BC Hydro
Power smart

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

July 30, 2024

[redacted]

[redacted]

[redacted]

RE: CEAP IR 100 - Kanaka Wind Project - Interconnection Feasibility Study Report

Enclosed is the Interconnection Feasibility study report for the proposed Kanaka 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 $19.2 M.

Major Scope of Work Identified:

- Add one 230 kV line position with the associated substation equipment at BC Hydro Nichola (NIC) substation
- Install telecom racks, fibre patch panel and all dielectric fibre entrance cable
- Supply and install protection relays and other required protection equipment
- Supply and install two digital teleprotection circuits and connect to protective equipment
- Other Telecom and Protection work, as required

Exclusions:

- GST
- Right-of-Way
- Permits

Key Assumptions:

- Construction will be done by contractor
- Early Engineering and Procurement
- 3 years of construction
- No station expansion will be required
- No ground improvements will be required

Key Risks:

- Transmission routing may be different than assumed, including number of disconnect switches and structure types may change
- Expansion of the existing control building may be required leading to increased costs and/or a longer project schedule
- No defined supply chain strategy, construction costs may increase depending on delivery method
- Project schedule may be longer than expected, leading to increased costs
- Costs may be affected by market conditions and escalation

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

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

Schedule

Based on the Interconnection Feasibility study, the non-binding good faith estimated in-service date for your project's Network Upgrades is Quarter 3, 2029 (calendar year). To achieve this timeline, we may need to expedite certain activities, including engineering design and procurement of long-lead equipment.

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

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

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

Next Steps

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

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

Sincerely,

[redacted]

Senior Manager, Transmission Interconnections

BC Hydro

Encl.: CEAP2024_IR_100_Kanaka Wind_FeS_Report_final.pdf

[redacted]

Kanaka Wind Project

Interconnection Feasibility Study

BC Hydro EGBC Permit to Practice No: 1002449

2024 CEAP IR # 100

Prepared for: [redacted]

[redacted]

300-APR-00025
2024 Jul 30

[redacted]

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Revision	Date	Description
0	2024 Jul	Initial release

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Executive Summary

[redacted] the interconnection customer (IC), requests to interconnect its Kanaka Wind Project (2024 CEAP IR # 100) to the BC Hydro (BCH) system. Kanaka Wind Project has forty-seven (47) [redacted] type-4 wind turbine generators on ten 34.5 kV feeders with total installed capacity of 197.4 MW. The proposed maximum power injection into the BC Hydro system is 193 MW. The proposed Point of Interconnection (POI) is on the 230 kV bus of BC Hydro's Nicola substation (NIC). The IC's project will connect to the POI via a 90 km 230 kV interconnection line. The IC's proposed commercial operation date (COD) is Oct 8, 2028.

To interconnect the Kanaka 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 NIC is required to interconnect the IC's generating project to the BC Hydro system.
2. The connection of Kanaka Wind Project does not cause any performance violation (i.e. thermal overload, voltage performance violation or voltage stability concern) under system normal and single contingencies conditions.
3. Kanaka Wind project is not arraged for islanded operation. 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.
4. 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 Kanaka wind farm as submitted does not meet the reactive capability requirement at zero MW output level.
5. New line protection relays will be installed at BC Hydro's Nicola substation (NIC) and IC's Kanaka Wind substation (P100) to protect the 230 kV interconnection line between NIC and P100. As part of the line protection addition, telecommunication facilities will be required between the two substations. 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.

[redacted]

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	Fraser 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”
WECC	Western Electricity Coordinating Council
WTG	Wind Turbine Generator

[redacted]

1 Introduction

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

Table 1-1 Summary of Project Information

Project Name	Kanaka Wind Project	
Name of Interconnection Customer (IC)	[redacted]	
Point of Interconnection (POI)	Nicola Substation 138 kV bus	
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 4.2 MW WTGs	
Plant Fuel	Wind	
Note 1: The maximum achievable power injection at the POI is approx. 188 MW after accounting for MW losses and service load which is lower than the IC proposed 193 MW.		

[redacted] the interconnection customer (IC), requests to interconnect its Kanaka Wind Project (2024 CEAP IR # 100) to the BC Hydro system. Kanaka Wind Project has forty-seven (47) [redacted] type-4 wind turbine generators on ten 34.5kV feeders with total installed capacity of 197.4 MW. The IC's proposed Point of Interconnection (POI) is on BC Hydro's Nicola substation (NIC) 230kV bus. The IC's project will connect to the POI via a 90 km 230 kV interconnection line. The proposed commercial operation date (COD) is Oct 8, 2028.

Figure 1-1 shows the Nicola area transmission system diagram. Nicola substation (NIC) is a major substation in this area with two existing 500/230 kV transformers (NIC T2 & T3) and two 230/138 kV transformers (NIC T5 & T6). NIC supplies the local area through one 230 kV transmission line 2L265 and three 138 kV transmission lines 1L243, 1L244 and 1L251. With connection of the IC'S project, less supply is required from NIC 500 kV for the local area.

[redacted]

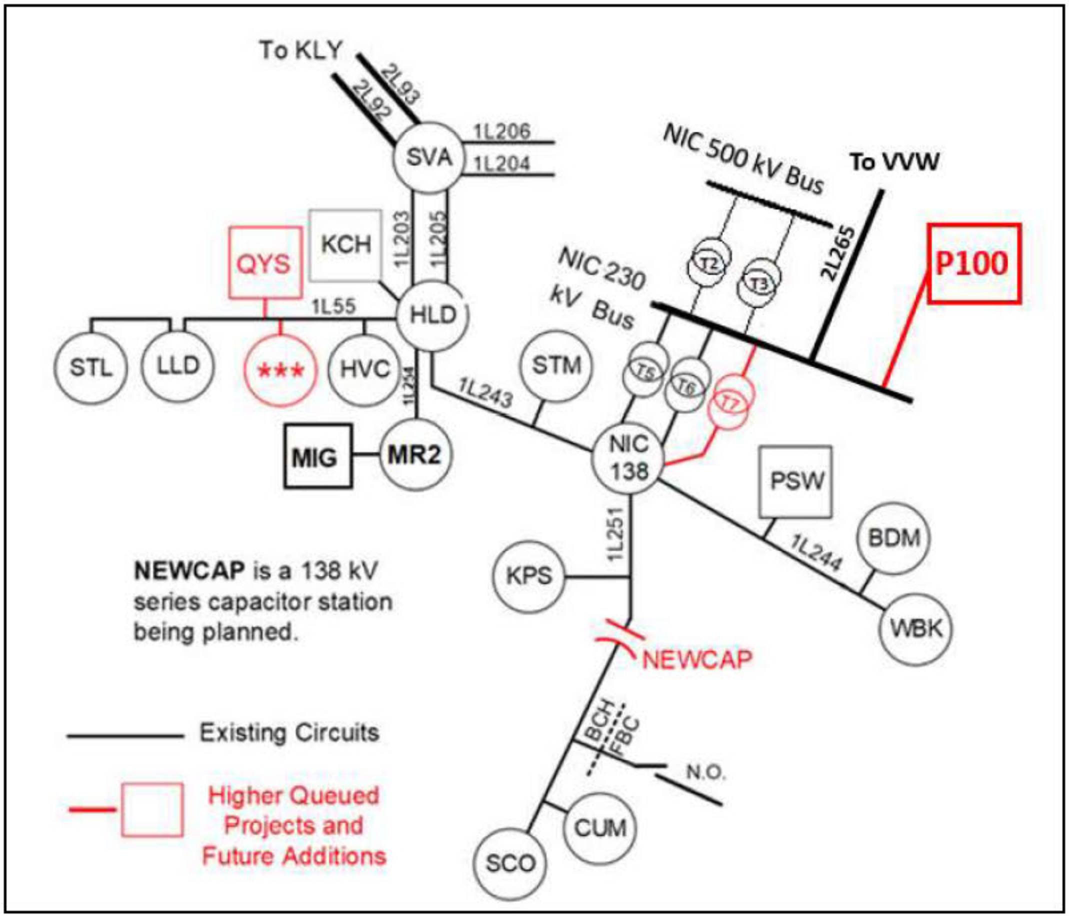

Figure 1-1: Nicola Area Transmission System Diagram

There are several high-queued load interconnections and their associated network upgrades in the study area. The relevant network upgrade being planned in the study region is:

- Nicola Substation Transformation Capacity Reinforcement: this project will add a new 230 kV/138 kV transformer at NIC (i.e. NIC T7) to mitigate the possible transformer overload associated with the industrial load increase in the region.

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.

[redacted]

4 Assumptions and Conditions

This Feasibility Study is performed based on the IC's submitted data and information available to BC Hydro on May 22, 2024 for the study purpose. Appendix A shows the plant single line diagram for the IC's project used in the study model. Certain assumptions were, as set out below, made to the extent required.

The power flow study cases used in this Feasibility Study are established based upon the BC Hydro's base resource plan and load forecasts available at the time of performing the study, which includes existing and future generations, transmission facilities, and loads in addition to the subject interconnection project in this study. Applicable seasonal conditions and the appropriate study years for the study planning horizon are also incorporated.

Additional assumptions are listed as follows.

1) The regional generation are dispatched to the patterns that stress the transmission system in the study area. In these patterns, the regional generations are typically set to their Maximum Power Outputs (MPO) unless otherwise specified.

2) For the purpose of performing this study, Nicola Substation Transformation Capacity Reinforcement project (i.e. addition of NIC T7) is assumed completed by the time the IC's generating project enters service.

[redacted]

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

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 and selected single contingency conditions for all three load conditions studied. With connection of the IC'S project, less supply is required from NIC 500 kV for the local area.

Table 5-1: Summary of Branch Loading Analysis Results

Case	IC's Plant Output	Contingency		Branch Loading		
		Cat.	Description	NIC T3	NIC T5	NIC T7
		Winter Rating		1425 MVA	287 MVA	300 MVA
28HW	Max	P0	System Normal	6 %	19 %	22 %
	Max	P1	Loss of Kanaka Wind	12%	18%	21%
	Max	P1	NIC T2 & NIC T6 [1]	11 %	26 %	31 %
	Max	P2	NIC 2CB11 [2]	6 %	31 %	36 %
		Summer Rating		1200 MVA	287 MVA	300 MVA
29HS	Max	P0	System Normal	7 %	21 %	24 %
	Max	P1	Loss of Kanaka Wind	13%	20%	24%
	Max	P1	NIC T2 & NIC T6 [1]	12 %	29 %	33 %
	Max	P2	NIC 2CB11 [2]	8 %	34 %	39 %
29LS	Max	P0	System Normal	3 %	14 %	16 %
	Max	P1	Loss of Kanaka Wind	8%	13%	15%
	Max	P1	NIC T2 & NIC T6 [1]	5 %	19 %	23 %
	Max	P2	NIC 2CB11 [2]	5 %	22 %	26 %

[redacted]

Note 1: NIC T2 and NIC T6 are in the same protection zone.
Note 2: NIC 230 kV bus breaker 2CB11 fault results in tripping of 2L265, NIC T2, NIC T6, VVW T2 and VVW T3.

5.1.2 Steady-State Voltage Analysis

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

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

Case	IC's Plant Output	Contingency		Bus Voltage (PU)		
		Cat.	Description	NIC 500	NIC 230	NIC 138
28HW	Max	P0	System Normal	1.06	1.05	1.02
	Max	P1	NIC T2 & NIC T6 [1]	1.06	1.05	1.02
	Max	P2	NIC 2CB11 [2]	1.06	1.05	1.02
29HS	Max	P0	System Normal	1.06	1.05	1.02
	Max	P1	NIC T2 & NIC T6 [1]	1.06	1.05	1.02
	Max	P2	NIC 2CB11 [2]	1.06	1.05	1.02
29LS	Max	P0	System Normal	1.06	1.05	1.03
	Max	P1	NIC T2 & NIC T6 [1]	1.06	1.05	1.02
	Max	P2	NIC 2CB11 [2]	1.06	1.05	1.03

Note 1: NIC T2 and NIC T6 are in the same protection zone.
Note 2: NIC 230 kV bus breaker 2CB11 fault results in tripping of 2L265, NIC T2, NIC T6, VVW T2 and VVW T3.

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 near zero MW output.

[redacted]

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 POI of the Kanaka Wind Project will be 230 kV switchyard of the existing Nicola Substation (NIC). The station upgrade scope at the existing Nicola Substation (NIC) is as follows.

- Add one 230 kV line position with the associated substation equipment. Refer to the 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 230 kV Kanaka Wind Project transmission line.
- The location of metering will be determined in the next stage.
- Other associated station work.

5.4 Protection & Control Requirements

New line protection relays will be installed at BC Hydro's Nicola substation (NIC) and IC's Kanaka Wind substation (P100) to protect the 230 kV interconnection line between NIC and P100 using a line current differential scheme (87L). As part of the line protection addition, telecommunication facilities will be required between the two substations.

The IC is to provide the following for the interconnection of Kanaka 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 P100 to provide protection coverage for the interconnection line between NIC and P100. BC Hydro P&C Planning will provide core protection settings for these relays to protect for transmission line faults which occur on this interconnection line. Non-core protection such as local breaker failure, auto-reclosing, backup protection, NERC PRC related settings 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 line protection relays and PPIS equipment by BCH servers.
- Provide anti-islanding protection as stated in Section 5.1.

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

- WECC Level 3 PY & SY, NIC – P100, with C37.94 interfaces.

Telecontrol Requirements for Telecom

- Two P100 SCADA circuits off FVO & SIO.

Other Requirements for Telecom

- None identified.

Certain assumptions were made for determining a potential telecom solution. Details of the telecom solution (e.g. assumptions made, alternatives investigated and work required for BCH and the IC) would be provided at the next study stage.

6 Cost Estimate and Schedule

The non-binding good faith estimated cost and time to construct the Network Upgrades required to interconnect the proposed project will be provided in a separate letter to the IC.

7 Conclusions

To interconnect the Kanaka 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 NIC is required to interconnect the IC's generating project to the BC Hydro system.

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

3. Kanaka Wind project is not arranged for islanded operation. 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.

4. 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 Kanaka wind farm as submitted does not meet the reactive capability requirement at zero MW output level, which will need to be addressed by the IC.

5. New line protection relays will be installed at BC Hydro's Nicola substation (NIC) and IC's Kanaka Wind substation (P100) to protect the 230 kV interconnection line between NIC and P100. As part of the line protection addition, telecommunication facilities will be required for each of the two substations. 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 Kanaka Wind Project single line diagram used for power flow study.

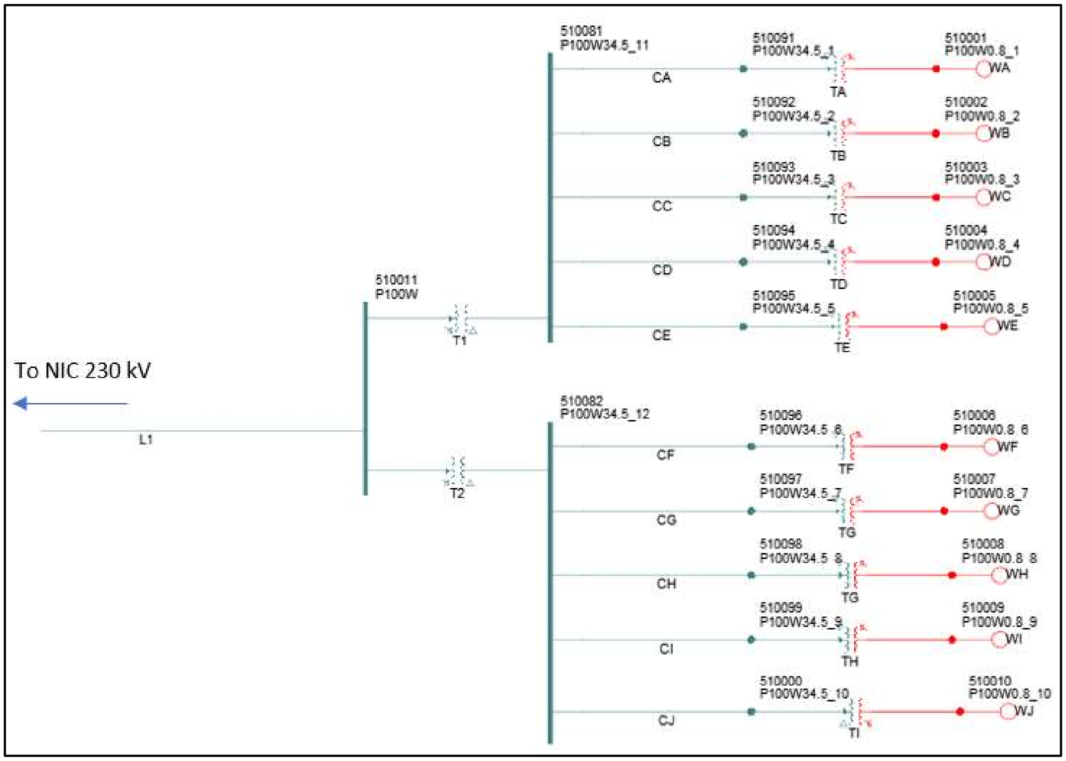

Figure A-1: Kanaka Wind Project Single Line Diagram for Power Flow Study.

As seen in the diagram, Kanaka Wind Project has two main power transformers dividing the plant into two parts.

- Part 1 has five (5) feeders connecting 25 wind turbines to the collector station.
- Part 2 has five (5) feeders connecting 22 wind turbines to the collector station.

Appendix B
One-Line Sketch for Connecting Kanaka Wind at Nicola Substation (NIC)

Figure B-1 shows the sketch for connecting Kanaka Wind at NIC.

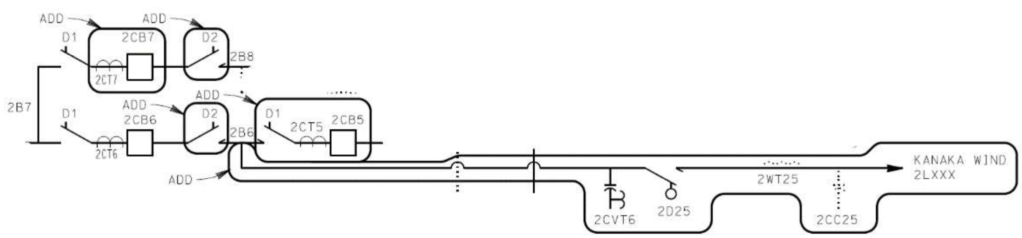

Figure B-1: Sketch for Connection at NIC