REPORT

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System Impact Assessment Report

CONNECTION ASSESSMENT & APPROVAL PROCESS

Final Report

Project: Oakville Hydro Municipal Transformer Station No.1

Applicant: Oakville Hydro Electricity Distribution Inc.

CAA ID 2009-374

IESO Market Facilitation Department

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System Impact Assessment Report

Oakville Hydro Municipal Transformer Station No.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 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 System Impact 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 applicant 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 System Impact 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

Executive Summary

Description

The purpose of this System Impact Assessment is to examine the effect of connecting the new 230/27.6 kV Oakville Hydro Municipal Transformer Station No.1 on the reliability of the IESO-controlled grid. This station is proposed to be tapped to the 230 kV lines T36B and T37B between Trafalgar TS and Burlington TS. The new station has been proposed by Oakville Hydro Electricity Distribution Inc. ("Oakville Hydro") to accommodate the anticipated load growth in the area.

SIA Findings

The assessment concludes that the addition of the new station will not materially affect the reliability of the IESO-controlled grid. The new station will not result in pre or post contingency loading of the existing transmission system beyond the rated capability of the lines. Also, the new station will not impact the system voltages performance in any manner which is detrimental to the IESO network.

Hydro One expects that the proposed Oakville Municipal Transformer Station No.1 will have minimal impact on the transmission system or connected customers and has advised that a formal Customer Impact Assessment (CIA) Report is not considered necessary.

IESO's Requirements for Connection

1. All 230 kV equipment must be capable of continuously operating in the range between 220 kV and 250 kV, as per Appendix 4.1, Reference 2 of the Market Rules. Equipment ratings provided by Oakville Hydro to the IESO shows that the motorized disconnect switches to be used on the 230 kV side are rated for maximum voltage of 242 kV. Oakville Hydro shall ensure that the equipment ratings adhere to the requirements mentioned in the Market Rules. Protective relaying must be set to ensure that transmission equipment remains in-service for voltages between 94% of the minimum continuous and 105% of the maximum continuous values in the Market Rules, Appendix 4.1.
2. Under-Load Tap Changer facilities (ULTC) must be available at the station. Oakville Hydro shall install and maintain facilities at Oakville Hydro MTS No.1 to provide 3% and 5% voltage reduction within five minutes of receipt of the direction from the IESO.
3. Oakville Hydro has indicated that the power factor at the defined metering point, the high voltage side of the transformer, will be maintained within the range of 0.85 lagging and 0.9 lagging. Oakville Hydro is required to maintain a power factor within the range of 0.9 lagging and 0.9 leading as measured at the defined metering point at Oakville Hydro MTS No.1. Oakville Hydro shall formulate a plan for reactive power compensation at the station to ensure compliance with the Market Rules and inform the IESO.
4. Oakville Hydro is required to ensure that the UFLS targets specified by the IESO are met after the addition of Oakville Hydro MTS No.1. In the event that these targets are not met, Oakville Hydro 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.
5. New protection systems at Oakville Hydro MTS No.1 must be designed to satisfy all the requirements of the Transmission System Code and any additional requirements identified by the transmitter. New protection systems must be coordinated with existing protection systems.

6. Oakville Hydro shall ensure that the new equipment be designed to sustain the fault levels in the area. If any future system enhancement results in an increased fault level higher than the equipment's capability, Oakville Hydro is required to replace the equipment at its own expense with higher rated equipment capable of sustaining the increased fault level, up to maximum fault level specified in Appendix 2 of the Transmission System Code.
7. As specified in Appendix 4.16 of the Market Rules, Oakville Hydro is required to install all the equipment needed to provide telemetry data to the IESO on a continuous basis.
8. Prior to connecting to the IESO controlled grid, Oakville Hydro shall ensure that the proposed facility is compliant with the applicable reliability standards set by the North American Electric Reliability Corporation (NERC) and the North East Power Coordinating Council (NPCC).
9. Oakville Hydro must complete the IESO Facility Registration/Market Entry process in a timely manner before IESO final approval for connection is granted.

Notification of Conditional Approval

Connecting the new transformer station, Oakville Hydro MTS No.1, to the IESO Controlled Grid does not adversely impact the reliability of the grid. It is recommended that a Notification of Conditional Approval for Oakville Hydro MTS No.1 be issued to Oakville Hydro, subject to the IESO's requirements.

– End of Section –

1. Project Description

The proposed Oakville Hydro MTS No.1 is a DESN station that will be located approximately 4 km West of Trafalgar TS near the intersection of 6th Line Road and Highway 407. The station will be supplied from the 230 kV lines T36B and T37B through two motorized disconnect switches.

The station will be comprised of two 75/100/125 MVA, 215.5/28 kV, star/zigzag/zigzag, three winding transformers configured in 'Bermondsey' configuration. The transformers will be equipped with under load tap changers (ULTC) having 32 steps to provide voltage control within ±40 kV. The primary windings of the transformers are solidly grounded while the equally rated dual secondary windings (secondary X and secondary Y) are grounded through 1.5 Ω reactors.

Four 27.6 kV circuit breakers will be installed on the low voltage side of the transformers (for both transformers, secondary windings X and Y will connect to the buses through circuit breakers). There will be two low voltage buses coupled through one normally open bus tie circuit breaker. The load will be fed from twelve feeder breakers. In addition, two breakers have been proposed for future reactive power compensation equipment. The station will be equipped with two station service transformers.

Oakville Hydro MTS No.1 will supply the growing load in the surrounding areas. Initially the station will supply 34.8 MW and 43.7 MW load in years 2011 and 2012, respectively. Later on, this load is expected to be shifted to Bronte TS and Oakville TS, both owned by Hydro One. In the year 2013, Oakville Hydro MTS No.1 is expected to supply a load of 1.7 MW which is predicted to reach 113.4 MW by year 2021.

The planned in service date for Oakville Hydro MTS No.1 is June, 2011.

– End of Section –

2. General Requirements

2.1 Voltage Requirements

Appendix 4.1, reference 2 of the Market Rules states that under normal conditions voltages are maintained within the range of 220 kV to 250 kV. Thus, the IESO requires that the 230 kV equipment must have a maximum continuous voltage rating of at least 250 kV.

Fault interrupting devices must be able to interrupt fault current at the maximum continuous voltage of 250 kV.

Protective relaying must be set to ensure that transmission equipment remains in-service for voltages between 94% of the minimum continuous and 105% of the maximum continuous values in the Market Rules, Appendix 4.1.

If revenue metering equipment is being installed as part of this project, please be aware that revenue metering installations must comply with Chapter 6 of the IESO Market Rules for the Ontario electricity market. For more details the applicant is encouraged to seek advice from their Metering Service Provider (MSP) or from the IESO metering group.

2.2 Voltage Reduction Facilities Requirements

The Market Rules (Chapter 4, Appendix 4.3) requires that distributors connected to the IESO controlled grid with directly connected load facilities of aggregated rating of 20 MVA or more and with the capability to regulate distribution voltage under load, shall install and maintain facilities to provide voltage reduction capability. This is required 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% within five minutes of receipt of the direction from the IESO.

Oakville Hydro shall install and maintain facilities at Oakville Hydro MTS No.1 to provide 3% and 5% voltage reduction within five minutes of receipt of the direction from the IESO.

2.3 Power Factor Requirements

The Market Rules require that the connection applicant have the capability to maintain a power factor within the range of 0.9 lagging and 0.9 leading as measured at the defined metering point of the facility.

Oakville Hydro is required to have the capability to maintain a power factor within the range of 0.9 lagging to 0.9 leading at the defined metering point (high voltage side of the transformer).

2.4 Under-frequency Load Shedding Requirements

In specifying the number, location, size and associated low frequency settings for the discrete blocks of load, for each distributor and connected wholesale customer, in conjunction with the relevant transmitter, that is subject to automatic UFLS, the IESO policy is that: (Chapter 5, Section 10.4.6 of the market rules)

a) In all automatic UFLS areas, there must be at least 30% of area load connected to under-frequency relays, after accounting for relay outages and the impact of generators that may trip prematurely on under-frequency. By taking UFLS relay and feeder outages into account, in order to ensure at least 30% of load shedding is achieved, 35% of the total peak load of connected wholesale customers and distributors must be connected to UFLS relays. The discrete load shedding requirements are given in (b).

b) For Market Participants with a peak demand of 100 MW or more, the UFLS relay connected loads shall be set to achieve the amount to be shed outlined in the final year of Ontario's UFLS Implementation Plan. The requirements of this final year are stated below (Chapter 5, Section 10.4.7 of the market rules). Market Participants are allowed some time as stated in the Ontario UFLS Implementation Plan to meet the requirements listed in the final year of implementation.

- At 59.5 Hz, 8% of UFLS area load must be disconnected with a total operating time of 0.3 s; and
- At 59.3 Hz, an additional 8% of UFLS area load must be disconnected with a total operating time of 0.3 s; and
- At 59.1 Hz, an additional 8% of UFLS area load must be disconnected with a total operating time of 0.3 s; and
- At 58.9 Hz, an additional 8% of UFLS area load must be disconnected with a total operating time of 0.3 s; and
- If the frequency remains below 59.5 Hz after 10 s, an additional 3% of UFLS area load must be disconnected.
- For Market Participants with both UFLS relays and shunt capacitors, all shunt capacitors must also be tripped at 59.5 Hz with a time delay of 3 s.

Oakville Hydro is required to ensure that the UFLS targets are met after the addition of Oakville Hydro MTS No.1. In the event that these targets are not met, Oakville Hydro 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.

2.5 Protection Systems

The connection applicant is required to initiate an assessment of the existing protection systems with the transmitter who shall identify any modifications to protection equipment or settings required to incorporate the new facility. The IESO will evaluate the impact of any protection modifications and associated changes to functionality, timing, or reach on system reliability. The IESO will not assess aspects of protection systems which are solely the accountability of the connection applicant (e.g. coordination of relay protections).

To allow sufficient time to assess the impact on power system reliability, the connection applicant must submit any proposed protection changes to the IESO at least six (6) months before any actual changes are to be implemented on the existing protection systems.

Please send documentation for protection changes triggered by new or modified primary equipment (i.e. new or replacement relays) to connection.assessments@ieso.ca.

For protection changes that are not associated with new or modified equipment (i.e. protection settings changes) please send documentation to protection.settings@ieso.ca.

The IESO would deem the modifications acceptable if they do not cause any new and/or reduced operating security limits under normal operating conditions. Should the modifications be unacceptable, the IESO would require the connection applicant to investigate other mitigating measures.

New protection systems at Oakville Hydro MTS No.1 must be designed to satisfy all the requirements of the Transmission System Code and any additional requirements identified by the transmitter. New protection systems must be coordinated with existing protection systems.

2.6 Fault Levels

The TSC requires that new equipment be designed to sustain the fault levels in the area where the equipment is installed. If any future system enhancement results in an increased fault level higher than the equipment's capability, the connection applicant is required to replace the equipment at their own expense with higher rated equipment capable of sustaining the increased fault level, up to maximum fault level specified in Appendix 2 of the Transmission System Code.

Oakville Hydro shall ensure that the new equipment be designed to sustain the fault levels in the area.

2.7 Online Monitoring Requirements

In accordance with the telemetry requirements for connected wholesale customers and distributors (see Appendices 4.17 and 4.22 of the Market Rules) the connection applicant must install equipment at this project with specific performance standards to provide telemetry data to the IESO. The data is to consist of certain equipment status and operating quantities which will be identified during the IESO Market Entry Process.

As part of the IESO Facility Registration/Market Entry process, the connection applicant must also complete end to end testing of all necessary telemetry points with the IESO to ensure that standards are met and that sign conventions are understood. All found anomalies must be corrected before IESO final approval to connect any phase of the project is granted.

Oakville Hydro is required to install all the equipment needed to provide telemetry data to the IESO on a continuous basis, as required by the Market Rules.

2.8 Reliability Standards

In support of the NERC standard EOP-005, the connection applicant may meet the restoration participant criteria. Please refer to Section 3 of Market Manual 7.8 (Ontario Power System Restoration Plan) to determine its applicability to the proposed facility.

The IESO monitors and assesses market participant compliance with these standards as part of the IESO Reliability Compliance Program. To find out more about this program, visit the webpage referenced above or write to ircp@ieso.ca.

Also, to obtain a better understanding of the applicable reliability obligations and find out how to engage in the standards development process, we recommend that the connection applicant join the IESO's Reliability Standards Standing Committee (RSSC) or at least subscribe to their mailing list at rssc@ieso.ca. The RSSC webpage is located at: http://www.ieso.ca/imoweb/consult/consult_rssc.asp.

Prior to connecting to the IESO controlled grid, the proposed facility must be compliant with the applicable reliability standards set by the North American Electric Reliability Corporation (NERC) and the North East Power Coordinating Council (NPCC). A list of applicable standards, based on the proponent's/connection applicant's market role/OEB licence can be found here:

http://www.ieso.ca/imoweb/ircp/reliabilityStandards.asp

2.9 Facility Registration/Market Entry Requirements

The connection applicant must complete the IESO Facility Registration/Market Entry 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 energization to the IESO-controlled grid, to allow the IESO to incorporate this project into IESO work systems and to perform any additional reliability studies.

As part of the IESO Facility Registration/Market Entry process, the connection applicant must provide evidence to the IESO confirming that the equipment installed meets the Market Rules requirements and matches or exceeds the performance predicted in this assessment. This evidence shall be either type tests done in a controlled environment or commissioning tests done on-site. In either case, the testing must be done not only in accordance with widely recognized standards, but also to the satisfaction of the IESO. Until this evidence is provided and found acceptable to the IESO, the Facility Registration/Market Entry process will not be considered complete and the connection applicant must accept any restrictions the IESO may impose upon this project's participation in the IESO-administered markets or connection to the IESO-controlled grid.

The evidence must be supplied to the IESO within 30 days after completion of commissioning tests. Failure to provide evidence may result in disconnection from the IESO-controlled grid.

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

– End of Section –

3. Data Verification

Oakville Hydro has provided the following specifications for the new equipment proposed for installation at Oakville Hydro MTS No.1:

Step-down Transformer	
Quantity	2
Thermal ratings	75/100/125 MVA
Rated voltage	215.5 kV/28 kV
Under-load tap changer (ULTC)	±40 kV in 32 steps in HV winding
Transformer connections	HV STAR (neutral grounded) Secondary X ZIGZAG (neutral grounded via 1.5 ohm neutral reactor) Secondary Y ZIGZAG (neutral grounded via 1.5 ohm neutral reactor)
10-day rating	165.7 MVA (summer)
Impedance	HX: 0.319+j11.496 % on 37.5 MVA base HY: 0.319+j11.496 % on 37.5 MVA base XY: j23 % on 37.5 MVA base
230 kV Transformer Disconnect Switches	
Quantity	2
Type	Motorized
Maximum continuous rated voltage	242 kV **(Not meeting the TSC requirement)**
Continuous current rating	1200A
Rated symmetrical short circuit capability	Withstand: 63 kA RMS symmetrical, 170 kA peak
Medium Voltage Switching Facilities	
Transformer Breakers	
Quantity	4
Maximum continuous rated voltage	36 kV
Short circuit interrupting capability	40 kA (symmetrical)
Rated continuous current	2500 A
Normal operation	Closed
Bus Tie Breaker	
Quantity	1
Maximum continuous rated voltage	36 kV
Short circuit interrupting capability	40 kA (symmetrical)
Continuous current rating	2500 A

Normal operation	Open
Feeder Breakers	
Quantity	12
Maximum continuous rated voltage	36 kV
Short circuit interrupting capability	40 kA (symmetrical)
Continuous current rating	1250 A

The system performance standards listed in the Transmission System Code requires that 230 kV and 27.6 kV systems be designed for fault levels up to 63 kA and 20 kA respectively. The MV breakers proposed for installation at the new Oakville Hydro MTS No.1 meet the interrupting capability recommended by the Transmission System Code (for 27.6 kV voltage level, the maximum three phase fault level is 17 kA and the interrupting time should be less than or equal to 8 cycles). Equipment ratings provided by Oakville Hydro shows that the motorized disconnect switches to be used on the 230 kV side are rated for maximum voltage of 242 kV. Oakville Hydro shall ensure that the motorized disconnect switches are rated for minimum 250 kV.

– End of Section –

4. Effect on System Reliability

This system impact assessment examined the effect that Oakville Hydro MTS No.1 will have on the loading of the transmission system encompassed by Burlington TS and Trafalgar TS, and on the system's voltage performance for pre and post contingency situations.

4.1 Description of Area Transmission

Trafalgar-Burlington 230 kV transmission system consists of four parallel circuits: T36B, T37B, T38B, and T39B. T36B and T37B are tapped to supply power to Palermo TS. T38B and T39B are tapped to supply power to Trafalgar DESN, Meadowvale TS, and Halton TS. The new Halton Hills GS is also connected to the T37B and T38B lines, injecting power into the power system.

Trafalgar TS is supplied by M572T and M573T 500 kV circuits originating from Milton TS. Trafalgar TS has 270 MVAr, 230 kV shunt capacitor for reactive power support to the area. This capacitor is normally connected to T37B and the switch connecting them to T36B is normally open.

Committed New Facilities

The following facilities were considered in service for the purpose of this assessment. The proposed in service date is mentioned against each facility.

- Halton Hills GS 630 MW Year 2010
- Middleport Capacitors 4x 250 MVAr Year 2010
- Buchanan Capacitors 1x 200 MVAr Year 2010
- Nanticoke Capacitors 2x 250 MVAr Year 2010
- Thorold GS 280 MW Year 2009
- York Energy Center 408 MVA Year 2011

Also, for the purpose of this study two Nanticoke units and two Lambton units are considered to be out of service.

The area transmission along with the proposed Oakville Hydro MTS No.1 is shown in Figure 1.

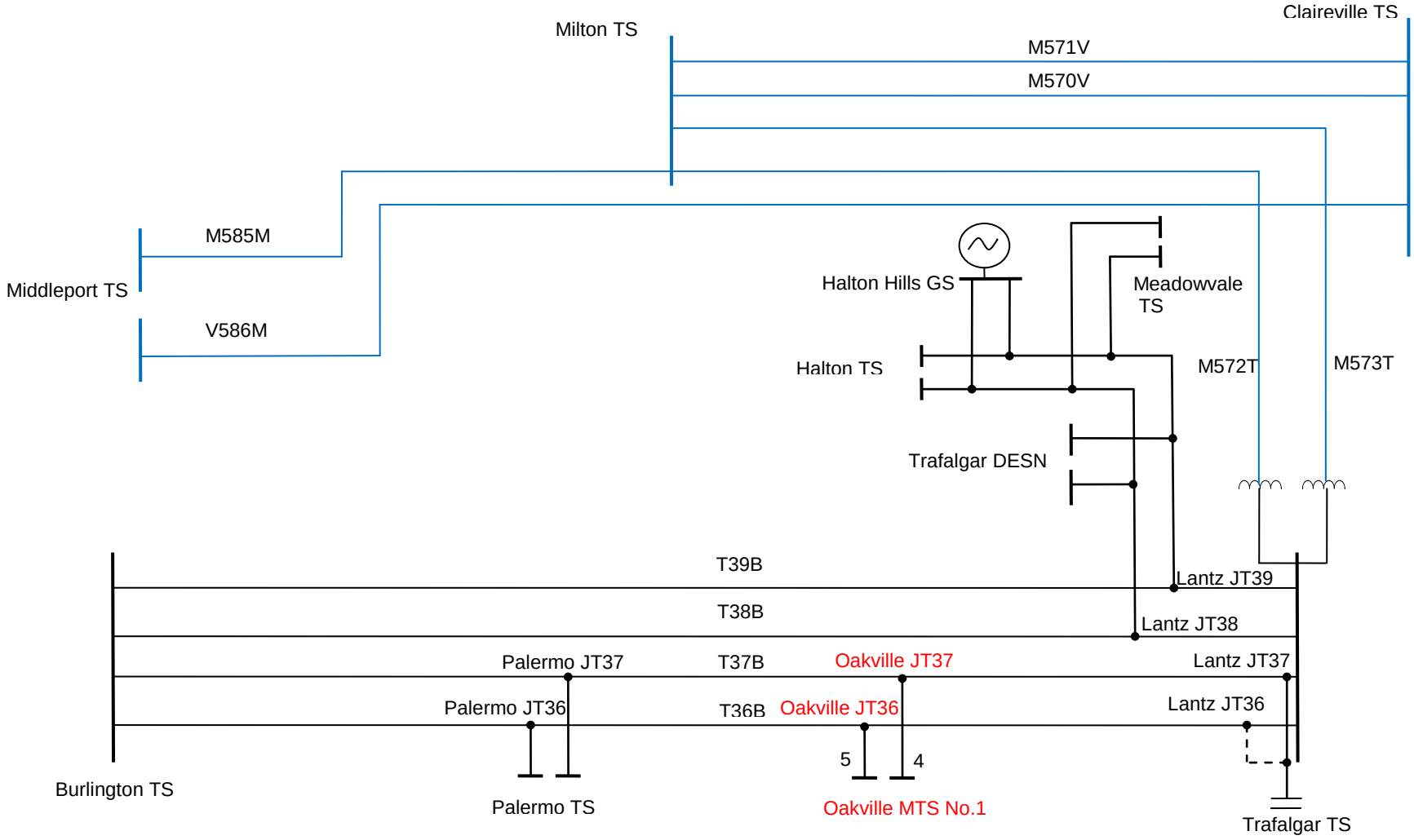

Figure 1: Oakville Hydro MTS No.1 and surrounding 230 kV and 500 kV Transmission System

4.2 Load Forecast

In this study, the Ontario loading is scaled based on the extreme weather coincident summer peak load forecast available to the IESO at the time of the study. For Oakville Hydro MTS No.1, the load forecast provided by Oakville Hydro for years 2011 to 2021 is used. This forecast is displayed in Table 1.

Oakville Hydro: Municipal Transformer Station No.1											
	Projected 10 Year Load Forecast										
	2011	2012	2013*	2014	2015	2016	2017	2018	2019	2020	2021
LOAD (MW)	34.8	43.7	1.7*	14.0	34.0	47.9	61.0	74.1	87.2	100.3	113.4

** The de-rating of Hydro One: Bronte TS and Hydro One: Oakville TS assumed resolved by Hydro One by the summer of 2013.*

Table 1: Load forecast for Oakville Hydro MTS No.1

4.3 Study Assumptions

Summer 2009 base case is used as a starting point for this study with the following assumptions, in order to represent system conditions beyond 2011 (when the proposed facility is scheduled to be in service):

- The area is considered summer peaking.
- Ontario demand is scaled to 26658 MW representing the forecast for year 2011 under extreme weather conditions. The load forecast for Ontario from 2011 to 2018 shows that Ontario demand is expected to be highest in year 2011. Therefore, this demand is used for stressing the Base case.
- For the above mentioned Ontario demand, the loads for Southwest and Toronto zones are scaled to 4990 and 10964 MW, respectively, which reflect the forecasted demands for these zones in 2011.
- To stress the local system Oakville Hydro load is assumed to be 113.4 MW.
- The new station is located 4 km West of Trafalgar TS and the tap length is assumed to be 0.13 km.
- A power factor of 0.85 lagging is assumed at the defined metering point of the new station as it is the lowest value in the range provided by the applicant.

4.4 FETT Flows

The FETT interface is defined as the sum of the eastwards flows through the lines M570V, M571V, V586M and B560V at Claireville TS, E8V and E9V at Orangeville TS, and R14T, R17T, R19T and R21T at Trafalgar TS. The FETT interface limit is normally a boundary condition of 4500 MW or the validity of other system limits.

During high Ontario demand, the power typically flows towards Toronto through the FETT interface.

Accordingly, the Base Case has been stressed to simulate the flow of 4500 MW over the FETT interface during peak load conditions to simulate high pre-contingency flows on the T x B lines.

Historically, the FETT flows reached up to -2612 MW when the flow was from East to West at a demand of 16500 MW. Since the negative FETT flow typically occurs under light loading condition when the addition of a new load station is not critical, this scenario was not considered in this study, as enough control actions are available to mitigate any potential reliability issues that may occur.

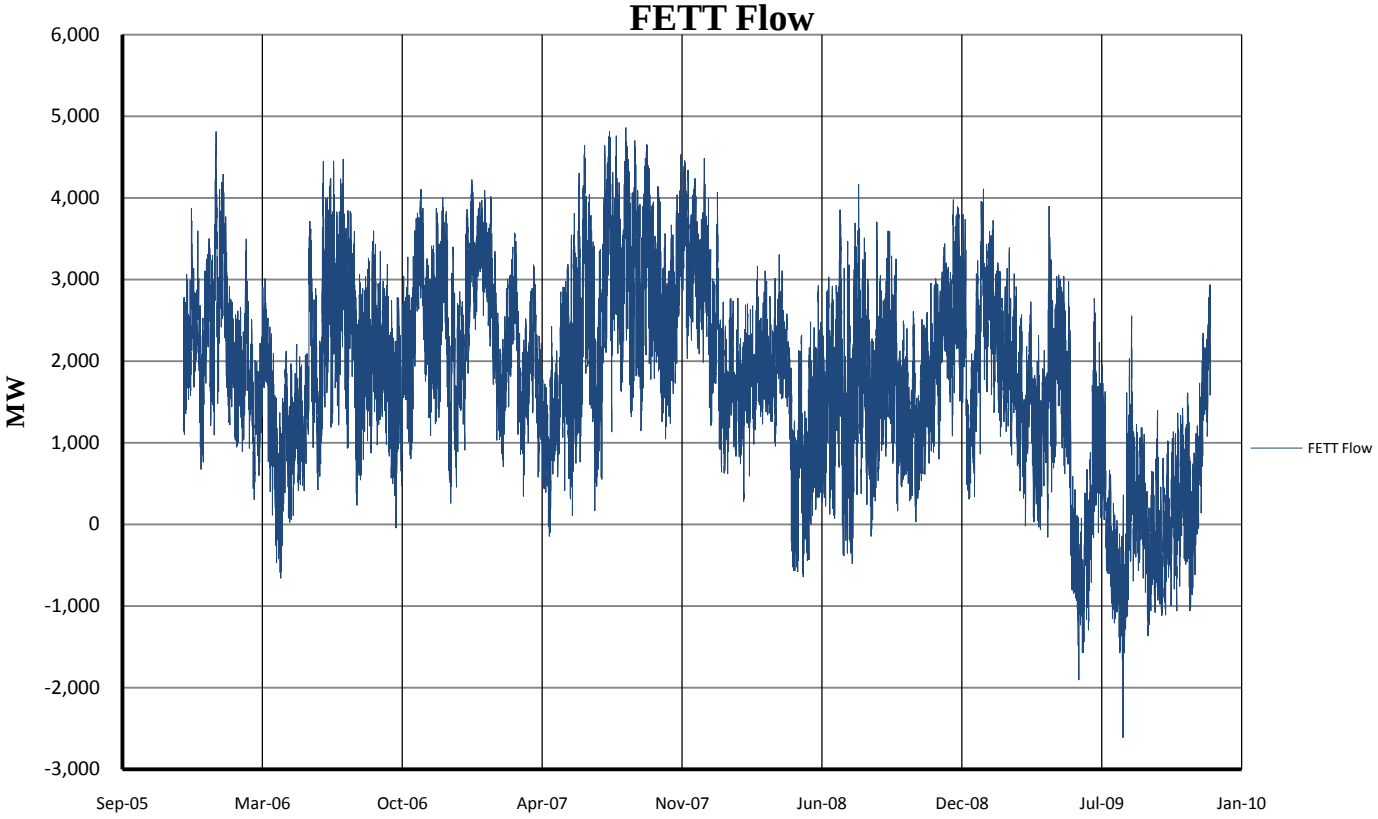

Figure 2: Historical FETT Flow

4.5 Reactive Power Compensation

The Market Rules require that the connection applicant have the capability to maintain a power factor within the range of 0.9 lagging and 0.9 leading as measured at the defined metering point of the facility. Table 2 shows the minimum reactive power compensation required to meet the pf requirement at the station, as defined by the MR, if the forecasted load has a power factor of 0.85 lagging at the defined metering point, as per the SIA application.

Year	2011	2012	2013	2014	2015	2016	2017	2018	2019	2020	2021
MW	34.8	43.7	1.7	14	34	47.9	61	74.1	87.2	100.3	113.4
Compensation(MVAr)	4.58	5.71	0.21	1.87	4.48	6.35	7.94	9.64	11.15	12.81	14.14

Table 2: Reactive power compensation requirement

4.5 Transmission Thermal Loading Assessment

The purpose of this assessment is to determine the effect of Oakville Hydro MTS No.1 on the thermal loading of the conductors in its vicinity. The criteria for the assessment are:

a) With all elements in service (and other applicable assumptions), circuit loadings shall be within the Continuous ratings.

b) With any one element out of service (and other applicable assumptions), circuit loadings shall be within the 10-day Long-term Emergency ratings (LTE).

c) With any two elements out of service (and other applicable assumptions), circuit loadings shall be within the 15-minute Short-term Emergency ratings (STE).

The thermal assessment is done for two different scenarios:

Scenario 1: Halton Hills GS in service

Various sub scenarios include all elements in service and planned outage of one of the following circuits: T36B or T37B, T38B or T39B, and M572T or M573T. Contingencies studied under each sub scenario include single and double contingencies on companion T x B circuits, Milton to Trafalgar 500 kV circuits, M585M and V586M circuits originating from Middleport TS and a contingency on T39B along with the failure of HT15 breaker at Trafalgar TS.

Scenario 2: Halton Hills GS out of service

All the sub scenarios and contingencies which are studied for Scenario 1 are repeated with Halton Hills GS out of service.

The thermal ratings of the conductors used in the study are provided by Hydro One and calculated for the summer conditions, i.e. temperature of 35°C, wind speed of 4 km/h and day time. The continuous ampacity ratings for the overhead conductors were calculated at the lowest of the sag temperature or 93°C operating temperature. The long term emergency ratings (LTE) for the overhead conductors were calculated at the lowest of the sag temperature or 127°C operating temperature. The 15 minute-LTR or short term emergency ratings (STE) were calculated at the sag temperature with a pre-load equal with the continuous ratings of the overhead lines.

4.5.1 Scenario 1: Halton Hills GS in Service

The complete set of results for this scenario is displayed in Appendix A.

All elements in service pre-contingency

With all elements in service, the current flows through all T x B lines are below their continuous ratings with the highest flow of 67.7% of the continuous rating through the section connecting Trafalgar TS to Lantz Junction on T38B and T39B.

Single contingencies

For the above mentioned single contingencies, the post contingency flows through T x B lines remained within the long term emergency ratings of the conductors. The highest flow, 85.2 % of LTE, is through the section connecting Trafalgar TS to Lantz Junction on T38B due to the loss of T39B.

Double contingencies

Simulation of double contingencies shows that the current flows through the T x B lines remained within the short term emergency ratings of the conductors. Of all double contingencies simulated, a contingency on T39B with the failure of the breaker HT15 at Trafalgar TS, which would remove M573T from service, results in the highest flows the section connecting Trafalgar TS to Lantz Junction on T38B, 62.3 % of the STE rating.

One element out of service pre-contingency

The current flows through the T x B lines out of service pre-contingency are within the long term emergency ratings of the conductors. The highest flow is 85.2% of the LTE on the section connecting Trafalgar TS to Lantz Junction on T38B when T39B is out of service pre-contingency.

Single contingencies

For the above mentioned single contingencies, the post contingency flows through T x B lines are within the short term emergency ratings. The highest flow is 67.2% of STE on Trafalgar to Lantz section of T38B circuit for a contingency on M585M with T39B out of service pre-contingency.

Double contingencies

For the simulated double contingencies, the current flows through the T x B lines are within the short term emergency ratings of the conductors. With T39B out of service pre-contingency and a double contingency on M585M /V586M, the flow through section connecting Trafalgar TS to Lantz Junction of T38B is loaded highest at 86.9% of STE.

4.5.2 Scenario 2: Halton Hills GS out of Service

The complete set of results for this scenario is displayed in Appendix B.

All elements in service pre-contingency

With all elements in service, the current flows through all T x B lines are below their continuous rating with a highest flow of 53.2% of the continuous rating through the section connecting Burlington TS to Palermo Junction on T36B and T37B.

Single contingencies

With all elements in service and a contingency on T37B circuit, the flow is highest through the section connecting Palermo Junction to Burlington TS of T36B circuit which is 56.8% of LTE.

Double contingencies

Simulation of double contingencies shows that the highest flow is 61.5% of STE through the section connecting Trafalgar TS to Lantz Junction of T37B due to the loss of M585M /V586M.

One element out of service pre-contingency

The current flows through the T x B lines out of service pre-contingency are within the long term emergency ratings of the conductors. The highest flow is 55% of the LTE on the section connecting Palermo Junction to Burlington TS on T37B when T36B is out of service pre-contingency.

Single contingencies

With T36B out of service pre-contingency, a single contingency on 500kV M585M circuit shows the highest flow, 50.6% of STE, through the section connecting Palermo Junction to Burlington TS of T37B.

Double contingencies

With T36B out of service pre-contingency and a double contingency on M585M /V586M, the flows through the section connecting Palermo Junction to Burlington TS of T37B is loaded highest at 76.4% of STE.

The results for both scenarios shows that with Oakville Hydro MTS No.1 in service the thermal loading of the monitored elements are within acceptable limits: with all transmission facilities in service, the equipment loading is within continuous ratings; with one element out of service, the equipment loading is within applicable long-term ratings; with any two elements out of service, the equipment loading is within applicable short-term emergency ratings.

4.6 System Voltage Assessment

The IESO voltage assessment criteria require the system voltage post contingency at the 230kV buses to be within 250 to 207 kV and for the 27.6 kV buses to be within 112% to 88% of the nominal voltage.

Also, the criteria require that the voltage changes post contingency should remain within the following limits:

- Percentage change in voltage before the tap changer action should not be more than 10%.
- Percentage change in voltage after the tap changer action should not be more than 10% at the high voltage buses, i.e. 500 kV, 230kV and 115 kV buses, and the change should not be higher than 5% at the medium voltage buses, i.e. 44kV, 27.6kV and 13.8kV buses.

The voltage limits are checked at the new Oakville Hydro MTS No.1 and in its vicinity at the following buses: Trafalgar TS, Lantz Junction, Palermo Junction, Palermo TS, Burlington TS, Oakville Junction and Oakville Hydro MTS No.1.

The study is done for two different scenarios:

Scenario 1: Halton Hills GS in service

Various sub scenarios include all elements in service and planned outage of one of the following elements: T36B, M572T or the capacitor at Lantz Junction. Contingencies studied under each sub scenario include single and double contingencies on companion T x B circuits, Milton to Trafalgar 500 kV circuits, M585M and V586M circuits originating from Middleport TS, and a contingency on T39B along with the failure of HT15 breaker at Trafalgar TS.

Scenario 2: Halton Hills GS out of service

All the sub scenarios and contingencies which are studied for Scenario 1 are repeated with Halton Hills GS out of service.

4.6.1 Scenario 1: Halton Hills GS in Service

The complete set of results for this scenario is displayed in Appendix C.

All elements in service pre- contingency

With all elements in service pre-contingency, all voltages at the monitored buses are within the ranges specified in Section 4.6 for both pre-contingency and post contingency conditions.

Single contingencies

For the above mentioned single contingencies, the highest change in voltage is 8.69% pre-ULTC action at the medium voltage bus of Palermo TS with Ontario loads modeled as voltage dependant. This change corresponds to the loss of T37B along with the Trafalgar 230 kV capacitor SC21.

Double contingencies

For the examined double contingencies, the highest change in voltages at all monitored buses is below 2.4% pre-ULTC action and 1.8% post ULTC action.

One element out of service pre-contingency

With one element out of service, all voltages at the monitored buses are within the ranges stated in Section 4.6 for pre-contingency and post contingency conditions.

Single contingencies

With one element out of service and a single contingency, the highest change in voltage pre-ULTC action is 8.87% at the medium voltage bus of Palermo TS with Ontario loads modeled as voltage dependant. This change in voltage corresponds to a planned outage of M572T and the loss of T37B along with the capacitor.

Double contingencies

With one element out of service and a single contingency, the highest change in voltage pre-ULTC action is 3.17% at the medium voltage bus of Palermo TS, assuming a planned outage of T36B and the loss of M585M and V586M.

4.6.2 Scenario 2: Halton Hills GS out of Service

The complete set of results for this scenario is displayed in Appendix D.

All elements in service pre- contingency

For pre-contingency and post contingency conditions, the voltages at all monitored buses are within the ranges specified in Section 4.6.

Single contingencies

With all elements in service, the highest change in voltage for the examined single contingencies is 8.98% pre-ULTC action with Ontario loads modeled as voltage dependant. This change occurred at the medium voltage bus of Palermo TS due to the loss of T37B along with the Trafalgar capacitor SC21.

Double contingencies

For the examined double contingencies, the highest change in voltage is 4.1% pre-ULTC action at the medium voltage bus of Palermo TS corresponding to the loss of M585M and V586M. The highest change in voltage post ULTC action is 2.88% at Burlington 115kV TS due to the same double contingency.

One element out of service pre-contingency

The voltages at all monitored buses are within the ranges specified in Section 4.6 for pre-contingency and post contingency conditions.

Single contingencies

For the examined single contingencies, the highest change in voltage pre-ULTC action is 9.25% at the medium voltage bus of Palermo TS with Ontario loads modeled as voltage dependant. This change is due to the loss of T37B along with the capacitor during an assumed planned outage of M572T.

Double contingencies

For the examined double contingencies, the highest change in voltage pre-ULTC action is 5.92% at the medium voltage bus of Palermo TS due to the loss of M585M and V586M during a planned outage of T36B. For the post ULTC action, the highest change in voltage is 2.95% at Palermo JT37 due to the loss of M585M and V586M during a planned outage of T36B.

The voltage assessment study shows that the voltage levels at all monitored buses remain within the prescribed limits pre-contingency and post contingency with Oakville Hydro MTS No.1 in service. Post contingency and pre-ULTC action, the change in voltages for single and double contingencies is less than 10% at all monitored buses. In addition, the change in voltages post ULTC action is less than 10 % and 5 % for high voltage and medium voltage buses, respectively.

4.7 Load Security Assessment

The load security criteria for the IESO-controlled grid are defined in Section 7.1 of the Ontario Resource and Transmission Assessment document. The following criteria apply to Oakville Hydro MTS No.1:

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 ratings and not more than 150 MW of load may be interrupted by configuration.
3. With two elements out of service, equipment loading must be within applicable short-term emergency ratings and not more than 600 MW of load may be interrupted by configuration.

With Oakville Hydro MTS connected and all the transmission in service the equipment loading is within the continuous ratings of the elements.

Section 4.5 and the results in Appendices A and B show that with Oakville Hydro MTS No.1 in service the loadings on all the elements are within their long term and short term ratings with one element out of service and two elements out of service respectively. Also with single element out of service not more than 150 MW load is interrupted and with two elements out of service the load interrupted is less than 600 MW.

The load security assessment with Oakville Hydro MTS No.1 in service meets the IESO Load security criteria.

– End of Section –

Appendix A: Thermal Loading-Scenario 1: Halton Hills in service

Table A1: All elements in service- Single contingency

											Contingency					
Halton Hills GS in service									T36B		T39B		M585M		V586M	
FROM BUS#	NAME	BASE KV	TO BUS#	NAME	Continuous	LTE	STE	Pre contingency		Post contingency		Post contingency		Post contingency		Post contingency	
					Amps	Amps	Amps	Amp	Percent	Amp	Percent	Amp	Percent	Amp	Percent	Amp	Percent
2	OAKVILLE JT37	220	4	T1 HV	-	-	-	161	-	342	-	161	-	163	-	162	-
2	OAKVILLE JT37	220	4277	LANTZ JT37	1110	1460	2080	149	13.42	262	17.95	222	15.21	301	20.62	274	18.77
2	OAKVILLE JT37	220	5248	PALERMO JT37	1110	1460	2080	269	24.23	286	19.59	346	23.70	430	29.45	399	27.33
3	OAKVILLE JT36	220	5	T2 HV	-	-	-	160	-	-	-	160	-	161	-	161	-
3	OAKVILLE JT36	220	4276	LANTZ JT36	1110	1460	2080	170	15.32	-	-	234	16.03	309	21.16	284	19.45
3	OAKVILLE JT36	220	5247	PALERMO JT36	1110	1460	2080	263	23.69	-	-	340	23.29	423	28.97	393	26.92
4104	TRAFALGAR	220	4190	LANTZ J38	1110	1460	2080	751	67.66	813	55.68	1244	85.21	881	60.34	860	58.90
4104	TRAFALGAR	220	4191	LANTZ J39	1110	1460	2080	751	67.66	813	55.68	-	-	882	60.41	860	58.90
4104	TRAFALGAR	220	4276	LANTZ JT36	1060	1400	1620	168	15.85	-	-	233	16.64	308	22.00	283	20.21
4104	TRAFALGAR	220	4277	LANTZ JT37	1060	1400	1620	559	52.74	349	24.93	582	41.57	612	43.71	593	42.36
5102	BURLINGTON	220	4190	LANTZ J38	1110	1460	2080	324	29.19	403	27.60	397	27.19	485	33.22	454	31.10
5102	BURLINGTON	220	4191	LANTZ J39	1110	1460	2080	324	29.19	403	27.60	-	-	485	33.22	454	31.10
5102	BURLINGTON	220	5247	PALERMO JT36	1110	1460	2080	421	37.93	-	-	496	33.97	580	39.73	549	37.60
5102	BURLINGTON	220	5248	PALERMO JT37	1110	1460	2080	408	36.76	588	40.27	484	33.15	569	38.97	538	36.85

Table A2: All elements in service-Double contingency

										Contingency							
										T38B/T39B		M585M/V586M		M573T/M572T		T39B--B/F HT15	
Halton Hills GS in service																	
FROM BUS#	NAME	BASE KV	TO BUS#	NAME	Continuous	LTE	STE	Pre contingency		Post contingency		Post contingency		Post contingency		Post contingency	
					Amps	Amps	Amps	Amp	Percent	Amp	Percent	Amp	Percent	Amp	Percent	Amp	Percent
2	OAKVILLE JT37	220	4	T1 HV	-	-	-	161	-	159	-	164	-	164	-	162	-
2	OAKVILLE JT37	220	4277	LANTZ JT37	1110	1460	2080	149	13.42	470	22.60	641	30.82	341	16.39	310	14.90
2	OAKVILLE JT37	220	5248	PALERMO JT37	1110	1460	2080	269	24.23	577	27.74	769	36.97	476	22.88	440	21.15
3	OAKVILLE JT36	220	5	T2 HV	-	-	-	160	-	158	-	163	-	163	-	161	-
3	OAKVILLE JT36	220	4276	LANTZ JT36	1110	1460	2080	170	15.32	482	23.17	644	30.96	345	16.59	315	15.14
3	OAKVILLE JT36	220	5247	PALERMO JT36	1110	1460	2080	263	23.69	579	27.84	764	36.73	468	22.50	433	20.82
4104	TRAFALGAR	220	4190	LANTZ J38	1110	1460	2080	751	67.66	-	-	1203	57.84	904	43.46	1296	62.31
4104	TRAFALGAR	220	4191	LANTZ J39	1110	1460	2080	751	67.66	-	-	1204	57.88	904	43.46	-	-
4104	TRAFALGAR	220	4276	LANTZ JT36	1060	1400	1620	168	15.85	481	29.69	644	39.75	344	21.23	314	19.38
4104	TRAFALGAR	220	4277	LANTZ JT37	1060	1400	1620	559	52.74	621	38.33	790	48.77	643	39.69	624	38.52
4190	BURLINGTON	220	5102	LANTZ J38	1110	1460	2080	324	29.19	-	-	822	39.52	532	25.58	492	23.65
4191	BURLINGTON	220	5102	LANTZ J39	1110	1460	2080	324	29.19	-	-	822	39.52	532	25.58	-	-
5102	BURLINGTON	220	5247	PALERMO JT36	1110	1460	2080	421	37.93	712	34.23	915	43.99	630	30.29	591	28.41
5102	BURLINGTON	220	5248	PALERMO JT37	1110	1460	2080	408	36.76	709	34.09	908	43.65	618	29.71	580	27.88

Table A3: T36B out of service pre contingency-Single contingency

										Contingency					
Halton Hills GS in service T36B out of service pre contingency										T39B		M585M		V586M	
FROM BUS#	NAME	BASE KV	TO BUS#	NAME	Continuous	LTE	STE	Pre contingency		Post contingency		Post contingency		Post contingency	
					Amps	Amps	Amps	Amp	Percent	Amp	Percent	Amp	Percent	Amp	Percent
2	OAKVILLE JT37	220	4	T1 HV	-	-	-	342	-	342	-	346	-	345	-
2	OAKVILLE JT37	220	4277	LANTZ JT37	1110	1460	2080	263	18.01	294	14.13	341	16.39	325	15.63
2	OAKVILLE JT37	220	5248	PALERMO JT37	1110	1460	2080	286	19.59	410	19.71	492	23.65	454	21.83
3	OAKVILLE JT36	220	5	T2 HV	-	-	-	-	-	-	-	-	-	-	-
3	OAKVILLE JT36	220	4276	LANTZ JT36	1110	1460	2080	-	-	-	-	-	-	-	-
3	OAKVILLE JT36	220	5247	PALERMO JT36	1110	1460	2080	-	-	-	-	-	-	-	-
4104	TRAFALGAR	220	4190	LANTZ J38	1110	1460	2080	813	55.68	1341	64.47	993	47.74	961	46.20
4104	TRAFALGAR	220	4191	LANTZ J39	1110	1460	2080	813	55.68	-	-	994	47.79	962	46.25
4104	TRAFALGAR	220	4276	LANTZ JT36	1060	1400	1620	-	-	-	-	-	-	-	-
4104	TRAFALGAR	220	4277	LANTZ JT37	1060	1400	1620	348	24.86	374	23.09	399	24.63	374	23.09
5102	BURLINGTON	220	4190	LANTZ J38	1110	1460	2080	403	27.60	525	25.24	610	29.33	571	27.45
5102	BURLINGTON	220	4191	LANTZ J39	1110	1460	2080	403	27.60	-	-	610	29.33	571	27.45
5102	BURLINGTON	220	5247	PALERMO JT36	1110	1460	2080	-	-	-	-	-	-	-	-
5102	BURLINGTON	220	5248	PALERMO JT37	1110	1460	2080	588	40.27	711	34.18	793	38.13	753	36.20

Table A4: T36B out of service pre contingency-Double contingency

										Contingency							
Halton Hills GS in service										T38B/T39B		M585M/V586M		M573T/M572T		T39B--B/F HT15	
T36B out of service pre contingency																	
FROM BUS#	NAME	BASE KV	TO BUS#	NAME	Continuous	LTE	STE	Pre contingency		Post contingency		Post contingency		Post contingency		Post contingency	
					Amps	Amps	Amps	Amp	Percent	Amp	Percent	Amp	Percent	Amp	Percent	Amp	Percent
2	OAKVILLE JT37	220	4	T1 HV	-	-	-	342	-	338	-	350	-	349	-	345	-
2	OAKVILLE JT37	220	4277	LANTZ JT37	1110	1460	2080	263	18.01	655	31.49	737	35.43	362	17.40	361	17.36
2	OAKVILLE JT37	220	5248	PALERMO JT37	1110	1460	2080	286	19.59	814	39.13	942	45.29	544	26.15	536	25.77
3	OAKVILLE JT36	220	5	T2 HV	-	-	-	-	-	-	-	-	-	-	-	-	-
3	OAKVILLE JT36	220	4276	LANTZ JT36	1110	1460	2080	-	-	-	-	-	-	-	-	-	-
3	OAKVILLE JT36	220	5247	PALERMO JT36	1110	1460	2080	-	-	-	-	-	-	-	-	-	-
4104	TRAFALGAR	220	4190	LANTZ J38	1110	1460	2080	813	55.68	-	-	1432	68.85	1030	49.52	1429	68.70
4104	TRAFALGAR	220	4191	LANTZ J39	1110	1460	2080	813	55.68	-	-	1432	68.85	1030	49.52	-	-
4104	TRAFALGAR	220	4276	LANTZ JT36	1060	1400	1620	-	-	-	-	-	-	-	-	-	-
4104	TRAFALGAR	220	4277	LANTZ JT37	1060	1400	1620	348	24.86	558	34.44	700	43.21	440	27.16	438	27.04
5102	BURLINGTON	220	4190	LANTZ J38	1110	1460	2080	403	27.60	-	-	1057	50.82	668	32.12	653	31.39
5102	BURLINGTON	220	4191	LANTZ J39	1110	1460	2080	403	27.60	-	-	1057	50.82	668	32.12	-	-
5102	BURLINGTON	220	5247	PALERMO JT36	1110	1460	2080	-	-	-	-	-	-	-	-	-	-
5102	BURLINGTON	220	5248	PALERMO JT37	1110	1460	2080	588	40.27	1078	51.83	1234	59.33	854	41.06	840	40.38

Table A5: T39B out of service pre contingency-Single contingency

Halton Hills GS in service										Contingency									
T39B out of service pre contingency										T36B		T37B & cap		T38B		M585M		V586M	
FROM BUS#	NAME	BASE KV	TO BUS#	NAME	Continuous	LTE	STE	Pre contingency		Post contingency		Post contingency		Post contingency		Post contingency		Post contingency	
					Amps	Amps	Amps	Amp	Percent	Amp	Percent	Amp	Percent	Amp	Percent	Amp	Percent	Amp	Percent
2	OAKVILLE JT37	220	4	T1 HV	-	-	-	161	-	343	-	347	-	159	-	162	-	162	-
2	OAKVILLE JT37	220	4277	LANTZ JT37	1110	1460	2080	222	15.21	294	14.13	247	11.88	470	22.60	423	20.34	386	18.56
2	OAKVILLE JT37	220	5248	PALERMO JT37	1110	1460	2080	346	23.70	410	19.71	411	19.76	577	27.74	553	26.59	514	24.71
3	OAKVILLE JT36	220	5	T2 HV	-	-	-	160	-	-	-	-	-	158	-	161	-	161	-
3	OAKVILLE JT36	220	4276	LANTZ JT36	1110	1460	2080	234	16.03	-	-	-	-	482	23.17	426	20.48	391	18.80
3	OAKVILLE JT36	220	5247	PALERMO JT36	1110	1460	2080	340	23.29	-	-	-	-	579	27.84	546	26.25	508	24.42
4104	TRAFALGAR	220	4190	LANTZ J38	1110	1460	2080	1244	85.21	1341	64.47	1286	61.83	-	-	1398	67.21	1370	65.87
4104	TRAFALGAR	220	4191	LANTZ J39	1110	1460	2080	-	-	-	-	-	-	-	-	-	-	-	-
4104	TRAFALGAR	220	4276	LANTZ JT36	1060	1400	1620	233	16.64	-	-	246	15.19	481	29.69	425	26.23	390	24.07
4104	TRAFALGAR	220	4277	LANTZ JT37	1060	1400	1620	582	41.57	374	23.09	-	-	621	38.33	677	41.79	649	40.06
5102	BURLINGTON	220	4190	LANTZ J38	1110	1460	2080	397	27.19	525	25.24	537	25.82	-	-	604	29.04	565	27.16
5102	BURLINGTON	220	4191	LANTZ J39	1110	1460	2080	-	-	-	-	-	-	-	-	-	-	-	-
5102	BURLINGTON	220	5247	PALERMO JT36	1110	1460	2080	496	33.97	-	-	733	35.24	712	34.23	702	33.75	663	31.88
5102	BURLINGTON	220	5248	PALERMO JT37	1110	1460	2080	484	33.15	710	34.13	-	-	709	34.09	692	33.27	653	31.39

Table A6: T39B out of service pre contingency-Double contingency

Halton Hills GS in service T39B out of service pre contingency										Contingency M585M/V586M		Contingency M573T/M572T	
FROM BUS#	NAME	BASE KV	TO BUS#	NAME	Continuous	LTE	STE	Pre contingency		Post contingency		Post contingency	
					Amps	Amps	Amps	Amp	Percent	Amp	Percent	Amp	Percent
2	OAKVILLE JT37	220	4	T1 HV	-	-	-	161	-	164	-	164	-
2	OAKVILLE JT37	220	4277	LANTZ JT37	1110	1460	2080	222	15.21	872	41.92	474	22.79
2	OAKVILLE JT37	220	5248	PALERMO JT37	1110	1460	2080	346	23.70	1000	48.08	610	29.33
3	OAKVILLE JT36	220	5	T2 HV	-	-	-	160	-	163	-	163	-
3	OAKVILLE JT36	220	4276	LANTZ JT36	1110	1460	2080	234	16.03	873	41.97	474	22.79
3	OAKVILLE JT36	220	5247	PALERMO JT36	1110	1460	2080	340	23.29	996	47.88	602	28.94
4104	TRAFALGAR	220	4190	LANTZ J38	1110	1460	2080	1244	85.21	1808	86.92	1413	67.93
4104	TRAFALGAR	220	4191	LANTZ J39	1110	1460	2080	-	-	-	-	-	-
4104	TRAFALGAR	220	4276	LANTZ JT36	1060	1400	1620	233	16.64	873	53.89	474	29.26
4104	TRAFALGAR	220	4277	LANTZ JT37	1060	1400	1620	582	41.57	971	59.94	723	44.63
5102	BURLINGTON	220	4190	LANTZ J38	1110	1460	2080	397	27.19	1049	50.43	662	31.83
5102	BURLINGTON	220	4191	LANTZ J39	1110	1460	2080	-	-	-	-	-	-
5102	BURLINGTON	220	5247	PALERMO JT36	1110	1460	2080	496	33.97	1145	55.05	762	36.63
5102	BURLINGTON	220	5248	PALERMO JT37	1110	1460	2080	484	33.15	1139	54.76	751	36.11

Table A7: T38B out of service pre contingency-Double contingency (Breaker failure)

Halton Hills GS in service										Contingency	
T38B out of service pre contingency										T39B--B/F HT15	
FROM BUS#	NAME	BASE KV	TO BUS#	NAME	Continuous	LTE	STE	Pre contingency		Post contingency	
					Amps	Amps	Amps	Amp	Percent	Amp	Percent
2	OAKVILLE JT37	220	4	T1 HV	-	-	-	161	-	160	-
2	OAKVILLE JT37	220	4277	LANTZ JT37	1110	1460	2080	222	15.21	597	28.70
2	OAKVILLE JT37	220	5248	PALERMO JT37	1110	1460	2080	346	23.70	716	34.42
3	OAKVILLE JT36	220	5	T2 HV	-	-	-	160	-	159	-
3	OAKVILLE JT36	220	4276	LANTZ JT36	1110	1460	2080	234	16.03	603	28.99
3	OAKVILLE JT36	220	5247	PALERMO JT36	1110	1460	2080	340	23.29	714	34.33
4104	TRAFALGAR	220	4190	LANTZ J38	1110	1460	2080	-	-	-	-
4104	TRAFALGAR	220	4191	LANTZ J39	1110	1460	2080	1244	85.21	-	-
4104	TRAFALGAR	220	4276	LANTZ JT36	1060	1400	1620	233	16.64	602	37.16
4104	TRAFALGAR	220	4277	LANTZ JT37	1060	1400	1620	582	41.57	739	45.62
5102	BURLINGTON	220	4190	LANTZ J38	1110	1460	2080	-	-	-	-
5102	BURLINGTON	220	4191	LANTZ J39	1110	1460	2080	397	27.19	-	-
5102	BURLINGTON	220	5247	PALERMO JT36	1110	1460	2080	496	33.97	856	41.15
5102	BURLINGTON	220	5248	PALERMO JT37	1110	1460	2080	484	33.15	851	40.91

Appendix B: Thermal Loading-Scenario 2: Halton Hills out of service

Table B1: All elements in service- Single contingency

										Contingency							
										T37B		T39B		M585M		V586M	
Halton Hills GS out of service																	
FROM BUS#	NAME	BASE KV	TO BUS#	NAME	Continuous	LTE	STE	Pre contingency		Post contingency		Post contingency		Post contingency		Post contingency	
					Amps	Amps	Amps	Amps	Percent	Amps	Percent	Amps	Percent	Amps	Percent	Amps	Percent
2	OAKVILLE JT37	220	4	T1 HV	-	-	-	170	-	-	-	171	-	164	-	164	-
2	OAKVILLE JT37	220	4277	LANTZ JT37	1110	1460	2080	344	31.0	-	-	456	31.2	520	35.6	483	33.1
2	OAKVILLE JT37	220	5248	PALERMO JT37	1110	1460	2080	448	40.4	-	-	569	39.0	644	44.1	605	41.4
3	OAKVILLE JT36	220	5	T2 HV	-	-	-	170	-	369	-	170	-	163	-	163	-
3	OAKVILLE JT36	220	4276	LANTZ JT36	1110	1460	2080	341	30.7	365	25.0	454	31.1	526	36.0	491	33.6
3	OAKVILLE JT36	220	5247	PALERMO JT36	1110	1460	2080	448	40.4	519	35.5	569	39.0	640	43.8	602	41.2
4104	TRAFALGAR	220	4190	LANTZ J38	1110	1460	2080	299	26.9	295	20.2	688	47.1	389	26.6	371	25.4
4104	TRAFALGAR	220	4191	LANTZ J39	1110	1460	2080	299	26.9	295	20.2	-	-	389	26.6	371	25.4
4104	TRAFALGAR	220	4276	LANTZ JT36	1060	1400	1620	340	32.1	364	26.0	454	32.4	525	37.5	490	35.0
4104	TRAFALGAR	220	4277	LANTZ JT37	1060	1400	1620	549	51.8	-	-	623	44.5	693	49.5	664	47.4
5102	BURLINGTON	220	4190	LANTZ J38	1110	1460	2080	513	46.2	650	44.5	640	43.8	707	48.4	668	45.8
5102	BURLINGTON	220	4191	LANTZ J39	1110	1460	2080	513	46.2	650	44.5	-	-	707	48.4	668	45.8
5102	BURLINGTON	220	5247	PALERMO JT36	1110	1460	2080	590	53.2	830	56.8	712	48.8	789	54.0	750	51.4
5102	BURLINGTON	220	5248	PALERMO JT37	1110	1460	2080	590	53.2	-	-	712	48.8	782	53.6	743	50.9

Table B2: All elements in service-Double contingency

										Contingency									
										T36B/T37B		T38B/T39B		M585M/V586M		M573T/M572T		T39B--B/F HT15	
Halton Hills GS out of service																			
FROM BUS#	NAME	BASE KV	TO BUS#	NAME	Continuous	LTE	STE	Pre contingency		Post contingency		Post contingency		Post contingency		Post contingency		Post contingency	
					Amps	Amps	Amps	Amps	Percent	Amps	Percent	Amps	Percent	Amps	Percent	Amps	Percent	Amps	Percent
2	OAKVILLE JT37	220	4	T1 HV	-	-	-	170	-	-	-	159	-	167	-	166	-	164	-
2	OAKVILLE JT37	220	4277	LANTZ JT37	1110	1460	2080	344	31.0		-	418	20.1	925	44.5	563	27.1	556	26.7
2	OAKVILLE JT37	220	5248	PALERMO JT37	1110	1460	2080	448	40.4	-	-	528	25.4	1052	50.6	696	33.5	684	32.9
3	OAKVILLE JT36	220	5	T2 HV	-	-	-	170	-	-	-	158	-	166	-	165	-	163	-
3	OAKVILLE JT36	220	4276	LANTZ JT36	1110	1460	2080	341	30.7	-	-	430	20.7	927	44.6	565	27.2	560	26.9
3	OAKVILLE JT36	220	5247	PALERMO JT36	1110	1460	2080	448	40.4	-	-	529	25.4	1049	50.4	690	33.2	679	32.6
4104	TRAFALGAR	220	4190	LANTZ J38	1110	1460	2080	299	26.9	355	17.1	-	-	730	35.1	390	18.8	647	31.1
4104	TRAFALGAR	220	4191	LANTZ J39	1110	1460	2080	299	26.9	355	17.1	-	-	730	35.1	391	18.8	-	-
4104	TRAFALGAR	220	4276	LANTZ JT36	1060	1400	1620	340	32.1	-	-	429	26.5	926	57.2	564	34.8	560	34.6
4104	TRAFALGAR	220	4277	LANTZ JT37	1060	1400	1620	549	51.8	-	-	607	37.5	996	61.5	753	46.5	731	45.1
5102	BURLINGTON	220	4190	LANTZ J38	1110	1460	2080	513	46.2	755	36.3	-	-	1115	53.6	760	36.5	753	36.2
5102	BURLINGTON	220	4191	LANTZ J39	1110	1460	2080	513	46.2	755	36.3	-	-	1115	53.6	760	36.5	-	-
5102	BURLINGTON	220	5247	PALERMO JT36	1110	1460	2080	590	53.2	-	-	665	32.0	1197	57.5	847	40.7	830	39.9
5102	BURLINGTON	220	5248	PALERMO JT37	1110	1460	2080	590	53.2	-	-	661	31.8	1192	57.3	838	40.3	823	39.6

Table B3: T36B out of service pre contingency-Single contingency on 230 kV circuit

										Contingency						
Halton Hills GS out of service										T37B		T38B		T39B		
T36B out of service pre contingency																
FROM BUS#	NAME	BASE KV	TO BUS#	NAME	Continuous	LTE	STE	Pre contingency		Post contingency		Post contingency		Post contingency		
					Amps	Amps	Amps	Amps	Percent	Amps	Percent	Amps	Percent	Amps	Percent	
2	OAKVILLE JT37	220	4	T1 HV	-	-	-	346	-	-	-	347	-	347	-	
2	OAKVILLE JT37	220	4277	LANTZ JT37	1110	1460	2080	394	27.0	-	-	538	25.9	538	25.9	
2	OAKVILLE JT37	220	5248	PALERMO JT37	1110	1460	2080	517	35.4	-	-	716	34.4	716	34.4	
3	OAKVILLE JT36	220	5	T2 HV	-	-	-	-	-	-	-	-	-	-	-	
3	OAKVILLE JT36	220	4276	LANTZ JT36	1110	1460	2080	-	-	-	-	-	-	-	-	
3	OAKVILLE JT36	220	5247	PALERMO JT36	1110	1460	2080	-	-	-	-	-	-	-	-	
4104	TRAFALGAR	220	4190	LANTZ J38	1110	1460	2080	344	23.6	355	17.1	-	-	637	30.6	
4104	TRAFALGAR	220	4191	LANTZ J39	1110	1460	2080	344	23.6	355	17.1	637	30.6	-	-	
4104	TRAFALGAR	220	4276	LANTZ JT36	1060	1400	1620	-	-	-	-	-	-	-	-	
4104	TRAFALGAR	220	4277	LANTZ JT37	1060	1400	1620	365	26.1	-	-	512	31.6	512	31.6	
5102	BURLINGTON	220	4190	LANTZ J38	1110	1460	2080	636	43.6	755	36.3	-	-	844	40.6	
5102	BURLINGTON	220	4191	LANTZ J39	1110	1460	2080	636	43.6	755	36.3	844	40.6	-	-	
5102	BURLINGTON	220	5247	PALERMO JT36	1110	1460	2080	-	-	-	-	-	-	-	-	
5102	BURLINGTON	220	5248	PALERMO JT37	1110	1460	2080	803	55.0	-	-	1004	48.3	1004	48.3	

Table B4: T36B out of service pre contingency-Single contingency on 500 kV circuit

										Contingency							
Halton Hills GS out of service										M573T		M572T		M585M		V586M	
T36B out of service pre contingency																	
FROM BUS#	NAME	BASE KV	TO BUS#	NAME	Continuous	LTE	STE	Pre contingency		Post contingency		Post contingency		Pre contingency		Pre contingency	
					Amps	Amps	Amps	Amps	Percent	Amps	Percent	Amps	Percent	Amps	Percent	Amps	Percent
2	OAKVILLE JT37	220	4	T1 HV	-	-	-	346	-	349	-	349	-	349	-	348	-
2	OAKVILLE JT37	220	4277	LANTZ JT37	1110	1460	2080	394	27.0	462	22.2	466	22.4	583	28.0	544	26.2
2	OAKVILLE JT37	220	5248	PALERMO JT37	1110	1460	2080	517	35.4	626	30.1	630	30.3	765	36.8	715	34.4
3	OAKVILLE JT36	220	5	T2 HV	-	-	-	-	-	-	-	-	-	-	-	-	-
3	OAKVILLE JT36	220	4276	LANTZ JT36	1110	1460	2080	-	-	-	-	-	-	-	-	-	-
3	OAKVILLE JT36	220	5247	PALERMO JT36	1110	1460	2080	-	-	-	-	-	-	-	-	-	-
4104	TRAFALGAR	220	4190	LANTZ J38	1110	1460	2080	344	23.6	406	19.5	406	19.5	521	25.0	485	23.3
4104	TRAFALGAR	220	4191	LANTZ J39	1110	1460	2080	344	23.6	406	19.5	406	19.5	521	25.0	485	23.3
4104	TRAFALGAR	220	4276	LANTZ JT36	1060	1400	1620	-	-	-	-	-	-	-	-	-	-
4104	TRAFALGAR	220	4277	LANTZ JT37	1060	1400	1620	365	26.1	440	27.2	444	27.4	540	33.3	495	30.6
5102	BURLINGTON	220	4190	LANTZ J38	1110	1460	2080	636	43.6	749	36.0	753	36.2	887	42.6	836	40.2
5102	BURLINGTON	220	4191	LANTZ J39	1110	1460	2080	636	43.6	749	36.0	753	36.2	887	42.6	836	40.2
5102	BURLINGTON	220	5247	PALERMO JT36	1110	1460	2080	-	-	-	-	-	-	-	-	-	-
5102	BURLINGTON	220	5248	PALERMO JT37	1110	1460	2080	803	55.0	918	44.1	922	44.3	1053	50.6	1002	48.2

Table B5: T36B out of service pre contingency-Double contingency

										Contingency							
Halton Hills GS out of service										T38B/T39B		M585M/V586M		M573T/M572T		T39B--B/F HT15	
T36B out of service pre contingency																	
FROM BUS#	NAME	BASE KV	TO BUS#	NAME	Continuous Amps	LTE Amps	STE Amps	Pre contingency Amps	Pre contingency Percent	Post contingency Amps	Post contingency Percent	Pre contingency Amps	Pre contingency Percent	Pre contingency Amps	Pre contingency Percent	Pre contingency Amps	Pre contingency Percent
2	OAKVILLE JT37	220	4	T1 HV	-	-	-	346	-	337	-	354	-	353	-	349	-
2	OAKVILLE JT37	220	4277	LANTZ JT37	1110	1460	2080	394	27.0	578	27.8	1096	52.7	612	29.4	657	31.6
2	OAKVILLE JT37	220	5248	PALERMO JT37	1110	1460	2080	517	35.4	752	36.2	1307	62.8	820	39.4	862	41.4
3	OAKVILLE JT36	220	5	T2 HV	-	-	-	-	-	-	-	-	-	-	-	-	-
3	OAKVILLE JT36	220	4276	LANTZ JT36	1110	1460	2080	-	-	-	-	-	-	-	-	-	-
3	OAKVILLE JT36	220	5247	PALERMO JT36	1110	1460	2080	-	-	-	-	-	-	-	-	-	-
4104	TRAFALGAR	220	4190	LANTZ J38	1110	1460	2080	344	23.6	-	-	1036	49.8	549	26.4	626	30.1
4104	TRAFALGAR	220	4191	LANTZ J39	1110	1460	2080	344	23.6	-	-	1036	49.8	549	26.4	-	-
4104	TRAFALGAR	220	4276	LANTZ JT36	1060	1400	1620	-	-	-	-	-	-	-	-	-	-
4104	TRAFALGAR	220	4277	LANTZ JT37	1060	1400	1620	365	26.1	540	33.4	1003	61.9	602	37.2	639	39.4
5102	BURLINGTON	220	4190	LANTZ J38	1110	1460	2080	636	43.6	-	-	1427	68.6	949	45.6	994	47.8
5102	BURLINGTON	220	4191	LANTZ J39	1110	1460	2080	636	43.6	-	-	1427	68.6	949	45.6	-	-
5102	BURLINGTON	220	5247	PALERMO JT36	1110	1460	2080	-	-	-	-	-	-	-	-	-	-
5102	BURLINGTON	220	5248	PALERMO JT37	1110	1460	2080	803	55.0	1029	49.50	1590	76.49	1122	53.96	1157	55.63

Table B6: T38B out of service pre contingency-Single contingency on 230 kV circuit

										Contingency					
Halton Hills GS out of service										T36B		T37B		T39B	
T38B out of service pre contingency															
FROM BUS#	NAME	BASE KV	TO BUS#	NAME	Continuous	LTE	STE	Pre contingency		Post contingency		Post contingency		Post contingency	
					Amps	Amps	Amps	Amps	Percent	Amps	Percent	Amps	Percent	Amps	Percent
2	OAKVILLE JT37	220	4	T1 HV	-	-	-	171	-	366	-	-	-	167	-
2	OAKVILLE JT37	220	4277	LANTZ JT37	1110	1460	2080	458	31.4	549	26.39	-	-	429	20.63
2	OAKVILLE JT37	220	5248	PALERMO JT37	1110	1460	2080	570	39.0	712	34.23	-	-	528	25.38
3	OAKVILLE JT36	220	5	T2 HV	-	-	-	170	-	-	-	370	-	167	-
3	OAKVILLE JT36	220	4276	LANTZ JT36	1110	1460	2080	456	31.2	-	-	516	24.8	426	20.48
3	OAKVILLE JT36	220	5247	PALERMO JT36	1110	1460	2080	571	39.1	-	-	714	34.3	527	25.34
4104	TRAFALGAR	220	4190	LANTZ J38	1110	1460	2080	-	-	-	-	-	-	-	-
4104	TRAFALGAR	220	4191	LANTZ J39	1110	1460	2080	688	47.1	636	30.58	580	27.9		-
4104	TRAFALGAR	220	4276	LANTZ JT36	1060	1400	1620	455	32.5	-	-	515	31.8	426	26.30
4104	TRAFALGAR	220	4277	LANTZ JT37	1060	1400	1620	624	44.6	496	30.62		-	577	35.62
5102	BURLINGTON	220	4190	LANTZ J38	1110	1460	2080	-	-	-		-	-	-	-
5102	BURLINGTON	220	4191	LANTZ J39	1110	1460	2080	641	43.9	840	40.38	852	41.0	-	-
5102	BURLINGTON	220	5247	PALERMO JT36	1110	1460	2080	714	48.9	-	-	1024	49.2	663	31.88
5102	BURLINGTON	220	5248	PALERMO JT37	1110	1460	2080	714	48.9	1002	48.17	-	-	663	31.88

Table B7: T38B out of service pre contingency-Single contingency on 500 kV circuit

										Contingency							
Halton Hills GS out of service										M573T		M572T		M585M		V586M	
T38B out of service pre contingency																	
FROM BUS#	NAME	BASE KV	TO BUS#	NAME	Continuous	LTE	STE	Pre contingency		Post contingency		Post contingency		Post contingency		Post contingency	
					Amps	Amps	Amps	Amps	Percent	Amps	Percent	Amps	Percent	Amps	Percent	Amps	Percent
2	OAKVILLE JT37	220	4	T1 HV	-	-	-	171	-	172	-	172	-	173	-	172	-
2	OAKVILLE JT37	220	4277	LANTZ JT37	1110	1460	2080	458	31.4	562	27.0	566	27.2	700	33.7	652	31.3
2	OAKVILLE JT37	220	5248	PALERMO JT37	1110	1460	2080	570	39.0	682	32.8	686	33.0	821	39.5	770	37.0
3	OAKVILLE JT36	220	5	T2 HV	-	-	-	170	-	172	-	172	-	172	-	172	-
3	OAKVILLE JT36	220	4276	LANTZ JT36	1110	1460	2080	456	31.2	561	27.0	565	27.2	699	33.6	650	31.3
3	OAKVILLE JT36	220	5247	PALERMO JT36	1110	1460	2080	571	39.1	682	32.8	687	33.0	821	39.5	770	37.0
4104	TRAFALGAR	220	4190	LANTZ J38	1110	1460	2080	-	-	-	-	-	-	-	-	-	-
4104	TRAFALGAR	220	4191	LANTZ J39	1110	1460	2080	688	47.1	646	31.1	645	31.0	643	30.9	648	31.2
4104	TRAFALGAR	220	4276	LANTZ JT36	1060	1400	1620	455	32.5	560	34.6	564	34.8	699	43.1	650	40.1
4104	TRAFALGAR	220	4277	LANTZ JT37	1060	1400	1620	624	44.6	704	43.5	708	43.7	801	49.4	758	46.8
5102	BURLINGTON	220	4190	LANTZ J38	1110	1460	2080	-	-	-	-	-	-	-	-	-	-
5102	BURLINGTON	220	4191	LANTZ J39	1110	1460	2080	641	43.9	754	36.3	759	36.5	892	42.9	841	40.4
5102	BURLINGTON	220	5247	PALERMO JT36	1110	1460	2080	714	48.9	828	39.8	833	40.0	965	46.4	914	43.9
5102	BURLINGTON	220	5248	PALERMO JT37	1110	1460	2080	714	48.9	828	39.8	833	40.0	965	46.4	914	43.9

Table B8: T38B out of service pre contingency-Double contingency

Halton Hills GS out of service										Contingency							
T38B out of service pre contingency										T36B/T37B		M585M/V586M		M573T/M572T		T39B--B/F HT15	
FROMB BUS#	NAME	BASE KV	TO BUS#	NAME	Continuous	LTE	STE	Pre contingency		Post contingency		Post contingency		Post contingency		Post contingency	
					Amps	Amps	Amps	Amps	Percent	Amps	Percent	Amps	Percent	Amps	Percent	Amps	Percent
2	OAKVILLE JT37	220	4	T1 HV	-	-	-	171	-	-	-	175	-	175	-	168	-
2	OAKVILLE JT37	220	4277	LANTZ JT37	1110	1460	2080	458	31.4	-	-	1240	59.6	757	36.4	560	26.9
2	OAKVILLE JT37	220	5248	PALERMO JT37	1110	1460	2080	570	39.0	-	-	1365	65.6	888	42.7	674	32.4
3	OAKVILLE JT36	220	5	T2 HV	-	-	-	170	-	-	-	175	-	174	-	168	-
3	OAKVILLE JT36	220	4276	LANTZ JT36	1110	1460	2080	456	31.2	-	-	1240	59.6	757	36.4	559	26.9
3	OAKVILLE JT36	220	5247	PALERMO JT36	1110	1460	2080	571	39.1	-	-	1365	65.6	889	42.7	674	32.4
4104	TRAFALGAR	220	4190	LANTZ J38	1110	1460	2080	-	-	-	-	-	-	-	-	-	-
4104	TRAFALGAR	220	4191	LANTZ J39	1110	1460	2080	688	47.1	538	25.9	866	41.6	595	28.6	-	-
4104	TRAFALGAR	220	4276	LANTZ JT36	1060	1400	1620	455	32.5	-	-	1239	76.5	756	46.7	558	34.4
4104	TRAFALGAR	220	4277	LANTZ JT37	1060	1400	1620	624	44.6	-	-	1259	77.7	882	54.4	699	43.1
5102	BURLINGTON	220	4190	LANTZ J38	1110	1460	2080	-	-	-	-	-	-	-	-	-	-
5102	BURLINGTON	220	4191	LANTZ J39	1110	1460	2080	641	43.9	1116	53.7	1436	69.0	962	46.3	-	-
5102	BURLINGTON	220	5247	PALERMO JT36	1110	1460	2080	714	48.9	-	-	1509	72.5	1039	50.0	815	39.2
5102	BURLINGTON	220	5248	PALERMO JT37	1110	1460	2080	714	48.9	-	-	1510	72.6	1039	50.0	815	39.2

Appendix C: Voltage Assessment-Scenario 1: Halton Hills in service

Note: The positive percentage change indicates a voltage decline and the negative percentage change indicates a voltage rise with reference to the pre-contingency voltages.

Table C1: All elements in service –Single contingency on 230 kV circuit

All Elements in service Single Contingencies (230 kV)				Voltage dependant load model											
				Loss of T36B				Loss of T37B along with the cap				Loss of T39			
BUS#	NAME	Pre Contingency		Pre ULTC		Post ULTC		Pre ULTC		Post ULTC		Pre ULTC		Post ULTC	
		BASE KV	V(KV)	V(KV)	% Change	V(KV)	% Change	V(KV)	% Change	V(KV)	% Change	V(KV)	% Change	V(KV)	% Change
4	T1 HV	220	243.05	242.38	0.28	241.89	0.48	-	-	-	-	243.52	-0.19	243.55	-0.21
6	LV 11	27.6	27.34	25.52	6.67	27.30	0.17	25.31	7.44	27.35	-0.02	27.40	-0.22	27.41	-0.24
4104	TRAFALGAR	220	243.20	243.03	0.07	242.68	0.21	241.05	0.88	240.16	1.25	243.65	-0.19	243.68	-0.20
4191	LANTZ J39	220	243.12	242.96	0.07	242.62	0.21	241.01	0.87	240.12	1.23	-	-	-	-
4277	LANTZ JT37	220	243.32	243.12	0.08	242.76	0.23	-	-	-	-	243.78	-0.19	243.81	-0.20
5247	PALERMO JT36	220	243.08	-	-	-	-	240.63	1.01	239.47	1.49	243.58	-0.21	243.61	-0.22
5403	BURLINGTON	118.05	123.72	123.80	-0.06	123.62	0.08	123.23	0.40	122.72	0.81	124.07	-0.28	124.08	-0.29
5	T2 HV	220	242.92	-	-	-	-	240.42	1.03	239.36	1.47	243.40	-0.20	243.43	-0.21
7	LV12	27.6	27.33	25.49	6.73	27.26	0.26	25.28	7.50	27.31	0.07	27.39	-0.22	27.39	-0.24
4190	LANTZJ38	220	243.12	242.96	0.07	242.62	0.21	241.01	0.87	240.12	1.23	243.51	-0.16	243.55	-0.18
4276	LANTZ JT36	220	243.18	-	-	-	-	241.01	0.89	240.10	1.27	243.63	-0.19	243.66	-0.20
5102	BURLINGTON	220	244.56	244.73	-0.07	244.38	0.07	243.60	0.39	242.68	0.77	245.17	-0.25	245.19	-0.26
5248	PALERMO JT37	220	243.16	242.34	0.34	241.77	0.57	-	-	-	-	243.67	-0.21	243.70	-0.22
6175	PALERMO BY	27.6	29.64	27.32	7.80	29.27	1.25	27.06	8.69	29.31	1.10	29.71	-0.25	29.31	1.09

Table C2: All elements in service –Single contingency on 500 kV circuit

All Elements in service Single Contingencies (500 kV)				Loss of M585M				Loss of V586M			
BUS#	NAME	Pre Contingency		Pre ULTC		Post ULTC		Pre ULTC		Post ULTC	
		BASE KV	V(KV)	V(KV)	% Change	V(KV)	% Change	V(KV)	% Change	V(KV)	% Change
4	T1 HV	220	243.05	241.21	0.76	241.33	0.71	241.49	0.64	241.61	0.59
6	LV 11	27.6	27.34	27.10	0.87	27.12	0.81	27.14	0.74	27.16	0.68
4104	TRAFALGAR	220	243.20	241.31	0.78	241.44	0.72	241.62	0.65	241.75	0.60
4191	LANTZ J39	220	243.12	241.25	0.77	241.38	0.72	241.55	0.65	241.69	0.59
4277	LANTZ JT37	220	243.32	241.44	0.77	241.57	0.72	241.74	0.65	241.87	0.60
5247	PALERMO JT36	220	243.08	241.34	0.72	241.45	0.67	241.57	0.62	241.68	0.58
5403	BURLINGTON	118.05	123.72	122.89	0.67	122.97	0.61	122.95	0.62	123.04	0.55
5	T2 HV	220	242.92	241.09	0.75	241.21	0.70	241.36	0.64	241.49	0.59
7	LV12	27.6	27.33	27.09	0.87	27.10	0.81	27.12	0.74	27.14	0.68
4190	LANTZJ38	220	243.12	241.25	0.77	241.38	0.72	241.55	0.65	241.69	0.59
4276	LANTZ JT36	220	243.18	241.29	0.78	241.42	0.72	241.60	0.65	241.73	0.60
5102	BURLINGTON	220	244.56	243.10	0.60	243.19	0.56	243.21	0.55	243.31	0.51
5248	PALERMO JT37	220	243.16	241.42	0.72	241.53	0.67	241.65	0.62	241.77	0.57
6175	PALERMO BY	27.6	29.64	29.39	0.83	29.40	0.78	29.42	0.73	29.44	0.67

Table C3: All elements in service –Double contingency

All Elements in service Double Contingencies				Loss of T38B & T39B				Loss of M572T & M573T				Loss of M585M & V586M			
BUS#	NAME	Pre Contingency		Pre ULTC		Post ULTC		Pre ULTC		Post ULTC		Pre ULTC		Post ULTC	
		BASE KV	V(KV)	V(KV)	% Change	V(KV)	% Change	V(KV)	% Change	V(KV)	% Change	V(KV)	% Change	V(KV)	% Change
4	T1 HV	220	243.05	246.07	-1.24	245.71	-1.09	238.75	1.77	239.19	1.59	238.21	1.99	238.81	1.74
6	LV 11	27.6	27.34	27.73	-1.43	27.69	-1.26	26.79	2.04	27.19	0.56	26.72	2.29	27.14	0.74
4104	TRAFALGAR	220	243.20	246.40	-1.32	246.10	-1.19	238.80	1.81	239.23	1.63	238.35	1.99	238.99	1.73
4191	LANTZ J39	220	243.12	-	-	-	-	238.75	1.80	239.18	1.62	238.30	1.98	238.94	1.72
4277	LANTZ JT37	220	243.32	246.51	-1.31	246.21	-1.19	238.92	1.81	239.36	1.63	238.47	1.99	239.11	1.73
5247	PALERMO JT36	220	243.08	245.83	-1.13	245.40	-0.95	238.97	1.69	239.42	1.51	238.31	1.96	238.87	1.73
5403	BURLINGTON	118.05	123.72	124.99	-1.03	124.67	-0.77	121.69	1.64	122.05	1.35	121.24	2.00	121.62	1.70
5	T2 HV	220	242.92	245.94	-1.24	245.59	-1.10	238.63	1.77	239.07	1.58	238.09	1.99	238.69	1.74
7	LV12	27.6	27.33	27.72	-1.43	27.67	-1.26	26.77	2.04	27.17	0.56	26.70	2.29	27.12	0.74
4190	LANTZJ38	220	243.12	-	-	-	-	238.75	1.80	239.18	1.62	238.30	1.98	238.94	1.72
4276	LANTZ JT36	220	243.18	246.37	-1.31	246.06	-1.18	238.78	1.81	239.21	1.63	238.33	1.99	238.96	1.74
5102	BURLINGTON	220	244.56	246.80	-0.92	246.24	-0.69	241.00	1.46	241.47	1.26	240.23	1.77	240.68	1.59
5248	PALERMO JT37	220	243.16	245.92	-1.14	245.49	-0.96	239.05	1.69	239.51	1.50	238.40	1.96	238.96	1.73
6175	PALERMO BY	27.6	29.64	30.03	-1.32	29.57	0.24	29.05	1.98	29.11	1.76	28.96	2.29	29.44	0.67

Table C4: M572B out of service pre-contingency –Single contingency on 230 kV circuit

M572T out of service Single Contingencies (230 kV)				Voltage Dependant load model											
				Loss of T36B				Loss of T37B along with the cap				Loss of T39			
BUS#	NAME	Pre Contingency		Pre ULTC		Post ULTC		Pre ULTC		Post ULTC		Pre ULTC		Post ULTC	
		BASE KV	V(KV)	V(KV)	% Change	V(KV)	% Change	V(KV)	% Change	V(KV)	% Change	V(KV)	% Change	V(KV)	% Change
4	T1 HV	220	241.51	240.81	0.29	240.42	0.45	-	-	-	-	241.92	-0.17	241.95	-0.18
6	LV 11	27.6	27.14	25.30	6.78	27.07	0.27	25.08	7.60	27.10	0.17	27.20	-0.20	27.20	-0.21
4104	TRAFALGAR	220	241.62	241.40	0.09	241.17	0.19	239.29	0.96	238.48	1.30	241.99	-0.15	242.02	-0.17
4191	LANTZ J39	220	241.56	241.35	0.09	241.11	0.19	239.26	0.95	238.46	1.28	-	-	-	-
4277	LANTZ JT37	220	241.74	241.50	0.10	241.25	0.20	-	-	-	-	242.12	-0.16	242.15	-0.17
5247	PALERMO JT36	220	241.62	-	-	-	-	239.05	1.06	237.99	1.50	242.09	-0.19	242.12	-0.21
5403	BURLINGTON	118.05	123.05	123.17	-0.10	123.03	0.02	122.56	0.40	122.10	0.77	123.42	-0.30	123.43	-0.31
5	T2 HV	220	241.39	-	-	-	-	238.73	1.10	237.75	1.51	241.80	-0.17	241.83	-0.18
7	LV12	27.6	27.13	25.27	6.85	27.03	0.36	25.05	7.67	27.06	0.26	27.18	-0.19	27.18	-0.21
4190	LANTZJ38	220	241.56	241.35	0.09	241.11	0.19	239.26	0.95	238.46	1.28	241.87	-0.13	241.91	-0.14
4276	LANTZ JT36	220	241.60	-	-	-	-	239.25	0.97	238.43	1.31	241.97	-0.15	242.01	-0.17
5102	BURLINGTON	220	243.33	243.56	-0.09	243.30	0.01	242.37	0.39	241.53	0.74	243.97	-0.26	244.00	-0.28
5248	PALERMO JT37	220	241.71	240.87	0.35	240.41	0.54	-	-	-	-	242.18	-0.19	242.21	-0.21
6175	PALERMO BY	27.6	29.43	27.09	7.93	29.57	-0.47	26.82	8.87	29.59	-0.55	29.50	-0.22	29.50	-0.24

Table C5: M572B out of service pre contingency –Single contingency on 500 kV circuit

M572T out of service Single Contingencies (500 kV)				Loss of M585M				Loss of V586M			
BUS#	NAME	Pre Contingency		Pre ULTC		Post ULTC		Pre ULTC		Post ULTC	
		BASE KV	V(KV)	V(KV)	% Change	V(KV)	% Change	V(KV)	% Change	V(KV)	% Change
4	T1 HV	220	241.51	240.00	0.63	240.23	0.53	240.02	0.62	240.26	0.52
6	LV 11	27.6	27.14	26.95	0.72	27.33	-0.67	26.95	0.71	27.33	-0.68
4104	TRAFALGAR	220	241.62	240.07	0.64	240.31	0.54	240.11	0.62	240.35	0.53
4191	LANTZ J39	220	241.56	240.02	0.64	240.25	0.54	240.06	0.62	240.30	0.52
4277	LANTZ JT37	220	241.74	240.19	0.64	240.43	0.54	240.24	0.62	240.48	0.52
5247	PALERMO JT36	220	241.62	240.18	0.60	240.40	0.50	240.17	0.60	240.40	0.50
5403	BURLINGTON	118.05	123.05	122.35	0.57	122.51	0.44	122.30	0.61	122.46	0.48
5	T2 HV	220	241.39	239.88	0.63	240.11	0.53	239.90	0.62	240.14	0.52
7	LV12	27.6	27.13	26.93	0.73	27.31	-0.67	26.93	0.71	27.31	-0.68
4190	LANTZJ38	220	241.56	240.02	0.64	240.25	0.54	240.06	0.62	240.30	0.52
4276	LANTZ JT36	220	241.60	240.05	0.64	240.29	0.54	240.09	0.62	240.33	0.53
5102	BURLINGTON	220	243.33	242.11	0.50	242.32	0.42	242.02	0.54	242.23	0.45
5248	PALERMO JT37	220	241.71	240.26	0.60	240.49	0.50	240.25	0.60	240.48	0.51
6175	PALERMO BY	27.6	29.43	29.22	0.70	29.25	0.59	29.22	0.71	29.25	0.59

Table C6: M572B out of service pre contingency –Double contingency

M572T out of service Double Contingencies				Loss of T38B & T39B				Loss of M585M & V586M				Loss of T39B & breaker failure (loss of M573T)			
BUS#	NAME	Pre Contingency		Pre ULTC		Post ULTC		Pre ULTC		Post ULTC		Pre ULTC		Post ULTC	
		BASE KV	V(KV)	V(KV)	% Change	V(KV)	% Change	V(KV)	% Change	V(KV)	% Change	V(KV)	% Change	V(KV)	% Change
4	T1 HV	220	241.51	244.16	-1.10	243.94	-1.01	237.15	1.81	237.88	1.50	239.12	0.99	239.43	0.86
6	LV 11	27.6	27.14	27.49	-1.26	27.46	-1.16	26.58	2.09	27.37	-0.83	26.83	1.14	27.22	-0.28
4104	TRAFALGAR	220	241.62	244.42	-1.16	244.27	-1.10	237.27	1.80	238.03	1.49	239.11	1.04	239.42	0.91
4191	LANTZ J39	220	241.56	-	-	-	-	237.23	1.79	237.99	1.48	-	-	-	-
4277	LANTZ JT37	220	241.74	244.54	-1.16	244.38	-1.09	237.39	1.80	238.15	1.49	239.24	1.03	239.55	0.91
5247	PALERMO JT36	220	241.62	244.06	-1.01	243.75	-0.88	237.30	1.79	237.99	1.50	239.44	0.90	239.75	0.77
5403	BURLINGTON	118.05	123.05	124.25	-0.98	123.99	-0.76	120.78	1.84	121.22	1.49	122.16	0.72	122.38	0.54
5	T2 HV	220	241.39	244.04	-1.10	243.82	-1.01	237.03	1.81	237.76	1.50	239.00	0.99	239.31	0.86
7	LV12	27.6	27.13	27.47	-1.26	27.44	-1.16	26.56	2.09	27.35	-0.83	26.82	1.14	27.20	-0.28
4190	LANTZJ38	220	241.56	-	-	-	-	237.23	1.79	237.99	1.48	239.03	1.05	239.33	0.92
4276	LANTZ JT36	220	241.60	244.39	-1.15	244.23	-1.09	237.24	1.80	238.01	1.49	239.10	1.03	239.40	0.91
5102	BURLINGTON	220	243.33	245.43	-0.86	244.98	-0.68	239.36	1.63	239.93	1.40	241.76	0.65	242.07	0.52
5248	PALERMO JT37	220	241.71	244.14	-1.01	243.84	-0.88	237.38	1.79	238.07	1.51	239.52	0.91	239.83	0.78
6175	PALERMO BY	27.6	29.43	29.78	-1.18	29.33	0.33	28.81	2.10	29.31	0.41	29.12	1.06	29.16	0.91

Table C7: T36B out of service pre contingency –Single contingency on 230 kV circuit

T36B out of service Single Contingencies (230 kV)				Loss of T39			
BUS#	NAME	Pre Contingency		Pre ULTC		Post ULTC	
		BASE KV	V(KV)	V(KV)	% Change	V(KV)	% Change
4	T1 HV	220	241.89	242.32	-0.18	242.35	-0.19
6	LV 11	27.6	27.30	27.36	-0.24	27.37	-0.26
4104	TRAFALGAR	220	242.69	243.07	-0.16	243.10	-0.17
4191	LANTZ J39	220	242.62	237.09	-	-	-
4277	LANTZ JT37	220	242.77	243.15	-0.16	243.18	-0.17
5247	PALERMO JT36	220	-	-	-	-	-
5403	BURLINGTON	118.05	123.63	124.05	-0.34	124.05	-0.34
5	T2 HV	220	-	-	-	-	-
7	LV12	27.6	27.26	27.32	-0.24	27.33	-0.26
4190	LANTZJ38	220	242.62	242.94	-0.13	242.98	-0.15
4276	LANTZ JT36	220	-	-	-	-	-
5102	BURLINGTON	220	244.39	245.13	-0.30	245.14	-0.31
5248	PALERMO JT37	220	241.78	242.29	-0.21	242.31	-0.22
6175	PALERMO BY	27.6	29.27	29.36	-0.31	29.36	-0.32

Table C8: T36B out of service pre contingency –Single contingency on 500 kV circuit

T36B out of service Single Contingencies (500 kV)				Loss of M585M				Loss of V586M			
BUS#	NAME	Pre Contingency		Pre ULTC		Post ULTC		Pre ULTC		Post ULTC	
		BASE KV	V(KV)	V(KV)	% Change	V(KV)	% Change	V(KV)	% Change	V(KV)	% Change
4	T1 HV	220	241.89	239.95	0.80	240.23	0.69	240.26	0.67	240.41	0.61
6	LV 11	27.6	27.30	27.00	1.10	27.48	-0.68	27.05	0.92	27.51	-0.78
4104	TRAFALGAR	220	242.69	240.69	0.82	240.97	0.71	241.04	0.68	241.19	0.62
4191	LANTZ J39	220	242.62	240.64	0.82	240.91	0.70	240.98	0.68	241.13	0.61
4277	LANTZ JT37	220	242.77	240.77	0.82	241.05	0.71	241.12	0.68	241.27	0.62
5247	PALERMO JT36	220	-	-	-	-	-	-	-	-	-
5403	BURLINGTON	118.05	123.63	122.82	0.66	122.96	0.54	122.87	0.61	122.95	0.55
5	T2 HV	220	-	-	-	-	-	-	-	-	-
7	LV12	27.6	27.26	26.96	1.10	27.44	-0.68	27.01	0.92	27.47	-0.79
4190	LANTZJ38	220	242.62	240.64	0.82	240.91	0.70	240.98	0.68	241.13	0.61
4276	LANTZ JT36	220	-	-	-	-	-	-	-	-	-
5102	BURLINGTON	220	244.39	242.97	0.58	243.17	0.50	243.06	0.54	243.16	0.50
5248	PALERMO JT37	220	241.78	239.95	0.76	240.22	0.65	240.21	0.65	240.34	0.60
6175	PALERMO BY	27.6	29.27	28.94	1.12	29.53	-0.90	28.99	0.97	29.01	0.89

Table C9: T36B out of service pre contingency –Double contingency

T36B out of service Double Contingencies				Loss of T38B & T39B				Loss of M572T & M573T				Loss of M585M & V586M			
BUS#	NAME	Pre Contingency		Pre ULTC		Post ULTC		Pre ULTC		Post ULTC		Pre ULTC		Post ULTC	
		BASE KV	V(KV)	V(KV)	% Change	V(KV)	% Change	V(KV)	% Change	V(KV)	% Change	V(KV)	% Change	V(KV)	% Change
4	T1 HV	220	241.89	244.72	-1.17	244.40	-1.04	237.32	1.89	237.89	1.65	236.70	2.15	237.45	1.84
6	LV 11	27.6	27.30	27.73	-1.58	27.68	-1.40	26.59	2.58	27.12	0.65	26.50	2.94	27.50	-0.73
4104	TRAFALGAR	220	242.69	245.69	-1.24	245.47	-1.15	238.01	1.93	238.56	1.70	237.53	2.13	238.30	1.81
4191	LANTZ J39	220	242.62	-	-	-	-	237.98	1.91	238.52	1.69	237.49	2.11	238.25	1.80
4277	LANTZ JT37	220	242.77	245.75	-1.23	245.53	-1.14	238.09	1.93	238.64	1.70	237.60	2.13	238.37	1.81
5247	PALERMO JT36	220	-	-	-	-	-	-	-	-	-	-	-	-	-
5403	BURLINGTON	118.05	123.63	124.90	-1.03	124.53	-0.73	121.60	1.64	122.01	1.31	121.10	2.05	121.48	1.74
5	T2 HV	220	-	-	-	-	-	-	-	-	-	-	-	-	-
7	LV12	27.6	27.26	27.69	-1.58	27.64	-1.41	26.55	2.59	27.08	0.65	26.45	2.95	27.46	-0.73
4190	LANTZJ38	220	242.62	-	-	-	-	237.98	1.91	238.52	1.69	237.49	2.11	238.25	1.80
4276	LANTZ JT36	220	-	-	-	-	-	-	-	-	-	-	-	-	-
5102	BURLINGTON	220	244.39	246.62	-0.91	245.97	-0.65	240.84	1.45	241.40	1.22	239.96	1.81	240.44	1.62
5248	PALERMO JT37	220	241.78	244.36	-1.07	243.90	-0.88	237.45	1.79	238.03	1.55	236.66	2.12	237.35	1.83
6175	PALERMO BY	27.6	29.27	29.73	-1.56	29.11	0.55	28.48	2.68	29.13	0.46	28.34	3.17	29.56	-1.00

Table C10: Capacitor at Trafalgar TS out of service pre contingency –Single contingency on 230 kV circuit

Capacitor at T37B out of service Single Contingencies (230 kV)				Voltage dependant load model							
				Loss of T36B				Loss of T39			
BUS#	NAME	Pre Contingency		Pre ULTC		Post ULTC		Pre ULTC		Post ULTC	
		BASE KV	V(KV)	V(KV)	% Change	V(KV)	% Change	V(KV)	% Change	V(KV)	% Change
4	T1 HV	220	240.51	239.82	0.29	239.33	0.49	240.85	-0.14	240.86	-0.15
6	LV 11	27.6	27.37	25.54	6.69	27.34	0.10	27.41	-0.16	27.41	-0.16
4104	TRAFALGAR	220	240.69	240.48	0.09	240.13	0.23	240.97	-0.12	240.98	-0.12
4191	LANTZ J39	220	240.63	240.43	0.08	240.08	0.23	-	-	-	-
4277	LANTZ JT37	220	240.67	240.43	0.10	240.07	0.25	240.96	-0.12	240.97	-0.12
5247	PALERMO JT36	220	240.83	-	-	-	-	241.25	-0.17	241.25	-0.17
5403	BURLINGTON	118.05	122.71	122.85	-0.11	122.67	0.03	123.08	-0.30	123.08	-0.30
5	T2 HV	220	240.51	-	-	-	-	240.85	-0.14	240.86	-0.15
7	LV12	27.6	27.35	25.51	6.76	27.30	0.18	27.40	-0.16	27.40	-0.16
4190	LANTZJ38	220	240.63	240.43	0.08	240.08	0.23	240.87	-0.10	240.88	-0.10
4276	LANTZ JT36	220	240.67	-	-	-	-	240.96	-0.12	240.97	-0.12
5102	BURLINGTON	220	242.71	242.98	-0.11	242.63	0.03	243.35	-0.26	243.35	-0.26
5248	PALERMO JT37	220	240.83	240.01	0.34	239.45	0.57	241.25	-0.17	241.25	-0.17
6175	PALERMO BY	27.6	29.31	26.96	8.01	29.39	-0.28	29.37	-0.20	29.37	-0.21

Table C11: Capacitor at Trafalgar TS out of service pre contingency –Single contingency on 500 kV circuit

Capacitor at T37B out of service Single Contingencies (500 kV)				Loss of M585M				Loss of V586M			
BUS#	NAME	Pre Contingency		Pre ULTC		Post ULTC		Pre ULTC		Post ULTC	
		BASE KV	V(KV)	V(KV)	% Change	V(KV)	% Change	V(KV)	% Change	V(KV)	% Change
4	T1 HV	220	240.51	238.64	0.78	238.92	0.66	238.95	0.65	239.20	0.54
6	LV 11	27.6	27.37	27.12	0.90	27.16	0.76	27.17	0.75	27.20	0.62
4104	TRAFALGAR	220	240.69	238.75	0.81	239.05	0.68	239.09	0.66	239.36	0.55
4191	LANTZ J39	220	240.63	238.72	0.79	239.01	0.67	239.05	0.66	239.32	0.54
4277	LANTZ JT37	220	240.67	238.74	0.80	239.04	0.68	239.08	0.66	239.34	0.55
5247	PALERMO JT36	220	240.83	239.05	0.74	239.32	0.63	239.31	0.63	239.55	0.53
5403	BURLINGTON	118.05	122.71	121.87	0.68	122.05	0.54	121.95	0.62	122.11	0.49
5	T2 HV	220	240.51	238.64	0.78	238.92	0.66	238.95	0.65	239.20	0.54
7	LV12	27.6	27.35	27.11	0.90	27.15	0.76	27.15	0.75	27.18	0.63
4190	LANTZJ38	220	240.63	238.72	0.79	239.01	0.67	239.05	0.66	239.32	0.54
4276	LANTZ JT36	220	240.67	238.74	0.80	239.04	0.68	239.08	0.66	239.34	0.55
5102	BURLINGTON	220	242.71	241.24	0.61	241.47	0.51	241.37	0.55	241.58	0.47
5248	PALERMO JT37	220	240.83	239.06	0.73	239.32	0.63	239.31	0.63	239.56	0.53
6175	PALERMO BY	27.6	29.31	29.06	0.86	29.09	0.73	29.09	0.74	29.13	0.62

Table C12: Capacitor at Trafalgar TS out of service pre contingency –Double contingency

Capacitor at T37B out of service Double Contingencies				Loss of T38B & T39B				Loss of M572T & M573T				Loss of M585M & V586M			
BUS#	NAME	Pre Contingency		Pre ULTC		Post ULTC		Pre ULTC		Post ULTC		Pre ULTC		Post ULTC	
		BASE KV	V(KV)	V(KV)	% Change	V(KV)	% Change	V(KV)	% Change	V(KV)	% Change	V(KV)	% Change	V(KV)	% Change
4	T1 HV	220	240.51	242.71	-0.91	242.52	-0.84	235.81	1.95	236.49	1.67	235.59	2.05	236.39	1.71
6	LV 11	27.6	27.37	27.66	-1.05	27.63	-0.96	26.75	2.25	27.19	0.64	26.73	2.35	27.18	0.69
4104	TRAFALGAR	220	240.69	242.96	-0.94	242.82	-0.88	235.85	2.01	236.52	1.73	235.75	2.05	236.59	1.70
4191	LANTZ J39	220	240.63	-	-	-	-	235.84	1.99	236.51	1.71	235.73	2.04	236.56	1.69
4277	LANTZ JT37	220	240.67	242.94	-0.94	242.80	-0.89	235.85	2.00	236.52	1.72	235.73	2.05	236.57	1.70
5247	PALERMO JT36	220	240.83	242.93	-0.87	242.65	-0.76	236.35	1.86	237.04	1.57	236.00	2.01	236.74	1.70
5403	BURLINGTON	118.05	122.71	123.85	-0.93	123.59	-0.72	120.52	1.78	121.02	1.38	120.22	2.03	120.70	1.64
5	T2 HV	220	240.51	242.71	-0.91	242.52	-0.84	235.81	1.95	236.49	1.67	235.59	2.05	236.39	1.71
7	LV12	27.6	27.35	27.64	-1.05	27.62	-0.96	26.74	2.25	27.18	0.65	26.71	2.36	27.16	0.69
4190	LANTZJ38	220	240.63	-	-	-	-	235.84	1.99	236.51	1.71	235.73	2.04	236.56	1.69
4276	LANTZ JT36	220	240.67	242.94	-0.94	242.80	-0.89	235.85	2.00	236.52	1.72	235.73	2.05	236.57	1.70
5102	BURLINGTON	220	242.71	244.71	-0.82	244.25	-0.63	238.88	1.58	239.56	1.30	238.34	1.80	238.96	1.55
5248	PALERMO JT37	220	240.83	242.93	-0.87	242.65	-0.76	236.36	1.86	237.04	1.57	236.00	2.01	236.74	1.70
6175	PALERMO BY	27.6	29.31	29.61	-1.02	29.57	-0.89	28.67	2.18	29.17	0.49	28.62	2.36	29.12	0.64

Appendix D: Voltage Assessment-Scenario 2: Halton Hills out of service

Note: The positive percentage change indicates a voltage decline and the negative percentage change indicates a voltage rise with reference to the pre-contingency voltages.

Table D1: All elements in service –Single contingency on 230 kV circuit

All Elements in service Single Contingencies (230 kV)				Voltage dependent load model											
				Loss of T36B				Loss of T37B along with the cap				Loss of T39			
BUS#	NAME	Pre Contingency		Pre ULTC		Post ULTC		Pre ULTC		Post ULTC		Pre ULTC		Post ULTC	
		BASE KV	V(KV)	V(KV)	% Change	V(KV)	% Change	V(KV)	% Change	V(KV)	% Change	V(KV)	% Change	V(KV)	% Change
4	T1 HV	220	241.42	240.71	0.29	240.04	0.57	-	-	-	-	240.92	0.21	241.01	0.17
6	LV 11	27.6	27.13	25.29	6.79	27.45	-1.19	25.05	7.68	27.45	-1.16	27.07	0.24	27.08	0.20
4104	TRAFALGAR	220	241.67	241.49	0.07	240.95	0.30	239.17	1.03	238.04	1.50	241.14	0.22	241.23	0.18
4191	LANTZ J39	220	241.60	241.42	0.07	240.88	0.30	239.11	1.03	237.98	1.50	-	-	-	-
4277	LANTZ JT37	220	241.79	241.57	0.09	241.02	0.32	-	-	-	-	241.25	0.22	241.35	0.18
5247	PALERMO JT36	220	241.31	-	-	-	-	238.53	1.15	237.11	1.74	240.89	0.17	240.97	0.14
5403	BURLINGTON	118.05	122.69	122.74	-0.04	122.45	0.20	122.07	0.51	121.35	1.09	122.58	0.09	122.62	0.06
5	T2 HV	220	241.29	-	-	-	-	238.44	1.18	237.13	1.72	240.80	0.20	240.89	0.17
7	LV12	27.6	27.11	25.26	6.85	27.41	-1.10	25.01	7.75	27.41	-1.08	27.05	0.24	27.06	0.19
4190	LANTZJ38	220	241.60	241.42	0.07	240.88	0.30	239.11	1.03	237.98	1.50	240.98	0.26	241.07	0.22
4276	LANTZ JT36	220	241.64		-	-	-	239.11	1.05	237.97	1.52	241.11	0.22	241.20	0.18
5102	BURLINGTON	220	242.56	242.66	-0.04	242.14	0.17	241.35	0.50	240.13	1.00	242.37	0.08	242.44	0.05
5248	PALERMO JT37	220	241.40	240.51	0.37	239.77	0.68	-	-	-	-	240.98	0.17	241.06	0.14
6175	PALERMO BY	27.6	29.38	27.04	7.98	29.45	-0.23	26.75	8.98	29.43	-0.16	29.32	0.20	29.34	0.16

Table D2: All elements in service –Single contingency on 500 kV circuit

All Elements in service Single Contingencies (500 kV)				Loss of M585M				Loss of V586M			
BUS#	NAME	Pre Contingency		Pre ULTC		Post ULTC		Pre ULTC		Post ULTC	
		BASE KV	V(KV)	V(KV)	% Change	V(KV)	% Change	V(KV)	% Change	V(KV)	% Change
4	T1 HV	220	241.42	238.47	1.22	239.02	0.99	239.29	0.88	239.50	0.80
6	LV 11	27.6	27.13	26.75	1.41	27.17	-0.13	26.86	1.01	27.23	-0.36
4104	TRAFALGAR	220	241.67	238.68	1.24	239.25	1.00	239.53	0.89	239.76	0.79
4191	LANTZ J39	220	241.60	238.61	1.24	239.18	1.00	239.46	0.89	239.68	0.79
4277	LANTZ JT37	220	241.79	238.80	1.24	239.37	1.00	239.65	0.89	239.87	0.79
5247	PALERMO JT36	220	241.31	238.46	1.18	238.97	0.97	239.23	0.86	239.41	0.79
5403	BURLINGTON	118.05	122.69	121.25	1.17	121.49	0.98	121.60	0.89	121.67	0.83
5	T2 HV	220	241.29	238.35	1.22	238.90	0.99	239.17	0.88	239.38	0.79
7	LV12	27.6	27.11	26.73	1.41	27.15	-0.13	26.84	1.01	27.21	-0.36
4190	LANTZJ38	220	241.60	238.61	1.24	239.18	1.00	239.46	0.89	239.68	0.79
4276	LANTZ JT36	220	241.64	238.65	1.24	239.22	1.00	239.50	0.89	239.72	0.79
5102	BURLINGTON	220	242.56	240.05	1.03	240.46	0.87	240.65	0.79	240.78	0.73
5248	PALERMO JT37	220	241.40	238.55	1.18	239.05	0.97	239.31	0.87	239.49	0.79
6175	PALERMO BY	27.6	29.38	28.98	1.39	29.05	1.14	29.09	1.01	29.11	0.93

Table D3: All elements in service –Double contingency

All Elements in service Double Contingencies				Loss of T38B & T39B				Loss of M572T & M573T				Loss of M585M & V586M			
BUS#	NAME	Pre Contingency		Pre ULTC		Post ULTC		Pre ULTC		Post ULTC		Pre ULTC		Post ULTC	
		BASE KV	V(KV)	V(KV)	% Change	V(KV)	% Change	V(KV)	% Change	V(KV)	% Change	V(KV)	% Change	V(KV)	% Change
4	T1 HV	220	241.42	246.47	-2.09	245.79	-1.81	234.34	2.93	235.78	2.34	232.96	3.50	234.74	2.77
6	LV 11	27.6	27.13	27.78	-2.40	27.70	-2.08	26.21	3.39	27.09	0.15	26.03	4.05	27.31	-0.66
4104	TRAFALGAR	220	241.67	246.77	-2.11	246.06	-1.82	234.45	2.99	235.91	2.38	233.26	3.48	235.11	2.71
4191	LANTZ J39	220	241.60	-	-	-	-	234.39	2.98	235.85	2.38	233.18	3.49	235.03	2.72
4277	LANTZ JT37	220	241.79	246.88	-2.11	246.18	-1.82	234.57	2.99	236.03	2.38	233.36	3.49	235.21	2.72
5247	PALERMO JT36	220	241.31	246.27	-2.06	245.65	-1.80	234.50	2.82	235.91	2.24	232.91	3.48	234.58	2.79
5403	BURLINGTON	118.05	122.69	125.42	-2.23	124.98	-1.87	119.25	2.80	120.10	2.11	118.20	3.66	119.16	2.88
5	T2 HV	220	241.29	246.34	-2.09	245.67	-1.82	234.22	2.93	235.66	2.33	232.85	3.50	234.63	2.76
7	LV12	27.6	27.11	27.77	-2.41	27.68	-2.09	26.20	3.39	27.07	0.15	26.02	4.05	27.29	-0.66
4190	LANTZJ38	220	241.60	-	-	-	-	234.39	2.98	235.85	2.38	233.18	3.49	235.03	2.72
4276	LANTZ JT36	220	241.64	246.73	-2.11	246.03	-1.82	234.43	2.98	235.89	2.38	233.22	3.48	235.07	2.72
5102	BURLINGTON	220	242.56	247.36	-1.98	246.81	-1.75	236.56	2.47	237.87	1.93	234.74	3.22	236.13	2.65
5248	PALERMO JT37	220	241.40	246.36	-2.05	245.73	-1.79	234.58	2.83	235.99	2.24	233.00	3.48	234.66	2.79
6175	PALERMO BY	27.6	29.38	30.09	-2.40	29.60	-0.73	28.41	3.32	29.01	1.28	28.18	4.10	29.22	0.56

Table D4: M572T out of service pre contingency –Single contingency on 230 kV circuit

M572T out of service Single Contingencies (230 kV)				Voltage dependent load model											
				Loss of T36B				Loss of T37B along with the cap				Loss of T39			
BUS#	NAME	Pre Contingency		Pre ULTC		Post ULTC		Pre ULTC		Post ULTC		Pre ULTC		Post ULTC	
		BASE KV	V(KV)	V(KV)	% Change	V(KV)	% Change	V(KV)	% Change	V(KV)	% Change	V(KV)	% Change	V(KV)	% Change
4	T1 HV	220	239.12	238.36	0.32	237.89	0.51	-	-	-	-	238.52	0.25	238.73	0.16
6	LV 11	27.6	27.18	25.34	6.79	27.12	0.22	25.07	7.76	27.52	-1.24	27.10	0.29	27.13	0.19
4104	TRAFALGAR	220	239.33	239.08	0.10	238.75	0.24	236.58	1.15	235.53	1.59	238.67	0.28	238.89	0.18
4191	LANTZ J39	220	239.26	239.02	0.10	238.68	0.24	236.53	1.14	235.47	1.58	-	-	-	-
4277	LANTZ JT37	220	239.45	239.16	0.12	238.82	0.26	-	-	-	-	238.79	0.28	239.01	0.18
5247	PALERMO JT36	220	239.11	-	-	-	-	236.15	1.24	234.82	1.79	238.61	0.21	238.81	0.13
5403	BURLINGTON	118.05	121.58	121.66	-0.07	121.49	0.07	120.95	0.52	120.33	1.03	121.48	0.08	121.58	0.00
5	T2 HV	220	239.01	-	-	-	-	235.93	1.29	234.70	1.80	238.40	0.26	238.61	0.17
7	LV12	27.6	27.16	25.30	6.85	27.08	0.31	25.04	7.82	27.48	-1.16	27.08	0.29	27.11	0.19
4190	LANTZJ38	220	239.26	239.02	0.10	238.68	0.24	236.53	1.14	235.47	1.58	238.51	0.31	238.74	0.22
4276	LANTZ JT36	220	239.30	-	-	-	-	236.53	1.16	235.46	1.60	238.64	0.28	238.87	0.18
5102	BURLINGTON	220	240.62	240.77	-0.06	240.45	0.07	239.39	0.51	238.30	0.96	240.45	0.07	240.62	0.00
5248	PALERMO JT37	220	239.19	238.27	0.38	237.74	0.61	-	-	-	-	238.69	0.21	238.89	0.13
6175	PALERMO BY	27.6	29.07	26.69	8.19	29.63	-1.94	26.38	9.25	29.01	0.21	29.00	0.25	29.03	0.15

Table D5: M572T out of service pre contingency –Single contingency on 500 kV circuit

M572T out of service Single Contingencies (500 kV)				Loss of M585M				Loss of V586M				Loss of M573T			
BUS#	NAME	Pre Contingency		Pre ULTC		Post ULTC		Pre ULTC		Post ULTC		Pre ULTC		Post ULTC	
		BASE KV	V(KV)	V(KV)	% Change	V(KV)	% Change	V(KV)	% Change	V(KV)	% Change	V(KV)	% Change	V(KV)	% Change
4	T1 HV	220	239.12	236.60	0.72	237.40	0.72	236.69	1.02	237.49	0.68	234.62	1.88	235.82	1.38
6	LV 11	27.6	27.18	26.85	-0.46	27.31	-0.46	26.86	1.17	27.32	-0.51	26.59	2.17	27.10	0.31
4104	TRAFALGAR	220	239.33	236.77	0.72	237.60	0.72	236.89	1.02	237.71	0.68	234.74	1.92	235.95	1.41
4191	LANTZ J39	220	239.26	236.70	0.72	237.53	0.72	236.82	1.02	237.64	0.68	234.67	1.92	235.89	1.41
4277	LANTZ JT37	220	239.45	236.89	0.73	237.71	0.73	237.00	1.02	237.82	0.68	234.86	1.92	236.07	1.41
5247	PALERMO JT36	220	239.11	236.65	0.70	237.43	0.70	236.72	1.00	237.49	0.68	234.77	1.82	235.95	1.32
5403	BURLINGTON	118.05	121.58	120.33	0.63	120.81	0.63	120.32	1.04	120.81	0.63	119.38	1.81	120.10	1.22
5	T2 HV	220	239.01	236.48	0.72	237.28	0.72	236.57	1.02	237.38	0.68	234.50	1.89	235.70	1.38
7	LV12	27.6	27.16	26.83	-0.46	27.29	-0.46	26.85	1.17	27.30	-0.50	26.57	2.18	27.08	0.31
4190	LANTZJ38	220	239.26	236.70	0.72	237.53	0.72	236.82	1.02	237.64	0.68	234.67	1.92	235.89	1.41
4276	LANTZ JT36	220	239.30	236.75	0.72	237.57	0.72	236.86	1.02	237.68	0.68	234.72	1.91	235.93	1.41
5102	BURLINGTON	220	240.62	238.44	0.62	239.14	0.62	238.42	0.91	239.13	0.62	236.79	1.59	237.89	1.13
5248	PALERMO JT37	220	239.19	236.74	0.70	237.51	0.70	236.80	1.00	237.58	0.67	234.85	1.81	236.03	1.32
6175	PALERMO BY	27.6	29.07	28.72	-0.55	29.23	-0.55	28.73	1.18	29.24	-0.58	28.45	2.14	29.01	0.19

Table D6: M572T out of service pre contingency –Double Contingency

M572T out of service Double Contingencies				Loss of T38B & T39B				Loss of M585M & V586M				Loss of T39B & Breaker Failure at Trafalgar			
BUS#	NAME	Pre Contingency		Pre ULTC		Post ULTC		Pre ULTC		Post ULTC		Pre ULTC		Post ULTC	
		BASE KV	V(KV)	V(KV)	% Change	V(KV)	% Change	V(KV)	% Change	V(KV)	% Change	V(KV)	% Change	V(KV)	% Change
4	T1 HV	220	239.12	244.68	-2.33	244.11	-2.09	230.06	3.79	233.52	2.34	233.67	2.28	235.28	1.61
6	LV 11	27.6	27.18	27.91	-2.67	27.83	-2.40	25.99	4.38	27.51	-1.20	26.47	2.63	27.38	-0.74
4104	TRAFALGAR	220	239.33	244.93	-2.34	244.32	-2.08	230.36	3.75	233.85	2.29	233.70	2.35	235.35	1.66
4191	LANTZ J39	220	239.26	-	-	-	-	230.28	3.75	233.77	2.29	-	-	-	-
4277	LANTZ JT37	220	239.45	245.05	-2.34	244.44	-2.08	230.46	3.75	233.95	2.30	233.83	2.35	235.47	1.66
5247	PALERMO JT36	220	239.11	244.60	-2.30	244.09	-2.08	230.03	3.80	233.41	2.38	233.98	2.15	235.54	1.49
5403	BURLINGTON	118.05	121.58	124.66	-2.53	124.36	-2.29	116.61	4.09	118.68	2.39	119.23	1.93	120.14	1.18
5	T2 HV	220	239.01	244.56	-2.32	243.99	-2.08	229.94	3.79	233.40	2.35	233.55	2.28	235.16	1.61
7	LV12	27.6	27.16	27.89	-2.67	27.82	-2.40	25.97	4.39	27.49	-1.20	26.45	2.64	27.36	-0.74
4190	LANTZJ38	220	239.26	-	-	-	-	230.28	3.75	233.77	2.29	233.54	2.39	235.20	1.70
4276	LANTZ JT36	220	239.30	244.90	-2.34	244.29	-2.09	230.32	3.75	233.81	2.29	233.69	2.34	235.33	1.66
5102	BURLINGTON	220	240.62	246.02	-2.24	245.62	-2.08	232.00	3.58	235.13	2.28	236.53	1.70	237.94	1.11
5248	PALERMO JT37	220	239.19	244.68	-2.30	244.17	-2.08	230.11	3.80	233.49	2.38	234.06	2.14	235.63	1.49
6175	PALERMO BY	27.6	29.07	29.85	-2.69	29.38	-1.07	27.76	4.50	29.46	-1.35	28.33	2.53	28.96	0.39

Table D7: T36B out of service pre contingency –Single contingency on 230 kV circuit

T36B out of service Single Contingency (230 kV)				Loss of T39			
BUS#	NAME	Pre Contingency		Pre ULTC		Post ULTC	
		BASE KV	V(KV)	V(KV)	% Change	V(KV)	% Change
4	T1 HV	220	240.06	239.48	0.24	239.59	0.20
6	LV 11	27.6	27.46	27.37	0.33	27.38	0.26
4104	TRAFALGAR	220	240.97	240.33	0.27	240.44	0.22
4191	LANTZ J39	220	240.90	-	-	-	-
4277	LANTZ JT37	220	241.04	240.40	0.27	240.51	0.22
5247	PALERMO JT36	220	-	-	-	-	-
5403	BURLINGTON	118.05	122.46	122.45	0.01	122.50	-0.03
5	T2 HV	220	-	-	-	-	-
7	LV12	27.6	27.42	27.33	0.33	27.34	0.27
4190	LANTZJ38	220	240.90	240.17	0.30	240.29	0.25
4276	LANTZ JT36	220	-	-	-	-	-
5102	BURLINGTON	220	242.17	242.15	0.01	242.23	-0.02
5248	PALERMO JT37	220	239.80	239.35	0.19	239.45	0.15
6175	PALERMO BY	27.6	29.46	29.37	0.28	29.39	0.21

Table D8: T36B out of service pre contingency –Single contingency on 500 kV circuit

T36B out of service Single Contingencies (500 kV)				Loss of M585M				Loss of V586M			
BUS#	NAME	Pre Contingency		Pre ULTC		Post ULTC		Pre ULTC		Post ULTC	
		BASE KV	V(KV)	V(KV)	% Change	V(KV)	% Change	V(KV)	% Change	V(KV)	% Change
4	T1 HV	220	240.06	236.90	1.32	237.76	0.96	237.45	1.09	238.11	0.81
6	LV 11	27.6	27.46	26.97	1.79	27.55	-0.33	27.05	1.48	27.15	1.10
4104	TRAFALGAR	220	240.97	237.77	1.33	238.66	0.96	238.35	1.09	239.05	0.80
4191	LANTZ J39	220	240.90	237.71	1.32	238.59	0.96	238.28	1.09	238.98	0.80
4277	LANTZ JT37	220	241.04	237.84	1.33	238.72	0.96	238.42	1.09	239.11	0.80
5247	PALERMO JT36	220	-	-	-	-	-	-	-	-	-
5403	BURLINGTON	118.05	122.46	121.01	1.18	121.39	0.87	121.19	1.04	121.46	0.82
5	T2 HV	220	-	-	-	-	-	-	-	-	-
7	LV12	27.6	27.42	26.92	1.80	27.51	-0.33	27.01	1.48	27.11	1.11
4190	LANTZJ38	220	240.90	237.71	1.32	238.59	0.96	238.28	1.09	238.98	0.80
4276	LANTZ JT36	220	-	-	-	-	-	-	-	-	-
5102	BURLINGTON	220	242.17	239.63	1.05	240.25	0.79	239.95	0.92	240.41	0.73
5248	PALERMO JT37	220	239.80	236.75	1.27	237.55	0.94	237.24	1.07	237.85	0.81
6175	PALERMO BY	27.6	29.46	28.90	1.88	29.60	-0.49	28.99	1.57	29.10	1.20

Table D9: T36B out of service pre contingency –Double contingency

T36B out of service Double Contingencies				Loss of T38B & T39B				Loss of M572T & M573T				Loss of M585M & V586M			
BUS#	NAME	Pre Contingency		Pre ULTC		Post ULTC		Pre ULTC		Post ULTC		Pre ULTC		Post ULTC	
		BASE KV	V(KV)	V(KV)	% Change	V(KV)	% Change	V(KV)	% Change	V(KV)	% Change	V(KV)	% Change	V(KV)	% Change
4	T1 HV	220	240.06	245.15	-2.12	244.47	-1.84	232.35	3.21	234.31	2.40	230.59	3.94	233.12	2.89
6	LV 11	27.6	27.46	28.24	-2.85	28.14	-2.47	26.25	4.39	27.46	0.00	25.97	5.41	27.73	-0.98
4104	TRAFALGAR	220	240.97	246.07	-2.12	245.37	-1.83	233.13	3.25	235.08	2.44	231.63	3.88	234.23	2.80
4191	LANTZ J39	220	240.90	-	-	-	-	233.07	3.25	235.02	2.44	231.55	3.88	234.14	2.81
4277	LANTZ JT37	220	241.04	246.13	-2.11	245.44	-1.83	233.20	3.25	235.15	2.44	231.68	3.88	234.27	2.81
5247	PALERMO JT36	220	-	-	-	-	-	-	-	-	-	-	-	-	-
5403	BURLINGTON	118.05	122.46	125.37	-2.38	124.93	-2.02	118.92	2.89	120.01	2.00	117.62	3.95	118.90	2.91
5	T2 HV	220	-	-	-	-	-	-	-	-	-	-	-	-	-
7	LV12	27.6	27.42	28.20	-2.86	28.10	-2.48	26.21	4.41	27.42	0.00	25.93	5.43	27.69	-0.98
4190	LANTZJ38	220	240.90	-	-	-	-	233.07	3.25	235.02	2.44	231.55	3.88	234.14	2.81
4276	LANTZ JT36	220	-	-	-	-	-	-	-	-	-	-	-	-	-
5102	BURLINGTON	220	242.17	247.27	-2.11	246.72	-1.88	235.99	2.55	237.68	1.85	233.75	3.48	235.60	2.71
5248	PALERMO JT37	220	239.80	244.86	-2.11	244.22	-1.84	232.42	3.08	234.34	2.28	230.36	3.94	232.72	2.95
6175	PALERMO BY	27.6	29.46	30.36	-3.07	29.16	0.99	28.10	4.60	29.57	-0.38	27.71	5.92	29.27	0.64

Table D10: Capacitor at Trafalgar TS out of service pre contingency –Single Contingency on 230 kV circuit

Capacitor at T37B out of service Single Contingencies (230 kV)				Voltage dependent load model							
				Loss of T36B				Loss of T39			
BUS#	NAME	Pre Contingency		Pre ULTC		Post ULTC		Pre ULTC		Post ULTC	
		BASE KV	V(KV)	V(KV)	% Change	V(KV)	% Change	V(KV)	% Change	V(KV)	% Change
4	T1 HV	220	238.38	237.65	0.31	237.00	0.58	237.86	0.22	237.96	0.18
6	LV 11	27.6	27.09	25.24	6.85	27.43	-1.24	27.02	0.25	27.39	-1.10
4104	TRAFALGAR	220	238.64	238.40	0.10	237.90	0.31	238.05	0.25	238.15	0.21
4191	LANTZ J39	220	238.58	238.34	0.10	237.84	0.31	-	-	-	-
4277	LANTZ JT37	220	238.62	238.34	0.12	237.83	0.33	238.03	0.25	238.13	0.21
5247	PALERMO JT36	220	238.59	-	-	-	-	238.20	0.16	238.29	0.13
5403	BURLINGTON	118.05	121.43	121.54	-0.09	121.28	0.12	121.40	0.02	121.44	-0.01
5	T2 HV	220	238.38	-	-	-	-	237.86	0.22	237.96	0.18
7	LV12	27.6	27.07	25.20	6.91	27.39	-1.16	27.01	0.25	27.37	-1.10
4190	LANTZJ38	220	238.58	238.34	0.10	237.84	0.31	237.89	0.29	238.00	0.24
4276	LANTZ JT36	220	238.62	-	-	-	-	238.03	0.25	238.13	0.21
5102	BURLINGTON	220	240.31	240.52	-0.09	240.05	0.11	240.26	0.02	240.33	-0.01
5248	PALERMO JT37	220	238.60	237.71	0.37	237.01	0.67	238.20	0.17	238.29	0.13
6175	PALERMO BY	27.6	29.39	27.04	8.00	29.50	-0.37	29.33	0.20	29.35	0.15

Table D11: Capacitor at Trafalgar TS out of service pre contingency –Single contingency on 500 kV circuit

Capacitor at T37B out of service Single Contingencies (500 kV)				Loss of M585M				Loss of V586M			
BUS#	NAME	Pre Contingency		Pre ULTC		Post ULTC		Pre ULTC		Post ULTC	
		BASE KV	V(KV)	V(KV)	% Change	V(KV)	% Change	V(KV)	% Change	V(KV)	% Change
4	T1 HV	220	238.38	235.36	1.27	235.90	1.04	235.89	1.04	236.29	0.88
6	LV 11	27.6	27.09	26.70	1.46	27.12	-0.09	26.76	1.21	27.17	-0.28
4104	TRAFALGAR	220	238.64	235.57	1.29	236.13	1.05	236.12	1.06	236.54	0.88
4191	LANTZ J39	220	238.58	235.51	1.29	236.07	1.05	236.06	1.06	236.48	0.88
4277	LANTZ JT37	220	238.62	235.55	1.29	236.11	1.05	236.10	1.06	236.52	0.88
5247	PALERMO JT36	220	238.59	235.68	1.22	236.19	1.01	236.15	1.02	236.53	0.86
5403	BURLINGTON	118.05	121.43	119.97	1.20	120.27	0.96	120.16	1.05	120.40	0.85
5	T2 HV	220	238.38	235.36	1.27	235.90	1.04	235.89	1.04	236.29	0.88
7	LV12	27.6	27.07	26.68	1.46	27.10	-0.09	26.75	1.21	27.15	-0.28
4190	LANTZJ38	220	238.58	235.51	1.29	236.07	1.05	236.06	1.06	236.48	0.88
4276	LANTZ JT36	220	238.62	235.55	1.29	236.11	1.05	236.10	1.06	236.52	0.88
5102	BURLINGTON	220	240.31	237.76	1.06	238.19	0.88	238.09	0.92	238.41	0.79
5248	PALERMO JT37	220	238.60	235.68	1.22	236.19	1.01	236.16	1.02	236.54	0.86
6175	PALERMO BY	27.6	29.39	28.97	1.44	29.04	1.18	29.04	1.20	29.09	1.01

Table D12: Capacitor at Trafalgar TS out of service pre contingency –Double contingency

Capacitor at T37B out of service Double Contingencies				Loss of T38B & T39B				Loss of M572T & M573T				Loss of M585M & V586M			
BUS#	NAME	Pre Contingency		Pre ULTC		Post ULTC		Pre ULTC		Post ULTC		Pre ULTC		Post ULTC	
		BASE KV	V(KV)	V(KV)	% Change	V(KV)	% Change	V(KV)	% Change	V(KV)	% Change	V(KV)	% Change	V(KV)	% Change
4	T1 HV	220	238.38	243.37	-2.09	242.76	-1.84	230.54	3.29	232.35	2.53	229.42	3.76	231.66	2.82
6	LV 11	27.6	27.09	27.74	-2.40	27.66	-2.11	26.06	3.80	27.36	-0.97	25.91	4.35	27.26	-0.63
4104	TRAFALGAR	220	238.64	243.59	-2.07	242.95	-1.81	230.62	3.36	232.43	2.60	229.70	3.75	232.02	2.77
4191	LANTZ J39	220	238.58	-	-	-	-	230.56	3.36	232.38	2.60	229.63	3.75	231.94	2.78
4277	LANTZ JT37	220	238.62	243.57	-2.07	242.93	-1.81	230.61	3.36	232.42	2.60	229.67	3.75	231.98	2.78
5247	PALERMO JT36	220	238.59	243.62	-2.11	243.07	-1.88	231.07	3.15	232.85	2.41	229.71	3.72	231.82	2.84
5403	BURLINGTON	118.05	121.43	124.37	-2.42	124.01	-2.12	117.65	3.11	118.80	2.17	116.68	3.91	117.97	2.85
5	T2 HV	220	238.38	243.37	-2.09	242.76	-1.84	230.54	3.29	232.35	2.53	229.42	3.76	231.66	2.82
7	LV12	27.6	27.07	27.73	-2.41	27.65	-2.12	26.04	3.81	27.34	-0.98	25.90	4.35	27.25	-0.64
4190	LANTZJ38	220	238.58	-	-	-	-	230.56	3.36	232.38	2.60	229.63	3.75	231.94	2.78
4276	LANTZ JT36	220	238.62	243.57	-2.07	242.93	-1.81	230.61	3.36	232.42	2.60	229.67	3.75	231.98	2.78
5102	BURLINGTON	220	240.31	245.47	-2.15	245.01	-1.96	233.74	2.73	235.42	2.03	232.07	3.43	233.90	2.67
5248	PALERMO JT37	220	238.60	243.62	-2.10	243.07	-1.87	231.07	3.16	232.85	2.41	229.71	3.73	231.83	2.84
6175	PALERMO BY	27.6	29.39	30.11	-2.46	29.63	-0.81	28.30	3.71	29.37	0.06	28.10	4.39	29.22	0.58