BC Hydro
Power smart

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

July 30, 2024

[redacted]

RE: CEAP IR 106 - Williams Lake Solar Project - Interconnection Feasibility Study Report

Enclosed is the Interconnection Feasibility study report for the proposed Williams Lake Solar 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 $62.6 M.

Major Scope of Work Identified:

- Expand the substation and extend the existing 230 kV bus structure at BC Hydro Soda Creek (SCK) substation
- Add one 230kV line position with the associated substation equipment at SCK
- Add one switched shunt reactor of 75 MVAR 230kV at SCK for the system voltage support under single contingency operation
- Supply and install one rack, 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 by contractor
- 3 years of construction
- No station expansion is required
- No ground improvements for crossing towers are required

Key Risks:

- 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, 2031 (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_106_Williams Lake Solar_FeS_Report_final.pdf

[redacted]

Williams Lake Solar Project

Interconnection Feasibility Study

BC Hydro EGBC Permit to Practice No: 1002449

2024 CEAP IR # 106

Prepared for: [redacted]

[redacted]

[redacted]

Report Metadata

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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 Williams Lake Solar Project (2024 CEAP IR # 106) to the BC Hydro (BCH) system. Williams Lake Solar Project has fifty (50) [redacted] solar inverter model, adding a total capacity of 200 MW into the BC Hydro system. The proposed Point of Interconnection (POI) is at the 230 kV bus of the BC Hydro's Soda Creek substation (SCK). The IC's project will connect to the POI via a customer built 130 km 230 kV interconnection line. The IC's proposed commercial operation date (COD) is Oct 1, 2028.

To interconnect the Williams Lake Solar 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 SCK is required to interconnect the IC's generating project to the BC Hydro system.

2. The connection of Williams Lake Solar Project caused a potential voltage performance issue. A new 75 MVAr 230 kV switched shunt reactor with AutoVar control scheme is required to be installed at the Soda Creek substation 230 kV bus to mitigate the potential issue. The size of the reactor will be further tuned in subsequent studies.

3. In addition to entrance protection and 2LXX line protection, the IC is required to install anti-islanding protection within their facility to disconnect the solar farm from the grid when an inadvertent island with the local loads 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 Williams Lake Solar farm as submitted does not meet the reactive capability requirement which will need to be addressed.

5. BC Hydro will provide line protection for new line between BC Hydro SCK substation and IC's Williams Lake Solar (P106) substation (BC Hydro end only). As part of the line protection for the new line, telecommunication facilities will be required between the two terminals to accommodate the new protection schemes. In addition, protection upgrades are required at SCK substation for the new 230 kV bus and the new shunt reactor 2RX1.

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
SCK	BC Hydro Soda Creek Substation
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

1 Introduction

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

Table 1-1 Summary of Project Information

Project Name	Williams Lake Solar Project	
Name of Interconnection Customer (IC)	[redacted]	
Point of Interconnection (POI)	230 kV bus of the BCH's Soda Creek Substation	
IC's Proposed COD	1st October 2028	
Type of Interconnection Service	NRIS ☒	ERIS ☐
Maximum Power Injection [1] (MW)	200 MW (Summer)	200 MW (Winter)
Number of Generator Units	50 x 4.0 MW	
Plant Fuel	Solar	
Note 1: The maximum achievable power injection at the POI is approx. 190.6 MW after accounting for MW losses and service load which is lower than the IC proposed 197.5 MW.		

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Figure 1-1 shows the Central Interior Regional transmission system diagram. The Central Interior regional transmission system is supplied from three 230 kV lines. One is from Williston (WSN) substation in the North (2L96) and two (2L86 and 2L94) are from Kelly Lake (KLY) in the South. The two main 230 kV substations in the middle of the region include Soda Creek substation (SCK) and BLW.

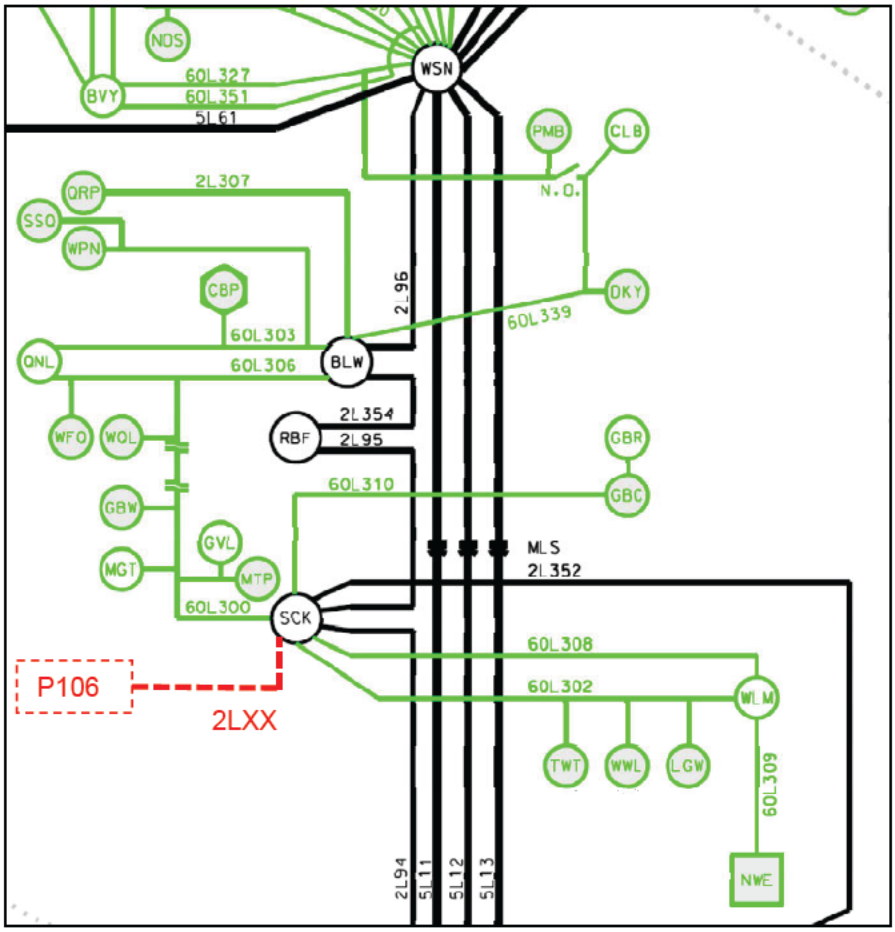

Figure 1-1: Central Interior Regional Transmission System Diagram in 2024 with the Proposed Williams Lake Solar Project Interconnection

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

The proposed customer-built 230 kV line (SCK-P106) 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 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, there is no branch overload identified under system normal condition (P0) and single contingency conditions (P1 and P2). Table 5-1 below shows the loadings on existing lines 2L354 and 2L96 with IC at maximum output.

Table 5-1: Summary of Branch Loading

Case	Contingency		Branch Loading		
	Category	Description	2L95	2L94	2L352
28HW	P0	System Normal	7%	21%	15%
	P1	2L95	na	24%	16%
	P1	2L94	13%	na	22%
	P1	2L352	15%	33%	na
29HS	P0	System Normal	16%	33%	15%
	P1	2L95	na	41%	19%
	P1	2L94	28%	na	25%

	P1	2L352	29%	51%	na
29LS	P0	System Normal	35%	29%	14%
	P1	2L95	na	45%	20%
	P1	2L94	48%	na	20%
	P1	2L352	46%	42%	na

5.1.2 Steady-State Voltage Analysis

A potential high voltage issue has been observed under light load condition caused by Williams Lake Solar project under single contingency condition.

A new 75 MVAr 230 kV switched shunt reactor with AutoVar control scheme is required to be installed at the Soda Creek substation 230 kV bus to mitigate the potential high voltage issue. The size of the reactor will be further tuned in subsequent studies.

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

Case	IPP's Generator Output	Contingency		Bus Voltage (P.U.)		
		Cate-gory	Description	RBF 230	SCK 230	KLY 230
29LS	0 MW	P1	2L354	1.104 PU	1.102 PU	1.071 PU
32LS	0 MW	P1	2L354	1.105 PU	1.103 PU	1.070 PU

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 not 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. Installation of reactive power equipment is required at the customer facility to meet the requirement.

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 solar farm does not meet this requirement at near zero MW output, which will need to be addressed.

5.1.4 Anti-Islanding Requirements

The IC is required to install anti-islanding protection within its facility to disconnect the IC's solar 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 existing Soda Creek substation is as follows.

- Expand the substation and extend the existing 230 kV bus structure.
- Add one 230kV line position with the associated substation equipment. Refer to one line diagram in Appendix B for details.
- Add one switched shunt reactor of 75 MVAR 230 kV for system voltage control.
- Expand the existing control building, if required, to accommodate the new P&C panels and other equipment.
- Terminate the Williams Lake Solar Project line.
- Other associated station work.

Following assumptions are made related to Station scope of work.

- There are no issues for the acquisition of the property on the west side of the substation, required for the expansion.
- The creek on the west side of the station can be mitigated for the 230kV bus structure design and installation; no civil engineering issues.

- There are no archeological findings that could impede with the station expansion.
- The high elevation differential on the West side of the station can be mitigated with appropriate technology for the bus solution (to be investigated in the next stage).

5.4 Protection & Control Requirements

For successful integration of the new solar farm, BC Hydro will provide line protections for 2LXX at BC Hydro's SCK Substation. As part of the line protection addition, telecommunication facilities will be required between SCK substation and Williams Lake Solar (P106). In addition, protection upgrades are required at SCK substation for the new 230 kV bus and the new shunt reactor 2RX1.

The IC is to provide the following for the interconnection of Williams Lake Solar 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 Williams Lake Solar (P106) to provide protection coverage for 2LXX. BC Hydro P&C Planning will provide core protection settings for these relays to protect transmission line 2LXX from SCK to the IC 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 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, SCK – P106, with C37.94 interfaces.

Telecontrol Requirements for Telecom

- One P106 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.

6 Cost Estimate and Schedule

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.

7 Conclusions

To interconnect the Williams Lake Solar 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 SCK is required to interconnect the IC's generating project to the BC Hydro system.

2. The connection of Williams Lake Solar Project caused a potential voltage performance issue. A new 75 MVAr 230 kV switched shunt reactor with AutoVar control scheme is required to be installed at the Soda Creek substation 230 kV bus to mitigate the potential issue. The size of the reactor will be further tuned in subsequent studies.

3. In addition to entrance protection and 2LXX line protection, the IC is required to install anti-islanding protection within their facility to disconnect the solar farm from the grid when an inadvertent island with the local loads 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 Williams Lake Solar farm as submitted does not meet the reactive capability requirement which will need to be addressed.

5. BC Hydro will provide line protection for new line between BC Hydro SCK substation and IC's Williams Lake Solar (P106) substation (BC Hydro end only). As part of the line protection for the new line, telecommunication facilities will be required between the two terminals to accommodate the new protection schemes. In addition, protection upgrades are required at SCK substation for the new 230 kV bus and the new shunt reactor 2RX1. 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 Williams Lake Solar Project single line diagram used for power flow study.

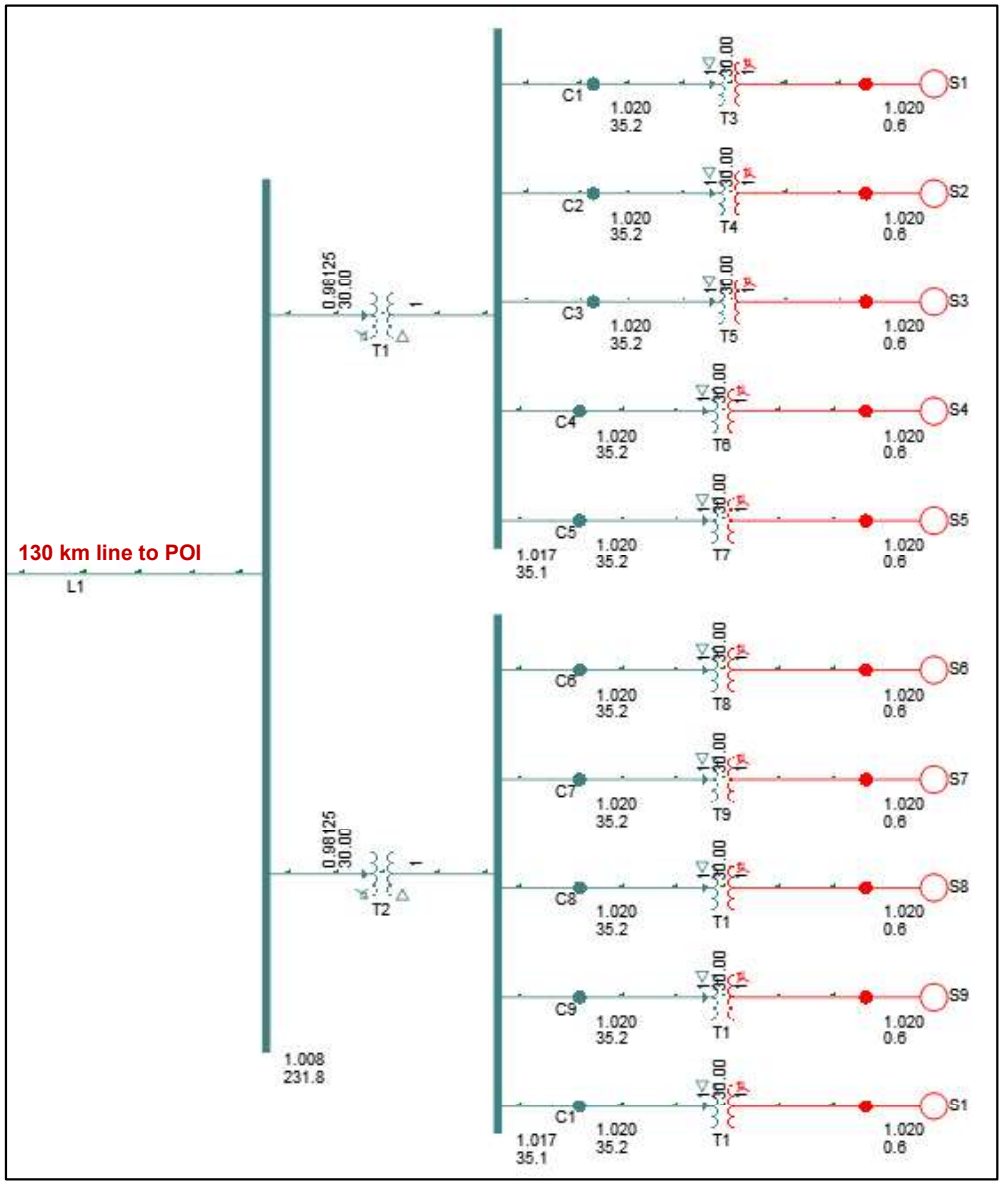

Figure A-1: Williams Lake Solar Project Single Line Diagram for Power Flow Study.

As seen in the diagram, Williams Lake Solar Project has two main power transformers dividing the plant into two parts.

- Part 1 has five (5) feeders connecting 25 solar inverters to the collector station.
- Part 2 has five (5) feeders connecting 25 solar inverters to the collector station.

Appendix B
One-Line Sketch for Addition of a 230 kV Line Position at SCK Substation

Figure B-1 shows the Stations Planning One-Line Sketch of the existing SCK substation with the connection of IC's project.

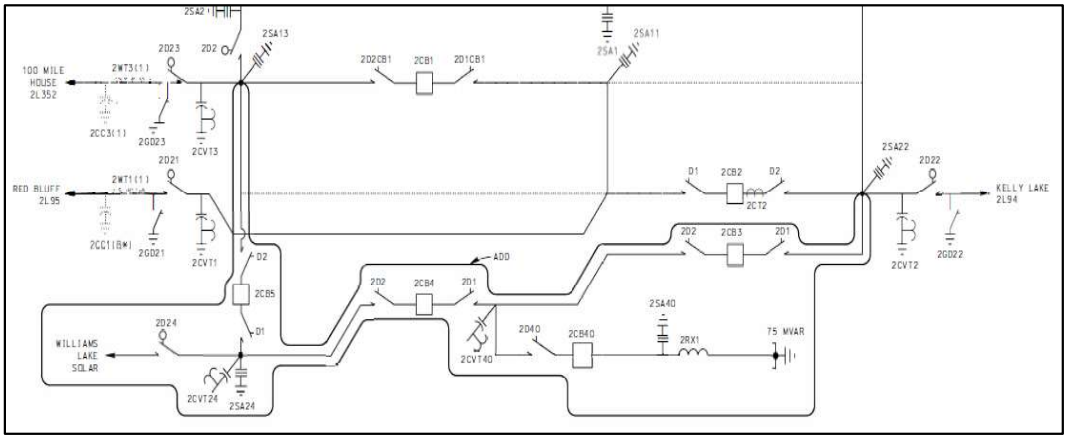

Figure B-1: Stations Planning One-Line Sketch of the existing SCK substation with the connection of IC's project.