REPORT

Power to Ontario.
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System Impact Assessment (SIA) Report

CONNECTION ASSESSMENT & APPROVAL PROCESS

Issue 2.0

FINAL DRAFT REPORT

Project: Goreway TS – New 230/27.6 kV T1/T2 DESN Station
Applicant: Hydro One Networks Inc.

CAA ID 2007-264

Transmission Assessments & Performance Department

July 16, 2008

System Impact Assessment (SIA) Report

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 conditional approval or disapproval of the proposed connection under Chapter 4, section 6 of the market rules.

Conditional approval of the proposed connection is based on information provided to the IESO by the connection applicant and Hydro One 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 Hydro One at the request of the IESO. Furthermore, the conditional approval is subject to further consideration due to changes to this information, or to additional information that may become available after the conditional approval has been granted.

If the connection applicant has engaged a consultant to perform connection assessment studies, the connection applicant acknowledges that the IESO will be relying on such studies in conducting its assessment and that the IESO assumes no responsibility for the accuracy or completeness of such studies including, without limitation, any changes to IESO base case models made by the consultant. The IESO reserves the right to repeat any or all connection studies performed by the consultant if necessary to meet IESO requirements.

Conditional 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, the conditional 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, the connection applicant must be aware that the IESO may revise drafts of this report at any time in its sole discretion without notice to the connection applicant. 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 the most recent version of this report is being used.

Hydro One

The results reported in this report are based on the information available to Hydro One, at the time of the study, suitable for a preliminary assessment of this transmission system reinforcement 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 facilities on load and generation customers.

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

Table of Contents

Summary

Hydro One Networks Inc. (HONI) is planning to build a new 230/27.6 kV T1/T2 Dual Element Spot Network (DESN) station at the existing Goreway transformer station (TS) site. The planned in-service date for the new station is May 1, 2010.

This developmental project is needed to accommodate load growth in the north-east area of the City of Brampton.

Conclusions

The proposed connection of a new T1/T2 DESN station at Goreway TS, subject to the requirements specified in this report, is expected to have no material adverse effect on the reliability of the integrated power system based on the System Impact Assessment (SIA) assumptions employed.

This SIA has concluded that:

- The existing 230/27.6 kV T5/T6 DESN station at Goreway TS is reaching its summer station capability. The new T1/T2 DESN station will provide load relief to the T5/T6 DESN station, and will accommodate load growth in the 27.6 kV distribution system serviced by Goreway TS.

- With the new T1/T2 DESN station incorporated, the pre-contingency voltages, post-contingency voltages and voltage declines on the IESO-controlled grid are within criteria.

- With the new T1/T2 DESN station incorporated, the pre- and post-contingency thermal loadings on the IESO-controlled grid are also within applicable equipment ratings.

- Without the existing SC5 and SC6 capacitor banks in service, historical Goreway 27.6 kV load data shows the power factor at the defined meter point is well above the 90% lagging market rules requirement. If load on the new T1/T2 DESN station has a similar power factor profile, no LV capacitor banks need to be installed at this time.

- With the new T1/T2 DESN station incorporated, the load security criteria for Goreway TS and the 230 kV double circuit line supplying Goreway TS is met.

IESO Requirements

The IESO has the following requirements for the connection of the new T1/T2 DESN station:

- HONI must complete the IESO Market Entry/Facility Registration process in a timely manner before IESO final approval for connection is granted. Models and data, including any controls that would be operational, must be provided to the IESO. This information should be submitted at least seven months before first connection to the IESO-controlled grid, to allow the IESO to incorporate the T1/T2 DESN station into IESO work systems and to perform any additional reliability studies.

  If the submitted models and data differ materially from the ones used in this assessment, then further analysis of the connection proposal will need to be completed by the IESO.

- HONI is required to provide specifications for the 230 kV transformer disconnect switches and to ensure that the switches are capable of continuously operating in the normal voltage range of 220 kV to 250 kV.

- HONI must notify the IESO if the assumed T1 and T2 impedance values in section 4.3 are to be materially different.

- All 230 kV connection equipment must remain in service, and not automatically trip, for voltages up to 5% above the maximum continuous rating of 250 kV, for up to 30 minutes, to allow the system to be re-dispatched to return voltages within their normal range.

- HONI is required to install facilities at the T1/T2 DESN station to allow for the detection of under frequency conditions, and the selection and tripping of feeder circuit breakers for load shedding. In the event that the existing under-frequency load shedding (UFLS) area load is insufficient in meeting the UFLS targets with the addition of the new load, HONI is required to submit during the IESO Market Entry process a revised schedule of feeder selections and their related load amounts for each shedding stage that will ultimately satisfy the UFLS targets.

- HONI is required to install facilities at the T1/T2 DESN station to provide local and remote voltage reduction capability of 3% and 5%. HONI will need to confirm during the IESO Market Entry process that this capability is available.

- In accordance with the telemetry requirements for 'medium performance', HONI must install equipment at the T1/T2 DESN station with specific performance standards that provides telemetry data to the IESO. The telemetry data is to consist of certain equipment status and operating quantities which will be identified to HONI during the IESO Market Entry Process.

- Protection systems to be employed at the T1/T2 DESN station must be designed to meet all the requirements of the Transmission System Code as specified in Schedules E, F and G of Appendix 1 (Version A).

- HONI must not make material changes to the functionality and fault clearing times of the V42H and V43 line protection systems without prior consent from the IESO when incorporating the T1/T2 DESN station.

Notification of Conditional Approval

It is recommended that a revised *Notification of Conditional Approval for Connection* be issued to HONI subject to the IESO receiving from HONI written acknowledgement that the requirements described above under the heading "IESO Requirements" will be implemented.

Provided the new T1/T2 DESN station at Goreway TS is designed and constructed to satisfy all applicable market rules requirements, including the requirements specified in this report, and provided it is connected as described in this report, HONI will be granted final approval via the IESO Market Entry process to connect facility to the IESO-controlled grid.

System Impact Assessment Report

1. Project Description

Hydro One Networks Inc. (HONI) proposes to build a new 230/27.6 kV T1/T2 Dual Element Spot Network (DESN) station at the existing Goreway transformer station (TS) site. It will connect to the IESO-controlled grid via the existing 230 kV line taps at Goreway TS.

As indicated in the SIA application for this project, the planned in-service date was originally the fall of 2009. HONI has recently informed the IESO that the date has moved back to May 1, 2010.

– End of Section –

2. Connection Proposal

2.1 Goreway TS

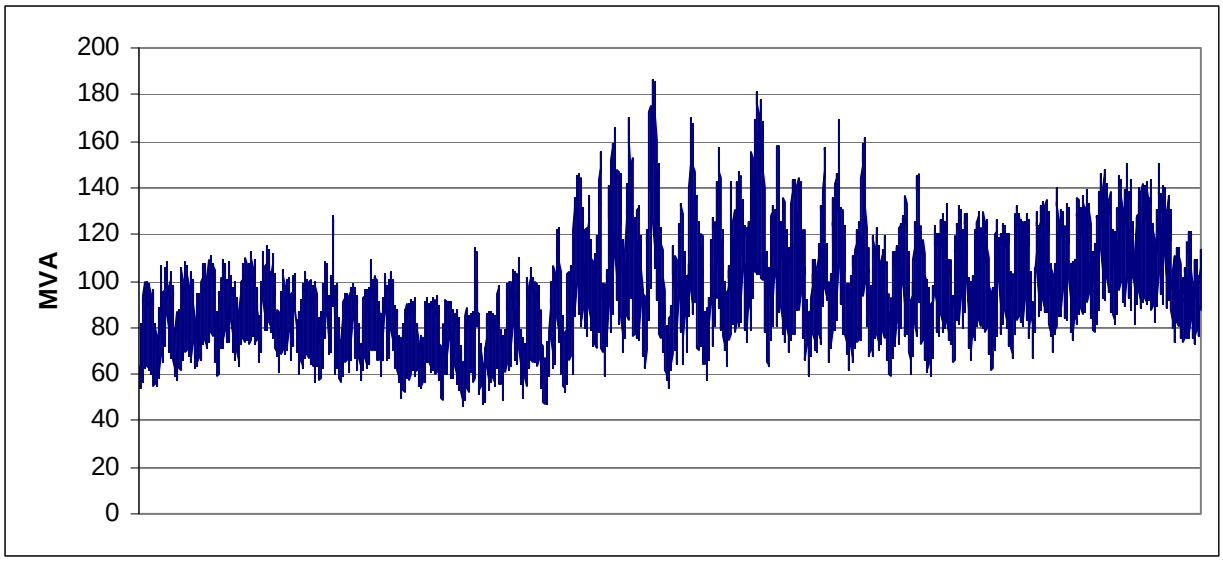
The existing Goreway transformer station (TS) is located in the north-east end of the City of Brampton and connects to the IESO-controlled grid via the 230 kV V76R/V73RS double circuit line between Claireville TS and Goreway TS. Figure 1 shows the location of Goreway TS relative to the existing 230 kV power system between Burlington TS to Claireville TS.

Goreway TS consists of a 230/27.6 kV T5/T6 DESN station and a 230/44 kV T4 station, where transformer T5 connects to circuit V73RS and transformers T4 & T6 connect to circuit V76R.

As part of the HONI Claireville TS reconfiguration project (CAA ID 2006-220), sometime in 2008, the 230 kV double circuit line between Claireville TS and Goreway TS will be re-terminated at Claireville TS. V76R will be renamed as V43 and V73RS will be renamed as V42H.

HONI has indicated that the load at the existing T5/T6 DESN station has reached its 10-Day limited time rating (LTR) of 192 MVA. Figure 2 shows the total MVA loading of this station in one hour average samples during the period of January 1, 2007 to December 31, 2007.

Figure 2 – Goreway T5/T6 DESN station – 2007 Total MVA Loading



From the above 2007 samples, the following information is derived:

- Average T5/T6 load = 96 MVA
- Maximum T5/T6 load = 186 MVA
- Minimum T5/T6 load = 46 MVA

The maximum T5/T6 load value of 186 MVA confirms that the T5/T6 DESN station is reaching its 10-Day limited time rating (LTR) of 192 MVA.

3.2 Proposed T1/T2 DESN Station

Figure 3 is a single line diagram of the proposed T1/T2 DESN station.

The station will be built comprising two (2) 75/100/125 MVA, three (3) phase 215.5/28-28 kV transformers with a minimum summer 10-Day LTR of 170 MVA and twelve (12) 27.6 kV feeder breaker positions.

Transformer T1 will connect to circuit V43 and transformer T2 will connect to circuit V42H. The transformers will be configured wye grounded on the high voltage (HV) side and zigzag-zigzag grounded on the low voltage (LV) side. The two LV neutrals of each transformer will grounded via 1.5 ohm neutral reactors. Each neutral reactor will have a continuous current rating of 1000 A and a 15 second current rating of 6000 A.

Voltage control of the LV buses is to be provided via a HV under-load tap changer (ULTC) rated at 215.5 kV with a range of $\pm$40 kV in sixteen (16) plus and sixteen (16) minus step positions (33 positions in total).

Connection of the transformers to the IESO–controlled grid is to be provided by motorized disconnect switch, while low voltage side isolation of each transformer is to be provided by a circuit breaker.

Provision for the future installation of the two (2) 27.6 kV capacitor banks and their associated breakers, switches and reactors is included in the design of the T1/T2 DESN station.

– End of Section –

3. General Requirements

3.1 Models & Data

HONI must complete the IESO Market Entry/Facility Registration process in a timely manner before IESO final approval for connection is granted. Models and data, including any controls that would be operational, must be provided to the IESO. This information should be submitted at least seven months before first connection to the IESO-controlled grid, to allow the IESO to incorporate the T1/T2 DESN station into IESO work systems and to perform any additional reliability studies.

If the submitted models and data differ materially from the ones used in this assessment, then further analysis of the connection proposal will need to be completed by the IESO.

3.2 230 kV Connection Equipment (Disconnects, Transformers, Buses)

230 kV connection equipment in southern Ontario must be capable of continuously operating in the range between 220 kV and 250 kV (Appendix 4.1, Reference 2 of the market rules).

Some recognized contingencies (e.g. load shedding, open line end) can cause a temporary voltage increase above the maximum continuous voltage of 250 kV. For these conditions, connection equipment may be exposed to voltages slightly above its maximum continuous rating for the short period of time that it takes the IESO to direct operations to restore a normal voltage profile, and to prepare for the next contingency. This re-preparation period will be as short as possible, but it will not take longer than 30 minutes.

The IESO requires that the 230 kV connection equipment at the T1/T2 DESN station have the following requirements:

- 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.

The Transmission System Code (TSC) recommends that 230 kV connection equipment have a rated 3-phase symmetrical short circuit capability of 63 kA and a rated single line to ground (SLG) symmetrical short circuit capability of 80 kA (usually limited to 63 kA).

3.3 Under-Frequency Load Shedding Facilities

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. For the purposes of administrating this, the province is divided up into a number of UFLS areas and the UFLS targets must be met for each of these areas.

The under-frequency automatic load shedding (UFLS) should be provided by tripping feeder circuit breakers to achieve:

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

HONI is required to install facilities at the station to allow for the detection of under frequency conditions, and the selection and tripping of feeder circuit breakers for load shedding. In the event that the existing UFLS area load is insufficient in meeting the UFLS targets with the addition of the new load, HONI is required to submit during the IESO Market Entry process a revised schedule of feeder selections and their related load amounts for each shedding stage that will ultimately satisfy the above targets.

3.4 Voltage Reduction Facilities

The market rules (Appendix 4.3) require 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.

HONI is required to install facilities at the T1/T2 DESN station to provide local and remote voltage reduction capability of 3% and 5%. HONI will need to confirm during the IESO Market Entry process that this capability is available.

3.5 IESO Telemetry Data

The market rules (Appendices 4.16, 4,20 and Appendix 4.21) list the requirements with respect to the telemetry data that must be provided to the IESO and to the performance standards that must be achieved on a continual basis.

In accordance with the telemetry requirements for ‘medium performance’, HONI must install equipment at the T1/T2 DESN station with specific performance standards that provides telemetry data to the IESO. The telemetry data is to consist of certain equipment status and operating quantities which will be identified to HONI during the IESO Market Entry Process.

3.6 Protection Systems

Protection systems to be employed at the T1/T2 DESN station must be designed to meet all the requirements of the Transmission System Code as specified in Schedules E, F and G of Appendix 1 (Version A).

To incorporate the T1/T2 DESN station, HONI must not make material changes to the functionality and fault clearing times of the V42H and V43 line protection systems without prior consent from the IESO.

– End of Section –

4. Data Verification

4.1 New 230 kV V42H & V43 Buses

To incorporate the T1/T2 DESN station, the existing 230 kV buses at Goreway TS need to be extended. The resulting buses will have the following specifications:

Nominal voltage	230 kV
Maximum continuous operating voltage	250 kV
Continuous rating	540 A
1 hour emergency rating	670 A
Short circuit capacity	63 kA symmetrical

4.2 New 230 kV T1 & T2 Transformer Disconnects

HONI has indicated that the transformer disconnects will have the same specifications has provided for the 230 kV buses.

4.3 New 230 kV T1 & T2 Transformers

The following specifications were assumed:

Continuous rating	125 MVA
Minimum summer 10 Day Limited Time Rating (LTR)	170 MVA
Impedance (pu on 37.5 MVA base)	11.5% (HX), 11.5% (HY), 21.85% (XY)

HONI did not provide impedance values for T1 & T2. The above impedance values were obtained from a similar sized and configured transformer owned by HONI.

HONI must notify the IESO if the assumed T1 and T2 impedance values are to be materially different.

– End of Section –

5. Fault Level Studies

Fault level studies were not required for this assessment.

– End of Section –

6. SIA Methodology

6.1 Assumptions

The following assumptions were made in the IESO studies:

- Scope: Since Goreway TS is radially connected to the Claireville 230 kV bus which is electrically strong, the proposed T1/T2 DESN station was studied independent of specific power system conditions (i.e., no stressing of transmission interfaces due to specific system flows).

- Base case – A base case representative of summer 2010 was used. Figure 4 shows the expected 2010 configuration of the 230 kV power system between Burlington TS to Claireville TS.

- Transmission facilities – All existing and proposed major transmission facilities with 2010 in-service dates or earlier were assumed in service. This included the following projects: Hurontario switching station and 230 kV circuits V41H(V72RS)/V42H(V73RS) extended (CAD ID 2006-224), Halton TS and Meadowvale TS LV shunt capacitors (CAA ID 2006-211), Pleasant T3/T4 DESN station (CAA ID 2006-231), Churchill Meadows TS (CAA ID 2006-230) and Claireville TS reconfiguration (CAA ID 2006-220).

- Generation facilities – Existing and proposed major generation facilities with 2010 in-service dates or earlier were assumed in service to meet the demand requirement of the base case. This included the Sithe Goreway GS (CAA ID 2000-008) and Halton Hills GS (CAA ID 2006-232) projects.

- Goreway Load data – A 2010 to 2016 summer peak load forecast for Goreway TS was provided by HONI. This data is shown in the table below:

Goreway TS	kV	2010 (MW)	2011 (MW)	2012 (MW)	2013 (MW)	2014 (MW)	2015 (MW)	2016 (MW)
T4	44	31.0	32.1	33.0	34.0	35.0	35.0	35.0
T5/T6 DESN*	27.6	181	181	181	181	181	181	181
Proposed T1/T2 DESN	27.6	15.5	23.5	30.6	38.0	45.5	53.3	61.3
Total		227.5	236.6	244.6	253.0	261.5	269.3	277.3

* To respect 10 Day LTR of 192 MVA, MW loadings are based on a 94% lagging power factor.

For the voltage and thermal analyzes in this assessment, the Goreway TS load values were scaled up to the 2016 levels at a 90% lagging power factor on the LV side. The remaining loads in the vicinity of Goreway TS were not scaled up due to the previously described 'Scope' assumption.

In addition, the active power loads were modeled as 50% constant impedance and 50% constant current, and the reactive power loads were modeled as 100% constant impedance.

- Equipment Ratings:
  1. The continuous and emergency ratings for 230 kV circuits V42H and V43 were provided by HONI. The ratings are summarized in the table below:

230 kV Circuits	Circuit Section		Continuous rating (A)	Emergency rating (A)	15-Minute LTR (A)
V42H/V43	Claireville TS	Goreway J	1371	1820	2310
	Goreway J	Goreway PH J	1060	1400	1631
	Goreway PH J	Goreway TS	860	1020	3310

Please note in above Table, the letter J' is short form notation for the word 'Junction'.

Since the ratings for both circuits are the same, when assessing the proposed T1/T2 DESN station with one element out of service, removing V42H is equivalent to removing V43.

2. The continuous and summer 10 Day LTRs for the existing Goreway transformers are summarized in the following table:

Transformer(s)	Continuous rating (MVA)	Summer 10 Day LTR (MVA)
T4	93	95
T5 & T6	125	192

6.2 Criteria

To assess the impact of the proposed T1/T2 DESN station, technical criteria defined in the IESO Ontario Resource and Transmission Assessment Criteria document were used. This document can be found on the IESO web site at
http://www.ieso.ca/imoweb/pubs/marketAdmin/IMO_REQ_0041_TransmissionAssessmentCriteria.pdf.

For the voltage analysis with all facilities in service pre-contingency, after a recognized single or double-element contingency, system pre-contingency voltages, post-contingency and voltage declines must be within criteria. In particular, voltage declines (500 kV, 230 kV and 115 kV) must be limited to a 10% voltage change before tap changer action (pre-ULTC) and after tap changer action (post-ULTC). At transformer stations, voltage declines (44 kV, 27.6 kV and 13.8 kV) must be limited to a 10% voltage change pre-ULTC and a 5% voltage change post-ULTC.

For the thermal analysis with all transmission elements in service, all circuit loadings must be less than their continuous ratings (calculated at 93°C). Following a contingency the circuit loadings must be less than their 15-Minute LTRs if there are post-contingency control actions available to reduce the loadings to within their emergency ratings. Otherwise, following a contingency the loadings must be less than their emergency ratings.

6.3 Tools & Models

The Siemens PSS/E software program was used by the IESO to complete the power flow studies.

The proposed T1/T2 DESN station was modeled in PSS/E using data provided by HONI.

– End of Section –

7. System Impact Assessment

Power flow studies were carried out to assess whether the proposed T1/T2 DESN station would materially impact the reliability of the integrated power system. This included examining the voltage performance of the power system and the thermal loading of transmission circuits for pre-contingency and post-contingency conditions.

In addition, a power factor analysis was completed to assess whether there is an immediate need for HONI to install LV capacitor banks.

Finally, a load security analysis of Goreway TS with the T1/T2 DESN station was completed to determine if the load security criteria detailed in the IESO Ontario Resource and Transmission Assessment Criteria document will be met.

7.1 Voltage Analysis

The voltage performance of Goreway TS and Claireville TS was evaluated with the proposed T1/T2 DESN station incorporated.

The table below shows the voltage results prior to and following thc loss of V42H:

	Pre-contingency (kV)	Pre-ULTC (kV)	% Change	Post-ULTC (kV)	% Change
Goreway T5/T6 B 27.6 kV	29.2	27.5	-5.6	29.1	-0.4
Goreway T5/T6 Y 27.6 kV	29.2	27.5	-5.6	29.1	-0.4
Goreway T1/T2 A 27.6 kV (new)	29.3	28.2	-3.8	29.0	-1.0
Goreway T1/T2 B 27.6 kV (new)	29.3	28.2	-3.8	29.0	-1.0
Goreway T4 44.0 kV	46.1	45.5	-1.2	46.6	1.1
Goreway 230 kV (V43)	240.9	238.0	-1.2	236.9	-1.7
Goreway 220 kV (V42H)	241.9	-	-	-	-
Claireville HK2 230 kV	241.5	239.6	-0.8	238.6	-1.2
Claireville HK1 230 kV	242.3	241.6	-0.3	240.8	-0.6

As shown, the 230 kV pre-contingency and post-contingency voltages are within the normal voltage range of 220 kV to 250 kV. In addition, the pre-ULTC and post-ULTC voltage declines do not exceed the maximum voltage decline criteria of 10%.

7.2 Thermal Analysis

The thermal loading on 230 kV circuit V43 was examined for the loss of V42H.

The table below summarizes the pre-contingency and post-contingency loading on the circuit sections of V43 between Goreway TS and Claireville TS:

Circuit Sections		Pre-Contingency		Post-ULTC, Post-Contingency			Ratings		
		I (A)	% of Cont.	I (A)	% of Emerg.	% of LTR	Cont. (A)	Emerg. (A)	15-Min LTR (A)
Claireville	Goreway J	373	27.2	725	39.8	31.4	1371	1820	2310
Goreway J	Goreway PH J	373	35.2	726	51.8	44.5	1060	1400	1631
Goreway PH J	Goreway	373	43.4	726	71.1	21.9	860	1020	3310

The pre-contingency loadings on V42H and V43 are well within the continuous ratings of the circuit sections. On loss of V42H (one element out of service), the post-contingency loadings on V43 are also well within the emergency ratings.

7.3 Power Factor Analysis

The market rules (Appendix 4.3, reference 1) 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. For the proposed T1/T2 DESN station, the defined meter point would be considered the HV sides of transformers T1 and T2.

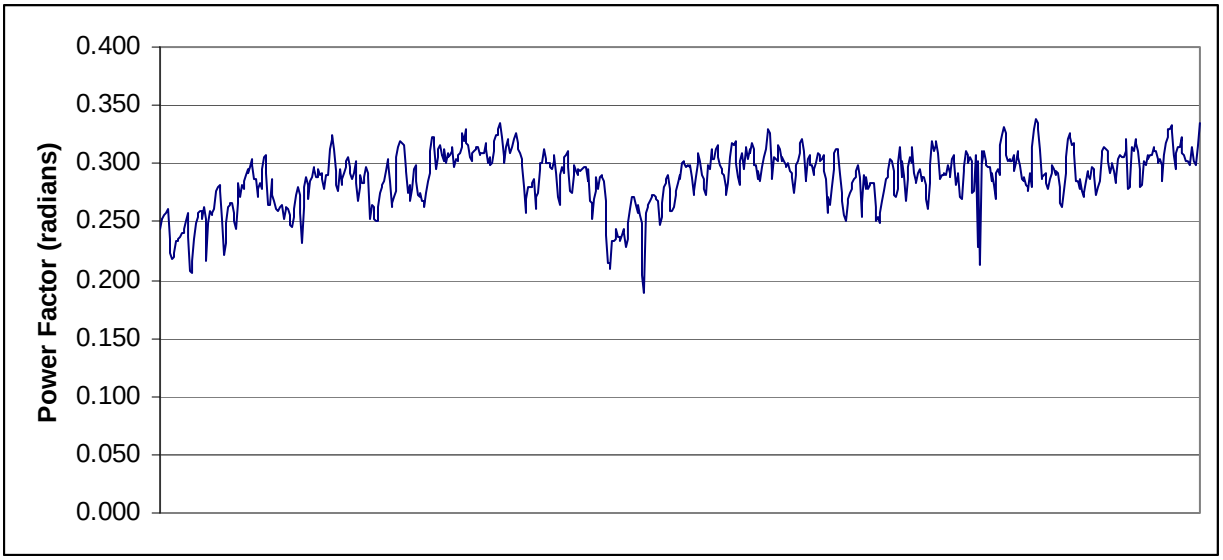
Power flow simulations were completed to determine the power factor on the HV side of the T1/T2 DESN station assuming the 2010 and 2016 load forecasts at a 90% lagging power factor on the LV sides of T1 and T2. Additional simulations were completed with a 5 Mvar LV capacitor bank connected to each bus. The results are shown below:

With no capacitor banks connected					
Year	MW (T1)	MW (T2)	Mvar (T1)	Mvar (T2)	HV Power Factor
2010	10.3	5.7	5.5	2.8	89% lagging
2016	33.5	28.6	18.4	15.2	88% lagging
With a 5 Mvar capacitor bank connected to each bus					
Year	MW (T1)	MW (T2)	Mvar (T1)	Mvar (T2)	HV Power Factor
2010	10.3	5.8	-0.2	-2.8	98% leading
2016	33.5	28.6	12.5	9.4	94% lagging

Based on the load assumptions used in the power flow simulations, the study results indicate that additional reactive compensation would be required. However, in an effort to more accurately determine if additional compensation would be required at the proposed T1/T2 DESN station, the summer power factor profile for the existing T5/T6 DESN station was examined.

Figure 4 shows the LV T5/T6 DESN station power factor profile in one hour average samples for July 2007. The power factor profile has been corrected to remove any reactive power contributions from capacitor banks SC5 and SC6.

Figure 4 – Goreway T5/T6 DESN station – July 2007 LV Power Factor



The power factor range required by the market rules translates into a load angle between +0.45 radians (90% lagging) and -0.45 radians (90% leading) when expressed in radians.

From the data shown in Figure 4, the July 2007 power factor profile on the LV side of the T5/T6 DESN station varied from 0.189 radians (98.2% lagging) to 0.338 radians (94.3% lagging), with an average value of 0.288 radians (95.9% lagging).

To better reflect the expected load characteristics at the proposed T1/T2 DESN station, a 95.9% lagging power factor was assumed on the LV side of the T1/T2 DESN station the provided load forecast. The following table summarizes the findings:

Year	27.6 kV side of proposed T1/T2 DESN station			230 kV side of proposed T1/T2 DESN station		
	P (MW)	Q (Mvar)	PF (pu)	P (MW)	Q (Mvar)	PF (pu)
2010	15.5	4.6	0.959	15.5	5.0	0.952
2016	61.3	18.2	0.959	61.4	24.7	0.928

The above findings show that no LV capacitor banks would need to be installed at the T1/T2 DESN station to the meet the minimum 90% lagging power factor requirement at the defined meter point.

7.4 Load Security

The load security criteria for facilities connected to the IESO-controlled grid are defined in section 7.1 of the Ontario Resource and Transmission Assessment document.

The following criteria applies to Goreway TS with the T1/T2 DESN station incorporated:

1. With all transmission facilities in service, equipment loading must be within continuous ratings.

2. With one element out of service, equipment loading must be within applicable long-term emergency ratings.

3. For a single element contingency, not more than 150 MW of load may be interrupted by configuration. Since the T4 station has only a single 230 kV supply, the total load supplied by this station cannot exceed 150 MW.

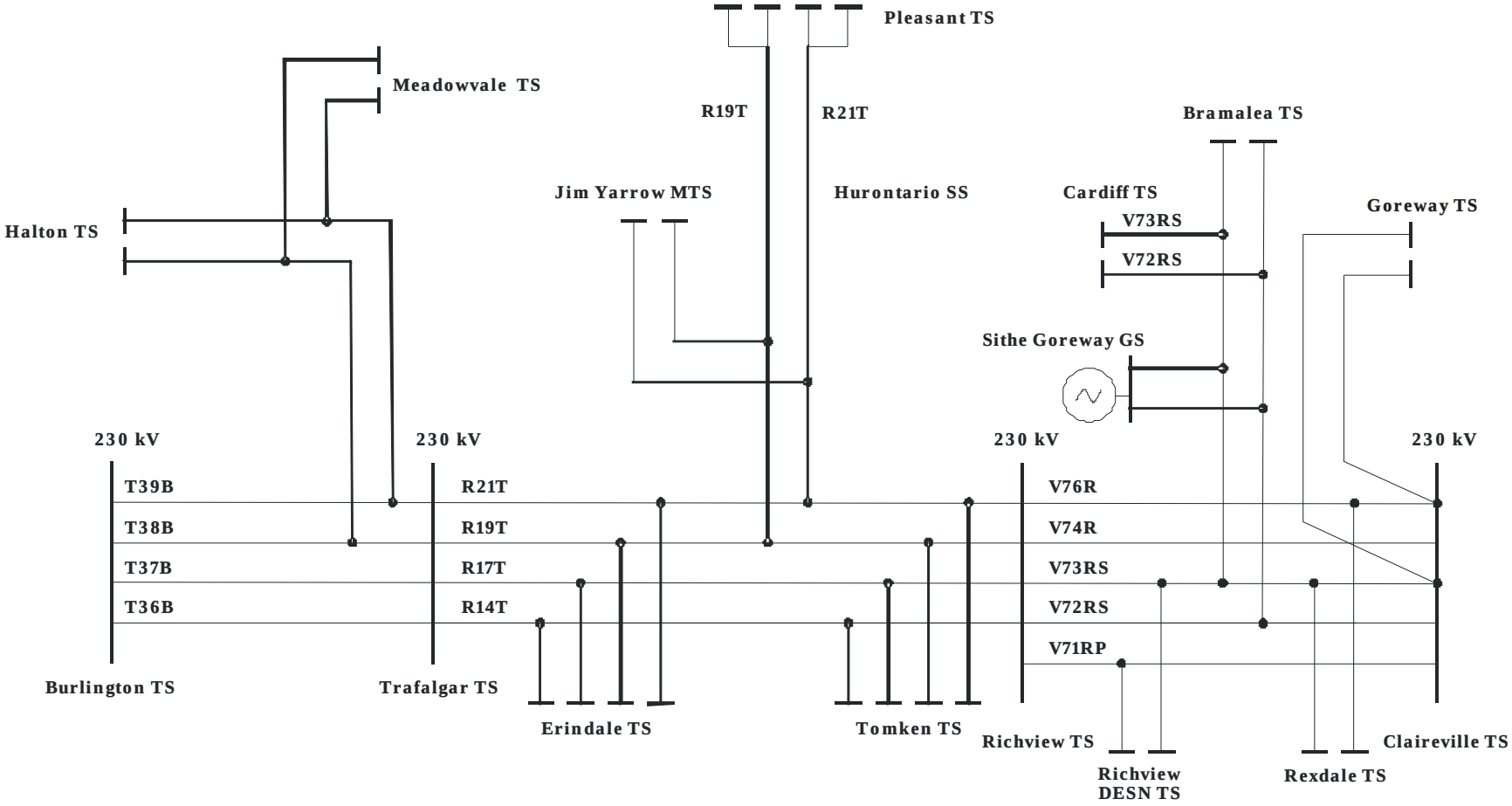
4. For a double-element contingency, not more than 600 MW of load may be interrupted by configuration. Since Goreway TS is the only facility connected on the radial 230 kV V42H/V43 double circuit from Claireville TS, the total load supplied by Goreway TS cannot exceed 600 MW.

For criteria 1 and 2, the results in section 7.2 of this SIA show that the pre- and post-contingency loadings on the V42H and V43 circuits sections between Goreway TS and Claireville TS would be within applicable ratings. The pre- and post-contingency loadings on the Goreway transformers would also be within applicable ratings.

For criterion 3, a contingency involving V43 would result in an interruption of load at the Goreway T4 station. However, based on a 2016 load forecast of 35 MW for this station, the interrupted load would not exceed 150 MW.

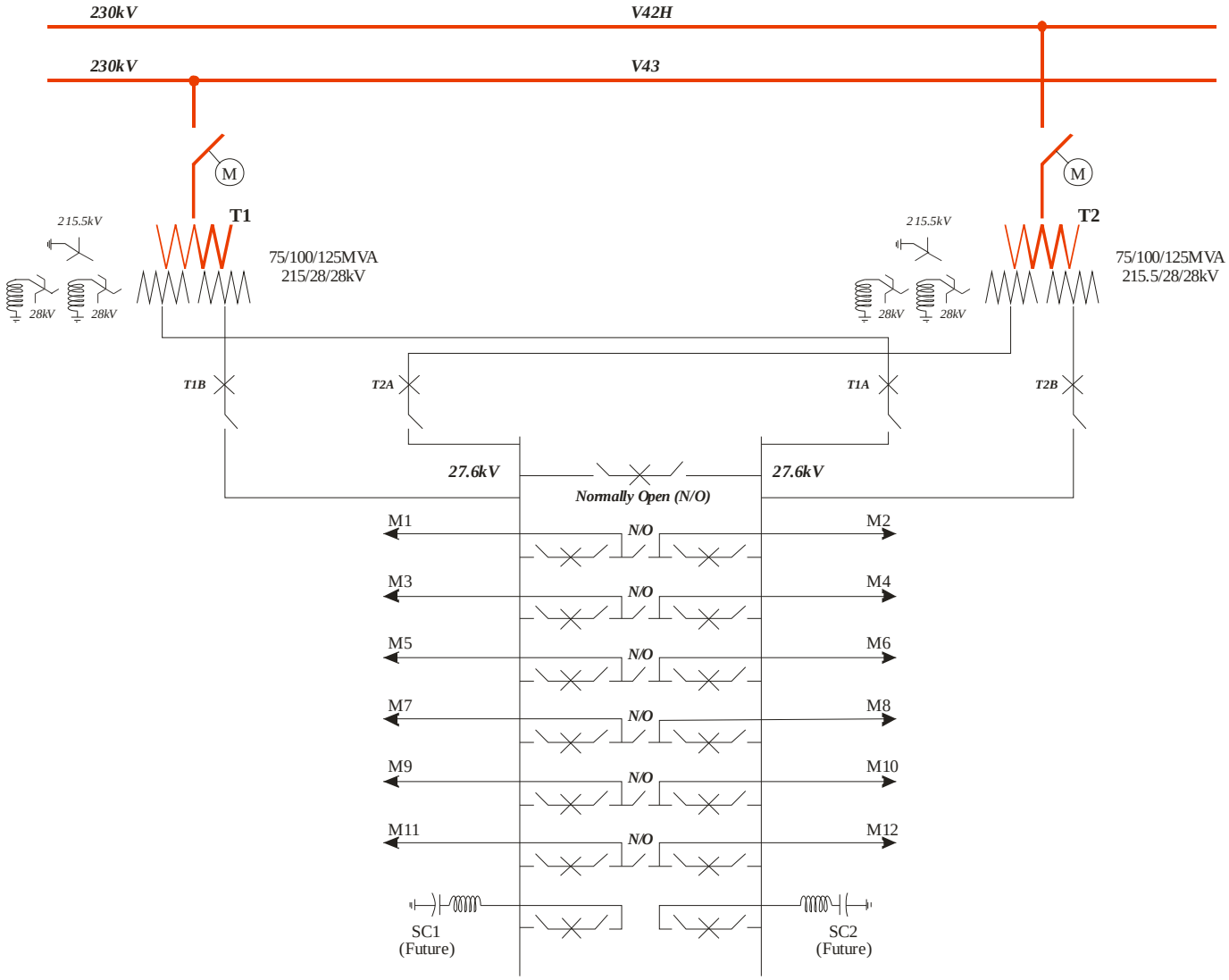
For criterion 4, a contingency involving the double circuit line V42H and V43 would result in the interruption of all loads at Goreway TS. Based on a total 2016 load forecast of 277 MW for Goreway TS, the interrupted load would not exceed 600 MW.

– End of Section –



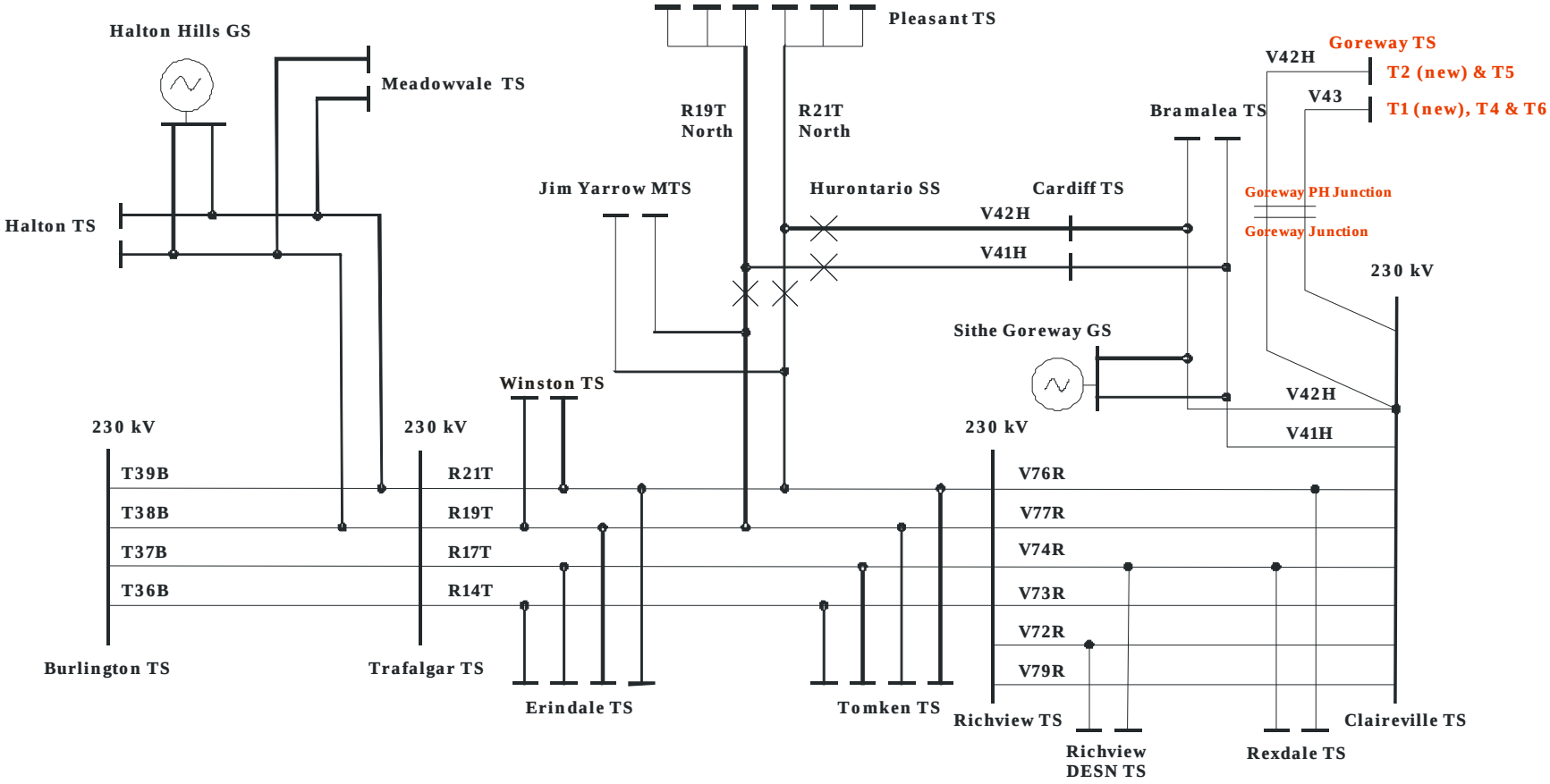
Existing 230 kV System Configuration between Burlington TS & Claireville TS

Figure 1



Goreway TS - New T1/T2 DESN Station

Figure 3



Year 2010 - 230 kV System Configuration between Burlington TS & Claireville TS

Figure 4

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