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REPORT

System Impact Assessment Report

Pointe Aux Roches Wind Farm

**CONNECTION ASSESSMENT &
APPROVAL PROCESS**

Final Report

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International Power Canada, Inc.

Market Facilitation Department

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System Impact Assessment Report

Pointe Aux Roches Wind Generation Project

Acknowledgement

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

Disclaimers

IESO

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

Approval of the proposed connection is based on information provided to the IESO by the connection applicant and the transmitter(s) at the time the assessment was carried out. The IESO assumes no responsibility for the accuracy or completeness of such information, including the results of studies carried out by the transmitter(s) at the request of the IESO. Furthermore, the connection approval is subject to further consideration due to changes to this information, or to additional information that may become available after the approval has been granted. Approval of the proposed connection means that there are no significant reliability issues or concerns that would prevent connection of the proposed facility to the IESO-controlled grid. However, connection approval does not ensure that a project will meet all connection requirements. In addition, further issues or concerns may be identified by the transmitter(s) during the detailed design phase that may require changes to equipment characteristics and/or configuration to ensure compliance with physical or equipment limitations, or with the Transmission System Code, before connection can be made.

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

HYDRO ONE

Special Notes and Limitations of Study Results

The results reported in this study are based on the information available to Hydro One, at the time of the study, suitable for a preliminary assessment of a new generation or load connection proposal.

The short circuit and thermal loading levels have been computed based on the information available at the time of the study. These levels may be higher or lower if the connection information changes as a result

of, but not limited to, subsequent design modifications or when more accurate test measurement data is available.

This study does not assess the short circuit or thermal loading impact of the proposed connection on facilities owned by other load and generation (including OPG) customers.

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

The ampacity ratings of Hydro One facilities are established based on assumptions used in Hydro One for power system planning studies. The actual ampacity ratings during operations may be determined in real-time and are based on actual system conditions, including ambient temperature, wind speed and facility loading, and may be higher or lower than those stated in this study.

The additional facilities or upgrades which are required to incorporate the proposed connection have been identified to the extent permitted by a preliminary assessment under the current IESO Connection Assessment and Approval process. Additional facility studies may be necessary to confirm constructability and the time required for construction. Further studies at more advanced stages of the project development may identify additional facilities that need to be provided or that require upgrading.

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POINTE AUX ROCHES WIND GENERATION PROJECT

IESO SYSTEM IMPACT ASSESSMENT

SIA Findings

International Power Canada is developing a new 48.6MW wind power generation farm in Lakeshore, Ontario. The project was awarded a contract under the government FIT program, and is expected to start commercial operation in July 2011.

Summary

This assessment examined the impact of injecting 48.6 MW of wind power generation to the provincial grid, via 115 kV circuit K6Z, on the reliability of the IESO-controlled grid.

The following conclusions and recommendations were made:

Conclusions and Recommendations

Conclusions:

The analysis concluded that:

- (1) The proposed wind farm does not have a material adverse impact on the reliability of the IESO-controlled grid.
- (2) The proposed project will not cause new violations of existing circuit breaker interrupting capabilities on the IESO-controlled grid.
- (3) Congestion is possible on the J3E/J4E circuits. The congestion is pre-existing but the proposed project could slightly increase it.
- (4) For all contingency cases tested with the proposed project in service, the voltage decline criteria are met.
- (5) With the proposed project in service, none of the recognized contingencies cause any material adverse impact to the transient performance of the IESO-controlled grid.
- (6) The reactive capability of the wind turbine generators along with the impedance between the wind turbine generators and the IESO-controlled grid results in a reactive power deficiency at the connection point.
- (7) Based on the information provided by the applicant, the fault ride through capability of the wind turbines is adequate.

Recommendations:

Since the Wind Farm Management System (WFMS) must coordinate the voltage control process, it is recommended that all WTGs control the PCC voltage to a reference value, reactive power compensation devices are automatically controlled/switched to regulate the overall WTGs' reactive power generation to around zero output, while the WF main transformer ULTC is adjusted to regulate the collector bus voltage such that it is within normal range. Once the WFMS description document is provided to the IESO, we will assess if the voltage control philosophy is acceptable.

IESO's Requirements for Connection

Transmitter Requirements

The following requirements are applicable for Hydro One for the incorporation of Pointe Aux Roches:

- (1) Change the relay settings of K6Z terminal stations to account for the effect of the wind farm.

Modifications to protection relays after this SIA is finalized must be submitted to IESO as soon as possible or at least six (6) months before any modifications are to be implemented. If those modifications result in adverse reliability impacts, the connection applicant and the transmitter must develop mitigation solutions.

Applicant Requirements

Specific Requirements: The following *specific* requirements are applicable to the applicant for the incorporation of Pointe Aux Roches. Specific requirements pertain to the level of reactive compensation needed, operation restrictions, Special Protection System, upgrading of equipment and any project specific items not covered in the *general* requirements:

- (1) The wind farm is required to have the capability to inject or withdraw reactive power continuously (i.e. dynamically) at a connection point up to 33% of its rated active power at all levels of active power output. Based on the equivalent parameters for the WF provided by the connection applicant, the IESO's simulations resulted in the following:
 - An overall reactive power deficiency of -16/+28.5Mvar, of which -16/+23.5Mvar represents dynamic reactive deficiency, was determined at the connection point. In order to meet the market rule requirements on reactive compensation:
 - A dynamic reactive compensation device of at least -16 /+23.5Mvar would have to be installed at the collector bus to provide the required dynamic reactive power capability for the facility.
 - In combination with the dynamic compensation device mentioned above, an additional static compensation device of +5Mvar would have to be installed at the collector bus to compensate for the losses within the facility.
 - The proponent plans to install a dynamic compensation device with a ± 8.75 Mvar continuous capability, accompanied by $4 \times +5$ Mvar static capacitors and a -6Mvar static reactor. This compensation arrangement will be acceptable to the IESO, since:

- The dynamic device has a temporary overload capability of ± 23.1 Mvar, hence it would satisfy the dynamic reactive compensation requirements.
 - The continuous capability of the dynamic device being only ± 8.75 Mvar, the 4 x +5 Mvar capacitors and the -6 Mvar reactor will ensure an overall reactive capability of +28.75/-14.75 Mvar at the collector bus, which will meet the overall reactive capability requirements.
 - The connection applicant has the obligation to ensure that the WF has the capability to meet the MR requirement at the connection point and be able to confirm this capability during the commission tests.
 - The static devices will need to be auto-switched via the Wind Farm Management System.
- (2) The applicant is required to provide a copy of the functionalities of the Wind Farm Management System (WFMS) to the IESO.

General Requirements: The proposed connection must comply with all the applicable requirements from the Transmission System Code (TSC), IESO Market Rules and standards and criteria. The most relevant requirements are summarized below and presented in more detail in Section 2 of this report.

- (1) The new generator must satisfy the Generator Facility Requirements in Appendix 4.2 of the Market Rules.
- (2) All 115 kV equipment must have a maximum continuous voltage rating and the ability to interrupt fault current at a voltage of at least 127 kV.
- (3) Any revenue metering equipment that is installed must comply with Chapter 6 of the Market Rules.
- (4) Equipment must sustain increase fault levels due to future system enhancements. Should future system enhancements result in fault levels exceeding equipment capability, the applicant is required to replace equipment at its own expense with higher rated equipment, up to 50 kA as per the Transmission System Code for the 115 kV system.
- (5) The 115 kV breakers must meet the required interrupting time of less than or equal to 5 cycles as per the Transmission System Code.
- (6) The connection equipment must be designed such that adverse effects due to failure are mitigated on the IESO-controlled grid.
- (7) The connection equipment must be designed for full operability in all reasonably foreseeable ambient temperature conditions.
- (8) The facility must satisfy telemetry requirements as per Appendices 4.15 and 4.19 of the Market Rules. The determination of telemetry quantities and telemetry testing will be conducted during the IESO Facility Registration/Market entry process.
- (9) Protection systems must satisfy requirements of the Transmission system code and specific requirements from the transmitter. New protection systems must be coordinated with existing

protection systems.

- (10) Protective relaying must be configured to ensure transmission equipment remains in service for voltages between 94% of minimum continuous and 105% of maximum continuous values as per Market Rules, Appendix 4.1.
- (11) Although the SIA has found that a Special Protection Scheme (SPS) is not required for Pointe Aux Roches, provisions must be made in the design of the protections and controls at the facility to allow for the installation of Special Protection Scheme equipment. Should a future SPS be installed to improve the transfer capability in the area or to accommodate transmission reinforcement projects, Pointe Aux Roches, will be required to participate in the SPS system and to install the necessary protection and control facilities to affect the required actions.
- (12) Protection systems within the generation facility must only trip appropriate equipment required to isolate the fault.
- (13) The autoreclosure of the new 115 kV breaker at the connection point must be blocked. Upon its opening for a contingency, it must be closed only after the IESO approval is granted. The IESO will require reduction of power generation prior to the closure of the breaker, followed by gradual increase of power to avoid a power surge.
- (14) The generator must operate in voltage control mode. The generation facility shall regulate automatically voltage at a point whose impedance (based on rated apparent power and rated voltage) is not more than 13% from the highest voltage terminal based within $\pm 0.5\%$ of any set point within $\pm 5\%$ of rated voltage. If the AVR target voltage is a function of reactive output, the slope $\Delta V / \Delta Q_{\max}$ shall be adjustable to 0.5%.
- (15) A disturbance monitoring device must be installed. The applicant is required to provide disturbance data to the IESO upon request.
- (16) Models and data, including any controls that would be operational, must be provided to the IESO through the IESO Facility Registration/Market Entry process at least seven months before energization to the IESO-controlled grid.
- (17) During the commissioning period, a set of IESO specified tests must be performed. The commissioning report must be submitted to the IESO within 30 days of the conclusion of commissioning. Field test results should be verifiable using the PSS/E models used for this SIA.
- (18) The registration of the new facilities will need to be completed through the IESO's Market Entry process before any part of the facility can be placed in-service. If the data or assumptions supplied for the registration of the facilities materially differ from those that were used for the assessment, then some of the analysis might need to be repeated.
- (19) The proposed facility must be compliant with applicable reliability standards set by the North American Electric Reliability Corporation (NERC) and the North East Power Coordinating Council (NPCC) prior to energization to the IESO controlled grid.
- (20) The applicant may need to meet the restoration participant criteria as per the NERC standard EOP-005. Further details can be found in section 3 of Market Manual 7.8 (Ontario Power System Restoration Plan).

Notification of Conditional Approval

From the information provided, our review concludes that the proposed changes will not result in a material adverse impact on the reliability of the IESO-controlled grid. It is recommended that a Notification of Conditional Approval be issued for Pointe Aux Roches subject to the requirements listed in this report being implemented.

1. Project Description

International Power Canada has proposed to develop a 48.6MW wind farm located in Lakeshore, Ontario, known as Pointe Aux Roches Wind Farm which has been awarded a Power Purchase Agreement under the FIT program with Ontario Power Authority. It is expected that commercial operation will start in July 2011.

Pointe Aux Roches will be connected to Hydro One's 115kV circuit K6Z via a 115/34.5kV OLTC 58MVA transformer located about 19km from Lauzon TS. The transformer will connect the 34.5kV collector bus which will connect two 34.5kV collector lines. The two lines will connect 27 wind turbines Vestas-V90-1.8MW 60Hz 690V VCUS, 14 turbines on the 1st line and 13 turbines on the 2nd. Each turbine will be connected through a 34.5/0.69kV 1.9MVA step up transformer.

Table 1 - Wind Farm layout.

Turbine Layout			
Collector	1	2	Total
Circuit ID	1	2	
Number of generators	14	13	27
Maximum MW	25.2MW	23.4MW	48.6MW
Maximum Mvar	0	0	0
Minimum. Mvar	0	0	0

– End of Section –

2. General Requirements

Generators

Each generator must satisfy the Generator Facility requirements in Appendix 4.2 of Market Rules.

The Market Rules (appendix 4.2) require that the generation facility directly connecting to the IESO-controlled grid must have the capability to operate continuously between 59.4Hz and 60.6Hz and for a limited period of time in the region above straight lines on a log-linear scale defined by the points (0.0s, 57.0Hz), (3.3s, 57.0Hz), and (300s, 59.0Hz).

The generators shall respond to frequency increase by reducing the active power with an average droop based on maximum active power adjustable between 3% and 7% and set at 4% . Regulation deadband shall not be wider than $\pm 0.06\%$. A sustained 10% change of rated active power after 10 s in response to a constant rate of change of frequency of 0.1%/s during interconnected operation shall be achievable.

The generators shall respond to frequency decline by temporary boosting their active power output by recovering energy from the rotating blades. It is not required for wind facilities to “spill” wind to provide a sustained response to frequency decline

The generators must be able to ride through routine switching events and design criteria contingencies assuming standard fault detection, auxiliary relaying, communication, and rated breaker interrupting times unless disconnected by configuration.

The generation facility directly connecting to the IESO-controlled grid must have the minimum capability to supply continuously all levels of active power output for 5% deviations in terminal voltage. Rated active power is the smaller output at either rated ambient conditions (e.g. temperature, head, wind speed, solar radiation) or 90% of rated apparent power. To satisfy steady-state reactive power requirements, active power reductions to rated active power are permitted. the generation facility must have the capability to inject or withdraw reactive power continuously (i.e. dynamically) at a *connection point* up to 33% of its rated active power at all levels of active power output except where a lesser continually available capability is permitted by the *IESO*.

If necessary, shunt capacitors must be installed to offset the reactive power losses within the facility in excess of the maximum allowable losses. If generators do not have dynamic reactive power capabilities as described above, dynamic reactive compensation devices must be installed to make up the deficient reactive power.

Connection Equipment (Breakers, Disconnects, Transformers, Buses)

1. Appendix 4.1, reference 2 of the Market Rules states that under normal conditions voltages are maintained within the range of 113 kV to 127 kV. Thus, the IESO requires that the 115 kV equipment in Ontario must have a maximum continuous voltage rating of at least 127 kV. Fault interrupting devices must be able to interrupt fault current at the maximum continuous voltage of 127 kV.

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. The Transmission System Code (TSC), Appendix 2 establishes maximum fault levels for the transmission system. For the 115 kV system, the maximum 3 phase symmetrical fault level is 50 kA and the single line to ground (SLG) symmetrical fault level is 50 kA.

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 the TSC's maximum fault level of 50 kA for the 115 kV system.

3. The connection equipment must be designed so that the adverse effects of failure on the IESO-controlled grid are mitigated.

4. The connection equipment must be designed so that it will be fully operational in all reasonably foreseeable ambient temperature conditions.

IESO Monitoring and Telemetry Data

In accordance with the telemetry requirements for a generation facility (see Appendices 4.15 and 4.19 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.

Protection Systems

1. Protection systems must be designed to satisfy all the requirements of the Transmission System Code as specified in Schedules E, F and G of Appendix 1 and any additional requirements identified by the transmitter. New protection systems must be coordinated with existing protection systems.

2. 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.

3. The Applicant is required to have adequate provision in the design of protections and controls at the facility to allow for future installation of Special Protection Scheme (SPS) equipment.

4. Any modifications made to protection relays by the transmitter after this SIA is finalized must be submitted to the IESO as soon as possible or at least six (6) months before any modifications are to be implemented on the existing protection systems. If those modifications result in adverse impacts, the connection applicant and the transmitter must develop mitigation solutions.

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

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

5. Protection systems within the generation facility must only trip the appropriate equipment required to isolate the fault. After the facility begins commercial operation, if an improper trip of the 115kV circuit K6Z occurs due to events within the facility, the facility may be required to be disconnected from the IESO-controlled grid until the problem is resolved.

Miscellaneous

1. The generators must operate in the voltage control mode. Operation of the facility in power factor control or reactive power control is not acceptable.

2. Connection Applicant is required to install at the facility a disturbance recording device with clock synchronization that meets the technical specifications provided by Hydro One. The device will be used to monitor and record the response of the facility to disturbances on the 115 kV system in order to verify the dynamic response of generators. The quantities to be recorded, the sampling rate and the trigger settings will be provided by Hydro One.

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 market 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.

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/connection applicant's market role/OEB licence can be found here:

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

In support of the NERC standard EOP-005, the proponent/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 proponent/ 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.

– End of Section –

3.Review of Connection Proposal

3.1 Proposed Connection Arrangement

The proposed connection arrangement is shown in Figure 1.

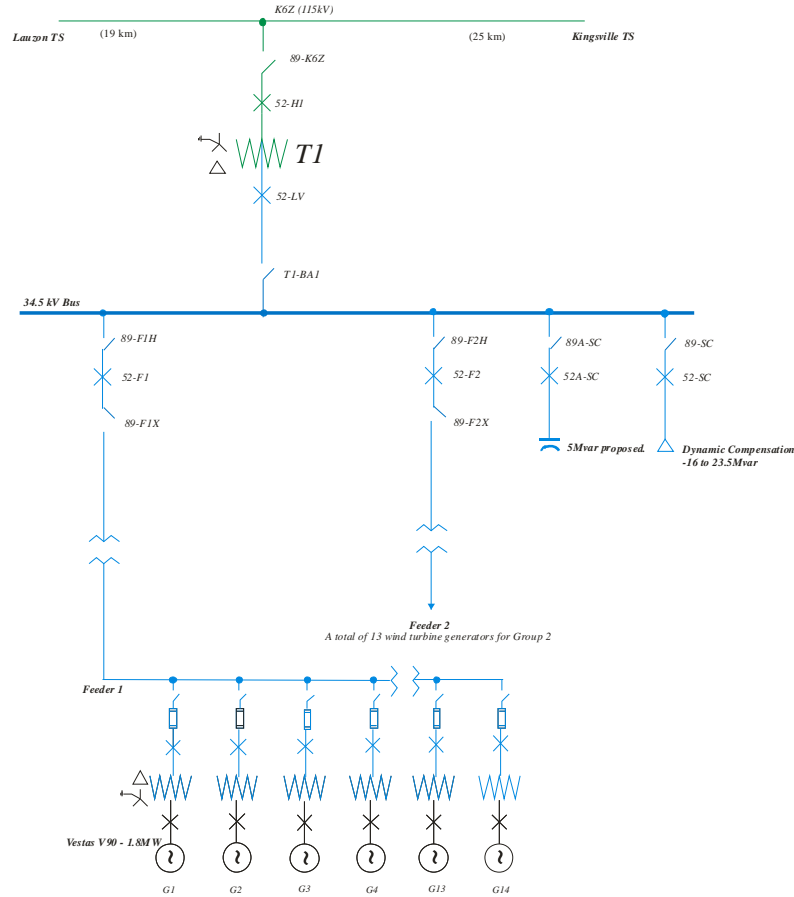


Figure 1: Proposed Connection Arrangement for Pointe Aux Roches

3.2 Existing System

The Windsor area is bounded by circuits C23Z and C24Z from Chatham to Lauzon, circuits C21J and C22J from Chatham to Keith and by circuit J5D from Keith to Michigan. The Windsor 115 kV area load is supplied from Lauzon 230/115 kV autotransformers T1 and T2, Keith 230/115 kV autotransformers T11 and T12, West Windsor, Windsor TransAlta, Brighton Beach, East Windsor Co-Generation, Gosfield Wind Farm as well as various embedded generating stations.

The Windsor 115 kV system, which is a sub-system of above area is considered, ‘closed’ when there is a continuous 115 kV transmission path between Lauzon TS and Keith TS. The Windsor 115 kV System is considered ‘open’ when the 115 kV transmission path between Lauzon TS and Keith TS is broken. Since the SIA is performed with all transmission elements in service, this assessment is limited to analyzing the closed Windsor 115 kV system configuration.

Pointe Aux Roches is proposed to connect to the existing Hydro One 115kV circuit K6Z between Lauzon TS and Kingsville TS.

The graphs below display the MW flow out K6Z, Lauzon TS. These are hourly average samples from Jan 1 to Dec 31, 2009 obtained from IESO real-time data. Positive values mean flow out of the station.

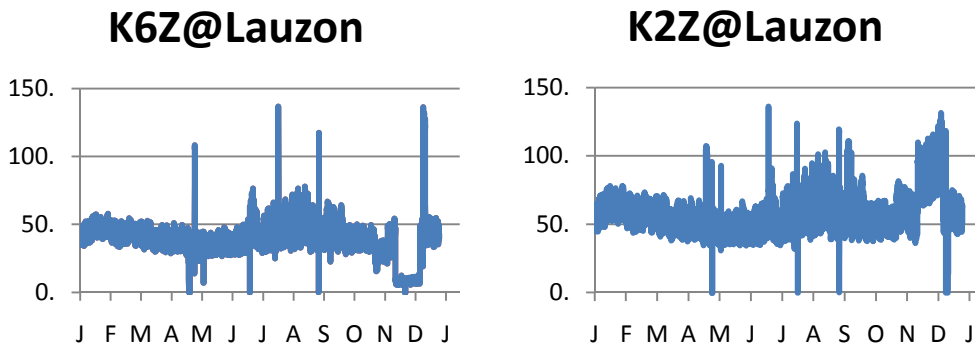


Figure 1: 2009 - MW flow on K6Z and K2Z.

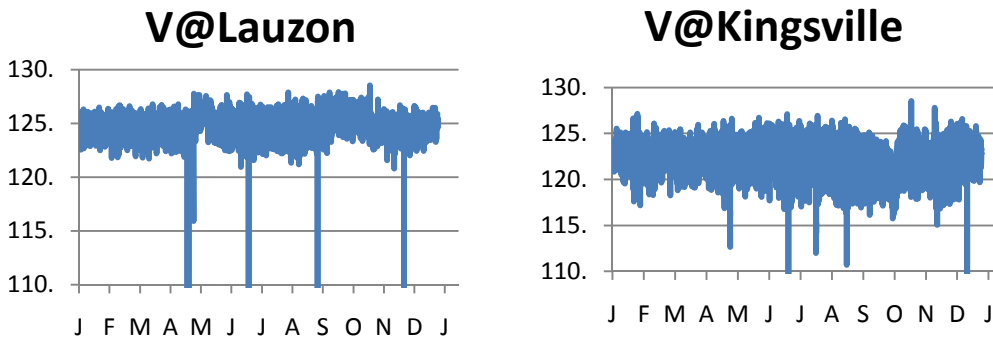


Figure 2: 2009 – Voltages (kV) at Lauzon and Kingsville where Pointe Aux Roches is to be located.

The above historical data was used in establishing study assumptions described in Section 6.1 of this report.

4. Data Verification

4.1 Tap Line

Specifications of the 115 kV tap line provided by the connection applicant are listed below.

Voltage	115 kV
Rating	120MVA (Summer Continuous), 180MVA (Summer Emergency)
Impedance	0.02107+0.08874j Ω
Charging	0.7419 m Ω
Length	200m

Treated as zero impedance in modeling.

The length of the tap line is short and treated as a zero impedance branch in the study.

4.2 Generator

Vestas V90 1.86MW Vestas Converter Unity System - Class I.
690V 3 Φ 60Hz Asynchronous with wound rotor.
Unity power factor.

Transformation	0.69/34.5 kV
Rating	1.9MVA
Impedance	0.078 on a base of 1.9MVA
Configuration	3 phase, high side: Δ , low side: Δ

4.3 Transformer

Specifications for the 34.5/115 kV step-up transformer is listed below.

Transformation	120/34.5 kV
Rating	58MVA (35/46/58; ONAN/ONAF/ONAF)
Impedance	0.08 on a base of 35 MVA
Configuration	3 phase, high side: Y, low side: Δ
Tapping	high side on-load tap changer (\pm 10% in 16 steps)

4.4 Circuit Breakers and Switches

Specifications of the isolation devices provided by the connection applicant are listed below.
Any missing data must be provided to the IESO.

Breakers and switches	LV	HV
Rated line-to-line voltage	34.5 kV	115 kV
Interrupting time (ms)	83.33	TBA
Rated continuous current (A)	2000	TBA
Rated short circuit breaking current (kA)	16	TBA

The connection applicant has not provided specifications for 115 kV breakers. The applicant must provide detailed information on the HV breaker and ensure it meets MR requirements.

4.5 Collector System

The 34.5 kV collector system equivalent circuit impedance provided by the connection applicant are listed as follows:

Feeder #	Equivalent Impedance(pu)	Charging (pu)
1	0.135+j0.391	0.00190
2	0.189+j0.548	0.00243

Per unit data are based on 100 MVA & 34.5 kV.

– End of Section –

5. Fault Level Assessment

Fault level studies were completed by Hydro One to examine the effects of the Pointe Aux Roches Wind Farm on fault levels at existing facilities in the area. Studies were performed to analyze the fault levels with and without Pointe Aux Roches and other proposed projects in the surrounding area. Studies were carried out with the following facilities and system assumptions:

Niagara, South West, West Zones:

- All hydraulic generation
- 6 Nanticoke
- 2 Lambton
- Brighton Beach (J20B/J1B)
- Greenfield Energy Centre (Lambton SS)
- St. Clair Energy Centre (L25N & L27N)
- East Windsor Cogen (E8F & E9F) + existing Ford generation
- TransAlta Sarnia (N6S/N7S)
- Imperial Oil (N6S/N7S)
- Thorold GS (Q10P)

Central, East Zones:

- All hydraulic generation
- 6 Pickering units
- 4 Darlington units
- 4 Lennox units
- GTAA (44 kV buses at Bramalea TS and Woodbridge TS)
- Sithe Goreway GS (V41H/V42H)
- Portlands GS (Hearn SS)
- Kingston Cogen
- TransAlta Douglas (44 kV buses at Bramalea TS)

Northwest, Northeast Zones:

- All hydraulic generation
- 1 Atikokan
- 2 Thunder Bay
- NP Iroquois Falls
- AP Iroquois Falls
- Kirkland Lake
- 1 West Coast (G2)
- Lake Superior Power

- Terrace Bay Pulp STG1 (embedded in Neenah paper)

Bruce Zone:

- 8 Bruce units (Bruce G1 and Bruce G2 maximum capacity @ 835 MW)
- 4 Bruce B Standby Generators

All constructed wind farms including:

- Erie Shores WGS (WT1T)
- Kingsbridge WGS (embedded in Goderich TS)
- Amaranth WGS – Amaranth I (B4V) & Amaranth II (B5V)
- Ripley WGS (B22D/B23D)
- Prince I & II WGS (K24G)
- Underwood (B4V/B5V)
- Kruger Port Alma (C24Z)
- Wolfe Island (injecting into X4H)

New Generation Facilities:

Committed wind generation:

- Greenwich Wind Farm (M23L and M24L)
- Gosfield Wind Project (K2Z)
- Kruger Energy Chatham Wind Project (C24Z)
- Raleigh Wind Energy Centre (C23Z)
- Talbot Wind Farm (W45LC)

Other committed generation projects:

- Greenfield South GS (R24C)
- Halton Hills GS (T38B/T39B)
- Oakville Generating Station (B15C/B16C)
- York Energy Centre (B82V/B83V)
- Island Falls (H9K)
- Becker Cogeneration (M2W)
- Wawatay G4 (M2W)
- Beck 1 G9: increase capacity to 68.5 MVA (Beck #1 115 kV bus)
- Lower Mattagami Expansion
- All renewable generation projects awarded FIT contracts

Transmission System Configuration:

Existing system with the following upgrades:

- Bruce x Orangeville 230 kV circuits up-rated
- Burlington TS: Rebuild 115 kV switchyards
- Leaside TS to Birch JCT: Build new 115 kV circuit. Birch to Bayfield: Replace 115 kV cables.
- Uprate circuits D9HS, D10S and Q11S

- Hurontario SS in service with R19T+V41H open from R21T+V42H (230 kV circuits V41H and V42H extended and connected from Cardiff TS to Hurontario SS). Hurontario SS to Jim Yarrow 2x3km 230 kV circuits in-service
- Cherrywood TS to Claireville TS: Unbundle the two 500 kV super-circuits (C551VP & C550VP)
- Allanburg x Middleport 230 kV circuits (Q35M and Q26M) installed
- Claireville TS: Reterminate circuit 230 kV V1RP to Parkway V71P Reterminate circuit 230 kV V72R to Cardiff(V41H)
- One 250 Mvar (@ 250 kV) shunt capacitor bank installed at Buchanan TS
- LV shunt capacitor banks installed at Meadowvale
- Modeling of Michigan system with short circuit equivalent provided by International Transmission Company (ITC).
- 1250 MW HVDC line ON-HQ in service
- Tilbury West DS second connection point for DESN arrangement using K2Z and K6Z
- Second 500kV Bruce-Milton double-circuit line in service. Double-circuit line from the Bruce Complex to Milton TS with one circuit originating from Bruce A and the other from Bruce B
- Windsor area transmission reinforcement:
 - 230 kV transmission line from Sandwich JCT (C21J/C22J) to Lauzon TS
 - New 230/27.6 DESN, Leamington TS, that will connect C21J and C22J and supply part of the existing Kingsville TS load
- Replace Keith 230/115 kV T11 and T12 transformers
- 115 kV circuits J3E and J4E upgrades
- Woodstock Area transmission reinforcement:
 - Karn TS in service and connected to M31W & M32W at Ingersol T
 - W7W/W12W terminated at LFarge CTS
 - Woodstock TS connected to Karn TS
- Nanticoke and Detweiler SVCs
- Series capacitors at Nobel SS in each of the 500 kV circuits X503 & X504E to provide 50% compensation for the line reactance
- Lakehead TS SVC
- Porcupine TS & Kirkland Lake TS SVC
- Porcupine TS: Install 2x125 Mvar shunt capacitors
- Essa TS : Install 250 Mvar shunt capacitor
- Hanmer TS: Install 149 Mvar shunt capacitor
- Pinard TS: Install 2x30 Mvar LV shunt capacitors
- Upper Mattagami expansion
- Fort Frances TS: Install 22 Mvar moveable shunt capacitor
- Dryden TS: Install shunt capacitors
- Lower Mattagami Expansion – H22D line extension from Harmon to Kipling.

System Assumptions:

- Lambton TS 230 kV operated open
- Claireville TS 230 kV operated open
- Leaside TS 230 kV operated open
- Leaside TS 115 kV operated open
- Middleport TS 230 kV bus operated open
- Hearn SS 115 kV bus operated open – as required in the Portlands SIA
- Napanee TS 230 kV operated open
- Cherrywood TS north & south 230kV buses operated open
- Cooksville TS 230 kV bus operated open

- Richview TS 230 kV bus operated open
- All capacitors in service
- All tie-lines in service and phase shifters on neutral taps
- Maximum voltages on the buses

The following table summarizes the symmetric fault levels near Windsor area and corresponding breaker ratings.

Table 2 - Short circuit results vs. breaker ratings - overloads are highlighted in red

Bus	Before – wind farm o/s				After – wind farm in service				Lowest Breaker Ratings (kA) (at max operational voltage)	
	3-phase Fault (kA)		L-G Fault (kA)		3-phase Fault (kA)		L-G Fault (kA)			
	Sym.	Asym.	Sym.	Asym.	Sym.	Asym.	Sym.	Asym.	Sym.	Asym.
Lauzon 115	25.151	29.223	27.768	34.090	26.029	30.294	29.497	36.153	39.3	40.2
Chatham 230	25.231	29.324	18.101	21.089	27.704	32.995	24.736	31.790	40	42.1
Keith 230	22.520	31.879	24.381	35.403	23.035	32.534	24.907	36.082	41.1	46.2
Keith 115	27.220	32.500	32.114	41.563	27.709	33.002	32.594	42.107	39.3	45
Essex 115	25.796	31.074	26.850	32.355	26.438	31.785	27.465	33.000	39.3	45.5
Lambton 230	43.305	60.811	48.482	70.38	43.482	61.041	48.653	70.593 ¹	63	66.3
Longwood 230	37.439	45.749	44.815	57.989	37.696	46.059	43.014	56.017	63	68.9
Buchanan 230	31.711	37.120	26.992	34.335	31.930	37.367	27.104	34.476	39.3	45

Based on the short circuit study results, there are no violations with the proposed project in service.

– End of Section –

¹ This value is greater than the capability of the Lambton unit breakers T4P and T3K of 66.3kA. In the worst case these breakers would trip for a fault on the generator side of the breaker. The contribution from the generator would then not be included in the total fault current that the breaker would see. The asymmetrical fault current contribution from Lambton G3 or G4 is approximately 9% of the overall fault levels on the Lambton 230 kV bus. Subtracting 9% from the total fault current (91% of 70kA) is 63.7kA, which is within the interrupting capability of the breaker of 66.3kA.

6. System Impact Studies

This connection assessment was carried out to identify the effect of the proposed facility on thermal loading of transmission interfaces in the vicinity, the system voltages for pre/post contingencies, the ability of the facility to control voltage and the transient performance of the system.

6.1 Assumptions and Background

System Conditions & Modeling Assumptions

Summer 2010 peak load conditions were the starting point for this study, along with the following assumptions:

- All transmission system elements were in service unless specified otherwise.
- The load in Windsor area (WAD) was scaled to 1000MW². This represents an average from the actual peaks that have been recorded in previous summers. With a fixed WAD the taps positions of the auto's at Lauzon and Keith were also fixed. Actual WAD is plotted below from 2005 to 2009.
- Loads are modeled as constant MVA pre and post-contingency, unless specified otherwise. When it is specified that loads are converted, a 50% constant current and 50% constant admittance model is used for the active power component and 100% constant admittance is used for the reactive power component.
- J5D is either importing 150MW or exporting 400MW as specified. Actual hourly interpolated data shows that J5D flow was recorded between +350MW (exporting) and -45MW (importing) 95% of the time. Actual 2009 J5D flows are plotted below.

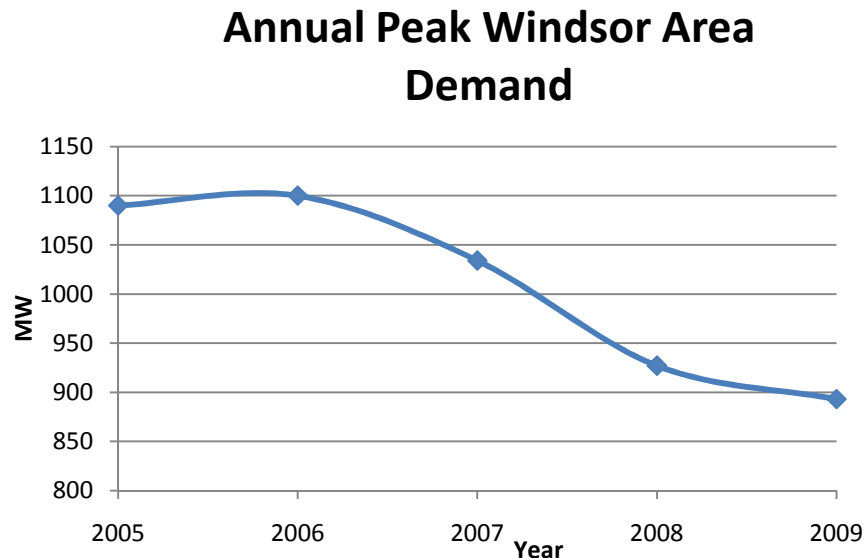


Figure 3 – Windsor demand trend from 2005 to 2009. Average 1000MW.

² The 2013 forecasted west zonal demand was applied evenly throughout the west zone. This resulted in a WAD of only 940MW. The WAD was increased to its historical average of 1000MW to apply additional stress to the case.

Hourly Interpolated J5D Flows 2009

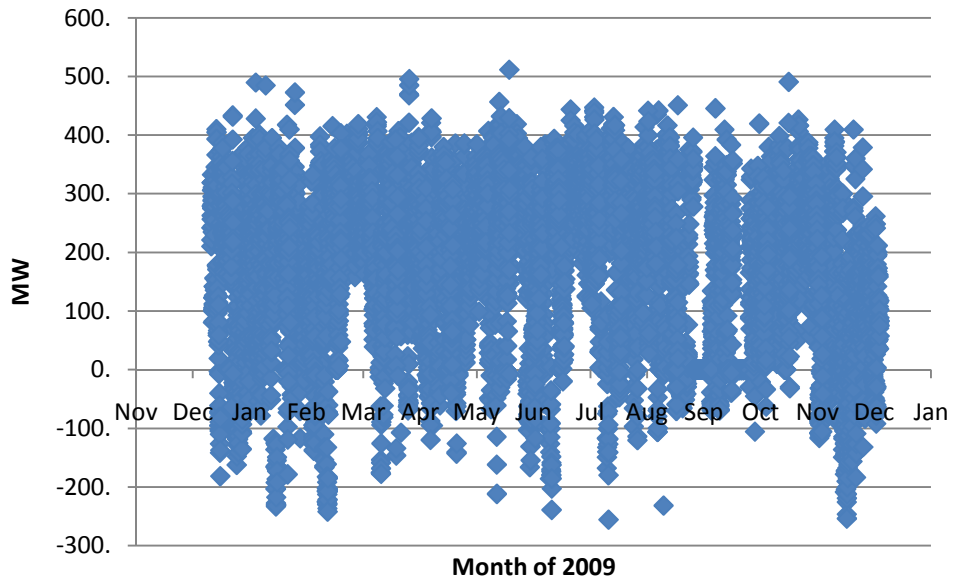


Figure 4 – J5D flow in 2009. 95% of values are between 350 to -45MW.

Table 3 – Distribution of WAD in study cases.

Station	P - MW	Q – Mvar (not including capacitive compensation)
Tilbury TS	5	2
Tilbury West DS	20	7
Kingsville	121 ³	55
Lemington	57	27
Walker EQ	76	36
Walker MTS2	98	43
Essex	55	22
Crawford	70	27
Keith BY	60	32
Malden Y	71	30
Malden B	73	32
Lauzon EJ	86	32
Lauzon BQ	100	27
Ford Keith	4	2
Chrysler	27	9
GM Windsor	5	3
Ford Windsor	18	10
Ford Essex	8	3
Belle River	36	14
Ford Annex	10	1
Total:	1000	415

- Leamington station is in service (CAA: 2008-318).
- Tilsbury West is connected with dual supply (CAA: 2008-332).
- The Auto's at Keith have been upgraded to 250MVA each (CAA: 2008-318).
- Lauzon TS is NOT yet reconfigured (CAA: 2008-318).
- The J3E/J4E circuits are NOT upgraded (CAA: 2008-318).
- Windsor Area SPS contingency based load rejection is armed as required at Kingsville.
- Keith capacitor is out of service.
- Raleigh, Port Alma I and II, Pointe Aux Roches are in service at full output.
- Comber East and West and Gosfield are at zero output.⁴
- Samsung Chatham in service at 240MW.

³ The load at Kingsville is expected to be halved when Leamington comes in service. This fact is omitted to account for any uncertainty with in-service dates and to create a "worst case" scenario to expose voltage stability and decline problems.

⁴ It is not likely that Pointe Aux Roches, Raleigh and Port Alma I&II will be at maximum output while Gosfield and Comber are at zero given they are all wind farms in the Windsor area. This is assumed here to develop a worst case thermal scenario by maximizing the loading on J3E/J4E.

Study Scenarios

Two scenarios were studied: J5D is either importing 150MW or exporting 400MW as specified. Adjustments were made to the J5D phase shifter and Brighton Beach generation to accommodate the desired flow of J5D.

Table 4 – Generation dispatch for study cases S1 & S2.

Transalta Windsor (TAWin)	East Windsor Cogeneration (EWCG)	West Windsor	Samsung	Comber E & W	Gosfield	Pointe Aux Roches	Raleigh and Port Alma
75	25+25	140	240	0	0	50	200+75

Case	Conditions	J5D (+ is out of Ontario)	Brighton Beach
S1	Importing	-155	50+50+50
S2	Exporting	395	200+170+150

Table 5 – Contingencies that were studied for voltage and thermal analysis.

Loss of Chatham Samsung	Loss of Brighton Beach	W44LC and/or W45LC
L28C and/or L29C	C21J and/or C22J	C23Z and/or C24Z
C24Z and/or C22J ⁵	C23Z and/or C21J	J5D
J2N	J1B + -50% in Brighton Beach steam output ⁶	J20B
J3E and/or J4E	K6Z and/or K2Z + Kingsville HV Switching Scheme	Z1E and/or Z7E
E8F and/or E9F	KeithT11 and T23 or KeithT12 and T22	Lauzon capacitor

Table 6 – Contingencies that were studied for dynamic analysis.

C21J and C22J double	C23Z and/or C24Z with and without LR	J3E and J4E double with and without LR
K2Z		

6.2 Protection Impact Assessment

A Protection Impact Assessment (PIA) was completed by Hydro One to examine the impact of the new generators on existing transmission system protections. The existing protections were described in the PIA report and the proposed protection settings were analyzed based on preliminary fault calculations. Finally, the proposed protection solutions and recommendations were presented.

There are no adverse reliability impacts caused the protection changes proposed in the PIA report.

⁵ As part of the upgrade to the Keith autos, Hydro One has proposed to add a breaker separating transformers T22 and T12 from C22J into two separate zones of protection. Therefore the loss of C22J no longer includes the loss of the T22/T12.

⁶ When the gas units have identical output, the loss or rejection of any one causes a rapid 50% reduction in power for the steam unit.

6.3 Special Protection System (SPS)

The SIA has found that a Special Protection Scheme (SPS) is not required for proposed project. However, provisions must be made in the design of the protections and controls at the facility to allow for the installation of Special Protection Scheme equipment. Should a future SPS be installed to improve the transfer capability in the area or to accommodate transmission reinforcement projects, the proposed project, will be required to participate in the SPS system and to install the necessary protection and control facilities to effect the required actions.

6.4 Reactive Power Compensation

Market Rules (MR) require that generators inject or withdraw reactive power continuously (i.e. dynamically) at a connection point up to 33% of its rated active power at all levels of active power output except where a lesser continually available capability is permitted by the IESO.

A generating unit with a power factor range of 0.90 lagging and 0.95 leading at rated active power connected via a main output transformer impedance not greater than 13% based on generator rated apparent power provides the required range of dynamic power at the connection point.

Typically, the impedance between the WTG and the connection point is larger than 13%. However, provided the WTG has the capability to provide a reactive power range of 0.90 lagging power factor and 0.95 leading power factor at rated active power, the IESO accepts the WF to compensate for the full reactive power requirement range at the connection point with switchable shunt admittances (e.g. capacitors and reactors). Where the WTG technology has no capability to supply the full dynamic reactive power range at its terminal, the shortfall has to be compensated with dynamic reactive power devices (e.g. SVC).

This section of the SIA indicates how the WF can meet the MR requirements regarding reactive power capability, but the connection applicant (CA) is free to deploy any other solutions which result in its compliance with the MR.

It is the CA's responsibility to ensure that the WF has the capability to meet the MR requirements at the connection point and be able to confirm this capability during the commission tests.

6.4.1 Dynamic Reactive Power Compensation

The following table summarizes the IESO's adequate level of reactive power from each generator and the available capability of Vestas V90 wind turbine generators, at rated terminal voltage and rated power.

Table 7 – Comparison of IESO requirements vs. Vestas V90 capability.

	Rated Voltage	Rated Active Power	Reactive Power Capability	Power Factor
IESO Requirements	400 V	1.8 MW	$Q_{\max} = 1.8 \times \tan [\cos^{-1} (0.9)] = 0.871 \text{ Mvar}$	0.9 lag
			$Q_{\min} = 1.8 \times \tan [\cos^{-1} (0.95)] = -0.592 \text{ Mvar}$	0.95 lead
Vestas - V90	400 V	1.8 MW	0 Mvar	NA
			0 Mvar	NA

The Vestas has no dynamic reactive capability and therefore cannot deliver the required dynamic reactive power. For 27 turbines the requirement is $0.871 \times 27 = 23.5 \text{ Mvar}$ & $-0.592 \times 27 = -16 \text{ Mvar}$.

A dynamic reactive device with a capability of **-16/+23.5 Mvar** has to be installed at the collector bus to compensate for the dynamic reactive power capability of the facility.

6.4.2 Static Reactive Power Compensation

In addition to the dynamic reactive power requirement identified above, the WF has to compensate for the reactive power losses within the facility to ensure that it has the capability to inject or withdraw reactive power up to 33% of its rated active power at the connection point. As mentioned above, the IESO accepts this compensation to be made with switchable shunt admittances.

Load flow studies were performed to calculate the need for static reactive compensation, based on the equivalent parameters for the WF provided by the connection applicant.

The reactive power capability in lagging p.f. of the generation facility was assessed under the following assumptions (outputting Mvar's):

- typical voltage of 121 kV at the connection point;
- maximum active power output from the turbine generators;
- maximum reactive power output from the dynamic reactive device assuming a maximum acceptable collect voltage of 1.05;

The reactive power capability in leading p.f. of the generation facility was assessed under the following assumptions (absorbing Mvar's):

- typical voltage of 121 kV at the connection point;
- minimum (zero) active power output from the turbine generators;

- maximum reactive power consumption from the dynamic reactive device, assuming a minimum acceptable collector voltage of 0.95;

The IESO's reactive power calculation used the equivalent electrical model for the WTG and collector feeders as provided by the connection applicant. It is very important that the WF has a proper internal design to ensure that the WTG are not limited in their capability to produce active and reactive power due to terminal voltage limits or other facility's internal limitations. For example, it is expected that the transformation ratio of the WTG step up transformers will be set in such a way that it will offset the voltage profile along the collector, and all the WTG would be able to contribute to the reactive power production of the WF in a shared amount.

Based on the equivalent parameters for the WF provided by the connection applicant, **+5Mvar** of static reactive power compensation would be required at the WF collector bus to meet the reactive power requirements assuming that a dynamic device of -16/+23.5Mvar was also installed. Thus the total static reactive requirement is +28.5Mvar and -16Mvar.

The proponent plans to install a dynamic compensation device with a ± 8.75 Mvar continuous capability, accompanied by $4 \times +5$ Mvar static capacitors and a -6Mvar static reactor. This compensation arrangement will be acceptable to the IESO.

The dynamic device has a temporary overload capability of ± 23.1 Mvar, hence it would satisfy the dynamic reactive compensation requirements.

The continuous capability of the dynamic device being only ± 8.75 Mvar, the $4 \times +5$ Mvar capacitors and the -6Mvar reactor will ensure an overall reactive capability of $+28.75/-14.75$ Mvar at the collector bus, which will meet the overall reactive capability requirements.

The connection applicant has the obligation to ensure that the WF design and the reactive power compensation system takes into account the real electrical parameters and real limitations within the WF facility.

During commissioning tests, the proponent will be required to prove the reactive power compensation arrangement meets the requirements.

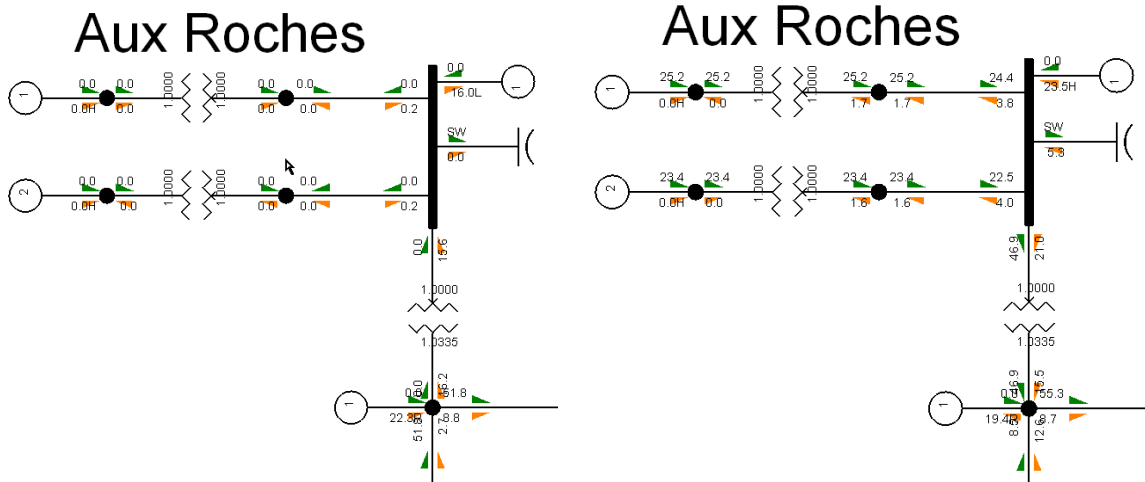


Figure 5 - Graphical load flow results demonstrating static reactive requirements

6.4.3 Static Reactive Power Switching

A switching study was carried out to investigate the effect of the new LV shunt capacitor banks on the voltage changes. It was assumed that the largest capacitor step size is 5Mvar.

Table 8 - Voltage change due to capacitor switching.

Capacitor at LV kV bus	LV bus voltage	ICG connection point
Pre-switching	32.9 kV	119.5 kV
Post-switching	33.3 kV	120.0 kV
ΔV	1.2%	0.4%

Table 9 - Voltage change due to reactor switching.

Capacitor at LV kV bus	LV bus voltage	ICG connection point
Pre-switching	33.9	120.8
Post-switching	33.2	120.2
ΔV	-2.1%	-0.5%

The IESO requires the voltage change on a single capacitor switching to be no more than 4 % at the any point in the ICG. The results show that switching a single capacitor of 5Mvar or a reactor of 8Mvar produces less than 4 % voltage change at the connection point.

The IESO has no restrictions on voltage changes within the WF facility. However, if the equipment within the proposed facility is sensitive to voltage changes, small enough shunt capacitor size steps have to be designed to cater to the facility needs.

6.5 Wind Farm Management System

If the generation facility connects to the IESO-controlled grid, the IESO requires that the facility assists maintaining voltage in the high voltage system. It is expected that the wind farm controls the voltage at a point as close as possible to the connection point to values specified by the IESO. This requires that wind farms possess the ability to supply sufficient dynamic reactive power to the high voltage system during voltage declines.

The generation facility shall regulate automatically voltage at a point whose impedance (based on rated apparent power and rated voltage) is not more than 13% from the highest voltage terminal based within $\pm 0.5\%$ of any set point within $\pm 5\%$ of rated voltage. If the AVR target voltage is a function of reactive output, the slope $\Delta V / \Delta Q_{max}$ shall be adjustable to 0.5%.

The Wind Farm Management System (WFMS) must coordinate the voltage control process. The IESO recommend the following two voltage control schemes:

Option #1

- (1) All WTGs control the PCC voltage to a reference value. A control slope is applied for reactive power sharing among the WTGs as well as with adjacent generators.
- (2) Capacitor banks are automatically switched in/out to regulate the overall WTGs' reactive generation to around zero output.
- (3) WF main transformer ULTC is adjusted to regulate the collector bus voltage (LT bus voltage) such that it is within normal range;

Option #2

- (1) The capacitor banks are automatically switched in/out according to the WF active power output. A sample capacitor switching scheme is shown in the following table.

P - overall WF active power output	Capacitor banks to be switched on
$0 < P < P_1$	(No capacitor)
$P_1 < P < P_2$	C_1
$P_2 < P < P_3$	$C_1 + C_2$
.....
$P_N < P < P_{MAX}$	$C_1 + C_2 + \dots + C_N$

- (2) All WTGs control the PCC voltage to a reference value. A control slope is applied for reactive power sharing among the WTGs as well as with adjacent generators.

The proponent has chosen option #2 and must submit a description of the functionalities of the WFMS, including the coordination between the automatic capacitor switching and generator reactive power production to control the voltage at a desired point. This document also must contain the settings of the automatic capacitor switching scheme. If the WFMS is unavailable, the IESO requires each generator controls its own terminal voltage.

6.6 Thermal Analysis

The assessment examined the effect the proposed facility would have on the thermal loadings of the Windsor area transmission elements.

The *Ontario Resource and Transmission Assessment Criteria* requires that all line and equipment loads be within their continuous ratings with all elements in service, and within their long-term emergency ratings with any element out of service. Lines and equipment may be loaded up to their short-term emergency ratings immediately following the contingencies to effect re-dispatch, perform switching, or implement control actions to reduce the loading to the long-term emergency ratings.

Impact of the Pointe Aux Roches project:

The following are the pre-contingency flows for various circuits in Windsor area prior to and after the connection of Pointe Aux Roches. When Pointe Aux Roches generation is placed in service, it is assumed that EWCG is displaced (or shifted) out of service. Studies indicated that this represented the worst case thermal scenario because it increases the flows expected during peak conditions on the J3E/J4E circuits where thermal overloading is most likely.⁷

Table 10 – 48.6MW shift Pointe Aux Roches vs. EWCG

Circuit	Pre Shift MW	Post Shift MW	Distribution
K6Z@Lauzon	49.1	9.7	-81%
K2Z@Lauzon	91	81.8	-19%
Kingsville T4+T2	33.5+32.7	35.7+35	4.7%+4.6%
BelleRiver T2	15.6	18.8	6.6%
Tilsbury T2	11.6	13.1	3%
Z1E@Lauzon	-5.4	17.5	47%
Z7E@Lauzon	-7.2	15.7	47%
J3E@Keith	127.3	128.7	3%
J4E@Keith	130.0	131.4	3%
C23Z@Chatham	65.3	63.9	-3%
C24Z@Chatham	-18.5	-19.9	-3%
C21J@Chatham	113.1	114.5	3%
C22J@Chatham	112.3	113.8	3%

Examination of the tabular results above demonstrate that, during some system conditions, the proposed project could slightly aggravate the overloading condition already present on the J3E/J4E circuits.

⁷ Assuming that renewable generation is most likely to displace fossil, other displacements are also possible such as Pointe Aux Roches vs. Brighton Beach or Pointe Aux Roches vs. Lambton. These displacements were disregarded because they did not increase (but rather decrease) the loading on J3E/J4E.

Results demonstrate that in the situations where Kingsville transformer T4 or T2 is out of service output from Pointe Aux Roches could cause pre-contingency overloading⁸ on the companion transformer. Operational measures may have to be employed to address this concern.

⁸ The situation which creates this overload is unlikely. As per the assumptions of this study, the situation would be generous winds surrounding Point Aux Roches, while Gosfield has no wind and peak summer conditions at Kingsville during a transformer outage. Nonetheless, should this overload occur, mitigating measures may include reducing output from Pointe Aux Roches, dispatching Kingsville generation GenSet or load transfers to Leamington.

Contingency analysis:

Contingency analysis with Pointe Aux Roches in service was performed to ensure that transmission elements would remain within their emergency ratings and to determine which contingencies would require arming of the Windsor Area SPS. A summary of the thermal analysis results is presented in the tables below; more detailed numerical results can be found in Table 17 in Appendix B.

Table 11 : S1; Importing – Overloaded elements and Windsor Area SPS arming required to relieve.

Contingency	Overloaded element(s) with Windsor Area SPS unarmed	Overloaded element(s) with Windsor Area SPS armed	Mode armed
J3E	J4E	none	100% of Kingsville load and/or Brighton Beach 115kV rejection (plus 50% reduction in Brighton Beach steam output).

Table 12: S2; Exporting – Overloaded elements and Windsor Area SPS arming required to relieve.

Contingency	Overloaded element(s) with Windsor Area SPS unarmed	Overloaded element(s) with Windsor Area SPS armed	Mode armed
J3E	J4E	none	100% of Kingsville load and/or Brighton Beach 115kV rejection (plus 50% reduction in Brighton Beach steam output).

The results of the thermal analysis show that there are overloads on the J3E/J4E circuits. These concerns pre-exist the Point-Aux-Roches project and are temporary as Hydro One has improvement plans in the area. While it is possible that for a specific dispatch Point-Aux-Roches slightly increases the loading on these circuits, that increase is negligible (3%) and other dispatches are possible that reduce the loading. In some situations it may be necessary to vary the dispatch to reduce the loading on J3E/J4E and/or arm the Windsor Area SPS.

In conclusion, addition of the proposed project does not result in material adverse impact on the thermal performance of the IESO-controlled grid.

6.7 Voltage Analysis

The assessment of the voltage performance in the Windsor area was done in accordance with the IESO’s *Ontario Resource and Transmission Assessment Criteria*. The criteria states that with all facilities in service pre-contingency, 230 kV, 115 kV, 44-13.8kV system voltage declines following a contingency

shall be limited to 10% before and after transformer tap changer action, and absolute maximums and minimums of 250-207kV, 127-108kV and 112%-88% of nominal, respectively. The 44-13.8kV system voltages are further limited to 5% voltage decline after tap changer action.

The voltage decline studies were performed with the Pointe Aux Roches facility in service as per the scenario table discussed above. Loads were not converted and represented as constant MVA models both pre-and post-contingency. A summary of the voltage analysis results is presented in the tables below; more detailed numerical results can be found in Table 16 in Appendix B.

Table 13: S2; Importing - voltage violations and required Windsor Area SPS arming to relieve.

Contingency	violation with Windsor Area SPS unarmed	violation with Windsor Area SPS armed	Mode armed
K2Z, K6Z	Excessive Pre-ULTC decline @ Kingsville and Tilsbury.	none	50 or 100% of Kingsville load rejection
Z1E+Z7E	Overvoltage pre-ULTC throughout the K6Z/K2Z area.	none	Lauzon capacitor tripping

Table 14: S1; Exporting - voltage violations and required Windsor Area SPS arming to relieve.

Contingency	violation with Windsor Area SPS unarmed	violation with Windsor Area SPS armed	Mode armed
K2Z, K6Z	106kV post ULTC @ Kingsville	none	50 or 100% of Kingsville load rejection
Z1E+Z7E	Overvoltage pre-ULTC throughout the K6Z/K2Z area.	none	Lauzon capacitor tripping

Excessive voltage decline can be seen for the loss of either the K6Z/K2Z circuits. This problem pre-exists Pointe-Aux-Roches and there are plans in place to relieve the loading at Kingsville by transferring load to Leamington TS. Results demonstrate that the Windsor Area SPS can remove concerns regarding post-contingency voltage violations. Voltage performance can also be improved by activating Transalta Windsor and EWCG generation which are assumed out of service in the study cases.

In conclusion, addition of the Pointe Aux Roches project does not result in material adverse impact on the voltage performance of the IESO-controlled grid.

6.8 Transient Analysis

Transient analyses was performed considering faults in Windsor area with the proposed project modeled in-service along with a ± 8.75 Mvar device installed on its collector bus (the manufacturer provided the dynamic model). Each equivalent wind turbine generator was assumed to be producing 25MW with a power factor of 1. All contingencies studied were three-phase faults cleared with normal fault clearing times. Double circuit contingencies were simulated as three phase faults occurring on two both circuits simultaneously. As necessary, Windsor Area SPS action was also simulated.

Contingencies	Performed on Case
C21J+C22J	S4
C23Z with and without LR	S3
C24Z with and without LR	S3
C23Z+C24Z with and without LR	S3
J3E+J4E with LR	S4
K2Z	S3

Two study scenarios were considered: all elements in service and C24Z out of service. In both cases all Windsor generation was maximized including all fossil and renewable generation, J5D was 400MW out of Ontario and the total Windsor area demand was 1000MW. Generation on C24Z is transferred to C23Z as necessary.

J5D (+ is out of Ontario)	Brighten Beach	TAWin	EWCG	West Windsor	Samsung	Point Aux Roches	Other wind	WAD
395	200+170+150	75	40+40	140	240	50	490	1000

Case	Conditions
S3	All in service
S4	C24Zos

The transient simulation plots are shown in Appendix C. The transient simulation results show that none of the simulated contingencies caused transient instability or undamped oscillations. All results show gradual attenuation of the oscillations. In conclusion, addition of the proposed project does not result in material adverse impact on the transient performance of the IESO-controlled grid.

6.9 Low-voltage ride through capability

As any other generators, the Vestas WTG is expected to trip only for contingencies which remove the generator by configuration or abnormal conditions such as severe and sustained under-voltage, over-voltage, under-frequency, over-frequency etc. The severity of under-voltage seen by the generator terminals is to be temporarily mitigated by the low voltage ride through (LVRT) capability.

In order to test the adequacy of the LVRT capability, three phase faults on K2Z, C23Z and C23Z with normal clearing time was simulated. These contingency are electrically close to the proposed project, and have the greatest impact on its terminal voltage. Based on the plots we can see that the terminal voltages remain well within the LVRT capability.

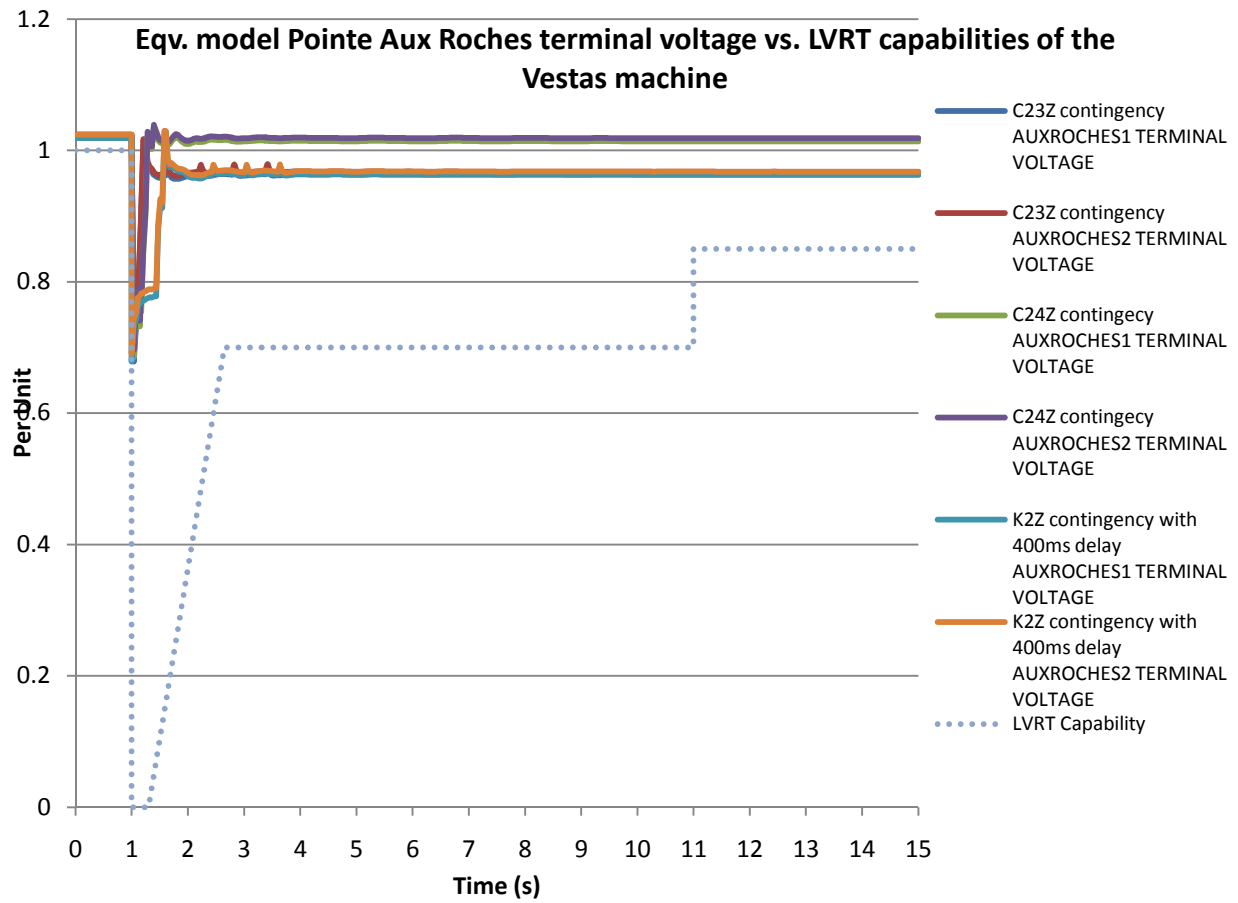


Figure 4: Terminal Voltage of Wind Generator During 3-phase fault at Lauzon TS

The new generating facility is required to ride through routine switching events and design criteria contingencies assuming standard fault detection, auxiliary relaying, communication, and rated breaker interrupting times, unless disconnected by configuration.

The LVRT capability must be demonstrated during commissioning by monitoring several variables under a set of IESO specified field tests and the result should be verifiable using the PSS/E model.

– End of Report –

Appendix A Market Rules: Appendix 4.2

Appendix 4.2 – Generation Facility Requirements

The performance requirements set out below shall apply to *generation facilities* subject to a *connection assessment* finalized after March 6, 2010. Performance of alternative technologies will be compared at the point of connection to the *IESO-controlled grid* with that of a conforming conventional synchronous *generation unit* with an equal apparent power rating to determine whether a requirement is satisfied.

Each *generation facility* that was authorized to connect to the *IESO-controlled grid* prior to March 6, 2010 shall remain subject to the performance requirements in effect for each system at the time of its authorization to connect to the *IESO-controlled grid* was granted or as agreed to by the *market participant* and the *IESO* (i.e. the “original performance requirements”). These requirements shall prevail until the main elements of an associated system (e.g. governor control mechanism, main exciter) are replaced or substantially modified. At that time, the replaced or substantially modified system shall meet the applicable performance requirements set out below. All other systems, not affected by replacement or substantial modification, shall remain subject to the original performance requirements.

Category	Generation facility directly connected to the IESO-controlled grid, generation facility greater than 50 MW, or generation unit greater than 10 MW shall have the capability to:
1. Off-Nominal Frequency	Operate continuously between 59.4 Hz and 60.6 Hz and for a limited period of time in the region above straight lines on a log-linear scale defined by the points (0.0 s, 57.0 Hz), (3.3 s, 57.0 Hz), and (300 s, 59.0 Hz).
2. Speed/Frequency Regulation	Regulate speed with an average droop based on maximum active power adjustable between 3% and 7% and set at 4% unless otherwise specified by the IESO. Regulation deadband shall not be wider than $\pm 0.06\%$. Speed shall be controlled in a stable fashion in both interconnected and island operation. A sustained 10% change of rated active power after 10 s in response to a constant rate of change of speed of 0.1%/s during interconnected operation shall be achievable. Due consideration will be given to inherent limitations such as mill points and gate limits when evaluating active power changes. Control systems that inhibit governor response shall not be enabled without IESO approval.
3. Low Voltage Ride Through	Ride through routine switching events and design criteria contingencies assuming standard fault detection, auxiliary relaying, communication, and rated breaker interrupting times unless disconnected by configuration.
Category	Generation facility directly connected to the IESO-controlled grid shall have the capability to:
4. Active Power	Supply continuously all levels of active power output for 5% deviations in terminal voltage. Rated active power is the smaller output at either rated ambient conditions (e.g. temperature, head, wind speed, solar radiation) or 90% of rated apparent power. To satisfy steady-state reactive power requirements, active power reductions to rated active power are permitted.
5. Reactive Power	Inject or withdraw reactive power continuously (i.e. dynamically) at a <i>connection point</i> up to 33% of its rated active power at all levels of active power output except where a lesser continually available capability is permitted by the IESO. A conventional synchronous unit with a power factor range of 0.90 lagging and 0.95 leading at rated active power connected via a main output transformer impedance not greater than 13% based on generator rated apparent power is acceptable.
6. Automatic Voltage Regulator (AVR)	Regulate automatically voltage within $\pm 0.5\%$ of any set point within $\pm 5\%$ of rated voltage at a point whose impedance (based on rated apparent power and rated voltage) is not more than 13% from the highest voltage terminal. If the AVR target voltage is a function of reactive output, the slope $\Delta V / \Delta Q_{max}$ shall be adjustable to 0.5%. The equivalent time constants shall not be longer than 20 ms for voltage sensing and 10 ms for the forward path to the exciter output. AVR reference compensation shall be adjustable to within 10%

	of the unsaturated direct axis reactance on the unit side from a bus common to multiple units.
7. Excitation System	Provide (a) Positive and negative ceilings not less than 200% and 140% of rated field voltage at rated terminal voltage and rated field current; (b) A positive ceiling not less than 170% of rated field voltage at rated terminal voltage and 160% of rated field current; (c) A voltage response time to either ceiling not more than 50 ms for a 5% step change from rated voltage under open-circuit conditions; and (d) A linear response between ceilings. Rated field current is defined at rated voltage, rated active power and required maximum continuous reactive power.
8. Power System Stabilizer (PSS)	Provide (a) A change of power and speed input configuration; (b) Positive and negative output limits not less than $\pm 5\%$ of rated AVR voltage; (c) Phase compensation adjustable to limit angle error to within 30° between 0.2 and 2.0 Hz under conditions specified by the IESO, and (d) Gain adjustable up to an amount that either increases damping ratio above 0.1 or elicits exciter modes of oscillation at maximum active output unless otherwise specified by the IESO. Due consideration will be given to inherent limitations.
9. Phase Unbalance	Provide an open circuit phase voltage unbalance not more than 1% at a <i>connection point</i> and operate continuously with a phase unbalance as high as 2%.
10. Armature and Field Limiters	Provide short-time capabilities specified in IEEE/ANSI 50.13 and continuous capability determined by either field current, armature current, or core-end heating. More restrictive limiting functions, such as steady state stability limiters, shall not be enabled without IESO approval.
11. Performance Characteristics	Exhibit <i>connection point</i> performance comparable to an equivalent synchronous <i>generation unit</i> with characteristic parameters within typical ranges. Inertia, unsaturated transient impedance, transient time constants and saturation coefficients shall be within typical ranges (e.g. $H > 1.2$ Aero-derivative, $H > 1.2$ Hydraulic less than 20 MVA, $H > 2.0$ Hydraulic 20 MVA or larger, $H > 4.0$ Other synchronized units, $X'd < 0.5$, $T'do > 2.0$, and $S1.2 < 0.5$) except where permitted by the IESO.

Appendix B Load Flow Simulation Result Tables

Table 15 - Detailed voltage decline results (%) showing the most important buses and contingencies

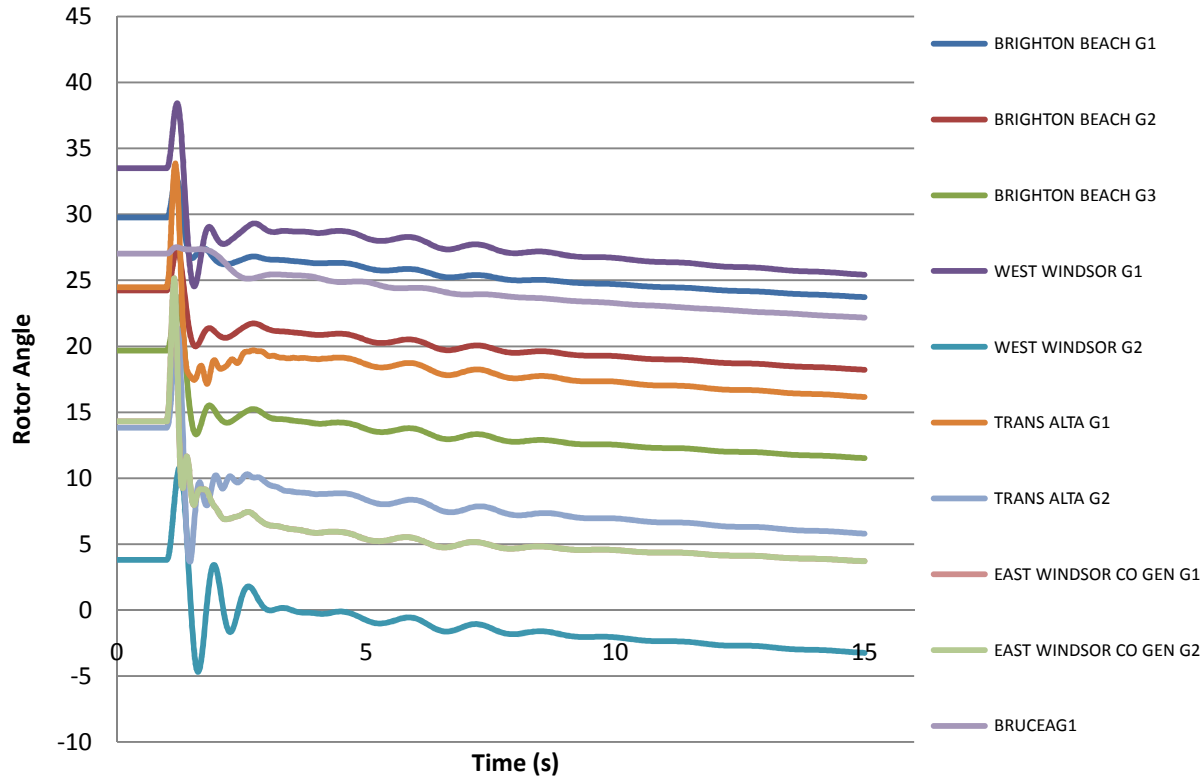
Bus	BELLE_RIV_TS27.600		CHATHAM_SS 220.00		ESEX_TS 118.05		KEITH_TS 118.05		KEITH_TS 220.00		KINGSVIL_K2Z118.05		KINGSVIL_K6Z118.05		KINGSVILLE 27.600		LAUZON_TS 118.05		TILB_WEST_B127.600		TILBURY_TS 27.600	
	pre ultc	post ultc	pre ultc	post ultc	pre ultc	post ultc	pre ultc	post ultc	pre ultc	post ultc	pre ultc	post ultc	pre ultc	post ultc	pre ultc	post ultc	pre ultc	post ultc	pre ultc	post ultc	pre ultc	post ultc
C21J	0	0	0	0	0	0	0	0	0	-1	0	0	0	0	0	0	0	0	0	0	0	0
C21J_C22J	0	0	1	1	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0
C22J	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0
C23Z	-2	1	0	0	-1	-1	0	0	0	0	-2	-2	-2	-2	-3	1	-2	-2	-2	0	-2	1
C23Z_LR	0	1	0	0	-1	0	0	0	0	0	2	3	3	3	3	2	-1	-1	0	1	1	1
C24Z	-2	1	0	0	-1	-1	0	0	0	0	-3	-2	-3	-2	-3	1	-2	-2	-2	0	-3	0
C24Z_C22J	-2	1	0	0	-1	-1	0	0	0	0	-3	-2	-3	-2	-3	1	-2	-2	-3	0	-3	0
C24Z_C23Z	-3	0	1	1	-2	-1	0	0	0	0	-3	-2	-3	-2	-3	2	-2	-2	-3	1	-3	1
C24Z_C23Z_LR	-1	2	1	1	-1	-1	0	0	0	0	2	2	2	2	3	3	-1	-1	0	0	0	0
C24Z_GR_LR	0	0	0	0	0	0	0	0	0	0	4	4	4	3	7	3	-1	-1	1	1	1	1
J3E	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0
J3E_GR_LR	2	2	0	0	1	1	0	0	0	0	4	4	5	5	5	2	1	1	2	1	3	0
J4E	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0
J4E_J3E	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0
J4E_J3E_LR	3	0	0	0	2	2	0	0	0	0	6	6	6	5	7	2	2	2	4	0	4	2
J4E_J3E_LR_SPLIT	6	2	1	1	5	5	0	0	0	0	9	9	9	7	9	2	5	4	7	0	7	2
K2Z	-8	1	0	0	-1	0	0	0	0	0	-8	-9	-8	-8	-8	1	-1	0	-10	0	N/A	N/A
K2Z_LR	1	0	0	0	1	1	0	0	0	0	5	4	7	5	10	3	1	1	-1	0	N/A	N/A
K6Z	-2	2	0	0	-1	0	0	0	0	0	-8	-7	-8	-6	-8	2	-1	0	-10	0	-7	-1
K6Z_K2Z	N/A	N/A	0	0	1	1	0	0	0	0	N/A	N/A	N/A	N/A	N/A	N/A	1	1	N/A	N/A	N/A	N/A
K6Z_LR	0	0	0	0	0	0	0	0	0	0	3	3	5	5	4	1	1	1	-2	0	1	1
Z1E	0	0	0	0	-1	-1	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0
Z7E	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0
Z7E_Z1E	11	0	1	1	-1	-1	0	0	0	0	-8	-8	-8	8	-8	3	-8	8	-8	0	-8	2
Z7E_Z1E_SHUNTR	3	0	0	0	-1	-1	0	0	0	0	4	3	4	3	4	0	3	2	4	-1	4	0

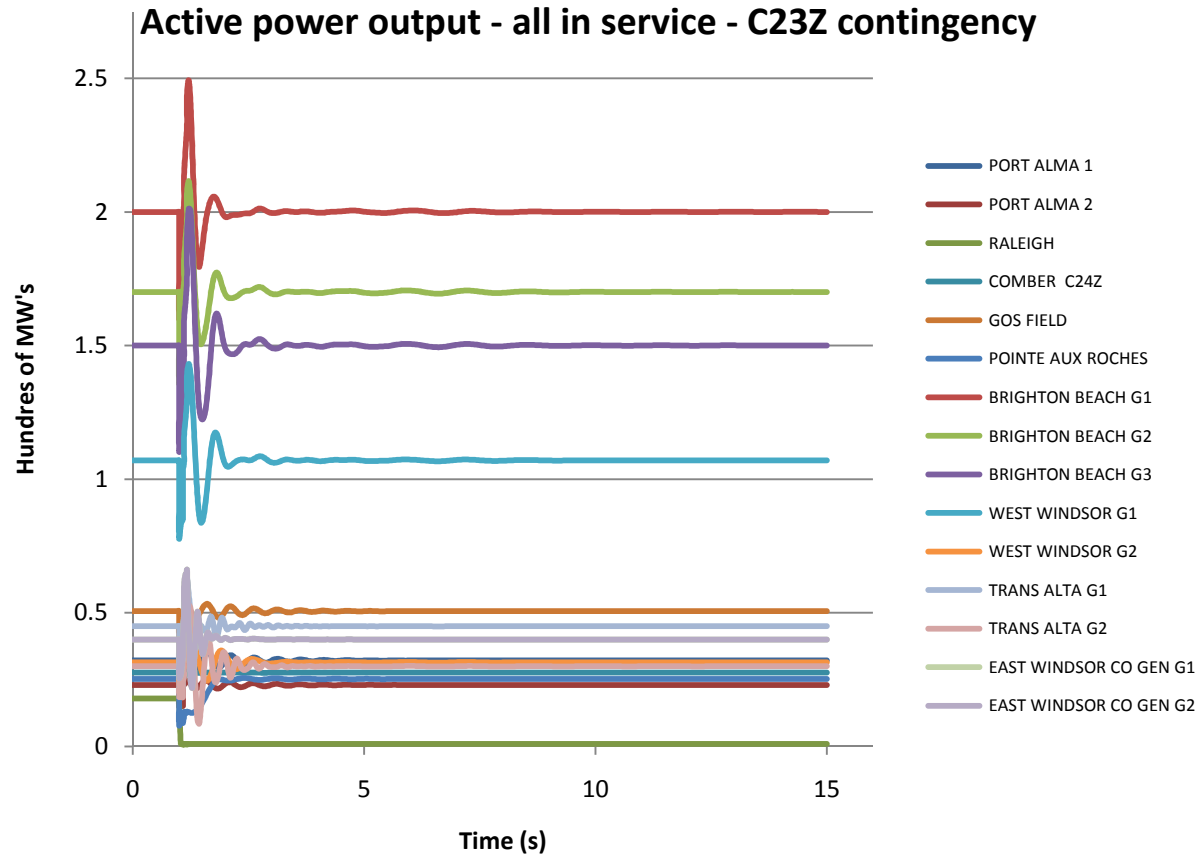
Table 16 - Detailed thermal results (%) showing the most important branches and contingencies

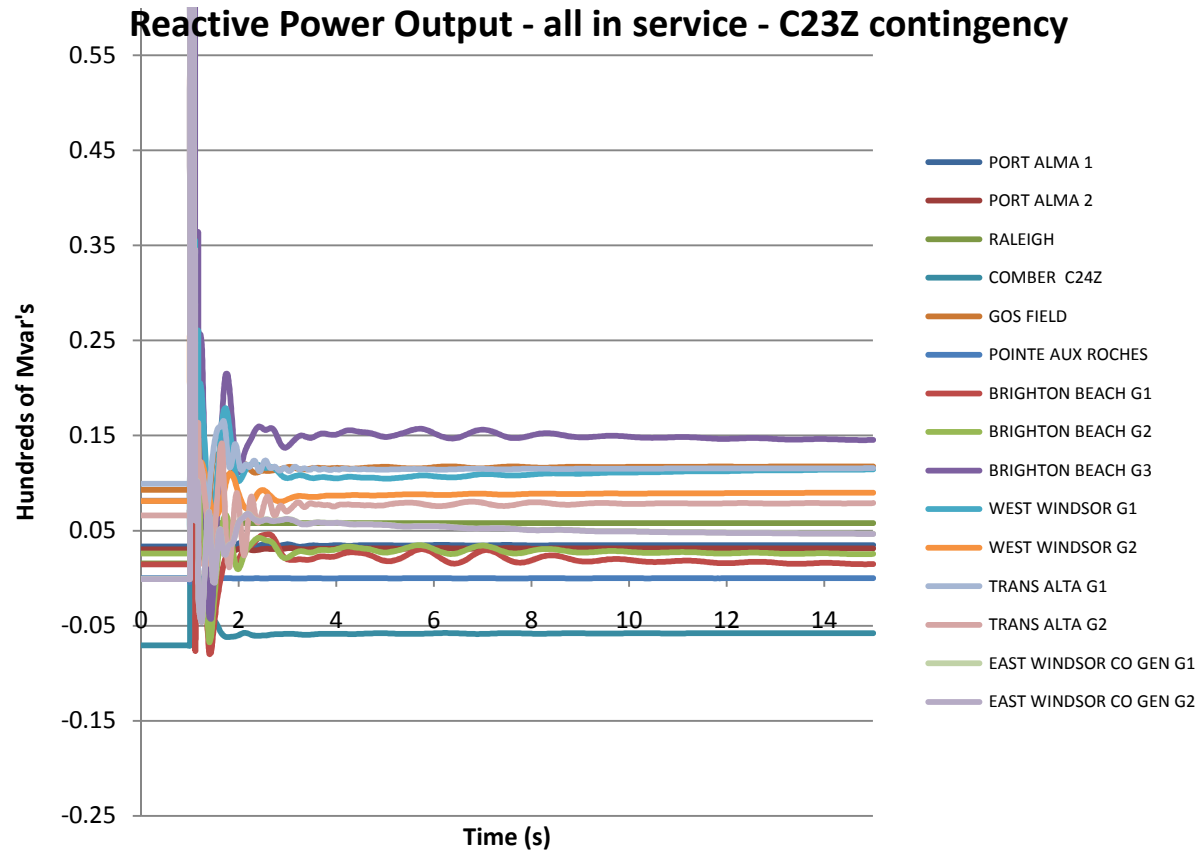
from bus in bold face, to bus in normal face.	C21J	C21J_C22J	C22J	C23Z	C23Z_LR	C24Z	C24Z_C22J	C24Z_C23Z	C24Z_C23Z_LR	C24Z_GR_LR	JBE	JBE_GR_LR	JAE	JAE_JBE	JAE_JBE_LR	JAE_JBE_LR_SPLUT	KZZ	KZZ_LR	K6Z	K6Z_KZZ	K6Z_LR	Z1E	Z7E	Z7E_Z1E	Z7E_Z1E_SHUNTR
BELLE_RIV_TS27.600																									
BELLE_R_TSK2118.05	25	25	25	25	19	25	25	25	19	22	25	19	25	25	19	19	0	0	43	0	43	25	25	25	25
BELLE_R_TSK6118.05	19	19	19	19	24	19	19	18	24	21	19	24	19	19	24	24	43	43	0	0	0	19	19	19	19
CHATHAM_SS 220.00																									
KEPA_WF_JC24220.00	7	8	6	18	12	0	0	0	0	0	6	5	6	18	4	5	7	8	7	11	9	6	6	5	4
LEAMINGICT21220.00	0	0	28	22	20	21	31	25	21	26	18	23	18	9	11	12	19	19	20	18	19	20	19	16	16
LEAMINGICT22220.00	40	0	0	31	28	30	0	35	30	36	25	32	25	12	16	17	27	27	28	26	26	29	27	23	23
LYNWOOD_JL28220.00	22	16	21	25	22	28	26	25	23	31	24	25	24	25	21	19	23	22	25	20	21	25	23	23	22
LYNWOOD_JL29220.00	27	21	27	30	28	33	31	30	28	36	29	30	29	30	27	25	29	27	30	26	27	30	29	28	27
RALEIGH-TAP 220.00	15	16	15	0	0	25	28	0	0	27	15	13	15	25	15	10	13	11	15	9	10	15	13	10	12
ESSEX_TS 118.05																									
CHRYSLER_E8F118.05	2	2	2	2	2	2	2	2	2	2	2	3	2	3	5	0	2	3	2	3	3	2	2	2	2
CHRYSLER_E9F118.05	3	3	3	5	3	5	5	5	4	4	3	2	3	3	3	0	3	2	3	2	2	4	4	4	4
CRAWFRD_JJ3E118.05	26	23	26	44	29	48	44	55	33	34	0	0	53	0	0	0	31	27	35	22	25	38	30	12	12
CRAWFRD_JJ4E118.05	33	30	34	55	37	60	55	69	41	43	67	28	0	0	0	0	39	35	45	30	34	48	38	14	14
W_TRANSALT_J118.05	9	10	9	19	7	23	19	30	9	11	9	19	9	23	23	12	9	15	13	17	14	0	37	0	0
WALKER_J_Z7E118.05	26	23	26	43	29	48	44	55	33	34	27	12	27	1	5	12	31	28	35	23	26	51	0	0	0
KEITH_TS 118.05																									
BRIGHTON_CG5118.05	43	42	43	43	43	43	44	44	43	0	43	0	43	43	43	43	43	43	43	43	43	43	43	43	43
CRAWFRD_JJ3E118.05	37	34	37	55	41	59	56	67	44	46	0	0	76	0	0	0	42	38	47	32	37	49	42	23	23
CRAWFRD_JJ4E118.05	48	44	48	71	52	77	72	86	58	59	86	52	0	0	0	0	54	48	60	40	46	64	54	31	31
KEITH_FWAPE 27.600	7	7	7	7	7	7	7	7	7	7	7	7	7	7	7	7	7	7	7	7	7	7	7	7	7
W_WIND_PWR_J118.05	83	82	83	84	82	85	87	86	83	85	82	82	82	83	83	83	82	82	82	83	82	83	82	83	83
KEITH_TS 220.00																									
BRIGHTON_J20220.00	54	54	54	54	54	54	54	54	54	41	54	41	54	54	54	54	54	54	54	54	54	54	54	54	54
KEITH_J5D_RG230.00	43	48	43	42	49	38	32	39	48	26	49	40	49	60	63	65	47	51	45	55	51	44	48	55	55
MALDEN_JC21J220.00	0	0	10	9	6	7	10	13	8	14	3	10	3	11	8	7	5	4	6	4	4	6	5	4	2
MALDEN_JC22J220.00	11	0	0	9	6	8	0	13	8	14	3	10	3	11	8	7	5	4	6	4	4	6	5	3	1
KINGSVIL_K22118.05																									
GOSFIELDCT 118.05	32	32	32	32	2	32	32	32	2	17	32	2	32	32	3	6	0	0	75	0	0	32	32	29	31
KINGSVIL_K6Z118.05																									
FIT_POINTE_A118.05	45	45	45	46	3	46	46	46	3	25	45	3	45	45	5	10	90	43	0	0	0	45	45	43	44
LAUZON_TS 118.05																									
JEFFERSN_J21118.05	18	20	18	16	12	19	16	26	9	14	17	29	17	31	32	21	14	24	16	28	23	0	35	0	0
JEFFERSN_J27118.05	18	20	18	15	12	19	15	25	9	14	18	30	18	32	33	21	14	24	16	28	23	35	0	0	0
LAUZON_J_K22118.05	36	36	36	37	10	37	37	37	10	23	36	10	36	36	10	9	0	0	79	0	25	36	36	33	35
LAUZON_J_K6Z118.05	22	22	22	22	8	22	22	22	8	8	22	8	22	22	9	11	62	28	0	0	0	22	22	21	21
TILB_WEST_B127.600																									
TILBURY_WES2118.05	29	29	29	29	28	29	29	29	28	29	29	28	29	29	28	28	50	50	0	0	0	29	29	29	29
TILBURY_WEST118.05	21	21	21	21	22	21	21	21	22	22	21	22	21	21	23	23	0	0	50	0	50	21	21	22	21
TILBURY_TS 27.600																									
TILBURY_TS 118.05	43	43	43	43	43	43	43	43	43	43	43	43	43	43	43	43	0	0	43	0	43	43	43	43	43

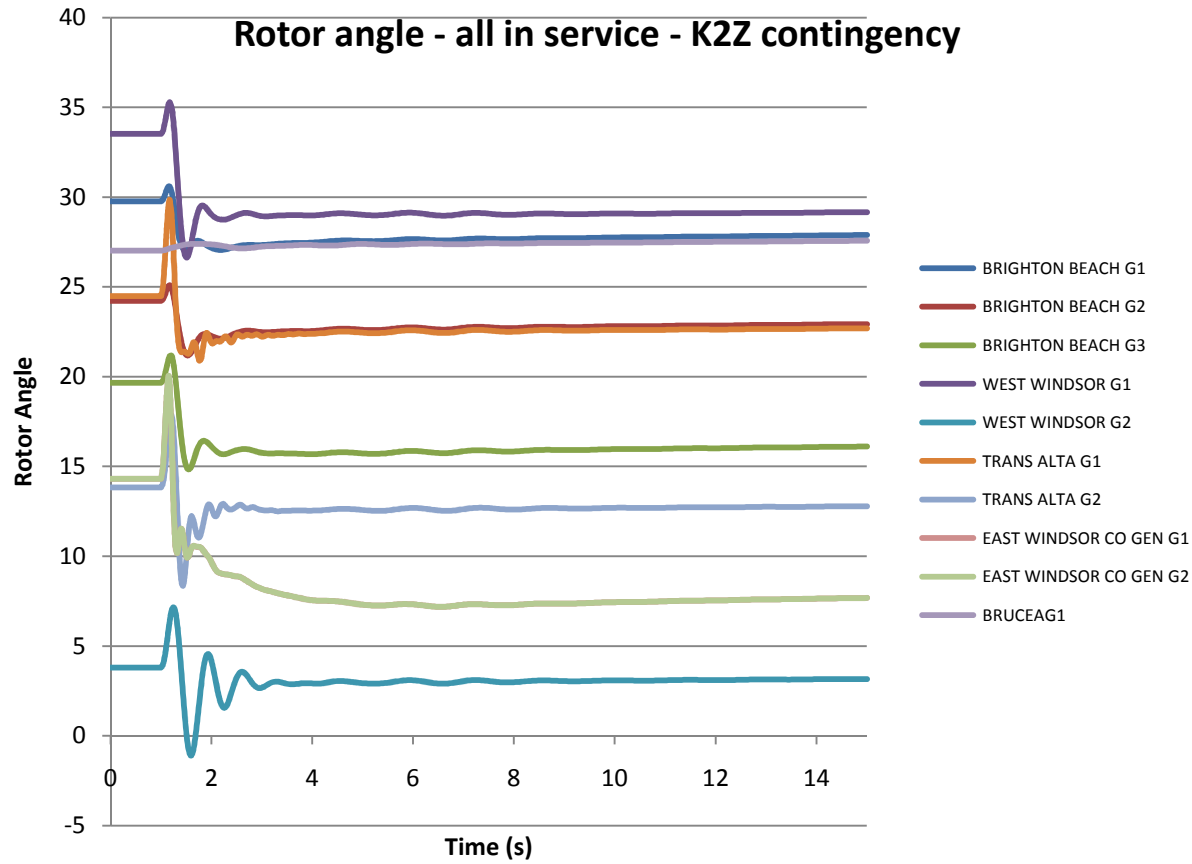
Appendix C Diagrams for Transient Simulation Results

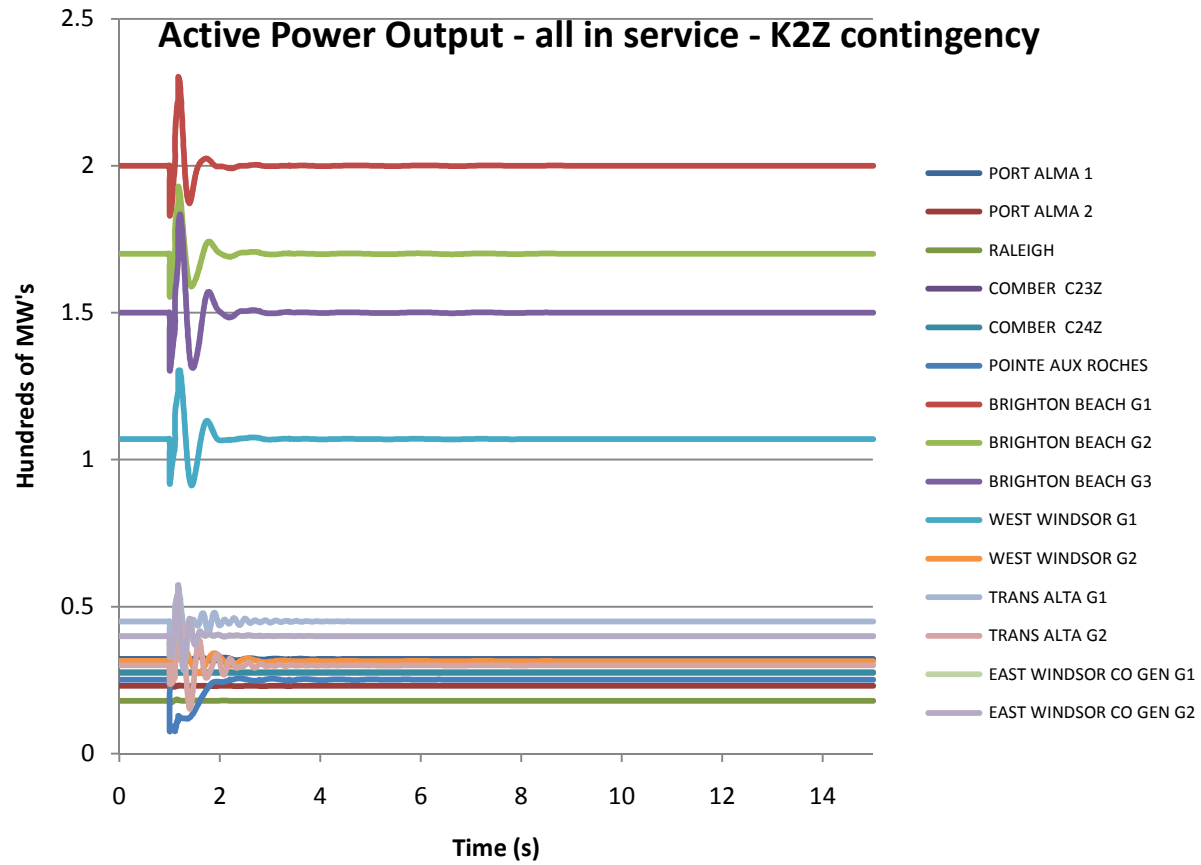
Rotor angle - all inservice - C23Z contingency

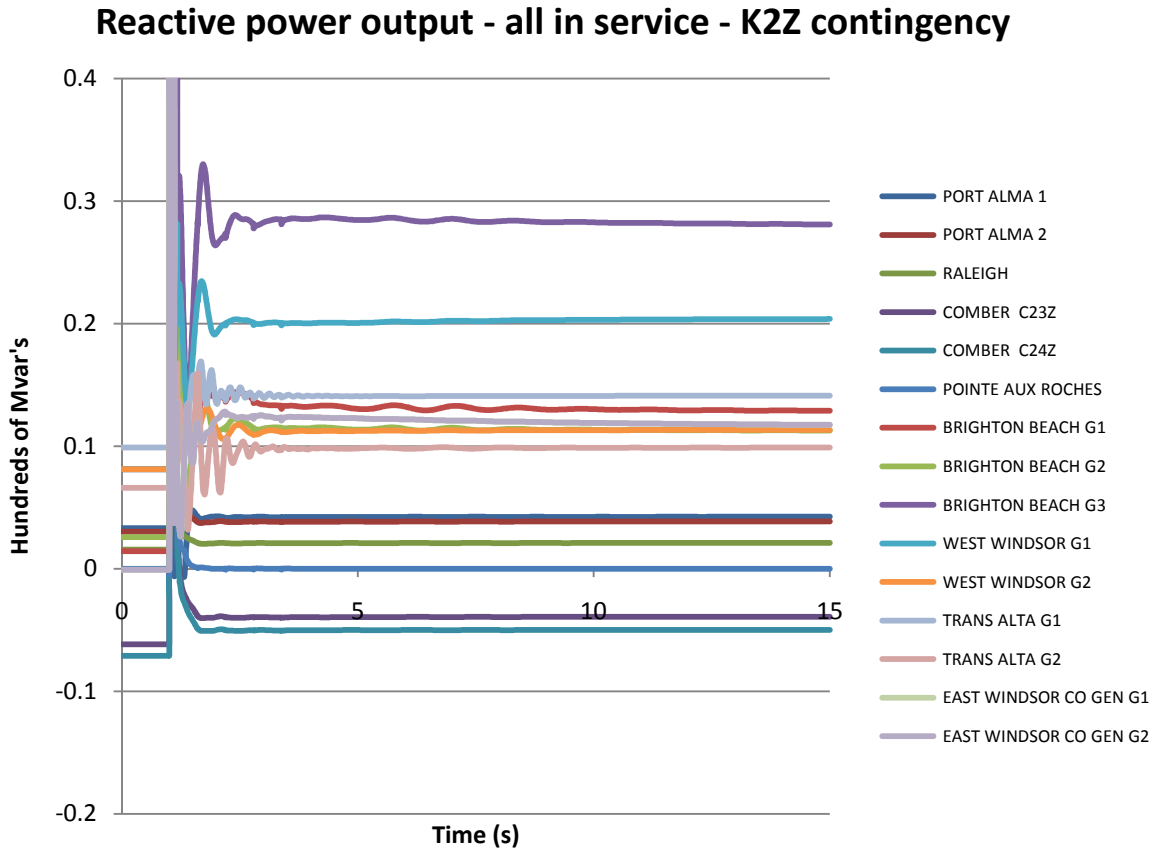


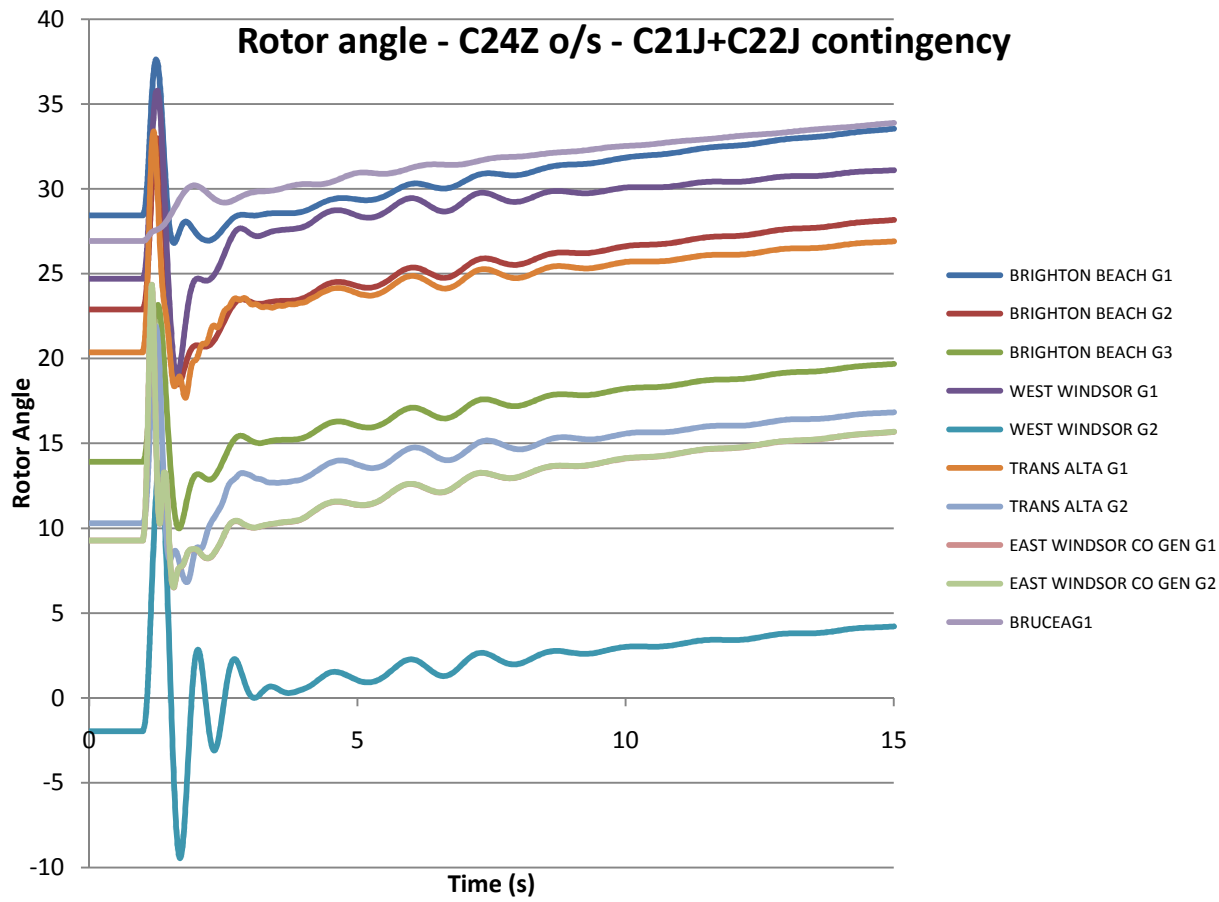


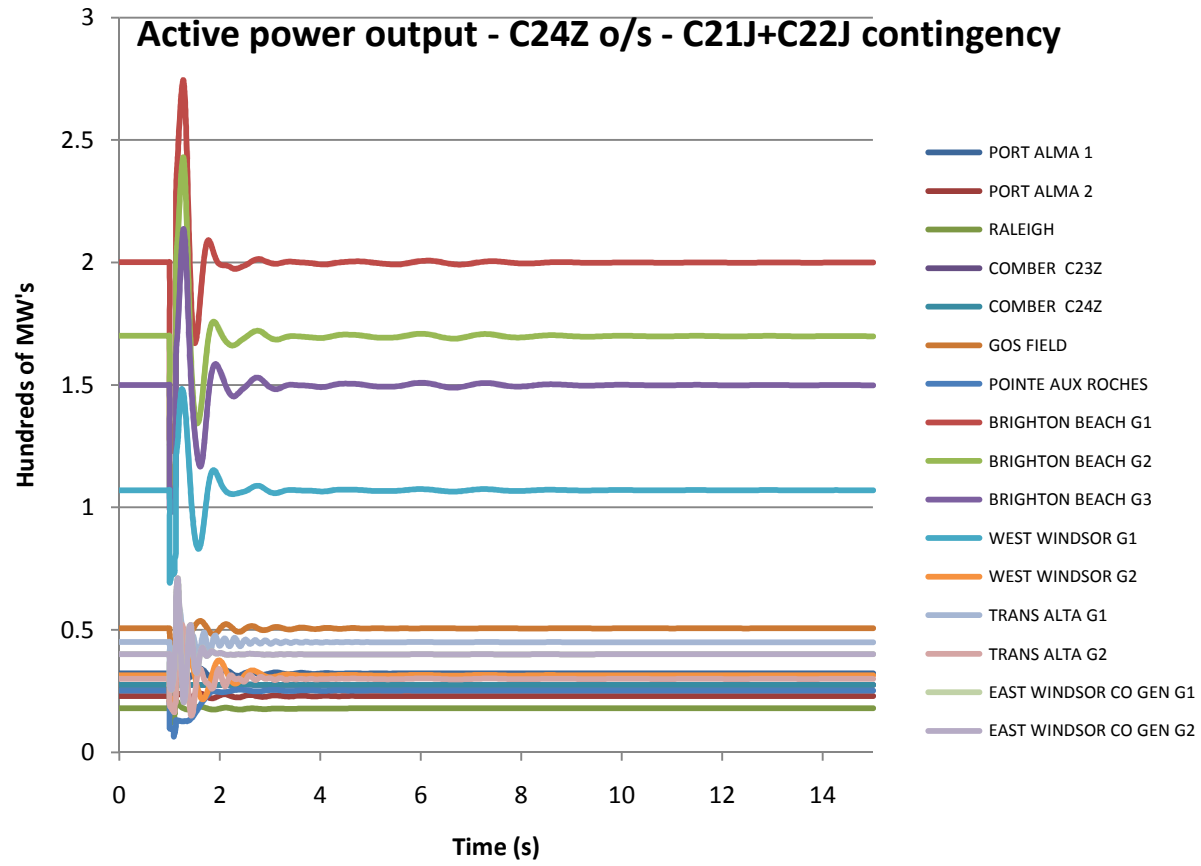


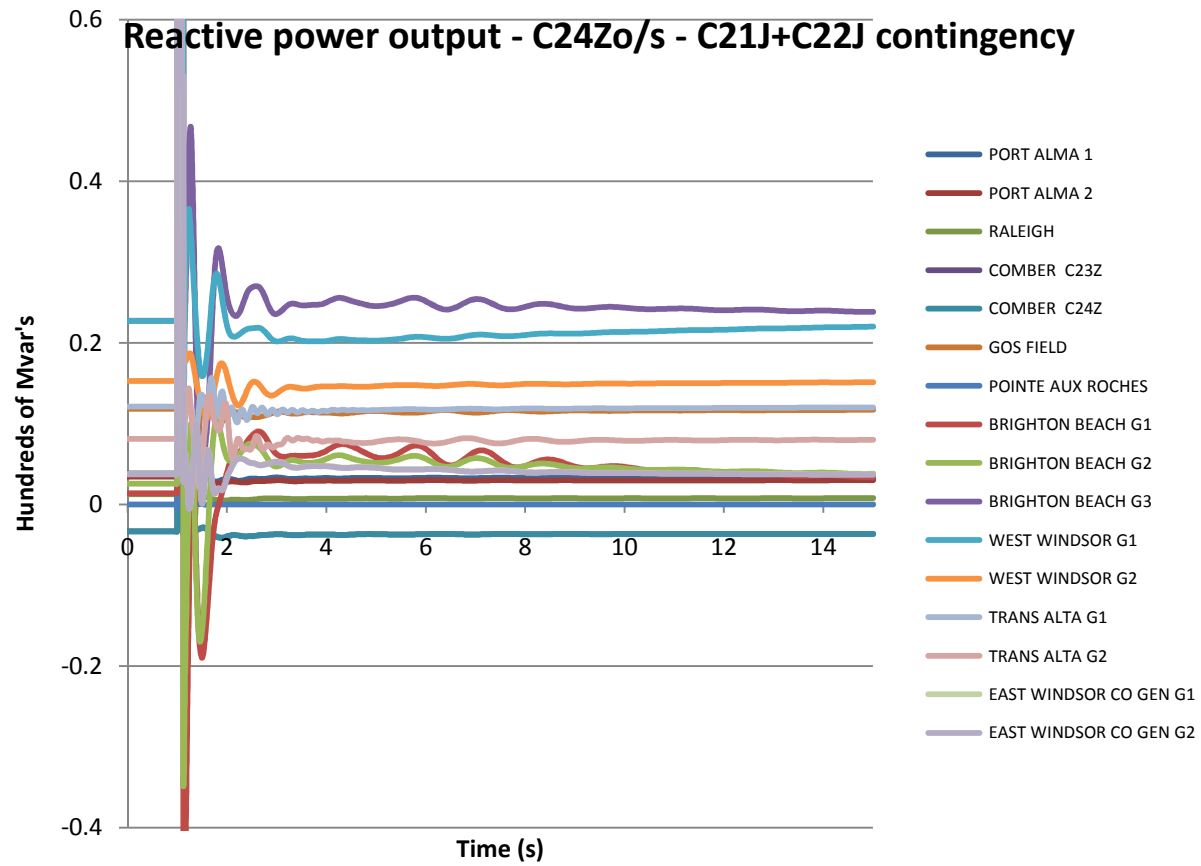


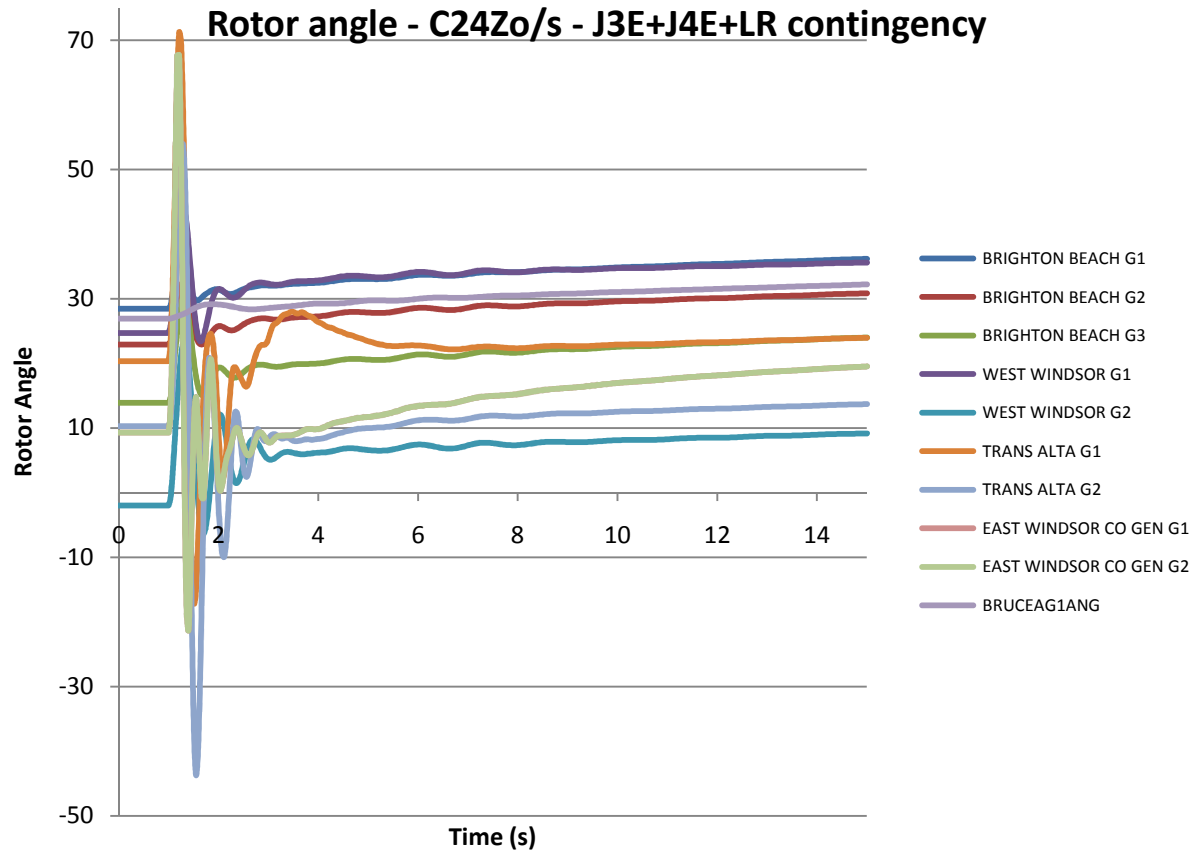


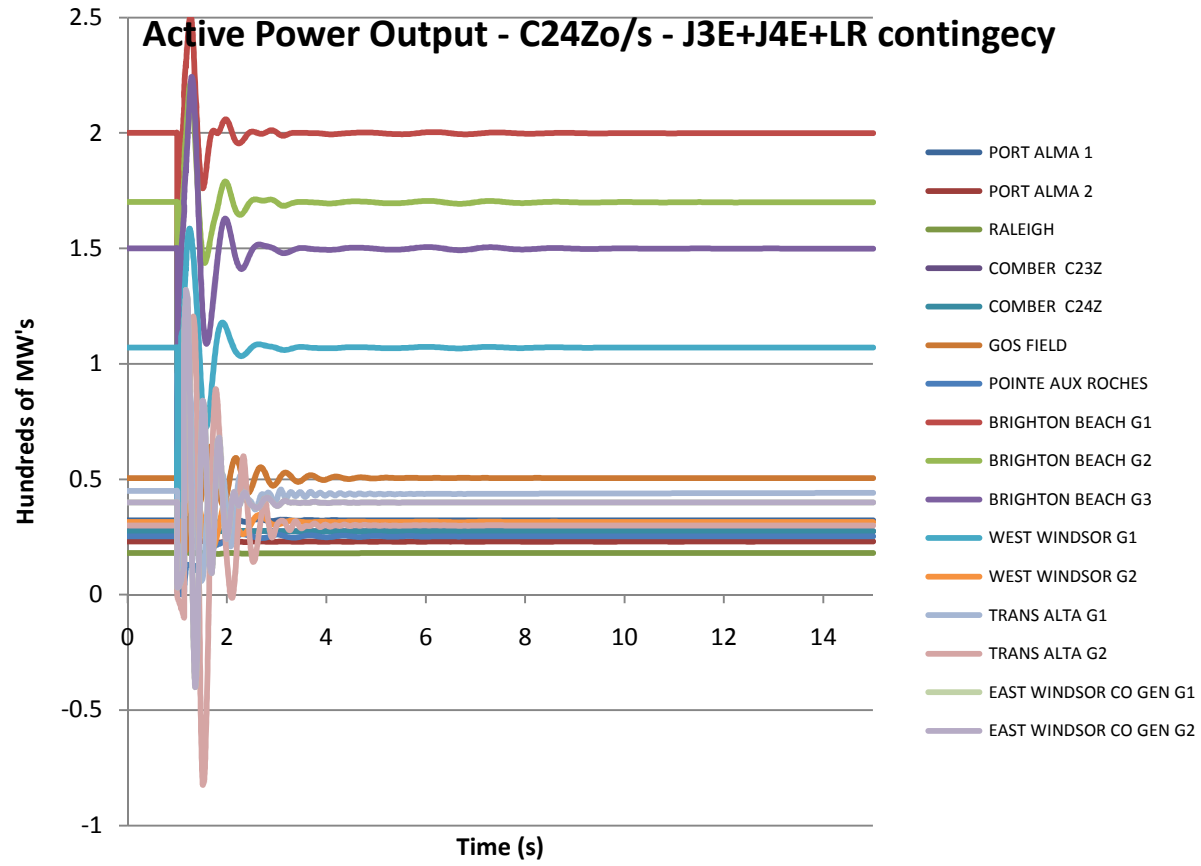


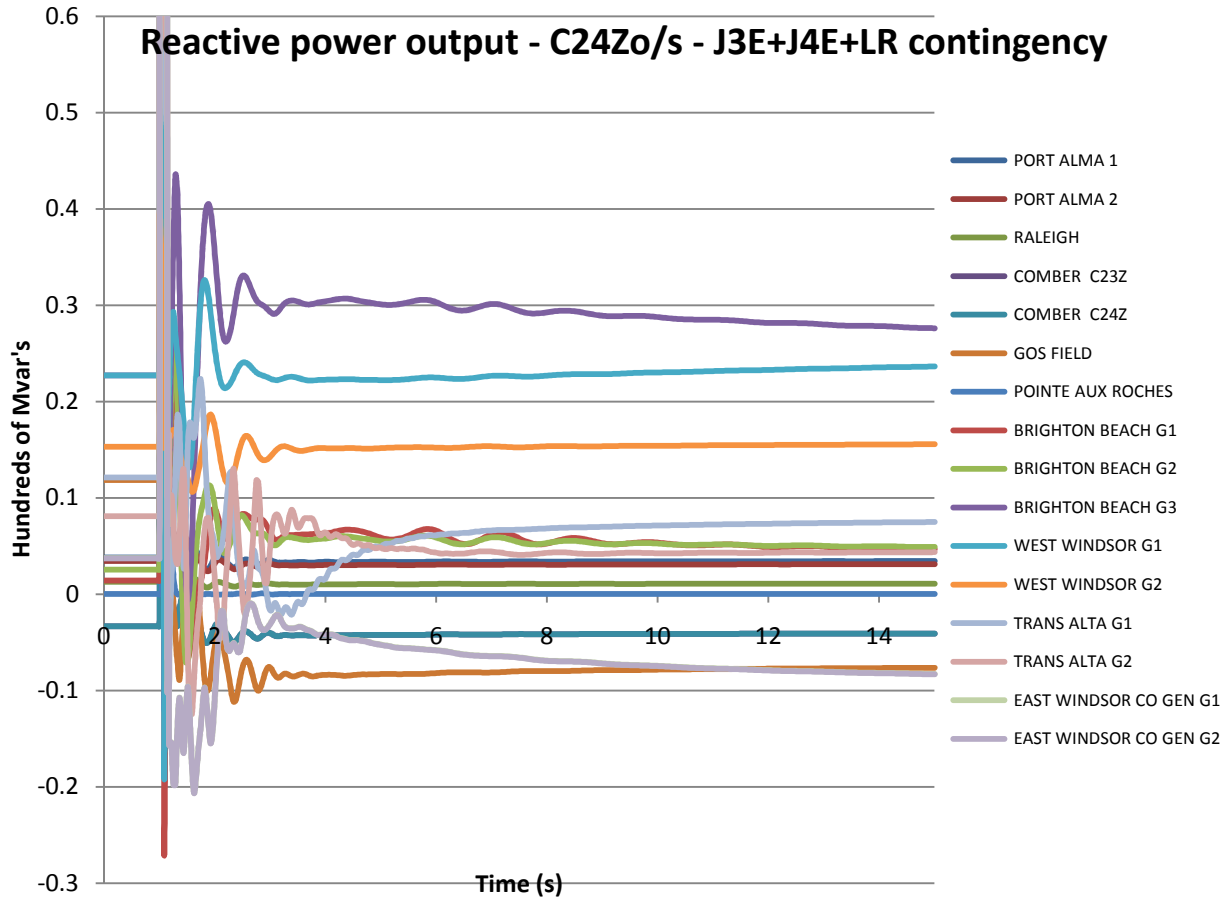












Appendix D Protection Impact Assessment



Hydro One Networks Inc.
483 Bay Street
Toronto, Ontario
M5G 2P5

PROTECTION IMPACT ASSESSMENT

POINTE AUX ROCHES WIND FARM

**48.6 MW WIND TURBINES
GENERATION CONNECTION**

Date: Set 03, 2010
P&C Planning Group Project # PCT-104

Prepared by:

Hydro One Networks Inc.

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Disclaimer

This Protection Impact Assessment has been prepared solely for the IESO for the purpose of assisting the IESO in preparing the System Impact Assessment for the proposed connection of the proposed generation facility to the IESO-controlled grid. This report has not been prepared for any other purpose and should not be used or relied upon by any person, including the connection applicant, for any other purpose.

This Protection Impact Assessment was prepared based on information provided to the IESO and Hydro One by the connection applicant in the application to request a connection assessment at the time the assessment was carried out. It is intended to highlight significant impacts, if any, to affected transmission protections early in the project development process. The results of this Protection Impact Assessment are also subject to change to accommodate the requirements of the IESO and other regulatory or legal requirements. In addition, further issues or concerns may be identified by Hydro One during the detailed design phase that may require changes to equipment characteristics and/or configuration to ensure compliance with the Transmission System Code legal requirements, and any applicable reliability standards, or to accommodate any changes to the IESO-controlled grid that may have occurred in the meantime.

Hydro One shall not be liable to any third party, including the connection applicant, which uses the results of the Protection Impact Assessment under any circumstances, whether any of the said liability, loss or damages arises in contract, tort or otherwise.

EXECUTIVE SUMMARY

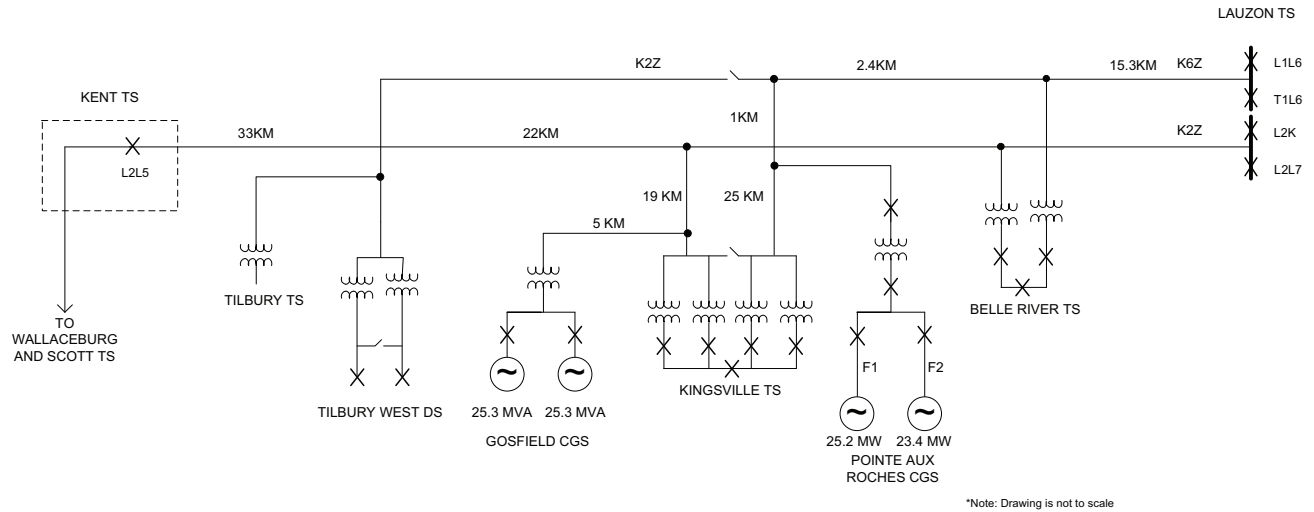


Figure 1: Pointe Aux Roches Wind Farm Connection to HONI Transmission System

It is feasible for Pointe Aux Roches Wind Farm to connect the proposed 48.6 MW generation at the location in Figure 1 as long as the following changes are made:

PROTECTION HARDWARE

- No hardware changes in the protection relays are required at Lauzon TS for circuit K6Z.

PROTECTION SETTINGS

- Protections at Lauzon TS and Pointe Aux Roches Wind Farm will operate in a direct underreaching and directional comparison blocking scheme. At Lauzon TS, the existing Zone 1 reach will be reduced to block short of the tap to the new Pointe Aux Roches Wind Farm generation facility. The Zone 2 reach will be extended to cover the new maximum apparent impedance due to the connection of the Pointe Aux Roches Wind Farm facility.

TELECOMMUNICATIONS

- New communications will be required between Pointe Aux Roches Wind Farm and Lauzon TS for Transfer Trip, Blocking and GEO signals to and from the Pointe Aux Roches Wind Farm.