BC Hydro
Power smart

Transmission System Information

For the 2024 Call for Power

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Transmission System Overview

The BC Hydro transmission system consists of the Extra High Voltage (EHV) bulk transmission system (referred to here as the EHV bulk system), and the regional transmission systems. This document is intended to provide indicative information about the BC Hydro's EHV bulk system and the regional systems for Independent Power Producers (IPPs) seeking to participate in the 2024 Call for Power.

The EHV bulk transmission system interconnects the large remote generating stations with British Columbia's major load centers in the Lower Mainland (LM) and on Vancouver Island (VI) and the major hub stations of regional transmission systems. The EHV bulk system also connects with the neighboring Alberta (AB) and United States (US) systems. The interties with AB and US also include some lower voltage inter-utility and inter-regional interconnections. The EHV bulk system is largely 500 kV, with small segments operated at lower voltage levels. The regional transmission systems are primarily 287 kV and below, for serving loads and interconnecting relatively small generating facilities in the BC Hydro service

area. Most generating facilities owned by IPPs and other customers are connected to the regional transmission systems (60 – 287 kV).

In the province, more than 70% of the province's electricity is consumed in the major load centers of the Lower Mainland and southern portion of Vancouver Island; and majority of electricity consumed in the province is produced by the remote generators in the North Interior region and the South Interior region, in which the Peace River generating stations and Columbia River generating stations are located respectively. This means that the majority of electricity consumed in the Lower Mainland and on Vancouver Island relies heavily upon the bulk transmission system to deliver the power over a long distance.

A map and one-line diagram of the transmission system is posted on the BC Hydro website at this address: https://www.bchydro.com/energy-in-bc/operations/transmission/transmission-system/maps.html

EHV Bulk Transmission System

The existing Extra-High Voltage bulk transmission system has the capability to deliver the expected maximum generation output from either the North Interior region or the South Interior region with moderate margins under normal operating conditions. Normal operating conditions mean all elements are in-service, and no bulk transmission circuit is out of service. However, the bulk system can be congested under a single contingency, resulting in one element of the bulk transmission system out of service either due to a fault event or for maintenance. Under a contingency like this, BC Hydro may reduce the generation output from the congested region and increases the generation output from other regions where adequate surplus generation is available in those regions to meet the demand. This planning strategy has worked well and has allowed BC Hydro to defer major transmission upgrade projects on the bulk system for the benefit of the ratepayers, while still meeting reliability requirements.

For planning the BC system to meet load growth, it is therefore, for the upcoming Call for Power, highly desirable and preferred to obtain new generation resources in the Lower Mainland and on Vancouver Island, as generation additions in these regions will help to reduce the transfer demand from the remote regions and delay a need for upgrading the EHV bulk system. In addition, generators added in or near the major load centers in LM and south VI will also help to reduce transmission losses on the EHV bulk system.

There are also areas in the province where anticipated load growth would benefit from new generation resources. For example, the EHV bulk system serving the North Coast (NC) region is currently a single radial 500 kV transmission system that runs from the Williston Substation in Prince George to the Skeena Substation near Terrace. There are three 500kV circuits in series on this route, traversing approximately 450 km, with the intermediate stations serving load at Glenannan and Telkwa. With anticipated industrial developments in the NC region, load growth is expected in foreseeable future. New generation resources that may be added in the North Coast region if awarded EPAs under the Call will help improve reliability of serving this region. However, the large additions of generation in NC area could stress further the already heavily loaded EHV lines to LM if the generation additions are higher than expected load growth in the NC.

From the perspective for planning the EHV bulk system, adding generation in regions outside of the Lower Mainland and Vancouver Island could result in a generation surplus relative to bulk transmission system capacity, which would trigger a major upgrade. Careful consideration will be necessary for determining how new generators would be interconnected together with the existing resources in operation.

A summary table below indicates the preference priorities for the listed regions from a bulk system perspective.

EHV Bulk System in Regions	**Preference Priority of new resource additions**	**Note**
Lower Mainland	Highly Preferred	Major load center
Vancouver Island	Highly Preferred	Major load center
North Coast	Preferred	Expected industrial load growth
Others	Neutral	

Regional Transmission Systems

As stated earlier, the regional transmission systems are mainly for serving loads and interconnecting relatively small generating facilities in the BC Hydro service area. In general, new generators added close to the local loads in the regional systems are beneficial as it will reduce the need to serve the loads from distance. However, in some of the regional transmission systems, significant intermittent generation resources are already connected and produce a substantial amount of electricity to serve a part of the provincial loads. For example, several wind farms with total installed capacity of more than 600 MW currently operate in the Peace region, and dozens of run-of-river generating stations with total installed capacity of close to 1000 MW operate in the south coast areas. Additional new intermittent generators added in those areas could result in increased stress to the regional systems and may require significant transmission upgrades to interconnect.

Intermittent resources typically produce their generation outputs varying with available power sources at the moment of production. This means that high outputs from the intermittent resources occur periodically or seasonally, and the outputs can be much lower or reduced to zero during other periods. The varying outputs could result in changes to the local area flow patterns, which at times stress the local components of the regional transmission system heavily to full capacity. In some cases such as for wind farms, the output changes can be more frequent and swifter, which could introduce voltage regulation concerns in the case of a weak connection. To manage the variable output uncertainties of intermittent resources, BC Hydro holds reserves on the system to maintain the integrity of the broader grid. A weak connection means that a sizable generating facility is connected into the grid at a point where the system fault level is relatively low; and in this case, the system voltage is prone to fluctuate with the flow variations. These flow variations are not necessarily addressed by reserves as the issue is region specific based on the configuration of the regional system. In locations such as these, adding energy storage such as a battery energy storage system (BESS) with proposed intermittent resources to mitigate the resultant flow variations in the regional systems may be desirable.

The regional transmission systems have been planned and developed primarily for load serving purposes, in which the existing system protection and control elements are typically less sophisticated compared to

those areas where sizable generators are connected. For interconnecting new generating resources in a local area, the existing protection and control schemes may be inadequate, and significant upgrades may be required in the regional system especially for interconnecting sizable new intermittent resources.

Additionally, the interconnection of new generators should not negatively impact the existing customers in the study areas. This generally means that new generators are expected to be interconnected via a dedicated line terminal at an existing substation or a newly built substation, and not directly tapped off a BC Hydro regional transmission line.

Appendix A provides details of current available line positions at BC Hydro's substations.

The summary table below indicates the preference priorities for the listed regional systems.

Regional Systems	**Preference Priority of new resource additions**	**Note**
Lower Mainland	Highly Preferred	Some areas with local generation may be congested
Vancouver Island	Highly Preferred	Some areas with local generation may be congested
North Coast	Preferred	Expected industrial load growth
Central Interior	Neutral	
Peace	Neutral	Some areas with local generation may be congested
South Interior East	Neutral	A preference may be given to new generators to be added close to sizable loads in the region
South Interior West	Neutral	A preference may be given to new generators to be added close to sizable loads in the region

More details of the specific regional transmission systems are described in the subsections below. Three thermal congestion codes are used to indicate the available thermal capacity for selected transmission segments under system normal conditions with all elements in service. The Possible code means that the segment is expected to have at least 50 MW room available to accommodate a new project in the Call; the May be Possible code means the segment has some room available but may not be adequate to accommodate a new project in the Call for Power; and the Not Possible code means that the segment has been fully occupied by the existing generators, and is likely not possible without major Network Upgrades. It can be expected that under a contingency condition such as loss of a line in the study area, the generators may need to be curtailed or disconnected to meet the required system performance under the contingencies.

For the transmission segments unlisted, this means that the segments may not be of concern, or a request for new resource interconnections to the segments although possible, is not expected. No details on the 60 kV network are discussed as the 60 kV network generally has a very limited room or no room under system normal to accommodate sizable new generators such as those with installed capacity of 50 MW and above.

Lower Mainland Regional System

The Lower Mainland Region includes the largest load center in BC, and is therefore highly preferred to receive new generation additions.

It is also noted that with the significant run-of-river generators presently operating in this region, some of the line segments in this region are already fully utilized seasonally with high generation outputs (including in winter and spring). These areas include parts of the Sunshine Coast, and much of the Bridge River system, including the 230kV network from Bridge River to Cheekye and to North Vancouver, and the Upper Harrison 360 kV system.

For the selected transmission segments in the region, the available thermal capacity under system normal is indicated with the congestion preliminary assessments in the table below. Note that factors other than system thermal limits under system normal can impact ability to accept a new injection into the BC Hydro system as well, including the required performance under both system normal and contingencies such as voltage and transient stability limits, acceptable overvoltage levels, and a potential need to participate in Remedial Action Schemes. In addition to system thermal limits, other factors will also be investigated during the later study stages of the Call.

Transmission Segments	Circuits involved	50MW Injection* Preliminary Assessment	Note
Sunshine Coast Area			
POW-SAY	1L33, 1L48	Possible	
SAY-MSA	1L37, 2L48	Not Possible for 1L37, May be Possible for 2L48	
[HSP]-MSA	2L47	May be Possible	
MSA-CKY	1L31, 1L32, 1L35	Possible for 1L31,1L32 May be Possible for 1L35	
COM-SEC	1L44	Not Possible	
Bridge River – North Shore Area			
BRT-KLY	2L90	Not Possible	
BRT-ROS	3L2, 3L5	Not Possible	360 kV (EHV)
BRT-CKY	2L1, 2L2, 2L5, 2L41, 2L42	Not Possible	
CKY-CYP/LYN	2L9, 2L13	Not Possible	
Fraser Valley East			
ROS-WAH	3L3	May be Possible	360 kV (EHV)
ROS-ALZ-CBN	2L78, 2L77	Possible	
Fraser Valley West & Metro Vancouver			
MDN 230kV	230kV station bus	Possible	Injection at Meridian
BUT 230kV	230kV station bus	May be Possible	Injection at Burrard
ARN 230kV	230kV station bus	Possible	Injection at Arnott

* Not Possible: segment highly congested from existing generation and will likely require major network upgrades
May be Possible: segment may have some thermal capacity available
Possible: segment thermally unconstrained for an additional 50 MW generator injection

Vancouver Island Regional System

The Vancouver Island Region is the second largest load center in the province, and the loads are largely concentrated in the south and southeast coast of the island from Victoria to Nanaimo. Southern Vancouver Island is highly preferred to receive new generation additions.

The northern portion of Vancouver Island hosts several existing hydro generating stations, run-of-river generators, and a wind farm (Cape Scott), which are the major generation sources on the island. A radial transmission system in segments travels from the Cape Scott wind farm to the Gold River substation over approximately 200 km, and can be heavily loaded seasonally. The 230 kV circuit from Gold River to Dunsmuir Substation can also be heavily loaded seasonally. Significant hydro generating facilities are also present in the southwest portion of the island and in the central island. Additional new generators to be added in those areas can be limited without triggering significant transmission upgrades.

For the selected transmission segments in the region, the available thermal capacity under system normal is indicated with the congestion preliminary assessments in the table below. In addition to system thermal limits, other factors will also be investigated during the later study stages of the Call.

Transmission Segments	Circuits involved	50MW Injection* Preliminary Assessment	Note
Northern Vancouver Island			
PHY-GLD	1L125,1L137,1L157,1L141, 1L130	Not Possible	
TSV-GLD	1L131	Possible	
GLD-JHT	1L120,1L121,1L118,1L117	Possible	
GLD-DMR	2L154	Possible	
Central Vancouver Island			
ICG-JHT	1L103, 1L104	Possible	
JHT-DMR	1L101, 1L102, 1L119, 1L106	Possible	
ASH-PAL	1L127, 1L142	May be Possible	
PAL-DMR	1L105, 1L114	Possible	
DMR-VIT 132 kV	132 kV corridor (multi lines)	Possible	
DMR-VIT 230 kV	230 kV corridor (multi lines)	Possible	
Southern Vancouver Island			
JOR-CLD	1L143	May be Possible	
CLD-GOW	1L146	Possible	
SAT-PIK 230 kV	2L170,2L126	Possible	
PIK-KTG 230 kV	2L131, 2L132	Possible	
PIK-HSY	2L144,2L145,2L146,2L143	Possible	
VIT-GTP 132 kV	1L10,1L11,1L12,1L14	Possible	

* Not Possible: segment highly congested from existing generation and will likely require major network upgrades
May be Possible: segment may have some thermal capacity available
Possible: segment thermally unconstrained for an additional 50 MW generator injection

North Coast Regional System

The North Coast region hosts some significant hydro generating plants. For example, the Forrest Kerr cluster is connected at the 287 kV BQN substation and the Long Lake Hydro is connected at the 138 kV LNT station. In each of the two cases, a long radial transmission connection to the 500 kV SKA substation may be congested seasonably. On the other side, significant industrial development is anticipated in the Kitimat area, which will result in substantial load growth in the foreseeable future.

For the selected transmission segments in the region, the available thermal capacity under system normal is indicated with the congestion preliminary assessments in the table below. In addition to system thermal limits, other factors will also be investigated during the later study stages of the Call.

Transmission Segments	Circuits involved	50MW Injection* Preliminary Assessment	Note
Terrace-Kitimat			
SKA-MIN	2L99	Possible	
Terrace-Prince Rupert			
SKA-RUP	2L101	Possible	
Terrace -Cassiar			
SKA-BQN/TAT	2L102, 2L374	Possible	
SKA-LNT/STW	1L381, 1L387, 1L402	May be Possible	
Bulkley			
TKW-HZN	1L385, 1L392	Possible	
TKW HUS	1L396	Possible	
BAB-TPY-HUS	1L390	Possible	
TPY-BRN	1L384	Possible	
Nechako			
GLN-TPY	1L384	Possible	
GLN-TAC	2L353	Possible	

* Not Possible: segment highly congested from existing generation and will likely require major network upgrades
May be Possible: segment may have some thermal capacity available
Possible: segment thermally unconstrained for an additional 50 MW generator injection

Central Interior Regional System

This region currently has very limited renewable generation resources in operation. Several existing thermal generating plants owned by industrial customers produce limited electricity to serve the local loads.

For the selected transmission segments in the region, the available thermal capacity under system normal is indicated with the congestion preliminary assessments in the table below. In addition to system thermal limits, other factors will also be investigated during the later study stages of the Call.

Transmission Segments	Circuits involved	**50MW Injection* Preliminary Assessment**	Note
KDS-MFE	1L373, 1L368, 1L366	Possible	
KDS-SVY-WSN	2L097	Possible	
	1L365	May be Possible	
WSN-BLW/RBF	2L096, 2L354	Possible	
KLY-SCK/HMH	2L086, 2L352, 2L095, 2L094	Possible	

* Not Possible: segment highly congested from existing generation and will likely require major network upgrades
May be Possible: segment may have some thermal capacity available
Possible: segment thermally unconstrained for an additional 50 MW generator injection

Peace Regional System

In addition to the major generating stations GMS, PCN, and Site C (in-construction) connected in the Peace bulk system, serval wind farms (such as Dokie, Meikle, Quality, and Bear Mountain) with total installed capacity of more than 600 MW are currently connected and inject significant power into the regional system, which results in high usages periodically on some transmission segments in the region.

For the selected transmission segments in the region, the available thermal capacity under system normal is indicated with the congestion preliminary assessments in the table below. In addition to system thermal limits, other factors will also be investigated during the later study stages of the Call.

Transmission Segments	Circuits involved	**50MW Injection* Preliminary Assessment**	Note
GMS-SNK	2L308, 2L309	Possible	
SNK-TLR	2L313, 2L337	May be Possible	
SNK-SGB	2L312, 2L340, 2L342	Possible	
SGB-BMT	2L329, 2L333	Possible	
SBK-SGB	2L391, 2L292	Possible	
BMT-DAW	1L348, 1L350	Possible	
DAW-TAY	1L377	Possible	
SBK-TAY	1L360	Possible	
TAY-FJN	1L367	Possible	
GMS-FJN/FOX	1L364	Possible	
GMS-SLS	1L349, 1L361	Possible	
FJN-TXB	1L371	Possible	
TAY-MCM/FBC	1L375	Not Possible	
BMT-NL2	1L355	Possible	

* Not Possible: segment highly congested from existing generation and will likely require major network upgrades
May be Possible: segment may have some thermal capacity available
Possible: segment thermally unconstrained for an additional 50 MW generator injection

South Interior East Regional System

The South Interior East Regional System mainly serves the local loads, and many in a radial configuration such as the Invermere/Golden area. The regional system also has two 138 kV circuits connected with the Alberta system, which are normally in parallel with the 500 kV tie with Alberta. Some sizable industrial loads are proposed in this region such as in Elk Valley.

For the selected transmission segments in the region, the available thermal capacity under system normal is indicated with the congestion preliminary assessments in the table below. In addition to system thermal limits, other factors will also be investigated during the later study stages of the Call.

Transmission Segments	**Circuits involved**	**50MW Injection* Preliminary Assessment**	Note
CBK -KSH	2L258, 2L259	Possible	
CBK-NTL	2L113	Possible	
NTL-BCK	1L274	Possible	
CBK-NLY	2L294	Possible	

* Not Possible: segment highly congested from existing generation and will likely require major network upgrades
May be Possible: segment may have some thermal capacity available
Possible: segment thermally unconstrained for an additional 50 MW generator injection

South Interior West Regional System

Like the South Interior East regional system, the South Interior West regional system serves the local loads in various pockets, and largely in a radial configuration such as the North Thompson and West Bank areas. In some of the areas, significant industrial loads are served such as Copper Mountain and Highland Copper. A few small intermittent generators are located in this regional system such as Kwoiek Creek and Bone Creek; a biomass plant connected near Merritt; and a solar farm in development near Highland Valley.

For the selected transmission segments in the region, the available thermal capacity under system normal is indicated with the congestion preliminary assessments in the table below. In addition to system thermal limits, other factors will also be investigated during the later study stages of the Call.

Transmission Segments	Circuits involved	**50MW Injection* Preliminary Assessment**	Note
BKL-VLM	1L210, 1L211, 1L225 and 1L212;	Possible	
SVA/VVW-BKL	1L206, 1L220, 1L241	Possible	
KLY-SVA	2L092, 2L093	Possible	
NIC/SVA- HLD	1L203,1L205,1L243	Possible	
HLD-HVC/STL	1L055	Possible	
HLD-MR2	1L254	Possible	
NIC-CUM	1L251	Possible	
NIC-WBK	1L244	Possible	
ACK/VNT-SAM	2L240, 1L218, 1L209	Possible	
VNT-MON	1L202	Possible	
SEL-KCL	2L288/289, 2L295/299	Not Possible	

* Not Possible: segment highly congested from existing generation and will likely require major network upgrades
May be Possible: segment may have some thermal capacity available
Possible: segment thermally unconstrained for an additional 50 MW generator injection

Appendix A: Preliminary New Line Position Assessment at Existing BC Hydro Substations

Background:

BC Hydro owns and operates substations throughout the province. Connecting to a BC Hydro substation with a line position is one of the most reliable ways for a new customer to connect to BC Hydro system. A line position usually consists of a circuit breaker, disconnects and associated equipment to connect customer owned line at a BC Hydro substation. In some specific situations, multiple circuit breakers, disconnects and associated equipment are required even for one line position addition. Detailed scope will be defined in the System Impact Study stage.

To provide indicative information for connecting to a BC Hydro substation with a line position in a reasonable timeframe, we have prepared preliminary information on the list of substations which can accommodate a new line position in a relatively straightforward manner. The sites listed are those that will not trigger significant station expansion that would require BC Hydro to acquire additional property. The substations listed could still trigger some station expansion within the existing BC Hydro property. Where we are aware that a station expansion is required within the existing property parcel, this has been indicated in the remarks section. The installation of new equipment and construction is required to accommodate a new line position in all substations.

This preliminary information is focused on 138kV, 230kV, 287kV and 360kV systems at BC Hydro substations where BC Hydro currently identifies there are transmission system capacity available to connect new generation. If the BC Hydro substations have those voltage levels, but they are not listed, it generally means a new line position cannot be accommodated in a straightforward manner at those BC Hydro substations.

The information on 60kV was excluded, as the size requirements of the 2024 Call for Power will likely require interconnections at 138kV or above. The information on 500kV was also excluded as BC Hydro currently does not allow new generator customers to connect at the 500kV level. A list of BC Hydro Substations that can accommodate a new line position in a relatively straightforward manner are provided below:

138kV system

Region	Substation	Substation Code	Remarks
North Coast	Houston	HUS	
	Smithers	SRS	
	Telkwa	TKW	
Peace Region	Dawson Creek	DAW	
	Fox Creek	FOX	Note 1
	Gordon M. Shrum	GMS	
	Kennedy	KDS	
	Morfee	MFE	
	Southbank	SBK	
	Sundance Lake	SLS	

	Taylor	TAY	
Southern Interior	Highland	HLD	
	Savona	SVA	Note 1
	Vernon Terminal	VNT	
	Valley View	VVW	
Vancouver Island	Keogh	KGH	
	Kokish Terminal	KTS	

Note 1: Expansion of station without property acquisition required.

230kV system

Region	Substation	Substation Code	Remarks
North Coast	Glenannan	GLN	Note 1
	Tachick	TAC	Note 1
Peace Region	Bear Mountain	BMT	
	Southbank	SBK	
	Shell Groundbrith	SGB	Note 1
	Sundance Lake	SLS	
	Sukunka	SNK	
	Tumbler Ridge	TLR	
Southern Interior	Ashton Creek	ACK	
	Bridge River Terminal	BRT	
	Cranbrook	CBK	
	Hundred Mile House	HMH	
	Nicola	NIC	
	Salmon Arm	SAM	
	Savona	SVA	Note 1
	Vernon Terminal	VNT	
	Valley View	VVW	Note 1

Note 1: Expansion of station without property acquisition required.

287kV system

Region	Substation	Three Letter Code	Remarks
North Coast	Bob Quinn	BQN	Note 1
	Tatoga	TAT	Note 1

Note 1: Expansion of station without property acquisition required.

360kV system

Region	Substation	Three Letter Code	Remarks
Southern Interior	Bridge River Terminal	BRT	