BC Transmission
CORPORATION
Building Connections

Operational Planning Study Report For

Alcan to BCTC Transfer Limit Increase

From 380 MW to 420 MW

Report No: SPPA2010-022

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System Planning & Performance Assessment, BCTC

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Executive Summary

This study is to update system operation requirements mainly for Alcan to BCTC transfer limit increase from 380 MW to 420 MW. In addition other findings are also included. The results will be used to update BCTC's SOO 7T-30 and SOO 7T-13.

This operational planning study has the following conclusions and requirements

- The maximum Alcan to BCTC transfer limit is updated to 420 MW.
- The transfer limit is updated to consider the loss of one of KIT potlines
- 2L103 15 minute overload ratings and its corresponding initial loadings are introduced to reflect Alcan's decision on applying gen shed KMO for loss of one potline during winter, while retain pre-outage restrictions during summer.
- KMO Generation shedding requirements are specified for loss of 5L4 or 5L41 when the transfer is above 380 MW.
- The tripping of 2L103 for SLG with successful reclosing on one of KIT to KMO lines and 5L61/5L62/5L63 is not required and the Alcan separation scheme needs to be updated to reflect this finding.

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1. Introduction

Alcan has requested to increase the transfer limit to BCTC from 380 MW to 420 MW due to potential more power surplus from shutting down some of their KIT potlines. To accommodate the 40 MW transfer limit increase, KMO generation shedding RAS modification for the contingencies loss of 5L4 or 5L41 is required and is being implemented. This operational planning study is to update system operation restrictions and generation shedding requirements to realize the 420 MW transfer limit with proposed generation RAS in service. In addition, this study also includes some other operation restriction updates. The study results will be reflected in BCTC's SOO 7T-30 and SOO 7T-13.

2. System Conditions

2.1 Existing North Coast System Protections

(1) Alcan-BCTC Tie (2L103) Tripping Scheme

Table 2.1 KIT-MIN (2L103) Tripping Scheme

Protections	settings
Under-frequency	57.5 Hz
Out-of-Step Relay	• Apparent impedance looking from MIN to KIT 0.18 --- 0.16 p.u • Apparent impedance looking from MIN to SKA 0.18 --- 0.16 p.u • Apparent impedance crossing |0.18 – 0.16| gap time 2 cycles • Supervision voltage 0.85 pu • Supervision voltage delay time 5 cycles
Under-voltage	KIT287 < 256 kV (0.89 pu) for 2.0 sec
Excess Power Flow to BCTC	Power relay with KIT-MIN > 500 MW for 1.5 seconds

(2) Alcan-KMO O/F Generation Shedding Scheme (temporary)

When KIT-MIN power flow transfer is above 150 MW, KMO three units will be armed for over frequency generation shedding at 61 Hz, 61.3 Hz and 61.6 Hz respectively.

2.2 Update on Alcan Separation Scheme

Studies indicated that single line to ground fault (**SLG**) with successful reclosing on one of KIT to KMO lines, or on 5L61/5L62/5L63 will not trigger 2L103 slip relay based on the 420 MW transfer limit. BCTC has asked Alcan to update the existing separation scheme at KIT to reflect the finding.

2.3 Update on 2L103 Thermal Ratings

2L99 and 2L103 ambient temperature dependent ratings are updated. Refer to Appendix A for 2L103 ratings, which include both continuous and 15 minute overloading ratings and the corresponding initial loadings.

2.4 Base Cases

The 2009 light and heavy summer loadings are used.

2.5 Kitimat Load

The individual potline load data, including MW and MVAr, especially the largest potline load data shall be sent to BCTC via datalink. . This largest potline load has been used to determine the Alcan to BCTC transfer limits for the summer situation where there is no generation shedding applied at KMO for loss of a potline load at KIT.

The load at KIT, LKIT, is defined as the total of the individual potline load.

2.6 Minette Load

Minette load is updated to reflect the Eurcan recent changes. According to BCH's 10 year load forecast, Eurocan generator is shut down, and the load is reduced to 4.3 MW.

2.7 Generation Shedding for Loss of a KIT Potline

Loss of one of the potlines at KIT (50 -100 MW), may result in the overload, or tripping of 2L103 by the excessive power relay at KIT depending on its pre-outage loading. Alcan has decided to arm generation shedding at KMO for loss of KIT potlines during winter to prevent the overload or tripping of 2L103. Rather than apply generation shedding at KMO, Alcan will accept pre-outage transfer restriction on 2L103 to resolve the 2L103 overload issue during summer.

Appendix A has two nomograms for the ratings of 2L103: one is ambient temperature dependent continuous ratings for summer and winter conditions; the other is 15 minute overload ratings and the corresponding initial loadings. The difference between the 15 minute rating and initial loading is set at 75 MW, which reflects the average potline MW loading at KIT.

2.8 Winter Conditions

Winter period is defined as from 1st November to 31st March inclusive. During this period, Alcan must comply with the following to avoid the overload or tripping of 2L103 for loss of one of Kitimat potlines:

1. Apply generation shedding at KMO for loss of any potline at KIT. The status of the arming must be datalinked to BCTC, or

2. Restrict the maximum transfer limit at (495 MW – largest potline load) if the generation shedding at KMO for loss of KIT potlines is not armed.

2.9 Summer Conditions

Summer period is defined as from 1st April to 31st October inclusive. During this period Alcan has decided to accept pre-outage transfer restriction instead of arming generation shedding to resolve the overload of 2L103 for loss of any KIT potlines. Therefore, the transfer limit needs to be restricted so that the post-contingency loading on 2L103 will not exceed its 15 minute thermal overload capability.

3. Study Results

3.1 Alcan to BCTC Transfer Limits (without separation scheme at KIT)

The Alcan to BCTC transfer limit, without separation scheme at KIT, is lower than that with separation scheme, and the maximum cannot be increased to 420 MW. All the transfer limits have been updated to include the impact for loss of one of the potline load at KIT, by introducing either generation shed at KMO, or setting the pre-outage restrictions based on 2L103 15 minute overload ratings, or 495 MW (reflect the excessive power relay set of 500 MW).

The Alcan to BCTC transfer limit, without separation scheme, for system normal condition and one of Kemano - Kitimat lines O.O.S. condition, has been updated as:

PT (P_2L103) is the lesser of

- 380 MW, or
- (less of (2L103_Rating or 495 MW) - Largest Potline Load) if generation shedding at KMO for loss of potlines is not armed, or
- (A + B*LMIN)

Where,

- ➢ A and B depend on LKIT
- ➢ 2L103_Rating is its ambient temperature dependant 15 minute overload capability

2L103_Rating has been introduced in the calculation of PT (P_2L103). Detailed computations of A and B, and Alcan to BCTC transfer limits PT = A + B*LMIN are not updated, and can be found in the existing SOO 7T-30.

3.2 Alcan to BCTC Transfer Limits (with separation scheme at KIT)

The Alcan to BCTC transfer limit, with separation scheme at KIT, can achieve a higher number than that without separation scheme. With KMO generation shedding RAS modification for the contingencies loss of 5L4 or 5L41 the Alcan to BCTC transfer limit can be increased to 420 MW under certain system conditions. The transfer limit has also been updated to include the impact for loss of one of the potlines at KIT, by introducing either generation shed at KMO, or setting the pre-outage restrictions based on 2L103 15 minute overload ratings, or 495 MW (reflect the excessive power relay set of 500 MW).

The Alcan to BCTC transfer limit for system normal condition and one of Kemano - Kitimat lines O.O.S. condition, has been updated as:

PT (P_2L103) is the lesser of

- 420 MW, or
- (less of (2L103_Rating or 495 MW) - Largest Potline Load) if generation shedding at KMO for loss of potlines is not armed, or
- (A + B*LMIN)

Where,

- A and B depend on LKIT
- 2L103_Rating is its ambient temperature dependant 15 minute overload capability

The following table details the computation of A and B, and Alcan to BCTC transfer limits based on KIT and MIN loads. From the table, only under system normal conditions with 7 units or 8 units in service can the Alcan to BCTC transfer limit be increased to 420 MW. Appendix B also lists the updated transfer limit nomograms (only the ones that have been updated to a new transfer limit of 420 MW).

3.3 Generation Shedding KMO for loss of 5L4 or 5L41

Under any system conditions, if Alcan to BCTC transfer is greater than 380 MW, 110 MW generation at KMO is required for loss of 5L4 or 5L41. The requirement has been specified in SOO 7T-13.

Table - Detailed Calculations on Alcan to BCTC transfer limits (with separation scheme at KIT)

System Condition	Number of Kitimat capacitor Banks In-Service	Number of Kemano Units On line	Kitimat Load, L_{KIT} (MW)	Kitimat to Minette Transfer Limit P_T (=P_2L103) (MW) (If $P_T < 0$, set P_T =0)	Calculation formulas for A and B	
System Normal **(with separation scheme at KIT)**	5	8	$300 < L_{KIT} \le 440$	420 MW	A = 420	B = 0.0
			$440 < L_{KIT} \le 480$	380 MW ~ 420 MW	A = 420 – 1.0 x (L_{KIT} - 440)	B = 0.0
			$480 < L_{KIT} \le 536$	324 MW ~ 380 MW	A = 380 - 1.0 × (L_{KIT} - 480)	B = 0.0
			$536 < L_{KIT} \le 580$	250 MW ~ 324 MW	A = 324 - 1.68 × (L_{KIT} -536)	B = 0.0 + 0.2 × (A - 324)/74
			$580 < L_{KIT} \le 630$	160 MW ~ 260 MW	A = 260 - 1.0 × (L_{KIT} - 580)	B = -0.2 + 0.1× (A - 250)/50
	6	8	$300 < L_{KIT} \le 440$	420 MW	A = 420	B = 0.0
			$440 < L_{KIT} \le 480$	380 MW ~ 420 MW	A = 420 – 1.0 x (L_{KIT} - 440)	B = 0.0
			$480 < L_{KIT} \le 536$	324 MW ~ 380 MW	A = 380 - 1.0 × (L_{KIT} - 480)	B = 0.0
			$536 < L_{KIT} \le 580$	280 MW ~ 324 MW	A = 324 - 1.0 × (L_{KIT} - 536)	B = 0.0
			$580 < L_{KIT} \le 630$	230 MW ~ 280 MW	A = 280 - 1.0 × (L_{KIT} - 580)	B = 0.0
	5	7	$L_{KIT} = 300$	420 MW	A = 420	B = 0.0
			$300 < L_{KIT} \le 400$	380 MW ~ 420 MW	A = 420 – 0.4 x (L_{KIT} - 300)	B = 0.0
			$400 < L_{KIT} \le 450$	335 MW ~ 380 MW	A = 380 – 0.9 × (L_{KIT} - 400)	B = 0.0
			$450 < L_{KIT} \le 536$	255 MW ~ 335 MW	A = 335 – 0.93 × (L_{KIT} - 450)	B = 0.0
			$536 < L_{KIT} \le 580$	170 MW ~ 255 MW	A = 255 – 0.8 × (L_{KIT} - 536)	B = 0.5 × (A - 255)/35
			$580 < L_{KIT} \le 630$	65 MW ~ 220 MW	A = 220 – 1.4 × (L_{KIT} - 580)	B =-0.5 + 0.35 × (A - 220)/70
	6	7	$L_{KIT} = 300$	420 MW	A = 420	B = 0.0
			$300 < L_{KIT} \le 360$	380 MW ~ 420 MW	A = 420 – 0.667 x (L_{KIT} - 300)	B = 0.0
			$360 < L_{KIT} \le 400$	360 MW ~ 380 MW	A = 380 – 0.5 × (L_{KIT} - 360)	B = 0.3
			$400 < L_{KIT} \le 450$	335 MW ~ 380 MW	A = 360 – 0.5 × (L_{KIT} - 400)	B = 0.3 + 0.3 × (A - 360)/25
			$450 < L_{KIT} \le 536$	255 MW ~ 335 MW	A = 335 – 0.93 × (L_{KIT} - 450)	B = 0.0
			$536 < L_{KIT} \le 580$	230 MW ~ 255 MW	A = 255 – 0.57 × (L_{KIT} - 536)	B = 0.0
			$580 < L_{KIT} \le 630$	180 MW ~ 230 MW	A = 230 – 1.0 × (L_{KIT} - 580)	B = 0.0

Appendix A – 2L103 Thermal Ratings

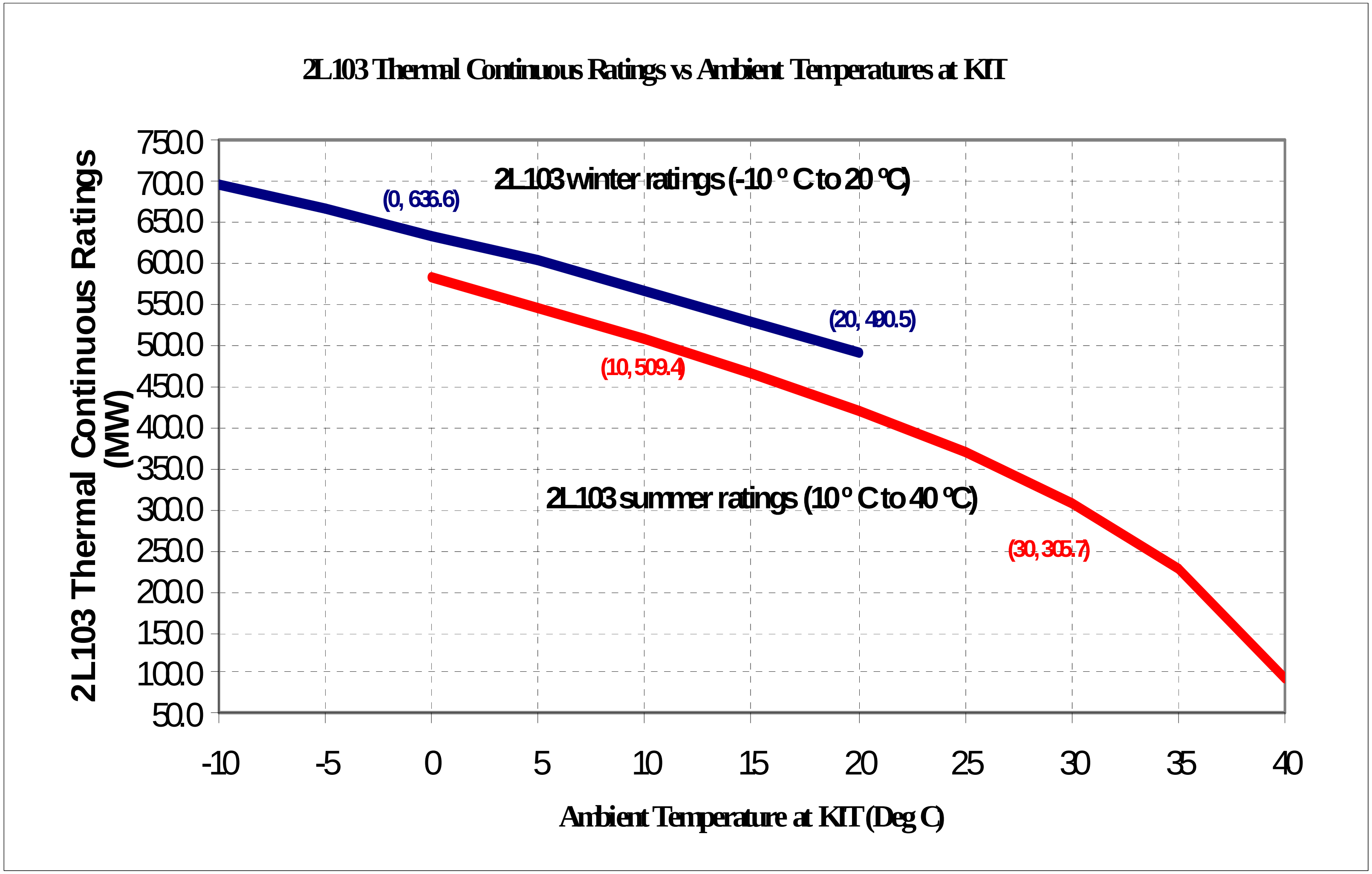
	STANDARD SUMMER CONDITIONS						STANDARD WINTER CONDITIONS					
Ambient Temp at KIT (C)	Thermal Continuous rating (A)	Thermal Continuous rating (MW)	15 min Thermal overload ratings				Thermal Continuous rating (A)	Thermal Continuous rating (MW)	15 min Thermal overload ratings			
			Initial Continuous Loading (A)	Initial Continuous Loading (MW)	Overload Rating (A)	Overload Rating (MW)			Initial Continuous Loading (A)	Initial Continuous Loading (MW)	Overload Rating (A)	Overload Rating (MW)
-10 º	-	-	-	-	-	-	1439	696	1354	655	1509	730
-5 º	-	-	-	-	-	-	1378	667	1293	626	1448	701
0 °	1204	582	1120	542	1275	617	1316	637	1228	594	1383	669
5 º	1131	547	1045	506	1200	581	1248	604	1159	561	1314	636
10 °	1053	509	964	466	1119	541	1175	568	1086	525	1241	600
15 º	967	468	876	424	1031	499	1098	531	1008	488	1162	562
20 º	872	422	779	377	934	452	1014	491	923	447	1077	521
25 º	764	370	668	323	824	399	-	-	-	-	-	-
30 °	632	306	538	260	693	335	-	-	-	-	-	-
35 º	470	227	371	180	526	255	-	-	-	-	-	-
40 º	195	94	84	41	239	116	-	-	-	-	-	-

Note 1: The standard summer and winter conditions are:

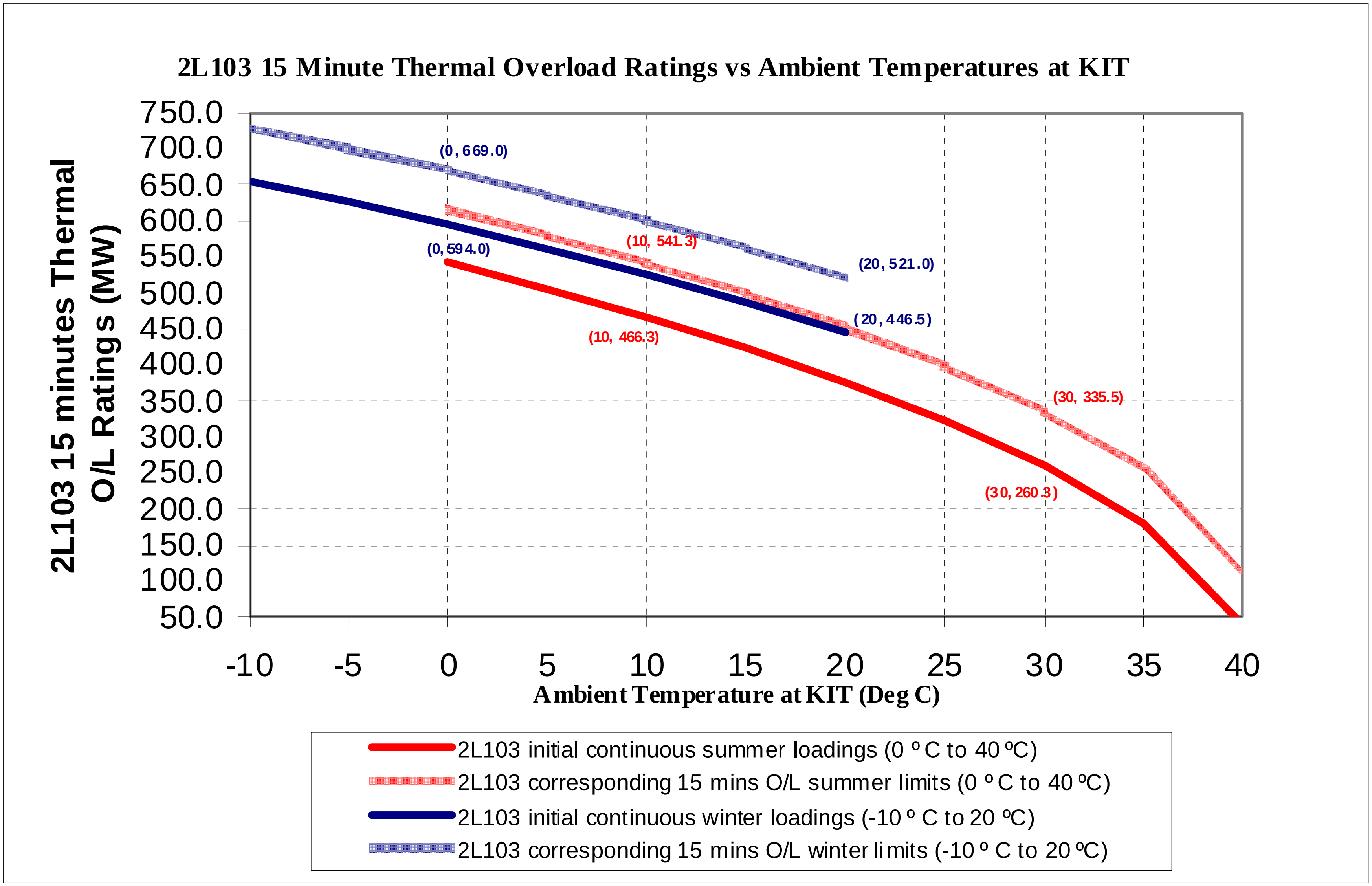
- Wind: 2 ft/sec wind (.61 m/sec)
- Sun: very clear and sunny (in winter, no sun)
- Time: 18:00
- Elevation: 2500 Ft, except as noted
- Month: July (summer), December (winter)

Note 2: Amp rating is based on 49 Celsius degree of maximum conductor temperature.
Note 3: MW rating is calculated based on the line voltage at 285 kV and 0.98 PF.

2L103 Thermal Continuous Ratings versus Ambient Temperatures at KIT

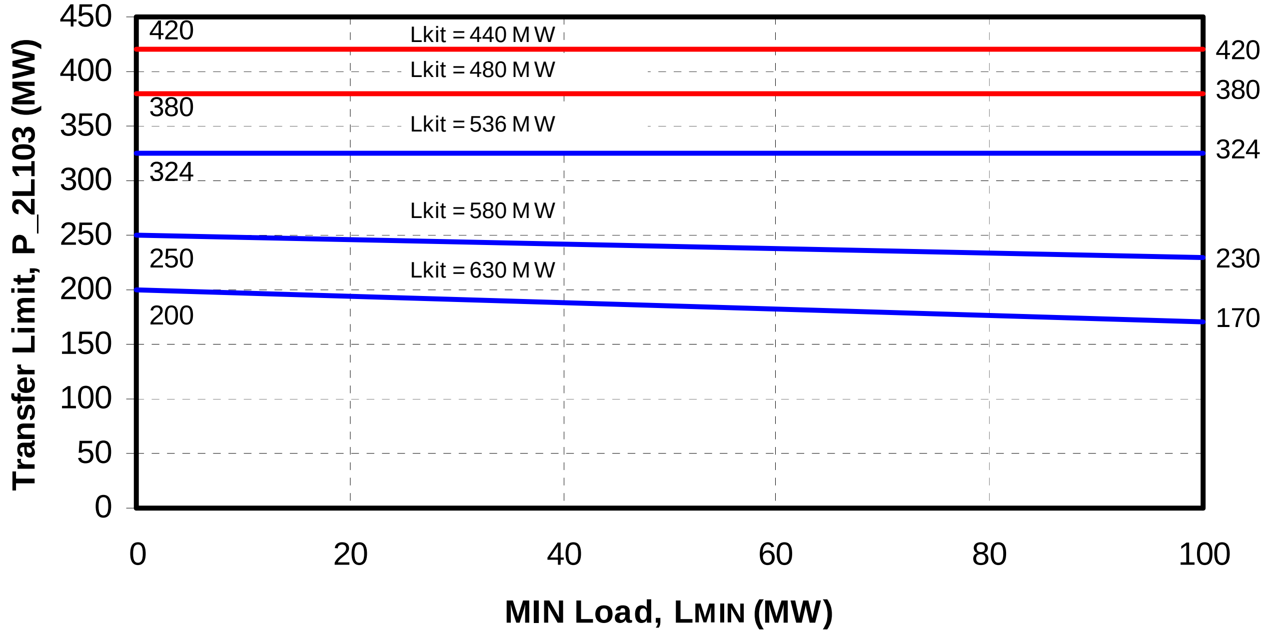


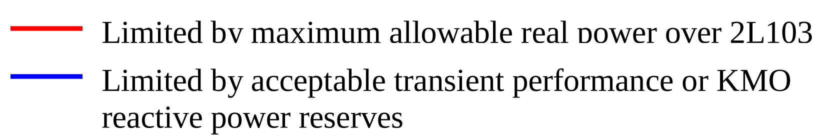
2L103 15 Minute Thermal Overload Ratings versus Ambient Temperatures at KIT



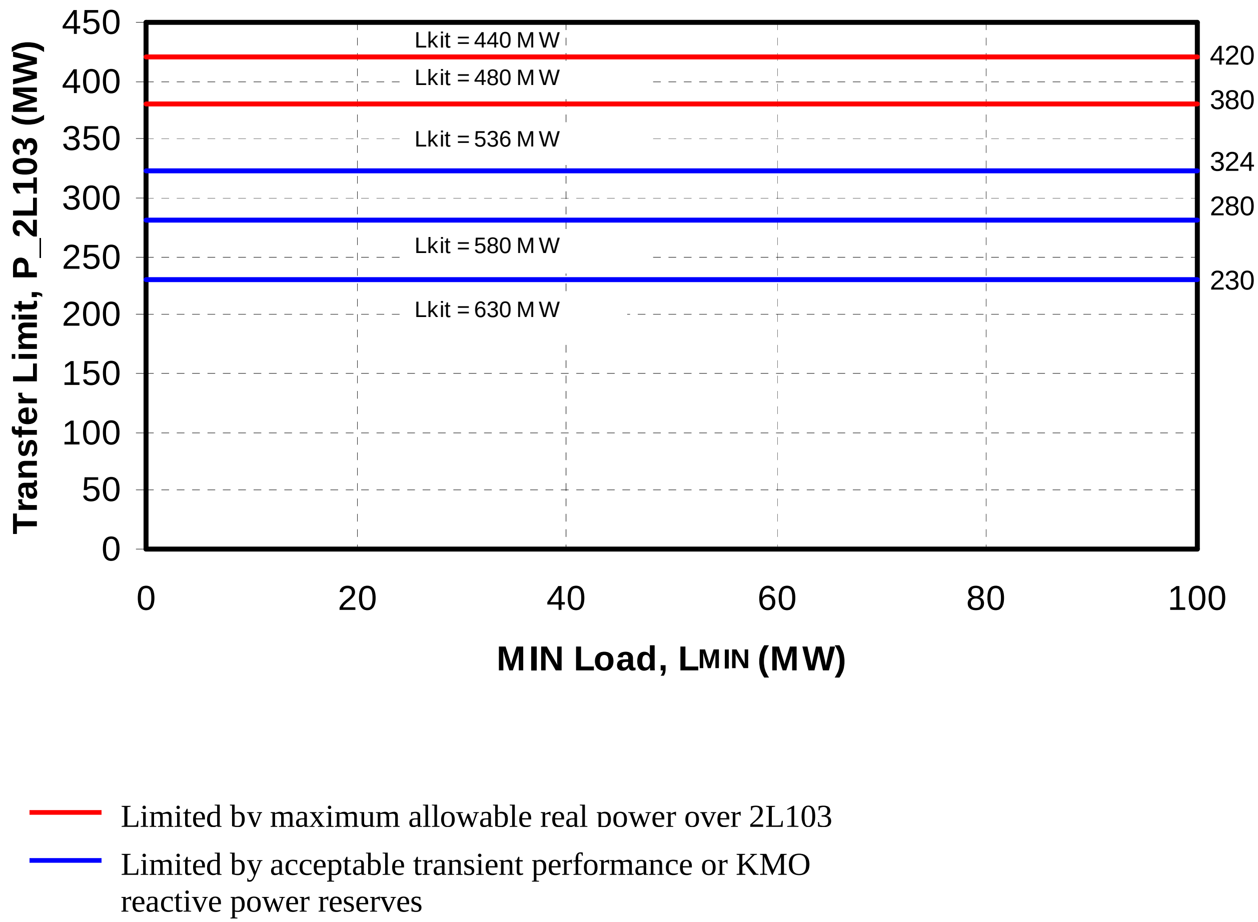
Appendix B Nomograms for Alcan Transfer Limit to BCTC (with separation scheme at KIT)

Nomogram 1 – System normal with 8 units AND 5 capacitor banks at KIT

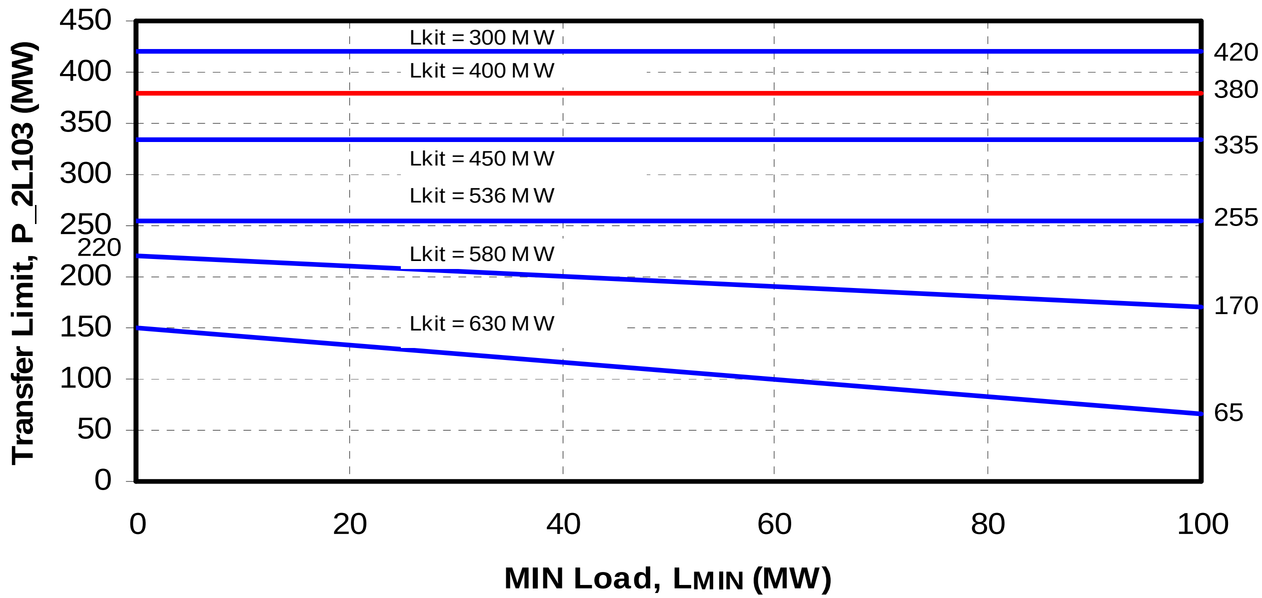




Nomogram 2 – System normal with 8 units AND 6 capacitor banks at KIT



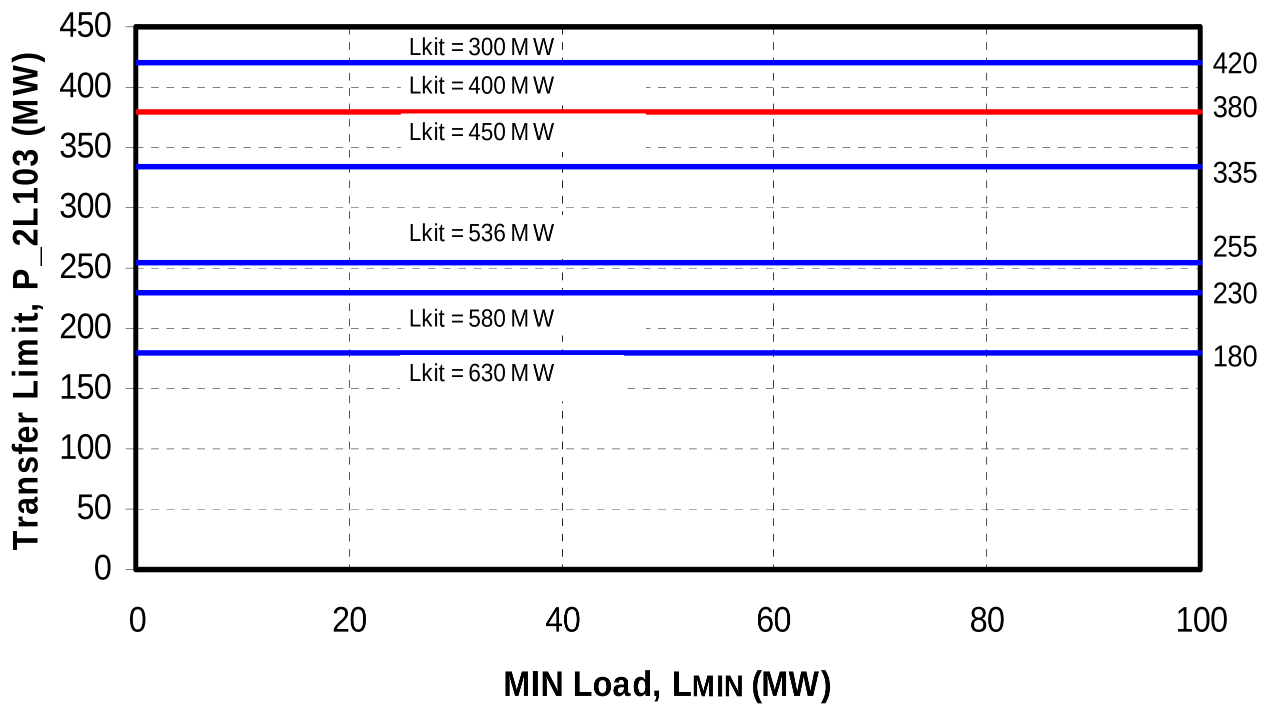
Nomogram 3 – System normal with 7 units AND 5 capacitor banks at KIT



Limited by maximum allowable real power over 2L103

Limited by acceptable transient performance or KMO reactive power reserves

Nomogram 4 – System normal with 7 units AND 6 capacitor banks at KIT



Limited by maximum allowable real power over 2L103

Limited by acceptable transient performance or KMO reactive power reserves