breaker ring bus at BC Hydro Tachik (TAC) substation
- Construct one 230kV line position with the associated substation equipment at TAC
- Expand the existing control building to accommodate the new P&C panels and other equipment at TAC
- Conduct other associated station work at TAC
- Supply and install racks, dehydrators, waveguides, microwave terminals and antennas
- Supply and install protection relays and other required protection equipment
- Supply and install digital teleprotection circuits and connect to protective equipment
- Other Telecom and Protection work, as required

Exclusions:

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

Key Assumptions:

- Construction will be done by contractor
- Early Engineering and Procurement
- 3 years of construction is considered
- Station expansion will not be required to add the new line position
- Control building will require expansion to accommodate the new P&C equipment
- No ground improvements will be required
- No piles will be required for construction
- No contaminated soil will be encountered during construction

Key Risks:

- 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

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_64_Sinkut Wind_FeS_Report_final.pdf

[redacted]

Sinkut Wind Project

Interconnection Feasibility Study

BC Hydro EGBC Permit to Practice No: 1002449

2024 CEAP IR # 64

Prepared for: [redacted]

[redacted]

Report Metadata

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Subheader:	Interconnection Feasibility Study
Title:	Sinkut Wind Project
Subtitle:	2024 CEAP IR # 64
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Confidentiality:	Public
Date:	2024 Jul 30
Volume:	1 of 1

Prepared for:

[redacted]

[redacted]

Revisions

Revision	Date	Description
0	2024 Jul	Initial release

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Executive Summary

[redacted] the interconnection customer (IC), requests to interconnect its Sinkut Wind Project (2024 CEAP IR # 64) to the BC Hydro (BCH) system. Sinkut Wind Project has thirty-five (35) [redacted] 5.7 MW type-3 wind turbine generators with total installed capacity of 199.5 MW. The proposed Point of Interconnection (POI) is at 230 kV bus of BC Hydro's Tachick substation (TAC). The IC's project will connect to the POI via a 34 km customer-built 230 kV interconnection line. The IC's proposed commercial operation date (COD) is November 1st, 2029.

To interconnect the Sinkut 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 230 kV line position at TAC substation is required to interconnect the IC's generating project to the BC Hydro system.
2. The connection of Sinkut Wind Project does not cause any performance violation (i.e. thermal overload, voltage performance violation or voltage stability concern) under system normal and single contingency conditions.
3. A direct transfer trip (DTT) from Glenannan substation (GLN) to TAC and TAC to the IC's entrance breaker is required to isolate the wind farm for any islanding scenarios 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 load forms.
4. The Sinkut Wind Project is required to participate in the existing North Coast Generation Shedding Application/Scheme to maintain system reliable operation under 500 kV line contingencies.
5. The existing BCH line 2L353 and the 230 kV TAC substation will become part of BC Hydro Bulk Electric System (BES) and need to be compliant with applicable NERC MRS requirements. The proposed new IC owned 230 kV interconnection line 2L3XX will be an IC's BES element and the IC will be responsible for the compliance with MRS requirement.

6. BC Hydro will provide line protections for new line 2L3XX to the Sinkut Wind Project and will revise the existing 2L353 line protections. As part of the line protection replacements, 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.

Contents

Appendices

Acronyms

The following are acronyms used in this report.

BCH	BC Hydro
BES	Bulk Electric System
CEAP	Competitive Electricity Acquisition Process
COD	Commercial Operation Date
DTT	Direct Transfer Trip
EDM	Edmonds Office
ERIS	Energy Resource Interconnection Service
FeS	Feasibility Study
FGE	Fort St. James Green Energy Generating Station
FLB	Fraser Lake Biomass Generating Station
FVO	Fraser Valley Office
GLN	Glenannan Substation
IBR	Inverter-Based Resources
IC	Interconnection Customer
MPO	Maximum Power Output
MRS	Mandatory Reliability Standards
NERC	North American Electric Reliability Corporation
NRIS	Network Resource Interconnection Service
OATT	Open Access Transmission Tariff
PGTC	Prince George to Terrace Capacitor Project
POI	Point of Interconnection
PY	Primary Protection
RAS	Remedial Action Scheme
SCADA	Supervisory Control and Data Acquisition
SIC	South Interior Control
SIO	South Interior Office
SKA	Skeena Substation
SY	Stand by Protection
TAC	Tachick Substation

TIR	BC Hydro “60 kV to 500 kV Technical Interconnection Requirements for Power Generators”
TVC	Transmission Voltage Customer
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	Sinkut Wind Project	
Name of Interconnection Customer (IC)	[redacted]	
Point of Interconnection (POI)	Tachick substation 230 kV bus	
IC's Proposed COD	1st November 2029	
Type of Interconnection Service	NRIS ☒	ERIS ☐
Maximum Power Injection [1] (MW)	191.21 MW (Summer)	191.21 MW (Winter)
Number of Generator Units	28 x 5.7 MW WTGs	
Plant Fuel	Wind	
Note 1: The maximum achievable power injection at the POI is approx. 191.21 MW after accounting for MW losses and station service load.		

[redacted] the interconnection customer (IC), requests to interconnect its Sinkut Wind Project (2024 CEAP IR # 64) to the BC Hydro system. Sinkut Wind Project has Thirty-five (35) [redacted] 5.7 MW type-3 wind turbine generators with total installed capacity of 199.5 MW. The IC's proposed Point of Interconnection (POI) is at the 230 kV bus of BC Hydro's Tachick substation (TAC). The IC's project will connect to the POI via a 34 km customer-built 230 kV interconnection line. The proposed commercial operation date (COD) is November 1, 2029.

Figure 1-1 shows the Glenannan-Tachick region transmission system diagram. Glenannan substation (GLN) is a major substation in this area with two existing 500/230 kV transformers (GLN T2 & T3) and two 230/138 kV transformers (GLN T5 & T6). GLN presently supplies one 230 kV transmission line — 2L353 to the BC Hydro's Tachick substation.

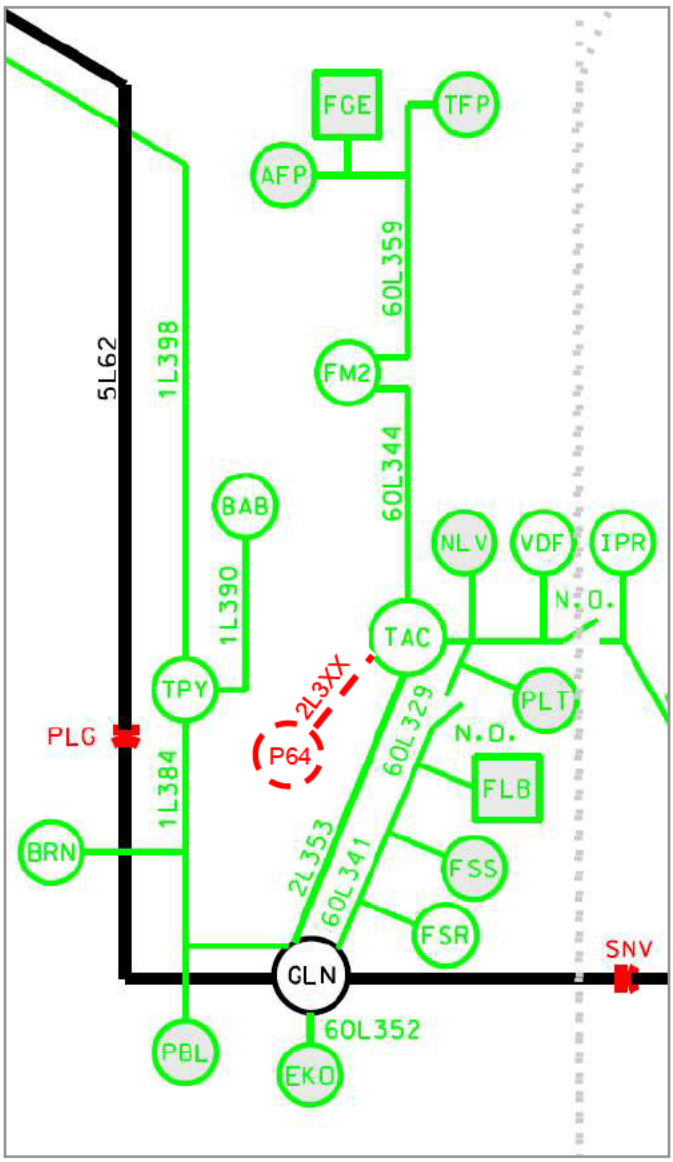

Figure 1-1: Glenannan-Tachick 230/66 kV Regional Transmission System Diagram in 2024

The existing line 2L353 is a radial circuit that mainly supplies TAC 230/66 kV substation.

There are two other customers' owned power plants in the study region.

- Fort St. James Green Energy Generating Station (FGE) has a total capacity of 40 MW and is connected to TAC via the line 60L344.

- Fraser Lake Biomass Generating Station (FLB) has a total capacity of 7.2 MW and is connected to GLN Substation via 60L329.

When 60L344 thermal overload protections detected conductor temperature exceeding the line rating (60^0 C), a runback signal will be sent to FGE to reduce the power injection at the 60L359 POI to 33 MW.

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). I non-biding good faith estimated cost of required Network Upgrades and estimate 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 made, 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.

5 System Studies and Results

Based upon the IC's submitted information and the area system conditions, the existing 230 kV TAC substation is required to convert to four (4) circuit breaker ring bus configurations to interconnect the IC's generating project to the BCH system.

A new IC owned 230 kV interconnecting line, temporarily referred to as: 2L3XX (TAC-P64). The temporary line designation will be replaced by permanent designation at a later stage of interconnection study.

The existing BCH line 2L353 and the 230 kV TAC substation will become part of BC Hydro Bulk Electric System (BES) and need to be compliant with applicable NERC MRS requirements. The proposed new IC owned 230 kV interconnection line 2L3XX will be an IC's BES element and the IC will be responsible for the compliance with MRS requirement.

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 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 2030 heavy winter (30HW) 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 condition and single contingencies for all three load conditions studied.

Table 5-1: Summary of Branch Loading Analysis Results

Case	IC's Plant Output	Contingency		Branch Loading
		Cat.	Description	2L353 (GLN-TAC)
Winter Rating				478 MVA
30HW	Max	P0	System Normal	39%
	Max	P1	60L329	45%
Summer Rating				420 MVA
30HS	Max	P0	System Normal	48%
	Max	P1	60L329	51.8%
30LS	Max	P0	System Normal	50.6%
	Max	P1	60L329	52.5%

Note: The facility rating of 2L353 line in the Table 5-1 is after converting 230 kV TAC substation to the four breaker ring bus configurations.

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 (30LS, 30HS, 30HW). Table 5-2 shows a summary of steady-state voltage performance under various system conditions and contingencies.

The study also finds that Sinkut Wind Project could improve the load bus voltage at TAC under heavy load conditions.

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

Case	IC's Plant Output	Contingency		Bus Voltage (PU)		
		Cat.	Description	GLN 230	TAC 230	P64 230
30HW	Max	P0	System normal	1.026	1.014	1.02
30HS	Max	P0	System normal	1.019	1.010	1.016
	0 MW	P0	System normal	1.032	1.035	1.043
	0 MW	P1.1	FGE G1	1.037	1.052	1.06
30LS	Max	P0	System normal	1.00	1.00	1.00
	0 MW	P0	System normal	1.04	1.045	1.053
	0 MW	P1.1	FGE G1	1.04	1.066	1.073

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 to meet the BC Hydro's reactive capability requirement at the plant's full MW operating range including zero MW output level, which is subjected to further verification in the next stage of interconnection study.

5.1.4 Anti-Islanding Requirements

If 2L353 line is open at either end (due to fault on the line or GLN 2CB1/GLN 2CB2 internal breaker fault/stuck breaker) or the loss of both 500/230 kV transformers and internal breaker fault/stuck breakers of 230 kV line breakers connecting to Sinkut wind at TAC substation, the IC's project may be inadvertently islanded with the BC Hydro loads, which is not allowed. A direct transfer trip (DTT) from GLN to TAC substation and the IC's entrance breaker is required to isolate wind farm in the above-mentioned islanding scenarios.

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 load forms.

North Coast regional transmission system including the Sinkut Wind Project will form an island operating condition from the rest of BCH system when loss of major North Coast 500 kV transfer cut-plane between Williston substation and GLN substation. The Sinkut Wind Project is required to participate in the existing North Coast Generation Shedding Application/Scheme to maintain system reliability under 500 kV line contingency operating conditions.

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

The station upgrade scope required to interconnect Sinkut Wind Project at the existing BC Hydro TAC substation is as follows.

- Add four 230 kV circuit breakers together with the associated substation equipment to build a four (4) circuit breaker ring bus configuration.
- Add one 230 kV line position with the associated substation equipment to terminate the 230 kV Sinkut Wind Project interconnecting line.
- Expand the existing control building, if required, to accommodate the new Protection & Control panels and other equipment.
- Other associated station work.

Refer to One-Line Sketch in Appendix B for details.

5.4 Protection & Control Requirements

BC Hydro will provide line protections for new line 2L3XX (TAC-P64) to the Sinkut wind project and will revise the existing 2L353 (GLN-TAC) line protections. As part of the line protection replacements for each of the two lines, telecommunication facilities will be required to accommodate the new protection schemes.

The IC is to provide the following for the interconnection of Sinkut wind 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 P64 to provide protection coverage for 2L3XX. BC Hydro P&C Planning will provide core protection settings for these relays to protect transmission line 2L3XX 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.

The remedial action schemes (RAS) requirements stated in Section 5.1 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.

Tele-protection Requirements for Telecom

- WECC Level 3 PY & SY, TAC – P64, with C37.94 interfaces.
- WECC Level 3 PY & SY, GLN – TAC, with C37.94 interfaces.

Telecontrol Requirements for Telecom

- Provide P64 SCADA circuits to FVO & SIO.
- Provide TAC REMACC circuit to EDM.

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 Sinkut 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 230 kV line position at TAC substation is required to interconnect the IC's generating project to the BC Hydro system.

2. Install four (4) 230 kV circuit breakers with associated substation equipment to build a four-breaker ring bus configuration at TAC substation.

3. The connection of Sinkut Wind Project does not cause any performance violation (i.e. thermal overload, voltage performance violation or voltage stability concern) under system normal and single contingency conditions.

4. A direct transfer trip (DTT) from Glenannan substation (GLN) to TAC and from TAC to the IC's entrance breaker is required to isolate the wind farm for any islanding scenarios 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 load forms.

5. The Sinkut Wind Project is required to participate in the existing North Coast Generation Shedding Application/Scheme to maintain system reliable operation under 500 kV line contingencies.

6. The existing BCH line 2L353 and the 230 kV TAC substation will become part of BC Hydro Bulk Electric System (BES) and need to be compliant with applicable NERC MRS requirements. The proposed new IC owned 230 kV interconnection line 2L3XX will be an IC's BES element and the IC will be responsible for the compliance with MRS requirement.

7. BC Hydro will provide line protections for new line 2L3XX to the Sinkut Wind Project and will revise the existing 2L353 line protections. As part of the line protection replacements, 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 Sinkut Wind Project single line diagram used for power flow study.

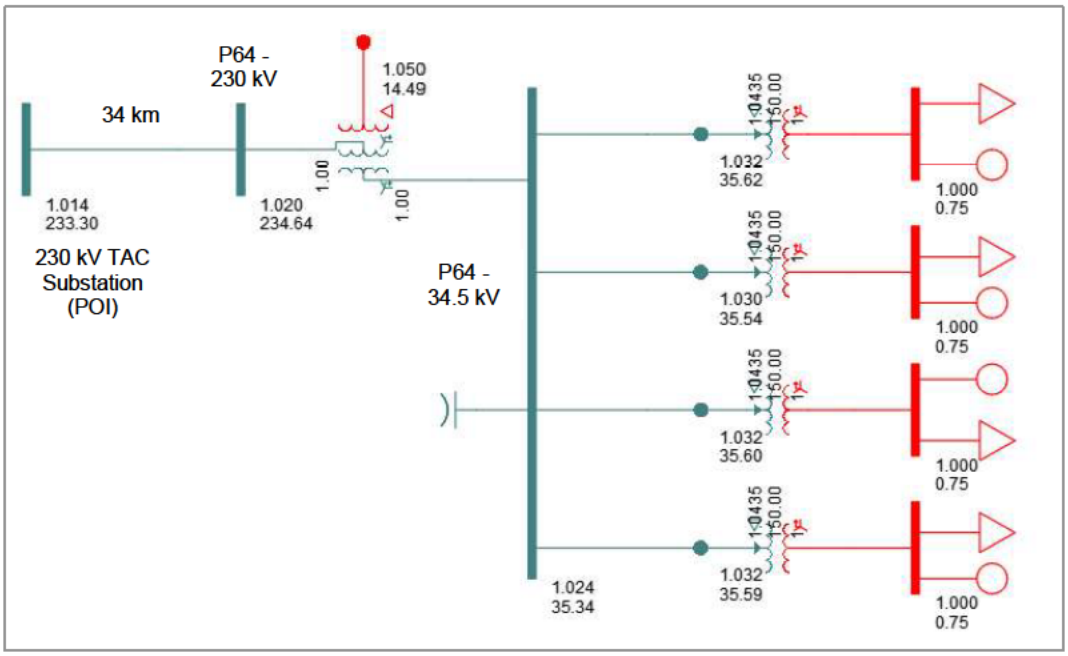

Figure A-1: Sinkut Wind Project Single Line Diagram for Power Flow Study.

As seen in the diagram, Sinkut Wind Project has a main power transformer, one 11 MVAr and one 20 MVAr switchable shunt capacitors at 34.5 kV system and four collector feeders.

- Three (3) feeders connect 9 wind turbines per feeder to the collector station.
- Remaining one feeder connect 8 wind turbines to the collector station.

Appendix B
One-Line Sketch of Upgrades at TAC Substation

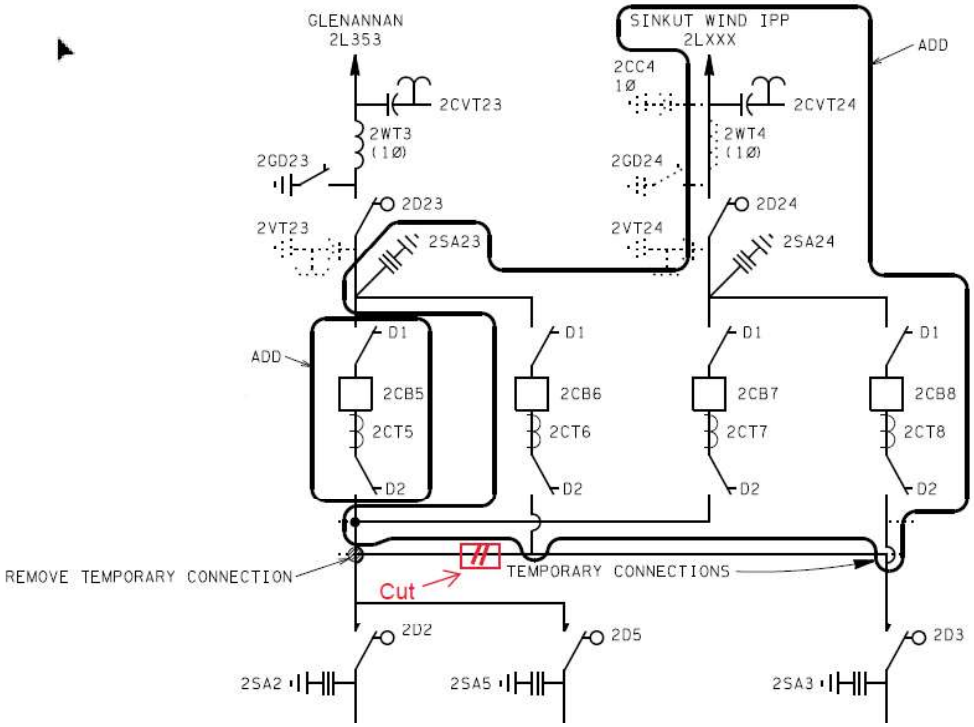

Figure B-1: One-Line Sketch for Upgrades at TAC Substation