



System Impact Assessment Report

CONNECTION ASSESSMENT & APPROVAL PROCESS

Issue 1.0

FINAL REPORT

Project: GTA West Transmission Reinforcement
Huronario SS – Stage 1

Applicant: Hydro One Networks Inc.

CAA ID 2006-224

Transmission Assessments & Performance Department

September 25, 2006

REPORT

SYSTEM IMPACT ASSESSMENT REPORT
GTA West Transmission Reinforcement
Hurontario SS – Stage 1

System Impact Assessment Report

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Hurontario SS – Stage 1

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 preliminary feasibility 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 preliminary feasibility 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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SIA Findings

Conclusions and Recommendations

This System Impact Assessment examined the impact of the proposed 4-breaker switching station, Hurontario SS, on the reliability of the IESO-controlled grid. Stage 1 of the project proposes to connect the 230 kV circuits R19T to V72R and R21T to V73R. This connection will be made by having circuits V72R and V73R extend west from Cardiff TS and connect at the R19T/R21T Pleasant tap. The North sections of R19T and R21T from the Pleasant tap supplying Pleasant TS and Jim Yarrow MTS will be respectively connected radial to R19T+V72R and R21T+V73R.

The study results concluded the following:

1. The proposed facilities would help reduce the amount of load supplied by circuits R19T+R21T below the 500 MW threshold bringing the area transmission in compliance with the *IESO Supply Deliverability Guidelines*.
2. With all elements in service, the pre-contingency and post-contingency flows are within long term and/or short term ratings of the equipment under 2009 summer peak extreme weather conditions.
3. Short circuit study results show an increase in fault currents with the addition of Hurontario SS. The largest increase is experienced at Sithe Goreway GS and the lowest at Claireville 230 kV bus, but fault levels do not exceed the interrupting capabilities of the lowest rated breakers except for the breakers at Claireville TS. The work undertaken by Hydro One to reconfigure Claireville switchyard will allow the split operation whenever the fault levels exceed the interrupting capability of the breakers as dictated by system conditions.
4. The voltage declines that occur following various contingencies are within the IESO assessment criteria.
5. The peak load connected to the new radial circuits R19T North and R21T North (Pleasant TS and Jim Yarrow MTS) will be close to the 500 MW deliverability threshold in 2009.
6. By 2009, during peak load conditions the loss of R19T North or R21T North will result in the loading of the remaining circuit above its continuous rating. This overloading cannot be mitigated by re-dispatching generation, requiring load curtailment post-contingency. However, this situation would occur even in the existing system under 2009 summer peak conditions, thus it is not caused by the new connection.
7. If the Sithe Goreway GS is not in service, the pre-contingency flows through Claireville autotransformers would approach or be above their continuous rating. Although some of the overloading of the Claireville autotransformers can be attributed to having the new connection of Hurontario SS, the overloading is mainly originated from the load growth in the GTA area, deficiency of 500/230kV transformation and lack of generation support on the 230 kV side. There are contingencies resulting in autotransformer loadings above the 10-day LTR, but none above the

15 minute-LTR. The post-contingency voltage decline is less than 10 %, therefore respecting the IESO assessment criteria.

8. The proposed facility would provide an additional path for the evacuation of Sithe Goreway generation. With the proposed connection in place, the power from Sithe Goreway GS power will flow eastbound towards Claireville TS and Richview TS as well as westbound towards Hurontario SS. This will mitigate potential overloads on V72R and V73R that would exist under current system configuration.

Recommendations:

In subsequent stages of the area transmission reinforcement plan Hydro One is proposing to construct additional circuits north from Hurontario SS to supply the load at Pleasant TS and Jim Yarrow MTS. The IESO confirms the need and supports the next stages of the plan which will resolve both the future deliverability level concerns and the thermal overloading issue on the R19T North and R21T North.

The impact and benefits of future stages of the Hurontario SS will be assessed by the IESO in a separate SIA. This System Impact Assessment is for Stage 1 of the proposal only.

IESO's Requirements for Connection

The following requirements were identified in this assessment:

1. Hydro One Networks is required to install all the equipment needed to monitor the information required by the IESO on a continuous basis as described in Appendix 4.16 of the market rules. The IESO requires that the status of all the breakers as well as voltages and active/reactive power flow to be monitored at Hurontario SS.
2. 230 kV equipment connected to terminal stations must be capable of continuously operating in the range between 220 kV and 250 kV (Appendix 4.1, Reference 2 of the Market Rules). In particular, the IESO requires that the 230 kV connection equipment have the following requirements:
 - connection equipment must have a maximum continuous voltage rating of at least 250 kV in southern Ontario,
 - equipment must be able to interrupt rated fault current for voltages up to the maximum continuous rating, and
 - equipment must remain in service, and not automatically trip, for voltages up to 5% above the maximum continuous rating, for up to 30 minutes, to allow the system to be re-dispatched to return voltages within their normal range.
3. Based on the Transmission System Code (Appendix 2), all 230 kV interrupting devices should have an interrupting capability of 63 kA. The new breakers are rated at this performance standard set in the TSC and it can be concluded that the interrupting ratings of the new breakers are adequate.

4. Hydro One will have to follow the Transmission System Code technical requirements for adequate protection at Hurontario SS. The existing protection systems are to be revised as required. The protection systems must be fully duplicated and supplied from separate batteries.
5. A formal Customer Impact Assessment (CIA) will not be required for the connected customers that participated in the area supply study since these customers are the only ones directly affected by the proposed facilities. However, Hydro One will have to perform a CIA to identify the impact of the new Hurontario SS on Site Goreway GS.

Notification of Approval for Connection Proposal

From the information provided, our review concludes that the proposed changes will not result in a material adverse effect on the reliability of the IESO-controlled grid

It is recommended that a Notification of Conditional Approval be issued for Stage 1 of Hurontario SS subject to the IESO receiving written acknowledgement that the requirements listed in this report will be implemented.

System Impact Assessment Report

1. Project Description

Hydro One initiated an area supply study with the Local Distribution Companies (LDC's) that service GTA West with the goal of identifying options to reinforce the West GTA transmission system. Part of the study focused on circuits R21T and R19T which are major arteries in the transmission system that provides electricity to GTA West, including the cities of Mississauga and Brampton, as well as delivering electricity to Toronto and points beyond. These circuits are two of four 230 kV circuits that connect Trafalgar TS and Richview TS. As well, R21T and R19T are part of the Flow East Towards Toronto (FETT) Interface in southern Ontario.

Under the existing transmission system, increasing load in GTA West is expected to cause congestion on circuits R21T and R19T within the next 10 years. As well, the load connected to these two circuits is exceeding the IESO's Supply Deliverability Guideline, which states the following:

“With all transmission elements in service, any single element or double circuit contingency should not result in an interruption of supply to a load level of 500MW or more.”¹

As a result of the 'GTA West Supply Study', Hydro One is planning to construct a new 230 kV 4-breaker switching station called Hurontario SS. Stage 1 of the proposal will connect circuits V72R to R19T and V73R to R21T. Circuits V72R and V73R will be extended from Cardiff TS to Hurontario SS which will be located on the Pleasant tap of R19T/R21T. Loads supplied by the existing R19T and R21T Pleasant taps, i.e. Pleasant TS and Jim Yarrow MTS will be supplied radial from Hurontario SS by the circuits R19T North and R21T North connected respectively to R19T+V72R and R21T+V73R.

This SIA addresses only the Stage 1 of the reinforcement project as described above. Future stages include adding additional circuits from Hurontario SS to Jim Yarrow and Pleasant TS as well as extending circuits from Milton TS to Hurontario SS. These stages will be reviewed and assessed in a separate SIA Study.

The construction of the new facility is scheduled to commence in the first quarter of 2007 with an expected in service date of May 2009.

The purpose of the System Impact Assessment is to evaluate the results of the studies and identify the benefit of the new facilities and their effect on system reliability.

– End of Section –

¹ IESO Supply Deliverability Guidelines, IMO_GDL_0021
www.ieso.ca/imoweb/pubs/marketAdmin/IMO_GDL_0021_IMOSupplyAvailabilityGuidelines.pdf

2. Review of Connection Proposal

2.1 Connection Arrangement

The existing connection arrangement is shown in Figure 1 below.

The new Hurontario SS will be located along the Pleasant tap on R19T and R21T where Milton to Claireville 500 kV right-of-way intersects R19T and R21T. The circuits V72R and V73R will be extended approximately 4.2 km from Cardiff TS to Hurontario SS. The loads supplied by existing R19T/R21T Pleasant tap, i.e. Pleasant TS and Jim Yarrow MTS will be supplied radial from Hurontario SS by the circuits R19T North and R21T North connected to circuits R19T+V72R and R21T and V73R respectively.

Figure 2 represents the proposed system, which is being assessed in this report. This system has also Sithe Goreway generating plant connected to V72R and V73R, which is expected to be in service before the Hurontario SS is commissioned.

Figure 1: Existing Connection

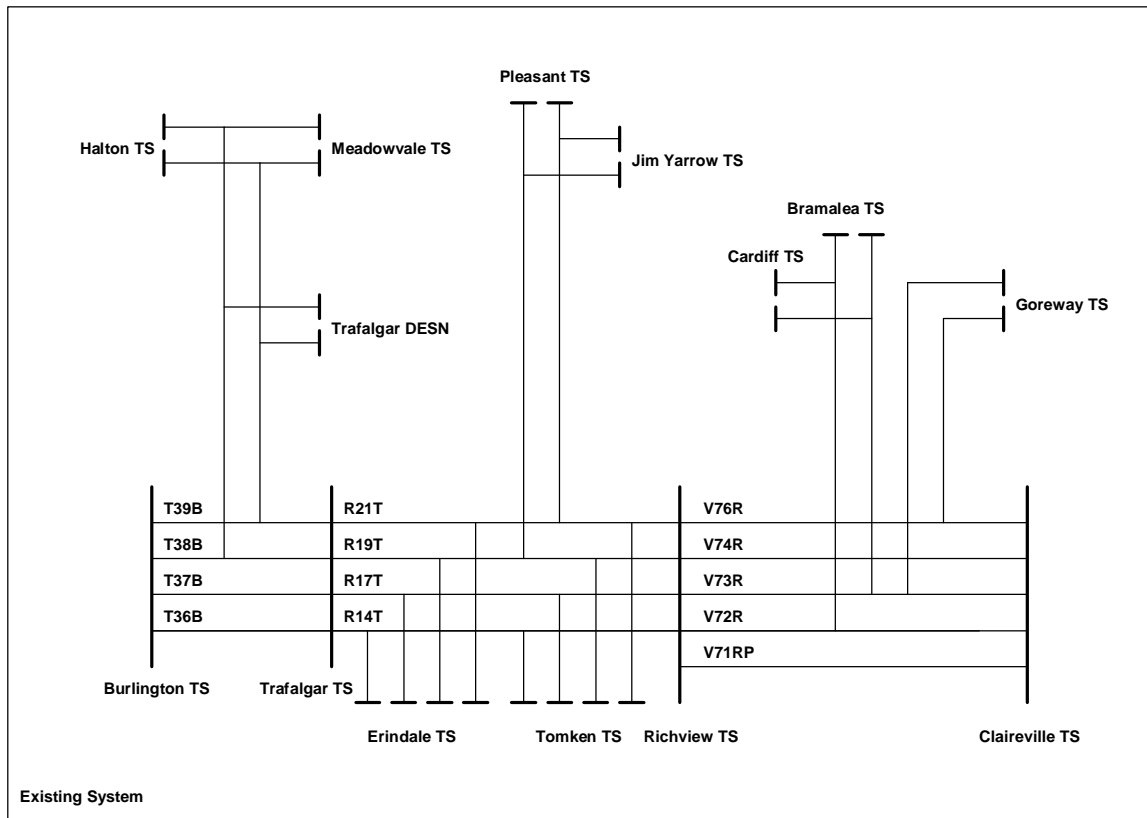
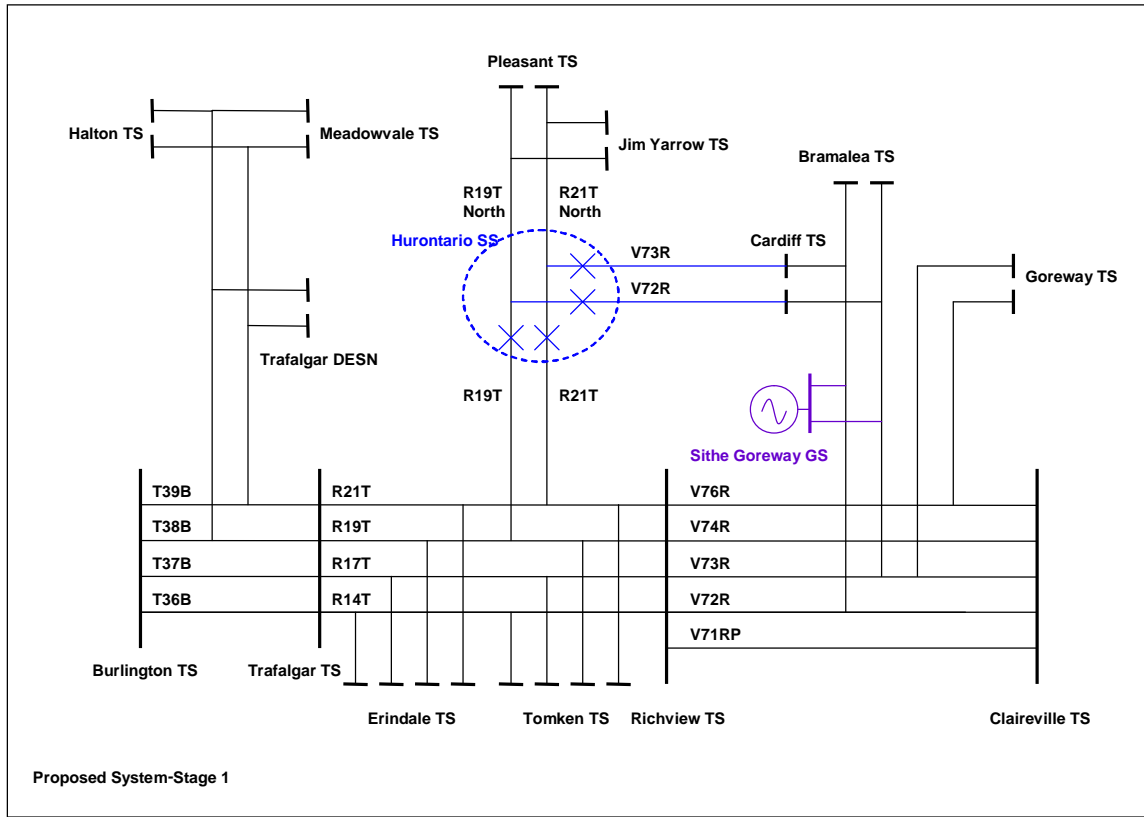


Figure 2: Proposed Connection – Stage 1



2.2 On-line Monitoring

The Market Rules (Chapter 4 section 7.4) require that each transmitter shall provide the IESO on a continual basis with on-line monitored quantities as specified in Appendix 4.16. 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 status of all the breakers as well as voltages and active/reactive power flow to be monitored at Hurontario SS.

2.3 Protection Systems

With respect to the protection and telecommunication requirements, Hydro One will have to follow the Transmission System Code technical requirements for adequate protection at Hurontario SS

The existing protection systems are to be revised as required.

– End of Section –

3. Data Verification

Hydro One has provided the following equipment specifications for new components making up Hurontario SS.

230 kV Circuit Breakers:

Voltage Class:	230 kV
Number required:	4
Continuous operating voltage:	250 kV
BIL	900 kV
Rated interrupting time	3 cycles
Short Circuit rating-3phase	63 kA (symmetrical)
Short Circuit rating – L-G	63 kA (symmetrical)

230 kV Transmission line (Cardiff to Hurontario) :

Maximum operating voltage:	250 kV
Approximate length	4.2 km
Conductor size	1780 MCM
Stranding	59/19
Cont. Rating	1700 A
LTR (50% pre loading)	2350 A
LTR (75% pre loading)	2100 A
R	0.00032 pu
X	0.00413 pu
B	0.00720 pu

4. System Description

4.1 Existing Transmission

R19T and R21T are part of the 230 kV transmission corridor between Trafalgar TS and Richview TS that provide electricity to GTA West including the cities of Mississauga and Brampton and also deliver electricity to Toronto and points beyond. These circuits are two of four 230 kV circuits that connect Trafalgar TS and Richview TS. Also, these circuits are part of the FETT interface in southern Ontario. Figures 1 and 2 show the existing and proposed connections.

Since circuits R19T and R21T share common towers, the loss of both circuits is a recognized contingency. This contingency would result in more than 500 MW of load being interrupted. For example, the load connected to these two circuits totaled above 850 MW on August 1, 2006.

4.2 Area Loads and Loads Growth

Figures 3 and 4 represent the load on R19T+R21T and FETT flow from June 1st to Aug 14th 2006.

Figure 3: R19T+R21T supplied load

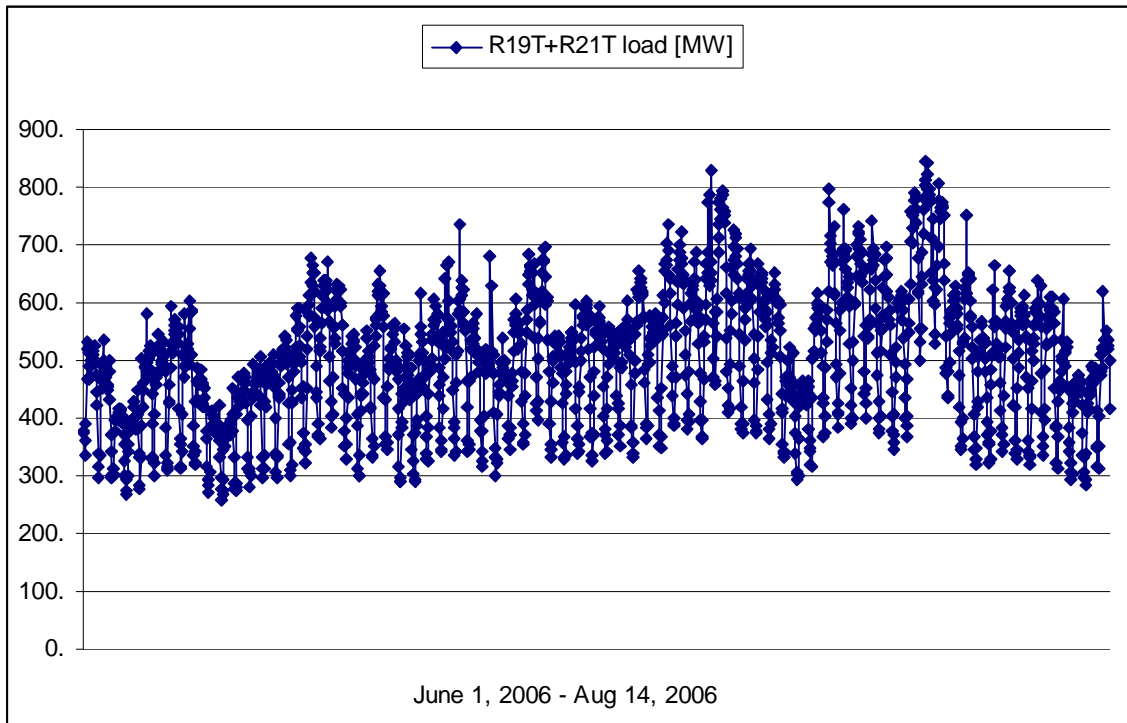
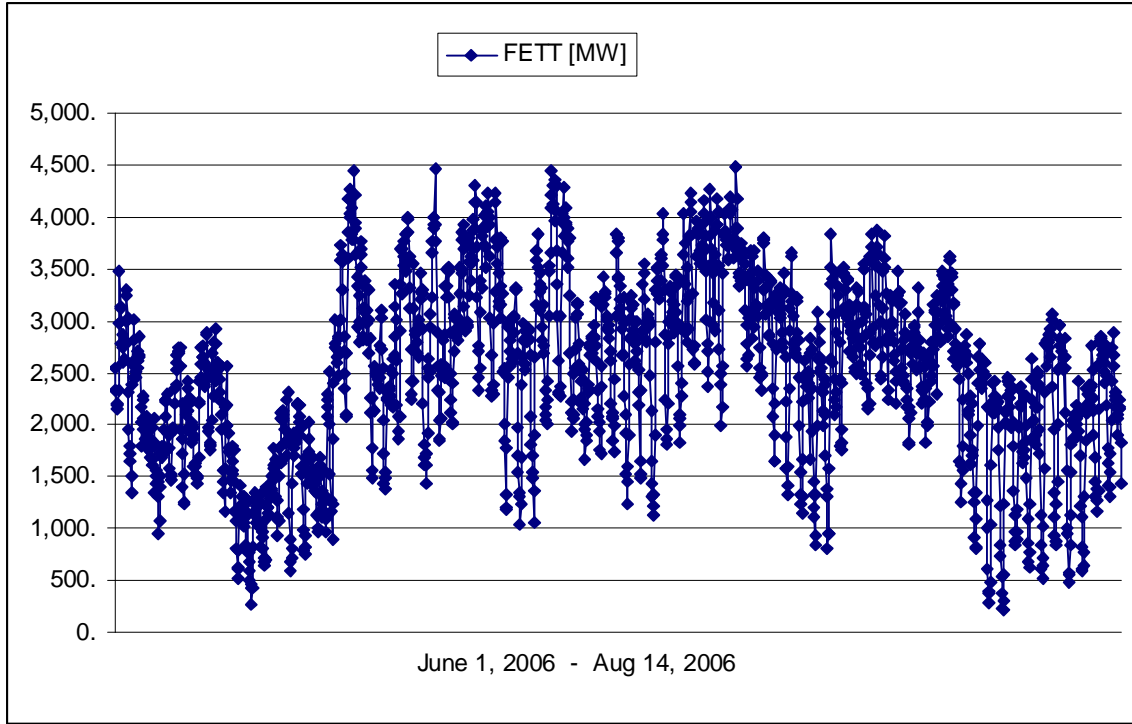


Figure 4: FETT flow



The load forecasts prepared by Hydro One and the LDC's shown below was compared with the loading that occurred on August 1, 2006 when the highest Ontario system peak was set and it was found that the forecast is reflecting a fair load distribution.

230/27.6 kV Stations	Bramalea TS ^{1,2,3}	Erindale TS ^{1,4}	Goreway TS ³	Pleasant TS ²	Cardiff TS ¹	Halton TS	Jim Yarrow MTS ²	Richview TS
2009 load [MW]	179	177	177	198	107	162	138	371

230/44 kV Stations	Bramalea TS ^{1,2,3}	Erindale TS ^{1,4}	Goreway TS ³	Pleasant TS ²	Tomken TS	Meadowvale TS ⁴
2009 load [MW]	196	405	32	148	319	181

- ¹ Net load; includes load transfers from Bramalea TS and Erindale TS to Cardiff TS as per Hydro One.
- ² Net load; includes load transfers from Pleasant TS and Bramalea TS as per Hydro One.
- ³ Net load; Includes load transfers from Bramalea TS as per Hydro One.
- ⁴ Net load; Includes load transfers from Meadowvale TS to Erindale TS as per Hydro One.

4.3 Deliverability Criteria

The deliverability levels for the IESO Controlled Grid are defined in IESO Supply Deliverability Guidelines as follows:

“For loads between 250MW and 500MW:

With all transmission elements in service pre-contingency, any single element contingency should not result in an interruption of supply to a load level greater than 250 MW.

With all transmission elements in service, for any double circuit contingency that results in a supply interruption of between 250MW and 500MW, all load should be restored by switching operations within a typical period of 30 minutes”

Under existing transmission system, increasing load in GTA West is expected to cause the overloading of circuits R21T and R19T within the next 10 years. At the same time, the load connected to these two circuits is exceeding the IESO’s *Supply Deliverability Guideline*.

Since circuits R19T and R21T share common towers, the loss of both circuits is a recognized contingency. This contingency would result in more than 500 MW of load being interrupted. Based on IESO records the load connected to these two circuits totaled above 850 MW on August 1, 2006.

<p>Since the IESO deliverability criteria for loads between 250 MW and 500 MW is exceeded, Hydro One is required to implement as soon as practical their plan for building the new Hurontario SS</p>
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– End of Section –

5. Short Circuit Assessment

Fault level studies were completed by Hydro One to specifically examine the effect of Hurontario SS on fault levels at existing facilities in the area. Studies were performed to analyze the fault levels before and after Hurontario SS comes into service. A summary of the study results is shown in Table 1 below.

The system model with Hurontario SS will include the 230 kV line extensions from Cardiff TS to Hurontario SS crossing of the R19/21T right-of-way. It will also include the following facilities and system assumptions:

Generation Facilities to be included in short circuit base case:

- Portlands Energy Centre in-service.
- 6 Pickering units: Pic B G5-8, PicA G1 & G4
- GTAA generation – 44 kV buses at Bramalea TS and Woodbridge TS = 117 MW
- Renewable RFP contracts:
- Erie Shores Wind Farm (W8T) 99 MW
- Kingsbridge Wind Farm (Goderich TS) 39.6 MW
- Melancthon Grey Wind Farm (B4V) 200 MW
- 8 Bruce units: Bruce B G5-8, Bruce A G1-4
- 4 Darlington units
- 8 Nanticoke units
- 4 Lennox units
- 4 Sithe-Goreway units

Facilities to be removed from base case:

- Lakeview TGS: all units

System Assumptions:

- Claireville TS 230 kV bus needs to be **closed**
- Leaside TS 115 kV bus needs to be **open**
- Richview TS 230 kV bus needs to be **open**
- Cherrywood TS needs to be operated with separate north & south 230 kV switchyards, and the 230 kV buses at Cherrywood North TS & Cherrywood South TS need to be **open**
- Hearn TS: 115kV busbar open vertically.
- Cooksville TS 230 kV bus needs to be **closed**
- Parkway TS with four 500/230kV auto-transformers. Mid-point of Claireville TS to Parkway TS 230 kV circuits V71RP and V75P is **closed**
- Ontario-Michigan phase shifters on neutral taps (minimum impedance taps)
- All new capacitor banks: Essa TS, Burlington TS, John TS, Leaside TS, Richview TS, & Trafalgar TS
- Circuit B3N in-service

Table 1: Fault levels with and without Hurontario SS

BUS kV	TOTAL FAULT CURRENT Symmetrical (kA)		Breaker Ratings Symmetrical (kA)**
	3-phase fault	L-G	
Existing system without Hurontario SS connected to Cardiff			
Claireville 230 kV	73.2	80.7	80.0
Richview 230 kV north yard	59.1	56.4	69.5
Richview 230 kV south yard	59.1	59.5	69.5
Goreway GS 230 kV bus	31.0	26.0	63.0
Trafalgar TS 230 kV bus	49.8	49.7	63.0
Hurontario SS 230 kV tap to R19T	16.8	11.8	63.0
Hurontario SS 230 kV tap to R21T	16.8	11.8	63.0
Proposed configuration with Hurontario SS connected to Cardiff			
Claireville 230 kV	73.3	80.8	80.0
Richview 230 kV north yard	60.3	57.7	69.5
Richview 230 kV south yard	59.2	59.7	69.5
Goreway GS 230 kV bus	38.1	32.5	63.0
Trafalgar TS 230 kV bus	51.6	51.2	63.0
Hurontario SS 230 kV tap to R19T	32.3	25.9	63.0
Hurontario SS 230 kV tap to R21T	32.2	25.8	63.0
Difference in Symmetrical Fault Current (kA) – with and without Hurontario			
Claireville 230 kV	0.1	0.1	80.0
Richview 230 kV north yard	1.2	1.3	69.5
Richview 230 kV south yard	0.1	0.2	69.5
Goreway GS 230 kV bus	7.1	6.5	63.0
Trafalgar TS 230 kV bus	1.8	1.5	63.0
Hurontario SS 230 kV tap to R19T	15.5	14.1	63.0
Hurontario SS 230 kV tap to R21T	15.4	14.0	63.0

* Based on a pre-fault voltage level of 250 kV for the 230 kV system.

**Worst case rating

The results in Table 1 generally show that there is an increase in fault currents with the addition of Hurontario SS. The increase ranges between is 7.1 kA at Sithe Goreway GS and the 0.1 kA at Claireville 230 kV bus. However, the fault levels do not exceed the interrupting capabilities of the lowest rated breakers except for the breakers at Claireville TS. But, the fault levels at Claireville TS exceed the breaker capability before the closing of the transmission loop via Hurontario SS. Hence, for the conditions simulated in these studies Claireville switchyard should be operated split even before the addition of Hurontario SS. Work currently undertaken by Hydro One to reconfigure Claireville switchyard will allow the split operation whenever dictated by system conditions.

– End of Section –

6. System Impact Studies

This connection assessment study focused on:

- 1) Pre and Post contingency thermal analysis on all main sections of the 230 kV circuits between Trafalgar and Richview, Claireville and Richview, and all 500/230 kV autotransformers supplying the GTA.
- 2) Various 500 kV and 230 kV contingencies were simulated to analyze voltage declines at the main busses
- 3) Additional analysis was performed to observe the effect of disconnecting Goreway GS on thermal ratings and voltage decline.

6.1 Study Assumptions

Based on the information provided by Hydro One, the following elements have been added to the load flow model.

(a) Transmission Line Data - Cardiff to Hurontario

R = 0.00032 pu	X = 0.00413 pu	B = 0.00720 pu	Length = 4.2 km
Size = 1780 MCM	Stranding = 59/19	Cont. Rating = 1700 A	
LTR = 2350 A with 50% pre-load		LTR = 2100 A with 75% pre-load	

(b) Hurontario SS

Hurontario SS is located 8.6 km from Hanlon Junction north on R19T and R21T.

(c) Pleasant TS: T3 and T4

Hydro One has submitted a proposal for a new 230/28-28 kV, 75/125 MVA DESN at Pleasant TS. These two new transformers were modeled similar to the existing Pleasant T5 and T6 transformers.

If any of the data is inaccurate, the applicant should provide the correct data to the IESO prior to the completion of IESO Facility Registration process.

To conduct the computer analysis, the IESO July 2006 base case model was used with following adjustments.

The Toronto zone load was scaled to match the 2009 extreme monthly peak load forecast of 10,544 MW. Then, individual GTA west station loads were adjusted to match the 2009 load forecast provided by Hydro One and other area LDC's as shown below:

System Impact Assessment Report Hurontario SS - Stage 1

230/27.6 kV Stations	Bramalea TS ^{1,2,3}	Erindale TS ^{1,4}	Goreway TS ³	Pleasant TS ²	Cardiff TS ¹	Halton TS	Jim Yarrow MTS ²	Richview TS
2009 load [MW]	179	177	177	198	107	162	138	371

230/44 kV Stations	Bramalea TS ^{1,2,3}	Erindale TS ^{1,4}	Goreway TS ³	Pleasant TS ²	Tomken TS	Meadowvale TS ⁴
2009 load [MW]	196	405	32	148	319	181

¹ Net load; includes load transfers from Bramalea TS and Erindale TS to Cardiff TS as per Hydro One.

² Net load; includes load transfers from Pleasant TS and Bramalea TS as per Hydro One.

³ Net load; Includes load transfers from Bramalea TS as per Hydro One.

⁴ Net load; Includes load transfers from Meadowvale TS to Erindale TS as per Hydro One.

The above load forecasts prepared by Hydro One and LDC's were compared with loading that occurred on August 1, 2006 when the highest record on Ontario system peak demand was set and it was found that the forecast is reflecting a fair load distribution.

Pleasant TS T3 and T4 were added and 13.11 MW of load was transferred from Pleasant T5+T6 to the new transformers.

Site Goreway GS is expected to be in service before the Hurontario SS is commissioned. Therefore, the GS was loaded at 900 MW with the 230 kV bus operating solid.

The FETT flow was maximized to create stress in the portion of system being studied.

Summary of Study conditions:

Total Ontario Load	27285 MW	Total Ontario Generation	28224 MW
Total Ontario Losses	823 MW	FETT	4661 MW
Flow South	1130 MW	Toronto Zone Load	10712 MW
FABC	4538 MW	Local Area Generation	240 MW Bramalea LV including GTAA and 900 MW Site Goreway

6.2 Thermal Loading Assessment

For thermal analysis, all main sections of the 230 kV circuits between Trafalgar and Richview, and Claireville and Richview were monitored. Also all the 500/230 kV autotransformers supplying GTA were monitored. A diagram of the area transmission is shown in Figure 5.

The following fifteen contingencies were simulated.

500 kV Contingencies

B560V + M571V
 V586M + M570V
 M572T + M573T
 Claireville T14
 C550VP + Pky T4 + Clvl T14 (Clvl W2L550 B/F)

230 kV Contingencies

R19T + R21T
 V71RP + V72R
 V72R + V73R
 V73R + V74R
 R14T + R17T
 R19T + R19TNorth (Hurontario R19T B/F)
 V72R + R19TNorth (Hurontario V72R B/F)
 V72R
 R19T
 R19T North

All contingencies except R19T were simulated with load modeled as constant P and Q. The R19T contingency for the existing system analysis was simulated with active power modeled as 50 % constant current and 50 % constant impedance, and the reactive power was modeled as 100 % constant impedance. For the proposed system and R19T contingency, the loads were not converted into voltage dependant functions.

Tables 2 to 4 illustrate the results of the thermal analysis showing the loading of the monitored circuits as a percentage of both continuous and LTR ratings with Hurontario SS in service.

The pre-contingency line flows were compared to the continuous line ratings at 35 C°, day time and 4 km/h wind. The *IESO Transmission Assessment Criteria* requires that all line and equipment loadings be within their continuous rating with all elements in service.

The post-contingency line flows were compared to both continuous ratings and limited time rating (LTR). The *IESO Transmission Assessment Criteria* requires the post-contingency loading to be less than the LTR. The LTR used for the circuits was the 15 minute LTR with pre-load conditions assumed to be 50 %, since this pre-loading reflects the pre-contingency flows.

The autotransformers short time ratings used in the tables was the 10-Day LTR, assuming pre-load conditions to be 95 %. However, the 10-day LTR limit is more conservative than the IESO requirements, and wherever this limit was violated, the flow was compared with 15-minute LTR.

Table 5 summarizes the results for both existing system and for the proposed system configuration.

The following are the main observations.

Pre-contingency:

- (a) With the new Hurontario SS the flow on circuits R19T and R21T was reduced by about 60 MW each at Trafalgar end.
- (b) Circuits V72R and V73R were carrying an additional 130 MW each from the Claireville end, but the loading was well below the continuous rating of the circuits.
- (c) The flows on the remaining Claireville to Richview circuits were slightly reduced while the flows on R14T and R17T increased slightly.
- (d) Trafalgar autotransformers were offloaded by about 50 MVA total while the Claireville autotransformers carried an additional 70 MVA total. No significant loading change on Parkway and Cherrywood autotransformers was noticed (less than 10 MVA load shift).
- (e) With Pleasant TS and Jim Yarrow MTS radially supplied from Hurontario SS (480 MW), the load remaining connected to the circuits R19T+R21T is less than 400 MW.
- (f) Ontario system losses are being reduced by 4 MW with the addition of the new SS.

Post-contingency

- (a) All simulated 500 kV contingencies resulted in acceptable loading on the 230 kV lines. The post-contingency loadings are within the continuous rating of the lines – see Table 2.
- (b) Some 500 kV contingencies resulted in loading of the Claireville autotransformers above their continuous rating. However, all autotransformer loadings are below the 10-day LTR. The worst contingency was a breaker failure at Claireville, W2L550, which removes from service C550VP + Parkway T4 + Claireville T14 and results in Claireville autotransformers carrying power equivalent to 94.2% of their 10-Day LTR. – see Table 3.
- (c) All 230 kV contingencies resulted in post-contingency flows below the continuous ratings.
- (d) The loss of either R19T North or R21T North would result in the loading of the remaining circuit above its continuous rating, but below the LTR, i.e. 103 % and 83.9 % respectively. Since these circuits are radial from Hurontario SS, the overloading cannot be solved by re-dispatching generation. However, this problem would be more severe under existing system configuration for similar load conditions. The loss of R19T or R21T would result in the section between Hanlon Junction and Jim Yarrow Junction being loaded to 108 % of its continuous rating – see Table 5. As proposed by Hydro One, future addition of circuits North from Hurontario SS that will supply Jim Yarrow MTS, Pleasant TS and future load growth will mitigate the overloading.

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Table 2 – 500 kV Contingencies – Line Loading (post-contingency studies assumed Hurontario SS I/S)

Contingency	Cont rating		Existing system Pre-contingency		Proposed system Pre-contingency		B560V+M571V		V586M+M570V		M572T+M573T		Civ T14		C550VP+Civ T14			
	Amp	LTR	Amp	Cont %	Amp	Cont %	Cont %	LTR	Cont %	LTR	Cont %	LTR	Cont %	LTR	Cont %	LTR		
Monitored Element	Cct	From	To	Amp	Cont %	Amp	Cont %	Cont %	LTR	Cont %	LTR	Cont %	LTR	Cont %	LTR	Cont %	LTR	
V71RP	CLAIRVIL	CLAIRV71	3131	4182	1327	42	1157	37	36	27	36	27	42	31	31	23	38	29
	CLAIRV71	RICH AH1	1601	2185	985	62	846	53	49	36	48	35	67	49	47	34	48	36
	CLAIRV71	TSTARJ71	1796	2484	388	22	363	20	22	16	22	16	16	11	15	11	26	19
	TSTARJ71	VAUG1J71	1904	2814	167	9	141	7	9	6	9	6	3	2	3	2	13	9
	VAUG1J71	RICHLJ71	1818	2693	23	1	52	3	1	1	1	1	8	5	8	6	4	2
	RICHLJ71	RICH2J71	1818	2693	234	13	260	14	14	9	13	9	20	13	20	13	9	6
	RICH2J71	PARKWAY	1701	2464	413	24	438	26	26	18	25	17	32	22	32	22	20	14
V72R	CLAIRVIL	CLAIRV72	3131	4182	299	10	571	18	13	10	13	10	32	24	13	10	13	10
	CLAIRV72	RICH J72	1796	2484	984	55	845	47	43	31	43	31	59	43	42	30	43	31
	RICH J72	RICH AH2	1601	2184	868	54	730	46	41	30	41	30	59	43	39	29	41	30
	CLAIRV72	CLV PJ72	1510	5977	831	55	435	29	29	7	30	8	18	5	29	7	28	7
	CLV PJ72	SITHJV72	1691	2508	834	49	441	26	26	17	27	18	17	11	27	18	25	17
	SITHJV72	BRAMAV72	1691	2508	355	21	791	47	44	30	43	29	61	41	44	30	44	30
	BRAMAV72	CARDV72	1700	2350	151	9	601	35	33	24	31	23	50	36	33	24	33	24
CARDV72	HURONT19	1700	2350			469	28	24	16	23	15	41	28	25	16	24	16	
V73R	CLAIRVIL	CLAIRV73	3131	4182	444	14	750	24	19	14	19	14	38	28	19	14	19	14
	CLAIRV73	RICH AH2	1601	2184	966	60	829	52	48	35	47	35	65	48	46	33	48	35
	CLAIRV73	CLV PJ73	1510	5977	831	55	435	29	29	7	30	8	18	5	29	7	28	7
	CLV PJ73	SITHJV73	1691	2508	834	49	441	26	26	17	27	18	17	11	27	18	25	17
	SITHJV73	BRAMAV73	1691	2508	355	21	791	47	44	30	43	29	61	41	44	30	44	30
	BRAMAV73	CARDV73	1700	2350	151	9	602	35	32	24	31	23	50	36	33	24	33	24
	CARDV73	HURONT21	1700	2350			469	28	24	17	23	17	41	30	25	18	24	18
V74R	CLAIRVIL	CLAIRV74	3156	4305	1594	51	1456	46	45	33	44	32	54	39	43	32	44	33
	CLAIRV74	WESTJV74	1796	2484	1095	61	959	53	50	36	49	36	66	47	48	35	50	36
	WESTJV74	RICH J74	2005	2772	904	45	768	38	35	25	35	25	49	36	33	24	35	25
	RICH J74	RICH AH1	1621	2277	792	49	657	41	36	26	36	25	54	38	35	25	36	26
V76R	CLAIRVIL	CLAIRV76	3156	4305	1387	44	1249	40	38	28	37	27	47	34	36	27	38	28
	CLAIRV76	WESTJV76	1796	2484	1105	62	967	54	50	36	50	36	66	48	48	35	50	36
	WESTJV76	RICH AH2	1796	2484	903	50	766	43	39	28	38	28	55	40	37	27	39	28
V75P	CLAIRVIL	CLAIRV75	3156	4305	900	29	873	28	29	21	29	21	25	19	25	18	32	23
	CLAIRV75	TSTARJ75	1796	2484	387	22	361	20	22	16	22	16	16	11	15	11	26	19
	TSTARJ75	VAUG1J75	2058	3025	166	8	140	7	8	5	8	6	3	2	3	2	12	8
	VAUG1J75	RICHLJ75	1977	2915	23	1	52	3	1	1	1	1	7	5	8	5	3	2
	RICHLJ75	RICH2J75	1818	2693	232	13	258	14	14	9	13	9	19	13	20	13	9	6
RICH2J75	PARKWAY	1701	2434	410	24	436	26	25	18	25	17	31	22	32	22	20	14	
R14T	TRAFALGA	ERINJR14	1645	2278	826	50	880	54	66	47	66	48	25	18	58	42	62	45
	ERINJR14	TOMKJR14	1230	1508	423	34	473	39	54	44	55	45	21	17	44	36	49	40
	TOMKJR14	RICH AH1	1230	1508	297	24	331	27	42	34	41	34	36	29	31	25	35	29
R17T	TRAFALGA	ERINJR17	1645	2278	825	50	879	53	66	47	66	48	25	18	58	42	62	45
	ERINJR17	TOMKJR17	1230	1508	422	34	473	38	54	44	55	44	21	17	44	36	49	40
	TOMKJR17	RICH AH1	1230	1508	298	24	332	27	42	34	41	34	36	29	31	25	35	29
R19T	TRAFALGA	ERINJR19	1645	2278	948	58	804	49	63	46	63	46	15	11	55	40	59	43
	ERINJR19	HANLNJ19	1230	1508	692	56	550	45	64	52	64	52	20	17	52	43	58	47
	HANLNJ19	TOMKJR19	1230	1508	277	23	504	41	52	43	52	43	26	21	44	36	47	39
	TOMKJR19	RICH AH2	1230	1508	292	24	396	32	42	34	42	34	30	24	34	28	37	30
	HANLNJ19	HURONTAR	1230	1508			180	15	17	14	18	15	11	9	17	14	17	14
R21T	TRAFALGA	ERINJR21	1645	2278	957	58	812	49	63	46	64	46	16	11	55	40	60	43
	ERINJR21	HANLNJ21	1230	1508	688	56	546	44	64	52	64	52	21	17	52	42	58	47
	HANLNJ21	TOMKJR21	1230	1508	277	23	502	41	52	43	52	43	26	21	43	35	47	39
	TOMKJR21	RICH AH2	1230	1508	295	24	395	32	42	34	42	34	30	25	34	28	37	30
	HANLNJ21	HURONTAR	1230	1508			178	15	16	13	18	14	11	9	17	14	17	14

Table 3 – 500 kV Contingencies – Autotransformer Loading (post-contingency studies assumed Hurontario SS I/S)

Contingency	Cont rating		Existing system Pre-contingency		Proposed system Pre-contingency		B560V+M571V		V586M+M570V		M572T+M573T		Civ T14		C550VP+Civ T14	
	MVA	10 day LTR	MVA	Cont %	MVA	Cont %	Cont %	LTR %	Cont %	LTR %	Cont %	LTR %	Cont %	LTR %	Cont %	LTR %
Trafalgar T15	906	1098	726	80	701	77	85	70	81	67	0	0	83	68	86	71
Trafalgar T14	808	974	717	89	693	86	94	78	90	74	0	0	92	76	96	80
Claireville T13	810	957	690	85	708	87	81	68	80	68	106	90	102	86	111	94
Claireville T14	808	962	704	87	722	89	83	69	82	69	108	91	0	0	0	0
Claireville T15	808	962	696	86	714	88	82	69	81	68	107	90	103	87	112	94
Claireville T16	936	1109	647	69	664	71	65	55	65	55	86	72	83	70	90	76
Parkway T3	960	1142	658	69	660	69	66	56	66	55	77	65	74	62	91	76
Parkway T4	960	1142	658	69	660	69	66	56	66	55	77	65	74	62	0	0
Cherrywood T15	847	1007	634	75	632	75	72	61	72	61	81	68	78	66	85	71
Cherrywood T16	803	955	637	79	635	79	77	64	77	64	86	73	83	70	90	76
Cherrywood T14	803	955	664	83	663	83	80	67	80	67	90	75	86	73	93	78
Cherrywood T17	1158	1209	655	57	654	57	55	52	55	52	61	59	59	57	64	61

Table 4 – 230 kV Contingencies –Line Loading (post-contingency studies assumed Hurontario SS I/S)

Contingency	Cont rating	LTR	R14T+R17T		R19T+R21T		V71RP+V72R		V72R+V73R		V73R+V74R		R19T+R19TNorth		V72R+R19TNorth		V72R		R19T			
			Amp	Amp	Cont %	LTR %	Cont %	LTR %	Cont %	LTR %	Cont %	LTR %	Cont %	LTR %	Cont %	LTR %	Cont %	LTR %	Cont %	LTR %	Cont %	LTR %
V71RP	CLAIRVIL	CLAIRV71	3131	4182	37	28	36	27	0	0	52	39	55	41	39	29	44	33	45	34	37	28
	CLAIRV71	RICH AH1	1601	2185	54	39	53	39	0	0	80	59	82	60	56	41	65	47	67	49	54	39
	CLAIRV71	TSTARJ71	1796	2484	21	15	20	14	0	0	22	16	24	17	20	14	22	16	22	16	19	14
	TSTARJ71	VAUG1J71	1904	2814	8	6	7	5	0	0	9	6	11	7	7	5	9	6	9	6	7	5
	VAUG1J71	RICHLJ71	1818	2693	3	2	3	2	0	0	2	1	2	1	3	2	1	1	1	1	3	2
	RICHLJ71	RICH2J71	1818	2693	13	9	15	10	0	0	13	9	11	8	15	10	13	9	12	8	15	10
	RICH2J71	PARKWAY	1701	2464	24	17	26	18	0	0	25	17	23	16	27	19	25	17	24	17	27	19
V72R	CLAIRVIL	CLAIRV72	3131	4182	16	12	22	17	0	0	0	0	18	13	18	14	0	0	0	0	21	16
	CLAIRV72	RICH J72	1796	2484	48	35	47	34	0	0	0	0	73	53	50	36	0	0	0	0	48	35
	RICH J72	RICH AH2	1601	2184	47	34	46	33	0	0	0	0	68	50	48	36	0	0	0	0	47	34
	CLAIRV72	CLV PJ72	1510	5977	36	9	37	9	0	0	0	0	63	16	34	9	0	0	0	0	29	7
	CLV PJ72	SITHJV72	1691	2508	33	22	33	22	0	0	0	0	57	38	31	21	0	0	0	0	26	18
	SITHJV72	BRAMAV72	1691	2508	41	28	56	37	0	0	0	0	80	54	24	16	0	0	0	0	55	37
	BRAMAV72	CARDFV72	1700	2350	30	22	43	31	0	0	0	0	57	42	10	7	0	0	0	0	43	31
	CARDFV72	HURONT19	1700	2350	23	16	35	25	0	0	0	0	42	30	0	0	0	0	0	0	34	25
V73R	CLAIRVIL	CLAIRV73	3131	4182	22	16	27	21	24	18	0	0	0	0	25	19	23	17	17	13	27	20
	CLAIRV73	RICH AH2	1601	2184	53	39	52	38	82	60	0	0	0	0	55	40	63	46	65	48	53	39
	CLAIRV73	CLV PJ73	1510	5977	36	9	37	9	64	16	0	0	0	0	33	8	62	16	69	18	29	7
	CLV PJ73	SITHJV73	1691	2508	33	22	33	22	57	39	0	0	0	0	30	20	56	38	62	42	26	18
	SITHJV73	BRAMAV73	1691	2508	41	28	55	37	80	54	0	0	0	0	72	49	92	62	76	51	50	34
	BRAMAV73	CARDFV73	1700	2350	30	22	43	31	58	42	0	0	0	0	62	45	69	50	53	39	38	27
	CARDFV73	HURONT21	1700	2350	23	16	35	25	43	31	0	0	0	0	54	39	51	37	38	28	29	21
V74R	CLAIRVIL	CLAIRV74	3156	4305	46	34	45	33	62	45	60	44	0	0	48	35	52	38	53	39	47	34
	CLAIRV74	WESTJV74	1796	2484	54	39	53	38	80	58	77	56	0	0	56	41	64	46	66	47	54	39
	WESTJV74	RICH J74	2005	2772	39	28	38	28	62	45	60	43	0	0	41	29	48	34	49	36	39	28
	RICH J74	RICH AH1	1621	2277	42	30	41	29	63	45	60	42	0	0	43	31	45	32	47	34	41	29
V76R	CLAIRVIL	CLAIRV76	3156	4305	40	29	39	29	55	40	60	44	65	48	41	30	46	33	47	34	40	29
	CLAIRV76	WESTJV76	1796	2484	54	39	53	39	81	58	78	56	87	63	57	41	64	46	66	48	55	40
	WESTJV76	RICH AH2	1796	2484	43	31	43	31	69	50	66	48	65	47	45	33	53	38	55	40	43	31
V75P	CLAIRVIL	CLAIRV75	3156	4305	28	20	27	20	43	32	29	21	48	35	28	20	29	21	29	21	27	20
	CLAIRV75	TSTARJ75	1796	2484	21	15	20	14	48	34	22	16	24	17	20	14	21	16	22	16	19	14
	TSTARJ75	VAUG1J75	2058	3025	8	5	7	4	17	12	8	5	10	7	6	4	8	5	9	6	6	4
	VAUG1J75	RICHLJ75	1977	2915	3	2	3	2	3	2	2	1	2	1	3	2	1	1	1	1	3	2
	RICHLJ75	RICH2J75	1818	2693	13	9	14	10	31	21	13	9	11	8	15	10	13	9	12	8	15	10
	RICH2J75	PARKWAY	1701	2434	24	17	26	18	43	30	24	17	23	16	27	19	25	17	24	17	27	19
R14T	TRAFALGA	ERINJR14	1645	2278	0	0	72	52	55	40	60	43	56	40	61	44	55	39	54	39	61	44
	ERINJR14	TOMKJR14	1230	1508	0	0	63	51	40	33	48	39	41	34	48	39	40	32	39	32	49	40
	TOMKJR14	RICH AH1	1230	1508	0	0	48	39	28	23	36	29	29	24	36	29	28	23	27	22	36	30
R17T	TRAFALGA	ERINJR17	1645	2278	0	0	72	52	55	40	60	43	56	40	61	44	54	39	54	39	61	44
	ERINJR17	TOMKJR17	1230	1508	0	0	63	51	40	33	48	39	41	33	48	39	40	32	39	32	49	40
	TOMKJR17	RICH AH1	1230	1508	0	0	48	39	28	23	36	29	29	24	36	29	28	23	27	22	36	30
R19T	TRAFALGA	ERINJR19	1645	2278	67	48	0	0	60	44	68	49	48	34	0	0	48	34	59	43	0	0
	ERINJR19	HANLNJ19	1230	1508	69	57	0	0	60	49	70	57	42	34	0	0	44	36	58	48	0	0
	HANLNJ19	TOMKJR19	1230	1508	59	48	0	0	28	23	33	27	52	42	0	0	44	36	27	22	0	0
	TOMKJR19	RICH AH2	1230	1508	49	40	0	0	24	20	29	24	42	35	0	0	33	27	24	20	0	0
	HANLNJ19	HURONTAR	1230	1508	21	17	0	0	42	34	49	40	21	17	0	0	0	0	43	35	0	0
R21T	TRAFALGA	ERINJR21	1645	2278	67	49	0	0	47	34	68	49	62	44	80	58	56	40	47	34	73	53
	ERINJR21	HANLNJ21	1230	1508	69	56	0	0	40	33	69	57	60	49	60	49	52	42	41	33	55	45
	HANLNJ21	TOMKJR21	1230	1508	59	48	0	0	52	42	33	27	28	23	48	39	43	35	47	39	51	42
	TOMKJR21	RICH AH2	1230	1508	49	40	0	0	42	34	29	24	24	20	49	40	39	32	39	32	43	35
	HANLNJ21	HURONTAR	1230	1508	20	17	0	0	21	17	48	40	42	35	31	25	43	35	20	16	10	8

Table 5 – 230 kV Existing System versus Proposed System

Cct	Monitored Element		Cont rating		Existing system		Proposed system		Existing System		Proposed System		Proposed System	
	From	To	Amp	LTR	Amp	Cont %	Amp	Cont %	Cont %	LTR %	Cont %	LTR %	Cont %	LTR %
V71RP	CLAIRVIL	CLAIRV71	3131	4182	1327	42	1157	37	43	32	37	28	38	28
	CLAIRV71	RICH AH1	1601	2185	985	62	846	53	62	46	54	39	54	40
	CLAIRV71	TSTARJ71	1796	2484	388	22	363	20	21	15	19	14	20	15
	TSTARJ71	VAUG1J71	1904	2814	167	9	141	7	9	6	7	5	7	5
	VAUG1J71	RICHLJ71	1818	2693	23	1	52	3	1	1	3	2	3	2
	RICHLJ71	RICH2J71	1818	2693	234	13	260	14	13	9	15	10	14	10
	RICH2J71	PARKWAY	1701	2464	413	24	438	26	25	17	27	19	26	18
	V72R	CLAIRVIL	CLAIRV72	3131	4182	299	10	571	18	10	7	21	16	17
CLAIRV72		RICH J72	1796	2484	984	55	845	47	56	40	48	35	48	35
RICH J72		RICH AH2	1601	2184	868	54	730	46	55	40	47	34	47	34
CLAIRV72		CLV PJ72	1510	5977	831	55	435	29	55	14	29	7	35	9
CLV PJ72		SITHJV72	1691	2508	834	49	441	26	49	33	26	18	32	21
SITHJV72		BRAMAV72	1691	2508	355	21	791	47	21	14	55	37	23	16
BRAMAV72		CARDFV72	1700	2350	151	9	601	35	9	6	43	31	10	7
CARDFV72		HURONTAR	1700	2350	469	28	469	28	34	25	34	25	0	0
V73R	CLAIRVIL	CLAIRV73	3131	4182	444	14	750	24	15	11	27	20	24	18
	CLAIRV73	RICH AH2	1601	2184	966	60	829	52	61	45	53	39	53	39
	CLAIRV73	CLV PJ73	1510	5977	831	55	435	29	55	14	29	7	34	9
	CLV PJ73	SITHJV73	1691	2508	834	49	441	26	49	33	26	18	31	21
	SITHJV73	BRAMAV73	1691	2508	355	21	791	47	21	14	50	34	68	46
	BRAMAV73	CARDFV73	1700	2350	151	9	602	35	9	6	38	27	57	43
	CARDFV73	HURONTAR	1700	2350	469	28	469	28	30	21	49	36	49	36
	V74R	CLAIRVIL	CLAIRV74	3156	4305	1594	51	1456	46	51	37	47	34	47
CLAIRV74		WESTJV74	1796	2484	1095	61	959	53	62	45	54	39	55	40
WESTJV74		RICH J74	2005	2772	904	45	768	38	46	33	39	28	39	29
RICH J74		RICH AH1	1621	2277	792	49	657	41	50	35	41	29	42	30
V76R	CLAIRVIL	CLAIRV76	3156	4305	1387	44	1249	40	44	33	40	29	40	30
	CLAIRV76	WESTJV76	1796	2484	1105	62	967	54	62	45	55	40	55	40
	WESTJV76	RICH AH2	1796	2484	903	50	766	43	51	37	43	31	44	32
V75P	CLAIRVIL	CLAIRV75	3156	4305	900	29	873	28	28	21	27	20	28	20
	CLAIRV75	TSTARJ75	1796	2484	387	22	361	20	21	15	19	14	20	15
	TSTARJ75	VAUG1J75	2058	3025	166	8	140	7	8	5	6	4	7	5
	VAUG1J75	RICHLJ75	1977	2915	23	1	52	3	1	1	3	2	2	2
	RICHLJ75	RICH2J75	1818	2693	232	13	258	14	13	9	15	10	14	10
	RICH2J75	PARKWAY	1701	2434	410	24	436	26	24	17	27	19	26	18
	R14T	TRAFALGA	ERINJR14	1645	2278	826	50	880	54	56	41	61	44	53
ERINJR14		TOMKJR14	1230	1508	423	34	473	39	43	35	49	40	38	31
TOMKJR14		RICH AH1	1230	1508	297	24	331	27	32	26	36	30	26	21
R17T	TRAFALGA	ERINJR17	1645	2278	825	50	879	53	56	41	61	44	53	38
	ERINJR17	TOMKJR17	1230	1508	422	34	473	38	43	35	49	40	38	31
	TOMKJR17	RICH AH1	1230	1508	298	24	332	27	32	26	36	30	26	22
R19T	TRAFALGA	ERINJR19	1645	2278	948	58	804	49	0	0	0	0	46	33
	ERINJR19	HANLJ19	1230	1508	692	56	550	45	0	0	0	0	42	34
	HANLJ19	TOMKJR19	1230	1508	277	23	504	41	0	0	0	0	42	34
	TOMKJR19	RICH AH2	1230	1508	292	24	396	32	0	0	0	0	31	25
	HANLJ19	HURONT19	1230	1508	180	15	180	15	0	0	0	0	0	0
R21T	TRAFALGA	ERINJR21	1645	2278	957	58	812	49	89	64	73	53	55	40
	ERINJR21	HANLJ21	1230	1508	688	56	546	44	79	64	55	45	51	42
	HANLJ21	TOMKJR21	1230	1508	277	23	502	41	40	32	51	42	36	30
	TOMKJR21	RICH AH2	1230	1508	295	24	395	32	58	47	43	35	32	26
	HANLJ21	HURONT21	1230	1508	178	15	178	15	10	8	38	31	38	31
R21T North	HANLJ21	J YARJ21	1230	1508	590	48			108	88				
	HURONT21	J YARJ21	1230	1508			588	48			49	40	103	84

6.3 Voltage Assessment

IESO’s Transmission Assessment Criteria states that after a contingency, with all *facilities* in service pre-contingency, system **voltage declines** are to be limited to 10%.

As shown in Table 6 and Table 7, all simulated contingencies resulted in voltage declines below 10%. Therefore, the *IESO Transmission Assessment Criteria* regarding voltage decline is respected.

All the simulations presented in the tables below were conducted with load being modeled as constant power for both pre and post-ULTC movement conditions.

Table 6 – 500 kV Contingencies – Voltages

Contingency		Pre-contingency	B560V+M571V		V586M+M570V		M572T+M573T		Civ T14		C550VP+Civ t14	
			pre ULTC	post ULTC	pre ULTC	post ULTC	pre ULTC	post ULTC	pre ULTC	post ULTC	pre ULTC	post ULTC
Trafalgar	kV	242.8	237.1	237.3	239.7	239.7	235.1	235.5	241.8	241.8	239.3	239.4
	dV [%]		-2.3	-2.3	-1.3	-1.3	-3.2	-3.0	-0.4	-0.4	-1.4	-1.4
Richview	kV	244	238.7	238.9	240.9	240.9	239.6	239.8	242.6	242.6	239.7	239.8
	dV [%]		-2.2	-2.1	-1.3	-1.3	-1.8	-1.7	-0.6	-0.6	-1.8	-1.7
Claireville	kV	243.6	238.6	238.8	240.6	240.6	239.9	240.1	242.1	242.1	239.3	239.4
	dV [%]		-2.1	-2.0	-1.2	-1.2	-1.5	-1.4	-0.6	-0.6	-1.8	-1.7
Parkway	kV	243.6	239.1	239.2	240.9	240.9	240.7	240.8	242.7	242.7	238.5	238.6
	dV [%]		-1.8	-1.8	-1.1	-1.1	-1.2	-1.1	-0.4	-0.4	-2.1	-2.1
Cherrywood N	kV	243.7	240	240.2	241.5	241.5	241.4	241.5	243	243	241.2	241.2
	dV [%]		-1.5	-1.4	-0.9	-0.9	-0.9	-0.9	-0.3	-0.3	-1.0	-1.0
Cherrywood S	kV	243.1	239.6	239.8	241	241	241	241.1	242.5	242.5	240.8	240.8
	dV [%]		-1.4	-1.4	-0.9	-0.9	-0.9	-0.8	-0.2	-0.2	-0.9	-0.9
Hurontario 19	kV	240.9	236	236.1	238.1	238	236.4	236.6	239.7	239.7	237.1	237.1
	dV [%]		-2.0	-2.0	-1.2	-1.2	-1.9	-1.8	-0.5	-0.5	-1.6	-1.6
Hurontario 21	kV	240.9	236	236.1	238.1	238	236.4	236.6	239.7	239.7	237.1	237.1
	dV [%]		-2.0	-2.0	-1.2	-1.2	-1.9	-1.8	-0.5	-0.5	-1.6	-1.6
Pleasant R19T	kV	239.9	234.8	235	237	236.9	235.2	235.5	238.6	238.6	236	236
	dV [%]		-2.1	-2.0	-1.2	-1.3	-2.0	-1.8	-0.5	-0.5	-1.6	-1.6
Pleasant R21T	kV	239.9	234.8	235	237	236.9	235.3	235.5	238.6	238.6	236	236
	dV [%]		-2.1	-2.0	-1.2	-1.3	-1.9	-1.8	-0.5	-0.5	-1.6	-1.6
Burlington	kV	241.7	236.3	236.6	239	239	235.4	235.8	240.9	240.9	238.9	238.9
	dV [%]		-2.2	-2.1	-1.1	-1.1	-2.6	-2.4	-0.3	-0.3	-1.2	-1.2
Sithe Goreway	kV	242.4	238	238.1	239.8	239.7	238.8	239	241.1	241.1	238.7	238.7
	dV [%]		-1.8	-1.8	-1.1	-1.1	-1.5	-1.4	-0.5	-0.5	-1.5	-1.5

Table 7 – 230 kV Contingencies – Voltages

Contingency		Pre-contingency	R14T+R17T		R19T+R21T		V71RP+V72R		V72R+V73R		V73R+V74R		V72R		R19T		R19T+R19T North		V72R+R19T North	
			pre ULTC	post ULTC	pre ULTC	post ULTC	pre ULTC	post ULTC	pre ULTC	post ULTC	pre ULTC	post ULTC	pre ULTC	post ULTC	pre ULTC	post ULTC	pre ULTC	post ULTC	pre ULTC	post ULTC
Trafalgar	kV	242.8	246.4	245.9	246.1	245.8	241.5	241.9	240.6	240.6	240.9	241.1	242.2	242.2	240.9	242	239.5	241.3	241.5	241.8
	dV [%]		1.5	1.3	1.4	1.2	-0.5	-0.4	-0.9	-0.9	-0.8	-0.7	-0.2	-0.2	-0.8	-0.3	-1.4	-0.6	-0.5	-0.4
Richview	kV	244	247.6	247	246.8	246.5	242.6	243.1	242.3	242.3	242	242.1	243.5	243.5	242.5	243.3	241.1	242.6	242.7	243
	dV [%]		1.5	1.2	1.1	1.0	-0.6	-0.4	-0.7	-0.7	-0.8	-0.8	-0.2	-0.2	-0.6	-0.3	-1.2	-0.6	-0.5	-0.4
Claireville	kV	243.6	246.7	246.2	245.7	245.4	242.4	242.8	242.5	242.5	241.6	241.8	243.3	243.3	242.1	242.8	240.9	242.2	242.4	242.7
	dV [%]		1.3	1.1	0.9	0.7	-0.5	-0.3	-0.5	-0.5	-0.8	-0.7	-0.1	-0.1	-0.6	-0.3	-1.1	-0.6	-0.5	-0.4
Parkway	kV	243.6	246.3	245.8	245.6	245.3	242.5	243	242.3	242.3	242.1	242.2	243.3	243.3	242.4	243	241.4	242.6	242.7	242.9
	dV [%]		1.1	0.9	0.8	0.7	-0.5	-0.2	-0.5	-0.5	-0.6	-0.6	-0.1	-0.1	-0.5	-0.2	-0.9	-0.4	-0.4	-0.3
Cherrywood N	kV	243.7	245.8	245.4	245.3	245.1	242.9	243.2	242.5	242.5	242.5	242.6	243.4	243.5	242.8	243.2	242	242.9	243	243.1
	dV [%]		0.9	0.7	0.7	0.6	-0.3	-0.2	-0.5	-0.5	-0.5	-0.5	-0.1	-0.1	-0.4	-0.2	-0.7	-0.3	-0.3	-0.2
Cherrywood S	kV	243.1	245.1	244.7	244.6	244.4	242.3	242.6	242	242	242	242.1	242.9	242.9	242.2	242.7	241.5	242.3	242.4	242.6
	dV [%]		0.8	0.7	0.6	0.5	-0.3	-0.2	-0.5	-0.5	-0.5	-0.4	-0.1	-0.1	-0.4	-0.2	-0.7	-0.3	-0.3	-0.2
Hurontario 19	kV	240.9	244.1	243.5	240.6	240.4	238.9	239.3	238.1	238.1	238	238.1	239.7	239.7	237.8	238.5	238.4	239.6	241.6	241.9
	dV [%]		1.3	1.1	-0.1	-0.2	-0.8	-0.7	-1.2	-1.2	-1.2	-1.2	-0.5	-0.5	-1.3	-1.0	-1.0	-0.5	0.3	0.4
Hurontario 21	kV	240.9	244.1	243.5	240.6	240.3	238.6	239.1	238	238	238.2	238.3	239.4	239.4	238.4	239.4	234.8	237	235.9	236.6
	dV [%]		1.3	1.1	-0.1	-0.2	-1.0	-0.7	-1.2	-1.2	-1.1	-1.1	-0.6	-0.6	-1.0	-0.6	-2.5	-1.6	-2.1	-1.8
Pleasant R19T	kV	239.9	243.1	242.5	239.6	239.3	237.9	238.3	237	237	236.8	236.9	238.7	238.7	236.8	237.5	225.6	230	227.2	229.4
	dV [%]		1.3	1.1	-0.1	-0.3	-0.8	-0.7	-1.2	-1.2	-1.3	-1.3	-0.5	-0.5	-1.3	-1.0	-6.0	-4.1	-5.3	-4.4
Pleasant R21T	kV	239.9	243.1	242.5	239.5	239.3	237.4	237.9	237	237	237.2	237.3	238.3	238.3	237.3	238.3	231.4	234	232.6	233.5
	dV [%]		1.3	1.1	-0.2	-0.3	-1.0	-0.8	-1.2	-1.2	-1.1	-1.1	-0.7	-0.7	-1.1	-0.7	-3.5	-2.5	-3.0	-2.7
Burlington	kV	241.7	244.9	244.5	244.6	244.3	240.7	241	239.4	239.4	240.2	240.3	241.2	241.2	240.3	241.1	239.3	240.6	240.7	240.9
	dV [%]		1.3	1.2	1.2	1.1	-0.4	-0.3	-1.0	-1.0	-0.6	-0.6	-0.2	-0.2	-0.6	-0.2	-1.0	-0.5	-0.4	-0.3
Sithe Goreway	kV	242.4	245.2	244.7	243.5	243.3	240.8	241.1	242.4	242.4	240.2	240.3	241.5	241.5	240.7	241.3	239.5	240.8	240.1	240.4
	dV [%]		1.2	0.9	0.5	0.4	-0.7	-0.5	0.0	0.0	-0.9	-0.9	-0.4	-0.4	-0.7	-0.5	-1.2	-0.7	-0.9	-0.8

6.4 Additional Analysis – Sithe Goreway GS Disconnected

For sensitivity purposes, additional load-flow analysis was conducted with Sithe Goreway generating plant disconnected from the system. Lennox GS was used to replace Sithe Goreway generation by increasing its output from 1000 MW to 1900 MW. All other system conditions remain unchanged.

All previously simulated contingencies were repeated. All contingencies except the loss of R19T+R19T North were simulated with load modeled as constant MVA. The R19T+R19T North stuck-breaker contingency was simulated with active power modeled as 50 % constant current and 50 % constant impedance, and the reactive power was modeled as 100 % constant impedance.

As shown in Tables 8 and 9, the 230 kV circuits were found to be within their continuous ratings pre-contingency and post-contingency for all contingencies.

Thermal overloading was identified on Claireville autotransformers. As presented in Table 10, Claireville autotransformers were close to or above their continuous rating pre-contingency. Following certain 500 kV contingencies, namely M572T + M573T and Claireville W2L550 breaker failure, the Claireville autotransformers were loaded up to 1015 MVA. This was above the 10-day LTR, but below the 15-minute LTR of about 1250 MVA, therefore respecting the IESO post-contingency thermal criteria.

Although some of the pre-contingency overloading of the Claireville autotransformers can be attributed to the new connections through Hurontario SS, the overloading mostly originated from the load growth in the GTA area, deficiency of 500/230 kV transformation and lack of generation on the 230 kV side.

About 38 MVA of additional power would be carried by the Claireville autotransformers due to the new Hurontario connection, representing less than additional 10 MVA per autotransformer. Also, about 26 MVA of power is being shifted from Trafalgar autotransformers to Claireville autotransformers.

Table 8 – 500 kV Contingencies – Line Loading (Sithe Goreway O/S)

Contingency			Cont rating	LTR	Sithe O/S-Existing system Pre-contingency		Sithe O/S-Proposed system Pre-contingency		B560V+M571V		V586M+M570V		M572T+M573T		Civ T14		C550VP+Civ T14	
Cct	Monitored Element		Amp	Amp	Amp	Cont %	Amp	Cont %	Cont %	LTR %	Cont %	LTR %	Cont %	LTR %	Cont %	LTR %	Cont %	LTR %
	From	To																
V71RP	CLAIRVIL	CLAIRV71	3131	4182	1002	32.0	910.7	29	28	21	28	21	34	26	22	16	29	22
	CLAIRV71	RICH AH1	1601	2185	821	51.3	747.5	47	43	31	42	31	62	45	40	29	41	30
	CLAIRV71	TSTARJ71	1796	2484	244	13.6	231.6	13	13	10	14	10	8	6	8	6	18	13
	TSTARJ71	VAUG1J71	1904	2814	50	2.6	54.4	3	0	0	1	1	6	4	8	5	5	3
	VAUG1J71	RICHLJ71	1818	2693	181	9.9	196.8	11	10	7	10	7	17	11	17	12	6	4
	RICHLJ71	RICH2J71	1818	2693	390	21.5	405.6	22	23	15	22	15	29	19	29	20	18	12
	RICH2J71	PARKWAY	1701	2464	567	33.3	581.6	34	35	24	34	23	41	29	42	29	30	21
V72R	CLAIRVIL	CLAIRV72	3131	4182	1118	35.7	290.1	41	38	28	37	28	57	43	36	27	37	27
	CLAIRV72	RICH J72	1796	2484	820	45.6	746.7	42	38	28	38	27	55	40	35	26	37	27
	RICH J72	RICH AH2	1601	2184	704	44.0	631	39	35	26	35	26	54	40	32	24	34	25
	CLAIRV72	CLV PJ72	1510	5977	367	24.3	592.9	39	36	9	35	9	56	14	36	9	35	9
	CLV PJ72	SITHJV72	1691	2508	371	22.0	596.2	35	33	22	32	21	50	34	32	22	32	21
	SITHJV72	BRAMAV72	1691	2508	373	22.0	597.2	35	33	22	32	22	50	34	32	22	32	21
	BRAMAV72	CARDFV72	1700	2350	151	8.9	389.6	23	20	15	19	14	38	28	20	14	20	14
	CARDFV72	HURONTAR	1700	2350			249.4	15	11	8	11	8	29	21	11	8	11	8
V73R	CLAIRVIL	CLAIRV73	3131	4182	1309	41.8	483.8	47	44	33	43	32	64	48	42	32	43	32
	CLAIRV73	RICH AH2	1601	2184	804	50.2	732.3	46	42	31	41	30	60	44	39	28	40	30
	CLAIRV73	CLV PJ73	1510	5977	366	24.2	593.1	39	36	9	35	9	56	14	36	9	35	9
	CLV PJ73	SITHJV73	1691	2508	371	21.9	596.4	35	33	22	32	21	50	34	32	22	32	21
	SITHJV73	BRAMAV73	1691	2508	372	22.0	597.4	35	33	22	32	21	50	34	32	22	32	21
	BRAMAV73	CARDFV73	1700	2350	151	8.9	390.8	23	20	15	19	14	38	28	20	14	20	14
	CARDFV73	HURONTAR	1700	2350			250.7	15	11	8	11	8	29	21	11	8	11	8
V74R	CLAIRVIL	CLAIRV74	3156	4305	1433	45.4	359.2	43	42	31	41	30	51	38	40	29	41	30
	CLAIRV74	WESTJV74	1796	2484	934	52	861.9	48	45	32	44	32	61	44	42	30	43	31
	WESTJV74	RICH J74	2005	2772	743	37	671.3	34	30	22	30	22	45	33	28	20	29	21
	RICH J74	RICH AH1	1621	2277	631	39	559.6	35	30	22	30	21	49	35	28	20	29	21
V76R	CLAIRVIL	CLAIRV76	3156	4305	1225	39	151.8	37	35	26	35	25	45	33	33	24	34	25
	CLAIRV76	WESTJV76	1796	2484	943	53	870.5	49	45	33	45	32	62	45	42	31	44	32
	WESTJV76	RICH AH2	1796	2484	740	41	668.5	37	34	24	33	24	50	36	31	22	32	23
V75P	CLAIRVIL	CLAIRV75	3156	4305	747	24	731.9	23	24	18	24	18	21	15	20	15	27	20
	CLAIRV75	TSTARJ75	1796	2484	243	14	230.5	13	13	9	14	10	8	6	8	6	18	13
	TSTARJ75	VAUG1J75	2058	3025	50	2.4	54.4	3	0	0	1	1	6	4	7	5	5	3
	VAUG1J75	RICHLJ75	1977	2915	182	9.2	197.9	10	9	6	9	6	15	10	16	11	6	4
	RICHLJ75	RICH2J75	1818	2693	388	21	403.7	22	23	15	22	15	29	19	29	20	18	12
	RICH2J75	PARKWAY	1701	2434	564	33	578.7	34	35	24	34	24	41	29	41	29	30	21
R14T	TRAFALGA	ERINJR14	1645	2278	886	54	914.5	56	68	49	68	49	25	18	61	44	66	47
	ERINJR14	TOMKJR14	1230	1508	482	39	508.4	41	57	46	57	46	21	17	48	39	53	43
	TOMKJR14	RICH AH1	1230	1508	344	28	363.3	30	44	36	43	35	36	30	34	28	38	31
R17T	TRAFALGA	ERINJR17	1645	2278	885	54	913.7	56	68	49	68	49	25	18	61	44	66	47
	ERINJR17	TOMKJR17	1230	1508	481	39	507.7	41	57	46	57	46	21	17	48	39	53	43
	TOMKJR17	RICH AH1	1230	1508	345	28	364	30	44	36	43	35	36	30	34	28	38	31
R19T	TRAFALGA	ERINJR19	1645	2278	1007	61	930.7	57	71	51	71	51	20	15	64	46	69	50
	ERINJR19	HANLNJ19	1230	1508	752	61	678.3	55	74	60	74	60	20	16	64	52	70	57
	HANLNJ19	TOMKJR19	1230	1508	315	26	424.4	35	45	37	45	37	26	21	37	30	41	33
	TOMKJR19	RICH AH2	1230	1508	300	24	337.5	27	37	30	36	29	34	28	29	24	31	25
	HANLNJ19	HURONTAR	1230	1508			345.8	28	34	28	35	28	10	8	33	27	35	29
R21T	TRAFALGA	ERINJR21	1645	2278	1016	62	938.9	57	71	52	71	52	21	15	64	46	69	50
	ERINJR21	HANLNJ21	1230	1508	748	61	674.1	55	74	60	73	60	20	16	64	52	70	57
	HANLNJ21	TOMKJR21	1230	1508	315	26	423.2	34	45	37	45	37	26	21	37	30	41	33
	TOMKJR21	RICH AH2	1230	1508	302	25	336.9	27	37	30	36	29	35	28	29	24	31	25
	HANLNJ21	HURONTAR	1230	1508			343.8	28	34	28	34	28	10	8	33	27	35	28

Table 9 – 230 kV Contingencies – Line Loading (Sithe Goreway O/S)

Contingency	Cont rating		R14T+R17T		R19T+R21T		V71R+V72R		V72R+V73R		V73R+V74R		V72R		R19T		R19T+R19TNorth*		V72R+R19TNorth			
	Amp	LTR	Cont LTR		Cont LTR		Cont LTR		Cont LTR		Cont LTR		Cont LTR		Cont LTR		Cont LTR		Cont LTR			
			%	%	%	%	%	%	%	%	%	%	%	%	%	%	%	%	%	%	%	
V71RP	CLAIRVIL	CLAIRV71	3131	4182	30	22	26	19	0	0	50	38	45	34	37	28	28	21	29	22	35	26
	CLAIRV71	RICH AH1	1601	2185	48	35	43	31	0	0	80	59	73	53	59	43	46	34	48	35	57	42
	CLAIRV71	TSTARJ71	1796	2484	15	11	12	9	0	0	19	14	15	11	14	10	11	8	12	9	13	10
	TSTARJ71	VAUG1J71	1904	2814	4	3	4	3	0	0	6	4	3	2	2	2	3	2	3	2	1	1
	VAUG1J71	RICHLJ71	1818	2693	10	7	12	8	0	0	4	3	7	5	9	6	12	8	11	8	10	7
	RICHLJ71	RICH2J71	1818	2693	21	14	23	16	0	0	15	10	20	13	21	14	24	16	23	15	22	15
	RICH2J71	PARKWAY	1701	2464	32	22	35	24	0	0	27	18	32	22	32	22	36	25	35	24	34	23
V72R	CLAIRVIL	CLAIRV72	3131	4182	38	29	49	37	0	0	0	0	65	49	0	0	50	38	35	26	0	0
	CLAIRV72	RICH J72	1796	2484	43	31	38	28	0	0	0	0	65	47	0	0	41	30	43	31	0	0
	RICH J72	RICH AH2	1601	2184	41	30	36	26	0	0	0	0	59	43	0	0	39	28	41	30	0	0
	CLAIRV72	CLV PJ72	1510	5977	34	9	62	16	0	0	0	0	62	16	0	0	59	15	27	7	0	0
	CLV PJ72	SITHJV72	1691	2508	30	20	56	38	0	0	0	0	56	38	0	0	53	36	24	16	0	0
	SITHJV72	BRAMAV72	1691	2508	30	20	56	38	0	0	0	0	56	38	0	0	53	36	24	16	0	0
	BRAMAV72	CARDFV72	1700	2350	17	13	43	31	0	0	0	0	32	23	0	0	42	30	10	7	0	0
	CARDFV72	HURONTAR	1700	2350	9	7	35	25	0	0	0	0	16	12	0	0	33	24	0	0	0	0
V73R	CLAIRVIL	CLAIRV73	3131	4182	44	33	55	41	71	53	0	0	0	0	63	47	49	37	55	41	70	52
	CLAIRV73	RICH AH2	1601	2184	47	34	42	31	71	52	0	0	0	0	58	43	45	33	47	34	56	41
	CLAIRV73	CLV PJ73	1510	5977	34	9	62	16	63	16	0	0	0	59	15	45	11	56	14	79	20	
	CLV PJ73	SITHJV73	1691	2508	30	20	56	38	56	38	0	0	0	53	36	40	27	51	34	71	48	
	SITHJV73	BRAMAV73	1691	2508	30	20	56	38	56	38	0	0	0	53	36	40	27	51	34	71	48	
	BRAMAV73	CARDFV73	1700	2350	17	13	43	31	33	24	0	0	0	29	21	26	19	40	29	47	34	
	CARDFV73	HURONTAR	1700	2350	9	7	35	25	16	12	0	0	0	13	9	17	12	32	23	28	20	
V74R	CLAIRVIL	CLAIRV74	3156	4305	43	32	40	30	56	41	60	44	0	0	49	36	43	32	44	32	48	36
	CLAIRV74	WESTJV74	1796	2484	49	35	44	32	71	51	77	56	0	0	59	43	48	34	49	35	57	41
	WESTJV74	RICH J74	2005	2772	34	25	31	22	54	39	60	43	0	0	43	31	33	24	34	25	42	30
	RICH J74	RICH AH1	1621	2277	36	26	31	22	53	38	60	43	0	0	40	28	34	24	36	25	38	27
V76R	CLAIRVIL	CLAIRV76	3156	4305	37	27	34	25	50	36	60	44	61	45	43	31	36	27	37	27	42	31
	CLAIRV76	WESTJV76	1796	2484	49	36	45	33	71	52	78	56	79	57	60	43	48	35	50	36	58	42
	WESTJV76	RICH AH2	1796	2484	38	28	34	25	60	43	67	48	57	41	48	35	37	27	38	28	46	33
V75P	CLAIRVIL	CLAIRV75	3156	4305	24	17	22	16	38	28	27	20	43	32	24	18	23	17	23	17	24	18
	CLAIRV75	TSTARJ75	1796	2484	14	10	12	9	38	28	19	14	15	11	14	10	11	8	12	9	13	10
	TSTARJ75	VAUG1J75	2058	3025	4	3	4	3	9	6	6	4	2	2	2	2	2	2	2	1	1	
	VAUG1J75	RICHLJ75	1977	2915	9	6	11	8	12	8	4	3	7	5	8	6	11	8	10	7	9	6
	RICHLJ75	RICH2J75	1818	2693	21	14	23	16	40	27	15	10	20	13	21	14	24	16	23	15	22	15
	RICH2J75	PARKWAY	1701	2434	32	22	35	24	53	37	27	19	31	22	32	23	36	25	35	24	33	23
R14T	TRAFALGA	ERINJR14	1645	2278	0	0	77	56	57	41	53	39	58	42	56	40	65	47	63	45	57	41
	ERINJR14	TOMKJR14	1230	1508	0	0	71	58	43	35	39	32	44	36	42	34	53	44	51	42	42	35
	TOMKJR14	RICH AH1	1230	1508	0	0	56	46	31	25	29	24	31	25	30	24	40	33	38	31	30	25
R17T	TRAFALGA	ERINJR17	1645	2278	0	0	77	56	57	41	53	39	58	42	56	40	65	47	63	45	57	41
	ERINJR17	TOMKJR17	1230	1508	0	0	70	57	43	35	39	32	44	35	41	34	53	44	51	42	42	35
	TOMKJR17	RICH AH1	1230	1508	0	0	56	46	31	25	29	24	31	25	30	24	41	33	38	31	30	25
R19T	TRAFALGA	ERINJR19	1645	2278	76	55	0	0	64	46	61	44	59	43	62	45	0	0	38	31	50	36
	ERINJR19	HANLNJ19	1230	1508	82	67	0	0	64	52	61	50	58	47	63	51	0	0	38	31	47	38
	HANLNJ19	TOMKJR19	1230	1508	54	44	0	0	29	24	27	22	38	31	28	23	0	0	38	31	47	38
	TOMKJR19	RICH AH2	1230	1508	45	36	0	0	25	21	26	21	32	26	26	21	0	0	38	31	35	29
	HANLNJ19	HURONTAR	1230	1508	34	28	0	0	46	38	47	39	33	27	47	38	0	0	38	31	0	0
R21T	TRAFALGA	ERINJR21	1645	2278	76	55	0	0	59	43	61	44	65	47	59	43	84	60	82	59	68	49
	ERINJR21	HANLNJ21	1230	1508	81	66	0	0	57	46	61	49	65	53	57	46	68	56	71	58	69	56
	HANLNJ21	TOMKJR21	1230	1508	54	44	0	0	38	31	27	22	29	24	35	28	46	37	38	31	35	29
	TOMKJR21	RICH AH2	1230	1508	44	36	0	0	32	26	26	21	26	21	30	24	42	34	38	31	36	30
	HANLNJ21	HURONTAR	1230	1508	34	28	0	0	33	27	47	39	47	38	36	27	29	24	49	40	68	55

* Loads converted to (50, 50) active power and (0, 100) reactive power

Table 10 – 500 kV Contingencies – Autotransformer Loadings (Sithe Goreway O/S)

Contingency	Cont rating		Site O/S-Existing system Pre-contingency		Site O/S Proposed System Pre-contingency		B560V+M571V		V586M+M570V		M572T+M573T		Civ T14		C550VP+Civ T14	
	MVA	LTR	MVA	Cont %	MVA	Cont %	Cont %	LTR %	Cont %	LTR %	Cont %	LTR %	Cont %	LTR %	Cont %	LTR %
Trafalgar T15	906	1098	756	83	742.6	82	89	74	85	70	0	0	88	73	92	76
Trafalgar T14	808	974	747	93	734.2	91	99	82	94	78	0	0	98	81	102	84
Claireville T13	810	957	790	98	799.4	99	93	78	92	78	119	101	116	98	124	105
Claireville T14	808	962	805	100	814.5	101	95	80	94	79	121	102	0	0	0	0
Claireville T15	808	962	797	99	806.4	100	94	79	93	78	120	101	117	98	126	106
Claireville T16	936	1109	741	79	749.5	80	75	64	75	63	96	81	94	79	101	85
Parkway T3	960	1142	725	76	726.2	76	74	62	73	61	85	72	82	69	101	85
Parkway T4	960	1142	726	76	726.5	76	74	62	73	62	85	72	82	69	0	0
Cherrywood T15	847	1007	655	77	653.8	77	75	63	75	63	85	71	81	69	90	76
Cherrywood T16	803	955	658	82	656.8	82	80	67	80	67	90	75	86	73	96	80
Cherrywood T14	803	955	673	84	672.6	84	82	69	81	69	91	77	88	74	97	82
Cherrywood T17	1158	1209	664	57	663.4	57	56	54	56	53	63	60	60	58	67	64

Table 11 and Table 12 present the voltage decline results. All the contingencies resulted in a voltage decline of less than 10 % respecting the IESO planning criteria.

Table 11 – 500 kV Contingencies – Voltage Decline (Sithe Goreway O/S)

Contingency		Pre-contingency	B560V+M571V		V586M+M570V		M572T+M573T		Civ T14		C550VP+Civ t14	
Bus			pre ULTC	post ULTC	pre ULTC	post ULTC	pre ULTC	post ULTC	pre ULTC	post ULTC	pre ULTC	post ULTC
Trafalgar	kV	242.2	234.4	235.8	238	238.1	232.2	233.3	240.2	240.3	236.4	237
	dV [%]		-3.22	-2.64	-1.73	-1.69	-4.13	-3.67	-0.83	-0.78	-2.39	-2.15
Richview	kV	243.5	235.9	237.3	239.1	239.1	236.6	237.5	241.1	241.1	236.5	237.2
	dV [%]		-3.12	-2.55	-1.81	-1.81	-2.83	-2.46	-0.99	-0.99	-2.87	-2.59
Claireville	kV	243.1	235.7	237	238.8	238.8	236.9	237.7	240.5	240.6	236.1	236.7
	dV [%]		-3.04	-2.51	-1.77	-1.77	-2.55	-2.22	-1.07	-1.03	-2.88	-2.63
Parkway	kV	243.8	237.4	238.6	240.1	240.1	239	239.7	242	242.1	236.3	236.9
	dV [%]		-2.63	-2.13	-1.52	-1.52	-1.97	-1.68	-0.74	-0.70	-3.08	-2.83
Cherrywood N	kV	243.5	238.4	239.3	240.5	240.6	239.8	240.3	242.2	242.2	239.4	239.8
	dV [%]		-2.09	-1.72	-1.23	-1.19	-1.52	-1.31	-0.53	-0.53	-1.68	-1.52
Cherrywood S	kV	242.9	238.2	239	240.1	240.2	239.5	240	241.7	241.8	239.1	239.5
	dV [%]		-1.93	-1.61	-1.15	-1.11	-1.40	-1.19	-0.49	-0.45	-1.56	-1.40
Hurontario 19	kV	240.3	232.6	234	235.9	235.9	233	233.9	237.8	237.9	233.4	234.1
	dV [%]		-3.20	-2.62	-1.83	-1.83	-3.04	-2.66	-1.04	-1.00	-2.87	-2.58
Hurontario 21	kV	240.3	232.6	234	235.9	235.9	233	233.9	237.8	237.9	233.4	234.1
	dV [%]		-3.20	-2.62	-1.83	-1.83	-3.04	-2.66	-1.04	-1.00	-2.87	-2.58
Pleasant R19T	kV	239.3	231.4	232.8	234.8	234.7	231.8	232.7	236.7	236.8	232.2	232.9
	dV [%]		-3.30	-2.72	-1.88	-1.92	-3.13	-2.76	-1.09	-1.04	-2.97	-2.67
Pleasant R21T	kV	239.3	231.4	232.8	234.8	234.7	231.8	232.7	236.7	236.8	232.2	232.9
	dV [%]		-3.30	-2.72	-1.88	-1.92	-3.13	-2.76	-1.09	-1.04	-2.97	-2.67
Burlington	kV	241.2	234	235.3	237.6	237.7	233	234	239.6	239.7	236.5	237
	dV [%]		-2.99	-2.45	-1.49	-1.45	-3.40	-2.99	-0.66	-0.62	-1.95	-1.74

Table 12 – 230 kV Contingencies – Voltage Decline (Sithe Goreway O/S)

Contingency		Pre-contingency	R14T+R17T		R19T+R21T		V71RP+V72R		V72R+V73R		V73R+V74R		V72R		R19T		R19T+R19TNorth*		V72R+R19TNorth	
			pre ULTC	post ULTC	pre ULTC	post ULTC	pre ULTC	post ULTC	pre ULTC	post ULTC	pre ULTC	post ULTC	pre ULTC	post ULTC	pre ULTC	post ULTC	pre ULTC	post ULTC	pre ULTC	post ULTC
Trafalgar	kV	242	246.8	245.9	245.9	245.3	240.6	241	244.5	243.9	239.9	240.1	241.5	241.6	239.2	241	241.6	241.2	240.2	240.6
	dV [%]		1.90	1.53	1.53	1.28	-0.66	-0.50	0.95	0.70	-0.95	-0.87	-0.29	-0.25	-1.24	-0.50	-0.25	-0.41	-0.83	-0.66
Richview	kV	244	248.5	247.4	246.8	246.1	241.7	242.3	246.5	245.7	240.9	241.2	242.9	243	240.7	242.3	243.1	242.7	241.3	241.8
	dV [%]		2.05	1.60	1.36	1.07	-0.74	-0.49	1.23	0.90	-1.07	-0.94	-0.25	-0.21	-1.15	-0.49	-0.16	-0.33	-0.90	-0.70
Claireville	kV	243	247.7	246.6	245.6	245	241.4	242	246.4	245.7	240.5	240.8	242.7	242.7	240.2	241.7	242.5	242.2	241	241.4
	dV [%]		1.89	1.44	1.03	0.78	-0.70	-0.45	1.36	1.07	-1.07	-0.95	-0.16	-0.16	-1.19	-0.58	-0.25	-0.37	-0.86	-0.70
Parkway	kV	244	247.6	246.7	246.1	245.6	242.5	243.1	246.3	245.7	241.9	242.1	243.4	243.5	241.6	242.8	243.5	243.2	242.2	242.5
	dV [%]		1.56	1.19	0.94	0.74	-0.53	-0.29	1.03	0.78	-0.78	-0.70	-0.16	-0.12	-0.90	-0.41	-0.12	-0.25	-0.66	-0.53
Cherrywood N	kV	244	246.4	245.6	245.3	244.8	242.5	242.9	245.3	244.8	242	242.1	243.1	243.2	241.8	242.7	243.2	243.1	242.2	242.5
	dV [%]		1.19	0.86	0.74	0.53	-0.41	-0.25	0.74	0.53	-0.62	-0.57	-0.16	-0.12	-0.70	-0.33	-0.12	-0.16	-0.53	-0.41
Cherrywood S	kV	243	245.6	244.9	244.6	244.2	242	242.4	244.7	244.2	241.5	241.7	242.6	242.7	241.3	242.2	242.7	242.5	241.8	242
	dV [%]		1.11	0.82	0.70	0.54	-0.37	-0.21	0.74	0.54	-0.58	-0.49	-0.12	-0.08	-0.66	-0.29	-0.08	-0.16	-0.45	-0.37
Hurontario 19	kV	240	245	243.9	240.6	240	237.8	238.3	242.4	241.6	236.6	236.9	238.9	239	235.4	236.9	240.1	239.8	240.2	240.6
	dV [%]		1.96	1.50	0.12	-0.12	-1.04	-0.83	0.87	0.54	-1.54	-1.41	-0.58	-0.54	-2.04	-1.41	-0.08	-0.21	-0.04	0.12
Hurontario 21	kV	240	245	243.9	240.6	240	237.4	238	242.4	241.5	236.9	237.2	238.6	238.7	236.2	238.1	237.4	236.8	234	234.8
	dV [%]		1.96	1.50	0.12	-0.12	-1.21	-0.96	0.87	0.50	-1.41	-1.29	-0.71	-0.67	-1.71	-0.92	-1.21	-1.46	-2.62	-2.29
Pleasant R19T	kV	239	244.1	242.9	239.6	239	236.7	237.3	241.4	240.5	235.4	235.8	237.8	237.9	234.4	236	N/A	N/A	N/A	N/A
	dV [%]		2.01	1.50	0.13	-0.13	-1.09	-0.84	0.88	0.50	-1.63	-1.46	-0.63	-0.59	-2.05	-1.38				
Pleasant R21T	kV	239	244.1	242.9	239.6	239	236.3	236.9	241.4	240.5	235.8	236.1	237.5	237.6	234.9	236.9	234.8	234.1	230.6	231.8
	dV [%]		2.01	1.50	0.13	-0.13	-1.25	-1.00	0.88	0.50	-1.46	-1.34	-0.75	-0.71	-1.84	-1.00	-1.88	-2.17	-3.64	-3.13
Burlington	kV	241	245.2	244.4	244.3	243.8	239.9	240.3	243.1	242.5	239.3	239.5	240.6	240.7	238.9	240.3	240.8	240.5	239.6	239.9
	dV [%]		1.66	1.33	1.29	1.08	-0.54	-0.37	0.79	0.54	-0.79	-0.70	-0.25	-0.21	-0.95	-0.37	-0.17	-0.29	-0.66	-0.54

* Loads converted to (50, 50) active power and (0, 100) reactive power

7.0 Customer Impact Assessment

Hydro One, Enersource Hydro Mississauga, Hydro One Brampton, Halton Hills Hydro, Milton Hydro and Hydro One Networks Distribution were joint participants in the study to determine suitable reinforcement for the existing facilities supplying the GTA West Area. The joint study addressed all of those concerns that would normally be addressed through the Customer Impact Assessment (CIA). Since those LDCs are the only load customers directly affected by the facilities, Hydro One concluded that a formal CIA will not be required for these customers. However, because Sithe Goreway GS will be connecting to the east of Cardiff TS and is scheduled to start commercial operation before the implementation of the proposed transmission reinforcement Hydro One will have to perform a CIA for Goreway GS.

– End of Report –

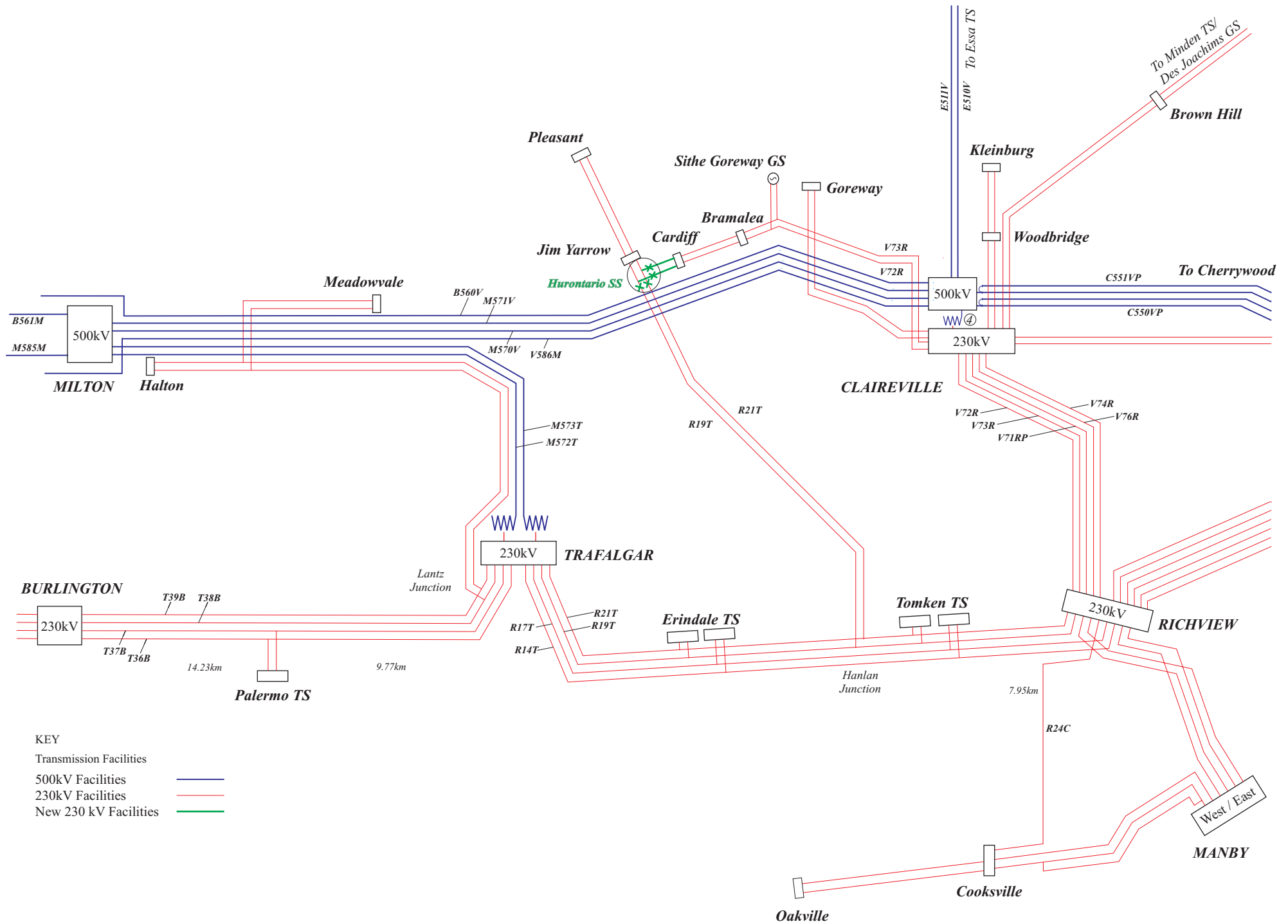


Figure 5. GTA West Area Transmission with New Hurontario SS