British Columbia Transmission CORPORATION™

Alcan to BCTC Transfer Limit Update For Kemano 7 Generators online with Updated Capability Curves

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System Planning and Performance Assessment

DISCLAIMER

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Executive Summary

This study has updated the Alcan to BCTC transfer limits for 7 Kemano units online based on a maximum output of 835 MW and the updated generator capability curves. This report also provides the transfer limits for the condition of SKA T1 or T2 out of service.

With the updated capability curves of KMO generators, the Alcan to BCTC transfer limits can be increased for certain operating conditions. Highlights are noted below:

- The Alcan to BCTC transfer limit can be increased by about 30 MW when KIT load is more than 580 MW based on 7 units on line. With a lower KIT load the transfer increase is correspondingly reduced.
- With SKA T1 or T2 out of service, the Alcan to BCTC transfer limits need to be reduced by 5 to 10 MW from the limits based on system normal condition.

Alcan to BCTC Transfer Limit Update
For Kemano 7 Generators online with Updated Capability Curves

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1 Introduction

Recently Alcan has provided BCTC updated KMO generator capability curves with a maximum output of 835 MW for 7 KMO units. To realize the benefit of increased generator capability Alcan has requested BCTC to review and update the Alcan to BCTC transfer limits based on 7 KMO units online for system normal condition with all equipment in service.

Operation planning studies have been conducted as requested and the results are stated in this report. Sensitivity studies to account for the effect of one KIT shunt capacitor bank off line are included. In addition, a study also has been conducted to assess the impact on transfer limit for one of the two SKA transformers (T1 and T2) OOS based on the new capability curves.

2 Study Assumptions

The studies are conducted based on the following assumptions.

a) The KIT separation scheme* is in service.
b) The power generated by Eurocan IPP supplies Eurocan load only.
c) The settings of the existing out-of-step relays at Minette (MIN) remain unchanged.
d) The maximum KMO generation output is 835 MW based on 7 KMO units online.
e) The maximum load at MIN is assumed to be 100 MW.
f) The maximum load at KIT is assumed to be 630 MW.
g) KMO generation shedding is available upon loss of 2L101.
h) There are no more than two generators connected to each KMO 287 kV transformer.

* KIT separation scheme contains two relays at KIT to detect multi-phase faults. One relay looks toward Alcan system and the other toward the BCTC system. If either relay detects any multi-phase fault, the KIT to MIN (2L103) line will be tripped immediately. In addition, detection of any fault including single line to ground or multiphase faults on the KMO-KIT line the relay will also trip open 2L103.

3 Alcan to BCTC Transfer Limits

The transfer limits are constrained by equipment thermal limits, maximum operating voltages, KMO generator var capability, transient stability and voltage stability concerns. Various pre-outage and post outage power flows, transient stability and voltage stability studies have been conducted to assess the transfer limits. Results indicate that Alcan to BCTC transfer limit varies with load at KIT (L_{KIT}) and MIN (L_{MIN}) and are summarized with the following equations:

Alcan to BCTC transfer limit **P_T (P_2L103)** is the minimum of:

- 380 MW, or
- 2L103 thermal limit (ambient temperature dependent), or
- $(A + B \times L_{MIN})$

Where

- A and B depend on KIT load (L_{KIT}). Details on computation are listed in Table - 2.
- L_{MIN} is load at MIN.

These loads are defined as below:

- L_{KIT} = -87KIT-88KIT- 2L103KIT
- L_{MIN} = -2L103MIN - 2L99MIN

Where:

- 87KIT = MW flow on 87L at KIT toward KMO
- 88KIT = MW flow on 88L at KIT toward KMO
- 2L103KIT = MW flow on 2L103 at KIT toward MIN
- 2L103MIN = MW flow on 2L103 at MIN toward KIT
- 2L99MIN = MW flow on 2L99 at MIN toward Skeena

L_{MIN} is the net of power into MIN on 2L103 and power going out from MIN on 2L99

- L_{MIN} is assumed to vary between 0 to 100 MW.
  However the equations can be applied for MIN load greater than 100 MW.

L_{KIT} is the net of power into KIT on 87L and 88L and power going out from KIT on 2L103

- L_{KIT} is assumed to vary between 300 to 630 MW
  If $L_{KIT} < 300$ MW, it is acceptable to set LKIT = 300 MW
  If $L_{KIT} > 630$ MW, the results are not applicable. A separate study needs to be conducted to determine the limits.

The actual values of the transfer limits for KMO 7 units online are listed in Table - 1.
Appendix A shows the transfer limits in graphical format.

Kemano generation shedding for loss of 2L101 is required during high transfers. Detailed requirements are specified in Table - 3.

Table - 1 Transfer limits from Alcan to BCTC

System Condition	Number of Kitimat Capacitor Banks In-Service	Number of Kemano Units On Line	Kitimat Load (MW)	Kitimat to Minette Transfer Limit (MW)
System Normal	6	7	$300 < L_{KIT} \leq 400$	360 MW ~ 380 MW
			$400 < L_{KIT} \leq 450$	335 MW ~ 380 MW
			$450 < L_{KIT} \leq 536$	255 MW ~ 335 MW
			$536 < L_{KIT} \leq 580$	230 MW ~ 255 MW
			$580 < L_{KIT} \leq 630$	180 MW ~ 230 MW
	5	7	$300 < L_{KIT} \leq 400$	380 MW
			$400 < L_{KIT} \leq 450$	335 MW ~ 380 MW
			$450 < L_{KIT} \leq 536$	255 MW ~ 335 MW
			$536 < L_{KIT} \leq 580$	170 MW ~ 255 MW
			$580 < L_{KIT} \leq 630$	65 MW ~ 220 MW
SKA T1 or T2 OOS (see Note 1)	6	7	$300 < L_{KIT} \leq 360$	380 MW
			$360 < L_{KIT} \leq 450$	Reduce the transfer limit by 10 MW
			$450 < L_{KIT} \leq 630$	Reduce the transfer limit by 5 MW
	5	7	$300 < L_{KIT} \leq 400$	380 MW
			$400 < L_{KIT} \leq 630$	Reduce the transfer limit from Alcan by 10 MW

Note 1 All of the following circuits and transformers must be in-service except for SKA T1 or SKA T2:

- 5L61
- 5L62
- 5L63
- SKA T1 and T2
- 2L99
- 2L103 and
- Two Kemano to Kitimat lines.

Table - 2 Calculation Formulas for A and B of $P_T = A + B \times L_{MIN}$

System Condition	Number of Kitimat Capacitor Banks In-Service	Number of Kemano Units On Line	Kitimat Load (MW)	Calculation Formulas for A and B	
System Normal	6	7	$300 < L_{KIT} \leq 360$	$A = 380$	$B = 0.0$
			$360 < L_{KIT} \leq 400$	$A = 380 - 0.5 \times (L_{KIT} - 360)$	$B = 0.3$
			$400 < L_{KIT} \leq 450$	$A = 360 - 0.5 \times (L_{KIT} - 400)$	$B = 0.3 + 0.3 \times (A - 360)/25$
			$450 < L_{KIT} \leq 536$	$A = 335 - 0.9 \times (L_{KIT} - 450)$	$B = 0.0$
			$536 < L_{KIT} \leq 580$	$A = 255 - 0.6 \times (L_{KIT} - 536)$	$B = 0.0$
			$580 < L_{KIT} \leq 630$	$A = 230 - 1.0 \times (L_{KIT} - 580)$	$B = 0.0$
	5	7	$300 < L_{KIT} \leq 400$	$A = 380$	$B = 0.0$
			$400 < L_{KIT} \leq 450$	$A = 380 - 0.9 \times (L_{KIT} - 400)$	$B = 0.0$
			$450 < L_{KIT} \leq 536$	$A = 335 - 0.9 \times (L_{KIT} - 450)$	$B = 0.0$
			$536 < L_{KIT} \leq 580$	$A = 255 - 0.8 \times (L_{KIT} - 536)$	$B = 0.5 \times (A - 255)/35$
			$580 < L_{KIT} \leq 630$	$A = 220 - 1.4 \times (L_{KIT} - 580)$	$B = -0.5 + 0.4 \times (A - 220)/70$

Table - 3 KMO Generation Shedding Requirement upon Loss of 2L101

System Condition	P_2L103 (MW)	Generation Shedding Requirement
System Normal	P_2L103 ≤ 150	No generation shedding
	150 < P_2L103 ≤ 250	Shed one KMO units of 100-114 MW
	250 < P_2L103 ≤ 350	Shed two KMO units of 200 - 224 MW
	350 < P_2L103	Shed three KMO units of 330 - 342 MW
One of Kemano – Kitimat Lines O.O.S.	P_2L103 ≤ 150	No generation shedding
	150 < P_2L103 ≤ 200	Shed one KMO unit of 100-114 MW
	200 < P_2L103	Shed two KMO units of 180 - 200 MW

4 Conclusions

This study has updated the Alcan to BCTC transfer limits for 7 Kemano units online with the maximum output up to 835 MW and the updated generator capability curves. This report also provides the transfer limits for the condition with either SKA T1 or T2 out of service.

With the increased reactive power capability of KMO generators, the Alcan to BCTC transfer limits can be increased for certain operating conditions. The following are the highlights of the study.

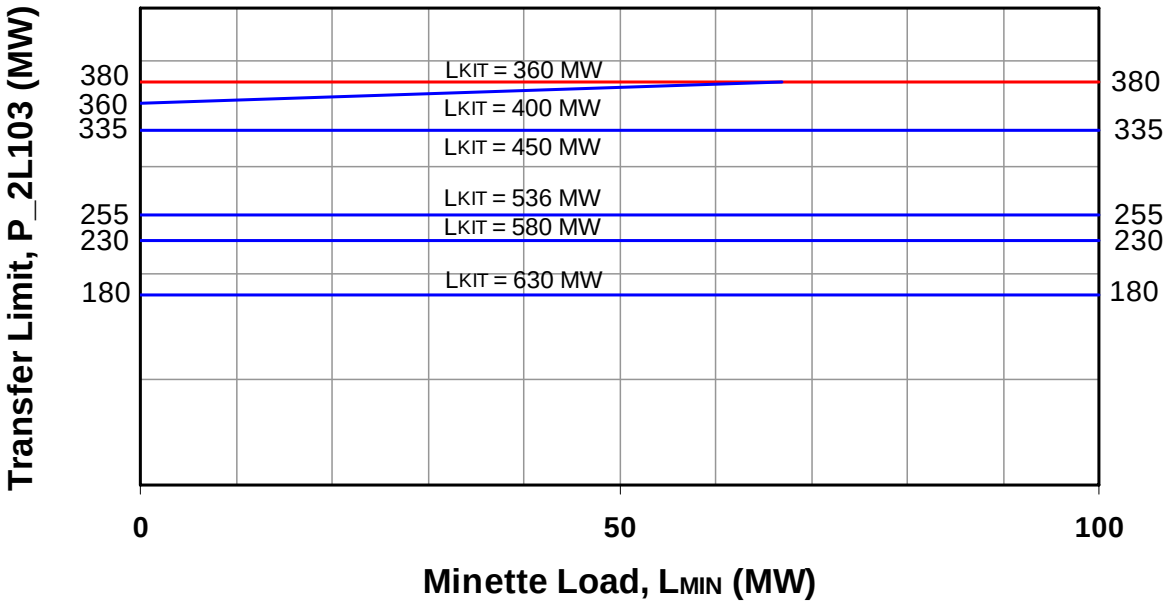
- The Alcan to BCTC transfer limit can be increased by about 30 MW when KIT load is more than 580 MW.

- With either SKA T1 orT2 out of service, the Alcan to BCTC transfer limits need to be reduced by 5 to 10 MW from the limits based on system normal condition.

5 Appendix A – Transfer Limit Nomogram

APPENDIX A-1

Alcan to BCTC Transfer limit
All circuits in service
Based on 7 KMO units and 6 capacitor banks at KIT in service

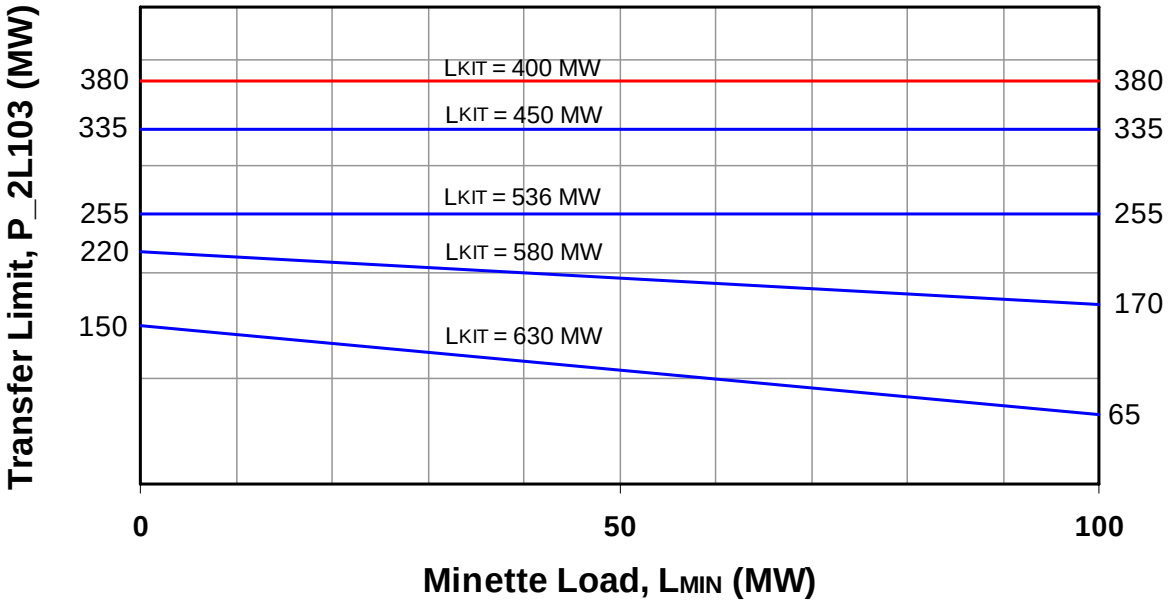


Limited by maximum allowable real power over 2L103

Limited by acceptable transient performance or KMO reactive power reserves

APPENDIX A-2

Alcan to BCTC Transfer limit
All circuits in service
Based on 7 KMO units and 5 capacitor banks at KIT in service



Limited by maximum allowable real power over 2L103

Limited by acceptable transient performance or KMO reactive power reserves