BC Hydro
Power smart

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

July 30, 2024

[redacted]

RE: CEAP IR 112 - Gilford Island Wind Project - Interconnection Feasibility Study Report

Enclosed is the Interconnection Feasibility study report for the proposed Gilford Island 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 $107.1M.

Major Scope of Work Identified:

- Expand the existing 230kV switchyard at Gold River substation (GLD) and construct a 3-circuit breaker ring bus
- Expand the existing control building at GLD to accommodate new protection and control equipment
- Supply and install one 70MVAr switchable reactor with associated equipment
- Supply and install protection relays and other required equipment
- Supply and install required telecommunication equipment

Exclusions:

- GST
- Right-of-way
- Property
- Permits

Key Assumptions:

- Construction by contractor
- 3 years of construction
- Site expansion of GLD is feasible
- Control building expansion at GLD is feasible
- Early Engineering and Procurement
- No ground improvements will be required
- No piles will be required for construction
- No contaminated soil will be encountered during construction
- A Certificate of Public Convenience and Necessity (CPCN) requirement will not impact the schedule

Key Risks:

- Additional right of way or acquisition of more property may be required
- Transmission routing may be different than assumed, including number of disconnect switches and structure types may change
- No defined supply chain strategy, construction costs may increase depending on delivery method
- Cost of construction may increase based on geotechnical condition of the actual project site
- Project schedule may be longer than expected, leading to increased costs
- Costs may be affected by market conditions and escalation
- A CPCN requirement may delay the project schedule and increase costs

Please note that the Revenue Metering requirements and associated costs required to interconnect your project have not been determined at this stage and, therefore, not included in the above estimate. Revenue Metering costs that are attributable to the Interconnection Customer are to be paid in cash. For more details on Revenue Metering requirements and responsibilities, please refer to:

https://www.bchydro.com/content/dam/BCHydro/customer-portal/documents/distribution/standards/ds-rmr-complex-revenue-metering.pdf.

Schedule

Based on the Interconnection Feasibility study, the non-binding good faith estimated in-service date for your project's Network Upgrades is Quarter 3 2030 (calendar year). To achieve this timeline, we may need to expedite certain activities, including engineering design and procurement of long-lead equipment.

Timely actions required from you to minimize risks to the schedule:

- Submission of additional technical data required for the System Impact Study and Facilities Study
- Submission of any required information or document such as demonstration of Site Control
- Execution of Combined Study Agreement and Standard Generator Interconnection Agreement
- Financial commitments and securities

Please note that changes to your interconnection request, delays in data submission, or financial commitments may also impact the target in-service date.

Next Steps

In September 2024, we will issue a final invoice for the Feasibility Study costs. This invoice will reflect the total amount due, taking into account the $15,000 Feasibility Study deposit you have already paid and any remaining amount on the non-refundable $15,000 Interconnection request deposit that we did not spend in reviewing and validating your interconnection request.

If you have any questions, please contact the BC Hydro CEAP Team at ceap2024@bchydro.com.

Sincerely,

Senior Manager, Transmission Interconnections

BC Hydro

Encl.: CEAP2024_IR_112_Gilford Island Wind _FeS_Report_final.pdf

[redacted]

Gilford Wind

Interconnection Feasibility Study

BC Hydro EGBC Permit to Practice No: 1002449

2024 CEAP IR # 112

[redacted]

[redacted]

Report Metadata

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[redacted]

Related Facilities:	Gold River substation (GLD)
Additional Metadata:	Transmission Planning 2024-108 Filing Subcode 1350

[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 Gilford Wind project (2024 CEAP IR # 112) to the BC Hydro (BCH) system. Gilford Wind has forty-seven (47) [redacted] 4.2 MW high wind operation turbines generators, adding a total capacity of 193 MW into the BC Hydro system. The proposed Point of Interconnection (POI) is at the 230 kV bus of BC Hydro's Gold River Substation (GLD). The IC's project will connect to the POI via a 110 km customer-built 230 kV interconnection line. The IC's proposed commercial operation date (COD) is Oct 8, 2028.

To interconnect the Gilford Wind 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 GLD is required to interconnect the IC's generating project to the BC Hydro system.

2. The connection of Gilford Wind project will also exacerbate the pre-existing thermal overload on the BC Hydro facilities under various single contingencies. These overloads are presently addressed by the North Vancouver Island Remedial Action Scheme (NVI RAS). The NVI RAS needs to be updated and the new wind generators at Gilford Wind project are required to be included in the updated NVI RAS.

3. The study finds significant voltage performance issue at GLD 230 kV under the loss of 2L154 when all Gilford wind generators are unavailable in the light summer condition (29ls). A 70 MVAR 230 kV switched shunt reactor with AutoVAR control scheme is required to be installed at the GLD substation to mitigate the high voltage.

4. The study identified potential voltage instability issue in North Vancouver Island regional under Circuit Breaker fault (DMR 1CB15) single contingency caused by the connection of Gilford Wind project. A new RAS is required for tripping the generations at GLD in NVI system for this event.

5. In addition to entrance protection and 2LXX line protection, 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.

6. The new line 2LXX from GLD to the IC's substation will become IC's BES and the IC will be responsible for the compliance with applicable NERC MRS requirements.

7. BC Hydro will provide line protections for 2LXX protections (BC Hydro end only). 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
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
GLD	Gold River Substation
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
NVI	North Vancouver Island
OATT	Open Access Transmission Tariff
POI	Point of Interconnection
RAS	Remedial Action Scheme
SIC	South Interior Control
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	Gilford Wind	
Name of Interconnection Customer (IC)	[redacted]	
Point of Interconnection (POI)	230 kV bus of the Gold River Substation	
IC's Proposed COD	8th October 2028	
Type of Interconnection Service	NRIS ☒	ERIS ☐
Maximum Power Injection [1] (MW)	193 MW (Summer)	193 MW (Winter)
Number of Generator Units	47 x 7.2 MW	
Plant Fuel	Wind	

[redacted] the interconnection customer (IC), requests to interconnect its Gilford Wind project (2024 CEAP IR # 112) to the BC Hydro system. Gilford Wind has forty-seven (47) [redacted] 4.2 MW high wind operation turbines generators, adding a total capacity of 193 MW into the BC Hydro system. The IC's proposed Point of Interconnection (POI) is at the 230 kV bus of the BC Hydro's Gold River Substation (GLD). The IC's project will connect to the POI via a 110 km customer-built 230 kV interconnection line. The proposed commercial operation date (COD) is Oct 8, 2028.

Figure 1-1 shows the North Vancouver Island (NVI) region 132/230 kV transmission system diagram. NVI is a generation-rich sub-area where most of the generation in Vancouver Island is located. Within the NVI 132/230 kV system, there are pre-existing branch overload concerns under contingencies.

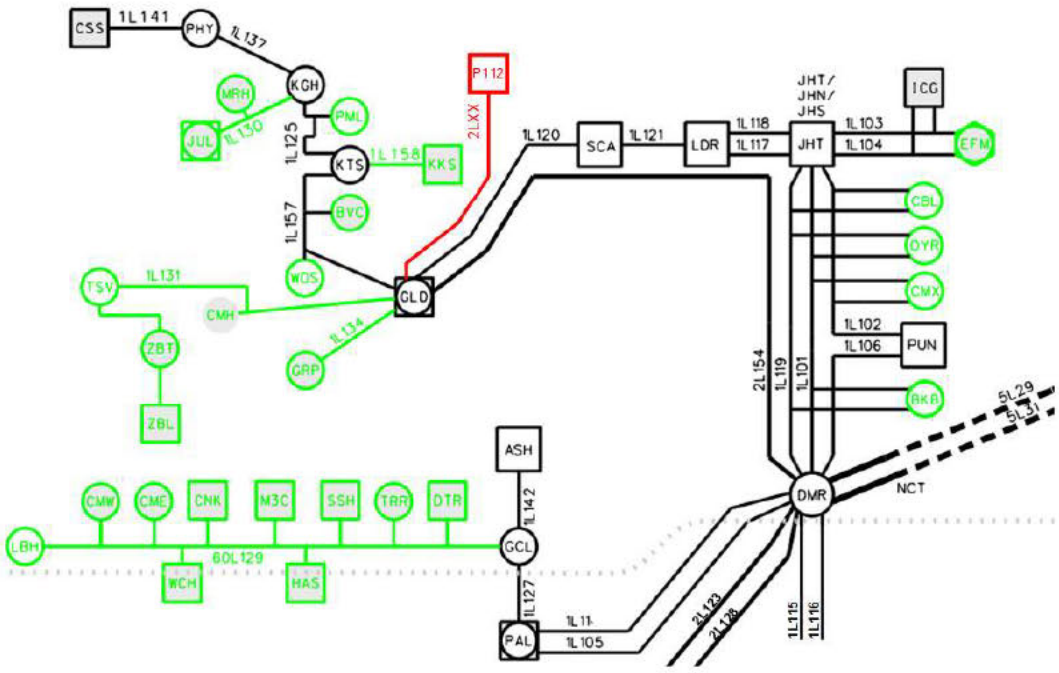

Figure 1-1: North Vancouver Island Region 132/230 kV Transmission System Diagram with the Proposed Gilford Wind Interconnection

The North Vancouver Island Remedial Action Scheme (NVI RAS) has been implemented to mitigate these issues, where the NVI RAS specifically addresses thermal overloads on the 1L120 (GLD-SCA) line and other 132 kV lines in the event of a loss of the 2L154 (GLD-DMR) line during periods of high CSS and KKS generation. As part of its operation, the RAS will reduce the generation output of CCS and KKS.

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.

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 current 2L154 line rating is constrained by the GLD transformer rating, rather than any terminal equipment from DMR. The rating of 2L154 is assumed 1009 A (summer) and 1304 A (winter) after proposed GLD reconfiguration.

3) The existing NVI RAS is feasible to be updated.

5 System Studies and Results

The proposed customer-built 230 kV line (GLD-P112) will be designated as 2LXX and will become IC's BES and the IC will be responsible for the complance with applicable MRS requirements. The temporary line designations will be replaced by permanent designations at a later stage of interconnection study.

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 2028 heavy summer (28hs), 2029 heavy summer (29hs) and 2031 heavy winter (31hw) 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.

Under the heavy and light summer condition (29hs, 30hs, 30ls), the connection of Gilford Wind project will also exacerbate the pre-existing thermal overload on the BC Hydro facilities 1L120 (GLD-SCA), 1L121 (SCA-LDR), 1L118 (LDR-JHT), 1L117 (LDR-JHT), 1L119 (JHT-DMR), 2L154 (GLD-DMR), 1L101 (JHT-DMR), 1L102 (JHT-PUN), 1L106 (PUN-DMR), and Gold River 230/132 kV transformers under various single contingencies. These overloads are presently addressed by the North Vancouver Island Remedial Action Scheme (NVI RAS). The NVI RAS needs to be updated and the new wind generators at Gilford Wind project are required to be included in the updated NVI RAS. The Gilford Wind generation is required to be tripped at IC's substation P112 under various system contingencies.

The updated NVI RAS would require additional circuits to be monitored, including the direction of MW flow. The units to be tripped/run backed will be determined based on the overloaded circuits and flow directions. The list of generation units to be included in the updated RAS contains the existing CSS, KKS, JHT, LDR, SCA, and Gilford Wind.

Table 5-1: Summary of Branch Loading Analysis Results

Case	North Vancouver Island Regional Generation/ Load	IPP's Generator Output	Contingency Identified		Branch Loading		
					2L154	1L120	1L121
			Cate-gory	Description	GLD-DMR	GLD-SCA	SCA-LDR
29LS	528.3 MW / 170 MW	197.4 MW	P0	System Normal	700.3 Amps 69.4 %	307.3 Amps 48.4 %	577.7 Amps 90.5 %
	528.3 MW / 170 MW	197.4 MW	P1	2L154 OOS	-	1472.8 Amps 231.8 %	1684.1 Amps 263.8 %
	456.2 MW / 170 MW	197.4 MW	P1	2L154 OOS w RAS[1]	-	1162.0 Amps 183.0%	1405.2 Amps 220.1 %
Note: [1] With existing NVI RAS							

5.1.2 Steady-State Voltage Analysis

Table 5-2 shows a summery of steady-state voltage performance under various system conditions and contingencies. With the connection of the IC's project, the voltage performance under system normal condition is acceptable for all load conditions (28hs, 29ls, 29hs, 31hw).

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

Case	North Vancouver Island Regional Generation/ Load	IPP's Generator Output	Contingency Identified		Bus Voltage	
					GLD 230	P112
			Cate-gory	Description	GLD-DMR	IC's 230 kV line to POI
29LS	528.3 MW / 170 MW	Without IC	P0	System Normal	1.01 pu	-
	528.3 MW / 170 MW	0 MW[1]	P0	System Normal	1.09 pu	1.13 pu
	528.3 MW / 170 MW	0 MW[1]	P1	2L154 OOS	1.21 pu	1.26 pu
Note: [1] when customer generations are unavailable but connected to BC Hydro's systrem						

In the light summer condition (29ls) when all Gilford wind generators are unavailable, the study finds significant voltage performance issue at GLD 230 kV

under the contingency loss of 2L154. A 70 MVAR 230 kV switched shunt reactor with AutoVAR control scheme is required to be installed at the GLD substation to mitigate the high voltage.

For internal breaker fault event (P2) of DMR 1CB15 breaker, all the 132 kV breakers connected to DMR bus 1B1 and 1B3 opens causing isolation of lines 1L119, 1L101 and 1L106 connecting to North Vancouver Island system resulting 2L154 as the only connected path to deliver NVI generation to DMR. The connection of Gilford Wind project causes potential voltage instability issues at North Vancouver Island. A new RAS is required for tripping the generation at GLD in NVI system for this event. The list of generation units to be included in the new RAS contains the existing CSS, KKS, JHT, LDR, and SCA units including new Gilford Wind project. Further details of the RAS scheme will be studied and determined in subsequent studies.

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 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 Solar Plant would be capable of meeting the BC Hydro's reactive capability requirement at the plant's zero MW output, which needs to be re-confirmed if the IC's project proceeds further.

5.1.4 Anti-Islanding Requirements

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 system impact study stage if needed.

5.3 Stations Requirements

The station upgrade scope at the GLD 230 kV is as follows.

- Expand the existing 230 kV switchyard to add three breaker ring bus. Refer to the one-line diagram Appendix B for details. It is assumed that expansion of the existing station is feasible to accommodate the proposed new facilities.
- Re-terminate 2L154 circuit with associated equipment in the new ring bus position.
- Re-terminate the high side of GLD T1/T4 transformers in the new ring bus position.
- Add one 70MVAr switchable reactor with associated equipment.
- Expand the existing control building, if required, to accommodate the new P&C panels and other equipment.
- Terminate the Gilford Wind project.
- Other associated station work.

5.4 Protection & Control Requirements

New line protection relays will be installed at BC Hydro's Gold River (GLD) and IC's Guildford Wind (P112) substations to protect 2LXX using line current differential scheme (87L). As part of the line protection replacements, telecommunication facilities will be required to accommodate the new protection schemes.

The IC is to provide the following for the interconnection of Gilford Wind:

- 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 P112 to provide protection coverage for 2LXX. BC Hydro P&C Planning will provide core protection settings for these relays to protect transmission line 2LXX 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.
- Provide redundant protection for the shunt reactor as stated in Section 5.1.

The runback schemes or RAS requirements stated 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 GLD and P112 for “GLD-P112 2LXX PY DIGITAL TELEPROT” and “GLD-P112 2LXX SY DIGITAL TELEPROT”. Physical interface shall be C37.94 optical over multimode fibre using ST connectors.

Telecontrol Requirements for Telecom

- One P112 SCADA circuit off FVO & SIO .

Other Requirements for Telecom

- Provide PY & SY T1s between GLD-P112.
- Provide MPLS links and LSPs for new GLD MPLS nodes.

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 Gilford 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 GLD is required to interconnect the IC's generating project to the BC Hydro system.

2. The connection of Gilford Wind project will also exacerbate the pre-existing thermal overload on the BC Hydro facilities under various single contingencies. These overloads are presently addressed by the North Vancouver Island Remedial Action Scheme (NVI RAS). The NVI RAS needs to be updated and the new wind generators at Gilford Wind project are required to be included in the updated NVI RAS.

3. The study finds significant voltage performance issues at GLD 230 kV under the loss of 2L154 when all Gilford wind generators are unavailable in the light summer condition (29ls). A 70 MVAR 230 kV switched shunt reactors with Auto VAR control scheme is required to be installed at the GLD substation to mitigate the high voltage.

4. The study identified potential voltage instability issue in North Vancouver Island regional under Circuit Breaker fault (DMR 1CB15) single contingency caused by the connection of Gilford Wind project. A new RAS is required for tripping the generations in NVI system for this event.

5. 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.

6. In addition to entrance protection and 2LXX line protection, the new line 2LXX will become part of IC's BES and the IC will be responsible for the compliance with applicable NERC MRS requirements.

7. BC Hydro will provide line protections for 2LXX protections (BCH end only). 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 Gilford Wind single line diagram used for power flow study.

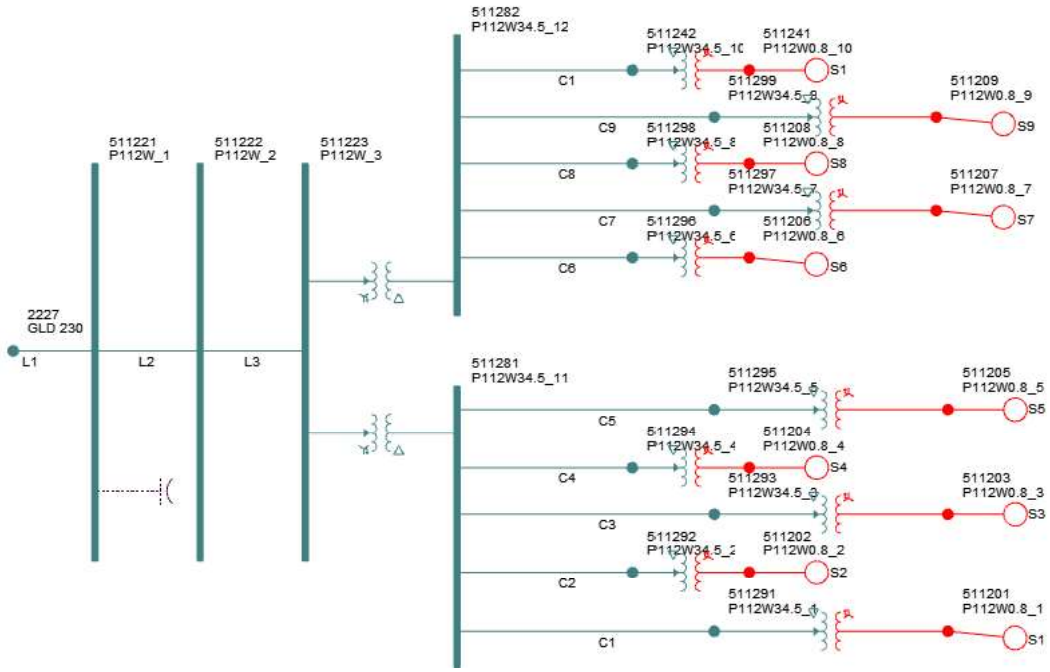

Figure A-1: Gilford Wind Single Line Diagram for Power Flow Study.

Appendix B
One-Line Sketch for GLD Station

Figure B-1 shows the Stations Planning One-Line Sketch for the potential upgrade at GLD.

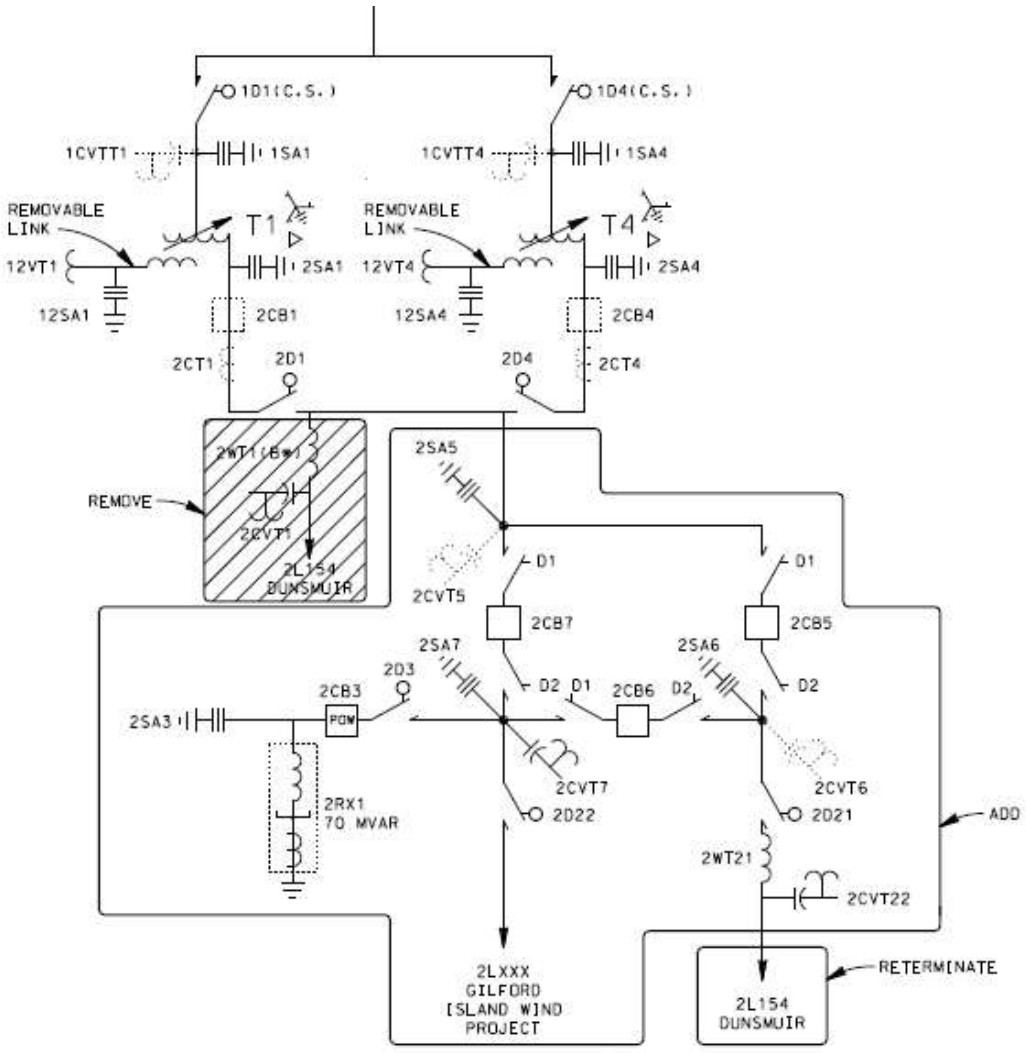

Figure B-1: Stations Planning One-Line Sketch for the potential upgrade at GLD.