BC Hydro
Power smart

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

July 30, 2024

[redacted]

**RE: CEAP IR 29 - 200MW Generation Station-Endako Project - Interconnection Feasibility Study Report**

Enclosed is the Interconnection Feasibility study report for the proposed 200MW Generation Station-Endako 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 $12.7 M.

**Major Scope of Work Identified:**

- Supply and install 230 kV line position with the associated substation equipment at BC Hydro's Glenanan (GLN) substation
- Supply and install 230 kV circuit breaker and associated disconnects in the existing 230 kV bus structure at GLN
- Supply and install protection relays and other required protection / telecom equipment

**Exclusions:**

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

**Key Assumptions:**

- Construction will be done by contractor
- 2 years of construction
- Early Engineering and Procurement
- No expansion of 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 expansion of the site if necessary to accommodate the new facilities (mentioned above) in 230 kV Switchyard at GLN

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 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_29_200MW Generation Station-Endako_FeS_Report_final.pdf

[redacted]

Endako Biomass Project

# Interconnection Feasibility Study

**BC Hydro EGBC Permit to Practice No: 1002449**

**2024 CEAP IR # 29**

Prepared for: [redacted]

[redacted]

# Report Metadata

| | |
|---|---|
| Header: | Endako Biomass Project |
| Subheader: | Interconnection Feasibility Study |
| Title: | Endako Biomass Project |
| Subtitle: | 2024 CEAP IR # 29 |
| Report Number: | 900-APR-00009 |
| Revision: | 0 |
| Confidentiality: | Public |
| Date: | 2024 Jul 30 |
| Volume: | 1 of 1 |
| Prepared for: | [redacted] |
| Related Facilities: | Glenannan substation (GLN) |
| Additional Metadata: | Transmission Planning 2024-50<br>Filing Subcode 1350 |

[redacted]

# Revisions

| Revision | Date | Description |
|---|---|---|
| 0 | 2024 Jul | Initial release |

[redacted]

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# Executive Summary

[redacted] the interconnection customer (IC), requests to interconnect its Endako Biomass Project (2024 CEAP IR # 29) to the BC Hydro (BCH) system. Endako Biomass Project Endako Biomass Project has six (6) synchronous generators with total installed capacity of 200 MW. The proposed Point of Interconnection (POI) is on the 230 kV bus of existing BC Hydro's Glenannan substation (GLN). The IC's project will connect to the POI via a 8 km customer built 230 kV interconnection line (2LP29). The IC's proposed commercial operation date (COD) is October 30, 2030.

To interconnect the Endako Biomass 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 GLN is required to interconnect the IC's generating project to the BC Hydro system.
2. The connection of Endako Biomass 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. An Anti-islanding Transfer Trip Scheme to Endako Biomass Substation (P29) is required to isolate the biomass plant when it is islanded with local loads during various operation conditions or under system contingencies (such as loss of both GLN T1 and GLN T2, or loss of both 5L61 and 5L62, or GLN 230 kV breaker internal faults resulting in Endako Biomass plant islanded with 2L353…). In addition, the IC is required to install anti-islanding protection within their facility to disconnect the IC's biomass plant from the grid when an inadvertent island with the local load forms.
4. If 5L61 is forced out of service, North Coast system including Endako Biomass Plant will form an island. It is required that Endako Biomass generation participates in the existing North Coast Generation Shedding Application/Scheme.
5. The new line 2LP29 (from GLN to P29) will become IC's Bulk Electric System (BES) and IC will be responsible for compliance with applicable MRS requirements.

6. BC Hydro will provide line protections for 2LP29 (BC Hydro end only). As part of the new line protection, telecommunication facilities will be required between GLN and Endako Biomass plant (P29). 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 |
| ERIS | Energy Resource Interconnection Service |
| FeS | Feasibility Study |
| 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 |
| TIR | BC Hydro “60 KV to 500 kV Technical Interconnection Requirements for Power Generators” |
| WECC | Western Electricity Coordinating Council |
| WTG | Wind Turbine Generator |
| EDM | Edmonds Office |
| FVO | Fraser Valley Office |
| WSN | Williston Substation |
| GLN | Glenannan Substation |
| SIO | South Interior Office |
| P29 | Endako Biomass plant (unofficial site code) |
| 2LP29 | 230kV transmission line from GLN to P29 |

# 1 Introduction

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

Table 1-1 Summary of Project Information

| | | |
|---|---|---|
| Project Name | Endako Biomass Project | |
| Name of Interconnection Customer (IC) | [redacted] | |
| Point of Interconnection (POI) | Glenannan substation 230kV bus | |
| IC's Proposed COD | 30 October 2030 | |
| Type of Interconnection Service | NRIS ☒ | ERIS ☐ |
| Maximum Power Injection (MW) | 195 MW (Summer) | 195 MW (Winter) |
| Number of Generator Units | 6 | |
| Plant Fuel | Biomass | |

[redacted] the interconnection customer (IC), requests to interconnect its Endako Biomass Project (2024 CEAP IR # 29) to the BC Hydro system. Endako Biomass Project has six (6) synchronous generators with total installed capacity of 200 MW. The IC's proposed Point of Interconnection (POI) is at the 230 kV bus of existing BC Hydro's Glenannan substation (GLN). The IC's project will connect to the POI via a 8 km customer built 230 kV interconnection line (2LP29). The IC's proposed commercial operation date (COD) is October 30, 2030.

Figure 1-1 shows the Glenannan transmission system diagram. BC Hydro's North Coast (NC) service area is supplied through a radial 500 kV transmission circuit that comprises three transmission lines: 5L61 between the Williston substation (WSN) and the Glenannan substation (GLN), 5L62 between GLN and the Telkwa substation (TKW), and 5L63 between TKW and the Skeena substation (SKA). GLN is a major substation in North Coast with two existing 500/230 kV transformers (WSN T1 & T2) and several step-down transformers to serve 230kV/138kV/66kV loads.

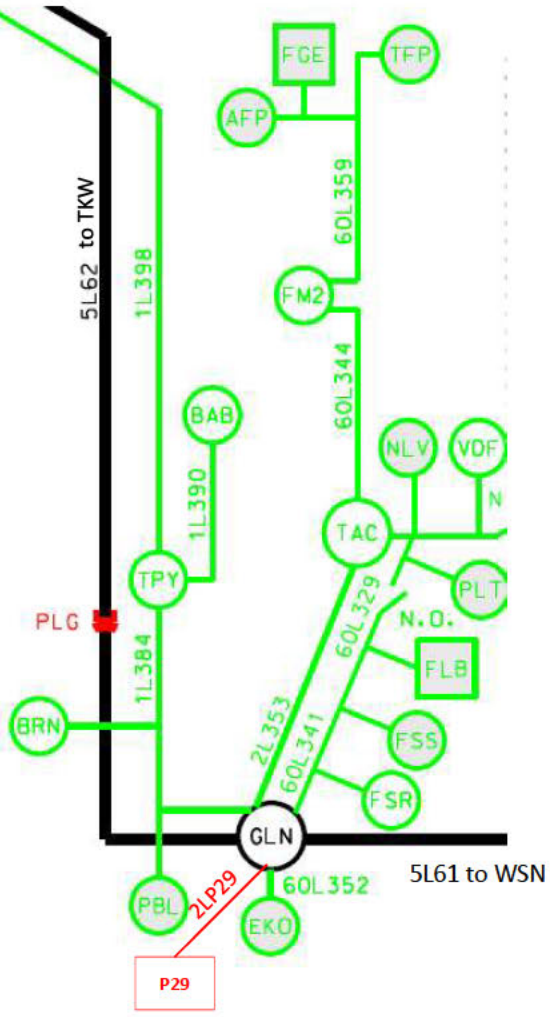



Figure 1-1: Glenannan Regional Transmission System Diagram with the Proposed Endako Biomass Project Interconnection

In the Glenannan region, there are two generation plants.

- 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.

# 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.

# 5 System Studies and Results

Based upon the IC's submitted information and the area system conditions, a new 230 kV line position at GLN is required to interconnect the IC's generating project to the BC Hydro system.

The IC's project will connect to the POI via a 8 km 230 kV interconnection line, 2LP29. The new line 2LP29 will become an IC's Bulk Electric System (BES) element and the IC will be responsible for the compliance with applicable MRS requirements.

## 5.1 Power Flow Study Results

Power flow studies were performed to evaluate whether the IC's generating project would cause 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 2031 light summer (31LS) 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 2031 heavy summer (31HS) 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.

For all the studied load conditions (31LS, 31HS, 31HW), there is no other branch or transformer overload identified under system normal condition and single contingencies.

Table 5-1: Summary of Branch Loading Analysis Results

| Case | IC's Plant Output | Contingency | | Branch Loading | |
|---|---|---|---|---|---|
| | | | | GLN T1 | GLN T2 |
| | | Cat. | Description | 500/230kV transformer | 500/230kV transformer |
| Winter Rating | | | | 714 MVA | 714 MVA |
| 31HW | Max | P0 | System Normal | 8% | 8% |

| | | | | | |
|---|---|---|---|---|---|
| | Max | P1 | GLN T1 | N/A | 16% |
| | Max | P1 | GLN T2 | 16% | N/A |
| Summer Rating | | | | 600 MVA | 600 MVA |
| 31HS | Max | P0 | System Normal | 12% | 12% |
| | Max | P1 | GLN T1 | N/A | 24% |
| | Max | P1 | GLN T2 | 24% | N/A |
| 31LS | Max | P0 | System Normal | 13% | 13% |
| | Max | P1 | GLN T1 | N/A | 26% |
| | Max | P1 | GLN T2 | 26% | N/A |

### 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 (31LS, 31HS, 31HW). Table 5-2 shows a summary of steady-state voltage performance under various system conditions and contingencies.

The study also finds that Endako Biomass Project could improve the load bus voltage at GLN 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 230kV | P29 230kV | TAC 230kV |
| 31HW | Max | P0 | System normal | 1.03 | 1.03 | 1.02 |
| 31HS | Max | P0 | System normal | 1.03 | 1.024 | 1.021 |
| | 0 MW | P0 | System normal | 1.035 | 1.035 | 1.024 |
| 31LS | Max | P0 | System normal | 1.04 | 1.04 | 1.03 |
| | 0 MW | P0 | System normal | 1.04 | 1.04 | 1.03 |

### 5.1.3 Islanding Requirements

During various operation conditions or under system contingencies (such as loss of both GLN T1 and GLN T2, or loss of both 5L61 and 5L62, or GLN 230 kV breaker internal faults resulting in Endako Biomass plant islanded with 2L353…), the IC's project will be inadvertently islanded with the existing generators and BC Hydro loads, which is not allowed. An Anti-islanding Transfer Trip Scheme to P29 is required to isolate the biomass plant. In addition, the IC is required to install anti-islanding protection within its facility to disconnect the IC's biomass plant from the grid when an inadvertent island with the local load forms.

If 5L61 is forced out of service, North Coast system including Endako Biomass Plant will form an island. It is required that Endako Biomass generation participates in the existing North Coast Generation Shedding Application/Scheme.

## 5.2 Fault Analysis

The short circuit analysis in the FS 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

A new 230 kV line position at GLN is required to interconnect the IC's generating project to the BC Hydro system. The IC's project will connect to the POI via a 8 km customer built 230 kV interconnection line, 2LP29.

Following is the scope of station work in GLN 230kV switchyard:

- Add a new 230 kV circuit breaker (2CB8) and associated disconnect in the existing 230 kV bus structure.
- Add disconnect, associated with existing 2CB7 circuit breaker.
- Expansion of the site if necessary to accommodate the new facilities (mentioned above) in 230 kV switchyard. It is assumed that property is available for this site expansion if required.
- Add one 230 kV line position with the associated substation equipment.
- Terminate Endako biomass ([redacted] 2LP29 230 kV transmission line.
- Other associated station work.

Refer to Appendix B - One-Line Sketch at GLN for details.

## 5.4 Protection & Control Requirements

BC Hydro will provide line protections for 2LP29 230 kV transmission line (BC Hydro end only) that will integrate Endako Biomass Plant to BC Hydro system at GLN. As part of the new line protection, telecommunication facilities will be required between GLN and Endako Biomass Plant (P29).

The IC is to provide the following for the interconnection of Endako biomass plant.

- 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 P29 to provide protection coverage for 2LP29 line. BC Hydro P&C Planning will provide core protection settings for these relays to protect transmission line 2LP29 between GLN and P29 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 islanding protection as stated in Section 5.1.

The RAS requirements stated in Section 5.1 are mainly to address the islanding concerns, 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**

- WECC Level 3 64 kbps synchronous circuits between GLN and P29 for “P29-GLN 2LP29 PY DIGITAL TELEPROT” and “P29-GLN 2LP29 SY DIGITAL TELEPROT”. Physical interface shall be C37.94 optical over multimode fibre using ST connectors.

**Telecontrol Requirements for Telecom**

- P29 SCADA circuit 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.

# 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 Endako Biomass 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 GLN is required to interconnect the IC's generating project to the BC Hydro system.

2. The connection of Endako Biomass 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. An Anti-islanding Transfer Trip Scheme to Endako Biomass Substation (P29) is required to isolate the biomass plant when it is islanded with local loads during various operation conditions or under system contingencies (such as loss of both GLN T1 and GLN T2, or loss of both 5L61 and 5L62, or GLN 230 kV breaker internal faults resulting in Endako Biomass plant islanded with 2L353…). In addition, the IC is required to install anti-islanding protection within their facility to disconnect the IC's biomass plant from the grid when an inadvertent island with the local load forms.

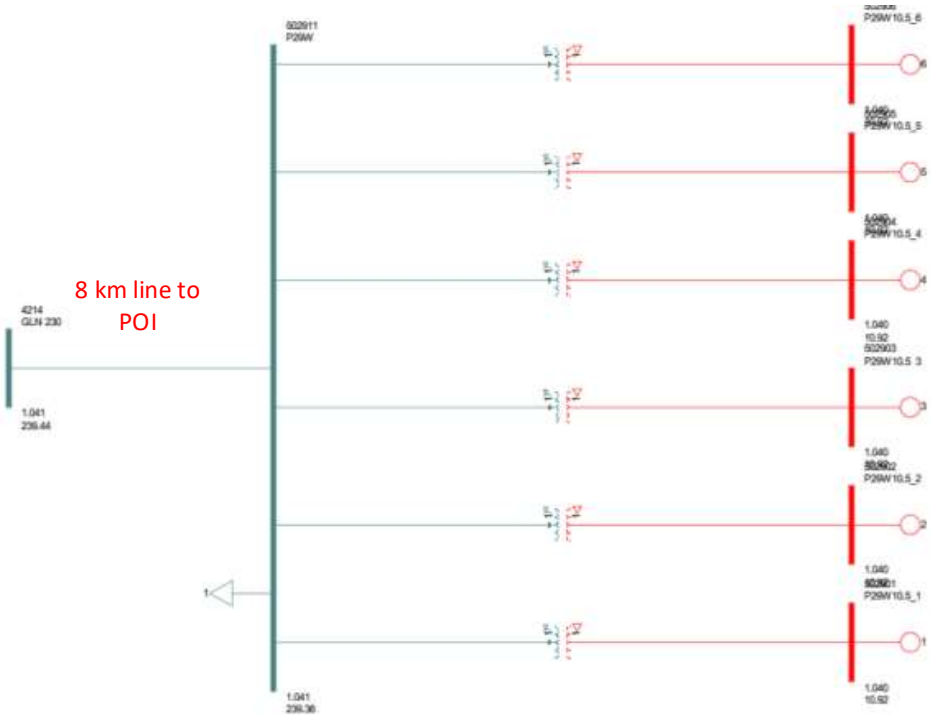
4. If 5L61 is forced out of service, North Coast system including Endako Biomass Plant will form an island. It is required that Endako Biomass generation participates in the existing North Coast Generation Shedding Application/Scheme.

5. The new line 2LP29 (from GLN to P29) will become IC's BES and IC will be responsible for compliance with applicable MRS requirements.

6. BC Hydro will provide line protections for 2LP29 (BC Hydro end only). As part of the new line protection, telecommunication facilities will be required between GLN and Endako Biomass plant (P29). 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: Endako Biomass Project Single Line Diagram for Power Flow Study.




As seen in the diagram, Endako Biomass Project has six (6) generator step-up transformers connecting six synchronous generators.

# Appendix B
# One-Line Sketch for GLN

Figure B-1 shows the Stations Planning One-Line Sketch for GLN.

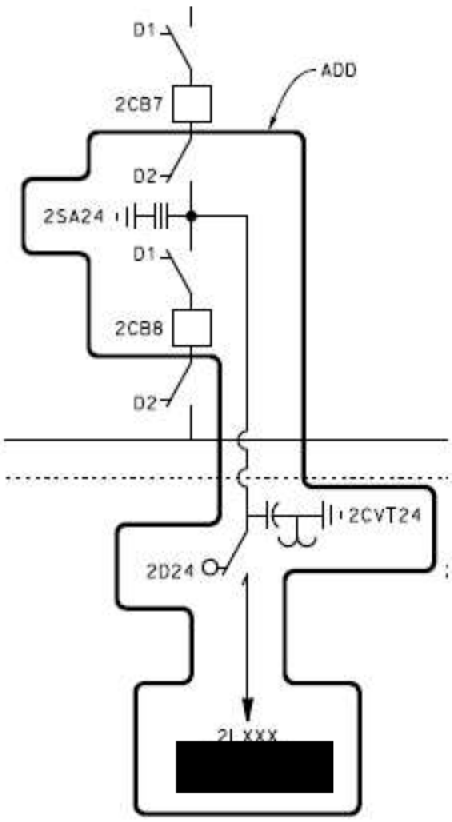



Figure B-1: Stations Planning One-Line Sketch for GLN.