BC Hydro
Power smart

[redacted]

West Fraser Quesnel River Pulp CHP Project

Interconnection System Impact Study

Report No: T&S Planning 2016-073

September 2016

British Columbia Hydro and Power Authority

Acknowledgements

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REVISION TABLE

Revision Number	Date of Revision	Revised By

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EXECUTIVE SUMMARY

The Interconnection Customer (IC), [redacted] is proposing to develop the West Fraser Quesnel River Pulp CHP natural gas generating facility within its existing Quesnel River Pulp substation (QRP). The generation project consists of one single generator unit with a 17.5 MVA maximum capacity within the QRP facilities which is located in the Quesnel area, south of Prince George, in the province of British Columbia.

QRP is an existing customer owned and operated substation which is supplied from BC Hydro's (BCH's) Barlow Substation (BLW) via a 230 kV circuit, 2L307. The proposed 17.5 MVA natural gas generating facility will act to displace part of the existing load at QRP and all of the energy produced is expected to be consumed within the plant, with no intended injection of energy into the BCH system. The official Point of Interconnection (POI) is at QRP and the proposed Commercial Operation Date (COD) is March 01, 2018.

This project was initially proposed with four generators having a total capacity of 18.6 MVA and connected to the existing 13.8 kV bus. A System Impact Study (SIS) was completed for that proposal with a final report sent to the IC (Report No.: T&S Planning 2014-074). The IC recently changed their application from four generators to a single unit which requires the need to determine any potential impacts of this change. This SIS re-study has identified that there is no significant change in the required system modifications and Network Upgrades as concluded earlier in the previous report to obtain acceptable system performance with the interconnection of the subject project.

The previous SIS concluded that the QRP proposed generation must be switched out for internal load levels below 40 MW to avoid the risk of Transient Over-voltages (TOVs) after isolation from the BLW end, due to the existing un-grounded system at QRP. The latest application is proposed with a single generator and a 230 kV (Y-ground) / 13.8 kV (delta) step-up transformer providing a ground source at QRP. Based on this, the threshold has been reduced to 30 MW. When the internal load at QRP falls below 30 MW, the single QRP generation unit is required to be switched off-line, regardless of load levels.

To interconnect the IC's project and its facilities to the BCH Transmission System, the System Impact Study (SIS) has identified the following conclusions and requirements:

<u>BC Hydro's Network Upgrades</u>

- One set of three 228 kV rated Surge Arrestor (SA) is required at BLW line terminal;
- Review of line protection settings at BLW for circuit 2L307 is required to determine changes that may need to be implemented;
- BCH Control Centres require reconfiguration and updating of existing network models, databases, and displays to accommodate the new generation at QRP station;
- Telecommunications work is required at either:

- Option 1 (Satellite): BCH control centres for implementing satellite communication channels or;
- Option 2 (Leased line): BLW station and BCH control centres for implementing a leased line for SCADA communication channels.

The non-binding, good faith, cost estimate for the above Network Upgrades is $483.5k (for Option 1 – satellite) or $500.4k (for Option 2 – leased line). The estimated time to implement the identified work is up to 6 months.

The above estimate and schedule do not include the work associated with Revenue Metering nor does it include the work required within the IC's facilities. Within the QRP facility, the IC is required to provide protection in accordance with "60 kV to 500 kV Technical Interconnection Requirements for Power Generators."

The key items that the IC is responsible for are listed below:

Quesnel River Pulp Station (QRP)

- Primary (PY) and Standby (SY) line protection for circuit 2L307 shall be provided;
- Standalone high voltage Capacitor Voltage Transformers (CVTs) are required;
- The proposed generation must be switched off-line when internal load levels fall below 30 MW;
- The IC is required to provide continuous Supervisory Control and Data Acquisition (SCADA) access from QRP to a BCH Control Centre via either satellite or leased line;
- Out-of-step protection is required at the QRP generator in order to isolate the unit from the BCH system for unexpected contingencies that can cause the generator to slip. The swing centre is expected to be within the IC's facilities.

The IC is not allowed to supply an islanded region which includes other BCH customers. The likelihood of this scenario occurring is extremely low and therefore, Power Quality protection is not needed. The IC may, however, choose to operate in a localized islanded mode only within its own facilities with the requirement that no power can be back-fed into the BCH system at any time, i.e. QRP entrance breaker 2CB12 is open when operating as a local island.

Additional Network Upgrade requirements may be identified in the Facilities Study (FS) stage. The Interconnection FS report will provide greater details of the Interconnection Network Upgrade requirements and associated cost estimates and estimated construction timeline for this project.

Table of Contents

1.0 INTRODUCTION

The project reviewed in this Interconnection System Impact Study (SIS) is as described in Table 1 below:

Table 1: Summary of Project Information

Project Name	West Fraser Quesnel River Pulp CHP	
Interconnection Customer	[redacted]	
Point of Interconnection (POI)	Quesnel River Pulp Station (QRP)	
IC Proposed COD	March 01, 2018	
Type of Interconnection Service	NRIS ☒	ERIS ☐
Maximum Power Injection (MW)	0 (Summer)	0 (Winter)
Number of Generator Units	1	
Plant Fuel	Natural Gas	

The Interconnection Customer (IC), [redacted] is proposing to develop the West Fraser Quesnel River Pulp CHP natural gas generating facility within their existing Quesnel River Pulp Station (QRP) which is located in the Quesnel area, south of Prince George, in the province of British Columbia.

This project was initially proposed with four generators having a total capacity of 18.6 MVA which were proposed to be connected onto the QRP existing 13.8 kV bus. A System Impact Study (SIS) was completed for that proposal with a final report sent to the IC (Report No.: T&S Planning 2014-074). The IC recently changed their application from four generators to a single unit with a step-up transformer which requires the need to determine any potential impacts of this change.

The latest proposal of the QRP natural gas generating project consists of a single 13.8 kV generator with a 17.5 MVA capacity and operating at 0.8/0.9 (lag/lead) power factor. The total power (14 MW) will be stepped up to the 230 kV level through a newly proposed 230 kV (Y-ground) / 13.8 kV (delta), 20 MVA transformer. The power will be completely consumed by the existing load at QRP and there is no energy intended to be transmitted into the BC Hydro (BCH) system at any time. The QRP station has a maximum load of around 90 MW and a minimum load of around 40 MW. QRP station is supplied from BCH's Barlow Substation (BLW) via a 5 km 230 kV circuit, 2L307. BCH's operating authority of 2L307 ceases at the QRP station perimeter. The official Point of Interconnection (POI) is on 2L307, just outside the station perimeter of QRP. The proposed Commercial Operation Date (COD) is March 01, 2018.

The Single Line Diagram for the project is illustrated below in Figure 1:

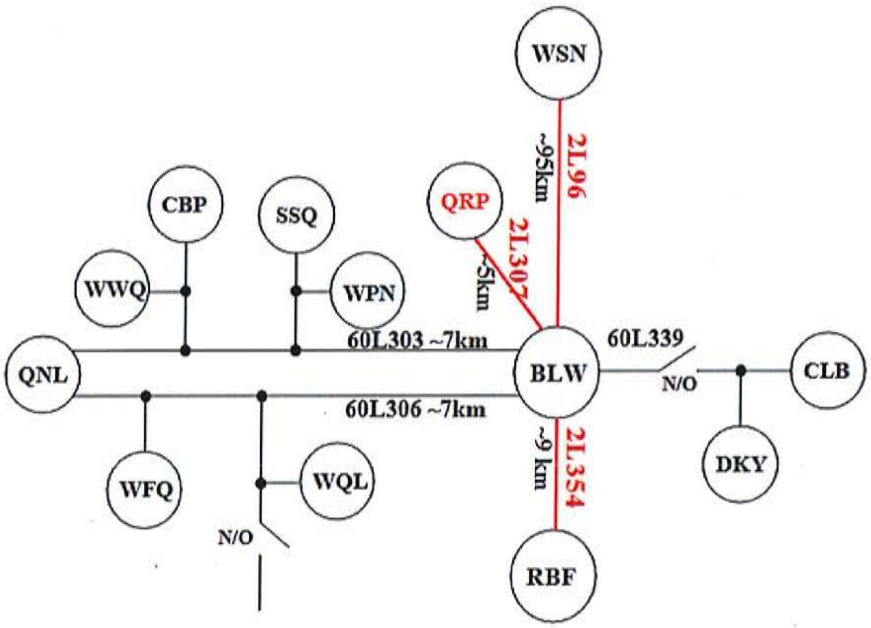


Figure1: Single Line Diagram of Interconnection Project and Surrounding Area

2.0 PURPOSE OF STUDY

The purpose of this Interconnection SIS is to assess the impact of the proposed interconnection on the BCH Transmission System. This study will identify constraints and Network Upgrades required for interconnecting the proposed generating project in compliance with the North American Electric Reliability Corporation (NERC) and Western Electricity Coordinating Council (WECC) reliability standards and the BCH transmission planning criteria.

3.0 TERMS OF REFERENCE

This study investigates and addresses the overloading, voltage deviation and stability issues of the transmission network in the Quesnel area as a result of the proposed interconnection. Topics studied include equipment thermal loading and rating requirements, system transient stability and voltage stability, transient over-voltages, protection coordination, operating flexibility, and telecom requirements. BCH planning methodology and criteria are used in the studies.

The SIS does not investigate operating restrictions and other factors for possible second contingency outages. Subsequent BC Hydro system studies will determine the requirements for reinforcements or operating restrictions/instructions for those kinds of events. Any use of firm or non-firm transmission delivery will require further analysis specific to the transmission service that may be requested later and

will be reviewed in a separate study. Determination of any detailed upgrades on the IC's facilities is beyond the SIS scope.

The work necessary to implement the network improvements identified in this SIS report will be described in greater detail in the Interconnection Facilities Study report for this project.

4.0 STUDY ASSUMPTIONS

The power flow conditions studied include generation, transmission facilities, and load forecasts representing the queue position applicable to this project. Applicable seasonal conditions and the appropriate study years for the study horizon are also incorporated. The 2018 light summer and 2018 heavy winter system configurations were selected for this study.

The study is carried out based on the updated model, data, and information submitted by the IC in April 2016.

5.0 SYSTEM STUDIES AND RESULTS

Power flow, short circuit, transient stability and analytical (PSCAD) studies were carried out to evaluate the impact of the proposed interconnection. Studies were also performed to determine the protection, control and telecommunication requirements and to evaluate possible over-voltage issues.

5.1 STEADY STATE POWER FLOW STUDIES

Pre-outage power flows were prepared to assess the impact of the proposed interconnection using the defined generation conditions with two basic system configurations:

1. 2018 light summer (LS);
2. 2018 heavy winter (HS)

A series of system normal and single contingency (i.e. N-1) power flow studies have been conducted to determine if the pre-contingency and post-contingency performance, including bus voltage deviations and facility loading levels, met the NERC Mandatory Reliability Standards (MRS) and WECC/BCH System Performance Criteria under different system conditions.

In the power flow analysis, equipment loading and voltage conditions in the Transmission System were investigated under system normal and single contingency conditions. Simulation results indicated that with no power injection from QRP plant into the BCH system, transmission equipment loadings and

voltage conditions are expected to be acceptable under steady state system normal conditions and single contingencies.

Details can be found in Table 2 below:

Table 2: Power Flow Results with 0 MW Injection from West Fraser Quesnel River Pulp CHP project

System Load Condition	Contingency	Bus Voltage (in per unit)			Power Flow (MW)	
		BLW 60 kV	QRP 230 kV	BLW 230 kV	2L96	2L354
2018 HW	System Normal	1.047	1.047	1.047	-80	45
	Loss of 2L96 / BLW T2	1.022	1.034	1.034	-	-35
	Loss of 2L354 / BLW T3	1.030	1.044	1.044	-35	-
2018 LS	System Normal	1.079	1.060	1.060	-21	1
	Loss of 2L96 / BLW T2	1.071	1.051	1.051	-	-20
	Loss of 2L354 / BLW T3	1.062	1.040	1.040	-20	-

Note: 'HW' and 'LS' stand for heavy winter and light summer, respectively

5.2 TRANSIENT STABILITY STUDY

A series of transient stability studies under various system operating conditions, including the 2018 light summer and heavy winter load cases, have been performed. The model of the generating project was based on the IC's data submission plus any additional assumptions where the IC's data was incomplete or inappropriate. The IC's dynamic models and parameters are shown in Appendix B.

The transient stability study has shown that with 0 MW maximum power injection from West Fraser Quesnel River Pulp CHP project into the BCH transmission system, the addition of generation at QRP does not adversely affect the power system dynamic performance.

Unexpected contingencies may cause the IC's units to slip. The IC is expected to detect the resulting slip conditions quickly and isolate the QRP units from the BCH system using Out-of-Step protection for each of the IC's generators. The expected swing centre is located inside the QRP plant.

The West Fraser Quesnel River Pulp CHP project at QRP is not allowed to supply power to other BCH customers when an islanded region occurs. The likelihood of this scenario occurring is extremely low.

Presently, there are no other existing customers connected to circuit 2L307. Therefore, Power Quality protection is not required for the project.

The IC may operate in a localized islanded mode only within its own facilities as long as it meets the requirement that no power can be back-fed into the BCH system, i.e. QRP entrance breaker, 2CB12, is open when operating as a local island.

A summary of the system transient stability study results for 2018 summer conditions is provided below in Table 4:

Table 4: Transient Stability Study Results
(Pre-outage condition: 2018 LS with 0 MW Injections from West Fraser Quesnel River Pulp CHP project)

Case	Outage	3Φ Fault Location	Fault Clearing Time (Cycles)		IC Max Rotor Swing (Deg.)		IC Stability Performance	Minimum Transient Voltage (p.u.)	
			Close End	Far End	CBP G1/G2	QRP G1-G4		CBP 66 kV Bus	BLW 66kV Bus
1	2L96 (WSN – BLW)	Close to BLW	BLW 7	WSN 6	29/27	55	Acceptable	>0.95	>0.95
2	2L354 (BLW – RBF)	Close to BLW	BLW 7	RBF 13	29/27	55	Acceptable	>0.95	>0.95
3	2L307 (BLW – QRP)	Close to BLW	BLW 5	N/A	16/14	N/A	Acceptable	>0.95	>0.95
4	60L306 (BLW– QNL)	Close to BLW	BLW 7	QNL 69	33/32	21	Acceptable	>0.95	>0.95
5	WPN T1 HV side	WPN T1 HV side	WPN 66 11	N/A	16/14	9	Acceptable	>0.95	>0.95
6	QNL 12B1	QNL 12B1	QNL 12B1 11	N/A	12/11	9	Acceptable	>0.95	>0.95

5.3 REMEDIAL ACTION SCHEME (RAS)

There is no Remedial Action Scheme (RAS) required for interconnecting the QRP generation at this study stage. RAS requirements may be identified in a future Facilities Study stage.

5.4 ANALYTICAL STUDIES

Based on the available information and project description provided by the IC, there are no concerns in relation to severe Transient Over-Voltages (TOVs) arising from protective and non-protective tripping of circuit 2L307 from the BLW end. Under normal load conditions, the load/generation ratio is sufficient to collapse the remaining islanded system eliminating the risk of TOVs due to self-excitation of the generator. Furthermore, given the short 5 km length of circuit 2L307, there are less concerns of severe TOVs due to resonance conditions under low generation scenarios with very low load at QRP.

The application of a Surge Arrestor (SA) rated at 228 kV is recommended at BLW 2L307 line terminal.

It is assumed that the minimum internal load at QRP seldom falls below 40 MW (5% probability). The ratio, 2.8, for this minimum load to the proposed maximum generation (14 MW) is sufficient to quickly collapse the resulting localized island at QRP after isolating from the BLW end. In the previous SIS (T & S Planning: 2016-074), the IC was required to switch out the proposed generation for internal load levels that fall below 40 MW, regardless of generation levels. Based on the latest submission in April 2016, the addition of the proposed 230 kV (Y-ground) / 13.8 kV (delta) step-up transformer provides a ground source at QRP. The internal load threshold is reduced to 30 MW, below which, the QRP generation unit is required to be switched off-line.

5.5 FAULT ANALYSIS

The short circuit analysis for the System Impact Study is based upon the latest BCH system model, which includes project equipment and impedances provided by the IC. The model included higher priority queued interconnection projects and planned system reinforcements but excluded lower priority queued projects. Thevenin impedances, including the ultimate fault levels at POI, are not included in this report but will be made available to the IC upon request.

BCH will work with the IC to provide accurate data as required during the project design phase.

5.6 TRANSMISSION LINE UPGRADES

There are no transmission line upgrades required in the BCH system for this project.

5.7 BCH STATION UPGRADES OR ADDITIONS

To interconnect the subject project at QRP, the following station work at BLW will be needed:

- One set of three 228 kV rated Surge Arrestor to be installed on 2L307 line terminal at BLW

5.8 PROTECTION & CONTROL and TELECOMMUNICATIONS

Protection Requirements

QRP Station

The IC, QRP station, shall provide primary (PY) and standby (SY) protection for circuit 2L307 between BLW and QRP in accordance with BCH's "60 kV to 500 kV Technical Interconnection Requirements (TIR) for Power Generators." Standalone high voltage 230 kV Capacitor Voltage Transformers (CVTs) are required as well. The above requirements are necessary to detect and protect against phase and ground faults on the transmission system as well as provide sufficient telemetry and status information in accordance with BCH's "60 kV to 500 kV Technical Interconnection Requirements (TIR) for Power Generators."

BCH's BLW Station

Review of existing PY and SY line protection settings for circuit 2L307 at BLW is required to confirm coordination of phase and ground protection.

Control Requirements

QRP Station

The IC is required to provide telemetry and status information from its site to the BCH Control Centres via a communication channel using Distributed Network Protocol 3 (DNP3) as per BCH's "60 kV to 500 kV Technical Interconnection Requirements for Power Generators." The BCH Control Centres require reconfiguration and updating of the existing network models, databases, and displays to accommodate the addition of QRP generating station and collect the QRP SCADA data.

BCH's BLW Station

No work at BLW required

Telecommunications Requirements

QRP Station

Provide continuous Supervisory Control and Data Acquisition (SCADA) access to the BCH Control Centres either by:

Option 1

Satellite – The IC is required to install an Infosat ku-band satellite terminal at QRP for providing continuous SCADA access off Ingledow Station (ING) Data Collection Point (DCP). The performance objectives must be met as per BCH's "60 kV to 500 kV Technical Interconnection Requirements (TIR) for Power Generators."

Option 2

Leased Line – The IC is required to arrange for installation of a 4-wire leased line from QRP to BLW. Installation of a telephone high voltage entrance is required and a Telenetics V3600 modem is to be connected to the IC provided Remote Terminal Unit (RTU).

(The IC is recommended to confirm with TELUS on the availability and cost of a 4-wire voice-band data private line service or fractional T1 leased line service. The estimate for the 4-wire type of service has been included in the SIS report. The estimate will increase significantly to accommodate the choice of using a T1 leased line service).

BLW Station

Option 1

Satellite – No work required

Option 2

Leased Line – BCH is required to install a Positron 4-wire high voltage isolation card, a 4-wire loopback card and connect the circuit to a 4-wire E&M card of BLW 3600 DACS.

BCH Control Centres

Option 1

Satellite – BCH is required to configure the SCADA master on the satellite provider facility at ING control centre for the IC's SCADA data.

Option 2

Leased Line – Install a Telenetics V3600 modem at BCH control centre and connect a 4-wire interface to the circuit from BLW. Connect an RS232 interface to the front end processor and configure for QRP SCADA data.

5.9 ISLANDING

Islanded operation with existing BCH customers is not arranged for this project.

5.10 BLACK START CAPABILITY

BCH does not require the proposed project to have black start (self-start) capability.

5.11 COST ESTIMATE AND SCHEDULE

The cost estimate for the identified BCH Network Upgrades is $483.5k (for Option 1 – satellite) or $500.4k (for Option 2 – leased line). The estimated time to implement the recommendations is 6 months after receiving approval of implementation funding and necessary outages. This estimate does not include any costs associated with Revenue Metering. Work required at the IC's site is not a part of this estimate and schedule.

6.0 REVENUE METERING

A single Point of Metering (POM) is required at the QRP station, located upstream from the 13.8 kV generator. The Revenue class meter must be approved and sealed by Measurement Canada (MC). Two element metering shall be utilized instead of the previous SIS proposal of three element metering.

The IC is responsible for supplying auxiliary power and telecom for revenue metering use at each of the points of metering. The location of the POM is subject to approval by BC Hydro's Revenue Metering department.

The planning, design, installation and commissioning of the metering should be coordinated between the Interconnection Customer and BC Hydro's Revenue Metering Department. The responsibilities and charges between the Interconnection Customer and BC Hydro shall be in accordance with Section 10 (10.1 and 10.2) of BC Hydro's Requirements for Complex Revenue Metering.

All meters will be supplied and maintained by BC Hydro. Main and backup meters will use the same Current Transformers (CTs) and Voltage Transformers (VTs) secondaries and shall not share the secondary with any other equipment. The meter will be leased to the Interconnection Customer by BC

Hydro. The Interconnection Customer will supply MC approved CTs and VTs with a valid MC approval number which must be provided. The metering instrument transformers must have a way to be isolated from both sources of energy for metering work with a visible means of isolation. Secondary cables and meters will be supplied by BCH.

A dedicated telecommunications channel is required for remotely read/downloaded data from the main and backup meters. The design, supply and installation of the communications equipment shall be coordinated between BCH Revenue Metering, BCH Telecom, the Power Generator and the Telecommunications Service Provider. The PG should provide a terminal/connector inside the BCH meter cabinet. Where the POI is on a 69 kV voltage class or higher BC Hydro transmission system **and** where a conventional wire-line telephone is installed, ground potential rise (GPR) protection shall be provided. Alternative technologies may be used, e.g. cellular, fiber optic, microwave, satellite etc. however these solutions must be discussed and approved by BCH before installation. The BCH MV-90 Server must be able to access and download data from the meters remotely as they do when they dial in a site using a standard phone line (wireless or landline). For more details, please, refer to Section 8 of BCH Revenue Metering Requirements for Complex Metering published at the Revenue Metering webpage and at the BC Hydro external website.

The estimated costs provided in this report do not include any costs for Revenue Metering.

7.0 CONCLUSIONS & DISCUSSION

In order to interconnect the subject proposal to the BCH Transmission System at the POI, this SIS has identified the following conclusions and requirements:

BC Hydro's Network Upgrades

- One set of three 228 kV rated Surge Arrestor (SA) is required at BLW line terminal;
- Review of line protection settings at BLW for circuit 2L307 is required to determine changes that may need to be implemented;
- BCH Control Centres require reconfiguration and updating of existing network models, databases, and displays to accommodate the new generation at QRP station;
- Telecommunications work is required at either:
  - Option 1: BCH control centres for implementing satellite communication channels or;
  - Option 2: BLW station and BCH control centres for implementing a leased line for SCADA communication channels.

The key items that the IC is responsible for are listed below:

Quesnel River Pulp Station (QRP)

- Primary (PY) and Standby (SY) line protection for circuit 2L307 shall be provided;
- Standalone high voltage Capacitor Voltage Transformers (CVTs) are required;
- The proposed generation must be switched off-line when internal load levels fall below 30 MW;
- The IC is required to provide continuous Supervisory Control and Data Acquisition (SCADA) access from QRP to a BCH Control Centre via either satellite or leased line;
- Out-of-step protection is required at the QRP generator in order to isolate the unit from the BCH system for unexpected contingencies that can cause the generator to slip. The swing centre is expected to be within the IC's facilities.

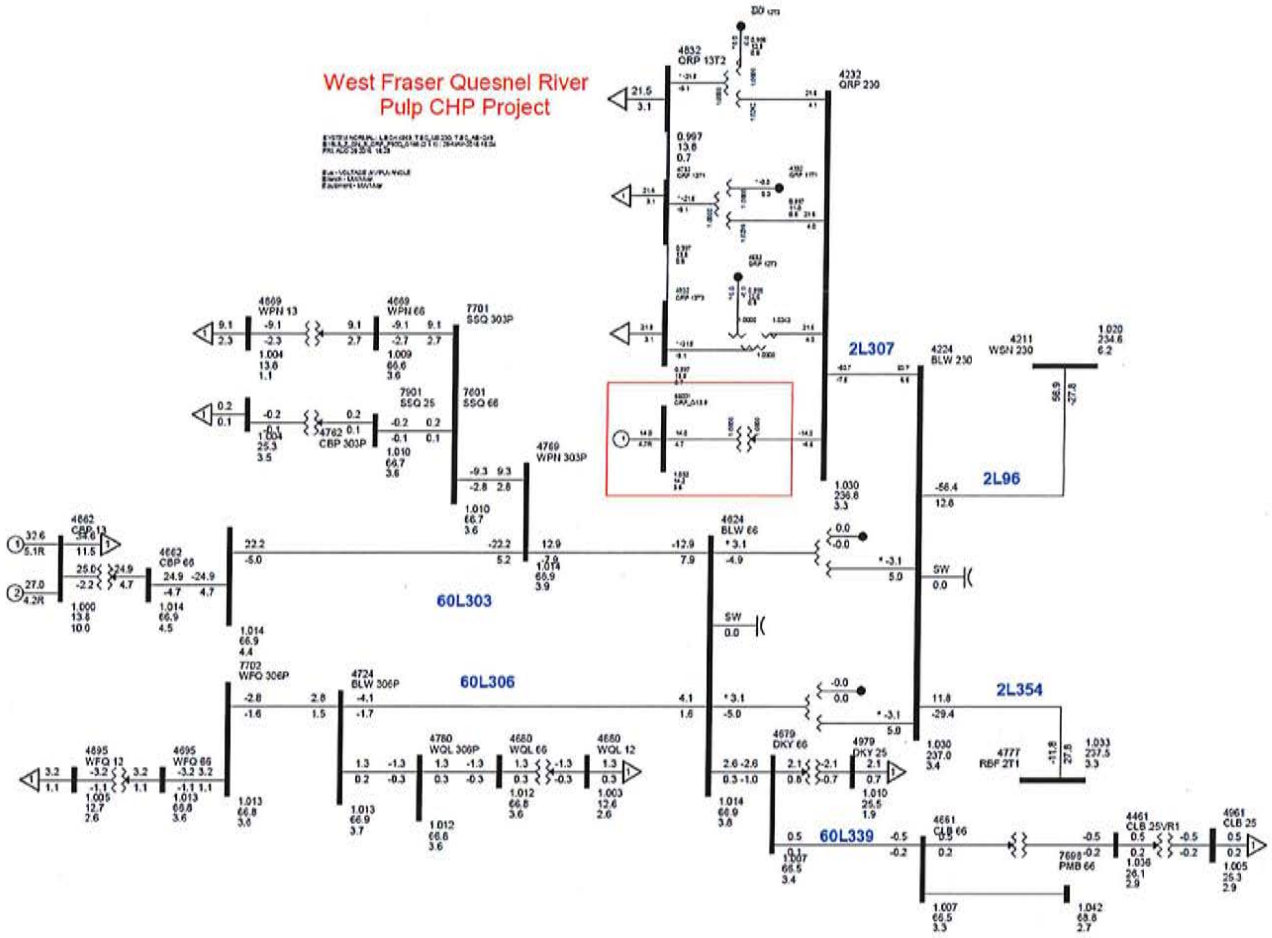
The IC is not allowed to supply an islanded region which includes other BCH customers. The likelihood of this scenario occurring is extremely low and therefore, Power Quality protection is not needed. The IC may, however, choose to operate in a localized islanded mode only within its own facilities with the requirement that no power can be back-fed into the BCH system at any time, i.e. QRP entrance breaker 2CB12 is open when operating as a local island.

The non-binding, good faith, cost estimate for the above Network Upgrades is $483.5k (for Option 1 – leased line) or $500.4k (for Option 2 – satellite). The estimated time to implement the identified work is up to 6 months.

The above estimate and schedule do not include the work associated with Revenue Metering nor does it include the work required within the IC's facilities. The work required within the IC facilities is not part of this estimate and schedule. Within the QRP facility, the IC is required to provide protection in accordance with "60 kV to 500 kV Technical Interconnection Requirements for Power Generators."

Additional Network Upgrade requirements may be identified in the Facilities Study (FS) stage. The Interconnection FS report will provide greater details of the Interconnection Network Upgrade requirements and associated cost estimates and estimated construction timeline for this project.

APPENDIX A – AREA SINGLE – LINE DIAGRAM



APPENDIX B – DYNAMICS DATA

Generator Model (GENROU): G1 (17.5 MVA)

Unit	T'do	T"do	T'qo	T"qo	H	D	Xd	Xq	X'd	X'q	X"d	Xl	S1.0	S1.2
G1	8.187	0.082	1.42	0.081	3.56	0	2.012	0.928	0.166	0.928	0.133	0.095	0.075	0.327

Excitation System Model (ESAC8B): G1 (17.5 MVA)

Unit	T_R	K_P	K_I	K_D	T_D	K_A	T_A	V_{RMAX}	V_{RMIN}	T_E	K_E	E_1	S_{E1}	E_2	S_{E2}
G1	0.005	30	25	5	0.01	1	0	9.51	0	0.212	1	4.76	0.05	6.34	0.5

APPENDIX C – REVENUE METERING

Revenue class meters approved and sealed by Measurement Canada (MC) shall be installed on the output of the generator. As per federal regulations, the meter should be periodically removed and re-verified in a MC authorized laboratory. The CTs and VTs used on the metering scheme shall also be of a model/type approved by Measurement Canada. The location of the Point-of-Metering (POM) is subject to approval by BC Hydro's Revenue Metering department. The planning, design, installation and commissioning of the point of metering should be coordinated between the power generator and BC Hydro's Revenue Metering Department. The responsibilities and charges between the Interconnection Customer and BC Hydro shall be in accordance with Section 10 (10.1 and 10.2) of BC Hydro's Requirements for Complex Revenue Metering. For a complete list of tasks, see table on pages 23-25.

All meters will be supplied and maintained by BC Hydro. Main and backup meters will use the same CTs and VTs secondaries and shall not share the secondary with any other equipment. The meter will be leased to the Interconnection Customer by BC Hydro. The revenue class instrument transformers (CTs and VTs units) will be supplied by the Interconnection Customer and must be a MC approved model. A list of approved models is available at the MC website under "Notice of Approval Database Section". The remotely read load profile revenue metering equipment should be in accordance with BC Hydro's Requirements for Complex Revenue Metering. The latest version of this document is published at the BC Hydro webpage under Forms and Guides.

Main and backup bi-directional load profile interval meters are required to measure the power received and the power delivered by BC Hydro (BCH) during each 30 minute time period. The meters will be programmed for 5 minute intervals and will be remotely read each day by the BCH Enhanced Billing Group using MV-90 software. The POM requires a dedicated communications line that is provided by the Customer. This line should be available on the meter cabinet and it is for revenue metering use only. The communication line provided could be a protected landline or a wireless alternative approved by BC Hydro. The landline should be installed in accordance with *"IEEE Standard 487 Guide for the Protection of Wire-Line Communication Facilities Serving Electric Power Stations".* If there is digital cellular phone coverage for data (IP), due to IT security reasons, BC Hydro will supply the wireless communications equipment at an incremental cost to the Interconnection Customer.

A *3*--element metering scheme with 3 CTs and 3 VTs connected L-N (Grd) will be used when the POM is located on the BC Hydro side of the power transformer. If the POM is located on the low side of the power transformer (Power Generator side of the power transformer) and the Power Generator (PG) installation is a three phase, three wire, delta connection, or a three phase, four wire, WYE with a **resistance or impedance grounded neutral** (treated as a DELTA connection), a *2*-element metering scheme with 2 CTs and 2 VTs connected L-L will be used instead.

For generation applications, all instrument transformer compartment doors shall be **key interlocked** with a BC Hydro side disconnect device and an Interconnection Customer side disconnect device(s). The key interlocks shall prevent opening instrument transformer compartment door(s) unless all disconnect devices are visibly open. *Where the POM is on the* Interconnection Customer *side of the power*

transformer, the BC Hydro side disconnect device shall be on the BC Hydro side of the power transformer to insure no-load losses.

If the impedance and losses between the POM and the PODR are significant, the meters will be programmed to account for the line and/or transformer losses between the POM and PODR. The Interconnection Customer shall provide the line parameters data and the power transformer testing report data signed and stamped by a professional engineer.

Where two or more Interconnection Customers or one Interconnection Customer with more than one generating station/generator share a private power line to connect to the BCH system, a main POM located in the Point-of-Interconnection (POI) will be required, as well as an individual POM on each one of the generating stations/generators.

During the planning phase, BC Hydro's Revenue Metering Department should be contacted to discuss costs and specifics of the project. The Interconnection Customer should prepare and submit drawings showing the single line diagram (SLD), station lay-out and informing the proposed metering scheme, the length of the secondary cables needed (between CT/VT and the meter cabinet), meter cabinet location, CTs and VTs location, model/maker, connections, and MC Approval numbers, as well as any other related documentation.

Information required in the design stage includes:

- Length of secondary cables
- CT and VT models and approvals from Measurement Canada and if they come with a second set of secondaries
- Single Line Diagram showing CTs, VTs, cabinets, all generating stations connecting to the POI
- Identify whether revenue metering cabinets are indoors or outdoors - implication on whether cabinets need to be insulated
- Communication medium contemplated to relay revenue metering data
- 3-line diagram of the interconnection of the revenue metering CT & VT
- Scaled Site Plan showing the relative location of the meter cabinet to the CT & VT (drawing showing the footprint for the sub)
- Private power line parameters data and/or the power transformer testing data signed and stamped by a professional engineer
- A set of manufacture switchgear drawings showing the installation of the revenue metering CT & VT (ensure the installation of the metering CT & VT complies with section 5.4 of BCH Requirements for Remotely Read Load Profile Revenue Metering, published at BCH website)
- A simplified version of the lockout access steps to the revenue metering CT & VT (if already available)
- Verification of dedicated 120V AC 15A circuit for the meter cabinet - as per section 6.4 of BCH requirements
- Contact name/phone on site for equipment/material delivery.
- Royal Mailing Address for the site (normal mailing address)

- Interconnection Customer Billing Information
- A copy of Measurement Canada issued Certificate of Registration for the Interconnection Customer
- Operational Site Access for BC Hydro Meter Tech (for metering installation, maintenance, etc.)

The BC Hydro's Revenue Metering department can be contacted at: metering.revenue@bchydro.com

