REPORT

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System Impact Assessment Report (Addendum)

CONNECTION ASSESSMENT & APPROVAL PROCESS

Project: *Woodstock Area Transmission Reinforcement*

Applicant: Hydro One Networks Inc.

CAA ID 2006-253

Final Report

Market Facilitation Department

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System Impact Assessment Report

Woodstock Area Transmission Reinforcement

Acknowledgement

The IESO wishes to acknowledge the assistance of Hydro One in completing this assessment.

Disclaimers

IESO

This report has been prepared solely for the purpose of assessing whether the connection applicant's proposed connection with the IESO-controlled grid would have an adverse impact on the reliability of the integrated power system and whether the IESO 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 IESO by the connection applicant and the transmitter(s) at the time the assessment was carried out. The IESO 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 IESO. 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 IESO-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 IESO in accordance with Chapter 4, section 6 of the Market Rules. The IESO assumes no responsibility to any third party for any use, which it makes of this report. Any liability which the IESO 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 IESO provides a draft of this report to the connection applicant, you must be aware that the IESO may revise drafts of this report at any time in its sole discretion without notice to you. Although the IESO 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.

HYDRO ONE

Special Notes and Limitations of Study Results

The results reported in this study are based on the information available to Hydro One, at the time of the study, suitable for a preliminary assessment of a new generation or load connection proposal.

The short circuit and thermal loading levels have been computed based on the information available at the time of the study. These levels may be higher or lower if the connection information changes as a result

of, but not limited to, subsequent design modifications or when more accurate test measurement data is available.

This study does not assess the short circuit or thermal loading impact of the proposed connection on facilities owned by other load and generation (including OPGI) customers.

In this study, short circuit adequacy is assessed only for Hydro One breakers and does not include other Hydro One facilities. The short circuit results are only for the purpose of assessing the capabilities of existing Hydro One breakers and identifying upgrades required to incorporate the proposed connection. These results should not be used in the design and engineering of new facilities for the proposed connection. The necessary data will be provided by Hydro One and discussed with the connection proponent upon request.

The ampacity ratings of Hydro One facilities are established based on assumptions used in Hydro One for power system planning studies. The actual ampacity ratings during operations may be determined in real-time and are based on actual system conditions, including ambient temperature, wind speed and facility loading, and may be higher or lower than those stated in this study.

The additional facilities or upgrades which are required to incorporate the proposed connection have been identified to the extent permitted by a preliminary assessment under the current IESO Connection Assessment and Approval process. Additional facility studies may be necessary to confirm constructability and the time required for construction. Further studies at more advanced stages of the project development may identify additional facilities that need to be provided or that require upgrading.

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WOODSTOCK AREA TRANSMISSION REINFORCEMENT
IESO SYSTEM IMPACT ASSESSMENT (ADDENDUM)

1. Introduction

Hydro One Networks was proposing to increase the power supply capability in Woodstock area by reinforcing the local transmission system with a new 230 kV power supply from Ingersoll.

The proposed Woodstock area transmission reinforcement will address the voltage concerns and increase the area transmission supply capability by providing a new 230 kV power supply point in Woodstock area. The proposed project includes modifying the existing system and installing new facilities as follows:

1. Removing the existing 14 km section of 115 kV circuits W7W/W12W between Ingersoll and Woodstock TS.
2. Establishing a new 230 kV/115 kV transformer station, Karn TS, immediately to the west of Woodstock.
3. Building 12 km 230 kV double circuits from Ingersoll to Karn.
4. Installing two 150/200/250 MVA, 242/121 kV transformers and associated equipment at Karn TS.
5. Building 2 km 230 kV double circuit line from Karn TS to Woodstock TS, initially to be operated at 115 kV.

A schematic diagram of the 230/115 kV transmission system in Woodstock area as well as the proposed Woodstock Area Transmission Reinforcement is shown in Figure 1.

The proposed Woodstock Transmission Reinforcement System Impact Assessment was completed (CAA ID 2006 -253) on April 24, 2007. Recently, Hydro One has submitted a modified design of the Woodstock Transmission Reinforcement to the IESO. Because there is a significant protection issue caused by the emergency by-pass facilities located at Salford junction, modifications are proposed to reconfigure connection arrangements at Salford Junction so that the double circuit line from Salford to Ingersol to Karn would be connected to M31W and M32W instead of M32W and M33W. A schematic diagram reflecting the proposed changes is shown in Figure 2. In addition, in order to simplify the protection design for the Woodstock Transmission Reinforcement project, Hydro One would like to remove the M31W-Q30M tie.

This connection assessment study concentrated on identifying the effect of the proposed change to the Woodstock Transmission Reinforcement project on thermal loading of the transmission lines and system voltages for pre and post contingency situations.

The project is scheduled for completion by May 31, 2011.

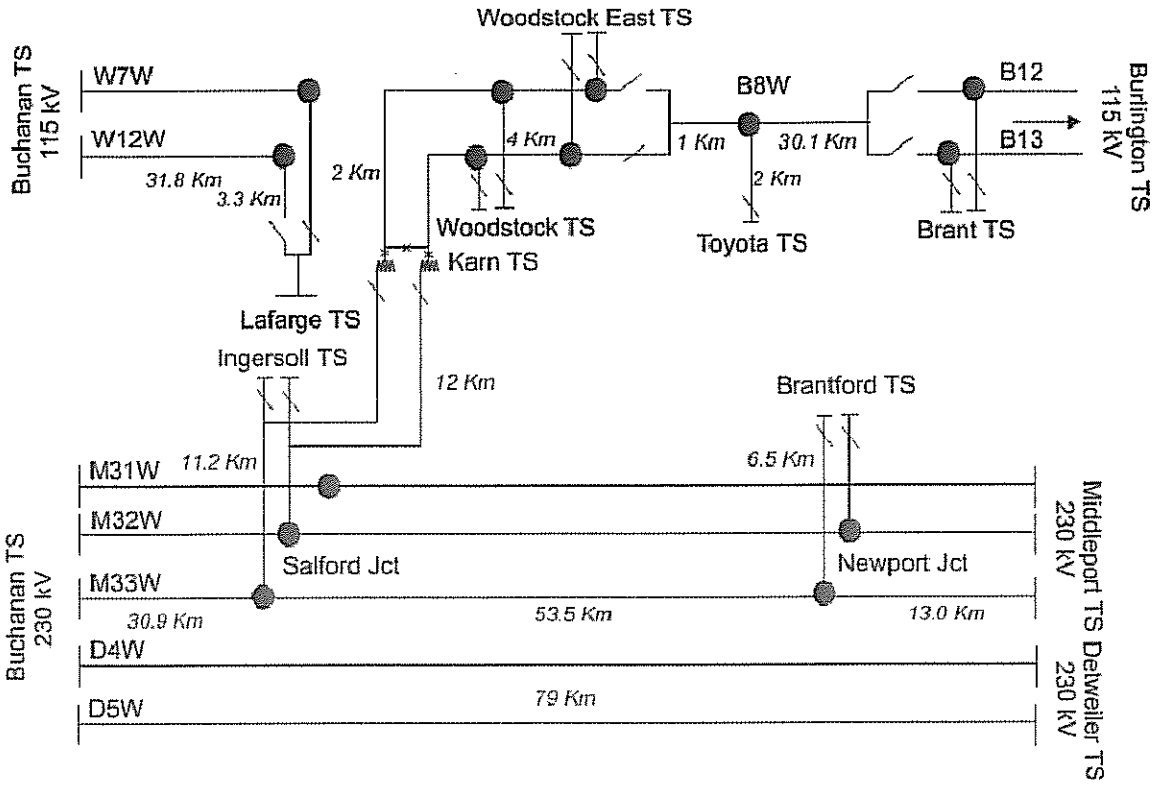

Figure 1: Originally Proposed Woodstock Area Transmission Reinforcement

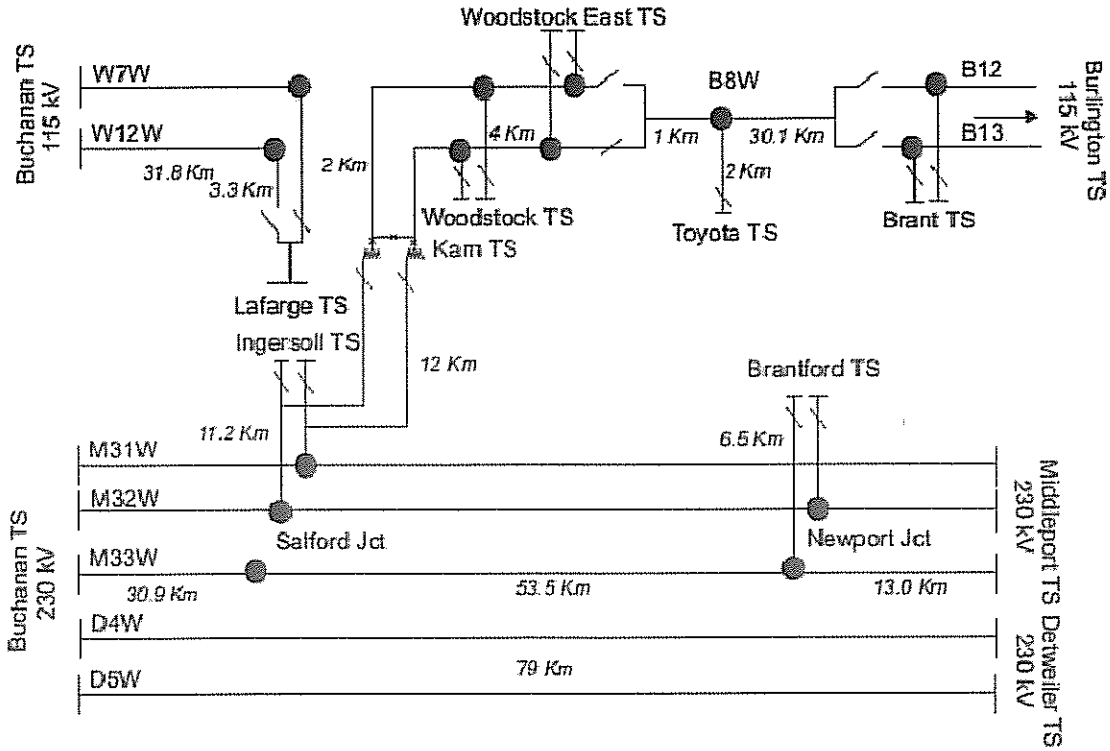

Figure 2: New Proposed Woodstock Area Transmission Reinforcement

2. Load Forecasts

The load forecast in the Woodstock area was provided by Hydro One and is summarized, along with station capabilities, in Table 1.

Table 1 Station Capability and Load Forecast (MVA)

Stations	Capability	2010	2011	2012	2013	2014	2015
Woodstock	92.1	92.1	92.1	92.1	92.1	92.1	92.1
Woodstock East	132.8	45.3	52.1	55.0	57.1	59.5	61.7
Toyota	N/A*	27.8	27.8	27.8	27.8	27.8	27.8
Load off Karn TS	***200.1***	***165.2***	***172.0***	***174.9***	***177.0***	***179.4***	***181.6***
Ingersoll	175	99.7	101.7	103.7	105.7	107.8	110.0
Brantford	173	208.9	212.2	215.6	218.9	223.3	226.7

*: single transformer

It should be noted that the loads at Brantford TS exceed the station loading capability. As indicated in the SIA study for Powerline TS (CAA ID 2005-196), load at Brantford is to be limited within the station capability and all the loads above the capability in that area will be supplied via Powerline TS.

3. Study Assumptions

The main system impact study was performed for 2009 summer peak loads under extreme weather conditions with a total Ontario demand of 30,397 MW. The same base case is used in this addendum study. It should be noted that due to economic recession and conservation the current load forecast for 2010 is about 25,000 MW which is far below the demand in the studying case. Therefore, the results in this report are more conservative.

The study was performed for a system with all transmission elements in service with the following assumptions:

1. In the pre-contingency load flow the Buchanan Longwood Input (BLIP) flow was 3,007 MW.
2. Loads in the Woodstock area were scaled to the levels of 2010 in Table 1, except that load at Brandford TS is at its capability, i.e., 173 MVA,
3. A load power factor of 0.9 for loads at stations in Table 1,
4. 2 × 20 MVAr LV shunt capacitors at Woodstock TS in service,
5. Existing 2 × 20 MVAr LV shunt capacitors at Brantford TS in service,
6. Existing 1 × 120 MVAr 115 kV shunt capacitor at Buchanan TS in service,

4. Circuit Ratings

Ratings of the 230 kV circuits M31W, M32W, M33W and D4W/D5W are shown in Table 2. The ratings for the existing circuits were calculated for the summer peak conditions, i.e. temperature of 35°C, wind speed of 5 km/h and for the day time. Pre-load dependant LTRs were calculated assuming circuit pre-contingency loading of 75%.

Table 2 Circuit Ratings

Circuits	Sections	Continuous Rating		15 Minutes LTR	
		A	MVA*	A	MVA*
M31W	Buchanan-Middleport	1710	681	2420	964
	Salford Jct-Ingersoll	830	331	1020	406
	Ingersoll-Karn	1410	561	1590	633
M32W	Buchanan-Middleport	2130	849	3250	1295
	Salford Jct-Ingersoll	830	331	1020	406
	Ingersoll-Karn	1410	561	1590	633
M33W	Buchanan-Middleport	2130	849	3250	1295
D4W/D5W	Buchanan-Detweiler	1710	681	2420	964

*: MVA@ 230 kV

5. Thermal Studies

This section covers an investigation of thermal capability of the 230 kV circuits related to the proposed change and any new thermal problems introduced by the change. Brantford TS would remain tapped to M32W & M33W whereas Ingersoll TS and Karn TS would be supplied from M31W and M32W. The proposed modifications would result in a new recognized contingency, namely M31W and M32W.

Simulations were performed to investigate power flows for pre-contingency conditions and after the loss of the following circuit(s): M31W, M32W, M33W, D4W, D5W, M31W/M32W, M32W/M33W and D4W/D5W. Results are shown in Table 3.

Table 3 Pre- and Post-contingency Power Flows (MVA)

Circuits	Pre-Con.	Contingency							
		M31W	M32W	M33W	D4W	D5W	M31W +M32W	M32W +M33W	D4W +D5W
M31W	234.5	-	324.2	261.5	241.6	241.6	-	375.0	254.6
M32W	313.6	391.0	-	427.6	321.0	321.0	-	-	334.6
M33W	319.9	349.0	462.8	-	329.2	329.2	451.0	-	346.1
D4W	69.7	91.9	92.6	99.8	-	89.8	115.5	140.1	-
D5W	69.7	91.9	92.6	99.8	89.8	-	115.5	140.1	-

The results indicate that pre-contingency power flows are far below the circuit continuous ratings and the post-contingency power flows on the remaining circuits are well within the LTR of the circuits. Therefore, it can be concluded that there is no thermal concern for the 230 kV circuits with the proposed change for the Woodstock Transmission Reinforcement project.

6. Voltage Studies

The following IESO criteria must be satisfied before any new equipment is connected to the transmission system:

1. The pre-contingency voltage on 230 kV buses can not be less than 220 kV.
2. The post-contingency voltage on 230 kV buses can not be less than 207 kV.
3. The voltage drop following a contingency can not exceed 10% pre-ULTC and 10% post-ULTC.

Load flow studies have been carried out to examine the voltage performance at stations with the proposed change to the Woodstock Transmission Reinforcement project. Contingencies associated with M31W, M32W and W7W are simulated for voltage studies. The simulation results for pre- and post-contingency voltages are shown in tables 4, 5 and 6.

Table 4 Pre- and Post-contingency Voltages for Loss of M31W

Stations	Buchanan	Karn		Woodstock		Woodstock E.		Toyota	
Buses (kV)	230	230	115	115	27.6	115	27.6	115	13.8
Pre-contingency (kV)	238.5	235.8	119.3	119.0	29.2	118.7	27.6	116.9	14.4
Pre-ULTC (kV)	237.2	227.3	113.6	112.8	27.3	112.2	25.8	111.5	13.7
Voltage Decline (%)	-0.5	-3.6	-4.7	-5.2	-6.5	-5.4	-6.5	-4.6	-4.8
Post-ULTC (kV)	237.5	226.1	112.7	111.8	29.5	111.1	28.3	110.3	14.1
Voltage Decline (%)	-0.4	-4.1	-5.5	-6.0	-1.0	-6.4	2.5	-5.6	-2.0

Table 5 Pre- and Post-contingency Voltages for Loss of M32W

Stations	Buchanan	Karn		Woodstock		Woodstock E.		Toyota	
Buses (kV)	230	230	115	115	27.6	115	27.6	115	13.8
Pre-contingency (kV)	238.5	235.8	119.3	119.0	29.2	118.7	27.6	116.9	14.4
Pre-ULTC (kV)	237.1	227.7	114.3	114.0	28.1	113.4	26.6	112.6	13.9
Voltage Decline (%)	-0.5	-3.4	-4.1	-4.2	-3.7	-4.4	-3.6	-3.6	-3.4
Post-ULTC (kV)	237.6	226.9	113.6	113.2	29.3	112.7	27.9	111.9	14.0
Voltage Decline (%)	-0.3	-3.7	-4.7	-4.8	-0.3	-5.0	1.0	-4.2	-2.7

Table 6 Pre- and Post-contingency Voltages for Loss of W7W

Stations	Buchanan	Karn		Woodstock		Woodstock E.		Toyota	
Buses (kV)	230	230	115	115	27.6	115	27.6	115	13.8
Pre-contingency (kV)	238.5	235.8	119.3	119.0	29.2	118.7	27.6	116.9	14.4
Pre-ULTC (kV)	238.2	236.7	120.9	114.4	27.9	113.7	25.8	113.0	13.9
Voltage Decline (%)	-0.1	0.3	1.3	-3.8	-4.4	-4.2	-6.5	-3.3	-3.4
Post-ULTC (kV)	238.9	237.2	114.8	113.9	29.1	113.1	27.8	112.3	14.1
Voltage Decline (%)	0.1	0.5	-3.7	-4.2	-0.3	-4.7	0.7	-3.9	-2.0

The study results indicate that all the pre-contingency voltages and post-contingency voltage declines meet the Market Rules requirements.

7. Removal of the M31W-Q30M Tie

The M31W-Q30M tie was temporarily built as a backup 25Hz supply to the Allanburg area about 20 years ago and has never been used. It is acceptable to remove the M31W-Q30M tie to reduce the complexity of the protection design for the Woodstock Area Transmission Reinforcement project.

8. Conclusions

The findings of this analysis are summarized as follows:

1. There is no thermal overloading concern associated with the 230 kV circuits with the proposed change to the Woodstock Transmission Reinforcement project.

2. Pre-contingency and post-contingency voltages in Woodstock area with the proposed project meet Market Rules requirements.

3. It is acceptable to remove the existing M31W-Q30M tie.

9. Requirements for Connection

This System Impact Assessment concludes that the modifications to the Woodstock Transmission Reinforcement are not expected to have a material adverse effect on the IESO-controlled grid. Study results show there is no significant difference from the original connection arrangements. The IESO requirements for the connection of the proposed Woodstock Area Transmission Reinforcement in the SIA report, issued on April 24, 2007, remain valid.

10. Notification of Approval

It is recommended that Notification of Conditional Approval for connection be issued to Hydro One, subject to IESO's Requirements for Connection listed above and in the initial SIA report (issued on April 24, 2007), and any further requirements that may be identified by Hydro One Networks Inc. in the Customer Impact Assessment.