REPORT

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System Impact Assessment Report

Connection Assessment & Approval Process

Final Report

CAA ID: **2009-364**
Project: **Kitchener MTS #9**
Applicant: **Kitchener-Wilmot Hydro Inc.**

Market Facilitation Department
Independent Electricity System Operator

Date: July 27, 2009

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System Impact Assessment Report

Acknowledgement

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

Disclaimers

IESO

This report has been prepared solely for the purpose of assessing whether the connection applicant's proposed connection with the IESO-controlled grid would have an adverse impact on the reliability of the integrated power system and whether the IESO should issue a notice of conditional approval or disapproval of the proposed connection under Chapter 4, section 6 of the Market Rules.

Conditional approval of the proposed connection is based on information provided to the IESO by the connection applicant and Hydro One at the time the assessment was carried out. The IESO assumes no responsibility for the accuracy or completeness of such information, including the results of studies carried out by Hydro One at the request of the IESO. Furthermore, the conditional approval is subject to further consideration due to changes to this information, or to additional information that may become available after the conditional approval has been granted.

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

Conditional approval of the proposed connection means that there are no significant reliability issues or concerns that would prevent connection of the proposed facility to the IESO-controlled grid. However, the conditional approval does not ensure that a project will meet all connection requirements. In addition, further issues or concerns may be identified by the transmitter(s) during the detailed design phase that may require changes to equipment characteristics and/or configuration to ensure compliance with physical or equipment limitations, or with the Transmission System Code, before connection can be made.

This report has not been prepared for any other purpose and should not be used or relied upon by any person for another purpose. This report has been prepared solely for use by the connection applicant and the IESO in accordance with Chapter 4, section 6 of the Market Rules. The IESO assumes no responsibility to any third party for any use, which it makes of this report. Any liability which the IESO may have to the connection applicant in respect of this report is governed by Chapter 1, section 13 of the Market Rules. In the event that the IESO provides a draft of this report to the connection applicant, the connection applicant must be aware that the IESO may revise drafts of this report at any time in its sole discretion without notice to the connection applicant. Although the IESO will use its best efforts to advise you of any such changes, it is the responsibility of the connection applicant to ensure that the most recent version of this report is being used.

Hydro One

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

The short circuit and thermal loading levels have been computed based on the information available at the time of the study. These levels may be higher or lower if the connection information changes as a result of, but not limited to, subsequent design modifications or when more accurate test measurement data is available.

This study does not assess the short circuit or thermal loading impact of the proposed facilities on load and generation customers.

In this report, short circuit adequacy is assessed only for Hydro One circuit breakers. The short circuit results are only for the purpose of assessing the capabilities of existing Hydro One circuit breakers and identifying upgrades required to incorporate the proposed facilities. These results should not be used in the design and engineering of any new or existing facilities. The necessary data will be provided by Hydro One and discussed with any connection 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 preliminary assessment under the current IESO Connection Assessment and Approval process. Additional facility studies may be necessary to confirm constructability and the time required for construction. Further studies at more advanced stages of the project development may identify additional facilities that need to be provided or that require upgrading.

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Summary and Conclusions

Kitchener-Wilmot Hydro Inc. is proposing to construct a new Transformer Station adjacent, and connected, to Hydro One's 230 kV circuits D4W and D5W in the Township of Wilmot. The connection point is 12.07 km away from Detweiler TS along circuits D4W/D5W. The proposed station will be a Dual Element Spot Network (DESN) comprising of two 215.5/28 kV, 50/66.7/83.3 MVA transformers, supplying the entire load of the Township of Wilmot. The proposed in-service date for the station is July 1st 2010.

The following conclusions are achieved based on this assessment:

- The proposed connection arrangement and equipments for Kitchener MTS #9 is acceptable.
- The voltage performance and thermal loading with Kitchener MTS #9 is expected to be acceptable under both pre-contingency and post-contingency operating conditions.
- The area transmission system meets the IESO load security criteria in supplying the new Kitchener MTS #9.
- Provide the applicant satisfy the requirements specified in the report, Kitchener MTS #9 will be granted final approval via the IESO Market Entry process to be connected to the IESO-controlled grid.

– End of Section –

NOCA and IESO Requirements

Notification of Conditional Approval

It is recommended that a revised *Notification of Conditional Approval for Connection* be issued to Kitchener-Wilmot Hydro Inc. subject to the IESO receiving from Kitchener-Wilmot Hydro Inc. written acknowledgement that the requirements in this report will be implemented.

IESO Requirements

Provided the applicant satisfies the following requirements, Kitchener MTS #9 will be granted final approval via the IESO Market Entry process to be connected to the IESO-controlled grid.

- The applicant must complete the IESO Market Entry/Facility Registration process in a timely manner before IESO final approval for connection is granted. Models and data, including any controls that would be operational, must be provided to the IESO. This information should be submitted at least seven months before first connection to the IESO-controlled grid, to allow the IESO to incorporate the Kitchener MTS #9 into IESO work systems and to perform any additional reliability studies.

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

  The IESO requires that proposed 230 kV connection equipment:

  - must have a maximum continuous voltage rating of at least 250 kV; and
  - must be able to sustain operation at voltages up to 262.5 kV for up to 30 minutes and not automatically trip.

  If revenue metering equipment is installed, revenue metering installations must comply with the appropriate Measurement Canada requirements as well as the 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.

  The Transmission System Code (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 applicant is required to replace the equipment at its own expense with higher rated equipment capable of sustaining the increased fault level, up to the TSC's maximum fault level of 63 kA for the 230 kV system.

- The applicant is required to install facilities at the station to allow for the detection of under frequency conditions, and the selection and tripping of feeder circuit breakers for load shedding. In the event that the existing UFLS area load is insufficient in meeting the UFLS targets with the addition of the new load, the applicant 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.

- The applicant is required to install facilities at the Kitchener MTS #9 to provide local and remote voltage reduction capability of 3% and 5%. The applicant will need to confirm during the IESO Market Entry process that this capability is available.

- The applicant must install equipment at the Kitchener MTS #9 with specific performance standards that provides telemetry data to the IESO. The telemetry data is to consist of certain equipment status and operating quantities which will be identified to the applicant during the IESO Market Entry Process. End to end telemetry testing must be completed by the applicant along with the IESO to ensure that standards are met and sign conventions are understood.

- New protection systems must be coordinated with existing protection systems and must be designed to satisfy the requirements of the Transmission System Code (TSC).

- 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.

- 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.
- 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/applicant's market role/OEB licence can be found at http://www.ieso.ca/imoweb/ircp/reliabilityStandards.asp

– End of Section –

1. Introduction

Kitchener-Wilmot Hydro Inc. is proposing to construct a new Transformer Station adjacent to and connected to Hydro One's 230 kV circuits D4W and D5W in the Township of Wilmot. The connection point is 12.07 km away from Detweiler TS along circuits D4W/D5W. The proposed station will be a Dual Element Spot Network (DESN) comprising of two 215.5/28 kV, 50/66.7/83.3 MVA transformers, supplying the entire load of the Township of Wilmot.

The proposed in-service date for the station is July 1st 2010.

The purpose of this System Impact Assessment (SIA) is to examine the impact of the proposed Kitchener MTS #9 on the reliability of the integrated power system. The report also provides Kitchener-Wilmot Hydro Inc. a list of requirements to the proposed station to ensure that the new facility, when connected, will not have material adverse impact on the reliability of the integrated power system.

– End of Section –

2. Project Description

The proposed Kitchener Municipal Transformation Station (MTS) #9 is a DESN type station with two 215.5/28 kV, 50/66.7/83.3 MVA power transformers. The site is located adjacent to the Hydro One corridor for the D4W/D5W transmission lines, near the intersection of Highway 7/8 and Wilmot Centre Road, just south of Baden in the Township of Wilmot. The connection point is 12.07 km away from Detweiler TS along circuits D4W/D5W. The proposed station is going to supply the entire load in the Township of Wilmot.

Two 230 kV circuit switchers connect the transformer primary windings to the D4W/D5W line taps. Each circuit switcher consists of one motorized disconnect and one circuit breaker that is to interrupt the fault within the transformer zones.

Two 28kV main breakers connect the transformer secondary windings to 28 kV Bus B17 and B18. The two transformer 28 kV secondary windings supply indoor gas-insulated metalclad switchgear. One normally closed (N/C) bus tie breaker (bus coupler) provides a parallel connection between Buses B17 and B18. Each 28 kV bus supplies 4 feeder breakers, one station service breaker, and two sets of PT.

The transformers are both identical and configured with a wye winding on the high side (grounded) and Zig-Zag (neutral grounded through reactor) winding on the low voltage side. Each transformer is equipped with under-load tap changer located on the high voltage winding with a range of about ±40 kV that is to be achieved in 33 steps. The transformer impedance is 15% based on 50 MVA.

The proposed Kitchener MTS #9 single line diagram is shown in Figure 1.

– End of Section –

3. General Requirements

3.1 Models & Data

The applicant must complete the IESO Market Entry/Facility Registration process in a timely manner before IESO final approval for connection is granted. Models and data, including any controls that would be operational, must be provided to the IESO. This information should be submitted at least seven months before first connection to the IESO-controlled grid, to allow the IESO to incorporate the Kitchener MTS #9 into IESO work systems and to perform any additional reliability studies.

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

3.2 230 kV Connection Equipments

Appendix 4.1, reference 2 of the Market Rules states that equipment on the 230 kV grid may be exposed to voltages as high as 250 kV. In addition, some recognized contingencies (e.g. load shedding, open line end) can cause a temporary voltage increase above the maximum continuous voltage. For these conditions, connection equipment may be exposed to voltages 5% above the maximum continuous voltage for the period of time that it takes the IESO to direct operations to restore a normal voltage profile and to prepare for the next contingency. This re-preparation period will be as short as possible but it should not take longer than 30 minutes.

Thus, the IESO requires that 230 kV connection equipment in Ontario:

- must have a maximum continuous voltage rating of at least 250 kV; and
- must be able to sustain operation at voltages up to 262.5 kV for up to 30 minutes and not automatically trip.

If revenue metering equipment is installed, revenue metering installations must comply with the appropriate Measurement Canada requirements as well as the 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.

The Transmission System Code (TSC), Appendix 2 establishes maximum fault levels for the transmission system. For the 230 kV voltage level, maximum 3-phase symmetrical fault level is 63 kA and single line to ground (SLG) symmetrical fault level is 80 kA (usually limited to 63 kA).

The Transmission System Code (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 applicant is required to replace the equipment at its own expense with higher rated equipment capable of sustaining the increased fault level, up to the TSC's maximum fault level of 63 kA for the 230 kV system.

3.3 Under-frequency Load Shedding Facilities

The Market Rules (Chapter 5, Section 10.4) require that each distributor and connected wholesale customer, in conjunction with the relevant transmitter, make arrangements to enable the automatic disconnection of up to 35% of its peak demand for conditions of system under-frequency. For the purposes of administrating this program, the province is divided up into a number of UFLS areas and the UFLS targets must be met for each of these areas.

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

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

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

3.4 Voltage Reduction Facilities

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

The applicant is required to install facilities at the Kitchener MTS #9 to provide local and remote voltage reduction capability of 3% and 5%. The applicant will need to confirm during the IESO Market Entry process that this capability is available.

3.5 IESO Telemetry Data

The Market Rules (Appendices 4.17 and Appendix 4.22) list the requirements with respect to the telemetry data that must be provided to the IESO and to the performance standards that must be achieved on a continual basis.

- The applicant must install equipment at the Kitchener MTS #9 with specific performance standards that provides telemetry data to the IESO. The telemetry data is to consist of certain

equipment status and operating quantities which will be identified to the applicant during the IESO Market Entry Process. End to end telemetry testing must be completed by the applicant along with the IESO to ensure that standards are met and sign conventions are understood.

3.6 Power Factor

The Market Rules (Appendix 4.3) require that wholesale customers and distributors connected to the IESO-controlled grid shall operate at a power factor within the range 90% lagging to 90% leading as measured at the defined meter point.

The applicant must ensure that load power factor, when measured at the defined meter point location meets the Market Rules requirements.

3.7 Protection Systems

New protection systems must be coordinated with existing protection systems and must be designed to satisfy the requirements of the Transmission System Code (TSC).

Facilities designated as essential to power system reliability must be protected by two redundant protection systems according to section 8.2.1a of the TSC. These redundant protections systems must satisfy all requirements of the TSC but in particular they may not use common components, common battery banks or common secondary CT or PT windings.

As currently assessed, this facility is not designated as essential to power system reliability and therefore the above requirements do not apply. In the future, as the electrical system evolves, this facility may be designated as such and at that time the above requirements will apply.

Provided that the TSC requirements are satisfied, the IESO does not have additional requirements.

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.

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.

3.8 Reliability Standards

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/applicant's market role/OEB licence can be found at http://www.ieso.ca/imoweb/ircp/reliabilityStandards.asp.

In support of the NERC standard EOP-005, the proponent/applicant may meet the restoration participant criteria. Please refer to Section 3 (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 proponent/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

– End of Section –

4. Data Verification

4.1 Connection Arrangement

The Kitchener MTS #9 shown in Figure 1 will not reduce the level of reliability of the integrated power system and is, therefore, acceptable to the IESO.

4.2 Connection Equipment

The connection equipment specifications are assessed based on the information provided by the applicant.

4.2.1 230 kV Circuit Switchers

The proposed 230 kV circuit switchers are located at the HV side of the station transformers. Each circuit switcher consists of one motorized disconnect and one circuit breaker interrupting fault current. The specifications of circuit switcher are shown in Table 1.

Table 1: Specifications for 230kV Circuit Switchers

Type	SF6
Voltage Rating	250 kV
Interrupting time rating	80 ms
Continuous Current Rating	1200 A
Short Circuit Symmetrical Rating	20 kA

The circuit switchers are to interrupt a primary fault within transformers zones. Currently, three-phase fault level on the 230-kV side of the proposed MTS is about 15 kA. Thus, short circuit symmetrical rating of the circuit switchers is adequate to interrupt the fault.

If any future system enhancement results in an increased fault level, higher than the equipment's capability, the applicant is required to replace the equipment at its own expense with higher rated equipment capable of sustaining the increased fault level, up to the TSC's maximum fault level of 63 kA for the 230 kV system.

4.3 Transformers T17 and T18

Table 2: Specifications for Transformers

Rated Voltages	Rating (MVA) (ONAN/ONAF/ONAF)	Impedance (pu)	Winding Connection		Taps
		S_B = 50MVA	HV	LV	
215.5/ 28 kV	50/66.7/83.3 MVA	j0.15	Y Grounded	Zig-Zag Grounded thru reactor	ULTC: ±40kV Number of Positions: 33

– End of Section –

5. Fault Level Assessment

Fault level studies were not required for this assessment.

– End of Section –

6. Impact on System Reliability

Power flow studies were carried out to assess whether the proposed Kitchener MTS #9 would materially impact the reliability of the integrated power system. This included examining the voltage performance of the power system and the thermal loading of transmission circuits for pre-contingency and post-contingency conditions.

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

Finally, a load security analysis was completed to determine if the load security criteria detailed in the IESO Ontario Resource and Transmission Assessment Criteria document will be met.

6.1 Study Assumptions

In this assessment, the 2010 summer base case was used with the following assumptions:

- Transmission facilities – All existing and proposed major transmission facilities with 2010 in-service dates or earlier were assumed in service.
- Generation facilities – All existing and proposed major generation facilities with 2010 in-service dates or earlier were assumed in service.
- System load – A load of approximately 28,092 MW with a load power factor of 0.91 was assumed.
- Equipment Ratings: Continuous and emergency ratings as provided by the equipment owners. Circuit thermal ratings used for 230 kV circuits surrounding Kitchener MTS #9 are in Table 3.

Table 3: Circuit Thermal Ratings

Circuit/Section	Conductor	Max Operating Temperature	Continuous(1)		LTE(2)		15-MIN LTR(3)	
			(A)	(MVA)	(A)	(MVA)	(A)	(MVA)
D4W/D5W(All sections)	1307.4 kcmil 28/19	150°C	1110	453	1460	595	1760	718

Note:

(1) Continuous ratings are obtained based on 235-kV voltage, 35°C ambient temperature at 4 km/hr wind velocity, with 93 °C maximum operating temperature.

(2) Long-term emergency ratings (LTE) are obtained based on 235-kV voltage, 35°C ambient temperature at 4 km/hr wind velocity, with 127 °C maximum operating temperature.

(3) 15-minute limited time ratings (LTR) are obtained based on 235-kV voltage, pre-load equal to continuous rating, 35°C ambient temperature at 4 km/hr wind velocity, with sag temperature.

- Two system conditions, which stress D4W/D5W the most, were studied according to the interface flow of BLIP (Buchanan Longwood Input Power). Under one condition, the BLIP was assumed to be at its positive maximum of 3500 MW, while under the other, the negative BLIP (NBLIP) was assumed to be at its limit of 1500 MW.

6.2 Load forecasting

The proposed Kitchener MTS #9 will supply the entire load of Wilmot Township. The applicant provided the historical data of Wilmot load which is currently supplied by Detweiler TS. The load forecasting of Wilmot load was also provided based on 1.5% annual load growth rate for the following 25 years. Table 4 summarizes the load forecasting for Kitchener MTS #9 until the horizon year 2020.

Table 4: Load Forecasting (MW)

Year	Wilmot Town Peak Load (MW)	Coincident Wellesley DS Load supplied by K-W Hydro (MW)	Peak shaving by DG (MW)	Peak Demand at Detweiler TS (MW)	Peak Demand at Kitchener MTS #9 (MW)
2004	29.80	4.38	-4.39	29.79	
2005	30.52	4.28	-4.38	30.42	
2006	30.04	3.93	-4.32	29.65	
2007	30.31	4.22	-4.27	30.27	
2008	29.41	4.00	-4.30	29.11	
Base	**30.02**	**4.16**	**-4.40**		
2009	30.47	4.22	-6.00	28.69	
2010	30.92	4.29	-7.60	27.61	27.61
2011	**31.39**	**4.35**	**-12.60**		**23.14**
2012	31.86	4.42	-12.60		23.68
2013	32.34	4.48	-12.60		24.22
2014	32.82	0	-12.60		20.22
2015	33.31	0	-12.60		20.71
2016	33.81	0	-12.60		21.21
2017	34.32	0	-12.60		21.72
2018	34.84	0	-12.60		22.24
2019	35.36	0	-12.60		22.76
2020	35.89	0	-12.60		23.29

Table 4 shows that all 27.6 kV feeders will be transferred from Detweiler TS to Kitchener MTS #9 by the end of 2010. Kitchener MTS #9 will initially supply some load at Wellesley DS, which will be transferred to Waterloo North 27.6 kV system by the end of 2013. There is distributed generation (DG) planned for development behind the new substation, and that will reduce the system load, as shown in the table above. For study in this assessment, the Wilmot load in 2011 was adopted without taking DG units into account.

6.3 Voltage Analysis

The voltage performance of Buchanan TS, Detweiler TS was evaluated with the proposed Kitchener MTS #9 incorporated. The following IESO criteria must be satisfied before any new equipment is connected to the transmission system:

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

The voltage results prior to and following the loss of D4W are shown in Table 5 and Table 6 for the two studied system conditions.

Table 5: Voltage Declines due to the Loss of D4W (BLIP: 3500MW)

Bus	Pre-Contingency (kV)	Post-Contingency			
		Pre-ULTC (kV)	*Change (%)*	Post-ULTC (kV)	*Change (%)*
Buchanan 230 kV	238.8	237.0	*-0.8*	238.7	*0.0*
Detweiler 230kV	243.9	244.5	*0.2*	245.0	*0.5*
Kitchener 230kV	243.0	242.9	*0.0*	243.6	*0.2*
Kitchener 27.6kV	28.1	27.5	*-2.1*	27.6	*-1.8*

Table 6: Voltage Declines due to the Loss of D4W (NBLIP: 1500MW)

Bus	Pre-Contingency (kV)	Post-Contingency			
		Pre-ULTC (kV)	*Change (%)*	Post-ULTC (kV)	*Change (%)*
Buchanan 230 kV	246.3	245.7	*-0.2*	245.7	*-0.2*
Detweiler 230kV	248.3	247.6	*-0.3*	247.5	*-0.3*
Kitchener 230kV	247.5	246.4	*-0.4*	245.3	*-0.9*
Kitchener 27.6kV	28.7	28.0	*-2.4*	27.9	*-2.8*

As shown in Table 5 and Table 6, the 230 kV pre-contingency and post-contingency voltages are within the normal voltage range of 220 kV to 250 kV. In addition, the pre-ULTC and post-ULTC voltage declines do not exceed the maximum voltage decline criteria of 10%.

6.4 Thermal Analysis

The criteria applied in assessing the thermal loading capability of the 230 kV circuits is:

- With all elements in-service, loading of any line shall be within its continuous rating; and
- For any single circuit contingency, post-contingency flow on any circuit shall not exceed the long-term emergency (LTE) rating.

The thermal loading on 230 kV circuit D5W was examined for the loss of D4W.

Table 7 and Table 8 summarize the pre-contingency and post-contingency loading on the circuit sections of D5W. The circuit ratings are from Table 3.

Table 7: Thermal Loading of D5W due to the Loss of D4W (BLIP: 3500MW)

Circuit Sections		Pre-Contingency				Post-Contingency				Ratings(MVA)		
		P (MW)	Q (MX)	S (MVA)	*% of Cont.*	P (MW)	Q (MX)	S (MVA)	*% of LTE*	Cont.	LTE	15-Min LTR
Detweiler	Kitchener	158.1	17.5	159.1	*35.1*	211.9	40.5	215.7	*36.3*	453	595	718
Kitchener	Buchanan	142.1	11.0	142.5	*31.5*	180.0	23.7	181.6	*30.5*	453	595	718

Table 8: Thermal Loading of D5W due to the Loss of D4W (NBLIP: 1500MW)

Circuit Sections		Pre-Contingency				Post-Contingency				Ratings(MVA)		
		P (MW)	Q (MX)	S (MVA)	*% of Cont.*	P (MW)	Q (MX)	S (MVA)	*% of LTE*	Cont.	LTE	15-Min LTR
Buchanan	Kitchener	280.5	-24.2	281.5	*62.2*	357.4	-14.4	357.7	*60.1*	453	595	718
Kitchener	Detweiler	260.5	-58.4	267.0	*58.9*	318.9	-83.1	329.5	*55.4*	453	595	718

The pre-contingency loadings on D4W and D5W are well within the continuous ratings of the circuit sections. On loss of D4W (one element out of service), the post contingency loading of circuit D5W is within its long-term emergency rating. There is no overloading foreseen under the system pre- and post-contingencies conditions.

6.5 Power Factor Analysis

The Market Rules (Appendix 4.3, reference 1) require that wholesale customers and distributors connected to the IESO-controlled grid shall operate at a power factor within the range of 90% lagging to 90% leading as measured at the defined meter point. For the proposed Kitchener MTS #9, the defined meter point would be considered the HV sides of transformers T17 and T8.

Power flow simulations were completed to determine whether any capacitor bank needs to be installed at Kitchener MTS #9. The power factor of the load at the LV side was assumed 0.94 which was provided by the applicant. The results are shown in Table 9. Table 9 indicates that no capacitor is required at Kitchener MTS #9.

Table 9: Required Capacitor Banks for Kitchener MTS #9

Year	P(MW)	Q at LV (MVAr)	Q at HV (MVAr)	Q Allowed @ HV (MVAr)	Capacitor Required (MVAr)
2011	31.4	11.4	13.2	15.2	0
2020	35.9	13.0	15.2	17.4	0

6.6 Load Security

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 Kitchener MTS #9:

(1) With all transmission facilities in service, equipment loading must be within continuous ratings.
(2) With one element out of service, equipment loading must be within applicable long-term emergency ratings.
(3) For a single element contingency, not more than 150 MW of load may be interrupted by configuration.
(4) For a double element contingency, not more than 600 MW of load may be interrupted by configuration.

For criteria (1) and (2), the results in Section 6.4 of this SIA show that the pre-contingency loadings on circuits D4W and D5W are within continuous ratings, and the post-contingency loadings are within long-term emergency ratings.

For criterion (3), a contingency involving circuit D4W or D5W would result in no load interruption at the Kitchener MTS #9.

For criterion (4), a contingency involving the double circuits D4W and D5W would result in the interruption of all load at Kitchener MTS #9. However, the load at Kitchener MTS #9 is far below 600 MW.

Thus, the area transmission system supplying the new Kitchener MTS #9 meets the IESO load security criteria.

– End of Section –

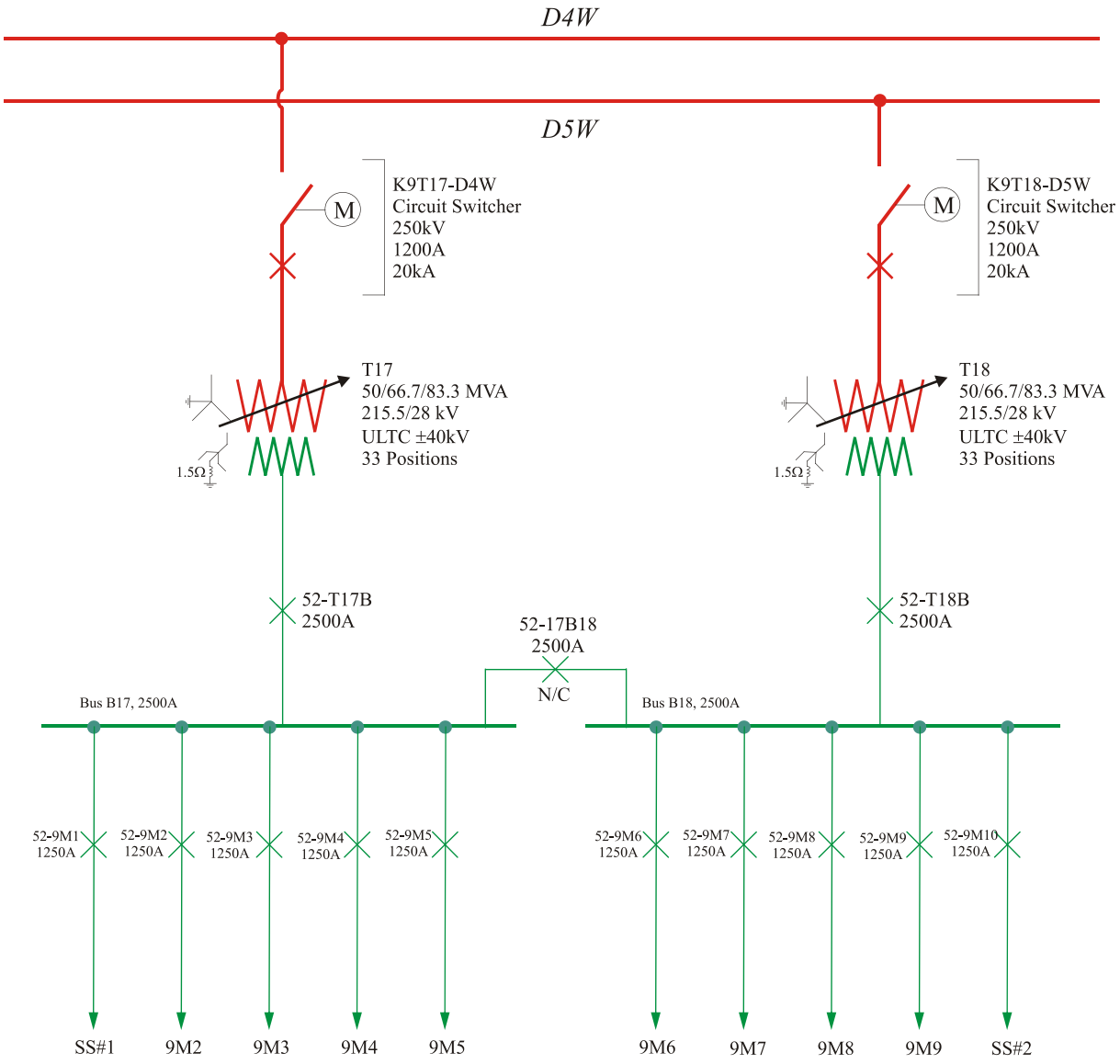

Figure 1: Single Line Diagram of Kitchener MTS #9

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