BC Hydro
Power smart

6911 Southpoint Drive (B03)
Burnaby, BC
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July 30, 2024

[redacted]

RE: CEAP IR 63 - Quesnel Solar Farm Project - Interconnection Feasibility Study Report

Enclosed is the Interconnection Feasibility study report for the proposed Quesnel Solar Farm 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 $13.1 M.

Major Scope of Work Identified:

- Expand the substation and extend the existing 60 kV bus structure at BC Hydro's Barlow Substation (BLW)
- Supply and install one 60kV line position with the associated substation equipment at BLW
- 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 piles or ground improvements will be required
- No contaminated soil will be encountered during construction

Key Risks:

- Additional Right of Way or acquisition of more property may be required
- 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 increase costs
- Cost of materials and major equipment 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 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_63_Quesnel Solar Farm_FeS_Report_final.pdf

[redacted]

Quesnel Solar Farm

Interconnection Feasibility Study

BC Hydro EGBC Permit to Practice No: 1002449

2024 CEAP IR # 63

Prepared for: [redacted]

[redacted]

Report Metadata

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Prepared for: [redacted]

[redacted]

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[redacted]

Revisions

Revision	Date	Description
0	2024 Jul	Initial release

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Executive Summary

[redacted] the interconnection customer (IC), requests to interconnect its Quesnel Solar Farm (2024 CEAP IR # 63) to the BC Hydro system. Quesnel Solar Farm has 141 [redacted] inverters, adding a total capacity of 49.6 MW into the BC Hydro system. The Point of Interconnection (POI) is at the 66 kV bus of BC Hydro's Barlow substation (BLW). The IC will build a new 66 kV transmission line, temperately designated as 60LXX, to interconnect with BC Hydro transmission system at the proposed POI.The IC's proposed commercial operation date (COD) is Oct 1st, 2028.

To interconnect the Quesnel Solar Farm 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 66 kV line position at BLW is required to interconnect the IC's generating project to the BC Hydro system.
2. The connection of Quesnal Solar does not cause any performance violation (i.e. thermal overload, voltage performance violation or voltage stability concern) under system normal and contingency conditions.
3. An Anti-islanding transfer trip scheme is required to isolate the IC at their entrance circuit breaker during various operation conditions or under system contingencies. In addition, the IC is required to install anti-islanding protection within their facility to disconnect the IC from the grid when an inadvertent island with the local loads form.
4. The solar farm does not meet the reactive power capability requirement specified in the TIR. At the full capacity of 49.6 MW, there are no reactive power capability left at the inverters, which will need to be addressed.
5. BC Hydro will provide line protections (BC Hydro end only) for the new 66 kV transmission line 60LXX that will integrate Quesnel Solar Farm to BC Hydro system at Barlow Substation (BLW). Telecommunication facilities will be required to accommodate the new protection schemes. The IC shall provide required relays, telecom facility and associated equipment at its facilities to accommodate the new protection schemes.

The above conclusions are made based on the IC's input data and study assumptions listed in Section 4, which represent the best available information on May 22, 2024.

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

Contents

Appendices

Acronyms

The following are acronyms used in this report.

BCH	BC Hydro
CEAP	Competitive Electricity Acquisition Process
COD	Commercial Operation Date
DTT	Direct Transfer Trip
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
P63	Project #63 - Quesnel Solar Farm
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

1 Introduction

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

Table 1-1 Summary of Project Information

Project Name	Quesnel Solar Farm	
Name of Interconnection Customer (IC)	[redacted]	
Point of Interconnection (POI)	Barlow Substation 66 kV bus	
IC's Proposed COD	1st October 2028	
Type of Interconnection Service	NRIS ☒	ERIS ☐
Maximum Power Injection [1] (MW)	49.6 MW (Summer)	49.6 MW (Winter)
Number of Generator Units	141 x 0.352 MW	
Plant Fuel	Solar	

[redacted] the interconnection customer (IC), requests to interconnect its Quesnel Solar Farm (2024 CEAP IR # 63) to the BC Hydro system. Quesnel Solar Farm has 141 [redacted] solar inverters, adding a total capacity of 49.6 MW into the BC Hydro system. The Point of Interconnection (POI) is at the 66 kV bus of the BC Hydro's Barlow substation (BLW). The IC's proposed commercial operation date (COD) is Oct 1st, 2028.

Figure 1-1 shows the Central Interior Regional transmission system diagram. Barlow Substation has three 230 kV connections and three 66 kV connections. The 230 kV lines are 2L96, 2L354, and 2L307 and the 66 kV lines are 60L339, 60L303, and 60L306 as shown in Figure 1-1.

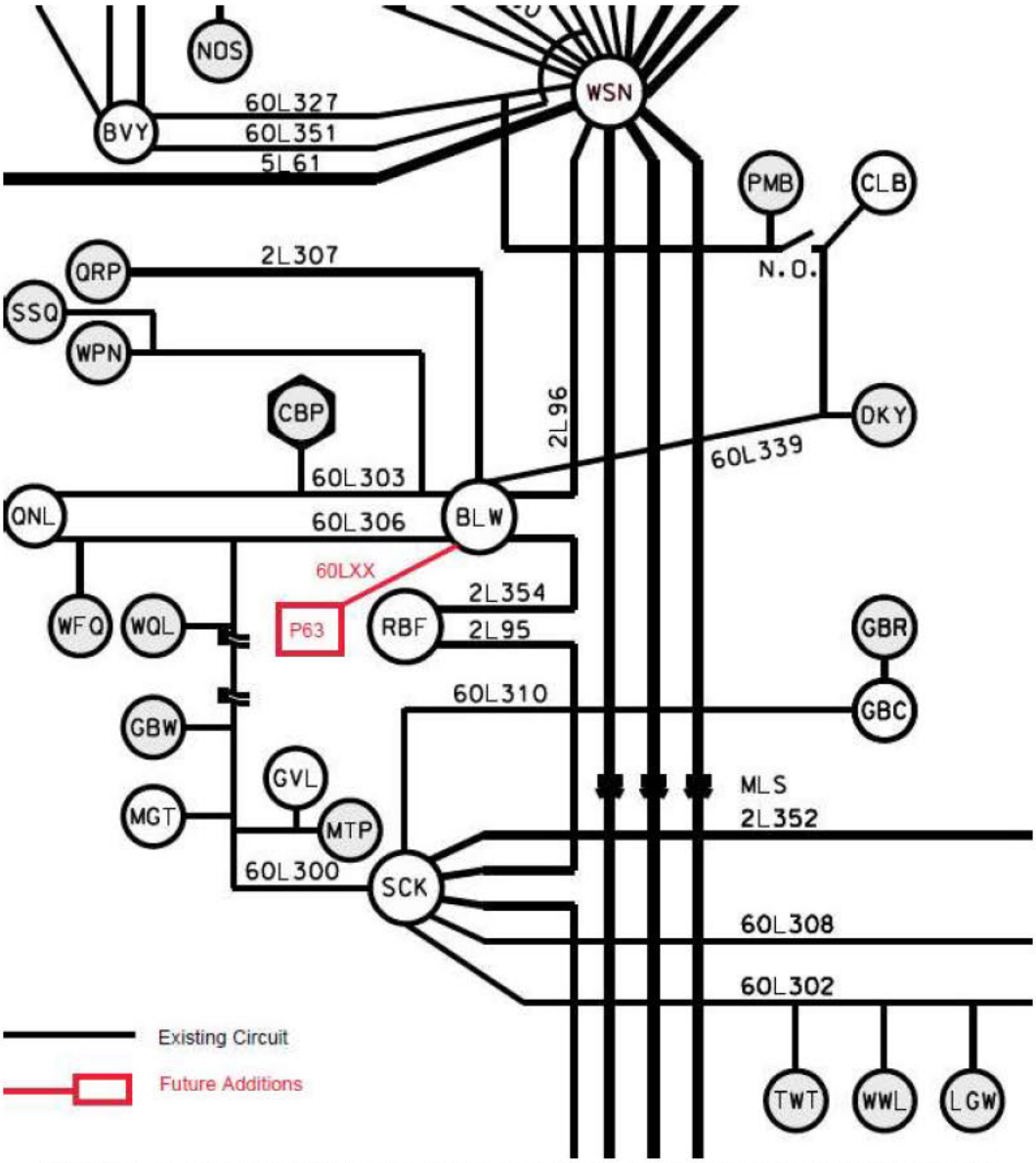

Figure 1-1: Central Interior Regional Transmission System Diagram with the Proposed Quesnel Solar Project Interconnection

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.

2) Other higher queue projects are included.

5 System Studies and Results

The new interconnetion line 60LXX (from BC Hydro's BLW substation to the IC's generation station) will be a non-Bulk Electric System (BES) element.

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 2028 heavy winter (28HW), 2029 light summer (29LS), 2029 heavy summer (29HS), and 2032 heavy summer (32HS) system load condition which is a stressed condition for this new generation project interconnection, taking into considerations of factors such as load conditions, seasons and generation patterns. The 2032 light summer (32LS) and 2031 heavy winter (31HW) cases are also checked at a high level to capture any possibility of performance violations under light and 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).

5.1.2 Steady-State Voltage Analysis

With the existing HMH Remadial Action Scheme (RAS), the voltage performance under system normal condition (P0), P1, and P2 single contingencies (TPL-001-4 Table 1) is acceptable.

Quesnel Solar project does not contribute to any lowvoltage performance concerns identified under heavy load conditions.

5.1.3 Reactive Power Capability Evaluation

The BCH TIR requires IBR generators have the dynamic reactive power capability at a minimum of +/- 33% of its Maximum Power Output (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 for this project, the study finds that the proposed generating project cannot meet the BC Hydro's reactive capability requirement, which will need to be addressed.

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 meets this requirement at zero MW output.

5.1.4 Anti-Islanding Requirements

The study finds the IC's project may be inadvertently islanded with the existing generators and BC Hydro loads, which is not allowed. An Anti-islanding transfer trip scheme is required to isolate the IC at their entrance circuit breaker for the following system contingencies.

- Loss of BLW T2 and T3
- BLW 66 kV Breaker (BLW 60CB4) Internal Fault
- Loss of 2L96 and 2L354
- Loss of 2L96 and 2L95

In addition, Quesnel Solar is not arranged for islanded operation. 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 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 Barlow substation (BLW) is as follows.

- Expand the substation and extend the existing 66 kV bus structure.
- Add one 66 kV line position with the associated substation equipment. Refer to the attached one-line diagram in Appendix B for details.
- Terminate the Quesnel Solar Farm line.

- Other associated station work.

5.4 Protection & Control Requirements

BC Hydro will provide line protections for 60LXX 66 kV transmission line (BC Hydro end only) that will integrate Quesnel Solar Farm to BC Hydro system at Barlow Substation (BLW). As part of the new line protection, telecommunication facilities will be required between BLW and Quesnel Solar Farm (tentatively designated as P63).

The IC, LD-CCI LP, to provide the following for the interconnection of Quesnel Solar Farm:

- 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 Quesnel Solar Farm (P63) to provide protection coverage for 60LXX. BC Hydro P&C Planning will provide core protection settings for these relays to protect transmission line 60LXX between BLW and P63 during a transmission line fault. Non-core protection such as local breaker failure, auto-reclosing, backup protection for station elements will not be provided by BC Hydro P&C Planning.
- The IC is responsible for NERC PRC-related tasks, settings to compliance standards within their facilities.
- The IC is responsible for providing a communications link for remote interrogation of the PPIS equipment by BCH servers.
- Provide anti-islanding protection as per Section 5.1.4.

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, BLW – P63, with C37.94 interfaces..

Telecontrol Requirements for Telecom

Provide P63 SCADA circuit off FVO & SIO.

Other Requirements for Telecom

- Provide PY & SY T1 over separate OC3s between P63-BLW.
- Provide MPLS links and LSPs for new BLW MPLS nodes.

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

6 Cost Estimate and Schedule

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

7 Conclusions

To interconnect the Quesnel Solar Farm and its facilities to the BCH Transmission System at the POI, this Feasibility Study has identified the following conclusions and requirements:

1. A new 66 kV line position at BLW is required to interconnect the IC's generating project to the BC Hydro system.
2. The connection of Quesnal Solar does not cause any performance violation (i.e. thermal overload, voltage performance violation or voltage stability concern) under system normal and contingency conditions.
3. An Anti-islanding transfer trip scheme is required to isolate the IC at their entrance circuit breaker during various operation conditions or under system contingencies listed in Section 5.1.4. In addition, the IC is required to install anti-islanding protection within their facility to disconnect the IC from the grid when an inadvertent island with the local loads form..
4. The solar farm does not meet the reactive power capability requirement specified in the TIR. At the full capacity of 49.6 MW, there are no reactive power capability left at the inverters which will need to be addressed.
5. BC Hydro will provide line protections (BC Hydro end only) for the new 66 kV transmission line 60LXX that will integrate Quesnel Solar Farm to BC Hydro system at Barlow Substation. Telecommunication facilities will be required to accommodate the new protection schemes. The IC shall provide required relays, telecom facility and associated equipment at its facilities to accommodate the new protection schemes.

Appendix A
Plant Single Line Diagram Used for Power Flow Study

Figure A-1 shows the Quesnel Solar Farm single line diagram used for power flow study.

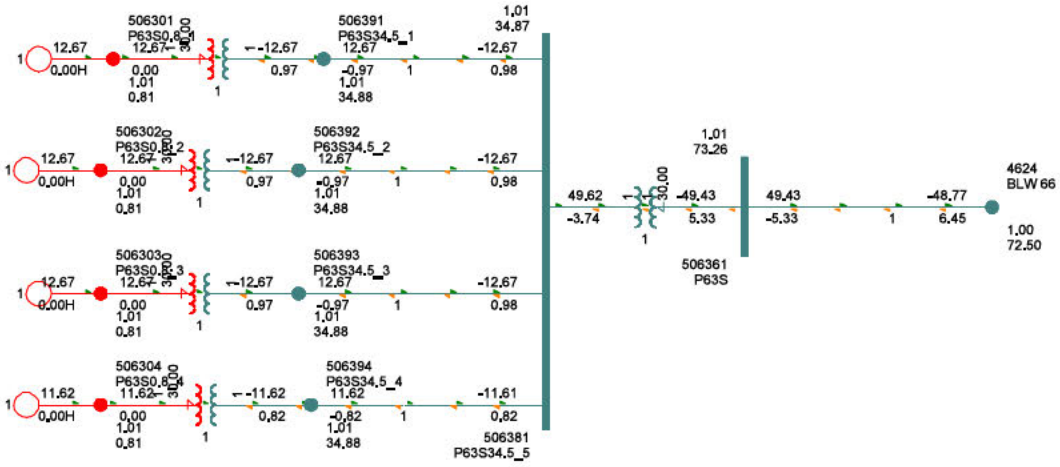

Figure A-1: Quesnel Solar Farm Single Line Diagram for Power Flow Study.

As seen in the diagram, Quesnel Solar Farm has one main power transformer connected to a bus with 4 feeders connecting four equivalent generating units, which aggregate the 141 solar inverters.

Appendix B
One-Line Sketch for BLW

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

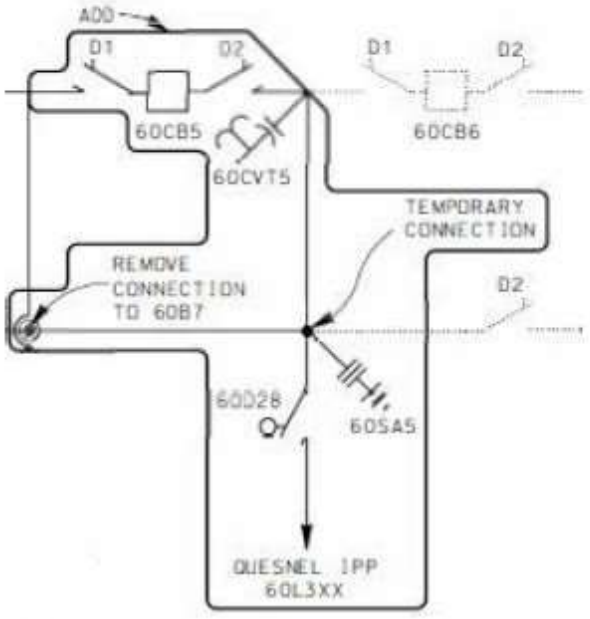

Figure B-1: Stations Planing One-Line Sketch for the BLW.