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July 27, 2007

ONTARIO ENERGY BOARD

Sharon Wong
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Reference: 82148/97

VIA COURIER

Ontario Energy Board
P.O. Box 2319, 26th Floor
2300 Yonge Street
Toronto, Ontario
M4P 1E4

Attention: Ms. Kirsten Walli, Board Secretary

**Re: Wolfe Island Leave to Construct Application – File No. EB-2007-0034
Answers to Interrogatories**

Dear Ms. Walli:

Please find enclosed 9 hard copies of the Answers to the OEB Staff Interrogatories.

Yours truly,


Sharon Wong

Encl.
SW/maem

EB-2007-0034

OEB BOARD SECRETARY	
File No:	SubFile: 10
Panel	Robert C
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Other	DC, CC, PN, BR
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**ANSWERS TO OEB Staff Interrogatories
(July 27, 2007)**

**Amended Leave to Construct Application
for CREC Wolfe Island Wind Farm
(File No. EB-2007-0034)**

Note:

Questions A-1 through A-14 are identical to those submitted for the original application. Please indicate, for each interrogatory question and for each sub-question whether or not it is affected by the amendments introduced or by any other change, and where there is any change, provide full details. Where there is no change it is sufficient to indicate "No change". Questions A-15 onward are new questions.

A-1. Reference: Exhibit A, Tab 2, page 1

Preamble: The application indicates that Canadian Hydro owns and operates numerous hydroelectric and wind power facilities.

Question/request:

Please indicate:

a) What corporate organization capabilities exist to complete the applied for Transmission Line project (including transformer and switching station); and/or

No change.

b) If the company intends to make use of contractors, please identify what their capabilities are or would be and provide an indication of their experience.

No change.

For each of a) and b) above, please provide this information with respect to:

- a) Project management
- b) Design
- c) Construction
- d) Operation and maintenance
- e) Examples of similar projects that have been undertaken

- A-2. Reference:** Exhibit A, Tab 2, Page 2, section 2.1
Preamble: The basic components of the project include Siemens Mark II wind turbine generators.
Question/request: Please indicate experience with these machines in installations in Ontario and elsewhere in Canada.

No change.

- A-3. Reference:** Exhibit A, tab 2, page 26, paragraph 7.0
Preamble: The IESO has provided a version 1.0 (unsigned) SIA document and it is indicated that a revised version is expected.
Question/Request:
Please provide a finalized signed SIA document.

A copy of the final SIA and the accompanying Notice of Approval of Connection Proposal is attached at tab 1.

- A-4. Reference:** Exhibit A, tab 2, page 3, paragraph 10
Preamble: Hydro One has provided an unsigned CIA document and it is indicated that a revised version is expected.
Question/Request: Please provide a finalized signed CIA document.

No change. A signed copy is at tab 3 of the answers to the Board Staff's original interrogatories.

- A-5. Reference:** Exhibit A, tab 2, page 27, paragraph 9.0 and page 29, line 1
Preamble: The References indicate that an Environmental Review Report is being completed and that a notice will be published.
Question/Request: Please:
a) Provide a copy of the report referred to; and

A Draft Environmental Review Report was voluntarily released for a 30 day agency and stakeholder review and comment period. The 30-day comment period concluded on June 29, 2007. The Draft Environmental Review Report is available on the project website (www.wolfeislandwind.com). A disc containing the draft ERR report is attached at tab 8 of the answers to Invista's interrogatories.

b) provide an update on the current status and schedule of the environmental review processes, including Federal and

Stantec Consulting is now reviewing the comments received during the comment period and is working to integrate responses as appropriate into a Final Environmental Review Report. The Final Environmental Review Report will be released for a formal 30 day review and comment enroute to closing out the Project's screening processes. Notice of the Final Environmental Review Report will be posted on the project website and in local papers.

A formal trigger for a federal level screening report was identified in mid-July 2007 by Natural Resources Canada (i.e., funding under their ecoEnergy programme). The Draft and Final Environmental Review Reports have and are being prepared as a harmonized environmental assessment document to address both federal and provincial screening processes.

At the present time, it is expected that the Final Environmental Review Report will be publicly available by mid / late August 2007.

c) Provincial processes.

See answer to A-5 b) above

A-6. Reference: Exhibit B Tab 2 Page 3

Preamble:

Question/Request:

a) Please indicate the relevant standards for design and construction of the transmission facilities.

b) Please indicate the voltage and nature of the existing facilities in the Hydro One right-of-way

c) Please indicate installation procedure for the 230kV cable in relation to continuing operation of the existing facilities in the right-of-way.

d) Please indicate design and construction standards and procedures, relating to high voltage and other electromagnetic effects, which will protect pre-existing facilities and personnel from direct and induced currents and voltages. Include in your discussion corrosion protection, cable location identification, and grounding for safety.

No change.

A-7. Reference: Exhibit B Tab 2 Page 7, Line 1

Preamble: Staff is interested in the reliability of the submarine cable.

Question/Request: Please indicate:

- a) the design mean time between failure of the submarine cable
- b) experience of CREC and other operators with similar installations
- c) the procedure for repair of a cable fault including it would be secured against leakage at the point of repair
- d) the estimated time to repair a fault in the cable in the summer
- e) the estimated time to repair a fault in the winter.

No change.

A-8. Reference: Exhibit B, Tab 6, page 14, at line 17.

Preamble: Teleprotection is provided through fibre optic cable within the main cable.

Question/Request:

- a) Please indicate how duplicate and independent channels are achieved for protection and communication purposes.
- b) Please indicate if all the transmission line protection equipment, batteries, and communications is duplicated consistent with grid protection standards, or
- c) Indicate those areas where the protection is not duplicated, and to what standard the protection is designed.

No change.

A-9. Reference: Exhibit B, Tab 18, page 2

Preamble: The System Impact Assessment identifies recommendations and requirements for incorporation of the wind generator station. CREC agrees to accommodate these, at exhibit A Tab 2 page 27 line 1.

Question/Request: Please

a) Provide or indicate the status of the finalized signed version of the SIA document

A copy of the final SIA and the accompanying Notice of Approval of Connection Proposal is attached at tab 1.

b) Indicate the progress to date and/or the plan for accommodating each of the four recommendations and eleven requirements of the SIA.

No change.

A-10. Reference: Exhibit A, Tab 19, Customer Impact Assessment, a) general and b) at page 11, paragraph 5.0

Preamble: Numerous requirements are indicated for Wolfe Island Connection

Question/Request:

a) Please provide a finalized signed off copy of the Customer Impact Assessment document.

b) For each of the requirements for connection (5.1, 5.2, and 5.3) please indicate how the requirements are to be met, or how they are being accommodated.

No change.

A-11. Reference: Exhibit B, tab 21

Preamble: Some aspects of the scheduling may have changed since the application was made.

Question/Request: Please provide a schedule update as required by circumstances.

The completion schedule remains unchanged provided that timely receipt of approvals and permits occurs. Several non-critical construction activities have been affected by circumstances, but these activities have not affected the scheduled completion date of October 31, 2008.

A-12. Reference: None

Preamble: A complete list is required of permits and approvals which are necessary for commencement of the transmission line project (including transformer stations and customer switching stations).

Question/Request:

a) Please identify all permits and approvals that will be required prior to commencement of the proposed project construction;

No change.

b) Indicate the current status and the time-line for obtaining each permit and approval.

An updated time-line for obtaining approvals is attached at tab 2.

A-13. Reference a) Exhibit A, Tab2, page 16, paragraph 5.0 Reference b)
Exhibit A, Tab 2, page 11, lines 9-12

Preamble: At line 20 it is indicated that "Favourable negotiations have been finalized with the majority of the landowners along this route". An update is requested for the status of land and land rights acquisition.

Question/Request:

a) Regarding ref a) please indicate the status in securing land and land rights for the Project for each of the Landowners including those on Wolfe Island and on the mainland.

An updated chart summarizing the status of the land and land rights for the transmission line project is attached at tab 3. Two landowners (Arnold Day and 1556910 Ontario Limited) have been removed because they were inadvertently included on the original chart, and CREC will now be requesting a 10 metre wide permanent easement from Paul Martin Construction, Dupont and Invista (rather than a 5 m easement with a 5 m temporary work area).

CREC amended the application to change the proposed route after meeting with both Utilities Kingston and Invista to discuss the change. See tab 10 of CREC's answers to Invista's interrogatories for notes of that meeting.

b) Regarding reference b) please indicate the status of the zoning appeals which have been made to the OMB, and which it is indicated could affect the Wolfe Island TS.

Two appeals were filed against by-law 27-2006 of the Township of Frontenac Islands, which by-law amends the zoning to permit the Wolfe Island Wind Energy Project. These appeals were heard by the Ontario Municipal Board on July 23, 24 and 25, 2007.

During the hearing, Minutes of Settlement were entered into between the Appellants, the Township and CREC.

On July 25, an oral decision of the Ontario Municipal Board was given, endorsing the Minutes of Settlement and resolving the appeals by allowing them in part, so as to modify the by-law in the manner outlined in Appendix A to the Minutes of Settlement.

By-law 27-2006 is a holding by-law. The holding symbol is to be removed upon:

- (a) The completion of the environmental screening process required by Ontario law pursuant to Ontario Regulation 116/01; and
- (b) The granting of site plan approval and entering into of a site plan agreement for each property upon which turbines are sited.

The principal modification required under the Minutes of Settlement is that upon the completion of the environmental screening process, once the location of each turbine has been fixed according to that process, the by-law will be modified to correspondingly stipulate the position of each turbine by reference to UTM coordinates, with a flexibility of 50 metres in any direction.

In order that the Board may retain its jurisdiction to modify the by-law by appending UTM coordinates, the Board will withhold its Order until advised of the completion of the ERR process, at which time the Board will be provided with the UTM coordinates in the form of a Schedule to By-law 27-2006 and the Order bringing the by-law into force will thereupon issue.

- c) In the event that expropriation becomes necessary, what will be the anticipated process and time-line to complete the expropriation proceedings?

No change.

- d) Please indicate what authority is required to commence laying of the submarine cable, and indicate the status of securing permission.

No change.

A-14. References: a) Exhibit B, Tab 13, Page 8; b) Exhibit B, Tab 20, Appendix B section 8.0 Aboriginal

Preamble: It is mentioned at reference a) that early consultations have occurred with First Nations and at reference b) there are no known First Nations or Aboriginal communities within the study area.

Question/Request: Please provide a status update on consultations with First Nations communities with regard to the following points:

- a) Identify all of the Aboriginal groups that have been contacted in respect of this application.

No change.

b) Indicate:

i) how the Aboriginal groups were identified;

No change.

ii) when contact was first initiated;

No change.

iii) the individuals within the Aboriginal group who were contacted, and their position in or representative role for the group;

No change.

iv) a listing, including the dates, of any phone calls, meetings and other means that may have been used to provide information about the project and hear any interests or concerns of Aboriginal groups with respect to the project.

See answer to question A-15 below for an update.

c) Provide relevant information gathered from or about the Aboriginals as to their treaty rights, or any filed and outstanding claims or litigation concerning their treaty rights or treaty land entitlement or aboriginal title or rights, which may potentially be impacted by the project.

No change.

d) Provide any relevant written documentation regarding consultations, such as notes or minutes that may have been taken at meetings or from phone calls, or letters received from, or sent to, Aboriginal groups.

See answer to question A-15 below for an update.

e) Identify any specific issues or concerns that have been raised by Aboriginal groups in respect of the project and, where applicable, how those issues or concerns will be mitigated or accommodated.

No change.

f) Explain whether any of the concerns raised by Aboriginal groups with respect to the applied-for project have been discussed with any government department or agencies, and if so, identify when contacts were made and who was contacted.

No change.

g) If any of the Aboriginal groups who were contacted either support the application or have no objection to the project proceeding, identify those groups and provide any available written documentation of their position. Also, indicate if their positions are final or preliminary or conditional in nature.

The Mohawk of the Bay of Quinte have indicated their support for the Wolfe Island Wind Project in the written comments that they have submitted in respect of the draft ERR, a copy of which is attached at tab 4.

h) Provide details of any known Crown involvement in consultations with Aboriginal groups in respect of the applied-for project.

No change.

A-15. Reference: Answers to Interrogatories April 18, 2007(original application), interrogatory question 14 e), second bullet

Preamble: The answer indicated that: "the MBQ have noted in their opinion that the Project is within their traditional territory and as such they are due economic accommodation".

Question/request: Bearing in mind the draft OEB policy on consultation with First Nations available on the Board website at (http://www.oeb.gov.on.ca/html/en/industryrelations/ongoingprojects_aboriginal-consultation-policy.htm), please indicate how CREC intends to deal with the position taken by MBQ.

CREC has been engaged in discussions with the leaders of the MBQ since 2004, and continues to be actively engaged with the MBQ. The MBQ are fully aware of the proposed project. A summary of the earlier discussions with the MBQ can be found in the draft ERR (a copy of the draft ERR is at tab 8 to the answers to the Invista's Interrogatories). In March 2007, senior representatives of CREC met with the Chief and Council of MBQ to present a Project overview, and there has been subsequent written dialogue with the MBQ. The MBQ have reviewed the

draft ERR and commented favourably on the proposed project – see letter of June 22, 2007 attached at tab 4.

One of the aims of CREC's discussions with the MBQ is to obtain the MBQ's written acknowledgment that the Crown's obligations to consult have been satisfied. CREC have twice served the MBQ with notice of the application for leave to construct as required by the Board's Letters of Direction, and the MBQ have chosen not to participate in the OEB proceeding in any way.

A-16. Reference: Letter from Utilities Kingston April 5, 2007

Preamble: Utilities Kingston requested a Pipeline Interference Study, and in part B of their Answers to Interrogatories on April 18, 2007, CREC advised that mitigation work will be done during the detailed design stage of the project.

Question/Request:

a) Please indicate when the "detailed design stage" will occur;

The detailed design stage is currently underway.

b) Is the "study" requested by Utilities Kingston a separate activity preceding the "mitigation work" to be done during design, and will there be a report indicating the results?;

Yes, the "study" as requested by Utilities Kingston is a separate activity. The results of the study will indicate whether, if any, mitigation work is required. If the report does show mitigation work is required, it will be integrated into the design as required to comply with the study recommendations.

c) Has the information CREC requested of Utilities Kingston and required for the study been received by CREC?

The information CREC requested from Utilities Kingston required for the study has been received. Further information may be required if the study consultant identifies any shortcomings during the analysis process.



June 20, 2007

Mr. Ross Keating
President & Chief Operating Officer
Canadian Hydro Developers Inc.
500, 1324-17th Avenue SW
Calgary, AB T2T 5S8

Dear Mr. Keating,

**Wolfe Island Wind Generation Station
IESO System Impact Assessment - CAA ID 2005-111
Notification of Approval of Connection Proposal**

Thank you for the information provided on the proposed Wolfe Island Wind Generating Station.

From the information provided, our review concludes that the proposed project will not result in a material adverse impact on the reliability of the IESO-controlled grid. The IESO is therefore pleased to grant conditional approval for the proposed wind generation station detailed in the attached assessment report. However, this approval is subject to the full implementation of the IESO's requirements, as detailed in the attached Report. Any material changes to your proposal may require re-assessment by the IESO in accordance with Market Manual 2.10, and may nullify your conditional approval.

Final approval will be granted upon successful completion of the IESO Market Entry process. During Market Entry process you will be expected to demonstrate that you have fulfilled the requirements in line with the proposal assessed by the IESO. Please contact market.entry@ieso.ca if you have not received a Facility Registration Summary package within the next 10 days.

For further information, please contact the undersigned.

Yours truly,

Michael Falvo
Manager - Transmission Assessments & Performance
Telephone: (905) 855-6209
Fax: (905) 855-6129
E-mail: mike.falvo@ieso.ca
cc: IESO Record

All information submitted in this process will be used by the IESO solely in support of its obligations under the *Electricity Act, 1998*, the *Ontario Energy Board Act, 1998*, the *Market Rules* and associated policies, standards and procedures and in accordance with its license. All information submitted will be assigned the appropriate confidentiality level upon receipt.

Canadian Hydro Developers Inc. acknowledges receipt of the System Impact Assessment Report setting out the IESO requirements for final approval, and commits to fulfill these requirements, and all other applicable Market Rules, before receiving final approval to connect to the IESO-controlled grid.

Dated: JUNE 21, 2007

Per: Jim Pinter

Name: JIM PINTER

Title: MANAGER TECHNICAL SERVICES



Power to Ontario.
On Demand.

System Impact Assessment Report

Wolfe Island
Wind Generation Station (WGS)

CONNECTION ASSESSMENT & APPROVAL PROCESS

CAA ID 2005-111

Applicant: Canadian Hydro Developers

Transmission Assessments & Performance
Department

2007 June 20

REPORT

System Impact Assessment Report – Disclaimer

Document ID	IESO_REP_0344
Document Name	System Impact Assessment Report
Issue	Issue 1.0
Reason for Issue	Final.
Effective Date	2007 June 20

System Impact Assessment Report

Wolfe Island 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.

System Impact Assessment Report

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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WOLFE ISLAND WIND GENERATION PROJECT

IESO SYSTEM IMPACT ASSESSMENT

SIA Findings

The Canadian Renewable Energy Corporation together with Canadian Hydro Developers is developing a new 198 MW wind power generation farm in Wolfe Island. The project was awarded a contract under the government RFP II, and is expected to start commercial operation at the end of 2008.

Summary

This Assessment examined the impact of injecting 198 MW of wind power generation to the 230 kV circuit X2H or X4H at Gardiner Transformer Station on the reliability of the IESO-controlled grid.

Following conclusions were made.

Conclusions

- (1) The proposed wind farm does not have a negative adverse impact to the reliability of the IESO-controlled grid provided the requirements for connection are fulfilled.
- (2) The post-contingency voltage declines are within IESO criteria.
- (3) The connection of the wind farm to the IESO-controlled grid via LV side of the Gardiner TS is not acceptable.
- (4) The original connection arrangement used a Customer Switching Station (CSS) in the mainland to locate new 230 kV switchgear. This switchgear will now be placed in Gardiner TS and the CSS will be eliminated. This change has no impact on SIA results.
- (5) Siemens MK II generators which are used in this wind farm do not fully meet IESO Market Rules on dynamic reactive capability requirement. The connection impedance between the wind turbine generators and the IESO-controlled grid exceeds the required limit.
- (6) The power flows in equipment are within required ratings.

IESO's Requirements for Connection

The following requirements for the incorporation of Wolfe Island WGS to X2H or X4H have been identified.

- (1) The generators must operate at nominal voltage of 673 V instead of 690 V. That means all generators should be able to operate in the range of 639 – 706 V and still be able to produce the full MW output. All auxiliary systems including low voltage ride through capability, protections, controls etc must operate reliably in this entire range.
- (2) The tap ratio of each generator step-up transformer must be changed from $34,500/690 = 50$ to $34,500/673 = 51.26$ or the tap must be placed at $51.26/50 = 1.025$ position compared to the nominal setting.
- (3) The first under-voltage trip setting of the generator must be at 605 V.
- (4) The output of each generator must be limited to 2.23 MW when directed by the IESO. The proponent has agreed to comply with this requirement. The Wind Farm Management System must have the capability to implement this limit in a timely manner in all 86 generators.
- (5) The total static reactive compensation requirement is 100 MVAR. Since there are two collector buses, 50 MVAR (5 steps of 10 MVAR) must be connected to each collector bus. These must be auto-switched by the Wind Farm Management System via suitable over/under voltage settings.
- (6) The generators and the capacitor bank must control the local 34.5 kV collector bus voltage to a value to be determined by the IESO operating staff. The Wind Farm Management System must coordinate and direct the combine voltage control by generators and capacitors to avoid 'hunting'. Periodically, the IESO will revise the voltage set point as necessary.
- (7) The generators should not trip for contingencies except for which the generators will be disconnected by configuration. If generators trip for contingencies for which they are not disconnected by configuration, the low voltage ride through capability must be upgraded.
- (8) The 34.5/230 kV transformers must have manual tap changer facilities.
- (9) At any time, the wind farm must be connected only to one circuit X2H or X4H. An interlock must be provided between disconnect switches to X2H and X4H such that only one is closed at any time.
- (10) During commissioning period, a set of IESO specified tests must be performed. The commissioning report must be submitted to the IESO within three months of the conclusion of commissioning. The field test results should be verifiable using the PSS/E models used for this SIA.
- (11) The Ontario Transmission System Code must be followed and protection systems must be coordinated with those of Hydro One. The back-up batteries and communication channels must be duplicated.
- (12) The connection of the wind farm to the IESO-controlled grid through LV side of the Gardiner TS is not permitted.
- (13) The autoreclosure of new 230 kV breakers at the connection point must be blocked. Upon its opening for a contingency, the resynchronization must be done only after the IESO approval is granted. The

IESO will require reduction of power generation prior to resynchronization followed by gradual increase of power to avoid a power surge.

- (14) The generator under-frequency settings should be set such that the generators do not trip for frequency variations that are above the curve in Figure 1.
- (15) If the Wind Farm Management System is unavailable, the generator factory settings must be set up such that each generator must start controlling its own terminal voltage while capacitors continue to control 34.5 kV voltage. Generators controlling power factor without the prior approval of the IESO is not permitted.
- (16) A disturbance monitoring device must be installed. The device must meet the technical specifications including the quantities to be recorded, the sampling rate and the trigger settings provided by Hydro One. In the event of a disturbance, the applicant is required to provide the collected data to the IESO upon request from the IESO.
- (17) Documentation describing the functionalities of the Siemens Wind Farm Management System (WFMS) must be provided to the IESO.
- (18) The applicant is responsible for providing real-time telemetering of following variables to the IESO.
 - net active and reactive power measured either at 34.5 kV or 230 kV side of the transformers T1,T2
 - status of new 34.5 kV and 230 kV breakers and disconnect switches
 - 230 kV and 34.5 kV voltages at the transformer station
 - in service status of the Wind Farm Management System
 - voltage controlling set point
- (19) The registration of the new facilities will need to be completed through the IESO's facility registration process before any part of the facility can be placed in-service. If the data or models 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 before the facilities are allowed to connect.

Notification of Conditional Approval

From the information provided, our review concludes that the proposed changes will not result in a material adverse effect on the reliability of the IESO-controlled grid. It is recommended that a Notification of Conditional Approval be issued for Wolfe Island wind generating station subject to the IESO receiving written acknowledgement that the requirements listed in this report will be implemented.

1. Project Description

Wolfe Island is the largest of the 1000 islands in eastern Ontario, and is located at the entrance of the St Lawrence River between Kingston, Ontario and Water Town, New York. This 125 square km island has roughly 1300 full-time residents which virtually double in summer.

As a part of selected RFP Renewable II projects, Canadian Renewable Energy Corporation together with Canadian Hydro Developers plan to develop a 198 MW wind power generation facility in Wolfe Island. The power generated at this facility will be converted to 230 kV at a new transformer station to be built on the island, transmitted across St Lawrence River using a large submarine cable and underground cable in the mainland then injected into the IESO-controlled grid at Gardiner TS. At any time, the power from the wind farm will be injected only into either X2H or X4H. The construction is to commence in the spring of 2007 with commercial operation expected to start in end of 2008.

The generating facility will consist of eighty six 2.55 MVA, 2.3 MW, 690 V, Siemens 2.3MK II, 60 Hz variable speed wind turbine generators that employ squirrel cage induction generators. Each of them has two AC/DC converters connected back-to-back interfacing the stator and the generator step-up transformer. Each converter has the capability to operate in all four quadrants, so they enable the two-way transfer of active and reactive power. While these converters perform conversion of power from fluctuating frequency at stator to constant frequency at step-up transformer, the dc link provides added advantage of restricting the propagation of disturbances between the generator and the grid. The harmonics generated by the dc link are attenuated by a filter and a series reactor connected to the generator terminals. During voltage drops in the grid, the low voltage ride through capability gets activated by the grid side AC/DC converter producing more reactive current at the expense of active current to increase the terminal voltage.

Each tower will have a generator, two AC/DC converters, a step-up transformer and a breaker and will be connected to a collector system that consists of six 34.5 kV circuits C1, C2, C3, C4, C5 and C6. Each circuit will have following number of generators connected and maximum power flow.

Circuit ID	C1	C2	C3	C4	C5	C6	Total
Number of generators	14	15	14	16	14	13	86
Maximum MW flow	32.2	34.5	32.2	36.8	32.2	29.9	197.8

Each 0.690/34.5 kV transformer has reactance of 0.06 pu on 2.6 MVA base and has manual off-load tap changers on HV windings. They will have 2 equal steps above nominal and 2 equal steps below nominal giving a total of -5 % to +5 % voltage variation. The circuits C1, C2 and C3 will be connected to one collector bus which will be connected to 110 MVA, 34.5/230 kV transformer T1 with reactance 0.0930 pu on 100 MVA base. Similarly, the circuits C4, C5 and C6 will be connected to another collector bus which will be connected to second 110 MVA, 34.5/230 kV transformer T2 with same reactance as T1. The collectors, the transformers T1, T2 and switch gear will be located in two new substations to be built by the within the Wolfe Island. The 230 kV side of T1 and T2 will be connected to Gardiner 230 kV busbar via an underground cable within the Wolfe Island and then a submarine cable across the St Lawrence River and then another underground cable in the mainland. The connection to X2H and X4H will comprise one breaker and two disconnects where one disconnect will be normally open and other normally closed. The 34.5/230 kV transformers will have manual tap change facilities. It will have 8 equal steps above nominal and 8 equal steps below nominal on HV winding giving a total of -10 % to +10 % voltage variation.

- End of Section -

2. General Requirements

Models & Data

1. The Connection Applicant must complete the IESO Facility Registration process before IESO final approval for connection is granted. Final models and data including any details of control systems that would be operational must be provided to the IESO prior to the first energisation of any equipment.

2. During commissioning, the Connection Applicant must provide evidence to the IESO that the equipment installed meets the Market Rules requirements and matches or exceeds the performance predicted. 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 accordance with widely recognized standards and to the satisfaction of the IESO. Until this evidence is provided, the Connection Applicant must accept any restrictions the IESO may impose upon their participation in IESO-administered market or connection to the IESO-controlled grid.

Generators

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

The generators must have the capability to operate $\pm 5\%$ of the nominal terminal voltage.

The generators must have the dynamic reactive power capabilities to supply reactive power continuously at all active power outputs in the range of 0.9 lag to 0.95 lead power factor based on rated active power at its generator terminals for at least one constant 230 kV system voltage.

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, dynamic reactive compensation devices must be installed to make up the deficient reactive power.

2. The generators must be able to ride through recognized contingencies on the IESO-controlled grid that does not disconnect the facility by configuration.

3. The connection and disconnection of the generators must minimize any adverse effects on the IESO-controlled grid.

Connection Equipment (Breakers, Disconnects, Transformers, Buses)

1. The 230 kV equipment connected to terminal stations must be capable of continuously operating in the range between 220 kV and 250 kV as per Appendix 4.1 of Market Rules.

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

The 230 kV equipment must be able to interrupt rated fault current for voltages up to the maximum continuous rating. They must remain in service, and not automatically trip for voltages up to 5% above the maximum continuous rating for up to 30 minutes to allow the system to be re-dispatched to return voltages within their normal range.

2. The Transmission System Code states that 230 kV connection equipment should have a rated 3-phase symmetrical short circuit capability of 63 kA and a rated single line to ground short circuit capability of 80 kA (usually limited to 63 kA). It also requires that 230 kV breakers have a rated interrupting time of three cycles (50 ms) or less.

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. This includes ensuring that SF6 breakers are equipped with heaters to prevent freezing.

IESO Monitoring and Telemetry Data

The Appendix 4.15 and Appendix 4.19 of Market Rules list the requirements with respect to the telemetry that must be provided to the IESO and to the standards that must be achieved on a continual basis by all generators.

In accordance with the requirements for a *major generation facility*, Connection Applicant must ensure that all the equipment needed to provide the telemetry data and meet the performance standards will be installed.

The IESO will finalize items to be telemetered during the IESO Market Entry Process.

Protection Systems

1. Faults within the facility must not trip 230 kV circuits X2H/X4H except for the failure of the new Wolfe Island 230 kV connection breaker. After the facility begins operation, if the tripping of X2H or X4H occurs due to events at the wind generation facility, the facility may be required to be disconnected until the problem is solved.

2. Protection systems must be designed to meet all the requirements of the Transmission System Code and any additional requirements identified by Hydro One.

3. The facility must be capable of operating at full active power for a limited period of time for frequencies as low as 58.8 Hz. The wind turbine generators must not trip for under-frequency system conditions that are below 60 Hz but above 57.0 Hz and above the curve shown in Figure 1.

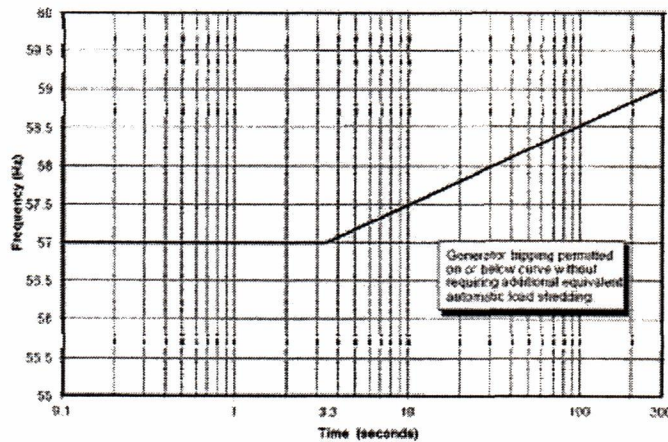


Figure 1: Standards for Setting Under-frequency Trip Protection for Generators

Miscellaneous

1. The generators must be capable of operating continuously in the range between 59.4 Hz and 60.6 Hz as specified in Appendix 4.1 of Market Rules.
2. The generators must operate in the voltage control mode. Operation of the facility in power factor control or reactive power control is not acceptable.
3. All plant auxiliaries must be capable of operating continuously within the voltage range of 220 kV to 250 kV.
4. 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 230 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.

- End of Section -

3. Review of Connection Proposal

3.1 Proposed Connection Arrangement

The proposed connection arrangement is shown in Figure 2.

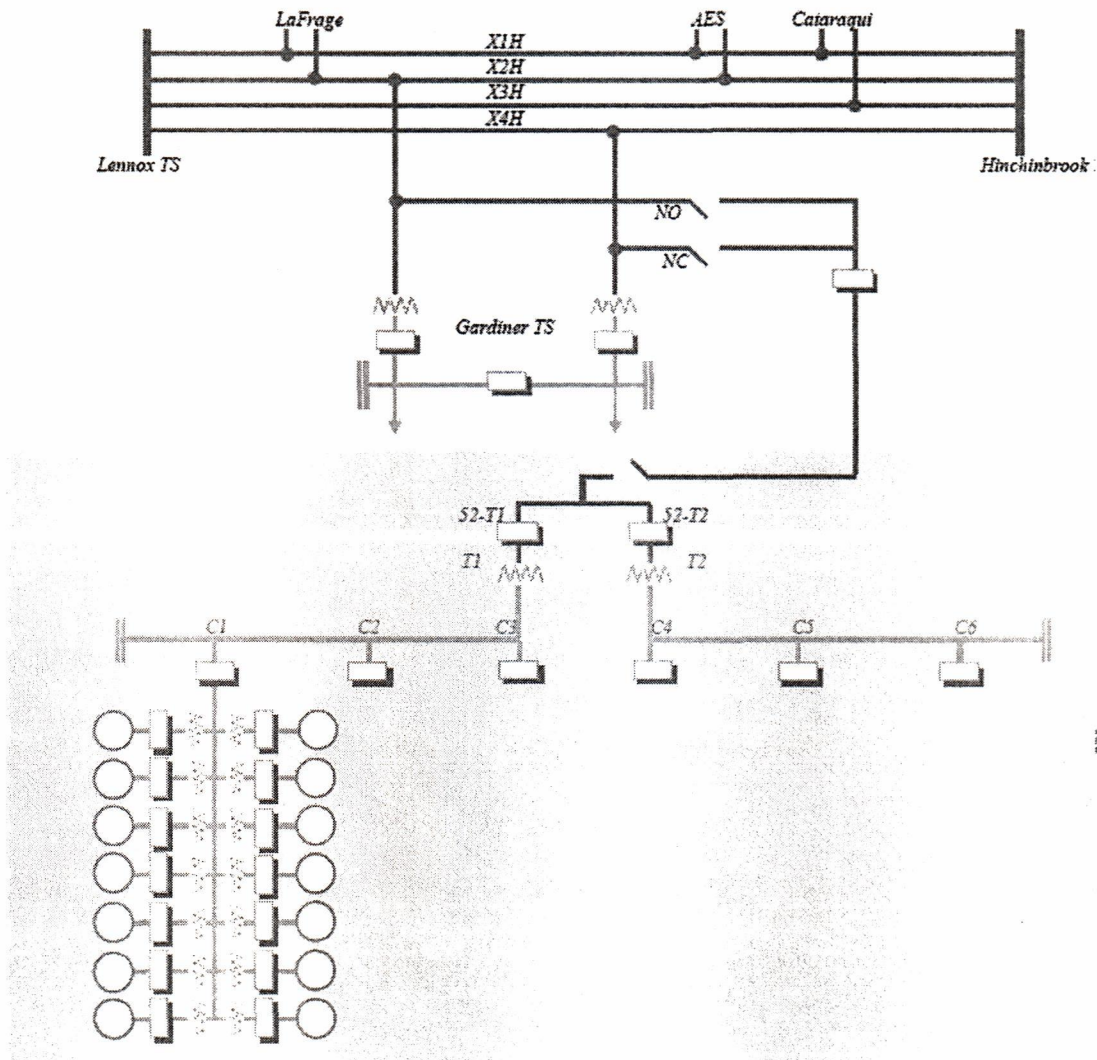


FIGURE 2 – PROPOSED CONNECTION ARRANGEMENT

The number of turbines N per circuit and MW injection is summarized below.

Circuit	C1	C2	C3	C4	C5	C6	Total
N	14	15	14	16	14	13	86
MW	32.2	34.5	32.2	36.8	32.2	29.9	197.8
	98.9			98.9			

3.2 Existing System

Figure 3A, 3B, 3C, 3D and 3E show the power flow in X2H and X4H at Lennox and Hinchinbrook, the net MW flow into X4H, the power flow in Gardiner transformers T1 and T2, and the Lennox 230 kV voltage in 1 Hr samples during the period of Jan 1 - Dec 31, 2005. The positive flow is leaving the bus.

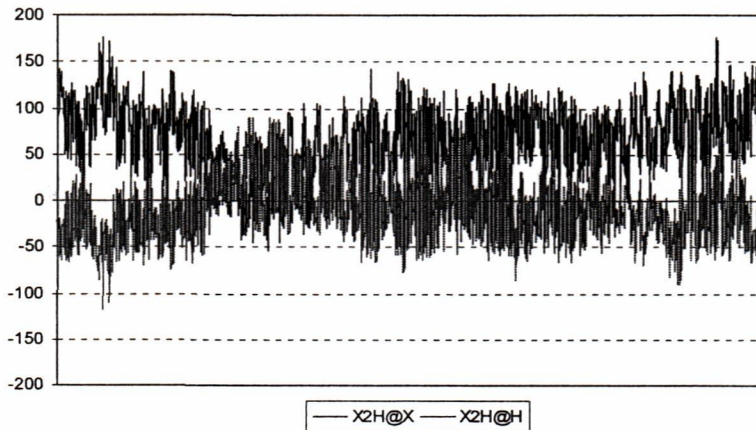


FIGURE 3A – MW FLOW IN X2H

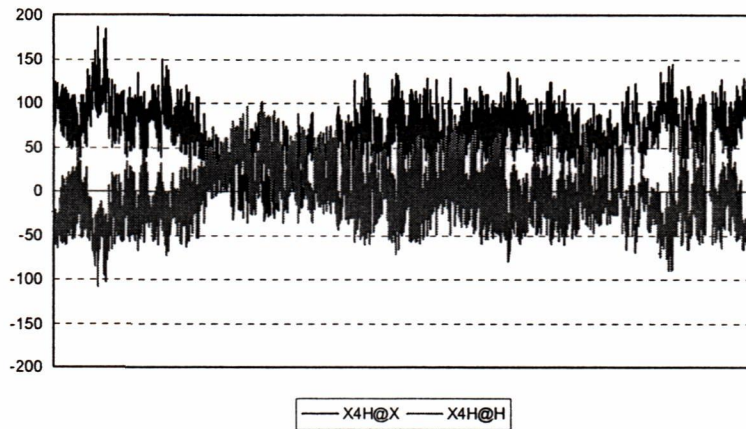


FIGURE 3B – MW FLOW IN X4H

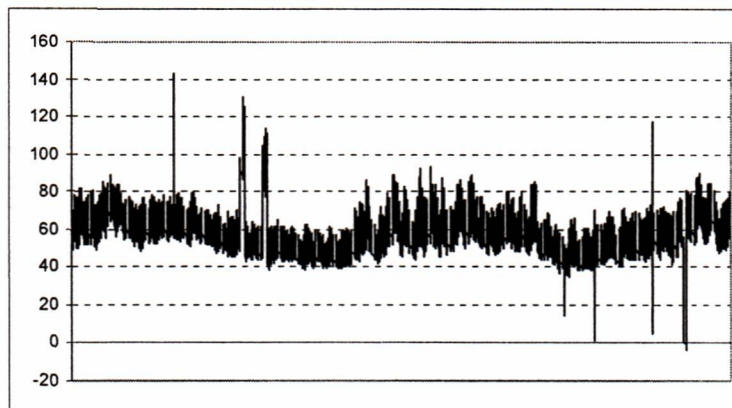


FIGURE 3C – X4H@X + X4H@H

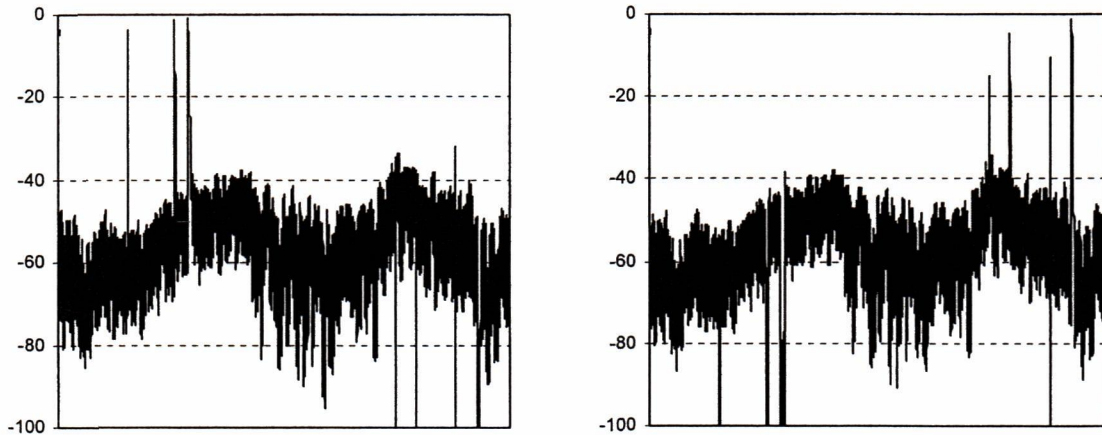


FIGURE 3D – MW FLOW IN GARDINER T1 AND T2

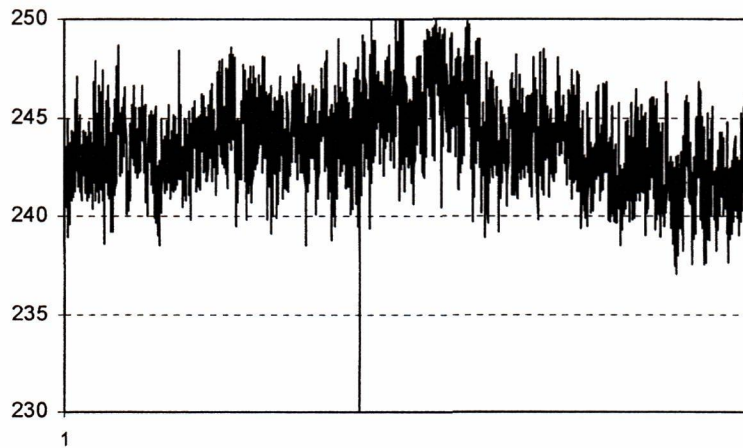


FIGURE 3E – LENNOX 230 kV VOLTAGE

- Figure 3E shows the Lennox 230 kV voltage. The IESO does not have real-time telemetry from Gardiner TS. Considering the electrical proximity of Gardiner to Lennox and the local loads in the vicinity, it can be assumed that the Gardiner voltage could be in the range of 240 – 245 kV. Thus, the reactive resources of the Wolfe Island wind project must have the capability to maintain such high voltages at the connection point. If not, the wind farm could absorb reactive power from the IESO-controlled grid and appear like a new reactive load.
- Figure 3D shows that the average flows in Gardiner T1 and T2 are about 60 MW each. That would mean the 2005 average Gardiner load was about 120 MW. Figure 3C show that the net MW flow into X4H circuit (X4H@X + X4H@H) is also approximately 60 MW which agrees with the MW flow obtained for Gardiner T1.
- From MW flows of Gardiner T1 and T2 given in Figure 3D, it can be concluded that occasionally the Gardiner load reached 170 MW. That means the 197 MW wind project might be able to fully support Gardiner load if sufficient wind prevails.

– End of Section –

4. Data Verification

4.1 Wind Turbine Generators

The data of the generator are given in Appendix A.

4.2 Transformers

Specifications for the Wolfe Island 34.5/230 kV step-up transformer is listed below.

Transformation	240/34.5 kV
Maximum Rating	110 MVA
Impedance	0.0930 pu based on 100 MVA
Configuration	3 phase, high side: wye, low side: delta
Tapping	on-load tap changers at HV ($\pm 10\%$ in 17 steps)

Each of 0.690/34.5 kV generator step-up transformers has reactance of 0.06 pu on 2.6 MVA base and has manual off-load tap changers on HV windings. They have 2 equal steps above nominal and 2 equal steps below nominal giving a total of -5% to $+5\%$ tap variation.

4.3 Circuit Breakers and Switches

Specifications for the breakers and the switches provided by the connection applicant are listed below. If any of the data are inaccurate or recently revised, including absent data must be provided to the IESO. The data must comply with IESO Market Rules and Transmission System Code.

Breakers	LV	HV
Rated line-to-line voltage	34.5 kV	-
Interrupting time	-	3 cycles
Interrupting media	-	SF6
Rated continuous current	-	1200 A
Rated short circuit breaking current	-	63 kA
Switches		
Rated line-to-line voltage	34.5 kV	-
Rated continuous current	-	1200 A

4.4 Connection Circuits

The impedance of the collector system and the 230 kV connections to Gardiner TS is given in Section 6.4.2.

– End of Section –

5. Fault Level Assessment

Following is an summary of the projected fault currents at key buses that are associated with 230 kV X2H/X4H circuits extracted from Customer Impact Assessment report produced by Hydro One when the in-feed from full output Wolfe Island project is connected to the circuit X4H. These projected currents are computed as if the buses of nominal voltages of 230, 115, 44 kV are at maximum permissible levels of 250, 127, 46 kV in the power system, so that a margin already exists when comparing with ratings.

Busbar	Sym 3-ph	Asym 3-ph	Sym LG	Asym LG
Lennox 230 kV	31.05	40.50	38.31	51.36
Gardiner X2H 230 kV	9.18	9.89	8.08	8.86
Gardiner X4H 230 kV	9.45	10.18	10.98	11.63
Lafarge X2H 230 kV	17.11	18.77	15.42	15.84
Hinchinbrook 230 kV	18.41	19.84	12.30	12.38
Wolfe Island 230 kV	8.40	8.53	10.13	10.38

The Ontario Transmission Code requires that the 230 kV circuit breakers have a minimum 63 kA 3-phase short circuit current interrupting capability and a minimum 80 kA single line to ground short circuit current interrupting capability.

It is concluded that the new fault levels resulting from the incorporation of the Wolfe Island wind farm does not exceed the fault interrupting capability of the breakers in the IESO-controlled grid.

– End of Section –

6. System Impact Studies

This connection assessment was done to identify the effect of the proposed facility on thermal loading of circuits, the system voltages for pre/post contingencies and the transient performance of the system.

6.1 Assumptions and Background

Following sections summarizes the assumptions and the background information used for the analysis.

6.1.1 Pre-contingency conditions

- The study was performed for a system with all transmission elements in service.
- The loads used were 2008 summer coincident peaks under extreme weather conditions. The total Ontario demand is 27,500 MW and the zonal load distribution is :

NW	NE	Essa	Ottawa	East	Toronto	Niagara	SW	Bruce	West
923	1169	1673	1916	1738	10149	1045	5391	57	3439

- The key generations and loads in the vicinity are followings.

Beauh. Import	St Law Import	Lennox GS	Saunders GS	AES GS	Wolfe Island	Gardiner Load
200	300	2200	925	140	198	170 with pf = 0.9

- The proposed Ontario-Quebec HVDC link has been modeled in the load flow used for the thermal analysis with a 1250 MW imports from Hydro Quebec to stress the eastern Ontario further.
- For voltage decline studies, the MW loads were converted into constant current and admittance loads equally. The MVar loads were converted only into constant admittance loads.
- The Gardiner TS load is assumed 170 MW. This is the forecast peak for 2008 and also the Figure 2D shows that this level of load was occasionally reached in 2005.
- The large power stations in the province had following number of units in service.

Darlington GS	Bruce GS	Nanticoke GS	Lennox GS	Pickering GS	Lambton GS
4	6	8	4	6	0

- Wind farm generates 198 MW. After losses, 173 MW is injected into Gardiner TS in which 77 MW or 45 % of the power flows into X4H and 96 MW or 55 % of the power flows into Gardiner load. The Gardiner load is 170 MW in which 96 MW or 56 % of the load comes through T1 connected to X4H and 75 MW or 44 % of the load comes through T2 connected to X2H. It can be concluded that the connection of the wind farm to one circuit only does not result into a material unbalance on the loading of the Gardiner transformers.

6.1.2 Siemens MK II reactive power limits

The Siemens MK II wind turbine generator has a dc link between the stator and the grid. Therefore, the reactive capability of the MK II generator not only depends on the AC voltage at terminals, but also depends on the active power capability of the DC link, i.e. the DC voltage and the DC current. As a result, the *reactive power capability* curves of MK II are different to those of synchronous machines, and the Q_{\max} and Q_{\min} can no longer be assumed constants within $\pm 5\%$ of rated voltage. Therefore, the variation of Q_{\max} and Q_{\min} in MK II with terminal voltage needs to be correctly modelled in the load flow simulation; if not, a conservative Q_{\max} and Q_{\min} corresponding to rated power within $\pm 5\%$ of rated voltage need to be used instead of using Q_{\max} and Q_{\min} corresponding to rated power and rated voltage.

The Figure 4 shows the pu reactive power capability of MK II corresponding to rated power. It must be noted that the pu values which are plotted as provided by Siemens are not based on machine MVA, but based on P_{\max} of 2.3 MW.

The IESO requires that any generator including MK II must be able to continuously operate within $\pm 5\%$ of rated voltage. For that entire range, the MK II must have the capability to generate $2.55 \times \sin [\cos^{-1}(0.9)]/2.3 = 0.47$ pu reactive power and to absorb $2.55 \times \sin [\cos^{-1}(0.95)]/2.3 = 0.34$ pu reactive power on P_{\max} base. The Figure 4 also shows this required level of lag and lead reactive power.

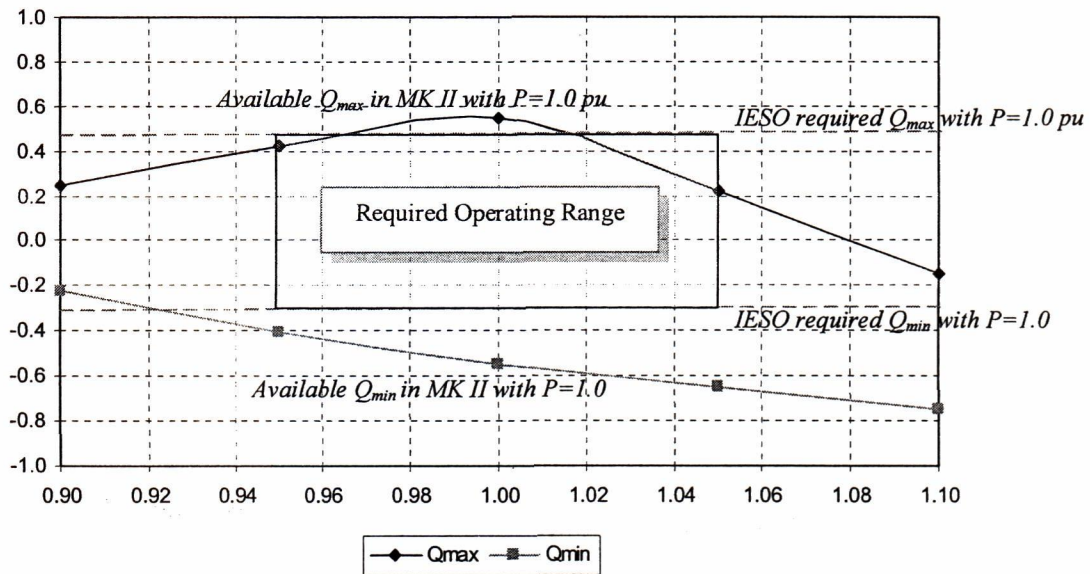


FIGURE 4 – VARIATION OF Q_{\max} AND Q_{\min} WITH TERMINAL VOLTAGE

It can be seen that if the rated voltage is 1.0 pu, at the extremes of the $\pm 5\%$ voltage range, the generator can deliver only $Q_{\max} = 0.42$ pu (at 0.95 pu voltage) and $Q_{\max} = 0.22$ pu (at 1.05 pu voltage). That would mean each MK II generator can be short of delivering $0.47 - 0.22 = 0.25$ pu or $0.25 \times 2.3 = 0.575$ MVAR of required dynamic reactive power. As far as the entire wind farm is concerned, it can be short of delivering $0.575 \times 86 = 49$ MVAR of required dynamic reactive power. Conversely, the MK II can absorb $Q_{\min} = 0.41$ pu (at 0.95 pu voltage) and $Q_{\min} = 0.65$ pu (at 1.05 pu voltage). That would mean each MK II has the capability to absorb excess reactive power than the amount required by the IESO.

6.2 Post-contingency voltage decline

The ΔV_1 was found for contingencies when the new facility is connected to the circuit X4H which is the normal operating mode. The ΔV_2 was found when the new facility is connected to the circuit X2H. The ΔV_1 and ΔV_2 given below are the worst of pre-ULTC and post-ULTC values. For pre-ULTC, ΔV_1 and ΔV_2 are calculated after loads are converted into voltage dependant functions and for post-ULTC, ΔV_1 and ΔV_2 are calculated after converting the loads back to constant MVA loads assuming that the loads have returned to the pre-contingency levels. The Gardiner capacitor bank was put O/S pre-contingency in order to produce a weak voltage profile in the local area. For the loss of wind farm, the power factor of all wind turbine generators was made 0.9 lag.

Monitored Bus	ΔV_1 %				ΔV_2 %
	Loss of X522A	Loss of X1H + X2H	Loss of Lennox T52	Loss of Wind Farm	Loss of X3H + X4H
Lennox 500 kV	0.5	0.1	0.3	0.1	0.1
Lennox 230 kV	0.3	0.4	2.1	0.2	0.3
Hawthorne 500 kV	6.8	0.0	0.2	0.1	0.0
Hawthorne 230 kV	4.8	0.0	0.2	0.1	0.0
Hawthorne 115 kV	4.6	0.0	0.2	0.1	0.0
Hinchinbrook 230 kV	0.3	1.8	1.5	0.3	1.7
Merivale 230 kV	4.4	0.0	0.1	0.1	0.0
Cataraqui 230 kV	0.3	1.5	1.8	0.3	1.5
Cataraqui 115 kV	0.3	2.6	1.6	0.2	2.6
Gardiner 230 kV	0.3	1.7	1.7	1.3	1.7
Gardiner 44 kV	0.2	9.4 (pre)	1.8	0.8	9.7 (pre)
Frontenac 44 kV	0.3	2.7 (pre)	1.6	0.3	2.7 (pre)

The voltage declines are within the required 10 % limit.

6.3 Thermal analysis

A purchase of 1250 MW from Hydro Quebec via proposed HVDC link has been modeled.

Ratings

	X1H@X	X2H@X	X3H@X	X4H@X	X1H@H	X2H@H	X3H@H	X4H@H	Gard T1
Continuous	1579 A	1579 A	1401 A	1579 A	1433 A	1393 A	1118 A	1528 A	125 MVA
STE	1717 A	1717 A	1524 A	1717 A	1556 A	1515 A	1213 A	1661 A	Xxx MVA

Pre-contingency analysis

Projected Current Flow/Continuous Rating							
X1H@X	X2H@X	X3H@X	X4H@X	X1H@H	X2H@H	X3H@H	X4H@H
0.20	0.19	0.27	0.11	0.08	0.15	0.09	0.20

Post-contingency analysis

Loss of	Projected Current Flow/STE Rating							
	X1H@X	X2H@X	X3H@X	X4H@X	X1H@H	X2H@H	X3H@H	X4H@H
X1H+X2H	-	-	0.43	0.25	-	-	0.09	0.23
X3H+X4H	0.36	0.38	-	-	0.11	0.19	-	-

The results do not indicate any thermal over-loading of circuits due to the incorporation of the wind farm.

6.4 Reactive Power Sources

6.4.1 Dynamic Reactive Power Source

The Figure 5 shows the dynamic reactive power range of MK II or the variation of Q_{max} and Q_{min} from 0.9 pu to 1.1 pu terminal voltage if the power output is at rated level (1.0 pu or 2.3 MW) and 97 % of the rated level (0.97 pu or 2.23 MW) with the IESO required level of Q_{max} and Q_{min} for any generator.

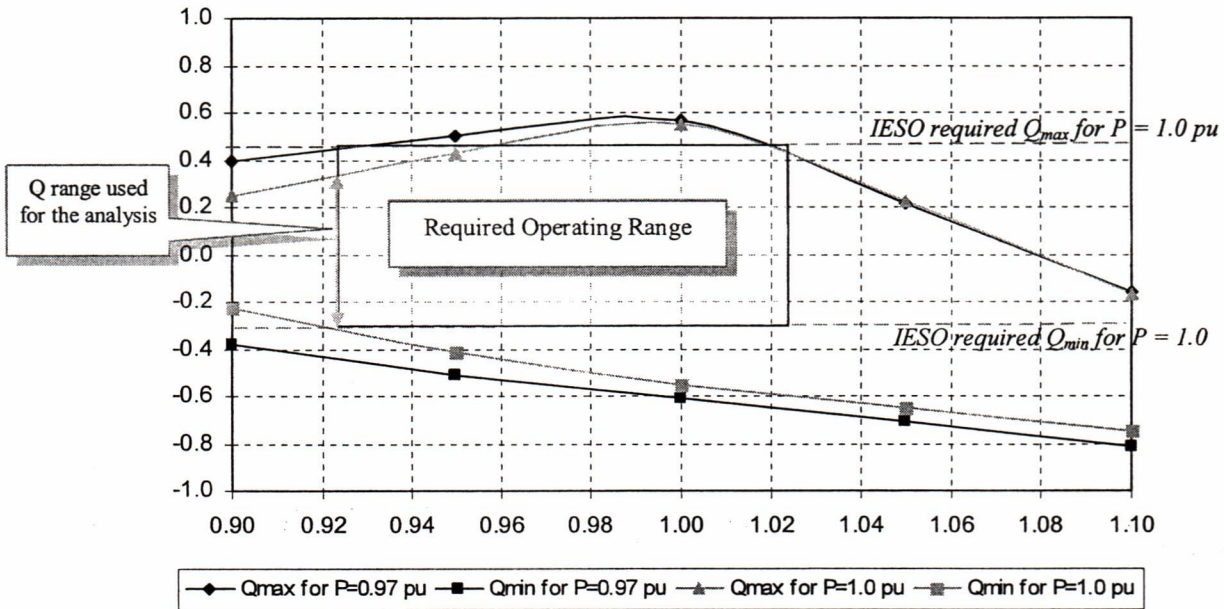


FIGURE 5 – VARIATION OF Q_{MAX} AND Q_{MIN} WITH WTG TERMINAL VOLTAGE

It was evident from the Figure 4 of the Section 6.1.2, that if the MK II is operated at 1.0 pu as nominal voltage, the generator is not able to supply the IESO required level of reactive power near the extremes of the $\pm 5\%$ voltage range. This will impose a requirement to have an extra dynamic reactive power source to compensate for above deficiency. As an alternative solution, it can be seen from Figure 5 that if the nominal operating voltage is reduced to 0.975 pu and the generator produces only up to 0.97 pu active power, the generator could largely meet the IESO requirement on reactive power capability without having any extra dynamic reactive power source.

This would mean,

- (a) the generator must be nominally operated at 673 V
- (b) the maximum power output should be 2.23 MW
- (b) the generator must be able to continuously produce 2.23 MW within 639-706 V range

The IESO has been notified that given the location of the wind farm, pitch angle, air density etc for the Wolfe Island installation, the MK II will exceed producing 2.23 MW only when the wind speed exceeds 13.5 m/s. The proponent reviewed the wind farm model that was prepared using the data collected during the year 2004 from Wolfe Island wind farm site meteorological measurement towers and indicated that the hourly mean wind speed exceeded 13.5 m/s only for an annualized 577 hours or 6.5 % of the time of the year. Therefore, the prediction is that the wind turbines in Wolfe Island will generate in excess of 2.23 MW only for a relative short period of the year. Therefore, the IESO has determined that during this short period of time, it could allow generators at Wolfe Island to make more than 2.23 MW when the wind speed exceeds of 13.5 m/s, but if the system conditions require, the proponent must limit the output of each turbine to 2.23 MW upon the request of the IESO control room. The proponent has agreed to comply with this requirement.

Having a lower requirement of this nature on reactive power for induction generation facilities is in accordance with Market Rules since the IESO has identified that the lower requirement does not adversely affect the reliability of the IESO-controlled grid. It must be noted that this is a mere 6 MW penalty on the entire wind farm output, but what is required is not a reduction of collective output of wind farm to 191 MW, but a reduction of each generator output to 2.23 MW. As this reduction must be performed in 86 separate generators, the WFMS must have the capability to perform this reduction in a rapid manner in order to maintain the security of the IESO-controlled grid.

In load flow and dynamic studies, the proposed Wolfe Island WGS was modeled with six radial circuits with a single equivalent MK II generator connected to end of each circuit. For the general analysis, it has been assumed that each generator is producing maximum output = 2.3 MW. The Q_{max} and Q_{min} used for the analysis correspond to 2.3 MW and the terminal voltage 0.925 pu since $Q_{max} = 0.35$ pu and $Q_{min} = 0.32$ pu that corresponds to 0.925 pu voltage are the minimums within 0.925 pu to 1.025 pu voltage range. The equivalent P_{max} , P_{min} , Q_{max} and Q_{min} are calculated by aggregating P_{max} , P_{min} , Q_{max} and Q_{min} for the number of generators connected to each circuit.

	Per WTG	C1	C2	C3	C4	C5	C6	Total
WTG	1	14	15	14	16	14	13	86
Q_{max} (MVA _r)	0.80	11.2	12	11.2	12.8	11.2	10.4	68.8
Q_{min} (MVA _r)	0.73	10.22	10.95	10.22	11.68	10.22	9.49	62.78
P_{max} (MW)	2.30	32.2	34.5	32.2	36.8	32.2	29.9	197.8
P_{min} (MW)	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00

6.4.2 Static Reactive Power Source

If any generator is operated within 1.05 – 0.95 pu voltage in a system where the reactance between generator terminals and the HT connection point is in excess of 0.1313 pu on generator MVA base, the reactive power produced by the generator will not be sufficient to maintain the HT voltage to a single value. This will result in the need to install a static reactive compensation.

If the rated terminal voltage is reduced to 0.975 pu, the maximum limit on reactance to avoid installing compensation will be reduced and consequently, the compensation for excess reactance must be increased. With 0.975 terminal voltage, the taps of each generator step-up transformer must be changed to 1.025 pu to obtain 1.0 pu voltage at the collector bus. This 0.025 pu tap change will increase the impedance of each of eighty six step-up transformers by a factor of $(0.025)^2$. Thus, the compensation must be further increased to account for this increase in the actual impedance.

Equivalent impedance

The followings are the impedances on 100 MVA base to represent the six feeders in the collector network and equivalent generator step-up transformers (tap changed to 1.025 pu).

	C1	C2	C3	C4	C5	C6
R_{Feeder}	0.3080	0.2736	0.4072	0.4251	0.2352	0.3306
X_{Feeder}	0.2001	0.1937	0.3742	0.3851	0.2040	0.3094
B_{Feeder}	0.0000778	0.0000886	0.0002122	0.000226	0.000114	0.000179
$R_{\text{Generator Transformer}}$	0.02367	0.02209	0.02367	0.02071	0.02367	0.02549
$X_{\text{Generator Transformer}}$	0.17318	0.16163	0.17318	0.15153	0.17318	0.18650

The 230 kV transmission consists of an underground cable in mainland, a submarine cable across the St Lawrence River and underground cables with in Wolfe Island. The parameters for this combination and 34.5/230 kV transformers T1 and T2 on 100 MVA base are followings.

	T1	T2	230 kV connection
R	0.0000	0.0000	0.001745
X	0.0930	0.0930	0.003888
B	-	-	0.000000

Followings are various reactances (on 100 MVA base) computed from data provided by the proponent.

Reactance of collector circuits C1, C2, C3 and their GSU transformers	= 0.1367 pu
Reactance of Wolfe Island T1	= 0.0930 pu
(a) Reactance of generator terminals of C1, C2, C3 and Wolfe Island T1	= 0.2297 pu
Reactance of collector circuits C4, C5, C6 and their GSU transformers	= 0.1535 pu
Reactance of Wolfe Island T2	= 0.0930 pu
(b) Reactance of generator terminals of C4, C5, C6 and Wolfe Island T2	= 0.2465 pu
(c) Reactance of the 230 kV cables	= 0.0038 pu
(a) // (b) + (c) Reactance of the entire wind farm up to Gardiner 230 kV bus	= 0.1228 pu

Capacitor requirement

The reactance of the entire wind farm on facility MVA base (219 MVA) is 0.2694 pu. The calculation of the static compensation is based on each generator is producing 2.23 MW, so that the generator can produce maximum reactive power (at 0.9 lag power factor).

	<i>Acceptable conditions</i>	<i>Actual conditions</i>
WTG terminal voltage	0.975 pu	0.975 pu
Total reactive power generation from wind farm	95 MVar	95 MVar
Total connection impedance on 219 MVA base	0.1306 pu	0.2694 pu
230 kV Gardiner voltage can be controlled up to	1.0 pu	0.96 pu
Reactive power injected into existing 230 kV system	69 MVar	41 MVar

The difference in actual and acceptable reactive power flow into 230 kV bus is 26 MVar. Due to this difference, the wind farm can maintain the Gardiner 230 kV voltage only up to 0.96 pu, i.e. 220 kV. If the voltage to be maintained to 1.0 pu, i.e. 230 kV, the above extra loss of 26 MVar must be supplied to the 230 kV bus in the form of a reactive compensation.

However, often the Gardiner voltage is more than 230 kV and can be as high as 245 kV at times. If that level of voltage is to be maintained by the wind farm, more than 26 MVar compensation must be added to the 230 kV bus. The additional compensation is calculated using QV analysis. Figure 6 shows the QV curve for the Gardiner 230 kV bus. This graph demonstrates the variation of the voltage with additional reactive power injected into 230 kV bus.

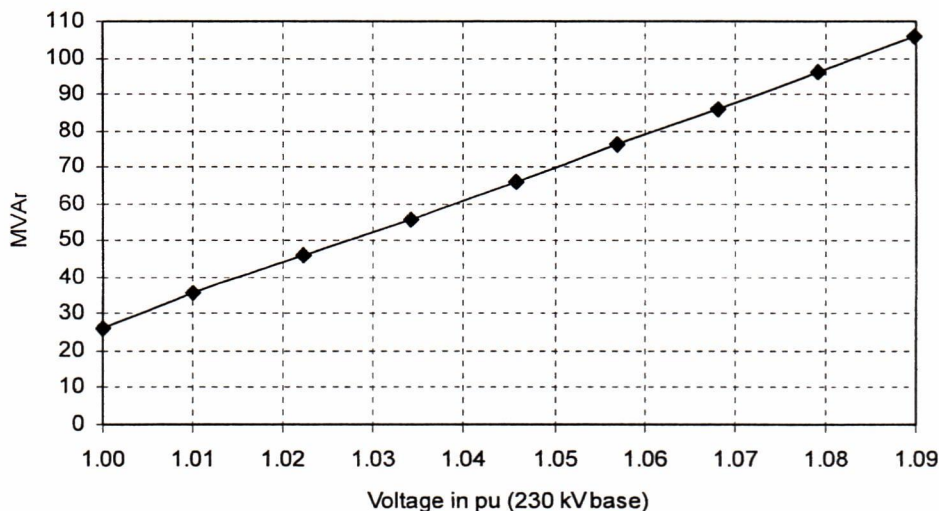


FIGURE 6 – QV CURVE FOR GARDINER 230 kV BUS

If the voltage reaches 245 kV or 1.07 pu, approximately 85 MVar of compensation would be required at 230 kV bus so that the wind farm could maintain that voltage. If not, the wind farm would draw reactive power from the grid. Instead to the 230 kV bus, the compensation can be provided to the collector buses if an added compensation is provided to supply losses occurring in the 230 kV cables and two 34.5/230 kV transformers. These losses appear to be about 10 - 15 MVar depends on the operating condition. Thus, the IESO requires 50 MVar to be provided at each collector bus and be supplied in 5 steps of 10 MVar.

In order to avoid hunting, the capacitor switching must be done automatically by a local over/under voltage scheme with suitable settings by the Wind Farm Management System. Instead of controlling the 230 kV voltage, it is also acceptable to the IESO if the capacitor bank controls the collector bus voltage to a level that is determined by the IESO operating staff. In that case, the Wind Farm Management System

must coordinate and direct the capacitor switching and generator reactive power production as both equipment controls the voltage at the same busbar.

Post-capacitor switching voltage

Following table shows different voltages if entire 100 MVAR is switched on. The generators are controlling the collector bus voltage to 1.0 pu. For this particular simulation, the 34.5/230 kV transformer tap has been set to 1.1 pu while generator step-up transformer taps are set to 1.025 pu.

Generator ID	G1	G2	G3	G4	G5	G6
Terminal voltage	691 V	688 V	693 V	700 V	677 V	682 V
Collector bus voltage	34.5 kV			34.5 kV		
230 kV bus	Gardiner = 242 kV, Wolfe Island = 242 kV					

The results show that even if the entire 100 MVAR capacitor bank is switched on, the turbine terminal voltages will be in the range of 677 - 700 V. This is within the required range of 673 – 706 V where the IESO lag power factor requirement is met. Further, since the first over-voltage trip setting is normally set to 740 V (10 % above nominal voltage of 673 V) the capacitor switching will not trip the generators. In case, the 230 kV voltage is higher than 242 kV, the voltage control set point of the generators can be raised above 1.0 pu.

It must be noted that the entire 100 MVAR of reactive compensation is required to cater losses only when all eighty six turbines are generating maximum capacity of 2.3 MW each. Based on historic wind speed statistics, all generators in Wolfe Island wind farm may not be running full capacity very frequently, thus the full 100 MVAR may not be switched on too frequently.

Voltage change due to capacitor switching

The IESO allows a voltage change ΔV on a single capacitor switching to be no more than 4 %. Following summarizes the percentage change in voltage due to simultaneous switching of the first 10 MVAR capacitors at both collector buses. All generators are made to operate at a fixed power factor to prevent their dynamic reactive power capability change bus voltages, so that the ΔV is only due to switching of the capacitors. The generators absorb maximum reactive power so that the ΔV due to capacitor switching is larger than under normal conditions. The transformer ULTCs have been locked.

ΔV % @ 34.5 kV collector buses	1.8, 1.8
ΔV % @ Wolfe Island 230 kV bus	0.7
ΔV % @ Gardiner 230 kV bus	0.6

The results show that 10 MVAR step size would not exceed IESO requirement on ΔV .

6.5 Transient Analysis

Eight contingencies were tested. They include a permanent three-phase fault on a circuit cleared with normal fault clearing time (TSC1, TSC3, TSC5, TSC6), simultaneous permanent phase to ground faults on different phases of each of two adjacent circuits on a multiple circuit tower cleared with normal fault clearing times (TSC2, TSC4), a permanent phase to ground fault on a circuit cleared by delayed fault clearing time (TSC7) and a multiple outage (TSC8). Usually, the double contingencies are not respected in

eastern Ontario, however they were included to provide any additional insight. It is assumed that 500, 230 and 44 kV breakers open in 2, 3 and 8 cycles respectively.

Contingencies

- TSC1 Normally cleared 3ph fault at X522A@X
- TSC2 Normally cleared LG fault at X1H@X + LG fault at X2H@X
- TSC3 Normally cleared 3ph fault at X2H@X
- TSC4 Normally cleared LG fault at X522A@X + LG fault at X523A@X
- TSC5 Normally cleared 3ph fault at Gardiner 44 kV load bus
- TSC6 Normally cleared 3ph fault at HT side of Wolfe Island Transformer T1
- TSC7 LG fault at X2H@X + H52L2 BF at Lennox and loss of T52 transformer
- TSC8 Three X4H terminal breakers open + fourth breaker open by a fault in adjacent circuit

The simulation results are shown in Appendix C.

None of the contingencies except TSC8 which associates a multiple-outage caused any unacceptable transient performance to the IESO-controlled grid. For the post-TSC8, the wind farm is connected to the 230 kV system only via two Gardiner 230/44 kV transformers in series. This high impedance caused a significant voltage drop at generator terminals for an extended period causing oscillations. Given that the terminal voltage is low and sustained, the low voltage ride through capability does not assist. The generator oscillations caused the Gardiner 230 kV voltage also to experience oscillations. Therefore, any probable outages that may result in the wind farm connecting to the 230 kV system only via 44 kV busbar must be avoided by connecting the wind farm to the companion circuit X2H pre-contingency.

Islanding

When X4H is tripped, the MK II generators in the wind farm will island with available capacitors. Subsequently, the capacitors may switch out by over-voltages and generators may trip by over-frequency. The IESO attempted to simulate the transient performance of this over-generated island to investigate the resulting island voltages and turbine speeds. It does not appear that the MK II model is suitably developed to simulate wide variations of frequency and voltage occurring in islanding situations.

6.6 Low-voltage ride through capability

As any other generator, the MK II is expected to trip only for contingencies which removes 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 generator terminals is to be temporarily mitigated by the LVRT capability. The LVRT feature is implemented by injection of additional reactive current by the grid side AC/DC converter to maintain generator terminal voltage in the event of a disturbance in the power system that caused terminal voltage to drop.

The implementation of LVRT should not require any instant modification to under-voltage protection settings. However, in PSS/E model for MK II, the LVRT feature accompanies a change of under-voltage setting as shown below.

<i>With No LVRT</i>		<i>With LVRT</i>	
<i>Voltage range</i>	<i>Event</i>	<i>Voltage range</i>	<i>Event</i>
1.00 – 0.90 pu	No trip	1.00 – 0.90 pu	No trip
0.90 – 0.85 pu	Relay 1 trips in 3.1 sec	0.90 – 0.70 pu	Relay 1 trips in 3.1 sec
0.85 – 0.80 pu	Relay 3 trips in 0.075 sec	0.70 – 0.15 pu	Relay 2 trips in 2.5 sec
		0.15 – 0.00 pu	Relay 3 trips in 0.15 sec

The LVRT capability must be demonstrated during commissioning by conducting a set of IESO specified field tests and the result should be verifiable using the PSS/E model with LVRT enabled.

The results of transient analysis performed with LVRT concluded that above settings are adequate.

6.7 Wind Farm Management System

The Wind Farm Management System must coordinate the voltage control process. The proponent 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.

– End of Section –

APPENDIX A

Generator Data

2.30	Machine Active Power Rating (MW)	MBASE
0.69	Stator Voltage Rating (kV)	
60	Rated network frequency (Hz)	FBASE
90200	Connection busbar number	
1	Generator Identifier	
0.0000	Generator Resistance in Loadflow (Rs, pu)	RSORCE
0.6415	Generator Reactance in Loadflow (Xd", pu)	XSORCE
2.6	Unit Transformer Rating (MVA)	Note 1
0.0084	Unit Transformer Resistance (pu)	Note 1
0.0600	Unit Transformer Reactance (pu)	Note 1

Value	Description	Ref:
1	Model Version Number	
1	Reactive control mode (0=fixed, 1=voltage, 2 & 3 not in use)	
1	Fault Ride Through mode (0=disabled, 1=enabled)	
1	Enable Under-voltage relay 1	
1	Enable Under-voltage relay 2	
1	Enable Under-voltage relay 3	
1	Enable Over-voltage relay 1	
1	Enable Over-voltage relay 2	
1	Enable Under-frequency relay 1	
1	Enable Under-frequency relay 2	
1	Enable Over-frequency relay 1	

Value	Description	Ref:
54.62		
1.0927	Generator Inertia Constant (MW.s/MVA)	
14.3349	Rotor Inertia Constant (MW.s/MVA)	
0.1458	Shaft Damping	
138.49	Shaft Stiffness	
1.2471	Description N/A	
1.1432	Description N/A	
1.1109	Description N/A	
1.0003	Description N/A	
1.40	Description N/A	
1.10	Description N/A	
0.10	Description N/A	
22	Description N/A	
100000	Description N/A	
3.00	Description N/A	
100000	Description N/A	
2.00	Description N/A	
0.10	Voltage dip threshold for FRT activation (pu)	Normal
0.40	Voltage dip threshold for FRT activation (pu)	Post-Fault
0.090	Description N/A	
0.090	Description N/A	
0.160	Description N/A	
1.00	Description N/A	

3.2	Description N/A	
63.7	Description N/A	
0.90	Description N/A	
50.00	Description N/A	
10.00	Description N/A	
0.472	Description N/A	
66.0	Description N/A	
1.0878	Description N/A	
0.0022	Description N/A	
0.1348	Description N/A	
0.040	Description N/A	
2.10	Description N/A	
0.70	Description N/A	
1.20	Description N/A	
0.70	Description N/A	
1.89	Description N/A	
2.00	Description N/A	
0.82	Description N/A	
0.50	Description N/A	
0.40	Description N/A	
4.00	Description N/A	
1.225	Air density	
15.00	User defined wind speed for rated power operation (m/s)	
1.00	Description N/A	
0.1768	Description N/A	
0.6464	Description N/A	
1.0069	Description N/A	
13.05	Description N/A	
-94.25	Description N/A	
-52.36	Description N/A	
0.15	Description N/A	
7.0	Description N/A	
-8.0	Description N/A	
45.0	Maximum pitch angle	
-1.0	Minimum pitch angle	
2.0	Description N/A	
0.060	Description N/A	
0.9655	Description N/A	
-4.7283	Description N/A	
-0.6755	Description N/A	
0.2174	Description N/A	
-0.2174	Description N/A	
1.00	Description N/A	
0.90	Under Voltage Relay 1 - Voltage Setting (pu)	
3.000	Under Voltage Relay 1 - Time Setting (s)	
0.100	Under Voltage Relay 1 - Relay activation time (s)	
0.70	Under Voltage Relay 2 - Voltage Setting (pu)	
2.400	Under Voltage Relay 2 - Time Setting (s)	
0.100	Under Voltage Relay 2 - Relay activation time (s)	
0.15	Under Voltage Relay 3 - Voltage Setting (pu)	FRT Mode

0.100	Under Voltage Relay 3 - Time Setting (s)	FRT Mode
0.050	Under Voltage Relay 3 - Relay activation time (s)	FRT Mode
0.85	Under Voltage Relay 3 - Voltage Setting (pu)	
0.075	Under Voltage Relay 3 - Time Setting (s)	
0.000	Under Voltage Relay 3 - Relay activation time (s)	
1.10	Over Voltage Relay 1 - Voltage Setting (pu)	
1.000	Over Voltage Relay 1 - Time Setting (s)	
0.000	Over Voltage Relay 1 - Relay activation time (s)	
1.20	Over Voltage Relay 2 - Voltage Setting (pu)	
0.200	Over Voltage Relay 2 - Time Setting (s)	
0.000	Over Voltage Relay 2 - Relay activation time (s)	
0.95	Under Frequency Relay 1 - Frequency Setting (pu)	
10.000	Under Frequency Relay 1 - Time Setting (s)	
0.000	Under Frequency Relay 1 - Relay activation time (s)	
0.94	Under Frequency Relay 2 - Frequency Setting (pu)	
0.100	Under Frequency Relay 2 - Time Setting (s)	
0.000	Under Frequency Relay 2 - Relay activation time (s)	
1.04	Over Frequency Relay 1 - Frequency Setting (pu)	
0.100	Over Frequency Relay 1 - Time Setting (s)	
0.000	Over Frequency Relay 1 - Relay activation time (s)	
0.10	Description N/A	
11.47	Description N/A	
22.91	Description N/A	
2.522	Description N/A	

DYRE Data (auto-generated from datasheet information. Copy/paste into DYRE file.)

/ SMK203 V1.0, 2.3 MW Turbine Data

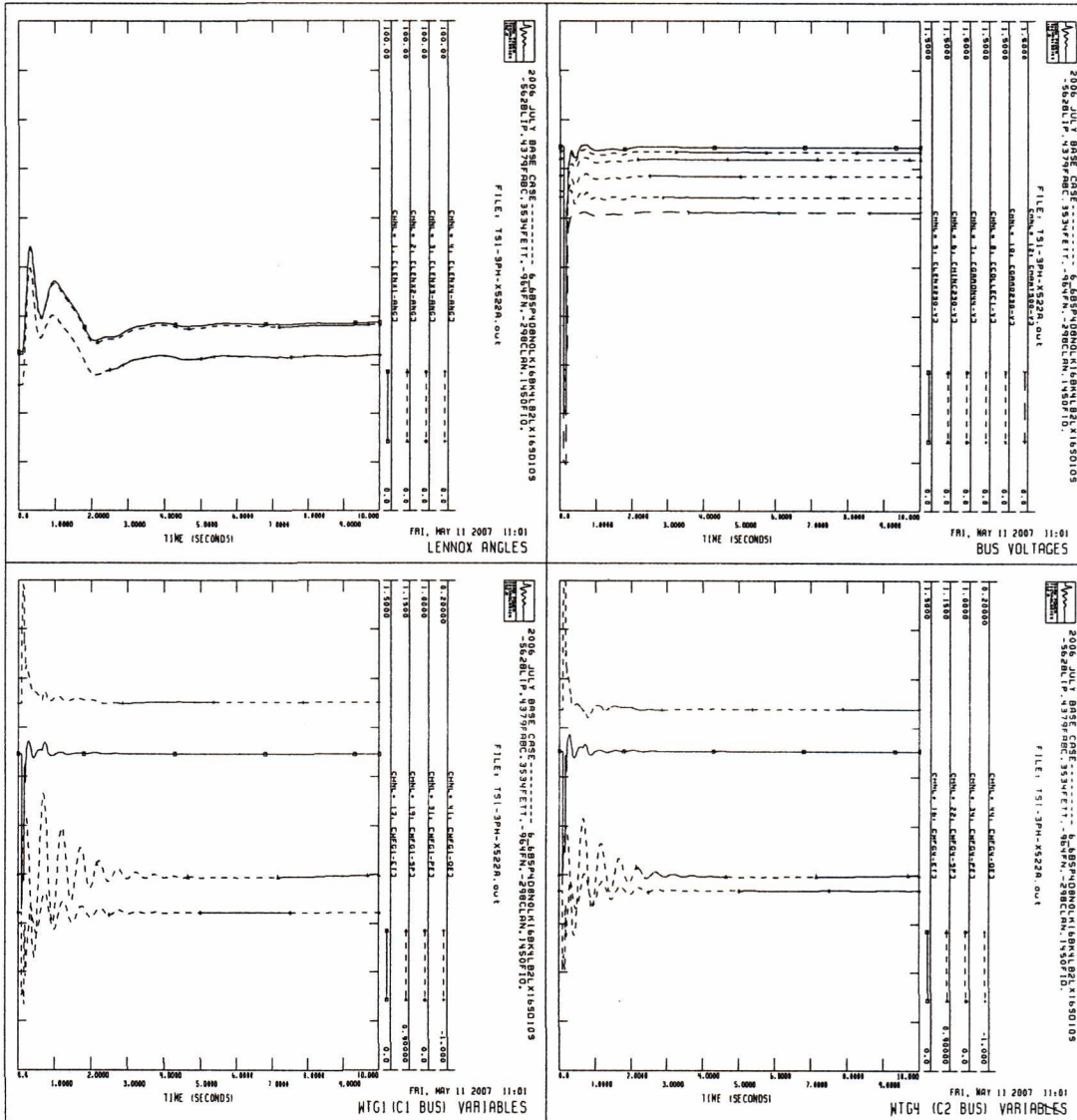
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1 1 1 1 1 1 1 1 1 1 1 54.62 1.0927 14.3349 0.1458 138.49 1.2471 1.1432 1.1109 1.0003 1.40 1.10 0.10 22 100000 3.00 100000
2.00 0.10 0.40 0.090 0.090 0.160 1.00 3.2 63.7 0.90 50.00 10.00 0.472 66.0 1.0878 0.0022 0.1348 0.040 2.10 0.70 1.20
0.70 1.89 2.00 0.82 0.50 0.40 4.00 1.225 15.00 1.00 0.1768 0.6464 1.0069 13.05 -94.25 -52.36 0.15 7.0 -8.0 45.0 -1.0 2.0 0.060
0.9655 -4.7283 -0.6755 0.2174 -0.2174 1.00 0.90 3.000 0.100 0.70 2.400 0.100 0.15 0.100 0.050 0.85 0.075 0.000 1.10 1.000 0.000
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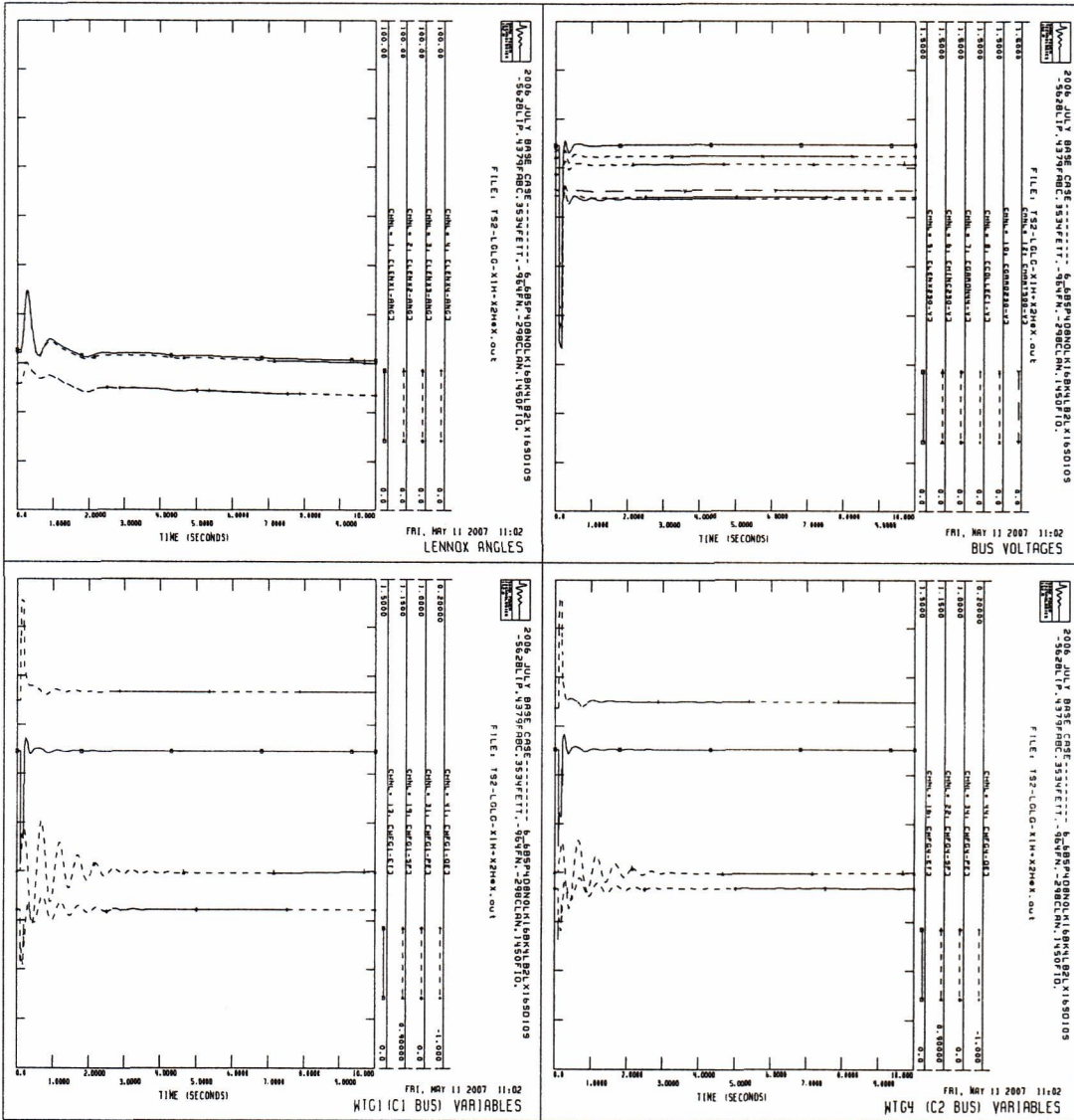
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APPENDIX B

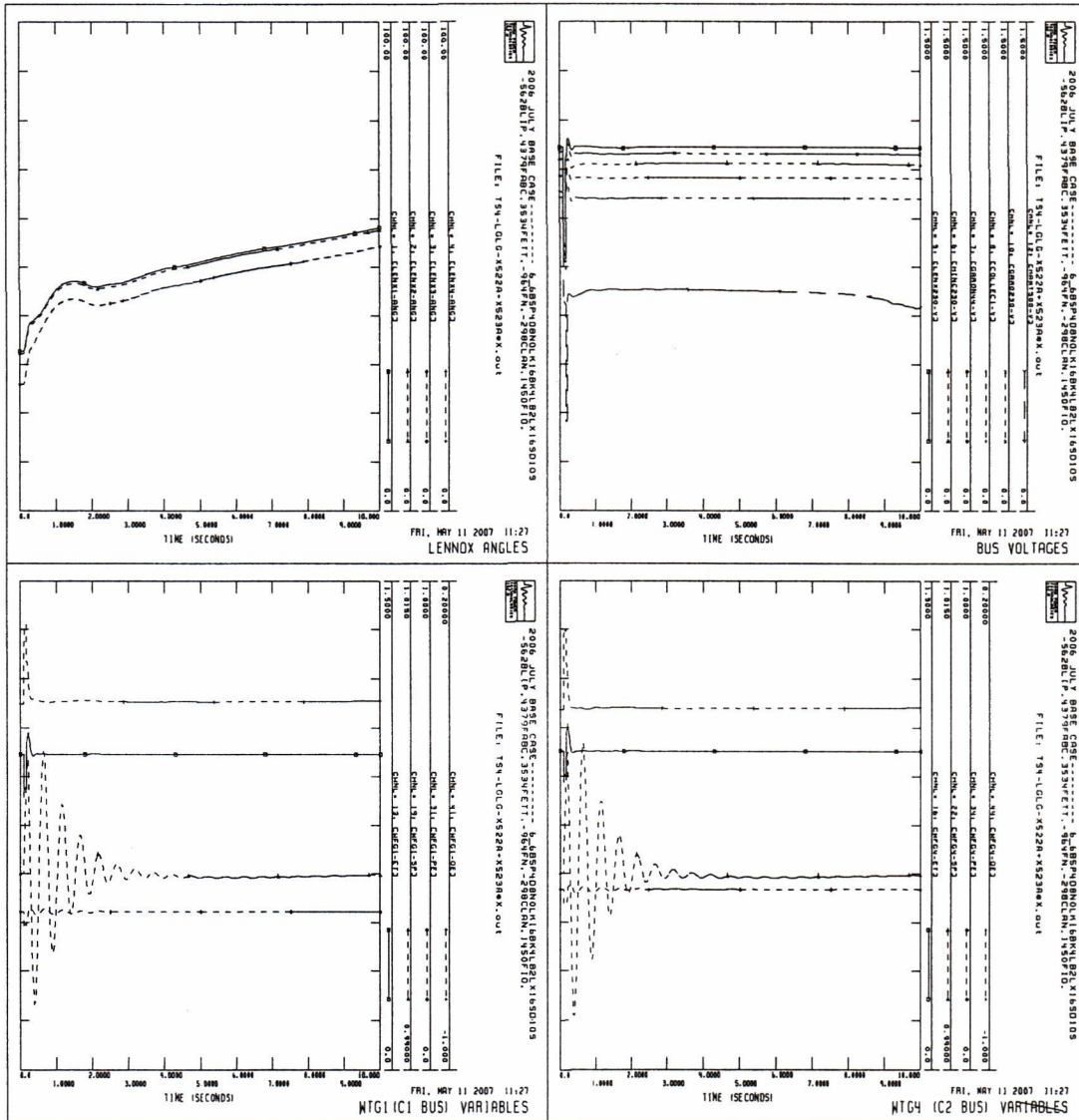
TSC1-Normally cleared 3ph fault at X522A@X



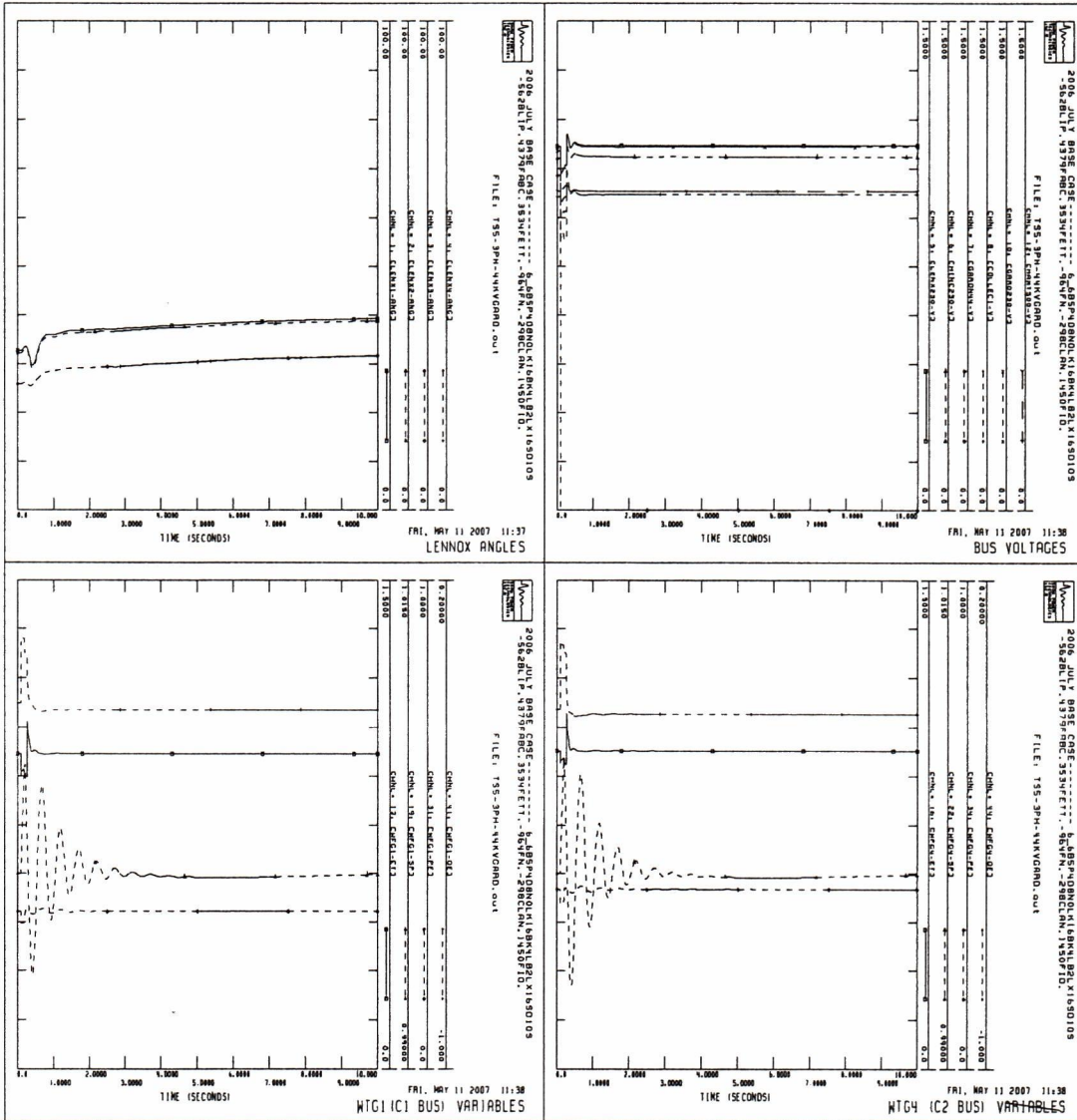
TSC2-Normally cleared LGLG faults at (X1H+X2H)@X



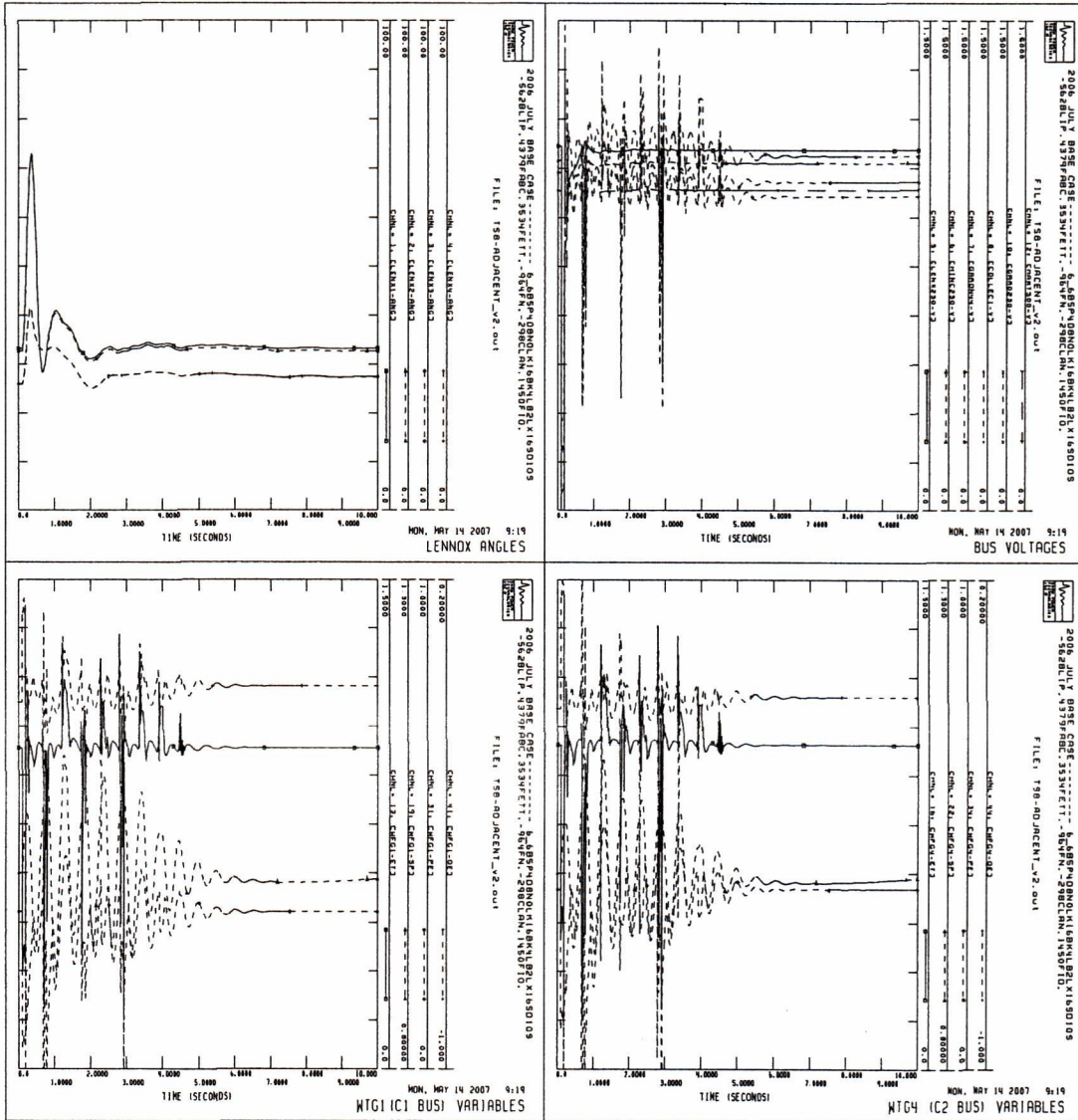
TSC4-Normally cleared LGLG faults at (X522A+X523A)@X



TSC5-Normally cleared 3ph fault at a 44 kV circuit



TSC8 - Three X4H terminal breakers open + fourth breaker open by a fault in adjacent circuit



**Wolfe Island Wind Project
230 kV Transmission System
Permit and Approval List
27 July 2007**

The following table outlines the possible permits and approvals that may ultimately be required for the Wolfe Island transmission system. The permitting and approvals will continue to be refined as the project advances and detailed design work and agreements are completed.

Table 1: Key Permits and Approvals Required for 230 kV Transmission System – Wolfe Island (2007)*

Permit / Approval	Responsible Agency Party	Start Date	End Date	Comments
Environmental Assessment				
Project Description (Federal)	NRCan / CEA Agency	August 2005	January 2006	<ul style="list-style-type: none"> activity completed
Environmental Review Report – Notice of Completion (provincial)	Proponent (with process overview from MOE)	31 August	31 August	<ul style="list-style-type: none"> activity in progress
Environmental Review Report – Statement of Completion (provincial)	Proponent (with process overview from MOE)	12 October	12 October	<ul style="list-style-type: none"> activity in progress assumes no Requests to Elevate are filed
Municipal – Township of Frontenac Islands				
Official Plan Amendment	Township of Frontenac Islands		December	<ul style="list-style-type: none"> activity completed
Zoning By-Law Amendment	Township of Frontenac Islands	November 2006	October	<ul style="list-style-type: none"> activity in progress Oral Decision issued by the Ontario Municipal Board
Site Plan Control By-Law	Township of Frontenac Islands	January	October	<ul style="list-style-type: none"> draft by-law in process, required approval by Council
Site Plan Agreement	Township of Frontenac Islands	October	October	<ul style="list-style-type: none"> activity not yet begun pending ERR completion
Site Plan Approval	Township of Frontenac Islands	October	November	<ul style="list-style-type: none"> activity not yet begun pending ERR completion
Road Occupancy Agreement	Township of Frontenac Islands	September	October	<ul style="list-style-type: none"> activity not yet begun

Table 1: Key Permits and Approvals Required for 230 kV Transmission System – Wolfe Island (2007)*

Permit / Approval	Responsible Agency Party	Start Date	End Date	Comments
Building Permits	Township of Frontenac Islands (Tier 1)	September	November	<ul style="list-style-type: none"> activity not yet begun
Building Permits	County of Frontenac (Tier 2)	September	December	<ul style="list-style-type: none"> activity not yet begun contingent on Township Building Permit approval
Municipal – City of Kingston				
Cut Permit	City of Kingston - Engineering	May	November	<ul style="list-style-type: none"> activity on-going contingent of ERR
Municipal Consent	City of Kingston - Engineering	May	November	<ul style="list-style-type: none"> activity on-going contingent of ERR
Tree Cutting Bylaw, Permit to Destroy or Injure Trees	City of Kingston, Cultural Services			<ul style="list-style-type: none"> need to be determined possibly required for trees over a certain diameter or age
Road Closure Application(s)	City of Kingston, Engineering			<ul style="list-style-type: none"> need to be determined contingent in part on final permits / agreements
Provincial Permits				
Land-Use	Ministry of Transportation Ontario ("MTO")	August	November	<ul style="list-style-type: none"> activity not yet begun contingent of ERR
Commercial Access Permit	MTO	August	November	<ul style="list-style-type: none"> activity not yet begun contingent of ERR
Encroachment Permit	MTO	August	November	<ul style="list-style-type: none"> activity not yet begun contingent of ERR
Archaeological Clearance – Stage 1	Ministry of Culture	July 2006	October 2006	<ul style="list-style-type: none"> activity completed
Archaeological Clearance – Stage II	Ministry of Culture	November 2006	November	<ul style="list-style-type: none"> activity on-going specific to foundation and excavation areas
Certificate of Approval (Air) – Substation	Ministry of the Environment ("MOE")	August	November	<ul style="list-style-type: none"> activity not yet begun contingent of ERR
Deposition of Crown Land (Easement)	Ministry of Natural Resources ("MNR")	November 06	October	<ul style="list-style-type: none"> activity on-going required for Lake bed use in the Lower Gap contingent of ERR

Table 1: Key Permits and Approvals Required for 230 kV Transmission System – Wolfe Island (2007)*

Permit / Approval	Responsible Agency Party	Start Date	End Date	Comments
Work Permit	MNR	November 2006	October	<ul style="list-style-type: none"> activity not yet begun contingent of ERR
System Impact Assessment	Independent Electricity System Operator		June	<ul style="list-style-type: none"> conditional approval Final approval to be granted upon successful completion of IESO Market Entry process
Customer Impact Assessment	Hydro One Networks Inc.		March	<ul style="list-style-type: none"> activity completed
Electricity Generation Licence - Amendment	Ontario Energy Board ("OEB")	September 2006	December 2006	<ul style="list-style-type: none"> activity completed
Transmitter Designation – for power line system (Section 81)	OEB	September 2006	17 April	<ul style="list-style-type: none"> activity completed
Leave to Construct – 230kV (Section 92)	OEB	December 2006	October	<ul style="list-style-type: none"> activity on-going
Federal Permits				
Navigable Waters	Transport Canada - Marine	August 2006	October	<ul style="list-style-type: none"> activity on-going contingent of ERR
In-Water works (submarine cable)	DFO	June 2006	October	<ul style="list-style-type: none"> activity on-going contingent of ERR
HADD Authorization or Letter of Advice	DFO	July	October	<ul style="list-style-type: none"> activity on-going see "Guidelines for the Use of Explosives In or Near Canadian Fisheries Waters)
Explosive Magazine License	NRCan	July	October	<ul style="list-style-type: none"> need to be determined
Land Easement/grant	Correctional Services Canada	June 2006	October	<ul style="list-style-type: none"> activity on-going contingent of ERR
Miscellaneous				
Migratory Bird Act (tree cutting during nesting)	Environment Canada / Canadian Wildlife Service	Day before construction	Valid for 3 days	<ul style="list-style-type: none"> need to be determined possibly required for any tree cutting in breeding bird window
Regulation of Development, Interference with Wetlands and Alterations to Shorelines and Watercourses Permit	Cataraqui Region Conservation Authority	April	October	<ul style="list-style-type: none"> activity not yet begun

Table 1: Key Permits and Approvals Required for 230 kV Transmission System – Wolfe Island (2007)*

Permit / Approval	Responsible Agency Party	Start Date	End Date	Comments
Tree Trimming/Cutting Agreements (power line – private lands)	Affected Landowners	September	October	<ul style="list-style-type: none">• activity not yet begun
Anchor Agreements (power line – private lands)	Affected Landowners	September	October	<ul style="list-style-type: none">• need to be determined, considering focus on underground power line instead of overhead line
Tee Tap	Hydro One	February	October	<ul style="list-style-type: none">• activity on-going• now inside Gardiner TS
Deposition of Crown Land (Easement)	Correctional Services Canada	November 06	October	<ul style="list-style-type: none">• see above under Federal

* All dates 2007 unless otherwise noted.

PROPOSED 240kV TRANSMISSION LINE ROUTE 1: Option A

PRELIMINARY - SUBJECT TO CHANGE

LANDOWNER	LAND	NATURE OF LAND OWNERSHIP	PURPOSE	PROGRESS TO DATE	LAND AREA	LAND RIGHTS PROPOSED
WOLFE ISLAND						
Gregory Donald MacDonald / Yvonne Roberta Van Noten	Pt Lts 16, 17, 18 and 19, Old Survey Concession. Now known as PIN 36320-0032 & PIN 36320-0036	Freehold	Transformer Station	Option for Surface Lease dated July 28, 2006. NO CHANGE	10.0 acres more or less	Leasehold
Gregory Donald MacDonald / Yvonne Roberta Van Noten	Pt Lts 16, 17, 18 and 19, Old Survey Concession. Now known as PIN 36320-0032 & PIN 36320-0036	Freehold	Operation & Maintenance Building	see above. NO CHANGE	included in Option for Surface Lease above	Leasehold
Gregory Donald MacDonald / Yvonne Roberta Van Noten	Pt Lts 16, 17, 18 and 19, Old Survey Concession. Now known as PIN 36320-0032 & PIN 36320-0036	Freehold	U/G transmission cable	Agreement to Grant Easement and Right-of-Way Agreement dated July 28, 2006. NO CHANGE	10 metre wide easement 10 metre temp work area	Permanent Easement
Corporation of the Township of Frontenac Islands (Highway 96)	PIN 36320-0055	Municipal	U/G transmission cable			Crossing Agreement
SUBMARINE						
DFO (Federal)	Submarine Cable corridor	Crown	Underwater transmission cable		No land requirements	none
Ministry of Transport (Navigable Waters) Ministry of Natural Resources (Ontario)	Submarine Cable corridor Submarine Cable corridor	Crown Crown (Provincial)	Underwater transmission cable Underwater transmission cable		No land requirements	none Work Permit, Land Use Permit
MAINLAND						
KoSa Canada	PIN 36003-0035 and PIN 36003-0058	Freehold	U/G transmission cable	Documents prepared and provided to KoSa. Currently in negotiations.	5 metre wide easement 10 metre wide temp work area - IT IS NOW PREFERABLE TO OBTAIN 10 METRE PERMANENT - NO TEMP WORK SPACE	Permanent Easement
DuPont Company of Canada		Easement	U/G transmission cable	Use of existing easement is not possible. No longer an option.	5 metre wide easement 5 metre temp work area	Permanent Easement
E.I. DuPont of Canada Limited	PIN 36003-0057	Freehold	U/G transmission cable	Documents prepared and provided to DuPont. Currently in negotiations.	5 metre wide easement 10 metre wide temp work area - IT IS NOW PREFERABLE TO OBTAIN 10 METRE PERMANENT - NO TEMP WORK SPACE	Permanent Easement
City of Kingston (Front Road)	PIN 36004-0033	Municipal	U/G transmission cable	CREC has not made formal application as yet because it must first complete the final engineered drawings.	5 metre wide easement 5 metre temp work area	Cut Permit Municipal Consent Site Plan Approval Permanent Easement
Her Majesty the Queen, In Right of the Minister of Justice (Collins Bay Penitentiary)	Pt Lts 9 - 15, Concession 1, Pt of the Upopened Rdal Btn Lts 9 & 10, Concession 1 as in Pts 1, 2 & 3, 13R-4621, except Pt 1, 13R-5619. PIN 36004-0032	Crown	U/G transmission cable	Currently a survey and two independent appraisals are being conducted on the property. Upon completion, the agreement will be prepared and executed.	10 METRE WIDE EASEMENT	Permanent Easement

City of Kingston (Hwy 33 - Bath Road)	PIN 36084-0644	Municipal	U/G transmission cable	CREC has not made formal application as yet because it must first complete the final engineered drawings.	5 metre wide easement 5 metre temp work area	Cut Permit Municipal Consent Site Plan Approval
Arnold C. Day	Pt Lt 10, Concession 2. PIN 36084-0221	Freehold	U/G transmission cable	Agreement to Grant Easement and Right-of-Way Agreement dated May 24, 2006	5 metre wide easement - NO LONGER REQUIRED	Permanent Easement
1556910 Ontario Limited (Money Mart)	Part 1, Pt Lt 10, Concession 2. PIN 36084-0220	Freehold	U/G transmission cable	No further discussions have been undertaken as transmission route has been varied.	5 metre wide easement - NO LONGER REQUIRED	Permanent Easement
Globe Realty (Royal Bank)	Pt Lt 10, Concession 2. PIN 36084-0217	Freehold	U/G transmission cable	Discussions currently underway regarding purchase of property by CREC.	5 metre wide easement 5 metre temp work area	Permanent Easement
Former Union Gas property purchased in January, 2007 by CREC	Pt Lt 10, Concession 2. Now known as 36084-0216	Freehold	U/G transmission cable	CREC is registered owner.	5 metre wide easement	Freehold / Fee Simple
R. Paul Martin Construction Co. Ltd.	PIN 36084-1445, Parts 11 to 20 on Plan 13R-17960, T/W ROW over Parts 1, 6, 8, 9 & 10; S/T ROW over Parts 18, 14, 12, 11, 19 & 17; S/T Easement over Parts 17, 16, 15, 14, 6, 5 & 4 as in Inst No. 185098 & 197001	Freehold	U/G transmission cable	Negotiations still underway. Owner has intervenor status in OEB Matter.	WE NOW REQUIRE 10 METRE PERMANENT	Permanent Easement
Carylann Martin, In Trust	PIN 36084-1446, Parts 1 to 10 on Plan 13R-17960, T/W ROW over Parts 1, 6, 8, 9 & 10; S/T ROW over Parts 18, 14, 12, 11, 19 & 17; S/T Easement over Parts 17, 16, 15, 14, 6, 5 & 4 as in Inst No. 185098 & 197001	Freehold	U/G transmission cable	Negotiations still underway. Owner has intervenor status in OEB Matter.	WE NOW REQUIRE 10 METRE PERMANENT	Permanent Easement
David Weinberg, Ruth Taub and Isadore Weinberg	Pt Lt 10, Concession 2. Now known as 36084-0213	Freehold	U/G transmission cable	Agreement to Grant Easement and Right-of-Way Agreement. Counsel for registered owners has advised that he is attempting to secure a POA in order to expedite execution of the Agreement and will report on progress shortly.	5 metre wide easement 5 metre temp work area	Permanent Easement
Corporation of the City of Kingston	36084-0210 (Plan 13R-5232)	Municipal	U/G transmission cable	CREC has not made formal application as yet because it must first complete the final engineered drawings.	5 metre wide easement 5 metre temp work area	
Mecyva Holdings Inc.	Pt Lt 10, Concession 2. Now known as P.I.N. 36084-0208	Freehold	U/G transmission cable	Agreement to Grant Easement and Right-of-Way Agreement dated January 19, 2007.	5 metre wide easement 5 metre temp work area	Permanent Easement
CN Railway	36084-0765(Rwy)		U/G transmission cable	Standard Wire Agreement executed by all parties.	5 metre wide easement 5 metre temp work area	Crossing Agreement
Hydro One Network	36084-0207	Freehold	U/G transmission cable	Hydro One and CREC have agreed to upgrade existing Transmission Station to accommodate CREC's connection. Hydro One will prepare necessary agreement.	To be determined by Hydro One engineers	To be determined



MOHAWKS OF THE BAY OF QUINTE



KENHTEKE KANIENKEHA

June 22, 2007

Rob Miller
Project Engineer
190 Collingwood Street
Kingston, ON
K7L 3X8

Dear Mr. Miller,

Please find attached the comments on the Environmental Review Report. The report was very extensive, and has demonstrated significant socio-economic benefits in support of the project.

In regards to the Property Value Impact Study, The Assessment of Potential Effects of a Wind Plant on Tourism on Wolfe Island, and Economic Benefits Assessment on Wolfe Island, we have no negative comments regarding the findings from the reports.

The above shall not be construed so as to derogate from or abrogate any inherent, aboriginal, treaty, constitutional or legal rights of the Mohawks of the Bay of Quinte.

The Mohawks of the Bay of Quinte would like to extend our warm regards, and the best of luck with this project. Please keep us informed as the project evolves.

Sincerely,

Kristin Maracle
Environmental Technical Services Officer
Mohawks of the Bay of Quinte

Cc: Tyendinaga Mohawk Council

VISION STATEMENT

Tyendinaga, as part of the Mohawk Nation, is a healthy, sustainable Kanienkehaka community, built on and united by our language, culture, traditions, knowledge and history. We exercise our rights and responsibilities for the protection of and respect for our people, our land, our resources and the environment.

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Tyendinaga Mohawk Territory
Ontario K0K 1X0
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Wolfe Island Wind Project

Environmental Review Report

With evidence of Climate Change currently in our weather patterns, it is obvious that there is a high demand for Renewable Energy. The temperatures are rising and there are unusual weather patterns, such as: hurricanes, flooding and drought. North American's should increase their usage of wind, water and biomass energy, to decrease the dependency on fossil fuels. With the Wolfe Island Wind Project being able to output enough energy to support up to 75,000 homes is phenomenal, as it will generate 537,000 MWh yearly. When looking at the environment as a whole, we are the ones that have to take it into our hands, to protect and renew it, for everything that is mentioned in this report; surface and groundwater quality, fish and fish habitat, air quality, wetlands, migratory birds, native species, species at risk, and the overall health and safety of our people.

It is stated in the report, that the Government of Ontario has a goal and principles of establishing a clean and healthy environment, economic growth, and strong communities for the long term. The development of the Wolfe Island Wind Project will, to a great extent, increase the chance of these goals and principles to be followed through.

The Environmental Review Report is very extensive, as it touches on every aspect, which the project may affect. The first concern is with the placement of the turbines in the south west corner of the project area. Turbines numbered 29-35 respectfully, are in a highly sensitive area, namely around: Provincially Significant Wetland, Rare Species Occurrence area, Area of Natural and Scientific Interest (ANSI) for Earth and Life. Initially there was a concern, by looking at the map, that the turbines and access roads were not set back enough from these sites. It is required that at least a 30m buffer be utilized when working around any waterway, and 100m away from provincially significant wetlands. This report is abiding by those setbacks, and then some. It is requesting 50m from a watercourse, and 120m from a provincially significant wetland. Although, the report has setbacks for those areas, it does not state how far the turbines and the access roads are going to be setback from the Rare Species Occurrence areas, and the Areas of Natural and Scientific Interest. It is suggested that these areas be assessed, on which rare species may be in the area, and mitigation measures taken to reduce the risk of potential harm.

In regards to the mitigation measures during construction, when moving machinery from site to site, the operation of machinery, moving aggregates and machinery from mainland to the project site, and clean up, they are all set out properly, and should be followed as reported on. Due to the residents relying on the lake, river and groundwater for their drinking water, it is especially important, to impose the mitigation measures, and proper handling of materials when working and moving aggregates and machinery around waterways, by ensuring there are no fluid leaks, or disruption when doing so.

If water needs to be drawn from the lake for aid with concrete, it is suggested that the intake pump and hose is located away from any sensitive shoreline and fish spawning bed areas. To ensure this, consult with the Department of Fisheries and Oceans, to locate such areas, and to establish mitigation measures if needed.

In regards to the silt barriers around the wetlands during construction; to my understanding, the bottom 3-4 inches should be buried to ensure that sediment and other debris will not enter the wetland.

With the bird mortality and collision with the turbines, is a sensitive issue to the residents. It looks as though, there are some birds listed with the Species at Risk that could be affected by the turbines, they are at a somewhat higher risk, but potentially would not be harmed by the turbine blades. The mortality rate of any SAR species has to be kept to a minimum during this project, or any other project for that matter.

In reading the Environmental Review Report on the Wolfe Island Wind Project, I have found that the report fully describes every aspect of the project thoroughly. All the mitigation measures that are set out should be followed to ensure the safety of the residents, and the surround environment. As stated before, with Climate Change, now seen more and more in our everyday lives, the Wolfe Island Wind Project is a extraordinary project that will not only benefit us immediately, but will benefit our local environment as well. Hopefully other municipalities will invite a project, such as this, into their communities, to help promote the usage of renewable energy.