REPORT

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System Impact Assessment Report

CONNECTION ASSESSMENT & APPROVAL PROCESS

Issue 1.0

Project: *Woodstock East TS*

Applicant: Hydro One Networks Inc.

CAA ID 2008-298

Final Draft Report

Transmission Assessments & Performance Department

April 12, 2008

Document ID	IESO_REP_0491
Document Name	System Impact Assessment Report
Issue	Issue 1.0
Reason for Issue	First issue.
Effective Date	April 12, 2008

System Impact Assessment Report

Woodstock East TS

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 EAST TS
IESO SYSTEM IMPACT ASSESSMENT

SIA Findings

The proposed Woodstock East TS is a developmental project which is required to relieve the present overloading of Woodstock TS and provide adequate power supply to the Woodstock area loads. The load in the area is expected to experience a rapid growth in the near future due to the "spin-off" industries resulting from the Toyota Woodstock plant.

Conclusions

This System Impact Assessment has examined the impact of the proposed Woodstock East TS on the reliability of the IESO-Controlled grid. The studies concluded that:

1. The proposed project will not have a materially adverse effect on the reliability of the IESO-Controlled grid.

2. The proposed project will relieve the overload at the existing Woodstock TS and increase the power supply capability in Woodstock area.

3. All the pre-contingency voltages, post-contingency voltages and voltage declines meet Market Rules requirements.

4. No thermal overload concerns were identified for the monitored transmission circuits in the studied scenarios. All power flows on the monitored circuits were observed to be within the continuous ratings of the circuits.

Notification of Approval for Connection Proposal

It is recommended that Notification of Conditional Approval for connection be issued to Hydro One, subject to IESO's Requirements for Connection listed below, and any further requirements that may be identified by Hydro One Networks Inc. in the Customer Impact Assessment.

IESO's Requirements for Woodstock East TS Connection

The IESO requirements for the connection of the proposed Woodstock East TS are as follows:

- It is required that Hydro One and the area LDC shall work together to initiate a plan for reactive load compensation at the station and/or customer side to ensure compliance with the Market Rules and to inform the IESO.

- The connection applicant is required to provide disconnect switch parameters and ensure that the performance of the equipment that is eventually installed meets or exceeds Market Rule requirements, i.e., the 230 kV disconnect switches must be capable of continuously operating in the range 220 kV and 250 kV.

- Hydro One is required to provide the short circuit of the 230 kV/115 kV equipment and components. If the short circuit capacity of the 230 kV equipment is below 63 kA, Hydro One will be required to upgrade the equipment at their own expense when and if the system short circuit levels exceed their withstanding (interrupting) capability.

- The Connection Applicant is required to confirm that voltage control will be available from local or remote location to provide 3% or 5% reduction to support the operating obligations.

- Hydro One is required to install all the equipment needed to continuously monitor the information that is required by the IESO. The IESO will finalize items to be monitored during the IESO Facility Registration Process.

1. Project Description

Hydro One Networks is proposing to establish a new 115-27.6 kV, 50/66.7/83.3 MVA DESN station in Woodstock area. To permit the connection of the new station, the Woodstock Area Transmission (WATR) facilities must be in service and also part of the 115 kV line facilities east of the existing Woodstock TS must be rebuilt. The new station will be connected to the rebuilt section of the 115 kV double circuit line B8W about 4 km east of Woodstock TS.

Woodstock TS has exceeded its 10-day summer LTR. In the short term, arrangements are being made for temporary load transfer of 8 MVA to Ingersoll TS to help relieve the problem. The proposed Woodstock East TS will relieve the overloading of the existing TS as well as provide additional capacity to accommodate future load growth in Woodstock area.

Woodstock area load is being supplied off Buchanan TS by a long 115 kV transmission corridor. The power supply capability of this transmission is limited due to voltage performance and is approaching its capacity. Hydro One has initiated a transmission reinforcement project to address the area problems which was recently assessed by the IESO under CAA ID 2007-263. 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 for Woodstock area load. The WATR project is scheduled for completion by April 2010. Due to transmission limitations in the area, the new Woodstock East TS cannot be connected to the grid before the WATR facilities are in-service.

A schematic diagram of the 230/115 kV transmission system in Woodstock area after the proposed Woodstock Area Transmission Reinforcement is shown in Figure 1. The proposed connection of Woodstock East TS is shown in Figure 2 and the single line diagram for Woodstock East TS is shown in Figure 3.

As shown in Figure 2, the proposed Woodstock East TS is located 4 km east of the existing Woodstock TS and west of Toyota TS. As part of this project Hydro One also plans to rebuild the double circuit line between Woodstock TS and the new transformer station. Hydro One has also indicated that, if suitable property cannot not be found in that area, a location within 1 km east of Toyota will be considered. In this case, about 6 km B8W circuit from the existing woodstock TS will be rebuilt to double circuit line to provide double power supply to the proposed Woodstock East TS. Since there is no significant electrical difference between these two options only the preferred first option was examined in this SIA study.

The project is scheduled for completion by June, 2010.

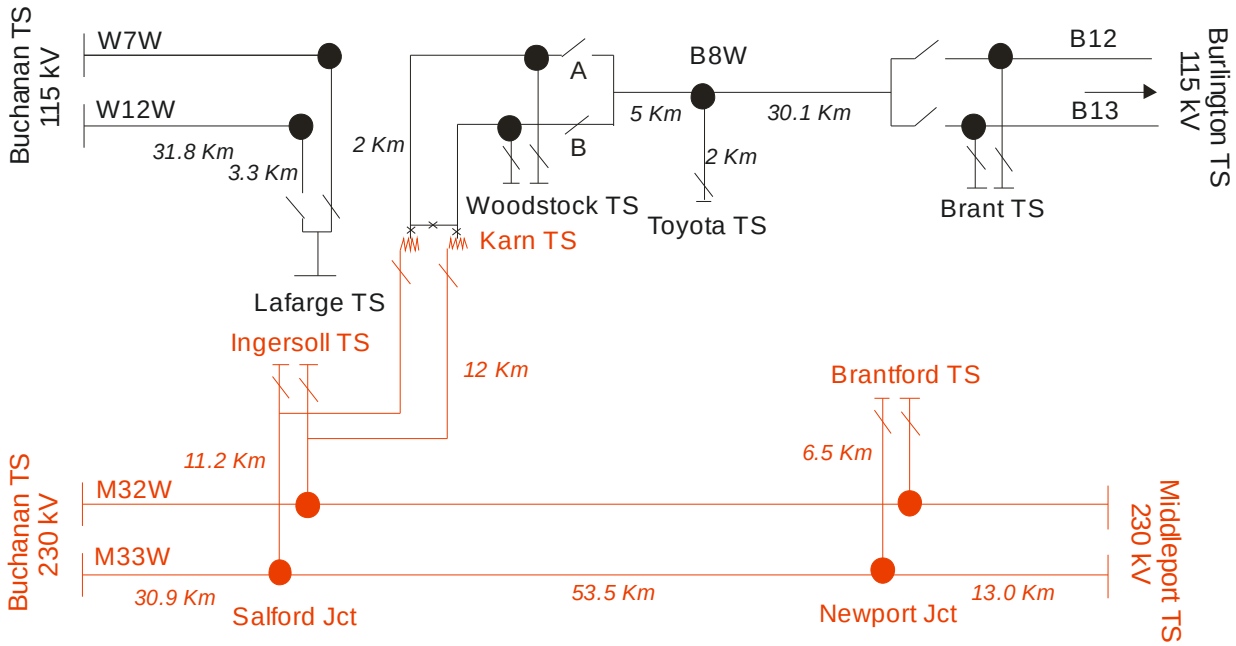

Figure 1. Proposed Woodstock Area Transmission Reinforcement

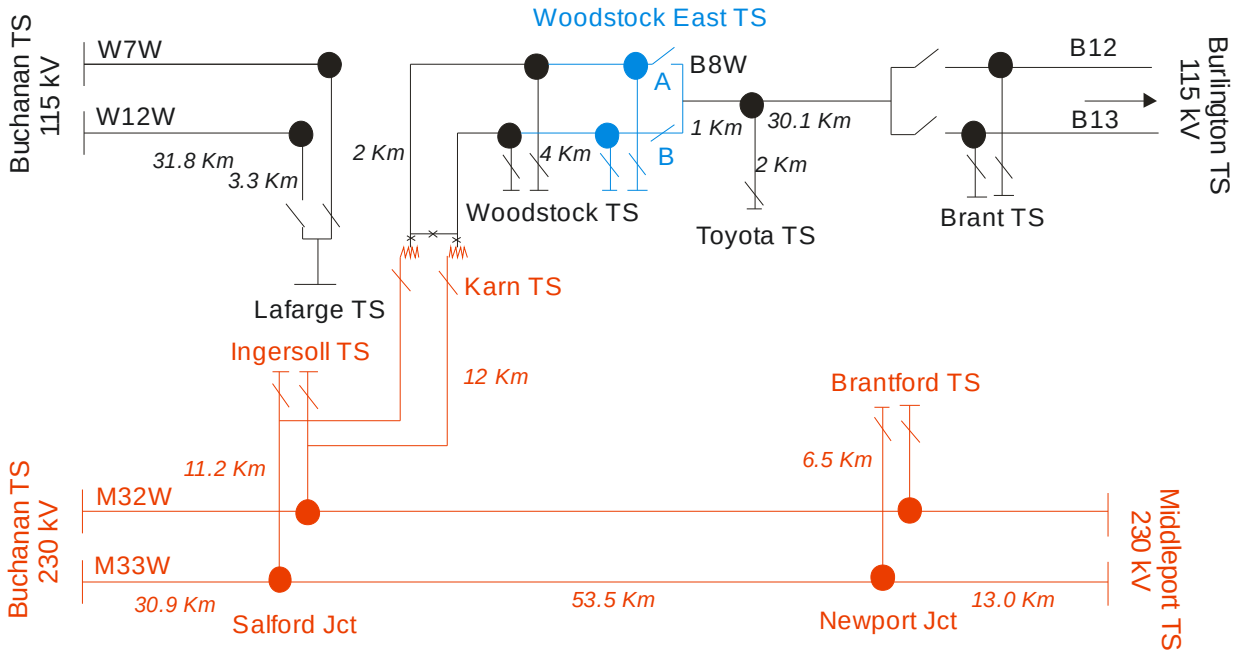

Figure 2. Proposed Connection of Woodstock East TS

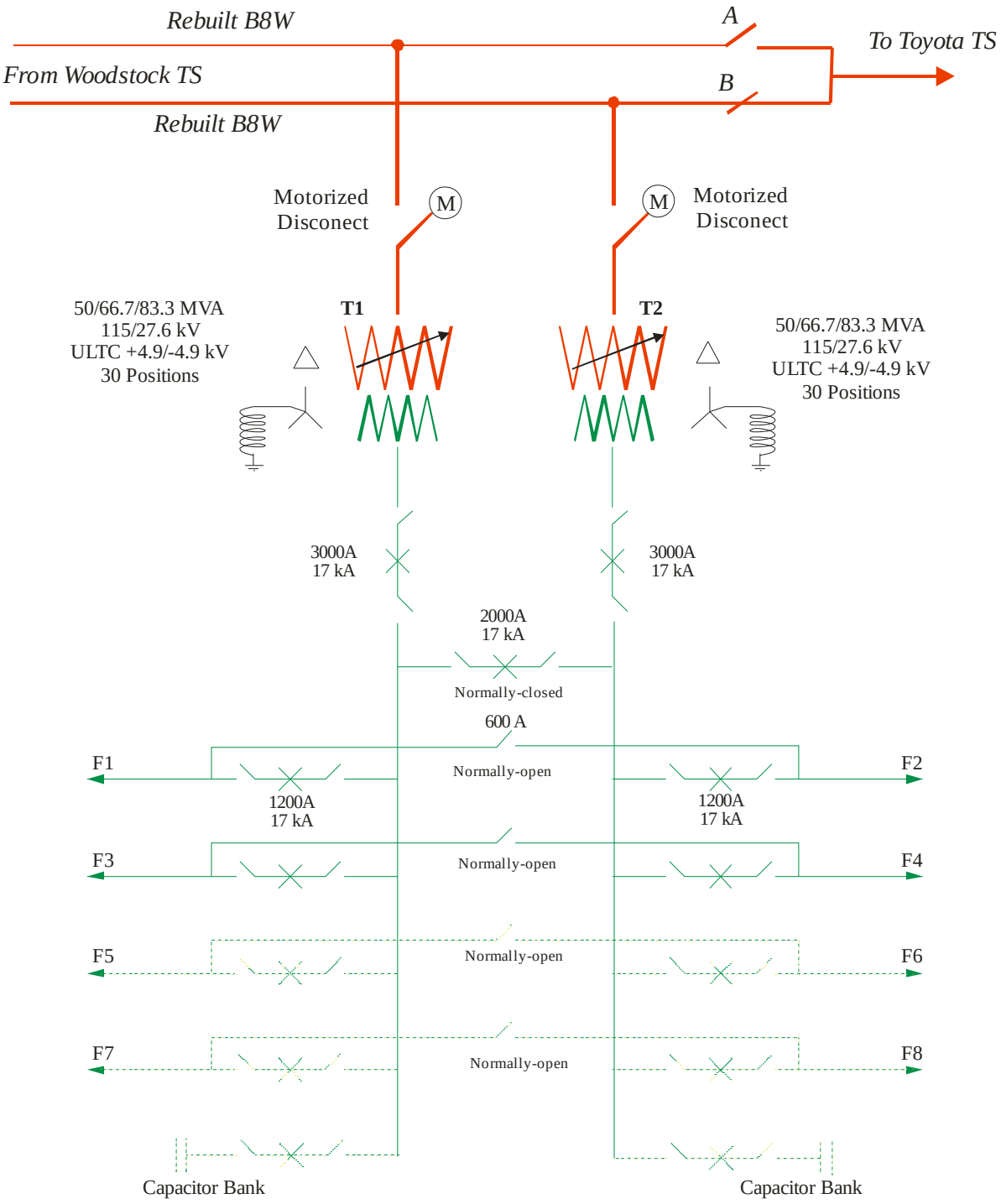

Figure 3. Single Line Diagram for Woodstock East TS

– End of Section –

2. General Requirements

2.1 Power Factor

The Market Rules require that wholesale customers and distributors connected to the IESO-controlled grid shall operate at a power factor within the range of 90% lagging to 90% leading as measured at the defined meter point.

The connection applicant has advised that Woodstock East TS load power factor is 0.9. The load flow analysis was carried out to determine transformer losses that will need to be compensated for in order to achieve minimal 0.9 power factor at high voltage side. The analysis indicated that the station load increase from 40.8 MW to 55.5 MW will correspond to transformers' losses being increased from 2.7 MVAr to 5.0 MVAr, hence bringing high voltage side power factor down from 0.88 to 0.87. By the time the station's load reaches its LTR of 132.8 MVA (119.5 MW @0.9 P.F.), the power factor will drop to 0.83. Thus, the load
at Woodstock East TS will need to be compensated to a higher power factor to ensure that IESO's power factor requirements are met. The summary of the study with the needed reactive compensation time scheduled are shown in Table 1 below.

Table 1 Reactive Power Compensation Requirements

Year	27.6 kV			220 kV			Compensation (MVAr)
	P (MW)	Q (MVAr)	P.F.	P (MW)	Q (MVAr)	P.F.	
2010	40.8	19.7	0.9	40.8	22.4	0.88	3
2011	46.9	22.7	0.9	46.9	26.2	0.87	4
2012	49.5	24.0	0.9	49.5	28.0	0.87	4
2013	51.4	24.9	0.9	51.4	29.2	0.87	5
2014	53.6	25.9	0.9	53.6	30.5	0.87	5
2015	55.5	26.9	0.9	55.5	31.9	0.87	5
	119.5	57.9	0.9	119.5	80.9	0.83	21

Based on the assumption that the station will operate with 0.9 load power factor, as indicated by the proponent, the power factor at the defined metered point will be slightly below 0.9 lagging when the stations is placed in service. As the load increases, additional reactive compensation will become necessary. Hydro One and the area LDC shall work together to initiate a plan for reactive load compensation at the station and/or customer side to ensure compliance with the Market Rules and to inform the IESO.

2.2 Underfrequency Load Shedding Requirements

The Market Rules (Chapter 5 section 10.4) require that each distributor and connected wholesale customer, in conjunction with the relevant transmitter, make arrangements to enable the automatic disconnection of up to 35% of its peak demand for conditions of system under-frequency. To meet this requirement an under frequency load shedding (UFLS) scheme must be installed at the new station.

The under frequency automatic load shedding should be provided by tripping 28 kV feeder breakers to achieve:

- Automatic load shedding of 12% of station load at a nominal set point of 59.3 Hz and
- Automatic load shedding of an additional 23% of station load at a nominal set point of 58.8 Hz, for a total load reduction of 35% of the total station load.

2.3 Voltage Reduction Facilities Requirements

The Market Rules (Chapter 4 Appendix 4.3) requires that distributors connected to the IESO controlled grid with directly connected load facilities of aggregated rating of 20 MVA or more and the capability to regulate distribution voltage under load, shall install and maintain facilities to provide voltage reduction capability to achieve load reduction during periods when supply resources are limited. Voltage reduction capability represents the capability of reducing demand by lowering the customer voltage by 3% and 5% and having the controlling authority to be able to effect the voltage reduction within five minutes of receipt of the direction from the IESO.

The Connection Applicant is required to confirm that voltage control will be available from local or remote location to provide 3% or 5% reduction to support the operating obligations.

2.4 On-line Monitoring

The Market Rules (Chapter 4 section 7.5) require that each connected distributor shall provide the IESO on a continual basis with on-line monitored quantities as specified in Appendix 4.17. It is required that Hydro One install all the equipment needed to monitor the information required by the IESO on a continuous basis. The IESO requires that the following quantities at Woodstock East TS be provided to the IESO on a continual basis via approved communication protocols:

1. The voltage on the 115 kV bus
2. The status of the 115 kV switches
3. The voltage on the 27.6 kV bus
4. The status of the transformer 27.6 kV breakers
5. The real and reactive power flow through both transformers

Hydro One is required to install all the equipment needed to continuously monitor the information that is required by the IESO. The IESO will finalize items to be monitored during the IESO Facility Registration Process.

2.5 Protection Systems

With respect to the protection and telecommunication requirements, the connection applicant will have to follow the Transmission System Code technical requirements for tapped transformer stations supplying load.

The diagram that was provided by the applicant shows each transformer being separated from the transmission system via a motorized disconnection switch. For this particular arrangement the Transmission System Code requires that transfer trip of the Transmitter's breakers at the terminal stations be provided for transformer faults or for a condition of failure to operate of the 115 kV breakers. In the case of Woodstock East TS, which is to be connected to the double circuit 115 kV lines B8W the transfer trip must be sent to Karn TS terminals of the faulted circuit.

3. Review of Connection Proposal

3.1 Connection Arrangement

3.1.1 115 kV circuits

To provide the supply to Woodstock East TS, Hydro One is proposing to rebuild B8W to a double circuit line from Woodstock TS to the tapping point of the new Woodstock East TS. The line will be built to the same standards specified in the WATR plan for rebuilding the existing line into Woodstock TS from Karn TS. This new 4 km line section from Woodstock TS to Woodstock East TS is to be steel pole or lattice built for 230 kV operation but initially operated at 115 kV. The new 115 kV line is to have the following ratings as provided by the connection applicant:

- Maximum operating voltage: 230 kV
- Maximum Continuous Rating: 1130 A (Summer, 30 °C)
- Maximum emergency Rating: 1810 A (Summer, 30 °C)

3.1.2 Woodstock TS

The existing 115 kV disconnect switches at Woodstock TS, 10L7-B8W and 10L12-B8W, allow W7W or W12W to be connected to B8W. With the rebuild of B8W to a double circuit line, these two switches, Labeled “A” and “B” in Figure 1, will be removed.

3.1.3 Woodstock East TS

The new Woodstock East TS will be connected to the rebuilt 115 kV double circuits B8W from Woodstock TS. The existing Woodstock TS and Toyota TS as well as the proposed Woodstock East TS will be supplied by Karn TS.

The proposed Woodstock East TS will be equipped with two transformers (115/27.6 kV, 50/66.7/83 MVA). The two transformers are identical and each transformer is configured with a delta winding on the high side. The LV windings are wye connected and the neutral is to be grounded via a 1.5 ohm reactor (1000 A continuous, 6000 A for 15 seconds). Each transformer is equipped with under-load tap changers located on the HV winding with ± 4.9 kV voltage band achieved in 29 steps.

The connection applicant indicated that the HV to LV impedance should be approximately 13.06% on the nameplate rating of 50 MVA.

Hydro One proposes to connect each transformer at Woodstock East TS to the IESO-controlled grid via one 230 kV motorized disconnect switch with a continuous current rating of 1200 A.

Similar to the existing in-line switches, 10L7-B8W and 10L12-B8W, at the Woodstock TS, two motor-operated disconnect switches, suitable for 230 kV operation, are to be installed between the rebuilt B8W two-circuit line and the existing single circuit B8W. These switches having continuous rating of 1200 A are labeled “A” and “B” in Figures 3.

Hydro One did not provide maximum continuous voltage for the 230 kV disconnect switches in the SIA applications. It should be noted that all 230 kV connection equipment must be capable of continuously operating in the ranges of 220 kV and 250 kV (Reference 2 of Appendix 4.1 of the Market Rules).

The connection applicant is required to provide disconnect switch parameters and ensure that the performance of the equipment that is eventually installed meets or exceeds Market Rule requirements, i.e., the 230 kV disconnect switches must be capable of continuously operating in the range 220 kV and 250 kV.

The proposed Woodstock East TS will consist of four feeders initially. The ultimate footprint for the station would accommodate eight feeder positions and 2 cap banks.

The new 27.6 kV circuit breakers and switches will be installed at Woodstock East TS with the rating as shown in Table 2.

Table 2 Breaker and Switch Ratings

Equipment	Nominal Voltage (kV)	Continuous Current Rating (A)	SC Interrupting Capability (kA/cycles)
Transformer Breakers	28	3000	17/5
Bus Tie Breaker	28	2000	17/5
Feeder Breakers	28	1200	17/5
Feeder Tie Switches	28	600	

– End of Section –

4. Data Verification

Based on standards for supply of municipal electrical utilities the capability of a transformer station is defined as the maximum load that one transformer can carry for a predefined period of time. This value is usually computed using specific transformer data and daily loading curves, and temperature data specific to the transformer location. Hydro One has indicated that the summer 10-day LTR @ 30 degrees is expected to be 132.8 MVA.

The system performance standards listed in the Transmission System Code require that the 230 kV and 115 kV system fault levels not exceed 63 kA and 50 kA (Sym.), respectively. This implies that 230 kV and 115 kV equipment installed should be sized to withstand or interrupt 63 kA and 50 kA (Sym.), respectively. However, lower capability equipment is allowed when the system short circuit levels are lower and no system expansion is expected.

The connection applicant has not provided the short circuit capacity for new 230 kV and 115 kV equipment and components.

Hydro One is required to provide the short circuit of the 230 kV/115 kV equipment and components. If the short circuit capacity of the 230 kV equipment is below 63 kA, Hydro One will be required to upgrade the equipment at their own expense when and if the system short circuit levels exceed their withstanding (interrupting) capability.

The high voltage motorized disconnect switches are designed to meet the requirements with maximum continuous operating voltage of 250 kV. The applicant has advised that interrupting rating is not required for the switches. However, each disconnect switch shall be rated to interrupt the maximum magnetizing current of the specified 250 MVA transformer.

A full description of the connection arrangement of the proposed Woodstock East TS is included in Section 3.1 of this report.

– End of Section –

5. Fault Level Assessment

This project involves the expansion of transmission system with loads being radially connected to a new supply point. In general, radial loads do not have a large impact on the system fault levels, but a small contribution in short circuit currents can be observed due to the grounding of the transformers. In the case of Woodstock East TS the high voltage winding is delta configured, hence line-to-ground faults will not results in any increase in fault level.

– End of Section –

6. Further Analysis

This connection assessment study concentrated on identifying the effect of the proposed Woodstock East TS on thermal loading of the transmission lines and system voltages for pre and post contingency situations.

6.1 Description of Area Transmission

After the completion of WATR project and Woodstock East TS project, the loads at Woodstock TS, Woodstock East TS and Toyota TS will be supplied via the rebuilt 115 kV double circuit line W7W/W12W and B8W emanating from Karn TS. The rebuilt circuits are joined to the single circuit B8W via disconnect switches at Woodstock East TS with one normally open and the other one normally close. At the other end, the circuit B8W is connected to double circuit 115 kV line B12/B13 at Brant TS via two disconnect switches which are operated normally open. The transmission system in Woodstock area after WATR project and Woodstock East TS is shown in Figure 2.

The area transmission is also equipped with one 115 kV, 120 MVAr shunt capacitor at Buchanan TS, 2×20 MVAr LV shunt capacitors at Brantford TS and 2×20 MVAr LV shunt capacitors at Woodstock TS.

6.2 Load Forecasts

The load forecast in the Woodstock area was provided by Hydro One and is summarized as well as station capability in Table 3.

Table 3 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 load 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.

6.3 Load Supply Deliverability

The load security and restoration criteria for IESO-controlled grid are defined in the Ontario Resource and Transmission Assessment Criteria document as follows:

"With any one element out of service, equipment loading must be within applicable long-term emergency ratings, voltages must be within applicable emergency ranges, and transfers must be within applicable normal condition stability limits. Not more than 150MW of load may be interrupted by configuration. Planned load curtailment or load rejection, excluding voluntary demand management, is not permissible.

With any two elements out of service voltages must be within applicable emergency ranges. Equipment may be loaded up to applicable short-term emergency ratings immediately following a contingency, but must be reduced to the long-term emergency ratings in the time afforded by the short-term ratings. Not more than 600MW of load may be interrupted as a result of the contingency, and this may include up to 150MW of planned load curtailment or load rejection, excluding voluntary demand management.

Where local generation exist, additional planned load curtailment or load rejection is permissible up to the capacity of the largest local generating unit, or 600 MW, whichever is less. The additional load curtailment is permitted only for generating unit outages with all transmission facilities in service or with any one or two elements out of service. Generating unit outages must consider any common failure modes between units of a multi-unit or combined-cycle plant.

The transmission system must be planned such that, following design criteria contingencies on the transmission system, affected loads can be restored within the restoration times listed below:
All load must be restored within approximately 8 hours.

When the amount of load interrupted is greater than 150MW, the amount of load in excess of 150MW must be restored within approximately 4 hours.

When the amount of load interrupted is greater than 250MW, the amount of load in excess of 250MW must be restored within 30 minutes."

The load supplied by the 115 kV double circuit line off Karn TS is higher than 150 MW but lower than 600 MW. Hence IESO criteria are met: (a) for one element out of service the load continues to be supplied via the remaining circuit and (a) for two elements out not more than 600 MW of load would be interrupted.

6.4 Study Assumptions

This system impact study was performed for 2009 summer peak area loads with the following assumptions:

1. Loads in Woodstock area were scaled to level in 2015 in Table 1 except that load at Brandford is at its capability, i.e., 173 MVA,
2. Load power factor of 0.9 for loads at stations in Table 1,
3. 2 × 20 MVAr LV shunt capacitors at Woodstock TS in service,
4. Existing 2 × 20 MVAr LV shunt capacitors at Brantford TS in service,
5. Existing 1 × 120 MVAr 115 kV shunt capacitor at Buchanan TS in service,
6. Voltage dependent load model for post-contingency pre-ULTC simulations (50% constant impedance and 50% constant current for active power and 0% constant current and 100% constant impedance for reactive power).

6.5 Voltage Analysis

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 pre-contingency voltage on 115 kV buses can not be less than113 kV.
4. The post-contingency voltage on 115 kV buses can not be less than 108 kV.
5. 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 Woodstock East TS project.

Contingencies associated with M32W or M33W and W7W are simulated for voltage studies. Simulation results indicate that there is no difference in voltages between contingencies associated with M32W and M33W. Therefore, only results with contingencies involved M32W are shown in this report.

The simulation results for pre- and post-contingency voltages are shown in Table 4 and Table 5.

Table 4 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)	241.8	236.0	120.0	118.5	28.4	118.0	28.1	117.9	13.4
Pre-ULTC (kV)	241.9	230.2	111.9	114.6	27.4	114.3	27.0	113.8	12.9
Voltage Decline (%)	-0.04	2.46	6.75	3.29	3.52	3.14	3.91	3.48	3.73
Post-ULTC (kV)	241.1	227.7	113.2	112.5	27.8	112.0	27.9	111.9	12.6
Voltage Decline (%)	0.29	3.52	5.67	5.06	2.11	5.08	0.71	5.09	5.97

Table 5 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)	241.8	236.0	120.0	118.5	28.4	118.0	28.1	117.9	13.4
Pre-ULTC (kV)	242.0	236.4	119.2	118.1	27.8	117.3	26.7	117.2	13.3
Voltage Decline (%)	-0.08	-0.17	0.67	0.34	2.11	0.59	4.98	0.59	0.75
Post-ULTC (kV)	241.8	235.8	118.6	117.4	27.8	116.5	27.8	116.4	13.2
Voltage Decline (%)	0.00	0.08	1.17	0.93	2.11	1.27	1.07	1.27	1.49

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

6.6 Thermal Study

This section covers an investigation of thermal capability of the 230 kV and 115 kV circuits related to the proposed project and any new thermal problems introduced by the new project. The same modified base case and study assumptions listed in section 5.3 were used.

Ratings of the 230 kV circuits M32W/M33W and the 115 kV circuits W7W/W12W are shown in Table 6. 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 6 Circuit Ratings

Circuits	Sections	Continuous Rating		15 Minutes LTR	
		A	MVA*	A	MVA*
M32W/M33W	Buchanan-Middleport	2130	849	3250	1295
	Salford Jct-Ingersoll	830	331	1020	406
	Ingersoll-Karn	1410	561	1590	633
W7W/W12W	Karn-Woodstock	1130	235	1810	376
B8W	Woodstock-Woodstock East	1130	235	1810	376

*: MVA@ 230 kV for M32W/M33W and 120 kV for W7W/W12W

Simulations were performed to investigate power flows for pre-contingency conditions and after the loss of M32W or W7W. Results are shown in Table 7.

Table 7 Pre- and Post-contingency Power Flow

Circuits	M32W/M33W			W7W/W12W	
Sections	Buchanan-Middleport	Salford Jct-Ingersoll	Ingersoll-Karn	Karn-Woodstock	Woodstock-Woodstock E
Continuous Rating (MVA)	894	331	561	235	235
Pre-Contingency (MVA)	211.8	151.9	95.4	94.5	57.2
% of Continuous Rating	23.7	45.9	17.0	40.2	24.3
LTR (MVA)	1295	406	633	376	376
Post-Contingency (MVA) (loss of M32W)	334.3	303.5	179.2	99.6	59.7
% of LTR	25.8	74.8	28.3	26.5	15.9
Post-Contingency (MVA) (loss of W7W)	213.4	145.9	93.4	180.0	96.0
% of LTR	16.5	35.9	14.8	47.9	25.5

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 and 115 kV circuits with the proposed Woodstock East TS project.

6.7 Summary

The findings of analysis are summarized as follows:

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

2. There is no thermal overloading concern associated with the 230 kV and the 115 kV circuits with the proposed Woodstock East TS project.

3. The area transmission system meets the planning criteria for load supply security.

– End of Report –