IMP_REP_109

Independent Electricity Market Operator

CONNECTION ASSESSMENT & APPROVAL PROCESS

Preliminary Assessment Report – Final Version

Date: April 22, 2003

Grimsby Power Inc. & Peninsula West Utilities Inc.

Build New 230-27.6kV 'Niagara West' MTS

CAA ID No. 2002 – 073

Long Term Forecasts & Assessments Department

Consistent Information Set Department

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Disclaimer

This report has been prepared solely for the purpose of assessing 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 the IMO should issue a notice of approval or disapproval of the proposed connection under Chapter 4, section 6 of the Market Rules.

Approval of the proposed connection is based on information provided to the IMO by the connection applicant and the transmitter(s) at the time the assessment was carried out. The IMO assumes no responsibility for the accuracy or completeness of such information, including the results of studies carried out by the transmitter(s) at the request of the IMO. Furthermore, the connection approval is subject to further consideration due to changes to this information, or to additional information that may become available after the approval has been granted. Approval of the proposed connection means that there are no significant reliability issues or concerns that would prevent connection of the proposed facility to the IMO-controlled grid. However, connection approval does not ensure that a project will meet all connection requirements. In addition, further issues or concerns may be identified by the transmitter(s) during the detailed design phase that may require changes to equipment characteristics and/or configuration to ensure compliance with physical or equipment limitations, or with the Transmission System Code, before connection can be made.

This report has not been prepared for any other purpose and should not be used or relied upon by any person for another purpose. 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. In the event that the IMO provides a draft of this report to the connection applicant, you must be aware that the IMO may revise drafts of this report at any time in its sole discretion without notice to you. 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.

Executive Summary

This Preliminary Assessment has investigated, in isolation of any other proposed developments, the impact of the proposed new 230-27.6kV 'Niagara West' MTS 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

Grimsby Power Inc. and Peninsula West Utilities Inc. have jointly proposed constructing a new 230-27.6kV transformer station in West Lincoln on Regional Road 12. The new transformer station will be a 230-27.6kV DESN station with two 40/53.3/66.7MVA 215.5-27.6/16kV 3-phase transformers and six 27.6kVfeeders. The primary winding of the transformers will be equipped with an under load tap changer having a ±34.5kV (± 16%) range in 33 steps. The station will be connected, via two 50m long line taps, to the Hydro One Networks Inc. three-ended Beck 2 – Middleport – Burlington 230kV transmission circuits Q23BM and Q25BM.

Initially the total summer peak demand at the new station will be about 30MVA and is forecast to increase by about 4MVA annually.

The scheduled in-service date for the new station is January 2004.

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 'Niagara West' MTS on the IMO-controlled Grid

The proposed plan is intended to relieve the existing Beamsville TS. This assessment has concluded that the proposed project will not materially affect the load meeting capability and reliability of the IMO-controlled grid.

The assessment shows that initially the new 'Niagara West' MTS would slightly increase the power flows on the 230kV transmission circuits from Beck 2 GS to Middleport TS, Burlington TS, and Beach TS. This potentially might limit the generating output at Beck 2 GS or the import from New York at the Niagara Peninsula interface. As the Allanburg Area 115kV system load demands grow in the future, the power flows on the 230kV circuits from Beck 2 GS to Middleport TS, Burlington TS, and Beach TS will decrease, subsequently reducing or even eliminating the necessity of constraining Beck 2 GS to respect transmission thermal limits.

However, it should be noted that depending on system conditions, constraining of Beck 2 GS and/or import from New York across the Niagara interface might have occurred without the addition of the new 'Niagara West' MTS. The new station would at most extend the constraining period slightly longer into the future.

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 West' MTS is maintained within the range of 0.9 lagging to 0.9 leading as measured at the defined metering point.
- Ensure that resources and facilities are available to maintain the capability of reducing the secondary voltage at the new 'Niagara West' MTS 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.

Customer Impact Assessment

Hydro One Networks Inc. has advised the IMO 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 West' MTS 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 existing 115kV Beamsville TS, which is owned by Hydro One Networks Inc., is presently supplying Grimsby Power Inc. and Peninsula West Utilities Inc. loads in the Niagara Peninsula. The total load demands at Beamsville TS have reached the load meeting capability of the transformer station. Grimsby Power Inc. and Peninsula West Utilities Inc., collectively referred to as the connection applicant herein, have jointly proposed building a new 230-27.6kV transformer station, designated as 'Niagara West' MTS to relieve the loading at the existing Beamsville TS and to meet future load growth in the area.

The new transformer station will be a 230-27.6kV DESN station with two 40/53.3/66.7MVA 215.5-27.6/16kV 3-phase transformers and six 27.6kVfeeder positions. The primary winding of the transformers will be equipped with an under load tap changer having a ±34.5kV (± 16%) range in 33 steps. Motorized 230kV disconnect switches and 27.6kV vacuum breakers will provide isolation for the transformers. Figure 1 shows the proposed facilities at the new transformer station.

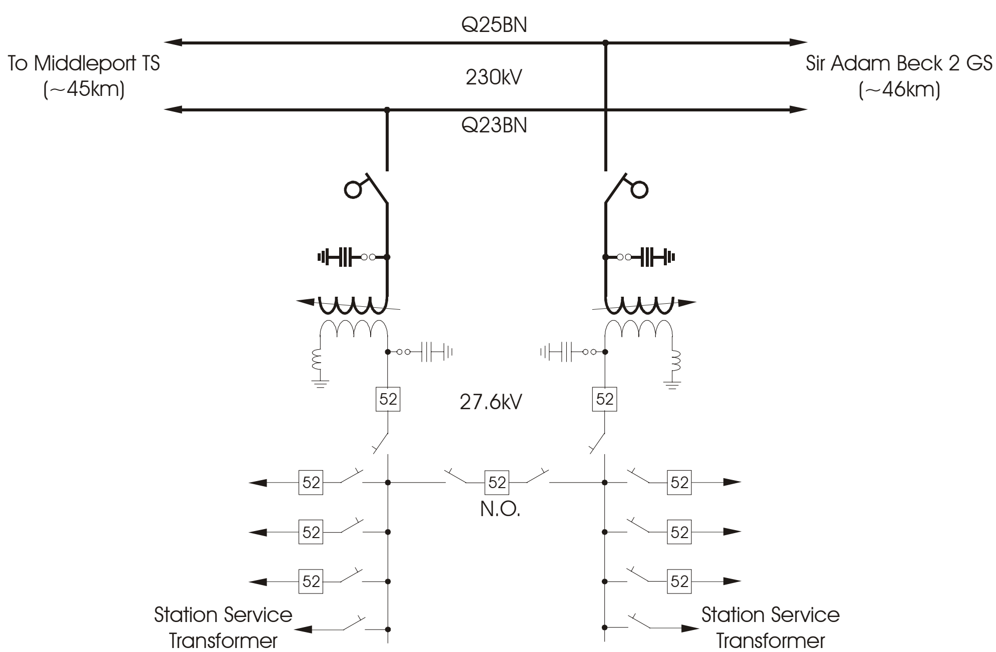

Figure 1 – 'Niagara West' MTS

The new station will be located in West Lincoln on Regional Road 12 and is approximately 46km from the Sir Adam Beck 2 GS (Beck 2 GS). The new station will be connected to the Hydro One Networks Inc. three-ended Beck 2 – Middleport – Burlington 230kV transmission circuits Q23BM and Q25BM via two 50m long 795kcmil ACSR line taps. Figure 2 shows the 230kV transmission system in the Niagara Peninsula and the location of the new transformer station.

The initial loads supplied from the new station will be loads transferred from Beamsville TS and the initial station summer peak demand will be about 30MVA. The station load demand is forecast to increase by about 4MVA annually. The new station has a firm summer overload capability of 100MVA.

The scheduled in-service date for the new station is January 2004.

Technical specifications of the major components are as follows:

Transformer:

Configuration:	3 phase
Thermal Rating (MVA):	40/53.3/66.7
Rated Voltage (kV):	215.5±16% in 33 steps –27.6/16
Temperature Rise (°C):	65
Positive Sequence Impedance:	Minimum 10% based on 215.5-27.6kV and 40MVA
Connection:	High Side – Wye ungrounded; Low Side – Zig-Zag 1.5 ohm reactor grounded

Motorized Disconnect Switch:

Rated Nominal Voltage (kV):	230
Rated Maximum Voltage (kV):	242
Rated Continuous Current (A):	2,000
Rated Momentary (3 sec.) Current (kA):	63

Low Voltage Switchgear:

Type:	Indoor SF_6 Gas Insulated Switchgear
Rated Nominal Voltage (kV):	27.6
Rated Maximum Voltage (kV)	36
Rated Continuous Current (A):	Main Bus – 2,500 Main Breakers – 2,500 Bus Tie Breaker – 2,500 Feeder Breakers – 1,250
Rated Interrupting Capability (kA):	16
Rated Momentary (3 sec.) Current (kA):	31.5

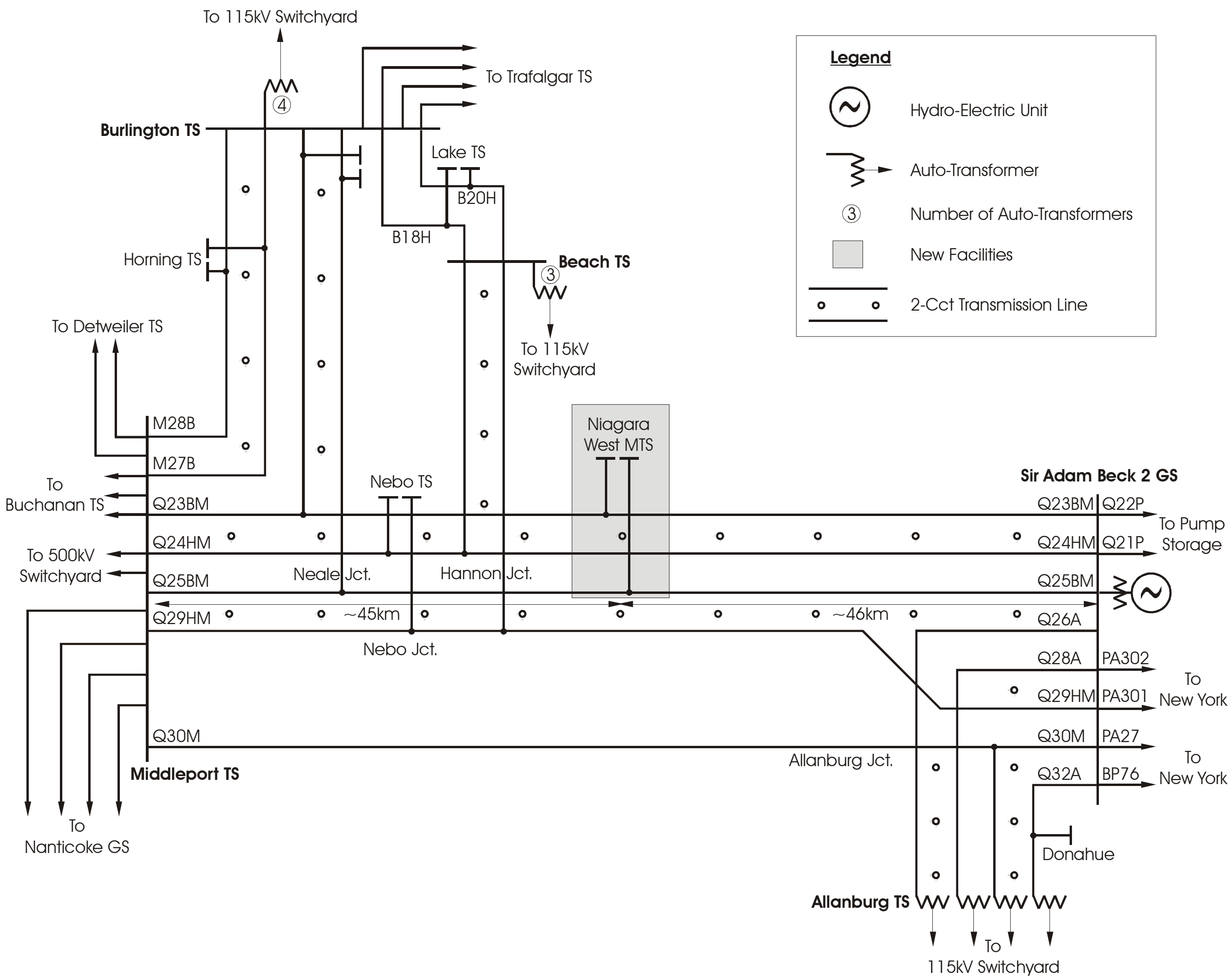

Figure 2 – 230kV Transmission System in Niagara Peninsula

2.0 Assessment

This Preliminary Assessment has investigated, in isolation of any other proposed developments, the impact of the proposed new 230-27.6kV 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 connection 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)

This assessment focuses only on the high voltage facilities that connect to the IMO-controlled grid. Low voltage facilities are not expected to have adverse impact on the IMO-controlled grid and will not be assessed.

All 230kV equipment connected to the IMO-controlled grid must be capable of operating within the normal operating voltage range of 220kV and 250kV.

The proposed new station will include two 40/53.3/66.7MVA 215.5-27.6/16kV transformers. The summer overload capability of the transformer is 100MVA (262A at 220kV). The primary winding of the transformers will be equipped with an under load tap changer that provides an operating range of 181kV to 250kV in 33 steps. The new transformers would be fully capable of operating within the range of 220kV to 250kV.

Each transformer will be connected to the IMO-controlled grid via a 230kV 2,000A motorized disconnect switch and a 50m long 795kcmil line tap. The motorized disconnect switches connecting the transformers to the IMO-controlled grid have a nominal voltage rating of 230kV and a 242kV maximum voltage rating. However, the IMO has received written confirmation from the consultant of the connection applicant indicating the vendor of the switches has assured that the switches are capable of operating at 250kV.

The 230kV disconnect switches have a continuous rating of 2,000A (about 762MVA at 220kV) and a momentary current rating of 63kA. The proposed transformer disconnect switches would be adequate for the proposed 40/53.3/66.7MVA transformers and the maximum 230kV system fault level.

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.

The connection applicant indicates that the loads supplied from the new 'Niagara West' MTS will be operating at a power factor of about 0.92 lagging and would be in compliance with the Market Rules.

The connection assessment application shows that there is no plan to install low voltage shunt capacitor banks for power factor correction at the new station. If, in the future, the power factor at the 'Niagara West' MTS should deteriorate and were to be consistently outside the specified range, the connection applicant 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 that automatic under-frequency load shedding facilities will be provided. The connection applicant further confirms that the automatic under-frequency load shedding relay would 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

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.

Both transformers at the 'Niagara West' MTS are equipped with under load tap changers, which under normal operating conditions will operate automatically to maintain the 27.6kV bus voltage. Remote manual control of the under load tap changers is also available via SCADA.

The 'Niagara West' MTS thus has the capability to reduce the secondary voltage at the new 'Niagara West' MTS 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 connection applicant shall obtain the exact monitoring requirements for the new 'Niagara West' MTS via the IMO Facility Registration process.

2.2 Impact of 'Niagara West' MTS 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 230kV transmission system, and voltage profile in the area.

The proposed new transformer station will be connected to the three-ended 230kV transmission circuits Q23BM and Q25BM. These two 230kV transmission circuits are part of the 230kV transmission system in Niagara Peninsula bounded by the Sir Adam Beck 2 GS, Middleport TS, and Burlington TS, as shown in Figure 2. It is expected that any impact on the IMO-controlled grid from the proposed new transformer station will be localized in the 230kV system in the Niagara Peninsula. The following assessment is therefore focused on the 230kV system bounded by Sir Adam Beck 2 GS, Middleport TS, and Burlington TS.

2.2.1 Short Circuit Assessment

The composition of the station load will be about 55% industrial, 23% commercial, and 22% residential. 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

There are a total of fourteen 230kV transmission circuits emanating from Beck 2 GS. Five of the fourteen circuits are radial circuits, three circuits Q26A, Q28A, and Q32A supply Allanburg TS and two circuits Q21/22P incorporate the Beck complex pump storage facilities. Four other circuits PA27, BP76, PA301, and PA302 are components of the interconnection to New York. The remaining five circuits, Q23BM, Q24HM, Q25BM, Q29HM, and Q30M, are integrated circuits connecting Beck 2 GS to major terminal stations within the IMO-controlled grid.

The new 'Niagara West' MTS will be connected to the 230kV circuits Q23BM and Q25BM, which are two of the five 230kV transmission circuits interconnecting Beck 2 GS, Middleport TS, Burlington TS, and Beach TS. Any impact of the new 'Niagara West' MTS on the IMO-controlled grid with respect to thermal loading of transmission lines would likely be on these five integrated 230kV circuits. The following assessment on transmission line loading, therefore, focuses only on the 230 kV transmission circuits Q23BM, Q24HM, Q25BM, Q29HM, and Q30M. Table 1 lists the summer ratings of these circuits.

Power flow studies for all elements in service and first contingencies were carried out to evaluate the impact of the new station on the thermal loading of the 230kV transmission system in the Niagara Peninsula. Summer loading conditions are expected to be more restrictive than winter. Therefore only 2004 and 2014 summer peak load conditions were studied.

As shown in Figure 2, those five integrated 230kV transmission circuits emanating from Beck 2 GS are all components of double circuit transmission lines. Only contingencies simulating L-L-G fault at double circuit transmission line were studied. One contingency simulates a L-L-G fault at the Beck 2 to Middleport double circuit section of the Q25BM and Q29HM line. The second contingency simulates a L-L-G fault at the Hannon Junction to Beach TS double circuit section of the Q24HM and Q29HM line.

The following assumptions were made in deriving the 2004 and 2014 load flow base cases:

- 2004 load at the new 'Niagara West' MTS was based on information provided by the connection applicant. The 2014 station load was projected using 4MVA per year growth provided by the connection applicant.
- The 2004 and 2014 station load demands at the remaining load supply points in the Niagara Peninsula region were projected using the historic 2002 summer peak demands at these load supply points and the IMO preliminary 10-year forecast growth rates for the region.
- Full output at Sir Adam Beck 2 GS (1520MW) and the pump storage facilities (125.7MW) with a total generation of 1645.7MW and about 690MW interconnection flow from New York resulting in heavy power flow on the 230kV transmission circuit emanating from Beck 2.
- Additional 115kV capacitor banks were assumed in-service by 2014 at Burlington TS and Beach TS to maintain pre-fault 115kV bus voltage at about 115kV.

The following criteria were applied in assessing the thermal loading capability of the 230kV transmission system in the area:

- With all elements in service, power flow on any transmission circuit shall be below the continuous rating (based on a maximum operating temperature of 93°C).
- 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)
	From	To					
Q23BM	Beck 2 GS	Niagara West	1192.5ACSR 54/19	108	1110	1270	1380
	Niagara West	Neale Jct.	1192.5ACSR 54/19	108	1110	1270	1380
	Neale Jct.	Middleport TS	795ACSR 26/7	116	870	1050	1130
	Neale Jct.	Burlington TS	1192.5ACSR 54/19	104	1110	1230	1310
Q25BM	Beck 2 GS	Niagara West	1192.5ACSR 54/19	109	1110	1280	1390
	Niagara West	Neale Jct.	1192.5ACSR 54/19	109	1110	1280	1390
	Neale Jct.	Middleport TS	795ACSR 26/7	130	870	1140	1260
	Neale Jct.	Burlington TS	1192.5ACSR 54/19	115	1110	1330	1480
Q24HM	Beck 2 GS	Hannon Jct.	1192.5ACSR 54/19	111	1110	1300	1420
	Hannon Jct.	Nebo Jct.	1192.5ACSR 54/19	150	1110	1610	1920
	Nebo Jct.	Middleport TS	1192.5ACSR 54/19	116	1110	1340	1500
	Hannon Jct.	Beach TS	1192.5ACSR 54/19	150	1110	1610	1920
Q29HM	Beck 2 GS	Hannon Jct.	1192.5ACSR 54/19	113	1110	1310	1450
	Hannon Jct.	Nebo Jct.	1192.5ACSR 54/19	129	1110	1450	1680
	Nebo Jct.	Middleport TS	1192.5ACSR 54/19	115	1110	1330	1480
	Hannon Jct.	Beach TS	1192.5ACSR 54/19	150	1110	1610	1920
Q30M	Beck 2 GS	Allanburg Jct	1192.5ACSR 54/19	150	1110	1610	1920
	Allanburg Jct.	Middleport TS	795ACSR 26/7	109	870	1000	1060

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 2004 Study

Two sets of studies were performed. The first set (Cases 1 to 3) 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 4 to 7) includes the new 'Niagara West' MTS in the Niagara Peninsula 230kV system. Table 2 lists the results of these studies.

Results of Cases 1 and 4 studies show that the addition of the new 'Niagara West' MTS will increase the Queenston Flow West (QFW[1]) slightly from 1773MVA to 1801MVA. This is the direct result of transferring load demands from Beamsville TS, which is part of the Allanburg Area 115kV load demands, to the 230kV system. The post contingency flows (Cases 2 to 3 and 4 to 5), with the new station, on the 230kV transmission circuits will similarly be higher.

The results show that the post contingency power flows on the 230kV transmission circuits, with or without the addition of the new station, would exceed the 15-minute limited time rating of the 230kV circuits. Although the addition of the new station would slightly increase the power flows of the 230kV circuits, the post contingency overloading problems are mainly the result of simulating maximum generation output at Beck 2 GS and heavy interconnection flow from New York.

It is expected that a lower interconnection flow from New York or a different generation pattern at Beck 2 GS would reduce the power flows on the 230 kV transmission system. Results of Case 7, which represents a reduction of 190MW at Beck 2 GS and a contingency of the 2-Cct Q25BM/Q29HM line, confirms the above argument.

Year 2014 Study

For the year 2014 study (Cases 8 to 10), only the system with the new 'Niagara West' MTS was simulated and studied. Results of the 2014 case studies are presented in Table 3.

Results of the year 2014 study show that even with generation output at Beck 2 GS and interconnection flow from New York that are similar to the 2004 study, the power flows on the 230kV transmission circuits are lower than those for the year 2004 study. The decreases in power flows on the 230kV circuits are mainly because of the increases in the Allanburg Area 115kV load demands.

Study Findings

Results of the power flow studies demonstrate the inter-relationship between the power flows on the 230kV transmission system in the Niagara Peninsula, the load demands in the Allanburg Area 115kV system, the generation pattern at the Sir Adam Beck generating station complex, and the interconnection flows with New York.

Part of the generating output from the Beck complex and the interconnection flows from New York will supply the Allanburg Area 115kV system load and the remaining power will be transmitted to the IMO-controlled grid via the 230kV transmission system in the Niagara Peninsula. As the load demands in the Allanburg Area increase, the power flows on the Niagara Peninsula 230kV transmission system will decrease and vice versa.

Initially the new 'Niagara West' MTS will be relieving load demands at Beamsville TS, the resulting power flows on the 230kV transmission system in the Niagara Peninsula will increase slightly. But as the load

[1] QFW is defined as the total power flows towards Middleport TS on the five integrated 230 kV transmission circuits (Q23BM, Q24HM, Q25BM, and Q29HM measured at Beck 2 GS, and Q30M measured at Allanburg Junction).

demands in the Allanburg Area 115kV system grow in the future, the power flows on the 230kV transmission circuits in the Niagara Peninsula will decrease correspondingly. In addition, the control of generating output at Beck 2 GS and/or the interconnection flows with New York could ensure that the 230kV transmission circuits would not encounter any thermal overload problems.

The addition of the new 'Niagara West' MTS might initially constrain the generating output at Beck 2 GS or the interconnection flow from New York, but it would not have any impact on the power transfer capability of the 230kV transmission circuits in the Niagara Peninsula.

Circuit	Section				Existing System QFW[1]=1773MVA			New 'Niagara West' MTS I/S QFW[1]=1801MVA			
					Case 1	Case 2	Case 3	Case 4	Case 5	Case 6	Case 7
	From	To	Continuous Rating[2] (A)	15-Min. LTR[3] (A)	All Elements I/S	Q25BM & Q29HM O/S	Q24HM & Q29HM O/S	All Elements I/S	Q25BM & Q29HM O/S	Q24HM & Q29HM O/S	Q25BM/Q29HM O/S & Reduced Output @ Beck 2 GS
Q23BM	Beck 2 GS	Niagara West	1110	1380	834	1263	1270	854	1301	1295	1199
	Niagara West	Neale Jct.	1110	1380	834	1263	1270	821	1237	1263	1135
	Neale Jct.	Middleport TS	870	1130	290	422	432	296	434	439	422
	Neale Jct.	Burlington TS	1110	1310	943	1325[4]	1353[4]	935	1309	1349[4]	1248
Q25BM	Beck 2 GS	Niagara West	1110	1390	841	O/S	1282	862	O/S	1307	O/S
	Niagara West	Neale Jct.	1110	1390	841	O/S	1282	829	O/S	1275	O/S
	Neale Jct.	Middleport TS	870	1260	294	O/S	439	300	O/S	446	O/S
	Neale Jct.	Burlington TS	1110	1480	946	O/S	1357	938	O/S	1352	O/S
Q24HM	Beck 2 GS	Hannon Jct.	1110	1420	970	1493[4]	O/S	976	1503[4]	O/S	1393
	Hannon Jct.	Nebo Jct.	1110	1920	242	278	O/S	242	280	O/S	262
	Nebo Jct.	Middleport TS	1110	1500	387	614	O/S	385	612	O/S	615
	Hannon Jct.	Beach TS	1110	1920	1009	1473	O/S	1011	1480	O/S	1405
Q29HM	Beck 2 GS	Hannon Jct.	1110	1450	980	O/S	O/S	986	O/S	O/S	O/S
	Hannon Jct.	Nebo Jct.	1110	1680	214	O/S	O/S	193	O/S	O/S	O/S
	Nebo Jct.	Middleport TS	1110	1480	350	O/S	O/S	350	O/S	O/S	O/S
	Hannon Jct.	Beach TS	1110	1920	993	O/S	O/S	998	O/S	O/S	O/S
Q30M	Beck 2 GS	Allanburg Jct	1110	1920	982	1319	1342	972	1312	1335	1227
	Allanburg Jct.	Middleport TS	870	1060	658	1058	1084[4]	667	1069[4]	1097[4]	970

Notes
1. QFW = Queenston Flow West is the total power flow out towards Middleport on 230kV circuits Q23BM, Q24HM, Q25BM, and Q29HM measured at Beck 2 GS and on Q30M measured at Allanburg Junction
2. Based on 93°C operating temperature with 30°C ambient temperature, 4km/h wind
3. Based on maximum operating temperature with a pre-load current equal to the continuous rating
4. Power flow on circuit exceeds the 15-minute LTR

Table 2 – 2004 Study Results

Circuit	Section		Current Ratings		Case 8	Case 9	Case 10
	From	To	Continuous Rating[1] (A)	15-Min. LTR[2] (A)	All Elements I/S	Q25BM & Q29HM O/S	Q24HM & Q29HM O/S
Q23BM	Beck 2 GS	Niagara West	1110	1380	807	1235	1213
	Niagara West	Neale Jct.	1110	1380	730	1086	1137
	Neale Jct.	Middleport TS	870	1130	327	459	449
	Neale Jct.	Burlington TS	1110	1310	909	1246	1308
Q25BM	Beck 2 GS	Niagara West	1110	1390	814	O/S	1223
	Niagara West	Neale Jct.	1110	1390	737	O/S	1147
	Neale Jct.	Middleport TS	870	1260	331	O/S	455
	Neale Jct.	Burlington TS	1110	1480	912	O/S	1312
Q24HM	Beck 2 GS	Hannon Jct.	1110	1420	921	1406	O/S
	Hannon Jct.	Nebo Jct.	1110	1920	215	210	O/S
	Nebo Jct.	Middleport TS	1110	1500	412	640	O/S
	Hannon Jct.	Beach TS	1110	1920	1011	1447	O/S
Q29HM	Beck 2 GS	Hannon Jct.	1110	1450	931	O/S	O/S
	Hannon Jct.	Nebo Jct.	1110	1680	183	O/S	O/S
	Nebo Jct.	Middleport TS	1110	1480	376	O/S	O/S
	Hannon Jct.	Beach TS	1110	1920	993	O/S	O/S
Q30M	Beck 2 GS	Allanburg Jct	1110	1920	989	1295	1322
	Allanburg Jct.	Middleport TS	870	1060	586	948	979

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

Table 3 – Year 2014 Case Study Results

2.2.3 Voltage Profile Assessment

The new station will be connected to transmission circuits Q23BM and Q25BM, which terminate at a major generating station, Sir Adam Beck 2 GS and two major 230kV stations, Middelport TS and Burlington TS in the Ontario transmission system. Middleport TS is also connected to the fossil fueled generating station Nanticoke GS. The bus voltages at these three terminal stations are expected to be very stable and the addition of the new 'Niagara West' MTS is not expected to have any adverse impact on the voltage profile within the area.

Power flow studies confirm that the maximum post-contingency voltage declines before and after tap changer action at the new 'Niagara West' MTS low voltage bus would be less than 1kV and at the high voltage bus would be less than 5kV. The post-contingency voltage declines at major station buses in the Niagara Peninsula would be less than 5kV as well. Table 4 lists the pre and post contingency voltages of the new 'Niagara West' MTS and major 115kV and 230kV station buses located in the Niagara Peninsula.

	2004 Study					2014 Study				
	Pre-Contingency (kV)	Post-Contingency & before ULTC action (kV)		Post-Contingency & after ULTC action (kV)		Pre-Contingency (kV)	Post-Contingency & before ULTC action (kV)		Post-Contingency & after ULTC action (kV)	
Station Bus	All Elements I/S	Q25BM & Q29HM O/S	Q24HM & Q29HM O/S	Q25BM & Q29HM O/S	Q24HM & Q29HM O/S	All Elements I/S	Q25BM & Q29HM O/S	Q24HM & Q29HM O/S	Q25BM & Q29HM O/S	Q24HM & Q29HM O/S
Niagara West HT	237.7	233.9	234.6	233.5	234.4	237.5	233.2	234.7	232.9	234.7
Niagara West LT	27.72	26.83	27.36	27.57	27.34	27.87	26.20	27.53	27.52	27.53
Beck 2	239.7	239.1	239.6	239.0	239.5	239.7	238.8	239.2	238.7	239.2
Burlington 230	235.9	233.3	233.7	232.9	233.4	236.1	233.7	234.2	233.5	234.2
Burlington 115	116.5	115.2	115.4	114.9	115.2	116.3	115.0	115.3	114.9	115.3
Beach 230	233.5	230.2	229.9	229.6	229.6	234.7	231.5	231.7	231.3	231.7
Beach 115	117.7	116.0	115.9	115.7	115.7	121.0	119.3	119.4	119.2	119.4
Middleport 230A	241.8	241.3	241.3	241.0	241.2	242.2	241.7	241.9	241.6	241.9
Middleport 230B	242.8	242.5	243.0	242.2	242.9	243.2	242.8	243.4	242.6	243.4
Allanburg 115	124.3	124.1	124.2	124.1	124.2	123.5	123.2	123.3	123.2	123.3

Table 4 – Station Bus Voltages

3.0 Conclusions

The new station is to relieve the overloading of the existing Beamsville TS. It does not have any adverse impact on the IMO-controlled grid. The assessment shows that initially the new 'Niagara West' MTS would slightly increase the power flows on the 230kV transmission circuits from Beck 2 GS to Middleport TS, Burlington TS, and Beach TS. This potentially might limit the generating output at Beck 2 GS or the import from New York at the Niagara Peninsula interface. However, as the Allanburg Area 115kV system load demands grow in the future, the power flows on the 230kV circuits will decrease, subsequently reducing or even eliminating the necessity of constraining output at Beck 2 GS or interconnection flow from New York to respect transmission thermal limits.

It should be noted that depending on system conditions, constraining of Beck 2 GS and/or import from New York across the Niagara interface might have occurred without the addition of the new 'Niagara West' MTS. The new station would at most extend the constraining period slightly longer into the future.

4.0 IMO's Requirements for Connection

Grimsby Power Inc. and Peninsula West Utilities Inc. shall:

- ❖ Ensure that the load supplied from the new 'Niagara West' MTS 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 230kV connection point to the IMO-controlled grid.
- ❖ Ensure that resources and facilities are available to maintain the capability of reducing the secondary voltage at the new 'Niagara West' MTS 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. has advised the IMO 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 connection applicant meeting the connection requirements outlined in Section 4.0 a Notification of Approval for this proposal be issued to the connection applicant.