BC Hydro
Power smart

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

July 30, 2024

[redacted]

RE: CEAP IR 35 - Troubridge Ridge Wind Farm Project - Interconnection Feasibility Study Report

Enclosed is the Interconnection Feasibility study report for the proposed Troubridge Ridge Wind Farm 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 $35.5 M.

Major Scope of Work Identified:

- Supply and install a new 230 kV CB and associated disconnects in the existing 230 kV bus structure to create 5-CB ring bus configuration at BC Hydro Saltery Bay (SAY) substation
- Supply and install one 230 kV line position with the associated substation equipment at SAY
- 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
- 3 years of construction
- Early Engineering and Procurement
- No expansion of existing station or control building required to accommodate new equipment
- No piles or ground improvements will be required
- No contaminated soil will be encountered during construction

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 increased costs
- Costs materials and major equipment be affected by market conditions and escalation
- Additional cost and/or schedule risk if station expansion is required

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 the BC Hydro CEAP Team at ceap2024@bchydro.com.

Sincerely,

Senior Manager, Transmission Interconnections

BC Hydro

Encl.: CEAP2024_IR_35_Troubridge Ridge Wind Farm_FeS_Report_final.pdf

[redacted]

Trouridge Ridge Wind Farm Project

Interconnection Feasibility Study

BC Hydro EGBC Permit to Practice No: 1002449

2024 CEAP IR # 35

Prepared for: [redacted]

[redacted]

431-APR-00007
2024 Jul 30

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[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 Trouridge Ridge Wind Farm Project (2024 CEAP IR # 35) to the BC Hydro system in the Sunshine Coast region. Trouridge Ridge Wind Farm Project has seven (7) [redacted] 7 MW type-4 wind turbine generators, adding a total capacity of 49 MW into the BC Hydro system. The IC will build a 3.75km long 230kV overhead transmission line to interconnect the generating plant with BC Hydro system. The Point of Interconnection (POI) is at BC Hydro's SAY 230 kV switchyard. The IC's proposed commercial operation date (COD) is Oct 1, 2028.

To interconnect the Trouridge Ridge Wind Farm 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 SAY is required to interconnect the IC's generating project to the BC Hydro system.

2. The study does not identify any thermal overload violations for P0, P1 and P2 contingencies due to the integration of Trouridge Ridge Wind Farm project. The study is based on the assumption that 2L48 summer rating will be at least 1000A by Oct. 2028.

3. The study does not find any voltage performance violation or voltage stability concern for P0, P1 and P2 contingencies due to the integration of Trouridge Ridge Wind Farm project.

4. Trouridge Ridge Wind Farm is not arranged for islanded operation. Anti-islanding direct transfer trip (DTT) from MSA to SAY is required to isolate the wind farm for protective and unintentional tripping of 2L48 at MSA. Analytical studies are required to follow up with detailed studies if the project is to proceed. In addition to entrance protection and 2LXXX protection, the IC is required to install anti-islanding protection within their facility to disconnect the wind farm from the grid when an inadvertent island with the local loads forms as a back up to the anti-islanding DTT.

5. According to BC Hydro's TIR, the IC's project must have sufficient reactive power capability over full MW operating range including at the zero MW output level. The Trouridge Ridge Wind Farm farm as submitted does not

meet the reactive capability requirement at zero MW output level, which will need to be addressed.

6. For successful integration of the IC's project, new line protection relays will need to be installed at BC Hydro's SAY and at the new IC's station: P35 for the protection of the new line 2LXXX. Telecommunication facilities will be required at MSA, SAY and P35. 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
CEAP	Competitive Electricity Acquisition Process
CKY	Cheekye Substation
COD	Commercial Operation Date
DTT	Direct Transfer Trip
ERIS	Energy Resource Interconnection Service
ETR	East Toba
FeS	Feasibility Study
FVO	Fraser Valley Office
FVW	Forestview station
GPT	Grief Point station
HSP	Howe Sound Pulp and Paper – Port Mellon Substation
IBR	Inverter-Based Resources
IC	Interconnection Customer
JMC	Jimmie Creek station
LAPS	Local Area Protection Schemes
MPO	Maximum Power Output
MSA	Malaspina Substation
MTC	Montrose
NERC	North American Electric Reliability Corporation
NRIS	Network Resource Interconnection Service
OATT	Open Access Transmission Tariff
P35	IC's Trouridge Ridge Wind Farm Station
POI	Point of Interconnection
POW	Powell River substation
RAS	Remedial Action Scheme
SAY	Saltery Bay Substation
SIO	South Interior Office
TIR	BC Hydro "60 KV to 500 kV Technical Interconnection Requirements for Power Generators"

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	Trouridge Ridge Wind Farm Project	
Name of Interconnection Customer (IC)	[redacted]	
Point of Interconnection (POI)	SAY	
IC's Proposed COD	1st October 2028	
Type of Interconnection Service	NRIS ☒	ERIS ☐
Maximum Power Injection (MW)	48.9 MW (Summer)	48.9 MW (Winter)
Number of Generator Units	7 x 7 MW WTGs	
Plant Fuel	Wind	
Note 1: The maximum achievable power injection at the POI is approx. 48.2 MW after accounting for MW losses and service load which is lower than the IC proposed 48.9 MW.		

[redacted] the interconnection customer (IC), requests to interconnect its Trouridge Ridge Wind Farm Project (2024 CEAP IR # 35) to the BC Hydro system in the Sunshine Coast region. Trouridge Ridge Wind Farm Project has seven (7) [redacted] 7 MW type-4 wind turbine generators, adding a total capacity of 49 MW into the BC Hydro system. The IC will build a 3.75km long 230kV overhead transmission line to interconnect the generating plant with BC Hydro system. The Point of Interconnection (POI) is at BC Hydro's SAY 230 kV switchyard. The IC's proposed commercial operation date (COD) is Oct 1, 2028.

Figure 1-1 shows the area system with the proposed Trouridge Ridge Wind Farm Project in the Sunshine Coast and North Shore Region area. MSA is a major 500/230/132kV substation which is supplied from Cheekye Substation (CKY) via 5L30 and 5L32, and in turn supplies Vancouver Island via dual 500 kV circuits 5L29 and 5L31. There are two 230 kV circuits: 2L47 supplies Howe Sound Pulp and Paper – Port Mellon Substation (HSP), and 2L48 is the main supply to Saltery Bay Substation (SAY). 1L37 is also the backup supply to SAY and is normally open at SAY. The Powell River substation (POW) is connected to BC Hydro's Saltery

Bay (SAY) station via 1L48 with 1L33 as standby. The two segments from POW to SAY and from SAY to MSA are radial connections.

The power from the nearby generating stations including East Toba (ETR), Montrose (MTC) and Jimmie Creek (JMC) are delivered to SAY by a 157.4km 230kV line 2L29. There are two distribution stations in the POW area: Grief Point station (GPT) and Forestview station (FVW). In normal operations, GPT is supplied off 1L33 tap with 1L48 as backup; FVW is supplied off 1L48 tap with 1L33 as backup.

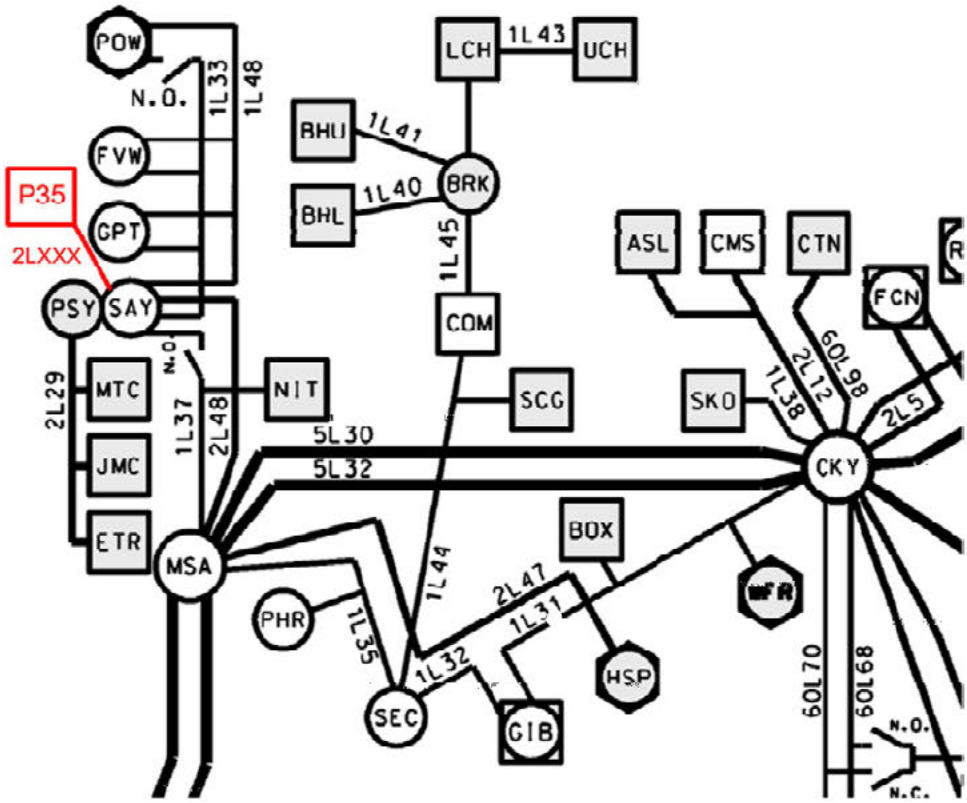

Figure 1-1: Sunshine Coast and North Shore Region 132/230/500 kV Transmission System Diagram

Figure A-1 shows the more detailed connection of the IC's project to the BC Hydro Transmission System.

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) The POW-SAY-MSA 132 kV and 230 kV transmission system (1L48 and 2L48) is stressed with power transfer 82 MW on 1L48 from POW to achieve firm power export to the US required by an existing customer, and full output from local IPPs including MTC, JMC, and ETR.

3) There is an ongoing BC Hydro project to replace conductors for 2L48 between Str 32-02C and Str 34-01 (Jervis Crossing, 3.5km long span over salty water). The expected ISD is Oct 2028. 2L48 ampacity will be at least 1000A in summer season after this project in service. In case the ISD of Oct 2028 is not achieved, it is reasonable to consider dynamic line rating monitoring or other method to justify the higher ampacity of this crossing.

5 System Studies and Results

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

For all the studied load conditions (29LS, 28HS, 28HW), there is no branch overload identified under system normal condition (P0).

In all the studied load conditions (29LS, 28HS, 28HW), there is no pre-existing branch overloads under P1 or P2 single contingencies (i.e., MSA T1/T5, MSA T2, 1L33, FVW T1). Based on the assumption that 2L48 rating for summer season will be at least 1000A, there is no thermal overload violation identified for any P1 or P2 contingencies after the connection of Trouridge Ridge Wind Farm Project. Study results for the most limiting contingencies are listed in the following Table 5-1.

Table 5-1: Summary of Branch Loading Analysis Results

Case	IPP's Generator Output	Contingency Identified		Branch Loading (Note 1)	
				2L48	MSA T1
		Cate-gory	Description	MSA-SAY	MSA 230KV -500KV
Summer Rating				398.4 MVA	600 MVA
29LS	49 MW	P0	System Normal	98 %	44 %
		P1	Loss of 1L33	99 %	48 %
		P1	Loss of FVW T1	100 %	48 %
		P1	Loss of MSA T2	98 %	89 %
29HS	49 MW	P0	System Normal	95 %	42 %
		P1	Loss of 1L33	98 %	43 %
		P1	Loss of FVW T1	99 %	43 %
		P1	Loss of MSA T2	95 %	84 %
Winter Rating				478 MVA	714 MVA
28HW	49 MW	P0	System Normal	76 %	31 %
		P1	Loss of 1L33	80 %	32 %
		P1	Loss of FVW T1	81 %	33 %

		P1	Loss of MSA T2	76 %	62 %

Note 1: it is based on continuous ratings to check thermal overload issues for P0 and P1 contingencies. 1000A(398.4MVA) is used for 2L48 summer rating in this study based on confirmed information from transmission design.

5.1.2 Steady-State Voltage Analysis

For all the studied load conditions (29LS, 29HS, 28HW), the voltage performance under system normal condition (P0) is acceptable. No voltage deviation violations are identified for N-1 contingencies. Voltage study results for the most limiting contingency for loss of MSA T2 are presented in the following Table 5-2.

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

Case	IPP's Generator Output	Contingency		Bus Voltage (PU)		
		Category	Description	MSA 500 kV	MSA 230 kV	SAY 230kV
28HW	49 MW	P0	System Normal	1.058	1.037	1.035
		P1	Loss of MSA T2	1.065	1.038	1.035

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 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. The proposed wind farm does not meet this requirement at zero MW output, which will need to be addressed.

5.1.4 Anti-Islanding Requirements

If 2L48 is open end at MSA, Trouridge Ridge Wind Farm may be inadvertently islanded with BC Hydro loads, which could result in over-voltage and is not allowed. Anti-islanding direct transfer trip (DTT) from MSA to SAY is required to isolate the wind farm for protective and unintentional tripping of 2L48 at MSA. Analytical studies are required to follow up with detailed studies if the project is to proceed. In addition, as a back up to the anti-islanding DTT the IC is required to

install anti-islanding protection within their facility to disconnect the Trouridge Ridge Wind Farm 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

The POI of the Trouridge Ridge Wind will be at SAY 230 kV switchyard.
Following is the scope of station work at SAY:

- Permanent bus cut at 230 kV bus is required to expand 4-CB ring bus to 5-CB ring bus configuration. Refer to the attached one-line sketch in Appendix B for details.
- Add a new 230 kV CB (2CB2) and associated disconnects in the existing 230 kV bus structure to create 5-CB ring bus configuration.
- Add 230 kV CVT (2CVT6) and SA (2SA6) as shown in one-line sketch attached in Appendix B.
- Add one 230 kV line position with the associated substation equipment for the Trouridge Ridge Wind Farm. Refer to the attached one-line sketch in Appendix B for details.
- Expand the existing control building, if required, to accommodate the new P&C panels and other equipment.
- Terminate the Trouridge Ridge Wind 230 kV 2LXXX transmission line.
- Other associated station work.

5.4 Transmission Line Requirements

Transmission engineering has done the thermal rating study of 2L048 and concluded as that 2L048's rating is limited by the section between Str 32-02C and 34-01 with 948A rating at summer (30°C). Other portion of 2L048 can provide minimum of 1125A in summer (30°C).

The replacement of the conductors between Str 32-02C and Str 34-01 (Jervis Crossing, 3.5km long span over salty water) is already underway within BC Hydro

as a separate project. The expected ISD is Oct 2028. It is assumed this project will meet the ampacity requirement of 1000 Amps.

In case the ISD of Oct 2028 is not achieved, It is reasonable to consider dynamic line rating monitoring or other method to justify the higher ampacity of this crossing.

5.5 Protection & Control Requirements

For successful integration of the IC's project, new line protection relays will need to be installed at BC Hydro's SAY and at the new station: P35 for the protection of the new line 2LXXX. Telecommunication facilities will be required at MSA, SAY and P35.

The IC is to provide the following for the interconnection of the Trouridge Ridge Wind Farm 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 P35 to provide protection coverage for the new line 2LXXX from SAY to P35. BC Hydro P&C Planning will provide settings for these relays.
- 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.
- Provide anti-islanding protection as stated in Section 5.1.

5.6 Telecommunications Requirements

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

Teleprotection Requirements for Telecom

- Provide WECC Level 3 64 kbps synchronous circuits between SAY and P35 station for “SAY-P35 2LXXX PY DIGITAL TELEPROT” and “SAY-P35 2LXXX SY DIGITAL TELEPROT”. Physical interface shall be C37.94 optical over multimode fibre using ST connectors.
- Provide WECC Level 3 transfer trip facilities between MSA and SAY for “MSA 2L48 PY ANTI-ISLANDING TT to SAY” and “MSA 2L48 PY ANTI-ISLANDING TT to SAY”.

Telecontrol Requirements for Telecom

- Provide P35 SCADA circuits to FVO and SIO.

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.

[redacted]

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 Trouridge Ridge Wind Farm 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 SAY is required to interconnect the IC's generating project to the BC Hydro system.

2. The study does not identify any thermal overload violations for P0, P1 and P2 contingencies due to the integration of Trouridge Ridge Wind Farm project. The study is based on the assumption that 2L48 summer rating will be at least 1000A by Oct. 2028.

3. The study does not find any voltage performance violation or voltage stability concern for P0, P1 and P2 contingencies due to the integration of Trouridge Ridge Wind Farm project.

4. Trouridge Ridge Wind Farm is not arranged for islanded operation. Anti-islanding direct transfer trip (DTT) from MSA to SAY is required to isolate the wind farm for protective and unintentional tripping of 2L48 at MSA. Analytical studies are required to follow up with detailed studies if the project is to proceed. In addition to entrance protection and 2LXXX protection, the IC is required to install anti-islanding protection within their facility to disconnect the wind farm from the grid when an inadvertent island with the local loads forms as a back up to the anti-islanding DTT.

5. According to BC Hydro's TIR, the IC's project must have sufficient reactive power capability over full MW operating range including at the zero MW output level. The Trouridge Ridge Wind Farm farm as submitted does not meet the reactive capability requirement at zero MW output level, which will need to be addressed.

6. For successful integration of the IC's project, new line protection relays will need to be installed at BC Hydro's SAY and at the new IC's station: P35 for the protection of the new line 2LXXX. Telecommunication facilities will be required at MSA, SAY and P35. The IC shall provide required relays, telecom facilty, 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 the Trouridge Ridge Wind Farm Project single line diagram used for power flow study.

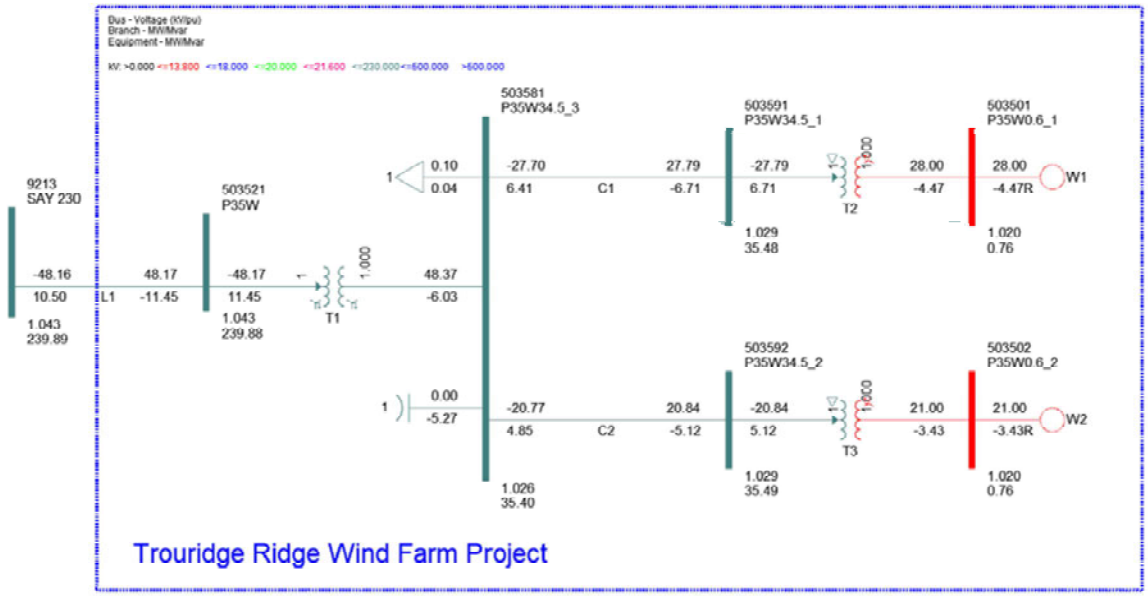

Figure A-1: Trouridge Ridge Wind Farm Project Single Line Diagram for Power Flow Study.

Appendix B
One-Line Sketch for BC Hydro's SAY Station

Figure B-1 shows the Stations Planning One-Line Sketch for SAY station updates to interconnect IC's Project.

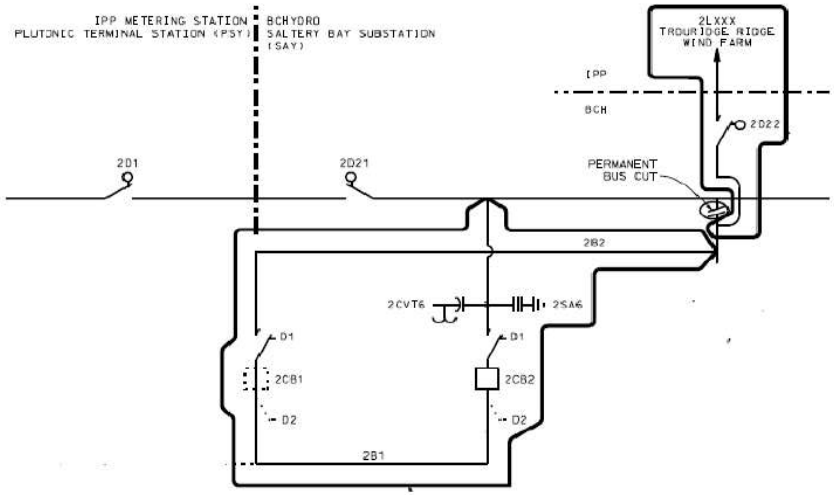

Figure B-1: Stations Planning One-Line Sketch for SAY.