Note re a Potential Interior to Lower Mainland (ILM) Transmission Reinforcement Project

BCTC is currently performing Definition Phase work related to a potential project to reinforce the transmission network between the BC Interior and the Lower Mainland. A new 500 kV series compensated line between Nicola (NIC) and Meridian (MDN) Substations (NIC-MDN, previously designated 5L83) is one of the options being examined. Definition Phase activities for this project have been included in both our F2005 and F2006 Capital Plans filed with the BCUC. The potential need for Interior to Lower Mainland (ILM) transmission capacity reinforcement was also identified in our 2005 Network Integration Transmission Service (NITS) Study for BC Hydro.
http://www.bctc.com/regulatory/applications/capital_plan_F2005.htm
http://www.bctc.com/the_transmission_system/transmission_system_capital_plan/
http://www.bctc.com/NR/rdonlyres/86705D4D-0560-4A56-AAB1-5F9FA32ADDF9/0/SP200526Final2.pdf

BCTC is also examining other options including upgrading existing lines and station facilities, other potential new line options, and "do-nothing" options. It will be necessary to perform additional study and assessment work before BCTC can finalize a preferred solution and appropriate timing for additional ILM transmission capacity.

BCTC does not anticipate finalizing a preferred solution until the latter part of calendar year 2007 and only after additional conceptual engineering and cost estimating, environmental overview, public and First Nations consultation. If significant new line construction is eventually selected as a preferred option, BCTC would seek the necessary regulatory approvals before construction. At this point BCTC believes the earliest potential in-service date for any major new ILM capacity would be 2013.

In the meantime, BCTC wishes to share certain preliminary findings. The information provided is preliminary and based on steady state powerflow modeling only, not taking into account any stability or other analysis at this point. The information provided is also based on BCTC constructs as to potential generation and load patterns. It should be noted that further analysis and different assumptions used in any analysis may produce different results. BCTC welcomes comments on potential benefits of ILM transmission capacity reinforcement, to Brenda Ambrosi, BCTC Customer Services Manager.

Nicola-Meridian (NIC-MDN) vs. Nicola-Ingledow (NIC-ING): Load Flow Assumptions

To compare the capability of potential NIC-MDN and NIC-ING reinforcement options, the following four steady state load flow scenarios are studied:

(a) Scenario 1: Models the winter peak load in 2014.

(b) Scenario 2: Models both off-peak winter load and peak summer load. This scenario is developed by scaling down the winter peak load of Scenario 1.

(c) Scenario 3: Scaled down winter peak load of Scenario 1 to model medium summer load.

(d) Scenario 4: Scaled down winter peak load of Scenario 1 to model light summer load.

In all four scenarios, the initial flow on 5L51 and 5L52 is assumed at 280 MW from BC to the US. The assumption is to include an existing 230 MW firm point-to-point transmission contract north to south and also to allow 50 MW for Transmission Reliability Margin (TRM). Table 1 summarizes the specifics of the above four load flow scenarios.

Table 1

Scenario No.	Load Season	Generation / Load (MW)					North to South / East to West (MW)	
		BC Hydro	NI	SI	VI	Coastal	To US	From Alberta
1	Winter Peak	11070 / 9922	3841 / 1369	5979 / 1010	636 / 2385	1250 / 7543	280	101
2	Heavy Summer OR Off-Peak Winter	6590 / 6206	2207 / 845	3384 / 676	508 / 1435	1000 / 4685	280	101
3	Medium Summer	5530 / 5274	1700 / 713	3130 / 590	356 / 1207	700 / 3970	280	101
4	Light Summer	3516 / 3479	1241 / 481	1874 / 434	203 / 684	400 / 2565	280	101

NI = North Interior region

SI = South Interior region

VI = Vancouver Island region

Coastal = Lower Mainland & Vancouver Island regions

In this study, continuous seasonal ratings of transmission circuits are used for the no-outage (N-0) studies. For contingency scenarios, overload ratings of the transmission circuits are applied.

NIC-MDN vs. NIC-ING: Comparison of N-0 North to South Limits

Table 2 shows the expected 2014 winter loading of the ILM lines for both NIC-MDN and NIC-ING reinforcement options. These flows are based on 280 MW north to south transfers on 5L51 and 5L52. The table indicates that at this north to south transfer level, the N-0 flows on all of the ILM lines are expected to remain within the continuous ratings of their respective lines no matter which reinforcement option is applied. It also indicates that most of the line flows are similar for both options.

Table 2

	ILM 500 kV Line	Termination Substations	Scenario 1 + NIC-ING	Scenario 1 + NIC-MDN
		From - To	%Loading / MW	%Loading / MW
1	5L41	Kelly Lake (KLY)- Clayburn (CBN)	63% / 1035	66% / 1085
2	5L42	KLY-Cheekye (CKY)	98% / 1612	94% / 1539
3	5L44	MDN-ING	8% / -243	27% / 795
4	5L81	NIC-ING	71% / 1305	74% / 1355

	ILM 500 kV Line	Termination Substations	Scenario 1 + NIC-ING	Scenario 1 + NIC-MDN
		From - To	%Loading / MW	%Loading / MW
5	5L82	NIC-MDN	81% / 1485	75% / 1381
6	NIC-MDN	NIC-MDN	N/A	53% / 1381
7	NIC-ING	NIC-ING	50% / 1305	N/A
8	5L87	NIC-KLY	28% / 590	27% / 568

To compare the N-0 north to south transfer performance of NIC-MDN and NIC-ING reinforcement options, the BC to the US flow on 5L51 and 5L52 is increased up to the point that flow on one of the ILM circuits (or flow on one of the inter-ties) reaches the continuous rating of that circuit. This level of north to south transfer is considered the N-0 north to south limit for the studied reinforcement option. The incremental generation required for defining the N-0 north to south limit of each option is modelled in the Interior regions.

Table 3 shows the N-0 north to south limits for both NIC-MDN and NIC-ING options.

Table 3

	N-0 Load Flow Scenarios	Load Season	BC Hydro Load (MW)	NI Gen. (MW)	SI Gen. (MW)	Coastal Gen. (MW)	East to West from Alberta (MW)	N-0 North to South Limit on 5L51 & 5L52 (MW)	Limiting T-Line
1	**Scenario 1 + NIC-ING**	Heavy Winter	9922	3855	7057	1250	101	1260	5L42
2	**Scenario 1 + NIC-MDN**	Heavy Winter	9922	4145	7057	1250	101	1500	5L42
3	**Scenario 2 + NIC-ING**	Off-peak Winter	6206	3817	7057	1000	101	4750	5L42
4	**Scenario 2 + NIC-MDN**	Off-peak Winter	6206	3470	7057	1000	101	4460	5L81
5	**Scenario 2 + NIC-ING**	Heavy Summer	6206	2269	7057	1000	101	3590	5L52
6	**Scenario 2 + NIC-MDN**	Heavy Summer	6206	2269	7057	1000	101	3590	5L52
7	**Scenario 4 + NIC-ING**	Light Summer	3479	250	6587	400	101	3630	5L52

	N-0 Load Flow Scenarios	Load Season	BC Hydro Load (MW)	NI Gen. (MW)	SI Gen. (MW)	Coastal Gen. (MW)	East to West from Alberta (MW)	N-0 North to South Limit on 5L51 & 5L52 (MW)	Limiting T-Line
8	**Scenario 4 + NIC-MDN**	Light Summer	3479	250	6587	400	101	3630	5L52

Comparison of the results leads to the following preliminary observations:

1- During peak hour winter loads, NIC-MDN reinforcement can facilitate N-0 north to south transfer of up to 1500 MW on 5L51 and 5L52 inter-ties. This level of north to south transfer is 240 MW more than the N-0 north to south limit that NIC-ING reinforcement can provide under similar conditions.

2- During off-peak hour winter loads, NIC-MDN reinforcement can facilitate N-0 north to south transfer of up to 4460 MW on 5L51 and 5L52 inter-ties. This level of north to south transfer is 290 MW less than the N-0 north to south limit that NIC-ING reinforcement can provide under similar conditions.

3- During heavy summer loads, both NIC-MDN and NIC-ING reinforcements can facilitate N-0 north to south transfer of up to 3590 MW on 5L51 and 5L52 inter-ties.

4- During light summer loads, both NIC-MDN and NIC-ING reinforcements can facilitate N-0 north to south transfer of up to 3630 MW on 5L51 and 5L52 inter-ties.

5- For all N-0 seasonal north to south limits, the flows on the existing MDN-ING circuit 5L44 remains below 90% of the continuous rating of the line.

NIC-MDN vs. NIC-ING: Comparison of Single Contingency (N-1) North to South Limits

Major single contingency outages in the ILM network are simulated to compare N-1 north to south limits of the NIC-MDN and NIC-ING reinforcement options. For both transmission options, steady state performance of the post-contingency transmission network during heavy winter and heavy summer loads are analyzed.

For the NIC-MDN reinforced network, single contingency outage of 5L41, 5L42, 5L81, 5L82 and 5L87 is investigated. In this study, single contingency outages of 5L51 and 5L52 inter-ties are not reviewed. Separate studies will be required to identify the Ingledow-Custer (ING-CUS) upgrades for maximizing firm transfers. After outage of each transmission line, the BC to the US power flow on 5L51 and 5L52 inter-ties is increased up to the point that one of the remaining ILM lines reaches its overload rating. This process is repeated for every single contingency outage and the N-1 north to south limits for all outages are recorded. The lowest north to south limit of all the simulated outages is defined to be the N-1 north to south limit of the NIC-MDN reinforcement option.

The above outage analysis is repeated for the NIC-ING reinforced network. Table 4 shows the N-1 north to south limits for both NIC-MDN and NIC-ING options.

Table 4

	N-1 Load Flow Scenarios	Load Season	BC Hydro Load (MW)	NI Gen. (MW)	SI Gen. (MW)	Coastal Gen. (MW)	East to West from Alberta (MW)	N-1 North to South Limit on 5L51 & 5L52 (MW)	Line Out / Line Limiting
1	**Scenario 1 + NIC-ING**	Heavy Winter	9922	3815	7057	1250	101	1220	5L42 / 5L41
2	**Scenario 1 + NIC-MDN**	Heavy Winter	9922	3785	7057	1250	101	1180	5L42 / 5L41
3	**Scenario 2 + NIC-ING**	Off-peak Winter	6206	3532	7057	1000	101	4510	5L42 / 5L41
4	**Scenario 2 + NIC-MDN**	Off-peak Winter	6206	2458	7057	1000	101	3610	5L81 / 5L44
5	**Scenario 2 + NIC-ING**	Heavy Summer	6206	2269	7057	1000	101	3590	See Note 1
6	**Scenario 2 + NIC-MDN**	Heavy Summer	6206	300	7057	1000	101	1620	5L81 / 5L44
7	**Scenario 4 + NIC-ING**	Light Summer	3479	250	6577	400	101	3620	5L41 / 5L52
8	**Scenario 4 + NIC-MDN**	Light Summer	3479	250	5198	400	101	2400	5L81 / 5L44

Note 1: At 3590 MW pre-contingency north to south transfer level, 5L52 reaches its normal summer rating. Therefore, north to south transfer can not be extended beyond 3590 MW.

Comparison of the results leads to the following preliminary observations:

1- During peak hour winter loads, NIC-MDN reinforcement can facilitate N-1 north to south transfer of up to 1180 MW on 5L51 and 5L52 inter-ties. This level of north to south transfer is 40 MW less than the N-1 north to south limit that NIC-ING reinforcement can provide under similar conditions.

2- During off-peak hour winter loads, NIC-MDN reinforcement can facilitate N-1 north to south transfer of up to 3610 MW on 5L51 and 5L52 inter-ties. This level of north to south transfer is 900 MW less than the N-1 north to south limit that NIC-ING reinforcement can provide under similar conditions.

3- During heavy summer loads, NIC-MDN reinforcement can facilitate N-1 north to south transfer of up to 1620 MW on 5L51 and 5L52 inter-ties. This level of north to south transfer is 1970 MW less than the N-1 north to south limit that NIC-ING reinforcement can provide under similar conditions.

4- During light summer loads, NIC-MDN reinforcement can facilitate N-1 north to south transfer of up to 2400 MW on 5L51 and 5L52 inter-ties. This level of north to south transfer is 1220 MW less than the N-1 north to south limit that NIC-ING reinforcement can provide under similar conditions.

NIC-MDN vs. Do-Nothing: Peak Load N-0 North to South Limits on 5L51 and 5L52

The 2014 winter peak steady state load flow scenarios 5 to 7, which are used for determining the non-firm north to south limits on 5L51 and 5L52, are summarized in Table 5.

Table 5

	Scenario No.	Upgrade	Generation / Load (MW)					Total ILM Flow (MW)	N-0 North to South Limit on 5L51/5L52 (MW)	Limiting Line
			BC Hydro	NI	SI	VI	Coastal			
1	**5**	**NIC-MDN**	10992 / 9922	3802 / 1369	5940 / 1010	562 / 2385	1250 / 7543	7990	1260	5L42
2	**5**	**None**	11095 / 9922	3905 / 1369	5940 / 1010	562 / 2385	1250 / 7543	6987	280	5L82
3	**6**	**NIC-MDN**	11006 / 9922	3677 / 1369	5940 / 1010	584 / 2385	1389 / 7543	7954	1360	5L42
4	**6**	**None**	11080 / 9922	3751 / 1369	5940 / 1010	584 / 2385	1389 / 7543	6923	330	5L82
5	**7**	**NIC-MDN**	10973 / 9922	3327 / 1369	5940 / 1010	584 / 2385	1706 / 7543	7821	1530	5L42
6	**7**	**None**	11049 / 9922	3403 / 1369	5940 / 1010	584 / 2385	1706 / 7543	6732	470	5L82

These scenarios model different levels of coastal generation in winter 2014. Regional generation for all scenarios is tuned to allow the network remain within its thermal limits during first contingencies. For each scenario, the ILM transmission system with and without NIC-MDN is studied. The NI generation is increased to augment the amount of N-0 power that can be transferred north to south. Nelway (NLY) phase-shifting transformer is adjusted to simulate all flows from BC to the US on 5L51 and 5L52. The N-0 north to south limit is reached when the increased north to south transfer causes one of the ILM circuits to reach its continuous thermal rating.

Table 5 shows the winter peak 2014 N-0 north to south limits for both NIC-MDN and Do-Nothing options. Comparison of the results leads to the following preliminary observations:

1- For the reviewed levels of coastal generation in the LM and VI, after addition of NIC-MDN, the peak hour north to south limits on 5L51 and 5L52 will increase.

2- The difference between the N-0 peak hour north to south limits of NIC-MDN and Do-Nothing option varies from 980 MW to 1060 MW for coastal generations ranging from 1250 MW to 1706 MW.

NIC-MDN vs. Do-Nothing: Peak Load N-1 North to South Limits on 5L51 and 5L52

Maximum N-1 north to south transfer capability of the ILM grid in winter 2014 is evaluated for both the non-reinforced network and the NIC-MDN reinforced grid. Since the north to south limits depend on the amount of coastal generation in the LM and VI, in this study, Scenario 8 with 2110 MW of coastal generation models the base scenario. At this level of coastal generation, the non-reinforced ILM grid can supply the 2014 peak load and 280 MW of north to south transfer at ING without any ILM N-1 overloads. A lower amount of coastal RMR will cause N-1 overload of the non-reinforced network.

The studied N-1 outages include 5L41, 5L42, 5L81, 5L82, and 5L87. In this study, single contingency outages of 5L51 and 5L52 inter-ties are not reviewed. Separate studies will be required to identify the ING-CUS upgrades for maximizing firm transfers. For the NIC-MDN reinforced transmission network, after applying each one of the line outages, the NI generation is increased to augment the amount of firm power that can be transferred north to south on 5L51 and 5L52. The N-1 north to south limit is defined when the increased north to south transfer causes one of the remaining ILM circuits to reach its overload rating.

Table 6 shows the winter peak 2014 N-1 north to south limits for both NIC-MDN and Do-Nothing options.

Table 6

	Scenario No. (Upgrade)	BC Hydro Load (MW)	NI Gen. (MW)	SI Gen. (MW)	Coastal Gen. (MW)	VI Gen. (MW)	East to West from Alberta (MW)	Peak Hour N-1 North to South Limit on 5L51& 5L52 (MW)	Line Out / Line Overload
1	8 (NIC-MDN)	9922	4728	5440	2110	562	101	1400	5L42 / 5L41
2	8 (Do-Nothing)	9922	3462	5440	2110	562	101	280	5L81 / 5L82

Comparison of the results leads to the following preliminary observations:

1- Reinforcing the ILM transmission grid with NIC-MDN will enhance the firm north to south transfer limit at ING by more than 1100 MW during peak load hours.
2- The N-1 heavy winter north to south limits on 5L51 and 5L52 increase as more generating resources are designated in the coastal areas of LM and VI.

NIC-MDN vs. Do-Nothing: Off-Peak Load N-0 North to South Limits on 5L51 and 5L52

In this section, the N-0 north to south limits of NIC-MDN and Do-Nothing options for off-peak load conditions are compared. Power flows at non-peak hours of winter as well as the peak and non-peak hours of summer are investigated. For winter and summer studies, continuous rating of transmission lines at 10 ^{O}C and 30 ^{O}C ambient temperatures are applied respectively.

The 2014 peak hour load flow scenario 5 is used to develop the off-peak load flow scenarios for this analysis. In this load flow scenario, the specified regional generation dispatch will maintain

the N-0 transmission network within its thermal boundaries. For off-peak load flow scenarios, the peak hour load is scaled down from 100% to 40% in 10% steps. Table 7 shows details of the load / resource allocations in load flow scenarios 9 to 14 which are used for both summer and off-peak winter analysis.

Table 7

	Scenario No. (Load %)	Upgrade Option	Generation / Load* (MW)					North to South / East to West (MW)	
			BC Hydro	NI	SI	VI	Coastal	To US	From Alberta
1	**5 (100%)**	**NIC-MDN**	10992 / 9922	3802 / 1369	5940 / 1010	562 / 2385	1250 / 7543	280	101
2	**5 (100%)**	**Do-Nothing**	11095 / 9922	3905 / 1369	5940 / 1010	562 / 2385	1250 / 7543	280	101
3	**9 (90%)**	**NIC-MDN**	9887 / 8966	2947 / 1234	5940 / 923	509/ 2139	1000 / 6810	280	101
4	**9 (90%)**	**Do-Nothing**	9952 / 8966	3012 / 1234	5940 / 923	509/ 2139	1000 / 6810	280	101
5	**10 (80%)**	**NIC-MDN**	8711 / 7969	2021 / 1096	5940 / 830	382 / 1890	750 / 6043	280	101
6	**10 (80%)**	**Do-Nothing**	8773 / 7969	2083 / 1096	5940 / 830	382 / 1890	750 / 6043	280	101
7	**11 (70%)**	**NIC-MDN**	7546 / 6960	856 / 953	5940 / 738	382 / 1653	750 / 5270	280	101
8	**11 (70%)**	**Do-Nothing**	7596 / 6960	906 / 953	5940 / 738	382 / 1653	750 / 5270	280	101
9	**12 (60%)**	**NIC-MDN**	6483 / 6009	250 / 822	5733 / 650	255 / 1423	500 / 4537	280	101
10	**12 (60%)**	**Do-Nothing**	6530 / 6009	250 / 822	5780 / 650	255 / 1423	500 / 4537	280	101
11	**13 (50%)**	**NIC-MDN**	5358 / 5067	250 / 688	4608 / 566	255 / 1177	500 / 3813	280	101
12	**13 (50%)**	**Do-Nothing**	5389 / 5067	250 / 688	4639 / 566	255 / 1177	500 / 3813	280	101
13	**14 (40%)**	**NIC-MDN**	4232 / 4090	250 / 552	3582 / 478	203 / 928	400 / 3061	280	101
14	**14 (40%)**	**Do-Nothing**	4251 / 4090	250 / 552	3601 / 478	203 / 928	400 / 3061	280	101

The NI and SI generation is increased to augment the amount of N-0 power that can be transferred north to south. NLY phase-shifting transformer is adjusted to simulate all flows from BC to the US on 5L51 and 5L52. The N-0 off-peak north to south transfer limit is reached when the increased north to south transfer causes one of the ILM circuits to reach its continuous thermal rating. Table 8 shows the off-peak N-0 north to south limits of NIC-MDN and Do-Nothing option at 10 ^{O}C and 30 ^{O}C ambient temperatures respectively.

Table 8

					Off-Peak Winter			Summer		
	N-0 Scenario (Upgrade)	**BC Hydro Load (MW)**	**SI Gen. (MW)**	**Coastal Gen. (MW)**	**NI Gen. (MW)**	**N-0 North to South Limit (MW)**	**Limiting T-line**	**NI Gen. (MW)**	**N-0 North to South Limit (MW)**	**Limiting T-line**
1	**Scenario 9 (NIC-MDN)**	8966	5940	1000	4944	1985	5L42	4607	1690	5L42
2	**Scenario 9 (None)**	8966	5940	1000	3576	760	5L42	3245	460	5L42
3	**Scenario 10 (NIC-MDN)**	7969	5940	750	4408	2360	5L42	4091	2080	5L42
4	**Scenario 10 (None)**	7969	5940	750	3226	1275	5L82	2849	940	5L82
5	**Scenario 11 (NIC-MDN)**	6960	5940	750	4408	3425	5L42	4106	3165	5L42
6	**Scenario 11 (None)**	6960	5940	750	2660	1875	5L82	2373	1420	5L82
7	**Scenario 12 (NIC-MDN)**	6009	5940	500	4316	4090	5L42	3692	3580	5L52
8	**Scenario 12 (None)**	6009	5940	500	2280	2300	5L82	1975	2020	5L82
9	**Scenario 13 (NIC-MDN)**	5067	5940	500	4377	4950	5L42	2556	3600	5L52
10	**Scenario 13 (None)**	5067	5940	500	1829	2895	5L82	1536	2620	5L82
11	**Scenario 14 (NIC-MDN)**	4090	5940	400	3838	5345	5L52	1524	3610	5L52
12	**Scenario 14 (None)**	4090	5940	400	1316	3360	5L81	1126	3180	5L82

Review of the results leads to the following preliminary observations:

1- For 2014 off-peak winter loads, the non-firm north to south limits on 5L51 and 5L52 will be augmented once the non-reinforced system is upgraded with NIC-MDN. The increase in off-peak winter north to south limits ranges from 1085 MW to 2055 MW.

2- For 2014 summer loads, the non-firm north to south limits on 5L51 and 5L52 will be augmented once the non-reinforced system is upgraded with NIC-MDN. The increase in summer north to south limits ranges from 430 MW to 1745 MW.

3- Generally, the increase in the off-peak north to south limits depends on the load level and the ambient temperature. The lower the load demand, the lighter the line flows and the higher the north to south limits. Also, the lower the ambient temperature, the higher the transmission lines' continuous ratings and the higher the north to south limits.

NIC-MDN vs. Do-Nothing: Off-Peak Load N-1 North to South Limits on 5L51 and 5L52

Maximum N-1 north to south capability of the ILM grid during off-peak load conditions in 2014 are investigated for both the NIC-MDN reinforced and the non-reinforced ILM grid. The 2014 peak hour load flow Scenario 8 with 2110 MW of coastal generation is used to develop the off-peak load flow scenarios. At this level of coastal generation, the non-reinforced ILM grid can supply the 2014 peak load and 280 MW of north to south transfers at ING without any ILM N-1 overloads. For off-peak load flow scenarios, the peak hour load is scaled down from 100% to 40% in 10% steps. Table 9 shows details of the load / resource allocations in load flow scenarios 15 to 20 which are used for both summer and off-peak winter analysis.

Table 9

	Scenario No. (Load %)	Upgrade Option	Generation / Load* (MW)					North to South / East to West (MW)	
			BC Hydro	NI	SI	VI	Coastal	To US	From Alberta
1	**8 (100%)**	**NIC-MDN**	10948 / 9922	3398 / 1369	5440 / 1010	562 / 2385	2110 / 7543	280	101
2	**8 (100%)**	**Do-Nothing**	11012 / 9922	3462 / 1369	5440 / 1010	562 / 2385	2110 / 7543	280	101
3	**15 (90%)**	**NIC-MDN**	9855 / 8966	3115 / 1234	5440 / 923	509/ 2139	1300 / 6810	280	101
4	**15 (90%)**	**Do-Nothing**	9920 / 8966	3180 / 1234	5440 / 923	509/ 2139	1300 / 6810	280	101
5	**16 (80%)**	**NIC-MDN**	8711 / 7969	2521 / 1096	5440 / 830	382 / 1890	750 / 6043	280	101
6	**16 (80%)**	**Do-Nothing**	8759 / 7969	2569 / 1096	5440 / 830	382 / 1890	750 / 6043	280	101
7	**17 (70%)**	**NIC-MDN**	7513 / 6960	1323 / 953	5440 / 738	382 / 1653	750 / 5270	280	101
8	**17 (70%)**	**Do-Nothing**	7566 / 6960	1376 / 953	5440 / 738	382 / 1653	750 / 5270	280	101
9	**18 (60%)**	**NIC-MDN**	6453 / 6009	513 / 822	5440 / 650	255 / 1423	500 / 4537	280	101
10	**18 (60%)**	**Do-Nothing**	6498 / 6009	558 / 822	5440 / 650	255 / 1423	500 / 4537	280	101
11	**19 (50%)**	**NIC-MDN**	5358 / 5067	250 / 688	4608 / 566	255 / 1177	500 / 3813	280	101
12	**19 (50%)**	**Do-Nothing**	5389 / 5067	250 / 688	4639 / 566	255 / 1177	500 / 3813	280	101
13	**20 (40%)**	**NIC-MDN**	4232 / 4090	250 / 552	3582 / 478	203 / 928	400 / 3061	280	101
14	**20 (40%)**	**Do-Nothing**	4251 / 4090	250 / 552	3601 / 478	203 / 928	400 / 3061	280	101

The studied N-1 outages include 5L41, 5L42, 5L81, 5L82, and 5L87. In this study, single contingency outages of 5L51 and 5L52 inter-ties are not reviewed. Separate studies will be required to identify the ING-CUS upgrades for maximizing firm transfers. For each one of the outages, the NI generation is increased to augment the amount of N-1 power that can be

transported north to south. NLY phase-shifting transformer is adjusted to simulate all flows from BC to the US on 5L51 and 5L52. The N-1 off-peak north to south limits are defined when the increased north to south causes one of the remaining ILM circuits to reach its overload rating.

Table 10 shows the off-peak N-1 north to south limits of NIC-MDN and Do-Nothing option at 10 ^{O}C and 30 ^{O}C ambient temperatures respectively. This table identifies which transmission circuit defines the north to south limit for every off-peak scenario.

Table 10

					Off-Peak Winter			Summer		
	N-0 Scenario (Upgrade)	**BC Hydro Load (MW)**	**SI Gen. (MW)**	**Coastal Gen. (MW)**	**NI Gen. (MW)**	**N-0 North to South Limit (MW)**	**Limiting T-line**	**NI Gen. (MW)**	**N-0 North to South Limit (MW)**	**Limiting T-line**
1	**Scenario 15 (NIC-MDN)**	8966	5940	1000	4715	1640	5L42 / 5L41	4163	1200	5L81 / 5L44
2	**Scenario 15 (None)**	8966	5940	1000	3520	540	5L81 / 5L82	3180	280	5L81 / 5L82
3	**Scenario 16 (NIC-MDN)**	7969	5940	750	4092	1660	5L42 / 5L41	3992	1560	5L81 / 5L44
4	**Scenario 16 (None)**	7969	5940	750	3088	730	5L81 / 5L82	2726	400	5L81 / 5L82
5	**Scenario 17 (NIC-MDN)**	6960	5940	750	4313	2920	5L42 / 5L41	2921	1730	5L81 / 5L44
6	**Scenario 17 (None)**	6960	5940	750	2530	1330	5L81 / 5L82	2170	1000	5L81 / 5L82
7	**Scenario 18 (NIC-MDN)**	6009	5940	500	4053	3460	5L42 / 5L41	2210	1860	5L81 / 5L44
8	**Scenario 18 (None)**	6009	5940	500	2104	1720	5L81 / 5L82	1719	1370	5L81 / 5L82
9	**Scenario 19 (NIC-MDN)**	5067	5940	500	3100	3640	5L81 / 5L44	1287	2031	5L81 / 5L44
10	**Scenario 19 (None)**	5067	5940	500	1582	2240	5L81 / 5L82	1241	1920	5L81 / 5L82
11	**Scenario 20 (NIC-MDN)**	4090	5940	400	2194	3780	5L81 / 5L44	557	2270	5L81 / 5L44
12	**Scenario 20 (None)**	4090	5940	400	1081	2710	5L81 / 5L82	830	2480	5L81 / 5L82

Review of the results leads to the following preliminary observations:

1- For 2014 off-peak winter loads, the non-firm north to south limits on 5L51 and 5L52 will be augmented once the non-reinforced system is upgraded with NIC-MDN. The increase in off-peak winter north to south limits ranges from 930 MW to 1740 MW.

2- For the 2014 summer loads which are between 90% and 50% of the peak hour load, the non-firm north to south limits on 5L51 and 5L52 will be augmented. At these summer load levels, the increase in summer north to south limits ranges from 1160 MW (at 80% of peak load) to 111 MW (at 50% of the peak load).
3- For the 2014 summer loads which are lower than 50% of the peak hour load, addition of NIC-MDN causes more NIC power to flow from MDN to ING during N-1 outage of 5L81. Consequently, the MDN-ING line 5L44 will be overloaded before 5L82. This situation will result in the NIC-MDN reinforced system to show lower north to south limits than the Do-Nothing system during light summer loads.

Disclaimer:

The options referred to in this note may not reflect all possibilities, and the content of this note is based on a number of assumptions which are subject to change. Accordingly, BCTC MAKES NO WARRANTIES, EXPRESS OR IMPLIED, WHETHER ARISING BY OPERATION OF LAW, COURSE OF PERFORMANCE OR DEALING, CUSTOM, USAGE IN THE TRADE OR PROFESSION, OR OTHERWISE, INCLUDING WITHOUT LIMITATION WARRANTIES OF MERCHANTABILITY AND FITNESS FOR A PARTICULAR PURPOSE WITH REGARD TO ACCURACY, CONTENT, OBSERVATIONS OR CONCLUSIONS.

Any use of this note, and any interpretations, opinions, conclusions, decisions or assumptions reached or made based on or in reliance on, in whole or in part, on this note, is solely at the risk of the party making such use, without recourse to BCTC or its directors, officers, employees or agents. In no event will BCTC or its directors, officers, employees or agents be liable for any damage, injury or loss that is in any way connected to this note including without limitation any indirect, special, incidental, punitive or consequential damages of any kind including loss of revenue, loss of profit or cost of capital.

This note is not intended to and shall not be interpreted to constitute any agreement by BCTC to provide any service or pursue any transmission system reinforcement project either at this point in time or in the future.