BC Hydro
Power smart

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

July 30, 2024

[redacted]

[redacted]

RE: CEAP IR 101 - 70 Mile House Solar Project - Interconnection Feasibility Study Report

Enclosed is the Interconnection Feasibility study report for the proposed 70 Mile House 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 $40.6 M.

Major Scope of Work Identified:

- Add one 230 kV line position with the associated substation equipment at BC Hydro Kelly Lake (KLY) substation
- Terminate fibre optic cable
- Supply and install protection relays and other required protection equipment
- Other Telecom and Protection work, as required

Exclusions:

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

Key Assumptions:

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

Senior Manager, Transmission Interconnections

BC Hydro

Encl.: CEAP2024_IR_101_70 Mile House Solar_FeS_Report_final.pdf

[redacted]

70 Mile House Solar Project

Interconnection Feasibility Study

BC Hydro EGBC Permit to Practice No: 1002449

2024 CEAP IR # 101

Prepared for: [redacted]

[redacted]

Report Metadata

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Additional Metadata:	Transmission Planning 2024-102 Filing Subcode 1350

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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 70 Mile House Solar Project (2024 CEAP IR # 101) to the BC Hydro (BCH) system. 70 Mile House Solar Project has fifty (50) [redacted] inverters with total installed capacity of 200 MW. The proposed Point of Interconnection (POI) is at the 230 kV bus of BC Hydro's Kelly Lake substation (KLY). The IC's project will connect to the POI via a 43km customer built 230 kV interconnection line. The IC's proposed commercial operation date (COD) is Oct 1, 2028.

To interconnect the 70 Mile House 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 KLY is required to interconnect the IC's generating project to the BC Hydro system.

2. The connection of 70 Mile House Solar Project does not cause any performance violation (i.e., thermal overload, voltage performance violation or voltage stability concern) under system normal conditions.

3. The connection of 70 Mile House Solar Project will:

   - Exacerbate the existing thermal overloads on 2L90 (Kelly Lake - Bridge River Terminal) and 500kV lines under single 500kV line contingencies, non-firm transfer conditions, and during the summer and winter peak load operations.

     IC is required to participate in the existing generation shedding Remedial Action Scheme (RAS) to mitigate the potential thermal overloads.

   - Cause thermal overloads on KLY T1 or KLY T4 under KLY breaker internal fault contingencies, non-firm transfer conditions and during light summer load operations.

     A new RAS is required to shed IC's generation at the KLY under KLY breaker internal breaker fault contingencies when the KLY T1 or KLY T4 is thermally overloaded.

4. 70 Mile House Solar Farm is not arranged for islanded operation. In addition to entrance protection and 2LXXX 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.

5. The proposed IC owned interconnecting line 2LXXX will become an IC's BES and the IC will be responsible for the compliance with applicable NERC Mandatory Reliability Standards requirements.

6. 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 70 Mile House Solar farm as submitted does not meet the reactive capability requirement at both maximum and minimum MW output range, which will need to be addressed.

7. BC Hydro will provide new line protection relays for 2LXXX (BC Hydro end only) and revise other protections at KLY for the connection of the IC. As part of new line protection for 2LXXX, WECC Level 3 telecommunication facilities will be required between KLY and the IC. The IC shall provide the required relays, telecom facility, and associated equipment at its facilities to accommodate the required 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
BES	Bulk Electric System
NERC	North American Electric Reliability Corporation
MRS	Mandatory Reliability Standards
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
WSN	Williston
KLY	Kelly Lake
BRT	Bridge River Terminal
SIC	South Interior Control
SIO	South Interior Office
FVO	Fraser Valley Office

1 Introduction

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

Table 1-1 Summary of Project Information

Project Name	70 Mile House Solar Project	
Name of Interconnection Customer (IC)	[redacted]	
Point of Interconnection (POI)	230 kV KLY bus	
IC's Proposed COD	1st October 2028	
Type of Interconnection Service	NRIS ☒	ERIS ☐
Maximum Power Injection [1] (MW)	196 MW (Summer)	98 MW (Winter)
Number of Generator Units	50 x 4 MW SUNGROW SG 4400 UD-MV inverter	
Plant Fuel	Solar	
Note 1: The maximum achievable power injection at the POI is approx. 196 MW after accounting for MW losses and service load which is lower than the IC proposed 200 MW.		

[redacted] the interconnection customer (IC), requests to interconnect its 70 Mile House Solar Project (2024 CEAP IR # 101) to the BC Hydro (BCH) system. 70 Mile House Solar Project has fifty (50) [redacted] inverter with total installed capacity of 200 MW. The proposed Point of Interconnection (POI) is at the 230 kV bus of BC Hydro's Kelly Lake substation (KLY). The IC's project will connect to the POI via a 43 km customer built 230 kV interconnection line. The IC's proposed commercial operation date (COD) is Oct 1, 2028.

Figure 1-1 shows the Williston - Kelly Lake - Bridge River region transmission system diagram. Kelly Lake substation is a major 500kV/230kV substation in this area with two 500/230 kV transformers (KLY T1 & T4). KLY substation currently operates with total six 500 kV transmission lines, three 500 kV transmission lines (5L11, 5L12 and 5L13) connecting to Williston (WSN) substation, one 500 kV line (5L87) linking to the Nicola substation in South interior and two 500 kV lines (5L41 and 5L42) supplying two 500 kV substations in the Lower Mainland. The KLY 230 kV bus is interconnected with the Bridge River Terminal station (BRT) via a 230 kV transmission line, designated as 2L90.

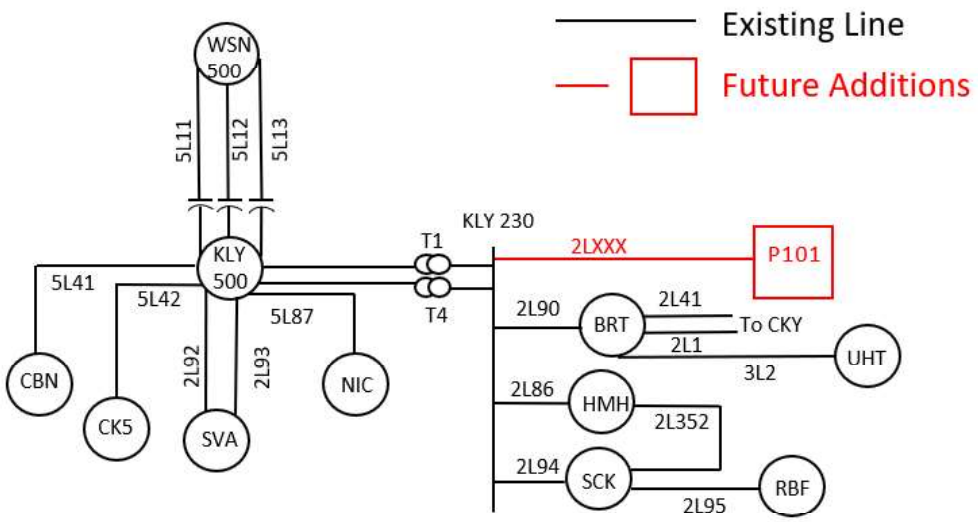

Figure 1-1: Williston - Kelly Lake – Bridge River Region 500/230 kV Transmission System Diagram in 2024 with the Proposed 70 Mile House Solar Project

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 study considers firm and non-firm transmission service under system normal and single contingency conditions.

3) Bridge River Transmission Reinforcement Project (BRTP) will be in-service in summer 2029.

5 System Studies and Results

Based upon the IC's submitted information and the area system conditions, the proposed POI is at the existing KLY 230 kV bus, approx. 43 km from the IC's substation. A new 230kV line position at KLY with associated substation equipment is required.

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 for all three load conditions studied.

Under system single contingencies, the following thermal overloads have been identified.

- The connection of the 70 Mile House Solar Project could exacerbate the existing thermal overloads on 2L90 (Kelly Lake - Bridge River Terminal), 5L41 (KLY- Clayburn), and 5L42 (KLY – Cheekye) under single 500 kV line contingencies, with high generation outputs in the Peace River area and during the summer and winter peak loads as well as non-firm transfer operations.

  The 70 Mile House Solar Project is required to participate in the existing generation shedding RAS to mitigate the potential thermal overloads.

- KLY T1 or KLY T4 could be thermally overloaded under contingencies of the KLY 2CB2 breaker internal fault (or KLY 2CB3, 2CB6) with high outputs from Bridge River area generations, non-firm transfer conditions, and during light summer load operations.

  A new RAS is required to shed IC's generation at KLY under KLY breaker internal breaker fault contingencies when the KLY T1 or KLY T4 is thermally overloaded and during the system light load operations. The overload detection mechanism and exact mitigation actions will be determined at the next study stage.

Table 5-1: Summary of Branch Loading Analysis Results

Case	IC's Plant Output	Contingency		Branch Loading			
				2L90	5L41	5L42	KLY T1/T4
		Cat.	Description	KLY-BRT	KLY - CBN	KLY - CK5	KLY T1/T4
Winter Rating				1003A	1900A	2180A	356 MVA
28HW	50%	P0	System Normal	76%	89%	78%	
	50%	P1	5L42	102%	126%		
	50%	P1	5L41	104%		112%	
Summer Rating				1014A	1900A	2180A	300 MVA
29HS	Max	P0	System Normal	71%	92%	71%	
	Max	P1	5L42	93%	126%		
	Max	P1	5L41	102%		104%	
29LS	Max	P0	System Normal				70%
	Max	P1	KLY 2CB2				106%

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	KLY 230	BRT 230
28HW	50%	P0	System normal	1.05	1.03
	0MW	P0	System normal	1.05	1.03
	50%	P1	5L41	1.03	1.01
29HS	Max	P0	System normal	1.06	1.04
	0 MW	P0	System normal	1.06	1.04
	Max	P1	5L41	1.03	1.0
29LS	Max	P0	System normal	1.05	1.01
	0 MW	P0	System normal	1.04	1.03
	Max	P1	5L41	1.05	1.03
	Max	P2.3	KLY 2CB2	1.05	1.03

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

5.1.4 Anti-Islanding Requirements

The 70 Mile House Solar Farm 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 next stage of interconnection study.

5.3 Stations Requirements

The POI of the 200 MW 70 Mile House Solar Project will be 230 kV switchyard of the existing Kelly Lake Substation. The station upgrade scope at the 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 70 Mile House Solar Project transmission line.
- The location of metering will be determined in the next stage.
- Other associated station work.

5.4 Protection & Control Requirements

For successful integration of the new IC, new line protection relays will be installed at BC Hydro's Kelly Lake and the IC's 70 Mile House Solar (P101) substations to protect 2LXXX using line current differential scheme (87L). As part of new line protection functionality, WECC Level 3 telecommunication facilities will be required between the two substations. BC Hydro will revise several line protections and provide new bus protections at KLY to accommodate station configuration changes for the connection of the IC.

The IC is to provide the following for the interconnection of its 70 Mile House Solar project (P101):

- 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 P101 to provide protection coverage for 2LXXX. BC Hydro P&C Planning will provide core protection settings for these relays to protect transmission line 2LXXX during a transmission line fault. 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 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 redundant protection for the reactive power compensation equipment at P101 that is to be specified by Regional System Planning.
- Provide anti-islanding protection as per Regional System Planning requirements.

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 KLY and P101 for “KLY – P101 2LXXX PY DIGITAL TELEPROT” and “KLY – P101 2LXXX SY DIGITAL TELEPROT” with C37.94 interfaces.

Telecontrol Requirements for Telecom

- Provide P101 SCADA circuit off FVO & SIO.

Other Requirements for Telecom

- Provide PY & SY T1s between P101-KLY.

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 70 Mile House Solar farm Project and its facilities to the BCH Transmission System at the POI, this Feasibility Study has identified the following conclusions and requirements:

1. A new 230 kV line position at KLY is required to interconnect the IC's generating project to the BC Hydro system.

2. The connection of 70 Mile House Solar Project does not cause any performance violation (i.e., thermal overload, voltage performance violation or voltage stability concern) under system normal conditions.

3. The connection of 70 Mile House Solar Project will:

   - Exacerbate the existing thermal overloads on 2L90 (KLY-BRT) and 500kV lines under single 500kV line contingencies, non-firm transfer conditions, and during the summer and winter peak load operations.

     IC is required to participate in the existing generation shedding RAS to mitigate the potential thermal overloads.

   - Cause thermal overloads on KLY T1 or KLY T4 under KLY breaker internal fault contingencies, non-firm transfer conditions and during light summer load operations.

     A new Remedial Action Scheme (RAS) is required to shed IC's generation at KLY under KLY breaker internal breaker fault contingencies when the KLY T1 or KLY T4 is thermal overloaded.

4. 70 Mile House Solar Farm is not arranged for islanded operation. In addition to entrance protection and 2LXXX 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.

5. The proposed IC owned interconnecting line 2LXXX will become an IC's Bulk Electric System (BES) and the IC will be responsible for the compliance with applicable NERC Mandatory Reliability Standards (MRS) requirements.

6. 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 70 Mile House Solar farm as submitted does not meet the reactive capability requirement at both maximum and minimum MW output range, which will need to be addressed.

7. BC Hydro will provide new line protection relays for 2LXXX (BC Hydro end only) and revise other protections at KLY for the connection of the IC. As part of new line protection for 2LXXX, WECC Level 3 telecommunication facilities will be required between KLY and the IC. The IC shall provide the required relays, telecom facility, and associated equipment at its facilities to accommodate the required protection schemes.

Appendix A
Plant Single Line Diagram Used for Power Flow Study

Figure A-1 shows 70 Mile House Solar farm Project single line diagram used for power flow study.

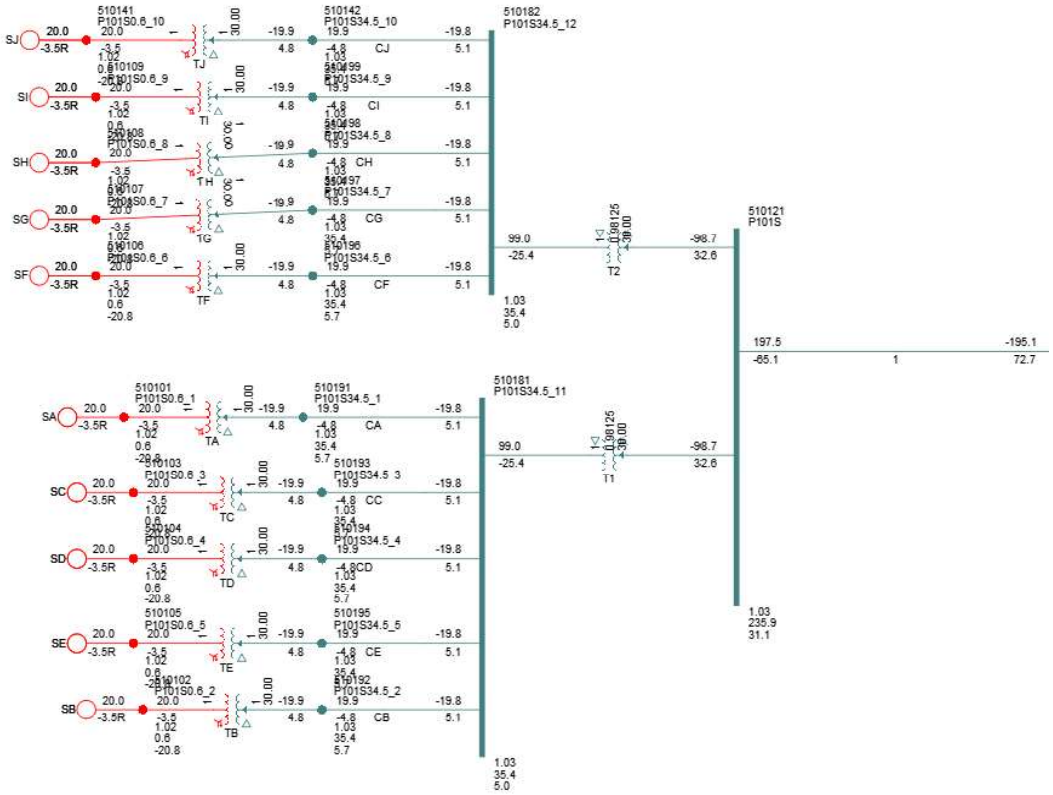

Figure A-1: 70 Mile House Solar farm Project Single Line Diagram for Power Flow Study.

As seen in the diagram, 70 Mile House Solar farm Project has two main power transformers dividing the plant into two parts.

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

Appendix B
One-Line Sketch at Kelly Lake Substation (KLY) 230 kV

Figure B-1 shows the Stations Planning One-Line Sketch at the KLY 230kV substation.

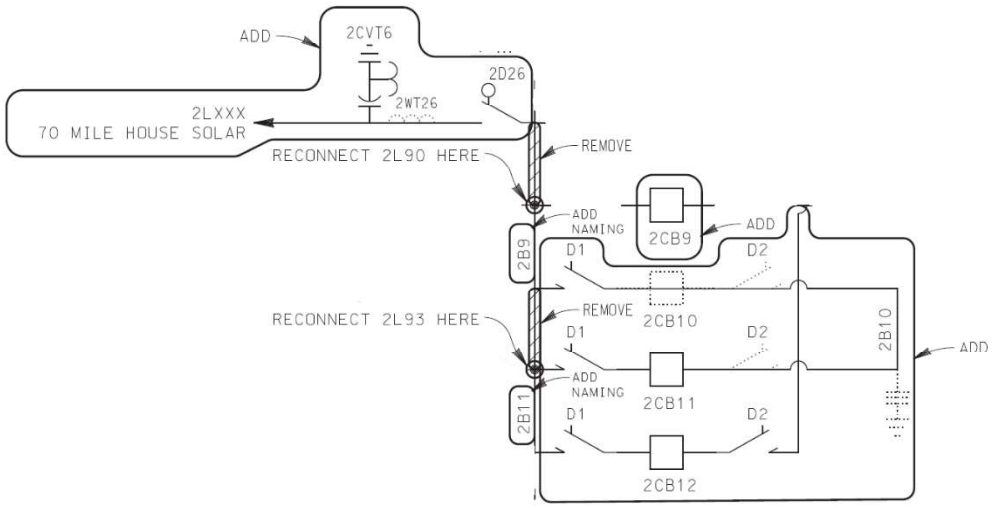

Figure B-1: KLY 230kV Substation Planning One-Line Sketch