IMP_REP_0099

CONNECTION ASSESSMENT & APPROVAL PROCESS

Preliminary Assessment Report – Final Version

Date: March 19, 2003

Niagara-on-the-Lake Hydro Inc.

Build New 115-27.6kV Transformer Station

CAA ID No. 2002 - 067

Long Term Forecasts & Assessments Department

Consistent Information Set Department

Disclaimer

This report has been prepared solely for the purpose of assessing, on a preliminary basis, whether the connection applicant's proposed connection with the IMO-controlled grid would have an adverse impact on the reliability of the integrated power system and whether a System Impact Assessment of the proposed connection should be conducted under Chapter 4, section 6 of the Market Rules. This report has not been prepared for any other purpose and should not be used or relied upon by any person for another purpose. In particular, this report does not address any other Market-related or any commercial aspects of the connection proposal. This report has been prepared solely for use by the Connection Applicant and the IMO in accordance with Chapter 4, section 6 of the Market Rules. The IMO assumes no responsibility to any third party for any use which it makes of this report. Any liability which the IMO may have to the Connection Applicant in respect of this report is governed by Chapter 1, section 13 of the Market Rules. The IMO may revise this report at any time, in its sole discretion, without notice to the Applicant. Although the IMO will use its best efforts to advise you of any such changes, it is the responsibility of the Connection Applicant to ensure that it is using the most recent version of this report.

This document may contain a summary of a particular Market Rule. Where provided, the summary has been used because of the length of the Market Rule itself. The reader should be aware, however, that where a Market Rule is applicable, the obligation that needs to be met is as stated in the "Market Rules". To the extent of any discrepancy or inconsistency between the provisions of a particular Market Rule and the summary, the provision of the Market Rule shall govern.

Executive Summary

This Preliminary Assessment has investigated, in isolation of any other proposed developments, the impact of the proposed new 115-27.6kV 'Niagara-on-the-Lake' MTS #1 on the IMO-controlled grid. It has been concluded that the proposal would not have any significant adverse system impact on the IMO-controlled grid and that a System Impact Assessment would not be necessary.

The Proposal

Niagara-on-the-Lake Hydro Inc. is proposing to construct a new 115-27.6kV transformer station that includes a single 25/33.3/41.7MVA, 115.5-28.4kV 3-phase transformer and three 27.6kV feeder positions. The station will be located in the Town of Niagara-on-the-Lake and will be connected, via a single short tap, to the 115kV Sir Adam Beck #1 GS to Glendale TS transmission circuit Q12S.

The initial load supplied from the new transformer station will be about 11MVA and is forecast to grow to about 39MVA by 2020.

The scheduled in-service date of the new station is June 30, 2003.

Compliance with Market Rules

The proposed plan is in compliance with the Market Rules, if the proponent fulfills the connection requirements outlined in Section 4.0 of this report.

Impact of New Facilities on the IMO-controlled Grid

The proposed plan is intended to relieve the expected overloading of the existing station facilities at the Niagara-on-the-Lake DS. This assessment has concluded that the proposed project will not materially affect the reliability of the IMO-controlled grid.

IMO's Requirements for Connection

The proponent shall fulfill the following connection requirements:

- Ensure that the power factor of the load supplied from the new 'Niagara-on-the-Lake' MTS #1 is maintained within the range of 0.9 lagging to 0.9 leading as measured at the defined metering point.
- Provide automatic under-frequency load shedding facilities at the new 'Niagara-on-the-Lake'MTS #1 to enable the disconnection of at least 30% of its total peak demand. If at least 30% of the distribution system peak demand of Niagara-on-the-Lake Hydro is already subject to an existing automatic under-frequency load shedding scheme, then this requirement would have been satisfied.
- Provide voltage reduction facilities that are capable of reducing the secondary voltage at the new 'Niagara-on-the-Lake' MTS #1 by 3% and 5% within 5 minutes of receiving direction from the IMO.
- Provide the necessary telemetering facilities as specified by the IMO.

Customer Impact Assessment

Hydro One Networks Inc., in consultation with the IMO, has concluded that this project will have no adverse impact on other customers in the area, and that a formal Customer Impact Assessment is not required.

Notification of Approval

It is recommended that Notification of Approval be granted for connection of the new 'Niagara-on-the-Lake' MTS #1 to the IMO-controlled grid, subject to the proponent meeting the connection requirements outlined in Section 4.0 of this report.

1.0 Description of Proposal

The total load demands within the franchise area of Niagara-on-the-Lake Hydro Inc., the connection applicant, have grown to the level that exceeds the load meeting capabilities of the existing facilities. The applicant is therefore proposing to build a new 115-27.6kV transformer station, designated as 'Niagara-on-the-Lake' MTS #1 in the Town of Niagara-on-the-Lake to relieve the loading at the existing Niagara-on-the-Lake DS and to meet expected load growth in the area. The new station would also serve as an alternate supply point to customer loads when either Niagara-on-the-Lake DS or Niagara Stanley TS is unavailable.

The new transformer station will include a 25/33.3/41.7MVA 115.5-28.4kV 3-phase transformer and three 27.6kVfeeder positions. The transformer will be equipped with an under load tap changer having a ±2.84kV (± 10%) range in 33 steps. The primary transformer protection and high voltage isolation from the transmission system will be provided by a 138kV 1200A SF_6 circuit switcher. A 34.5kV 1200A manually operated disconnect switch provides low voltage isolation of the transformer.

Technical specifications of the transformer, circuit switcher, and low voltages switching facilities are as follows:

Transformer:

Manufacturer:	VA Tech
Configuration:	3 phase
Thermal Rating (MVA):	25/33.3/41.7
Rated Voltage (kV):	115.5-28.4kV±10% in 33 steps
Temperature Rise (°C):	65
Positive Sequence Impedance:	Minimum 10% based on 28.4kV and 25MVA
Connection:	High Side – Delta; Low Side – Wye solidly grounded

Circuit Switcher:

Manufacturer:	S&C Electric Company
Model:	Series 2000
Rated Voltage (kV):	138kV
Interrupting Time (ms):	100ms (6 cycles)
Interrupting Media:	SF_6
Rated Continuous Current (A):	1200
Rated Symmetrical Short Circuit Rating (kA):	25

Transformer Disconnect Switch:

Manufacturer:	S&C Electric Company
Model:	Alduti-Rupter
Rated Voltage (kV):	34.5kV
Rated Continuous Current (A):	1200
Rated Momentary Current Rating (kA):	40 (Asym)

Low Voltage Feeder Recloser:

Manufacturer:	G&W Electric Company
Model:	Viper
Rated Voltage (kV):	34.5kV
Interrupting Media:	Solid Dielectric vacuum interrupter
Rated Continuous Current (A):	800
Rated Symmetrical Short Circuit Rating (kA):	12.5 (Sym)

Figure 1 shows the proposed facilities at the new transformer station.

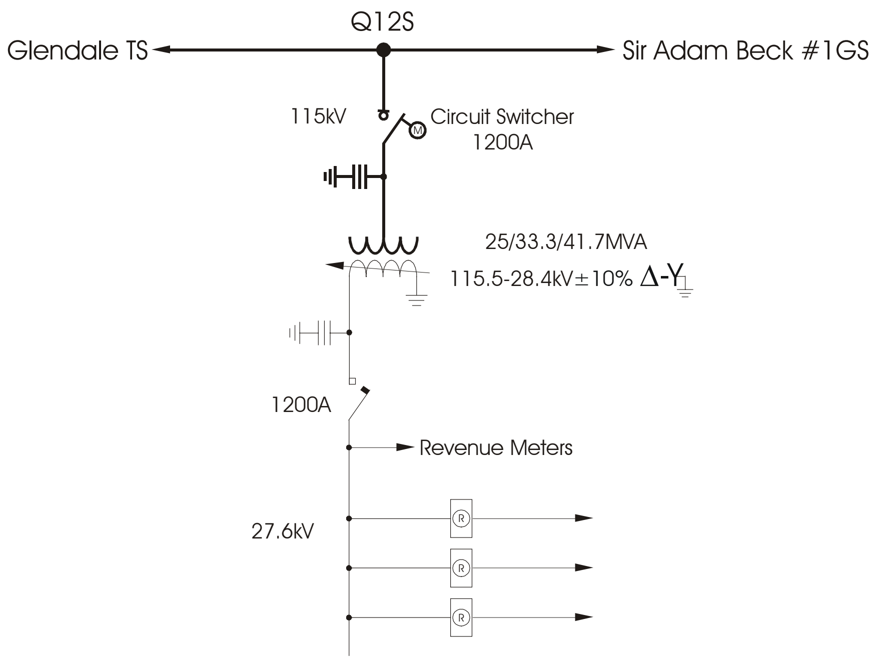

Figure 1: 'Niagara-on-the-Lake' MTS #1

The new station is adjacent to the right of way of the Hydro One Networks Inc. Sir Adam Beck #1 GS (Beck 1 GS) to Glendale TS 115kV transmission circuit Q12S and is about 8.5km from Beck 1 GS. The new station will be connected, via a single 50m long 336kcmil ACSR line tap, to the 115kV transmission circuit Q12S.

Figure 2 shows the 115kV transmission system in the Niagara peninsula and the location of the new transformer station.

The initial summer peak load supplied from the new station will be about 11MVA, of which about 9MVA will be transferred from the existing Niagara-on-the-Lake DS. The summer peak load demands at the new station is forecast to grow to about 39MVA by 2020.

The scheduled in-service date for the new station is June 30, 2003.

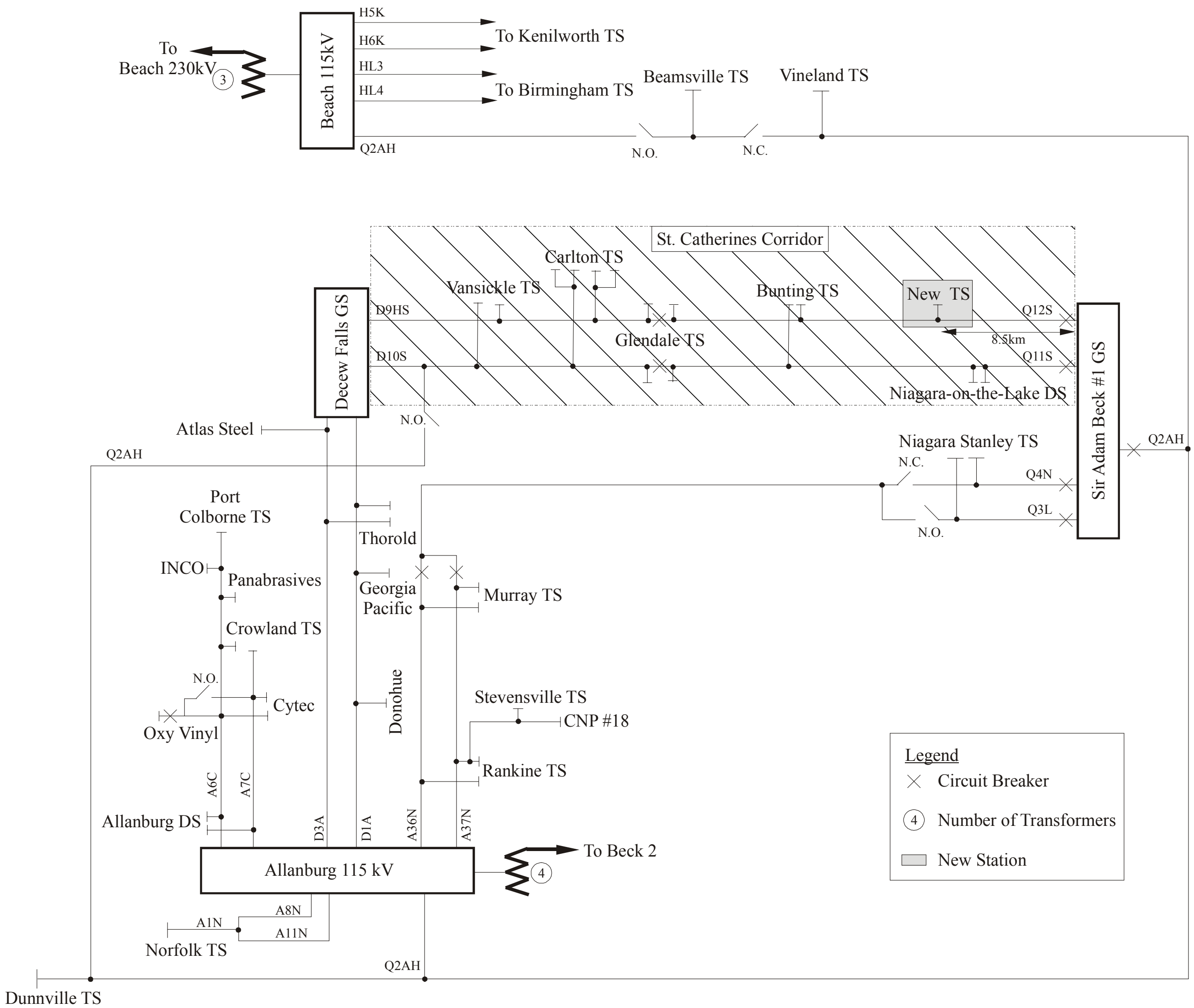

Figure 2: Beck 1 - Decew Falls - Allanburg Corridor 115kV Transmission System

2.0 Assessment

This Preliminary Assessment has investigated, in isolation of any other proposed developments, the impact of the proposed new 115-27.6kV transformer station on the IMO-controlled grid and is based on information included in the connection assessment application. Results presented in this report are only valid for the data provided by the applicant. If subsequent equipment testing indicates that the specifications for new facilities are significantly different from the values provided, then additional studies might be required to re-assess the impact on the IMO-controlled grid.

2.1 Compliance with Market Rules

References:
Market Rules: Chapters 4 and 5
Appendix 4.1: IMO-Controlled Grid Performance Standards
Appendix 4.3: Requirements of Connected Wholesale Customers and Distributors Connected to the IMO-Controlled Grid
Appendix 4.17: IMO Monitoring Requirements – Connected Wholesale Customers and Distributors
Appendix 4.22: IMO Monitoring Requirements – Distributors and Connected Wholesale Customers Performance Standards

2.1.1 Connection Equipment Ratings (Market Rules Chapter 4 Section 3.0, Appendices 4.1 and 4.3)

All 115kV equipment connected to the IMO-controlled grid must be capable of operating within the normal operating voltage range of 113kV and 127kV.

The new 138kV 1200A circuit switcher is capable of operating at a maximum voltage of 145kV and with a thermal rating of approximately 260MVA would be more than adequate for the proposed 42MVA transformer.

Based on information from Hydro One Networks Inc., the present maximum 115kV fault level at the Beck 1 GS is approximately 26kA. After allowing for the attenuating effect of the 8.5km of 115kV transmission line to the tapping point for the new station, the maximum fault interrupting duty that could be imposed on the new circuit-switcher is expected to be well within its rating of 25kA.

While the 25kA rating is considered to be adequate for the existing system conditions, changes to the system configuration could result in future fault levels exceeding this rating. Since the rating of the circuit-switcher is less than the 50kA rating specified in Appendix 2 of the Transmission System Code, then should the fault levels increase beyond the circuit-switcher's rating, Niagara-on-the-Lake Hydro Inc. would be required to implement one of the following options:

- Replace the circuit-switcher with one having a higher rating (if a suitable model is available).
- Replace the circuit-switcher with a circuit breaker having a higher rating.
- Use the circuit-switcher only for routine switching and not for fault clearance, and initiate transfer-tripping to trip 115kV circuit Q12S in the event of a transformer fault, or an uncleared low voltage fault.

2.1.2 Power Factor (Market Rules Chapter 4 Section 3.0 and Appendix 4.3)

Connected wholesale customers connected to the IMO-controlled grid shall operate at a power factor within the range of 0.9 lagging to 0.9 leading as measured at the defined metering point.

Historic load data of the existing Niagara-on-the-Lake DS shows that the load demands in the area were consistently at or better than 0.9 lagging power factor. It is therefore expected that the load supplied from the new transformer station would be operating within the ranged specified by the Market Rules.

As the Niagara-on-the-Lake Hydro Inc. system has historically been operating within the power factor range specified by the Market Rules, the applicant is not planning to install low voltage shunt capacitor bank for power factor correction at the new station. If in the future, the power factor at the 'Niagara-on-the-Lake' MTS #1 should deteriorate and were to be consistently outside the specified range, Niagara-on-the-Lake Hydro Inc. shall undertake to install power factor correction facilities at the station.

2.1.3 Under-Frequency Load Shedding (Market Rules Chapter 5 Section 10.4, Market Rules Chapter 4 Section 3.0, and Appendix 4.3)

As part of the demand control actions that are required to ensure system security under emergency operating conditions, the Market Rules stipulate that distributors, in conjunction with the relevant transmitter, shall make arrangements to enable automatic under-frequency load shedding of at least 30% of its total peak customer demand.

Information included in the connection assessment application shows no evidence of automatic under-frequency load shedding facilities.

Automatic under-frequency load shedding facilities shall be provided at the new 'Niagara-on-the-Lake' MTS #1 to enable the disconnection of at least 30% of its total peak demand.

The automatic under-frequency load shedding relay shall be set to shed:
- 12% of the total station peak demand at 59.3Hz, and
- an additional 23% of the total station peak demand at 58.8Hz

However, if the applicant can show evidence that at least 30% of its distribution system peak demand is already subject to an existing automatic under-frequency load shedding scheme, then the above requirement might be waived.

2.1.4 Voltage Reduction Requirements (Market Rules Chapter 5 Section 10.3, Market Rules Chapter 4 Section 3.0, and Appendix 4.3)

As part of the demand control actions, the Market Rules further stipulate that distributors connected to the IMO-controlled grid with directly connected load facilities of aggregated rating above 20MVA and with the capability to regulate distribution voltages under load, shall provide the capability to reduce distribution voltages by 3% and 5% within 5 minutes of receiving direction from the IMO.

Niagara-on-the-Lake Hydro Inc. shall therefore install and maintain facilities to provide the capability to reduce the secondary voltage at the new 'Niagara-on-the-Lake' MTS #1 by 3% and 5% within 5 minutes of receiving direction from the IMO to do so.

2.1.5 On-line Monitoring Requirements (Market Rules Chapter 4 Section 7.5, Appendices 4.17 and 4.22)

In order to facilitate the operations of the IMO-controlled grid, certain information including active and reactive power demands, status of circuit switcher, etc shall be provided to the IMO on a continual basis.

General monitoring requirements and minimum performance standards are outlined in the Market Rules Appendices 4.17 and 4.22.

The applicant shall obtain the exact monitoring requirements for the new 'Niagara-on-the-Lake' MTS #1 via the IMO Facility Registration process.

2.2 Impact of 'Niagara-on-the Lake' MTS #1 on the IMO-controlled Grid

The new station is to be used solely for load supply, with no embedded generation connected. The following assessment therefore concentrates on investigating the impact of the new facilities on the IMO-controlled grid in regard to fault level, thermal loading of the 115kV transmission system, and voltage profile in the area.

The new 'Niagara-on-the-Lake' MTS #1 will be located in an area defined as the Allanburg 115kV area, which is considered a local area such that only single contingencies will be respected. The new station will be connected to the Beck 1 GS to Glendale TS 115kV transmission circuit Q12S, which is a component of the 115kV system that is defined as the St. Catherines Corridor in the IMO-controlled grid. Figure 2 shows the 115kV transmission system in the Allanburg 115kV area.

The intent of the new 'Niagara-on-the-Lake' MTS #1 is to relieve the overloading problem at the existing Niagara-on-the-Lake DS and to meet future load growth in the Niagara-on-the-Lake Hydro Inc. system. Initially some of the load that is presently supplied from Niagara-on-the-Lake DS will be transferred to the new 'Niagara-on-the-Lake' MTS #1. Although this load transfer from the existing Niagara-on-the-Lake DS to the new station will reduce the amount of load interrupted for single-circuit contingencies involving circuit Q11S or Q12S, supply interruptions will be unavoidable for these particular contingencies with the proposed connection arrangement. Had Niagara-on-the-Lake Hydro Inc. expanded the existing DS to change it to a DESN arrangement rather than establishing a new transformer station, then this could have limited the customer interruption exposure to single circuit contingencies. However the applicant has indicated that customer loads can be, via their distribution system, transferred between the existing DS and the new station for protracted outages of either Q11S or Q12S. This is a definite improvement with respect to customer supply reliability over the existing arrangement.

2.2.1 Short Circuit Assessment

The composition of the station load will be about 20% industrial, 40% commercial, and 40% residential. As there is no known plan to connect any embedded generation, large synchronous, or induction motors to the new station. The new station would, therefore, not expect to have any significant impact on the existing fault level in the area.

2.2.2 Local Thermal Loading Considerations

Power flow studies for all elements in service and for single circuit contingencies were carried out to evaluate the impact of the new station on the thermal loading of the 115kV transmission system in the Allanburg 115kV area. 2003 and 2013 summer peak load conditions were studied.

The following assumptions were made in deriving the 2003 and 2013 load flow base cases:

- Based on information provided by the applicant, the 2003 summer peak loads at the new station was set at 11MVA and the 2013 station load was projected to be 23MVA(10 MW at 2003 and 35MW at 2020)
- 8MW of the existing Niagara-on-the-Lake DS load was transferred to the new station
- The 2003 and 2013 station load demands at the remaining load supply points in the Allanburg 115kV area were based on the historic 2002 summer peak demands at these load supply points and using the IMO preliminary 10-year forecast growth rates for the Niagara Peninsula region.
- The station loads at Beamsville TS and Vineland TS were restricted to their respective 10-day limited time ratings of 27.8MW and 56.6MW

❖ The following two generation patterns at Beck 1GS and Decew Falls GS were assumed

Generation Pattern (A)
This pattern stresses the thermal loading of transmission circuits emanating from Beck 1 GS (Circuits Q2AH, Q4N, Q11S and Q12S)
- All seven units at Beck 1 GS are in-service with a total generation of 415MW
- Decew Falls GS is not available

Generation Pattern (B)
This pattern stresses the thermal loading of transmission circuits D9HS and D10S that terminate at Decew Falls GS.
- Full output at Decew Falls ND1 and Decew Falls GS with a total generation of 151.5MW
- Six units at Beck 1 GS in-service with a total generation of 254MW to maintain the power flow through the four auto-transformers at Allanburg TS at a level that is similar to Case (A)

The studies focused on the transmission circuits emanating from Beck 1 GS (Q2AH, Q3L, Q4N, Q11S, and Q12S) and the two transmission circuits from Decew Falls GS to Glendale TS (D9HS and D10S). Table 1 lists the summer ratings of these circuits.

The following criteria were applied in assessing the thermal loading capability of the 115kV transmission system in the area:

❖ With all elements in service, power flow on any transmission circuit shall be below the continuous rating.
❖ With the loss of a single circuit, the post contingency flow on any transmission circuit shall not exceed the limited time rating (LTR).
❖ Should the post contingency flow on any transmission circuit exceed the emergency rating but is below the LTR, control actions such as load rejection and/or re-scheduling of generation shall be deployed to lower the power flow below the emergency rating.

Circuit	Section	Conductor Size	Max. Op. Temp. (°C)	Continuous Rating[1] (A)	Emergency Rating[2] (A)	15-Min. LTR[3] (A)
D9HS	Decew Falls – Glendale	605 ACSR 54/7	150	710	1020	1130
D10S	Decew Falls – Glendale	605 ACSR 54/7	150	710	1020	1130
Q2AH	Beck 1 – Holland Road Jct	732 ACSR 16/7	127	780	1000	1110
	Holland Road Jct – Allanburg	732 ACSR 16/7	127	780	1000	1110
	Holland Road Jct – Beamsville	605 ACSR 54/7	110	710	820	860
Q3L	Beck 1 – Stanley	997.2 ACSR 21/7	150	950	1370	1620
Q4N	Beck 1 – Stanley	997.2 ACSR 21/7	150	950	1370	1620
	Stanley –Murray	593 ACSR 15/7	127	690	880	950
Q11S	Beck 1 – Glendale	605 ACSR 54/7	127	710	910	990
Q12S	Beck 1 – Glendale	605 ACSR 54/7	127	710	910	990

Notes
1. Based on 93°C operating temperature with 30°C ambient temperature, 4km/h wind
2. Based on maximum operating temperature
3. Based on maximum operating temperature with a pre-load current equal to the continuous rating

Table 1 – Transmission Circuit Current Ratings

Year 2003 Study

Two sets of studies were performed. The first set (Cases 1 and 6) represents the existing transmission system and serves as a baseline for comparison to evaluate the impact of the new station on the IMO-controlled grid. The second set (Cases 2 to 5 and Cases 7 to 9) includes the new station in the Allanburg 115kV system. Outage conditions were studied only in those cases that have the new station in service. Also post-contingency load transfer between the Niagara-on-the-Lake DS and the new station were simulated in the outage cases. Results of these studies are presented in Table 2. Circuit loadings that exceed the circuit continuous ratings are shaded.

Results of cases 1, 2, 6, and 7 show that the addition of the new 'Niagara-on-the-Lake' MTS #1 onto circuit Q12S and the subsequent load transfer from the existing Niagara-on-the-Lake DS will increase the power flow on circuit Q12S, while the flow on Q11S, which supplies the existing Niagara-on-the-Lake DS will decrease. These cases further demonstrate that power flows on the St. Catherines Corridor transmission circuits are very dependent on the output of the generating stations in the area. High output at Beck 1 GS will increase the flows on Q11S and Q12S and will reduce the flows on circuits D9HS and D10S. While high output at Decew Falls GS will have opposite effect on these circuits.

Result of Case 4 shows that with full output at Beck 1 GS, power flow on circuit Q12S will exceed the circuit continuous rating but within the 15-minute limited time rating (LTR) after the loss of circuit Q11S and the transfer of all the loads supplied from the existing Niagara-on-the-Lake DS to the new station. Control actions such as generation re-scheduling and the curtailment of post-contingency load transfer would have to be deployed to respect the emergency rating. This particular condition is the direct result of the proposed plan. With the existing system, the loss of circuit Q11S will also result in the loss of all the loads (about 30MW) supplied from the existing Niagara-on-the-Lake DS. The resulting power flow on Q12S will be less and well within its emergency rating.

Case 5 shows that with similar system conditions circuit Q11S will be loaded to about 90% of its emergency rating after the loss of Q12S and the transfer of loads between the existing DS and the new station.

Case 8 shows that with full output at Decew Falls GS and reduced output at Beck 1 GS, the loss of circuit D9HS will load the companion circuit D10S to about 94% of its emergency rating.

The above noted post contingency conditions can be alleviated by restricting load transfer or by re-scheduling the outputs at the generating stations in the area. However, it should be noted that those problems identified by Cases 5 and 8 would have occurred with the existing system and are not the results of the proposed plan.

Year 2013 Study

Only critical contingencies involving the St. Catherines Corridor transmission circuits were simulated. Results of the 2013 case studies are presented in Table 3. As expected, results of load flow studies demonstrate that future load growth in the area will aggravate the loading problems of the St. Catherines Corridor transmission circuits. Within the next 10 to 15 years, reinforcement of the Allanburg 115kV system would be required, as control actions alone might not be enough to alleviate the overloading problems in the area.

Results of Cases 11 and 12 show that with high output at Beck 1GS, the post-contingency power flow on the companion circuit for the loss of Q11S or Q12S will exceed circuit emergency rating but within the 15-minute LTR even without any load transfer between the Niagara-on-the-Lake DS and the new station.

However, Cases 15 and 16 show that decreasing generation output at Beck 1 GS with a corresponding generation increase at Decew Falls GS will alleviate overloading of Q11S and permit the transfer of load between stations.

Case 14 shows that with maximum output at Decew Falls GS, either D9HS or D10S will be loaded to the 15-minute LTR after the loss of the companion circuit. Similarly re-scheduling generation within the area is expected to alleviate any potential overload problem.

2.2.3 Voltage Profile Assessment

With two generating stations, Beck 1 GS and Decew Falls GS, within the area and two 115kV 117MX shunt capacitor banks at Allanburg TS, it is expected that the operating voltage in the area will meet the requirement specified in the Market Rules.

Results of load flow studies show that with all elements in service, the stations within the St. Catherines Corridor were maintaining the pre-contingency operating voltages within 119kV to 122kV and post-contingency voltages between 116kV and 122kV.

Case	Generation	System	Outage	D9HS				D10S				Q2AH @ Beck				Q4N @ Beck				Q11S				Q12S			
				Ratings (A)			Flow (A)	Ratings (A)			Flow (A)	Ratings (A)			Flow (A)	Ratings (A)			Flow (A)	Ratings (A)			Flow (A)	Ratings (A)			Flow (A)
				Con't	Emg	LTR		Con't	Emg	LTR		Con't	Emg	LTR		Con't	Emg	LTR		Con't	Emg	LTR		Con't	Emg	LTR	
1	Full output at Beck and Decew Falls GS O/S	Exist'g	None	710	1020	1130	258	710	1020	1130	343	780	1000	1110	307	950	1370	1620	520	710	910	990	594	710	910	990	524
2		New TS I/S	None	710	1020	1130	273	710	1020	1130	327	780	1000	1110	308	950	1370	1620	521	710	910	990	556	710	910	990	556
3			Q4N	710	1020	1130	197	710	1020	1130	250	780	1000	1110	517	950	1370	1620	0	710	910	990	638	710	910	990	648
4			Q11S[1]	710	1020	1130	393	710	1020	1130	456	780	1000	1110	395	950	1370	1620	624	710	910	990	0	710	910	990	926
5			Q12S[2]	710	1020	1130	457	710	1020	1130	437	780	1000	1110	414	950	1370	1620	646	710	910	990	881	710	910	990	0
6	Full output at Decew Falls GS	Exist'g	None	710	1020	1130	451	710	1020	1130	523	780	1000	1110	170	950	1370	1620	352	710	910	990	413	710	910	990	320
7		New TS I/S	None	710	1020	1130	466	710	1020	1130	508	780	1000	1110	172	950	1370	1620	354	710	910	990	375	710	910	990	352
8			D9HS	710	1020	1130	0	710	1020	1130	961	780	1000	1110	150	950	1370	1620	328	710	910	990	415	710	910	990	368
9			D10S	710	1020	1130	936	710	1020	1130	0	780	1000	1110	141	950	1370	1620	315	710	910	990	424	710	910	990	389

Notes
(1): After the loss of Q11S loads supplied from existing Niagara-on-the-Lake DS were transferred to new 'Niagara-on-the-Lake' MTS #1
(2): After the loss of Q12S loads supplied from new 'Niagara-on-the-Lake' MTS #1 were transferred to existing Niagara-on-the-Lake DS

Table 2 – 2003 Case Study Results

Case	Generation	System	Outage	D9HS				D10S				Q2AH @ Beck				Q4N @ Beck				Q11S				Q12S			
				Ratings (A)			Flow (A)	Ratings (A)			Flow (A)	Ratings (A)			Flow (A)	Ratings (A)			Flow (A)	Ratings (A)			Flow (A)	Ratings (A)			Flow (A)
				Con't	Emg	LTR		Con't	Emg	LTR		Con't	Emg	LTR		Con't	Emg	LTR		Con't	Emg	LTR		Con't	Emg	LTR	
10	Full output at Beck and Decew Falls GS O/S	New TS I/S	None	710	1020	1130	370	710	1020	1130	414	780	1000	1110	218	950	1370	1620	484	710	910	990	604	710	910	990	627
11			Q11S[1]	710	1020	1130	444	710	1020	1130	519	780	1000	1110	347	950	1370	1620	635	710	910	990	0	710	910	990	928
12			Q12S[1]	710	1020	1130	524	710	1020	1130	525	780	1000	1110	355	950	1370	1620	645	710	910	990	918	710	910	990	0
13	Full output at Decew Falls GS	New TS I/S	None	710	1020	1130	561	710	1020	1130	593	780	1000	1110	78	950	1370	1620	315	710	910	990	421	710	910	990	421
14			D9HS	710	1020	1130	0	710	1020	1130	1133	780	1000	1110	48	950	1370	1620	277	710	910	990	462	710	910	990	466
15			Q12S[1]	710	1020	1130	529	710	1020	1130	748	780	1000	1110	154	950	1370	1620	406	710	910	990	646	710	910	990	0
16			Q12S[2]	710	1020	1130	534	710	1020	1130	798	780	1000	1110	126	950	1370	1620	373	710	910	990	733	710	910	990	0

Notes
(1): No load transfer after the loss of Q12S
(2): 50% of 'Niagara-on-the-Lake' MTS #1 load transferred to existing Niagara-on-the-Lake DS after the loss of Q12S

Table 3 – 2013 Case Study Results

3.0 Conclusions

The addition of the new station and subsequent load transfer from the existing Niagara-on-the-Lake DS will result in the re-distribution of power flows on the St. Catherines Corridor transmission circuits. The addition of the new station will also reduce the amount of load interrupted for single-circuit contingencies involving circuit Q11S or Q12S. In addition, customer loads can be transferred between the existing DS and the new station via the applicant's distribution system for protracted outages of either Q11S or Q12S. This is a definite improvement with respect to customer supply reliability over the existing arrangement.

Power flow studies show that the Allanburg 115kV area transmission system could run into post contingency transmission circuit overloading problems under certain generation patterns. These problems can be alleviated by restriction of post contingency load transfer between stations and/or re-scheduling of generation within the area. However, it should be noted that these problems would have occurred irrespective of the proposed project.

It has therefore been concluded that the proposed project does not materially change the load meeting capability or the reliability of the IMO-controlled grid.

4.0 IMO's Requirements for Connection

Niagara-on-the-Lake Hydro Inc. shall:

- Ensure that the load supplied from the new 'Niagara-on-the-Lake' MTS #1 shall operate at a power factor within the range of 0.9 lagging to 0.9 leading as measured at the defined metering point, which is the 115kV connection point to the IMO-controlled grid.
- Provide automatic under-frequency load shedding facilities at the new 'Niagara-on-the-Lake'MTS #1 to enable the disconnection of at least 30% of its total peak demand. This requirement would be considered to be met, if the proponent confirms that at least 30% of its distribution system peak demand is already subject to an existing automatic under-frequency load shedding scheme.
- Provide voltage reduction facilities that are capable of reducing the secondary voltage at the new 'Niagara-on-the-Lake' MTS #1 by 3% and 5% within 5 minutes of receiving direction from the IMO to do so.
- Provide the necessary telemetering facilities as specified by the IMO via the Facility Registration Process.

5.0 Customer Impact Assessment

Hydro One Networks Inc., in consultation with the IMO, has concluded that this project will have no adverse impact on other customers in the area, and that a formal Customer Impact Assessment is not required.

6.0 Recommendation

Based on the above assessment, it is recommended that a System Impact Assessment would not be necessary and subject to the applicant meeting the connection requirements outlined in Section 4.0 a Notification of Approval for this proposal be issued to the applicant.

7.0 Related Matters

The IMO has, in other studies and connection assessments, identified the following operational problems with the present Allanburg 115kV system:

- Post contingency voltage decline following the loss of autotransformer T1 or T2 at Allanburg TS, when the companion autotransformer is out of service.
- Pre and post contingency loadings on autotransformer T1 at Allanburg TS could exceed the continuous and limited time ratings of T1 under certain generation patterns at Beck 1 GS and certain flow patterns on the 230kV Sir Adam Beck #2 GS to Middleport TS transmission circuit Q30M
- When Decew Falls GS is not available, the load demands in the Allanburg 115kV area will dictate the minimum number of generating units at Beck 1 GS to maintain pre-contingency voltage level in the area
- Under certain generation patterns at the generating stations within the area, 115kV transmission circuits in the area could experience post-contingency overloading

These problems can be alleviated by deploying a load rejection scheme, load transfer, and by re-scheduling generation within the Allanburg 115kV area, i.e. Decew Falls GS and Beck 1 GS. However, these generation re-scheduling practices would likely increase the constraint management costs.

Hydro One Network Inc. is fully aware of the existing operational issues in the Allanburg 115kV area and plans, including the transfer of about 80MW of load from the Allanburg 115kV area to Caledonia TS in the Nanticoke GS area in 2004, are being formulated to address the issues.