System Impact Study

Long Term Point-To-Point OASIS Request
AREF: 98379860, 98379861, 98379862
On the GMS.MCA.REV to BC.US.BORDER Path

October 1, 2023 to October 1, 2030

BC Hydro EGBC Permit to Practice No: 1002449

Revision 1

Report No: Transmission Planning 2023-012
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For signing 2023 LTFPTP SIS report only

2023-04-21

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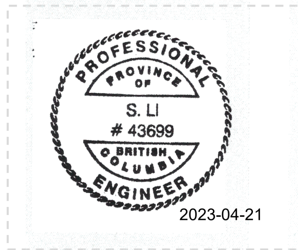

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Executive Summary

Pursuant to BC Hydro OATT Section 19, three 500 MW of Long Term Firm Point-to-Point (LTFPTP) transmission service requests (TSRs) with OASIS AREF# 98379860, #98379861 and #98379862 have been studied:

OASIS #	98379860	98379861	98379862
Point of Receipt	GMS.MCA.REV	GMS.MCA.REV	GMS.MCA.REV
Point of Delivery	BC.US.BORDER	BC.US.BORDER	BC.US.BORDER
Amount Requested	500 MW	500 MW	500 MW
Start Time	2023-10-01	2024-06-01	2024-06-01
Stop Time	2028-10-01	2029-10-01	2030-10-01
Term	5 Years	5 Years 4 Months	6 Years 4 Months
Submission Date	2022-11-22	2022-11-22	2022-11-22

This SIS concludes the following with reference to the BCH transmission system:

1. The 500 MW Service with OASIS AREF# 98379860 cannot be accommodated in whole as Long Term Firm transmission service without system upgrades.
2. To accommodate full 500 MW of LTFPTP Transmission Service, the 5L41 series capacitor at station CHP needs to be upgraded to a continuous rating of 3000 A. However, upon a high-level assessment, the possible earliest in-service date (ISD) of this system upgrade is beyond the Stop Time of the request. Therefore, a full accommodation of the 500 MW LTFPTP service is not granted for the entire service period requested.
3. 370 MW of LTFPTP Partial Service with OASIS AREF# 98379860 can be accommodated without the necessary system upgrades identified in this study.
4. There is insufficient capacity to accommodate a roll-over right after the initial Partial Service period is due.

A separate document entitled Evaluation of Conditional Firm Service (CFS) determines the remaining capacity that can be granted to the OASIS AREF# 98379860, # 98379861 and # 98379862 and the associated rollover rights. For the purpose of administering CFS, the Transmission Customer will need to create a new TSR that has the same attributes as TSR 98379860, with the exception of 130 MW as the requested capacity.

BC Hydro (Transmission Provider) will tender a Service Agreement for Partial Service of 370 MW to the Transmission Customer on April 21, 2023. The Transmission Customer must respond to the Transmission Provider within 15 days, by May 6, 2023 with an executed Service Agreement for Partial Service, should the Transmission Customer elect to take partial service.

ACRONYMS

The following are acronyms used in this report for BC Hydro’s three letter codes and the planning regions.

GMS	Gordon M. Shrum Generating Station
PCN	Peace Canyon Generating Station
STC	Site C Generating Station
WSN	Williston Substation
KLY	Kelly Lake Substation
MDN	Meridian Substation
CKY	Cheekye Substation
ING	Ingledow Substation
NIC	Nicola Substation
CUS	Custer Substation in US
REV	Revelstoke Generating Station
MCA	Mica Creek Generating Station
ACK	Ashton Creek Substation
SEL	Selkirk Substation
VAS	Vaseaux Lake Substation
CHP	Chapmans Series Capacitor Station
CRK	Creekside Series Capacitor Station
AMC	American Creak Series Capacitor Station

NI	North Interior
SI	South Interior
LM	Lower Mainland
LMVI	Lower Mainland and Vancouver Island

LTFPTP	Long Term Firm Point-to-Point Transmission Service
OATT	Open Access Transmission Tariff

1. Introduction

Pursuant to BC Hydro Open Access Transmission Tariff (OATT) Sections 17.1, 17.2, and 17.3, the Transmission Service Requests (TSRs) with OASIS AREF# 98379860, 98379861 and 98379862 were submitted by the Transmission Customer, BC Hydro Power Supply (BCPS), to the Transmission Provider, British Columbia Hydro and Power Authority (BC Hydro). The requests were accepted and deemed complete. An excerpt of the key information is as follows, with the full details shown in Appendix A.

Table 1-1: OASIS AREF 98379860, 98379861 and 98379862

OASIS #	98379860	98379861	98379862
Point of Receipt (POR)	GMS.MCA.REV	GMS.MCA.REV	GMS.MCA.REV
Point of Delivery (POD)	BC.US.BORDER	BC.US.BORDER	BC.US.BORDER
Amount Requested	500 MW	500 MW	500 MW
Start Time	2023-10-01	2024-06-01	2024-06-01
Stop Time	2028-10-01	2029-10-01	2030-10-01
Term	5 Years	5 Years 4 months	6 Years 4 months
Submission Date	2022-11-22	2022-11-22	2022-11-22

In accordance with the BC Hydro OATT Sections 19.1 and 19.2, BC Hydro (Transmission Provider) determined that a System Impact Study (SIS) was needed to accommodate the service that was requested by BCPS (Transmission Customer) on November 11, 2022, and subsequently a System Impact Study Agreement was executed on December 15, 2022.

It can be observed from Table 1-1 that each of the three TSRs requests a 500 MW power transfer along the same delivery path with a different but overlapping service period. A previous SIS was performed in 2022 for a similar TSR with a 700 MW transfer along the same delivery path for a service period between Oct 2022 and Oct 2027, and concluded that:

- The 700 MW Service cannot be accommodated in whole as Long Term Firm transmission service without system upgrades.
- A less than 500 MW LTFPTP Partial Service from GMS.MCA.REV to BC.US.BORDER can be accommodated without the necessary system upgrades identified in the 2022 SIS report.

With the new TSR submission, the Transmission Customer also indicated that they would not want to execute a Service Agreement with required system upgrades. Thus, this SIS is mainly to determine the amount of a Partial Service that can be offered in response to the first TSR with OASIS AREF# 98379860. A separate document entitled Evaluation of Conditional Firm Service (CFS) determines the remaining capacity that can be granted to the OASIS AREF# 98379860, # 98379861 and # 98379862.

This SIS evaluates the incremental impact of the 500 MW export on the BC Hydro transmission grid. This 500 MW export is in addition to the current transmission commitments, which includes:

- The Network Integration Transmission Service (NITS) that serves the domestic loads.
- The pre-existing Long Term Firm Point-to-Point (LTFPTP) transmission service agreements

The current transmission commitments above have been accommodated to meet, in addition to applicable planning standards, the requirements as specified in BC Hydro's Generation Dispatch in Transmission Planning (GDTP) Guideline, which was filed with BCUC in BC Hydro's 2021 Integrated Resource Plan Application Appendix H-3, section 2[1].

[1] The GDTP Guideline suggests that there is no immediate need to expand the transmission system to deliver the system surplus generation to serve the loads, which sets out the minimum transmission capability under a range of system conditions. In compliance with the GDTP requirements, generation re-dispatch after single system contingencies become necessary to adequate serve the current transmission commitments and the 500 MW LTFPTP service for the first TSR in this request. See pages 1282 to 1290 of PDF: https://docs.bcuc.com/Documents/Proceedings/2021/DOC_65194_B-1-BCH-IntegratedResourcePlan-Public.pdf

The study outcomes indicate whether the 500 MW requested in the TSR # 98379860 can be granted without system reinforcements; if system reinforcements are required for a full service, how much partial Long Term Firm Point-to-Point transmission service can be made available for the period requested in the TSR # 98379860 before system reinforcements will be added, and whether a roll-over right can be offered after the initial Partial Service period is due.

2. Study Scope

The SIS only determines, under specified assumptions and limitations, whether 500 MW of transmission capacity is available, and if not, the network upgrades will be needed to provide that transfer capacity for the duration of the transmission service request. The SIS does not determine nor guarantee the availability of generation resources should a transmission service agreement be executed. It is up to the Transmission Customer (BCPS) of the executed Service Agreement to provide the generation resources.

In accordance with the System Impact Study Agreement and BC Hydro OATT Section 19.3, this System Impact Study identifies the following to accommodate the Transmission Service Request:

- any transmission system constraints
- necessary Network Upgrades to accommodate the first TSR in full
- amount of partial service to be offered should the full amount of the request cannot be accommodated with no upgrade
- availability of a roll-over right of the partial service to be offered

A separate document entitled Evaluation of Conditional Firm Service (CFS) determines the remaining capacity that can be granted to the OASIS AREF# 98379860, # 98379861 and # 98379862 and the rollover rights associated. Note that the study analyzed the BCH System only. A study of transfer limits in the neighboring systems is not within the scope of this study. **Customers requesting these services are responsible for obtaining transmission service from the neighboring Transmission Service Providers.**

3. Planning Criteria and Study Methodology

3.1. Planning Standards and Criteria

BC Hydro follows the general methodology outlined in BC Hydro's OATT Attachment D, *Methodology for Completing a System Impact Study*, as shown in Appendix B of this report.

BC Hydro performs this SIS to determine the impact of the requested transmission service on the BC Hydro transmission System in accordance with the following standards and criterion.

1. NERC Standard TPL-001-4 Standard
2. WECC Criterion TPL-001-WECC-CRT-3.2

To supplement the planning standard and criteria, BC Hydro's TPL-001-4 Study Methodology documents (Report No: T&S-Planning 2020-003 and T&S-Planning 2020-004) are also used in this SIS.

This SIS reviews the limiting factors including branch loading, voltage performance, voltage stability and transient stability limits under both normal and contingency conditions.

This SIS considers the following categories of contingencies:

- System normal or N-0 (Planning Event P0 in TPL-001-4)
- Single contingencies or N-1 (Planning Events P1 and P2 in TPL-001-4)
- Multiple contingencies (Planning Events P3 to P7 in TPL-001-4)

3.2. Generation Dispatch Methodology

In addition to the above NERC standard and the WECC criterion, the BC Hydro's Generation Dispatch in Transmission Planning (GDTP) Guideline is adopted for setting up the generation dispatch scenarios, which is used in the study for this Transmission Customer.

The GDTP Guideline specifies the generation dispatch scenarios that need to be implemented for three types of cut-planes, i.e., source, network, and load cut-planes. The ones of interest for this SIS are the source and network cut-planes only, as follows:

Source cut-planes:

Cut-plane 1 - South of GMS/PCN

Cut-plane 2 – South of Williston

Network cut plane:

Cut plane 9 – Interior to Lower Mainland (ILM)

This SIS follows the GDTP principles listed below to set up generation dispatch scenarios for the ILM.

1. Under both N-0 and N-1 conditions, the ILM must be capable of serving the Lower Mainland and Vancouver Island (LMVI) peak load (including the firm export to US) with the specified coastal generation scenario[2].

2. Under N-0 condition, the ILM must have the capability to transfer either the maximum North Interior generation or South Interior generation from the source side to the load side.

3. Under N-1 condition, the ILM must be capable of serving the LMVI peak loads (including the firm export to US) with the following conditions:
   - for a single line outage on KLY-LM, 12% of the total generating capacity in the South Interior region is set to be out of service.
   - for a single line outage on NIC-LM, 12% of the total generating capacity in the North Interior region is set to be out of service.

Surplus generation as described in the GDTP is a key driver for the outcomes in this study. The GDTP states that when there is a surplus generating capacity, there is no immediate need to expand the transmission system to deliver that surplus generation to serve the load. That is, when the transmission system performance becomes inadequate following a contingency, generation re-dispatch from one region to another (limited up to the surplus generation capacity) can be used to mitigate the inadequacy concern. For example, if there is a constraint identified after one of the Peace-to-Williston lines is out of service, generation re-dispatch from the North Interior to South Interior region may be used to alleviate the constraint. The maximum amount of generation re-dispatch allowed is limited to the surplus generation capacity available in the BC Hydro system. Refer to Section 5.1.1 for the detailed analysis.

Table 3-1 shows the surplus generation before and after addition of the 500 MW LTFPTP transmission service in the first TSR. The pre-LTFPTP surplus generation is duplicated from the NITS Base Resource Plan (BRP) r12 used in this SIS. The post-LTFPTP surplus generation is derived by subtracting 500 MW plus the associated loss from the pre-LTFPTP surplus generation column.

Table 3-1: Surplus Generation Used in This SIS

Fiscal Year	Pre-LTFPTP Surplus Generation (MW)	Post-LTFPTP Surplus Generation (MW)
F2024	809	271
F2025	674	136
F2026	1336	799
F2027	1423	885
F2028	1323	785
F2029	1200	663

[2] For the resource plan considered in this SIS, the largest load-side generator in the LMVI area (a 275 MW unit) is turned off to create the generation dispatch scenario required in the GDTP. With the turn-off, the Planning Event P3 as defined in NERC TPL-001-4 is inherently satisfied when assessing the first single contingency.

Note that the table above pertains to the winter peak load conditions only. However, the surplus generation in summer load conditions is not available for the study purpose. It can be expected that the system surplus generation in summer is significantly higher than those listed in Table 3-1 as the summer peak load in the BC Hydro system is much lower than its winter peak by about 2000 MW. As mentioned in Section 2, it is up to the Transmission Customer to provide adequate generation resources for this transmission service request.

4. System Study Conditions

In this SIS, a range of system conditions and factors were considered when assessing the impact of the requested LTFPTP transmission service on BC Hydro's transmission system, which include, but are not limited to, relevant load forecasts, system interchanges, resource plans, generation dispatch scenarios, and in-plan transmission capital projects.

The study period mirrors the Start Time and Stop Time of the fist TSR, from October 2023 to October 2028, plus additional years as necessary. Study cases for both winter and summer are included. The winter cases represent system conditions from November to April and the summer cases represent system conditions from May to October.

4.1. Resource Plan

The study is performed based on the BC Hydro NITS Base Resource Plan (BRP) released on March 5, 2021 (referred to NITS BRP r12). The available resources in NITS BRP r12 inform the generation dispatch scenarios in this SIS.

Site C is the major capital project that will add a total of 1145 MW of generating capacity in the Peace region, and will enter service by the end of 2025.

Per the NITS BRP r12, one of MCA units is scheduled to be out of service in 2027, and another unit in 2028. It has been confirmed that the MCA outages are deferred to 2029 or later and this change to the BRP has been considered in this SIS.

4.2. Load Forecasts

The BC Hydro Dec 2020 System Reference Load Forecast and Aug 2021 Distribution Substation Load Forecast were used in this SIS. Note that the Aug 2021 Distribution Substation Load Forecast contains an improvement of power factors in comparison to previous years' load forecast.

4.3. System Interchanges

The pre-existing power interchanges (Committed Long Term Firm Point-to-Point transmission service) between the BC Hydro system and the neighboring utilities are modelled as follows:

1. BC Hydro to US (ING-CUS)[3]: 230 MW
2. Alberta to BC Hydro[4]: 0 MW
3. BC Hydro to Fortis BC[5]: 200 MW

4.4. Transmission Capital Projects

The study cases used in this SIS include all the existing transmission facilities and the in-plan transmission capital projects. Four of the in-plan transmission capital projects that are most relevant are listed below.

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[3] 50 MW is used as Transmission Reliability Margin (TRM) on the BC Hydro to US transfer path, i.e., WECC Path 3.

[4] The interchange on the BC Hydro to Alberta transfer path, i.e., WECC Path 1, is set at zero upon a coordinated arrangement by the Transmission Customer.

[5] The 200 MW net transfer from BC Hydro to Fortis BC (FBC) represents the existing firm power sale to FBC. In addition, this study model also represents firm and non-firm power wheeled through BC Hydro network (from FBC generation to FBC load centre), which has no net power exchange between the two entities.

1. **Burrard Synchronous Condensers Ceasing Operation**
   Burrard synchronous condenser station (BSY) currently has three operable units. These units are near their end-of-life and are scheduled to cease operation by winter 2025.

2. **Lower Mainland Capacitive and Reactive Power Reinforcement (LMCRPR)**
   The LMCRPR project will provide reactive power supports to the Lower Mainland system after Burrard synchronous condensers cease operation. The addition of several 230 kV shunt capacitors and reactors was included in the SIS with the following scheduled in-service date (ISD):

   - Installation of 2 x 125 MVAr of mechanically switched shunt capacitor banks at ING 230 kV Bus in Oct 2025
   - Installation of 1 x 125 MVAr of mechanically switched shunt capacitor banks at CBN 230 kV Bus in Feb 2026
   - Installation of 2 x 132 MVAr of mechanically switched shunt reactors at MDN 230 kV Bus in Feb 2026
   - Installation of 1 x 125 MVAr of mechanically switched shunt capacitor banks at MLN 230 kV Bus in Oct 2026

3. **Kelly Lake Substation (KLY) New Reactor Addition**
   KLY Synchronous Condenser (SC2) is near the end-of-life and the recommended option to replace the KLY SC2 is to install a new 75 MVA, 12 kV switchable shunt reactor at the same station. The scheduled in-service date (ISD) for the KLY new reactor is before winter 2025.

4. **Auto-Var Control Scheme Addition to Shunt Reactors**
   The shunt reactors at the Kelly Lake (KLY) and six other substations are currently manually controlled by grid operators. A capital project is initiated to place all these reactors under automatic controls to locally regulate bus voltages. The purpose of this capital project is to increase of operational efficiency and ILM path transfer capability. The scheduled in-service date (ISD) for this project is July 2024.

5. Transfer Capability and Demand Analysis

Along the path from POR at GMS.MCA.REV to POD at BC.US.BORDER, there are seven cut-planes as shown in Figure 5-1 below. These are the crossings between the following system nodes or stations:

- Cut-plane 1: South of GM Shrum (GMS) and Peace Canyon (PCN)
- Cut-plane 2: South of Williston
- Cut-plane 6: West of Ashton Creek and Selkirk
- Cut-plane 7: Mica to Nicola
- Cut-plane 8: Revelstoke to Ashton Creek
- Cut-plane 9: Interior (NIC and KLY) to Lower Mainland
- Western intertie of WECC Path 3: BC Ingledow (ING) substation to the US border (Lower Mainland to US)

Adequate transfer capabilities on each of these cut-planes shall be maintained to accommodate a specific firm transmission service request in a safe and secure manner. If a transmission service request transverses multiple cut-planes, then adequate transfer capability must exist on each of the cut-planes for the path to be considered secured. For a firm transmission service request with the POR at GMS/MCA/REV and the POD at BC-US border near Custer Substation, all of the above 7 cut-planes must have adequate transfer capability to accommodate the 500 MW Long-term Firm Point-to-Point service request before a full Transmission Service can be granted.

As described in Section 3 Planning Criteria and Study Methodology, the transfer capability is determined as per the NERC Transmission Planning Standard (TPL-001-4) and WECC performance criterion (TPL-001-WECC-CRT-3.2). Transmission constraints are identified based on branch ratings, voltage performance, voltage stability and transient stability. The system study conditions outlined in Section 4 are applied.

Among those cut-planes, the study focuses mainly on the three limiting cut-planes: Cut-plane 1 – South of GMS/PCN, Cut-plane 2 – South of Williston, and Cut-plane 9 – Interior to Lower Mainland. The analysis of the transfer capability and the committed use (or transfer demand) across each of these cut-planes are discussed in sections 5.1, 5.2, and 5.3. Other cut-planes are discussed in section 5.4.

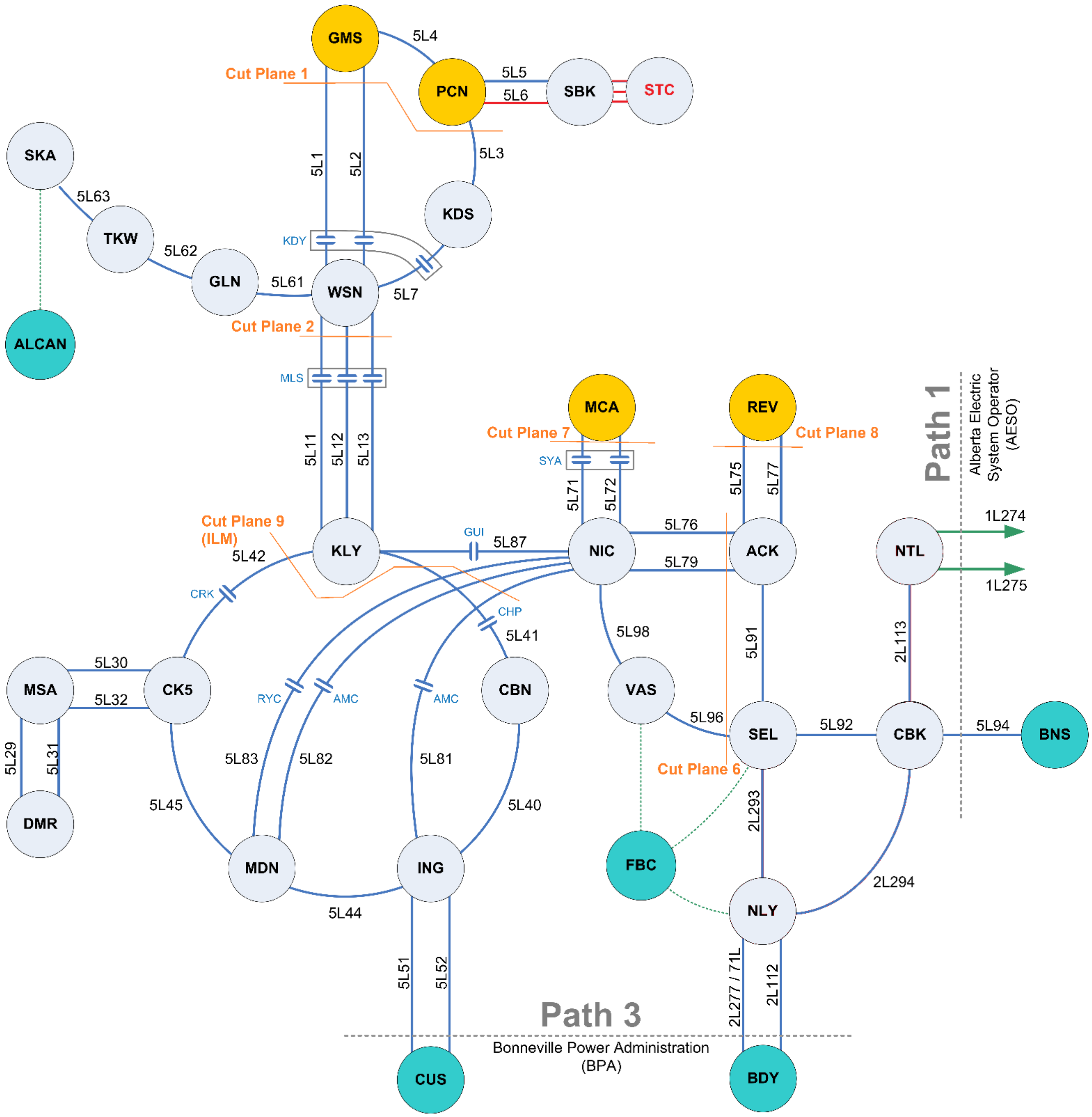

Figure 5-1: BC Hydro Grid One Line Diagram

5.1. Cut-plane 1 – South of GMS/PCN

This cut-plane crosses lines 5L1, 5L2 and 5L3. The power generated from GM Shrum (GMS), Peace Canyon (PCN) and future Site C (STC) in the Peace Region is transmitted through this cut-plane southward to Williston Substation (WSN).

The Peace Region is one of the largest power generation bases in British Columbia. The transfer demand through this cut-plane is driven by the surplus generation in this region. Higher generation and lower local load in the Peace Region yield higher transfer demand on this cut-plane, and vice versa.

In accordance with the GDTP Guideline as noted in Section 3.2, under system normal for this source cut-plane, the Peace generation needs to be dispatched to the maximum as specified in the GDTP. No system constraint was observed to serve the winter peak load in the system normal condition. Figure 5-2 shows the transfer capability and the committed use on this cut-plane under system normal.

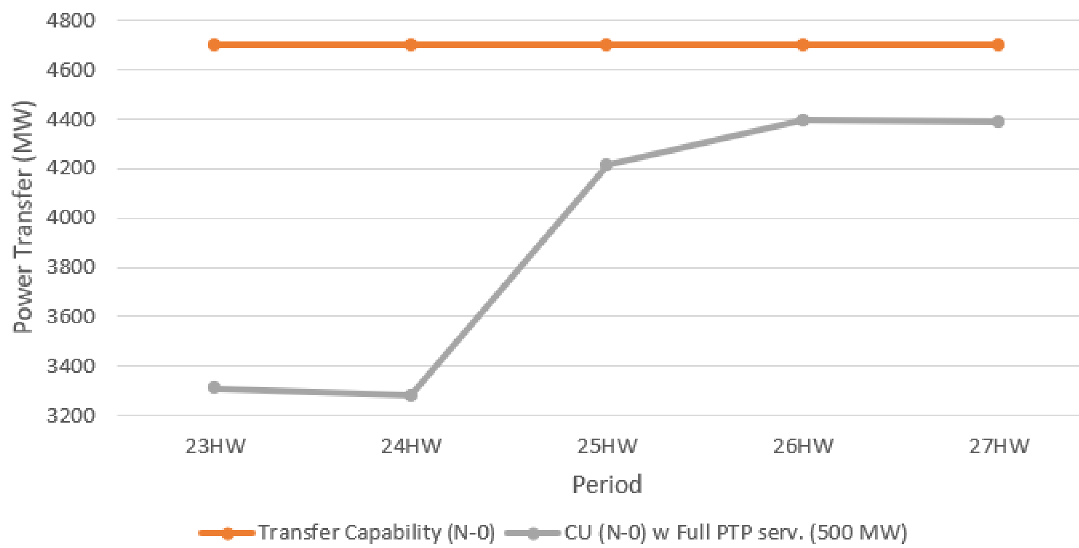

Figure 5-2: Transfer Capability and Committed Use Plot for South of GMS/PCN Cut-plane, N-0

When a single contingency occurs on one of the 500 kV lines crossing the cut-plane with the Peace generation outputs at the maximum in pre-contingency, overloading on the series capacitors of the remaining circuits (5L1, 5L2 or 5L3) were observed starting in winter 2025. As per the GDTP, there is no immediate need to expand the transmission system to address such a constraint, and instead, a part of Peace Region generation equivalent to the system surplus generation capacity can be shed to eliminate overloading on the series capacitors. The shedding amount can be made up via generation re-dispatch and delivered from South Interior after a momentary change to the system interchanges.

Figure 5-3 shows the N-1 transfer capability and the committed use on this cut-plane under a single contingency. It can be observed with Peace generation shedding or re-dispatch up to the system surplus generation capacity, the South of GMS/PCN cut-plane has adequate transfer capability to fully accommodate the 500 MW Long-Term Firm Point-to-Point transmission service in winter peak. As noted in Section 3.2, the system surplus generation capacity here refers to the post-LTFPTP values.

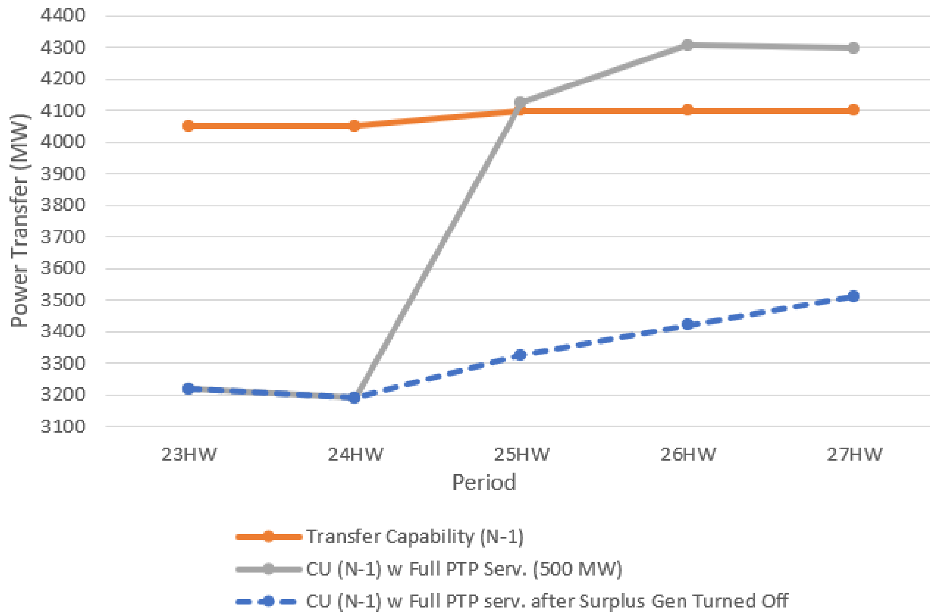

Figure 5-3: Transfer Capability and Committed Use Plot for South of GMS/PCH Cut-plane, N-1

The heavy summer load condition is the heavily stressed scenario for the South of GMS/PCN cut-plane because the summer ratings of circuits 5L1 and 5L2 are slightly lower than their winter ratings and the local load is lower in the summer, which yields higher transfer demand on the cut-plane. It is found that overloading occurs on 5L1 or 5L2 under single contingencies of the parallel lines during the 2028 heavy summer load period if the Peace generation operates at the maximum in pre-contingency (or the system scenario before the considered contingency is applied). With Peace generation shedding or re-dispatch up to the system surplus generation capacity, the South of GMS/PCN cut-plane has adequate transfer capability to fully accommodate the 500 MW Long-Term Firm Point-to-Point transmission service in summer peak.

Summer light load conditions could be more stressed for this source cut-plane after a single contingency if the Peace generation operates at the maximum in the pre-contingency. However, compared to the heavy summer cases discussed above, additional system surplus generation under light load conditions would be available to shed and re-dispatch after a contingency. Therefore, overloading in post-contingency can be mitigated adequately in the summer light load conditions.

Table 5-1 shows the South of GMS/PCN transfer capability and the expected committed use with full LTFPTP service in winter peak load scenario.

Table 5-1: South of GMS/PCN Capacity with Full LTFPTP Service in Heavy Winters

	2023 Heavy Winter	2024 Heavy Winter	2025 Heavy Winter	2026 Heavy Winter	2027 Heavy Winter
System Normal Capacity (N-0)	4700	4700	4700	4700	4700
N-1 Transfer Capability (MW)	4050 [(a)]	4050 [(a)]	4050 [(a)]	4100 [(b)]	4100 [(b)]
CU before re-dispatch (MW)	3219	3190	4125	4306	4297
CU after re-dispatch (MW)	(No re-dispatch needed)	(No re-dispatch needed)	3326	3421	3512
Full LTFPTP service can be accommodated?	Yes	Yes	Yes	Yes	Yes

Note: (a) N-1 transfer capability before Site-C generation in service.
(b) N-1 transfer capability after Site-C generation in service.

5.2. Cut-plane 2 – South of Williston

South of Williston cut-plane crosses lines 5L11, 5L12, 5L13 and 2L96. Electricity from WSN flows south through this cut-plane towards Kelly Lake substation (KLY). The resultant flow from WSN to KLY via this cut-plane depends on the generation at Peace and North Coast, and the Rio-Tinto Alcan import as well as the local load in the region.

In accordance with the GDTP Guideline, under system normal for this source cut-plane, the upstream generation needs to be dispatched to the maximum as specified in the GDTP. No system constraint was observed to serve the winter peak load in the system normal condition. Figure 5-4 shows the transfer capability and the committed use on this cut-plane under system normal.

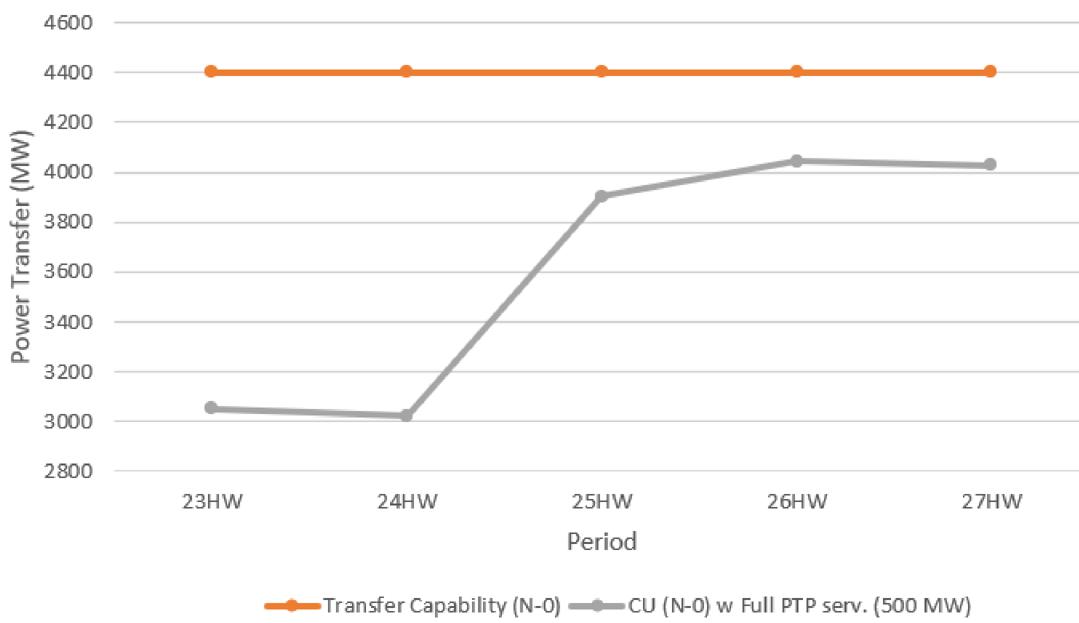

Figure 5-4: Transfer Capability and Committed Use Plot for South of Williston Cut-plane, N-0

When a single contingency occurs on one of the 500 kV lines (5L11, 5L12 and 5L13) crossing the cut-plane with the upstream generation outputs at the maximum in pre-contingency, overloading on the series capacitors of the remaining circuits (5L11, 5L12 or 5L13) were observed starting in winter 2025. A part of the upstream generation equivalent to the system surplus generation capacity is shed to eliminate overloading on the series capacitors. The shedding amount is made up via generation re-dispatch and delivered from South Interior after a momentary change to the system interchanges.

Figure 5-5 shows the N-1 transfer capability and the committed use on this cut-plane under a single contingency. After the N-1 contingency, the upstream generation including the generation in the Peace and North Coast regions can be shed or re-dispatched up to the system surplus generation for the post-LTFPTP. With the generation shedding and redispatch, the South of Williston cut-plane has adequate transfer capability to fully accommodate the 500 MW Long-Term Firm Point-to-Point transmission service in winter peak.

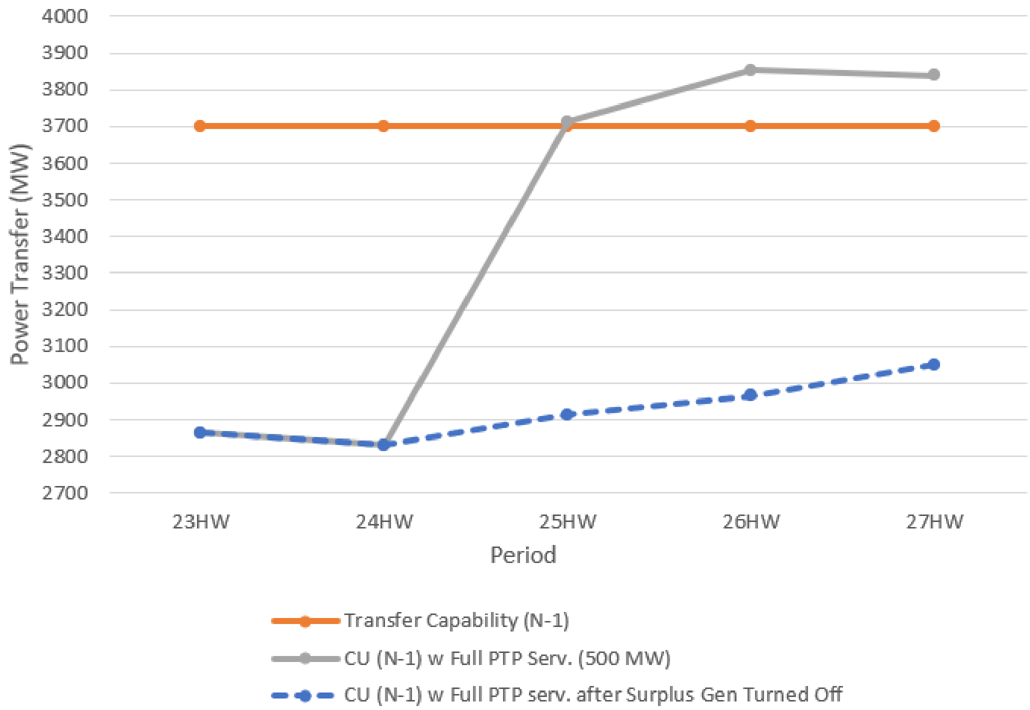

Figure 5-5: Transfer Capability and Committed Use Plot for South of Williston Cut-plane, N-1

Similar to the South of GMS/PCN cut-plane, the transfer demand on the South of Williston cut-plane is higher under heavy summer load conditions due to the lower local load in the summer. To mitigate overloading on series capacitors of 5L11, 5L12 and 5L13, a part of the upstream generation equivalent to the system surplus generation capacity is shed. The South of Williston cut-plane has adequate transfer capability to fully accommodate the 500 MW Long-Term Firm Point-to-Point transmission service in summer peak.

Summer light load conditions could be more stressed for this source cut-plane after a single contingency if the upstream generation operates at the maximum in pre-contingency. However, compared to the heavy summer cases discussed above, additional system surplus generation under light load conditions would be available to shed and re-dispatch. Therefore, the overloading in post-contingency can be mitigated adequately in the summer light load conditions.

Table 5-2 shows the South of Williston transfer capability and the expected transfer with full LTFPTP transmission service in winter peak load scenario.

Table 5-2: South of Williston Capacity with Full LTFPTP service in Heavy Winters

<table>
<tr><th></th><th>2023
Heavy Winter</th><th>2024
Heavy Winter</th><th>2025
Heavy Winter</th><th>2026
Heavy Winter</th><th>2027
Heavy Winter</th></tr>
<tr><td>System Normal Capacity (N-0)</td><td>4400</td><td>4400</td><td>4400</td><td>4400</td><td>4400</td></tr>
<tr><td>N-1 Transfer Capability (MW)</td><td>3700</td><td>3700</td><td>3700</td><td>3700</td><td>3700</td></tr>
<tr><td>CU before re-dispatch (MW)</td><td rowspan="2">2863
(No re-dispatch needed)</td><td rowspan="2">2832
(No re-dispatch needed)</td><td>3714</td><td>3853</td><td>3839</td></tr>
<tr><td>CU after re-dispatch (MW)</td><td>2913</td><td>2965</td><td>3051</td></tr>
<tr><td>Full LTFPTP service can be accommodated?</td><td>Yes</td><td>Yes</td><td>Yes</td><td>Yes</td><td>Yes</td></tr>
</table>

5.3. Cut-plane 9 - Interior to Lower Mainland (ILM)

This cut-plane is generally referred to as the ILM cut-plane, which crosses lines 5L41, 5L42, 5L81, 5L82, 5L83 and 2L90. Through this cut-plane, electricity is transmitted from the generation in both Northern Interior and South Interior to the BC provincial load centers in the Lower Mainland and Vancouver Island (LMVI), which is approximately 70% of provincial demand.

The flow through the ILM cut-plane is driven by the net load in the LMVI region including the export to the US border near Custer Substation. Decreasing the load or increasing the Coastal Generation will reduce the committed use on the ILM cut-plane.

The ILM system is fed by two sources at KLY from the generation in the Northern Interior and NIC from the generation in South Interior, respectively. The ILM system connected to these two resources is asymmetrical: there are three lines (5L81, 5L82 and 5L83) connecting NIC to Lower Mainland while two lines (5L41 and 5L42) connect KLY to Lower Mainland. With this configuration, the connection from Kelly Lake to Lower Mainland is prone to be congested under a contingency and the ILM system generally has higher transfer capability when transmitting more generation from South Interior.

In accordance with the GDTP Guideline, under system normal for the network cut-plane, the Lower Mainland and Vancouver Island loads plus the export to US may be served by either maximum Peace generation or maximum Columbia generation with specified coastal generation outputs. No system constraint was observed to serve the system winter peak in the normal operating condition. Figure 5-6 shows the transfer capability and the committed use on this cut-plane under system normal.

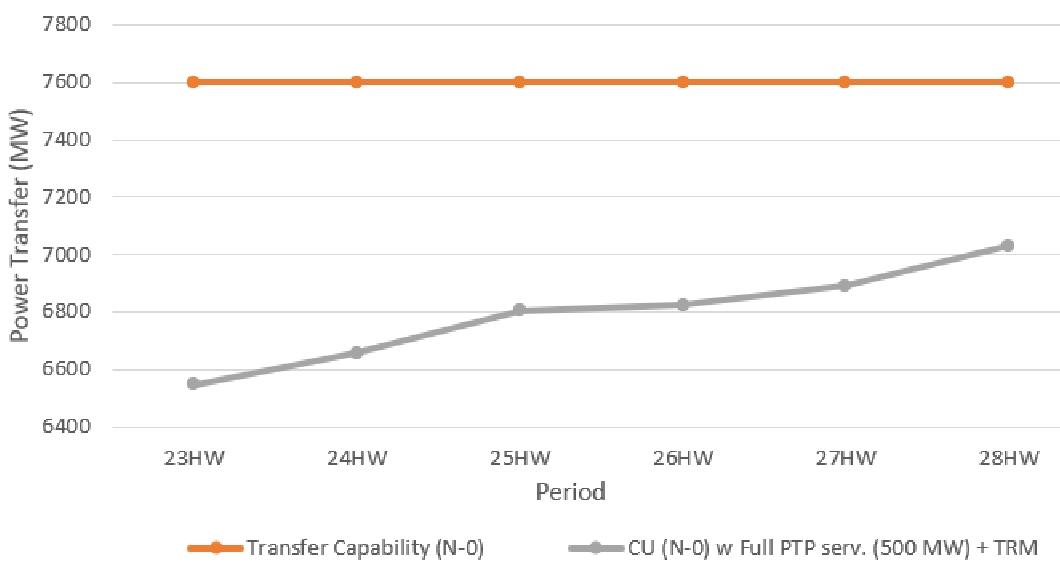

Figure 5-6: Transfer Capability and Committed Use Plot for ILM Cut-plane, N-0

When the Peace generation operates at the maximum in the heavy winter load condition, if a single contingency occurs on one of the 500 kV lines between KLY and Lower Mainland (5L41 and 5L42), overloading on the series capacitor of the remaining circuit (5L41 or 5L42) was observed. As per the GDTP, generation re-dispatch from the Peace region to the Columbia region is used to alleviate the overloading as long as adequate reserve can be maintained in the Columbia generation.

When the Columbia generation operates at the maximum in the heavy winter load condition, if a single contingency occurs on the 500 kV line between NIC and lower Mainland (5L83), overloading on the series capacitor of the circuit (5L81 and 5L82) were observed before generation re-dispatching. Generation re-dispatch from the Columbia region to the Peace region is used to alleviate the overloading as long as adequate generation reserve can be maintained in the Peace generation per the GDTP.

The SIS identified the thermal constraints on the ILM cut-plane with full 500 MW LTFPTP transmission service starting from 2025 heavy winter. This thermal constraint is limited by the continuous ratings of the series capacitor on 5L41 when an outage occurs on one of ILM

500 kV lines followed by required generation re-dispatch. To accommodate the 500MW export in full, the 5L41 Series Capacitor at CHP will need to be uprated to have a continuous rating of 3000 A.

Without the rating upgrade, only partial LTFPTP transmission service can be accommodated from 2025 winter onwards.

Given the summer rating and winter rating of series capacitors are the same, the most stressed system condition for the ILM cut-plane is the winter peak load cases. The summer load in LMVI is much lower than winter peak load, which results in lower transfer and more capacity for LTFPTP transmission service on the ILM cut-plane. Thus, only winter peak load cases are discussed in the report.

The cut-plane capability under a single contingency and the expected CU with full and partial LTFPTP service are shown in Figure 5-7, Table 5-3 and Table 5-4.

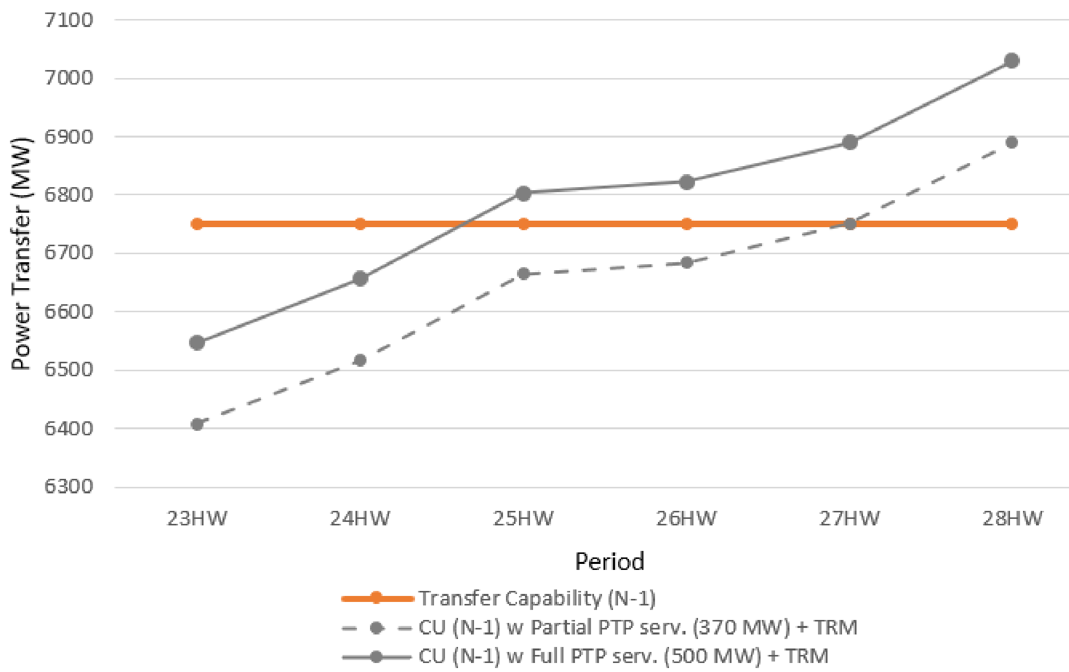

Figure 5-7: Transfer Capability and Committed Use Plot for ILM Cut-plane, N-1

Table 5-3: ILM Cut-plane Capacity with Full LTFPTP Service

	2023 Heavy Winter	**2024 Heavy Winter**	**2025 Heavy Winter**	**2026 Heavy Winter**	**2027 Heavy Winter**
N-1 Transfer Capability (MW)	6750 (a)	6750 (a)	6750 (a)	6750 (a)	6750 (a)
CU with full LTFPTP service +TRM(b) (MW)	6546	6656	6803	6822	6890
Full LTFPTP service can be accommodated?	Yes	Yes	**No**	**No**	**No**

Note: (a) Generation re-dispatch is applied for transmission capability determination.

(b) 50 MW of Transmission Reliability Margin (TRM) on the BC Hydro to US transfer path is included

Table 5-4: ILM Cut-plane Capacity with Partial LTFPTP Service

	2023 Heavy Winter	2024 Heavy Winter	2025 Heavy Winter	2026 Heavy Winter	2027 Heavy Winter
N-1 Transfer Capability (MW)	6750 [(a)]	6750 [(a)]	6750 [(a)]	6750 [(a)]	6750 [(a)]
CU with 370 MW Partial LTFPTP service +TRM[(b)] (MW)	6407	6517	6664	6683	6750
370 MW Partial LTFPTP service accommodated?	Yes	Yes	Yes	Yes	Yes

Note: (a) Generation re-dispatch is applied for transmission capability determination.

(b) 50 MW of Transmission Reliability Margin (TRM) on the BC Hydro to US transfer path is included

5.4. Other Cut-planes

The transfer capability of other cut-planes is also investigated in the study. Those cut-planes have adequate transfer capability to accommodate the 500 MW LTFPTP transmission service in full for the entire requested period therefore no details are discussed in the report.

Those cut-planes include:

- West of Ashton Creek and Selkirk (Cut-plane 6)

  This cut-plane crosses lines 5L96, 5L76 and 5L79. Power from Ashton Creek Substation and Selkirk Substation flows through this cut-plane westward to NIC Substation.

- Mica to Nicola (Cut-plane 7)

  Mica to Nicola cut-plane crosses lines 5L71 and 5L72. Power from Mica generating station (MCA) flows through this cut-plane to NIC Substation.

- Revelstoke to Ashton Creek (Cut-plane 8)

  Revelstoke to Ashton Creek cut-plane crosses lines 5L75 and 5L77. Power from Revelstoke generating station (REV) flows through this cut-plane to Ashton Creek Substation (ACK).

- BC ING to US border (Lower Mainland to US), which is the western tie of WECC Path 3

5.5. Transfer Analysis Results

The transfer capabilities established in sections 5.1 to 5.4 are associated with transmission constraints identified under either system normal or single contingency conditions. To supplement these results, this SIS includes a high-level assessment of multiple contingencies and extreme events under selected scenarios. The assessment indicates that BC Hydro's transmission system performance under those contingencies meets the requirements under the NERC Planning Standard[6]. As such, the transfer capabilities established in sections 5.1 to 5.4 remain valid under all contingencies and scenarios studied.

[6] In accordance with NERC TPL-001-4 Table 1, non-consequential load loss and interruption of firm transmission services are allowed to meet the system performance requirement for certain categories of planning events.

Table 5-5 below shows whether the requested LTFPTP service with TSR 98379860 can be fully accommodated through each of the 7 cut-planes from the GMS.MCA.REV to BC.US.BORDER.

Table 5-5: LTFPTP Accommodated Across Cut-planes

	2023 Oct. – 2024 Oct.	2024 Nov. – 2025 Oct.	2025 Nov. – 2026 Oct.	2026 Nov. – 2027 Oct.	2027 Nov. – 2028 Oct.
South of GMS/PCN (Cut-plane 1)	Full	Full	Full	Full	Full
South of Williston (Cut-plane 2)	Full	Full	Full	Full	Full
West of Ashton Creek and Selkirk (Cut-plane 6)	Full	Full	Full	Full	Full
Mica to Nicola (Cut-plane 7)	Full	Full	Full	Full	Full
Revelstoke to Ashton Creek (Cut-plane 8)	Full	Full	Full	Full	Full
Interior to Lower Mainland (Cut-plane 9)	Full	Full	Partial (440 MW)	Partial (410 MW)	Partial (370 MW)
BC to US border (Lower Mainland to US)	Full	Full	Full	Full	Full

The key results are summarized below.

- The ILM cut-plane is the bottleneck for a full accommodation of the 500 MW LTFPTP transmission service.
- Without the rating upgrade of the 5L41 series capacitor, a full 500 MWLTFPTP transmission service cannot be accommodated starting 2025 winter onwards. Only a Partial Service of 370 MW can be accommodated for the 5-year period between October 2023 and October 2028, per the Start Time and Stop Time of TSR 98379860.
- With the continuous rating upgrade to 3000 A of the series capacitor on 5L41 at CHP, the requested 500 MW export can be fully accommodated. Refer to Section 6 for the detail.

In addition, this study finds that there is insufficient capacity to accommodate a roll-over right for the 370 MW Partial Service of TSR 98379860. The future load growth in LMVI and the expected reduction of the system surplus generation will have additional negative impact on a rollover right of the partial service after October 2028.

6. Network Upgrades

Table 6-1 below shows the network upgrade needed to accommodate TSR 98379860 in full.

Table 6-1: Network Upgrades Identified in this SIS

Upgrade Required	Details
To uprate the 5L41 series capacitor (SC): • 5L41 SC (CHP) upgrade to a continuous rating of 3000 A.	The earliest in-service date (ISD) is beyond the Stop Time of the request upon a high-level assessment. A full accommodation of the requested 500 MW export can be achieved upon completion of series capacitor rating upgrades.

7. Conclusions

This SIS concludes the following with reference to the BCH transmission system:

1. The 500 MW Service with OASIS AREF# 98379860 cannot be accommodated in whole as Long Term Firm transmission service without system upgrades.
2. To accommodate full 500 MW of LTFPTP Transmission Service, the 5L41 series capacitor at CHP needs to be upgraded to a continuous rating of 3000 A. However, the possible earliest in-service date (ISD) of this system upgrade is beyond the Stop Time of the request upon a high-level assessment. Therefore, a full accommodation of the 500 MW LTFPTP service is not granted for the entire service period requested.
3. 370 MW of LTFPTP Partial Service with OASIS AREF# 98379860 can be accommodated without the necessary system upgrades identified in this study.
4. There is insufficient capacity to accommodate a roll-over right after the initial Partial Service period is due.

A separate document entitled Evaluation of Conditional Firm Service (CFS) determines the remaining capacity that can be granted to the OASIS AREF# 98379860, # 98379861 and # 98379862 and the rollover rights associated. For the purpose of administering CFS, the Transmission Customer will need to create a new TSR that has the same attributes as TSR 98379860, with the exception of 130 MW as the requested capacity.

BC Hydro (Transmission Provider) will tender a Service Agreement for Partial Service of 370 MW to the Transmission Customer on April 21, 2023. The Transmission Customer must respond to the Transmission Provider within 15 days, by May 6, 2023 with an executed Service Agreement for Partial Service, should the Transmission Customer elect to take partial service.

Appendix A: TSR 98379860, 98379861, 98379862

TSR 98379860 - Profile 1 - Microsoft Edge

https://www.oasis.oati.com/webSmartOASIS/TransmissionReservationDetail?TSRID=31071353&AREF=98379860&TP=BCHA&FromHistory=0&overrideTimeZone=PD

Transmission Reservation Detail [AREF : 98379860] - [RECEIVED] [ORIGINAL] (All times are in PD) PD

Status Flow & Actions

TSR Information

TP	Seller	Customer	POR	POD	Path	Start Time	Stop Time	MW Req	MW Grant
			Source:		**Request Type:** ORIGINAL				
BCHA	BCHA	BCPS	GMS.MCA.REV	BC.US.BORDER	W/BCHA/BCHA-BPAT/GMS.MCA.REV-BC.US.BORDER/	2023-10-01 00:00 PD	2028-10-01 00:00 PD	500	
			Sink:		**Service Code:** YRLY_FIRM_PTP_EXTENDED				

Reservation Profile

Start Time	Stop Time	MW Req	MW Grant	MWH	Bid Price	Offer Price	Extension Flag
2023-10-01 00:00 PD	2028-10-01 00:00 PD	500		21924000.00	$83461.0000		0
			Profile Total:	21924000.00			

Service Details

Preconfirmed	Increment	Class	Type	Period	Window	Subclass	Nerc Priority	Ceiling Price	Price Unit
NO	YEARLY	FIRM	POINT_TO_POINT	FULL_PERIOD	EXTENDED		7	$83461.0000	$CDN/MW-Y

Comments

Status	Seller	Provider	Customer
	Not enough ATC. ATC pending on higher queued.		

Additional Information

Competing Request Flag:		**Related:**		**Provider Approval:**	
Negotiated:		**Reassigned:**		**Provisions:**	
Affiliate:	NO	**Sale:**		**Rollover Waived:**	
Impacted:	0	**Request:**		**CG Status:**	
Effective Queued Time:		**Seller:**		**CG Deadline:**	
Queued:	2022-11-22 09:02:46 PS	**Deal:**		**Concomitant Eval Flag:**	
Updated:	2022-11-22 09:03:26 PS	**Posting:**		**Status Notification:**	
Response:		**SIS:**	NO		
Unconditional:				**Service Update Flag:**	0

Customer/Seller Information

Type	Entity	Name	Phone	Email	Fax
Customer	BCPS	Brian_Samson	(604) 895-7047	joseph.mikawoz@powerex.com	(604) 891-5056
Seller	BCHA	BCHA_WEBTRANS			

Audit Statuses

Time Of Last Update	Modifying Company Code	Modifying Name	Status
2022-11-22 09:02 PS	BCPS	Brian_Samson	QUEUED
2022-11-22 09:03 PS	BCHA	BCHA_WEBTRANS	RECEIVED

TSR 98379861 - Profile 1 - Microsoft Edge

https://www.oasis.oati.com/webSmartOASIS/TransmissionReservationDetail?TSRID=31071354&AREF=98379861&TP=BCHA&FromHistory=0&overrideTimeZone=PD

Transmission Reservation Detail [AREF : 98379861] - [RECEIVED] [ORIGINAL] **(All times are in PD)** PD

Status Flow & Actions

TSR Information

TP	Seller	Customer	POR	POD	Path	Start Time	Stop Time	MW Req	MW Grant
			Source:		**Request Type:** ORIGINAL				
BCHA	BCHA	BCPS	GMS.MCA.REV	BC.US.BORDER	W/BCHA/BCHA-BPAT/GMS.MCA.REV-BC.US.BORDER/	2024-06-01 00:00 PD	2029-10-01 00:00 PD	500	
			Sink:		**Service Code:** YRLY_FIRM_PTP_EXTENDED				

Reservation Profile

Start Time	Stop Time	MW Req	MW Grant	MWH	Bid Price	Offer Price	Extension Flag
2024-06-01 00:00 PD	2029-10-01 00:00 PD	500		23376000.00	$83461.0000		0
			Profile Total:	23376000.00			

Service Details

Preconfirmed	Increment	Class	Type	Period	Window	Subclass	Nerc Priority	Ceiling Price	Price Unit
NO	YEARLY	FIRM	POINT_TO_POINT	FULL_PERIOD	EXTENDED		7	$83461.0000	$CDN/MW-Y

Comments

Status	Seller	Provider	Customer
	Not enough ATC. ATC pending on higher queued.		

Additional Information

Competing Request Flag:		**Related:**		**Provider Approval:**	
Negotiated:		**Reassigned:**		**Provisions:**	
Affiliate:	NO	**Sale:**		**Rollover Waived:**	
Impacted:	0	**Request:**		**CG Status:**	
Effective Queued Time:		**Seller:**		**CG Deadline:**	
Queued:	2022-11-22 09:02:46 PS	**Deal:**		**Concomitant Eval Flag:**	
Updated:	2022-11-22 09:03:27 PS	**Posting:**		**Status Notification:**	
Response:		**SIS:**	NO		
Unconditional:				**Service Update Flag:**	0

Customer/Seller Information

Type	Entity	Name	Phone	Email	Fax
Customer	BCPS	Brian_Samson	(604) 895-7047	joseph.mikawoz@powerex.com	(604) 891-5056
Seller	BCHA	BCHA_WEBTRANS			

Audit Statuses

Time Of Last Update	Modifying Company Code	Modifying Name	Status
2022-11-22 09:02 PS	BCPS	Brian_Samson	QUEUED
2022-11-22 09:03 PS	BCHA	BCHA_WEBTRANS	RECEIVED

TSR 98379862 - Profile 1 - Microsoft Edge

https://www.oasis.oati.com/webSmartOASIS/TransmissionReservationDetail?TSRID=31071355&AREF=98379862&TP=BCHA&FromHistory=0&overrideTimeZone=PD

Transmission Reservation Detail [AREF : 98379862] - [RECEIVED] [ORIGINAL] **(All times are in PD)**

PD

Status Flow & Actions

TSR Information

TP	Seller	Customer	POR	POD	Path	Start Time	Stop Time	MW Req	MW Grant
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BCHA	BCHA	BCPS	GMS.MCA.REV	BC.US.BORDER	W/BCHA/BCHA-BPAT/GMS.MCA.REV-BC.US.BORDER/	2024-06-01 00:00 PD	2030-10-01 00:00 PD	500	
				Sink:	**Service Code:** YRLY_FIRM_PTP_EXTENDED				

Reservation Profile

Start Time	Stop Time	MW Req	MW Grant	MWH	Bid Price	Offer Price	Extension Flag
2024-06-01 00:00 PD	2030-10-01 00:00 PD	500		27756000.00	$83461.0000		0
			Profile Total:	27756000.00			

Service Details

Preconfirmed	Increment	Class	Type	Period	Window	Subclass	Nerc Priority	Ceiling Price	Price Unit
NO	YEARLY	FIRM	POINT_TO_POINT	FULL_PERIOD	EXTENDED		7	$83461.0000	$CDN/MW-Y

Comments

Status	Seller	Provider	Customer
	Not enough ATC. ATC pending on higher queued.		

Additional Information

Competing Request Flag:		**Related:**		**Provider Approval:**	
Negotiated:		**Reassigned:**		**Provisions:**	
Affiliate:	NO	**Sale:**		**Rollover Waived:**	
Impacted:	0	**Request:**		**CG Status:**	
Effective Queued Time:		**Seller:**		**CG Deadline:**	
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Updated:	2022-11-22 09:03:28 PS	**Posting:**		**Status Notification:**	
Response:		**SIS:**	NO		
Unconditional:				**Service Update Flag:**	0

Customer/Seller Information

Type	Entity	Name	Phone	Email	Fax
Customer	BCPS	Brian_Samson	(604) 895-7047	joseph.mikawoz@powerex.com	(604) 891-5056
Seller	BCHA	BCHA_WEBTRANS			

Audit Statuses

Time Of Last Update	Modifying Company Code	Modifying Name	Status
2022-11-22 09:02 PS	BCPS	Brian_Samson	QUEUED
2022-11-22 09:03 PS	BCHA	BCHA_WEBTRANS	RECEIVED

Appendix B: BC Hydro OATT Attachment D

ATTACHMENT D

Methodology for Completing a System Impact Study

BC Hydro will perform system planning studies and apply its published planning criteria, standards and procedures to determine the impacts of the requested Transmission Service. The transfer capability of the system will be assessed for the period of the requested service to determine if the requested service can be accommodated. Thermal loading, transient stability, and voltage stability limits will be investigated for normal and outage conditions. If this analysis indicates that the requested Transmission Service cannot be accommodated, then alternative reinforcements will be investigated. A least cost transmission expansion plan will be developed for consideration by BC Hydro and the Transmission Customer and will include but not be limited to the following considerations: technical, economic, reliability, losses, environmental and social. The Transmission Customer can decide whether to proceed, modify, or cancel its request. More details can be found in the BC Hydro System Planning document entitled "Planning Process".

ACCEPTED: JAN 17 2011

ORDER NO. G 1 92 10

COMMISSION SECRETARY