ONTARIO ENERGY BOARD

IN THE MATTER OF the *Ontario Energy Board Act, 1998*, S.O. 1998, c.15 (Sched. B);

AND IN THE MATTER OF an application by South Kent Wind LP for an Order or Orders pursuant to section 92 of the *Ontario Energy Board Act, 1998* (as amended) granting leave to construct transmission facilities in Chatham-Kent, Ontario.

LEAVE TO CONSTRUCT APPLICATION

SOUTH KENT WIND LP

June 14, 2011

EXHIBIT LIST

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ONTARIO ENERGY BOARD

IN THE MATTER OF the *Ontario Energy Board Act, 1998*, S.O. 1998, c.15 (Sched. B);

AND IN THE MATTER OF an application by South Kent Wind LP for an Order or Orders pursuant to section 92 of the *Ontario Energy Board Act, 1998* (as amended) granting leave to construct transmission facilities in Chatham-Kent, Ontario.

APPLICATION

1. The Applicant, South Kent Wind LP, is a limited partnership formed pursuant to the laws of Ontario. The Applicant's two limited partners are Pattern South Kent LP Holdings LP ("Pattern") and Samsung Renewable Energy Inc. ("Samsung"), each of which holds a 49.99% interest in the Applicant. South Kent Wind GP Inc., which is indirectly wholly owned by Samsung and affiliates of Pattern, is the general partner of the Applicant and holds 0.02% interest in the Applicant.

2. The Applicant hereby applies to the Ontario Energy Board (the "Board") pursuant to section 92 of the *Ontario Energy Board Act, 1998* (the "Act") for an order or orders granting leave to construct the following facilities, all within the Municipality of Chatham-Kent:

   i. two 34.5/230 kV step-up substations (the "Collector Substations");
   ii. an approximately 27 km 230 kV transmission line that will run between the Collector Substations (the "Corridor Line");
   iii. an approximately 5.7 km 230 kV transmission line that will run from a tie-point on the Corridor Line to the Chatham SS owned by Hydro One Networks Inc. (the "Tie Line"); and
   iv. a fenced-in metering station with two meters to be located adjacent to the Chatham SS.

3. The facilities described in paragraph 2 are collectively referred to herein as the "Transmission Project".

4. As set out in the April 1, 2010 Directive from Energy Minister Brad Duguid to the Ontario Power Authority (the "Directive") (attached at Exhibit B, Tab 2, Schedule 2), the Government of Ontario has entered into a Green Energy Investment Agreement (the "Agreement") with Samsung C&T Corporation and Korea Electric Power Corporation (collectively the "Korean Consortium"). An affiliate of Pattern is Samsung's development partner.

5. Under the terms of the Agreement, the Korean Consortium has agreed to develop 2,500 MW of wind and solar renewable generation projects in Ontario in five phases. The Agreement is structured such that Phase 1 provides for targeted generation capacity of 400 MW of Wind and 100 MW of solar with the targeted commercial operation date of March 31, 2013.

6. As part of the commitment under the Agreement to develop Phase 1, a 270-MW wind farm located within the Municipality of Chatham-Kent in southwestern Ontario (the "Wind Farm") is being developed. The Wind Farm will further the Ontario Government's policy objective to increase the amount of renewable energy generation being added to the province's energy supply mix. In particular, the Wind Farm will contribute a total of 270 MW of clean, renewable energy to the provincial electricity grid.

7. The impetus of this Application is to construct the Transmission Project to connect the Wind Farm to the Independent Electricity System Operator ("IESO") controlled grid.

8. The Applicant plans to locate the 27 km Corridor Line within a 90-foot wide Canadian Southern Railway Company ("CSR") corridor that is currently subject to an abandonment process being undertaken by CSR. The Tie Line will be located on the properties of 9 private landowners and on a municipal right-of-way.

9. The Applicant is in the process of securing the necessary land rights for the Transmission Project. The landowners affected by this Application will be filed in confidence to protect their identities.

10. The IESO completed a System Impact Assessment Report ("SIA") for the Wind Farm and Transmission Project dated May 5, 2011. The Applicant has received a *Notification of Conditional Approval of Connection Proposal* from the IESO dated May 4, 2011. The IESO concluded that "the proposed connection will not result in material adverse impact on the reliability of the integrated power system".

11. Hydro One Networks Inc. ("Hydro One") completed a final Customer Impact Assessment Report ("CIA") for the Wind Farm and Transmission Project dated May 6, 2011.

12. Environmental approvals for the Wind Farm and Transmission Project are being obtained in accordance with the renewable energy approval process set out in Ontario Regulation 359/09 under the *Environmental Protection Act*.

13. The Transmission Project and the cost of connecting to HONI's Chatham SS will be paid for by the Applicant. Therefore the cost the Transmission Project and the connection to the Chatham SS will have no impact on transmission rates in Ontario. Discussions between the Applicant and HONI are ongoing regarding cost responsibility for any remote upgrades required by HONI to its transmission system.

14. This Application is supported by written evidence that is consistent with the July 17, 2006 Board staff proposal: *Minimum Filing Requirements for Transmission and Distribution Rate Applications and Leave to Construct Projects.* The Applicant's written evidence may be amended from time-to-time, prior to the Board's final decision on this Application.

15. The Applicant requests that pursuant to Section 34 of the Board's *Rules of Practice and Procedure* this proceeding be conducted by way of written hearing.

16. The Applicant requests that a copy of all documents filed with the Board in this proceeding be served on the Applicant and the Applicant's counsel as follows:

    (a) The Applicant:

    South Kent Wind LP

100 Simcoe Street, Suite 105
Toronto, Ontario
M5H 3T4

Attention:	Kim Sachtleben	
	Telephone:	(713) 308-4272
	Fax:	(713) 571-8004
	Email:	kim.sachtleben@patternenergy.com

(b) The Applicant's Counsel:

Andrew Taylor, Energy Law
120 Adelaide Street West
Suite 2500
Toronto, Ontario
M5H 1T1

Attention:	Andrew Taylor	
	Telephone:	(416) 644-1568
	Fax:	(416) 367-1954
	Email:	ataylor@energyboutique.ca

Dated at Toronto, Ontario, this 14th day of June, 2011.

South Kent Wind LP
By its counsel

Andrew Taylor

SUMMARY OF THE PRE-FILED EVIDENCE

1.0 The Applicant

The Applicant, South Kent Wind LP, is a limited partnership formed pursuant to the laws of Ontario. The Applicant's two limited partners are Pattern South Kent LP Holdings LP ("Pattern") and Samsung Renewable Energy Inc. ("Samsung"), each of which holds a 49.99% interest in the Applicant. South Kent Wind GP Inc., which is indirectly wholly owned by Samsung and affiliates of Pattern, is the general partner of the Applicant and holds 0.02% interest in the Applicant. A more detailed description of the Applicant and its partners is at Exhibit B, Tab 1, Schedule 1. An organizational chart that illustrates the ownership structure of the Applicant is at Exhibit B, Tab 1, Schedule 2.

2.0 Approval Sought

The Applicant has applied to the Ontario Energy Board (the "Board") pursuant to section 92 of the *Ontario Energy Board Act, 1998* (the "Act") for an order or orders granting leave to construct the following facilities, all within the Municipality of Chatham-Kent:

i. two 34.5/230 kV step-up substations (the "Collector Substations");
ii. an approximately 27 km 230 kV transmission line that will run between the Collector Substations (the "Corridor Line");
iii. an approximately 5.7 km 230 kV transmission line that will run from a tie-point on the Corridor Line to the Chatham SS owned by Hydro One Networks Inc. (the "Tie Line"); and
iv. a fenced-in metering station with two meters to be located adjacent to the Chatham SS.

These facilities are collectively referred to in the pre-filed evidence as the "Transmission Project".

3.0 Need for the Transmission Project

As set out in the April 1, 2010 Directive from Energy Minister Brad Duguid to the Ontario Power Authority (the "Directive") (attached at Exhibit B, Tab 2, Schedule 2), the Government of Ontario has entered into a Green Energy Investment Agreement (the "Agreement") with Samsung C&T Corporation and Korea Electric Power Corporation (collectively the "Korean Consortium"). An affiliate of Pattern is Samsung's development partner.

Under the terms of the Agreement, the Korean Consortium has agreed to develop 2,500 MW of wind and solar renewable generation projects in Ontario in five phases. The Agreement is structured such that Phase 1 provides for targeted generation capacity of 400 MW of Wind and 100 MW of solar with the targeted commercial operation date of March 31, 2013.

As part of the commitment under the Agreement to develop Phase 1, a 270-MW wind farm located within the Municipality of Chatham-Kent in southwestern Ontario (the "Wind Farm") is being developed. The Wind Farm will further the Ontario Government's policy objective to increase the amount of renewable energy generation being added to the province's energy supply mix. In particular, the Wind Farm will contribute a total of 270 MW of clean, renewable energy to the provincial electricity grid.

The impetus of this Application is to construct the Transmission Project to connect the Wind Farm to the Independent Electricity System Operator ("IESO") controlled grid.

4.0 Route for the Transmission Project

A detailed description of the Transmission Project route is at Exhibit B, Tab 4, Schedule 1, and a route map (1:50,000 scale) is at Exhibit B, Tab 4, Schedule 2.

The Applicant plans to locate the Corridor Line within a 90-foot wide Canadian Southern Railway Company ("CSR") corridor (the "Corridor") that is currently subject to an abandonment process being undertaken by CSR. There are two rail lines within the Corridor. One is abandoned and the other is scheduled for abandonment at the end of July, 2011. The Municipality of Chatham-Kent (the "Municipality") recently purchased the portion of the Corridor between Communication Road and Elgin County to the east. For this portion of the Corridor (ie. the eastern portion of the Corridor), the Municipality will grant an easement to Chatham-Kent Transmission ("CKT") (ET-2010-0351). CKT, in turn, will grant a sub-easement to the Applicant for its transmission facilities.

In regard to the portion of the Corridor from Communications Road west to the Railbed Substation (ie. the western portion of the Corridor), negotiations are underway with CSR to secure the necessary land rights for this portion of the Corridor.

The Tie Line will be located on the properties of 9 private landowners (farms) and on a municipal right-of-way. To date, 5 of the 9 private landowners have indicated that they are agreeable to entering into easement agreements with the Applicant. The Applicant has no reason to believe that the remaining 4 landowners will not enter into easement agreements.

An illustration of the land ownership along the Tie Line is at Exhibit B, Tab 4, Schedule 3. The form of easement for private landowners is at Exhibit B, Tab 4, Schedule 6(i).

5.0 Consultations

Under the Renewable Energy Approval ("REA") Regulation (O.Reg. 359/09), public, municipal and Aboriginal consultation is stipulated.

The Applicant held two-first public meetings on November 22, 2010 in Blenheim, and on November 23, 2010 in Tilbury. The notice for these meetings is set out at Exhibit B, Tab 5, Schedule 2. The second community consultation meeting(s) will be held when the Applicant has gathered all the information needed to make its REA application.

The Applicant provided a Municipal Consultation Form to the Municipality on October 14, 2010. Consultations with the Municipality are on-going.

The Applicant has obtained from the Ministry of the Environment a list of Aboriginal communities that must be notified regarding the Project. This list is set out at Exhibit B, Tab 5, Schedule 3. To date, the Aboriginal communities have received a letter providing notification of the project, the Project Description Report and the two notices relating to the notification of the project and the first public meetings. Three Aboriginal communities have responded, and follow-up with these Aboriginal communities and the others are on-going.

6.0 Construction and In-Service Schedule

A Gantt chart that illustrates the overall construction schedule for the Transmission Project is attached at Appendix B, Tab 5, Schedule 2. As set out in the Gantt chart, construction is scheduled to commence in February of 2012, with an in-service date of September 2012. A 2-month float has been built into the Transmission Project schedule. This 2-month float can be utilized to compensate for unforeseen delays.

5.0 System Impact Assessment

The IESO completed a System Impact Assessment Report ("SIA") for the Wind Farm and Transmission Project dated May 5, 2011. The Applicant has received a *Notification of Conditional Approval of Connection Proposal* from the IESO dated May 4, 2011. The IESO's conclusions in the SIA include:

(1) the proposed wind farm does not have a material adverse impact on the reliability of the IESO-controlled grid; and

(2) the proposed project does not cause new violations of existing circuit breaker interrupting capabilities on the IESO-controlled grid.

The Applicant will comply with the requirements set out in the SIA, and will consider the IESO's recommendations upon completion of design and modeling of the Wind Farm and Transmission Project. We note that the location of the Tie Line has been moved approximately 3 km west (from Huffman Road to Fargo Road) since the SIA was completed. The Applicant does not believe that this change should impact the conclusions contained in the SIA, but has nevertheless advised the IESO of this development.

The SIA is at Exhibit B, Tab 8, Schedule 1, and the *Notification of Conditional Approval of Connection Proposal* is at Exhibit B, Tab 8, Schedule 2.

6.0 Customer Impact Assessment

Hydro One Networks Inc. ("Hydro One") completed a final Customer Impact Assessment Report ("CIA") for the Wind Farm and Transmission Project dated May 6, 2011. Hydro One's conclusions in the SIA include:

- "Load flow studies confirmed a strong 230 kV system between Chatham SS, Keith TS and Lauzon TS with no material change in the voltage performance indicating that the proposed generation does not provide post-contingency voltage support."

- "Short-circuit studies were carried out to determine new projected fault levels at customer transmission connection points. They showed minimal impact on present short-circuit levels for the majority of Chatham-Kent-Essex area customers."

The Applicant will comply with the requirements contained in the CIA subject to ongoing negotiations with Hydro One.

7.0 Other Approvals

Environmental approval for the Wind Farm and Transmission Project are being obtained in accordance with the renewable energy approval process ("REA") set out in Ontario Regulation 359/09 under the *Environmental Protection Act*. This process is underway, as well as the process to obtain non-REA approvals required, such as railway crossing and highway crossing approvals. A list of all approvals required or potentially required is at Exhibit B, Tab 7, Schedule 1.

8.0 Cost of the Transmission Project

The Transmission Project and the cost of connecting to HONI's Chatham SS will be paid for by the Applicant. Therefore the cost the Transmission Project and the connection to the Chatham SS will have no impact on transmission rates in Ontario. Discussions between the Applicant and HONI are ongoing regarding cost responsibility for any remote upgrades required by HONI to its transmission system.

THE APPLICANT AND ITS PARTNERS

A chart that illustrates the organizational structure of the Applicant is set out at Exhibit B, Tab 1, Schedule 2. Information on the Applicant and its ultimate parent companies is set out below.

1) South Kent Wind LP (the "Applicant")

The Applicant is a limited partnership that was formed pursuant to the laws of the Province of Ontario on January 10, 2011 for the purposes of managing the development, construction and operation of the Wind Farm. The Applicant's two limited partners are Pattern South Kent LP Holdings LP and Samsung Renewable Energy Inc., each holding 49.99% interests. South Kent Wind GP Inc., which is indirectly wholly owned by Samsung and affiliates of Pattern, is the general partner of the Applicant and holds a 0.02% interest in the Applicant.

2) Pattern Energy Group LP ("PEG")

Pattern is a wholly-owned subsidiary of PEG, which is one of North America's leading independent wind and transmission companies. Its mission is to provide our customers with clean, renewable energy, which it seeks to achieve by developing, constructing, owning and operating projects that are built for lasting success. PEG has projects totalling over 520 MW in operation and has many years of experience developing, managing construction and operating both High Voltage AC and DC transmission lines. This includes the 52 mile Trans Bay Cable - a 400 MW DC undersea transmission project serving approximately 40% of the load in the city of San Francisco—in which the company does not hold an ownership interest. The PEG team has developed, permitted, financed, constructed and operated over one hundred miles of high voltage AC transmission lines associated with the Wind Farms they have developed.

In addition, Pattern is growing and building on its current development pipeline, which includes over 4,000 MW of wind power and multiple transmission projects in the United States, Canada and Latin America.

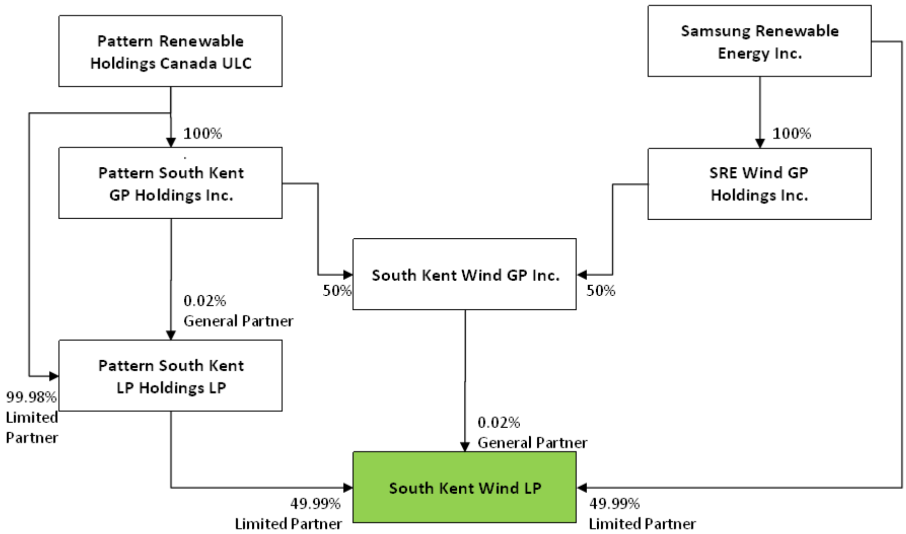
Pattern is a U.S.-based company led by a committed and seasoned management team whose members, each with over 20 years experience in the energy industry, have worked together for nearly 10 years. As a team they have developed, financed and managed more than $4 billion of energy assets. Pattern has recently opened an office in Toronto and will open a project office in Blenheim in July, 2011.

The senior management team is supported by a deep and talented team of scientists, engineers, financial experts, and construction and operations specialists who bring expertise and a rigorous analytical perspective to all aspects of the business.

3) Samsung C&T Corporation

Samsung is a wholly-owned subsidiary of Samsung C&T Corporation, which is a Korea-based company engaged in the construction and trading business. It operates its business under two divisions. Its construction business division is engaged in construction works, such as commercial and residential building construction; civil engineering works, including construction of subways, roads, bridges, harbours, airports and large-scale reclamation projects; and plant building, covering nuclear power plants, electric power plants, energy storages and transmission facilities, petrochemical plants, industrial facilities and environmental facilities, as well as housing development and other related services. Its trading business division exports and imports chemicals, steel products, nonferrous metals, transportation equipment, textiles, apparels, daily necessities and others. The company, formerly known as Samsung Corporation, was founded in 1938 and is headquartered in Seoul, South Korea. It is a public company whose shares trade on the Korea Stock Exchange.

South Kent Wind LP
Ownership Structure



NEED FOR THE PROPOSED FACILITIES

In January of 2010, the Province of Ontario entered into a Green Energy Investment Agreement (the "Agreement") with Samsung C&T Corporation and Korea Electric Power Corporation (together the "Korean Consortium"). Under the terms of the Agreement, the Korean Consortium has agreed to develop 2,500 MW of wind and solar renewable generation projects in Ontario in five phases. The Agreement is structured such that Phase 1 provides for targeted generation capacity of 400 MW of Wind and 100 MW of solar with the targeted commercial operation date of March 31, 2013.

As part of the commitment under the Agreement to develop Phase 1, a 270-MW wind farm located within the Municipality of Chatham-Kent in southwestern Ontario (the "Wind Farm") is being developed. For more information on the Wind Farm, please refer to Exhibit B, Tab 3, Schedule 1. The Wind Farm will further the Ontario Government's policy objective to increase the amount of renewable energy generation being added to the province's energy supply mix. In particular, the Wind Farm will contribute a total of 270 MW of clean, renewable energy to the provincial electricity grid.

The Transmission Project is needed to connect the Wind Farm to the Independent Electricity System Operator ("IESO") controlled grid. Because the Wind Farm is consistent with the Government of Ontario's policy to promote the use of renewable energy sources, the Transmission Project is in the public interest in accordance with subsection 96(2) of the *Ontario Energy Board Act, 1998*:

> **96(2)** In an application under section 92, the Board shall only consider the following when, under subsection (1), it considers whether the construction, expansion or reinforcement of the electricity transmission line or electricity distribution line, or the making of the interconnection, is in the public interest:
>
> 1. The interests of consumers with respect to prices and the reliability and quality of electricity service.

2. **Where applicable and in a manner consistent with the policies of the Government of Ontario, the promotion of the use of renewable energy sources.** [emphasis added]

Ministry of Energy and Infrastructure

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Ontario

MC-2010-1247

April 1, 2010

MAY 06 2010

Mr. Colin Andersen
Chief Executive Officer
Ontario Power Authority
1600–120 Adelaide Street West
Toronto ON M5H 1T1

Dear Mr. ~~Andersen~~: COLIN

I write pursuant to my authority as the Minister of Energy and Infrastructure, in order to exercise the statutory powers of ministerial direction which I have in respect of the Ontario Power Authority (the "OPA") under subsection 25.32(4.1) and section 25.35 of the *Electricity Act, 1998* (the "EA").

Background

The Government of Ontario has entered into a Green Energy Investment Agreement (the "Agreement") with Samsung C&T Corporation and Korea Electric Power Corporation (collectively, the "Korean Consortium"). Under the terms of this Agreement, the Korean Consortium has agreed to develop 2,500 megawatts (MW) of wind and solar renewable generation projects in Ontario in five Phases. The Korean Consortium has further committed to bringing manufacturing plants to Ontario to manufacture wind and solar generation components. The Agreement is structured such that Phase 1 provides for Targeted Generation Capacity of 400 MW of wind and 100 MW of solar with the Targeted Commercial Operation Date of March 31, 2013.

With respect to Phase 1, on September 30, 2009, my predecessor directed the OPA, in carrying out the Transmission Availability Test under the Ontario Power Authority's Feed-In Tariff (FIT) Program Rules, to hold in reserve 240 MW of transmission capacity in Haldimand County and a total 260 MW of transmission capacity in Essex County and the Municipality of Chatham-Kent jointly for renewable energy generating facilities whose proponents have signed a province-wide framework agreement. Each of the remaining four Phases, includes Targeted Generation Capacity of 400 MW of wind and 100 MW of solar, respectively with targeted Commercial Operation Dates of December 31, 2013, December 31, 2014, December 31, 2015 and December 31, 2016.

.../cont'd

Given the complex nature of the regulatory environment within which all parties must work, the Ministry believes it advisable to establish an Implementation Task Force composed of representatives from the Ministry and the OPA to ensure that the myriad of technical and logistical issues can be resolved in a co-operative and efficient manner.

Direction

Therefore, pursuant to my statutory authority under subsection 25.32(4.1) of the *Electricity Act, 1998,* I hereby direct the OPA to negotiate one or more power purchase agreements as appropriate with respect to each Phase with the Korean Consortium or the appropriate Project Companies. The term "Project Company" has the same meaning as is given to it in the Agreement.

The OPA shall commence negotiations of power purchase agreements:

i. when a Project Company has demonstrated that it has the necessary "Access Rights" with respect to a project as that term is defined from time to time in the FIT Program Standard Definitions and used in the Agreement; and

ii. upon the recommendation of the Implementation Task Force, as described below.

Each power purchase agreement entered into shall be consistent with the Agreement and incorporate its relevant provisions and shall be substantially similar to those provided for under the OPA's FIT Contract and the FIT Program Rules with such necessary modifications as are required to reflect the terms of the Agreement. Pursuant to Articles 8 and 9 of the Agreement, the Korean Consortium shall be paid an economic development adder which is contingent upon the fulfilment of its manufacturing commitments.

I therefore further direct, pursuant to the authority provided to me under subsection 25.35 of the *Electricity Act, 1998,* that the OPA shall, consistent with section 5.2 of the FIT Program Rules, give priority to projects within the scope of this direction when assessing transmission availability with respect to the FIT Program. In this regard, the OPA shall work together with MEI and the Korean Consortium and other agencies in order to align each project with expected transmission build-out for the province and the needs of the feed-in-tariff program, including the needs of other developers.

Furthermore, I direct, pursuant to my authority under subsection 25.32(4.1), that the OPA co-ordinate its work with the Ministry in implementing the Agreement by working with the Ministry to establish an Implementation Task Force composed of employees of the OPA and of the Ministry who have the requisite technical, legal, regulatory and other relevant expertise as well as such other persons with such expertise as the OPA and the Ministry may require. In respect of the Ministry, the employees shall be individuals who are appointed, in writing, under my authority. In respect of the OPA, the OPA shall appoint such employees as it deems fit.

..../cont'd

The main objective of the Implementation Task Force will be to identify and resolve any technical, logistical or other implementation issues in a timely, co-operative and efficient manner related to the implementation of the Agreement and of this Direction. One of the primary tasks of the Implementation Task Force will be to participate in the Working Group established pursuant to the Agreement.

In addition, I exercise my authority under section 25.35 in order to clarify the direction of September 30, 2009. The OPA, in carrying out Transmission Availability Test(s) under the FIT Program Rules, shall hold in reserve 240 MW of transmission capacity in Haldimand County and a total 260 MW of transmission capacity in Essex County and the Municipality of Chatham-Kent for the Korean Consortium or its Project Companies.

This Direction shall be effective and binding as of the date hereof.

Sincerely,

Brad Duguid
Minister

Ministry of Energy and Infrastructure

Office of the Deputy Minister

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Téléc.: 416-327-6755

Ontario

April 14, 2010

Mr. Colin Andersen
Chief Executive Officer
Ontario Power Authority
1600-120 Adelaide Street West
Toronto ON M5H 1T1

Dear Mr. Andersen:

Further to Minister Duguid's direction of April 1, 2010, I am writing to advise of the appointment of the following staff to the Implementation Task Force, through which the Ministry and the Ontario Power Authority (OPA) will work together to operationalize the Green Energy Investment Agreement:

Pearl Ing, Director, Renewables & Energy Facilitation Branch
Jon Norman, Director, Transmission & Distribution Policy
Garry McKeever, Director, Energy Supply & Competition Policy

I am confident that the OPA and MEI, working together, will achieve the Province's objectives of the Green Energy Investment Agreement.

Yours truly,

Fareed

Fareed Amin
Deputy Minister

c: Hagen Lee, Manager, Business Development & Government Relations

TECHNICAL DESCRIPTION OF THE PROPOSED FACILITIES

The proposed transmission facilities (the "Transmission Project") that are the subject of this Section 92 application are necessary to connect a 270 MW wind farm in Chatham Kent, Ontario (the "Wind Farm"). Therefore, in order to provide context for the Transmission Project, a description of both the Wind Farm and the Transmission Project are set out below.

1) The Wind Farm:

The Wind Farm consists of one hundred and twenty three 2.3 MW Siemens SWT-2.3-101 turbines. The turbines are de-rated to accommodate Ontario's stringent noise guidelines, giving a total Wind Farm capacity of approximately 270 MW. These wind turbines have a hub height of 100 m and a rotor diameter of 101 m. The 2.3 MW, 60 Hz Wind Turbine Generators are asynchronous generators. The wind turbine generators ("WTG") will be connected to the AC collector system through an AC/DC/AC converter. Voltage output of the power converter is at 690 Vac, with a power factor range of 0.9 leading to 0.9 lagging. Voltage will then be stepped up from 690 Vac to 34.5 kV through a unit step up transformer located in the base of each WTG. A map that illustrates the location of the Wind Farm is at Exhibit B, Tab 4, Schedule 2.

2) The Collector Substations:

The Transmission Project includes two collector substations. The westernmost substation is named the "Railbed Substation", and the other is named the "Sattern Substation" (collectively the "Collector Substations"). Power collected from the WTGs will be brought to the two Collector Substations by means of a 34.5 kV collector system using both underground and overhead lines. The Collector Substations will step up the collector voltage from 34.5 kV to 230 kV.

2.1) Layout and electrical design:

The Collector Substation buildings will be prefabricated self-supporting skid-mounted buildings installed on concrete footings to accommodate bottom entry of the power cables into the medium voltage ("MV") switchgear. The Collector Substation buildings (or "E-houses") will accommodate:

- 34.5 kV switchgear;
- protection and control equipment;
- communication equipment;
- SCADA equipment;
- DC battery, battery charger and DC power distribution equipment; and
- UPS and AC Power distribution equipment.

The following electrical equipment will be installed outdoors at each of the Collector Substation:

- 34.5/230 kV, 3 Ph, 60 Hz step up transformers. These transformers will have two stages of fan cooling, and will be rated 95/125/160 MVA. The transformers will have grounded Wye configuration on the 230 kV primary side and delta configuration on the 34.5 kV secondary side. The IESO recommends but does not require the substation transformers be equipped with Under Load Tap Changers (ULTC).
- 230 kV circuit breakers (designated as 52-T1 and 52-T2 on the single line diagrams at Exhibit B, Tab 3, Schedule 2).
- Motorized, three phase disconnect switches (designated as 89-T2-1 on the single line diagrams at Exhibit B, Tab 3, Schedule 2).
- Surge arrestors.
- A station service transformer.

- A zig-zag, pad mounted grounding transformer.

The Applicant will evaluate all recommendations from the SIA and CIA reports during final design and modeling of the Project.

The station service transformers that serve the control buildings and substation needs will be connected to Hydro One rural distribution, and will be pole mounted. Other outdoor equipment associated with station service transformer will include a fused cut-out, surge arrestor, fused disconnect and metering provided by a registered Metering Service Provider (MSP).

The Collector Substations will each be equipped with the grounding systems designed and installed pursuant to the requirements of Ontario Electrical Safety Code (the "OESC"). The maximum permissible resistance of the grounding system will be determined by the maximum available ground fault current injected into the ground. The ground resistance will be such that under all soil conditions that could exist in practice will limit the potential rise of all parts of the substation to 5000 V and the touch and step voltage will not exceed the tolerable values as specified in OESC. All equipment installed at the Collector Substations will be connected to their substation grounding grid.

2.2) Protection, Control and SCADA Considerations:

All Protection and control will be designed in accordance with the Ontario Energy Board's Transmission System Code and Hydro One's requirements.

The turbine supplier will provide the SCADA system for each wind turbine which will be linked to the Collector Substations through a fibre-optic link running alongside the collector system. In addition to being used for on-site project operations, the communication system will ensure that parties involved in operating and/or monitoring the Wind Farm have access to all data that they require. Detailed list of signals required by each party will be defined in the detailed design phase. Participants requiring information will be as follows:

- Owner site Operations and Maintenance (O&M) personnel
- Owner Remote Operation Centre
- OEM 24 hr Remote Operation Centre
- OEM on-site service center (if required)
- Hydro One Networks Inc (Hydro One) - Transfer Trip, Generator End Open, and other signals. Signals will be sent using fiber optic cables, radios, leased telephone line and/or other approved methods. Details will be provided as detailed engineering proceeds.
- IESO - Metering and status information as determined by completed SIA report

Protective Relaying

Protective relaying will be provided in accordance with Ontario Transmission Code, CIA/SIA requirements, and the single line diagram at Exhibit B, Tab 3, Schedule 2. Protection required will include, but will not be limited to:

- anti-islanding protection;
- HV line protection: line differential current, over-current, directional over-current, distance, over and under frequency protection;
- 34.5 kV switchgear protection: line differential current, over-current, directional over-current, over and under frequency protection;
- transformer protection: differential current, over-current, ground fault, plus gas pressure relays, oil and winding temperature devices; and
- other protection as required for installed buses and other equipment.

Protective relaying will be fully redundant (A and B systems) and consist of both main and alternate relays. Alternate relays will be of a different manufacturer from main relays.

SCADA and Control

SCADA and control systems will allow the operator to monitor and control the behaviour of substation equipment and each WTG as well as the wind farm as a whole. From each turbine, the

SCADA system will monitor energy output, availability, information received from sensors in the WTG, alarm signals and any other information as required. Control system will be used to implement any requirements for voltage or frequency control, reactive power production or operation in general. (For example to curb power production at the request of the system operator or to shut down the turbine in dangerous weather conditions.) SCADA and control systems will consist of:

- Fiber optic network connecting all WTGs with their associated intermediate substation, and intermediate substations.
- SCADA and control cabinets in each of the WTGs. Each SCADA cabinet will be equipped to allow for termination of fiber optic cable.
- SCADA and control cabinets in each of the two substation E-house buildings. Each SCADA cabinet will be equipped to allow for termination of fiber optic cable.
- Data collection cabinet and Fiber Optic interface at the meteorological tower.
- Software as required to allow for all required communication and data processing.

Substation Transformer Protection

The transformers at the Collector Substations will be protected by modern A & B microprocessor based differential relays, namely SEL-387 and GE-T60. Different manufacturer relays are used to enhance reliability and prevent common mode failure. Other built-in functions are also used as follows:

- Directional phase and ground overcurrent elements.
- Instantaneous and time delayed phase elements.
- Instantaneous and time delayed ground elements.

Breaker failure protection for the 230 KV breaker at each substation will be programmed to trip all the necessary local and remote breakers at Chatham switching station in the event that the breaker fails to clear a fault. Tripping and reclosing schemes will be finalized with Hydro One. Additionally, both the HV and LV sides of each transformer is protected by surge arrestors. The transformers will also be equipped with sudden pressure relay (63PR), pressure relief device (63PRD), and temperature trip and alarm (49T).

3) <u>The Transmission Line</u>:

The transmission line that will connect the Collector Substations to the Chatham switching station ("Chatham SS") owned by Hydro One Networks Inc. ("Hydro One") will be a 230 kV single circuit construction line on predominantly steel mono-poles, with the following characteristics:

- Tangent structures: either direct buried mono-poles or mono-poles on foundations (wood or steel)
- Angle structures: self-support steel poles on foundations
- Conductor: 1 x 795 ACSR Drake per phase
- Shield-wire: Aluminum clad steel with optical ground wire
- Insulators: Post type or braced post insulators

The portion of the transmission line that will run between the Collector Substations will be approximately 27 km, and will run within a Canadian Southern Railway Company ("CSR") corridor (the "Corridor Line"). For more information on CSR's corridor, please refer to Exhibit B, Tab 4, Schedule 1. The Corridor Line is illustrated on the maps at Exhibit B, Tab 4, Schedule 2.

From a T-junction on the Corridor Line located approximately 18 km from the Railbed Substation, a transmission line will run approximately 5.7 km to Hydro One's Chatham SS (the "Tie Line").

For the entire transmission line, single monopole design with post (or braced post) insulators will be the basis for transmission line design. All three insulators will be placed on the same side of the structure and span lengths limited to reduce right-of-way width requirements. The single monopoles also reduce the structure footprint which is otherwise larger for lattice steel towers or H-framed structures. An illustration of the single monopole design is at Exhibit B, Tab 3, Schedule 5.

The transmission line will be designed in accordance latest versions of applicable codes particularly 'CSA C22.3 No.-1 – Overhead Systems'. The local ambient conditions for wind, ice and temperature will be taken into account to ensure safe and reliable operation of the transmission line. The transmission line will be constructed using good construction practices, minimal disruptions and 'IEEE 524-2004 – Guide to the Installation of Overhead Transmission Line Conductors'.

Transmission Line Protection

Protection for the 230 kV lines will consist of two independent (A and B line differential protection systems) sets of high speed protection complete with modern multi-functional relays and communication media on separate paths. At each substation, it is a requirement to match the protection and communication media with the Hydro One facilities at the Chatham SS, preliminary proposals of which are indicated on Single Line Diagrams (SLDs) at Appendix B, Tab 3, Schedule 2. Hydro One does not require a generator-owned high voltage interrupter at the point of interconnection with Chatham SS. Close coordination with Hydro One is required to achieve the desired results and comfort level for the 230 kV lines protection. The system is designed to continue providing line protection with the failure of a single protection system element (communications link, a set of CTs, CVT inputs, or a relay).

SEL-387L and GE-L90 are used as A & B microprocessor based line differential relays for the 230 kV lines. This prevents common mode failure problems. To account for the possibility of loss of the fiber optic cable or a device such as a junction box that results in loss of all fiber paths, backup line protection at each substation is provided by a number of elements as follows:

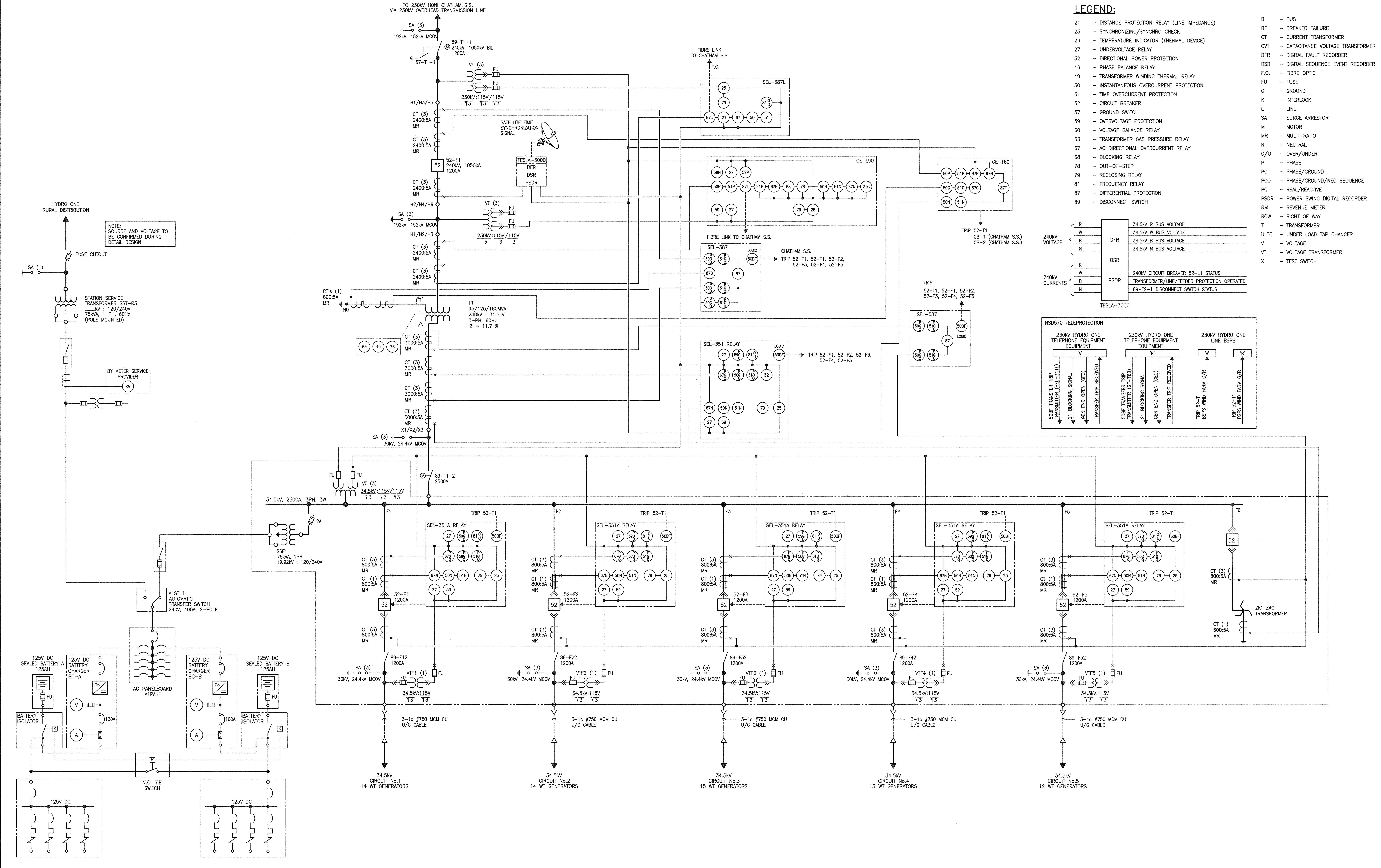
- Time delayed phase mho distance elements.
- Time delayed ground mho distance elements.
- Phase instantaneous and inverse time over-current elements.
- Directional ground instantaneous and inverse time over-current elements.
- Overvoltage and under-voltage elements.
- Over-frequency and under-frequency elements.

4) <u>The Metering Station:</u>

HONI has verbally informed the Applicant that its IESO meters cannot be located in its Chatham SS. The Applicant therefore intends to construct a small fenced area adjacent to the Chatham SS at the point of ownership change between the Applicant and HONI. The fenced area would contain the required IESO revenue meter, the Applicant's back up metering, and the required equipment to provide inputs to the meters which includes at a minimum Potential and Current transformers as well as any switches required to isolate the equipment for maintenance.

5) <u>Connection to the Grid</u>:

The project transmission line is terminated in Chatham SS on a new 230 kV, breaker and a half, diameter being installed by HONI within the existing fenced area. The new diameter will require the construction of 230 kV bus and the installation of two new 230 kV circuit breakers with associated isolation switches, protection and communication equipment. There is room within the existing control house for the required relay panels and communications equipment. A single line diagram of the connection to the Chatham SS is at Exhibit B, Tab 3, Schedule 4.



NOTES:

1. THE SELECTION OF RELAYS IS INTENDED TO INDICATE AVAILABLE FUNCTIONS, MANUFACTURER AND MODEL NUMBER AND SPECIFIC PROTECTION FUNCTIONS WILL BE CONFIRMED DURING DETAIL DESIGN.
2. THE NEED FOR REACTIVE COMPENSATION WILL BE EVALUATED FOLLOWING SIA/CIA REPORT AND REQUIRED EQUIPMENT WILL BE PROVIDED ACCORDINGLY.

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DO NOT USE FOR CONSTRUCTION

PRELIMINARY
NOT FOR CONSTRUCTION

REFERENCE DRAWINGS

DRAWING NO.	DRAWING TITLE
H335936-0000-70-082-0002	PATTERN ENERGY WIND FARM, 230-34.5kV SUBSTN No.1, SINGLE LINE DIAG.
H335936-0000-70-082-0001	PATTERN ENERGY T.S. 230kV INTERCONNECTION, MAIN SINGLE LINE DIAGRAM

CIVIL | ELECTRICAL | MECHANICAL | GEOTECHNICAL | HYDROTECHNICAL | ARCHITECTURAL | OTHER

REVISIONS

NO.	DESCRIPTION	CHK'D	APP'D	DATE
G	REVISED 115kV TO 230kV	HW	GH	2010-12-08
D	REVISED STATION NAMES	HW	GH	2010-09-28

LICENSED PROFESSIONAL ENGINEER K.B. SALMON 90327826 PROVINCE OF ONTARIO

ISSUE AUTHORIZATION

REV.	ISSUE FOR	AUTH. BY		DATE
G	REISSUED FOR CIA/SIA	HW	GH	2010-12-08
F	REISSUED FOR CIA/SIA	HW	GH	2010-10-19
E	ISSUED FOR REVIEW	HW	GH	2010-10-04
D	REISSUED FOR CIA/SIA	HW	GH	2010-09-28
C	ISSUED FOR CIA/SIA	HW	GH	2010-09-02
B	REVISED TO CLIENTS COMMENTS	HW	GH	2010-08-26
A	ISSUED FOR CLIENT REVIEW	HW	GH	2010-08-24

HATCH™

DESIGNED BY H. Witt DATE 10-08-13
DRAWN BY L. Montean DATE 10-08-13
CHECKED BY G. Holden DATE 10-08-16
DISCIP. ENGR. G. Holden DATE 10-08-16
PROJ. DES. COORD.
PROJ. ENGR.
PROJ. MGR. I. Shaw
PROJECT NUMBER H335936

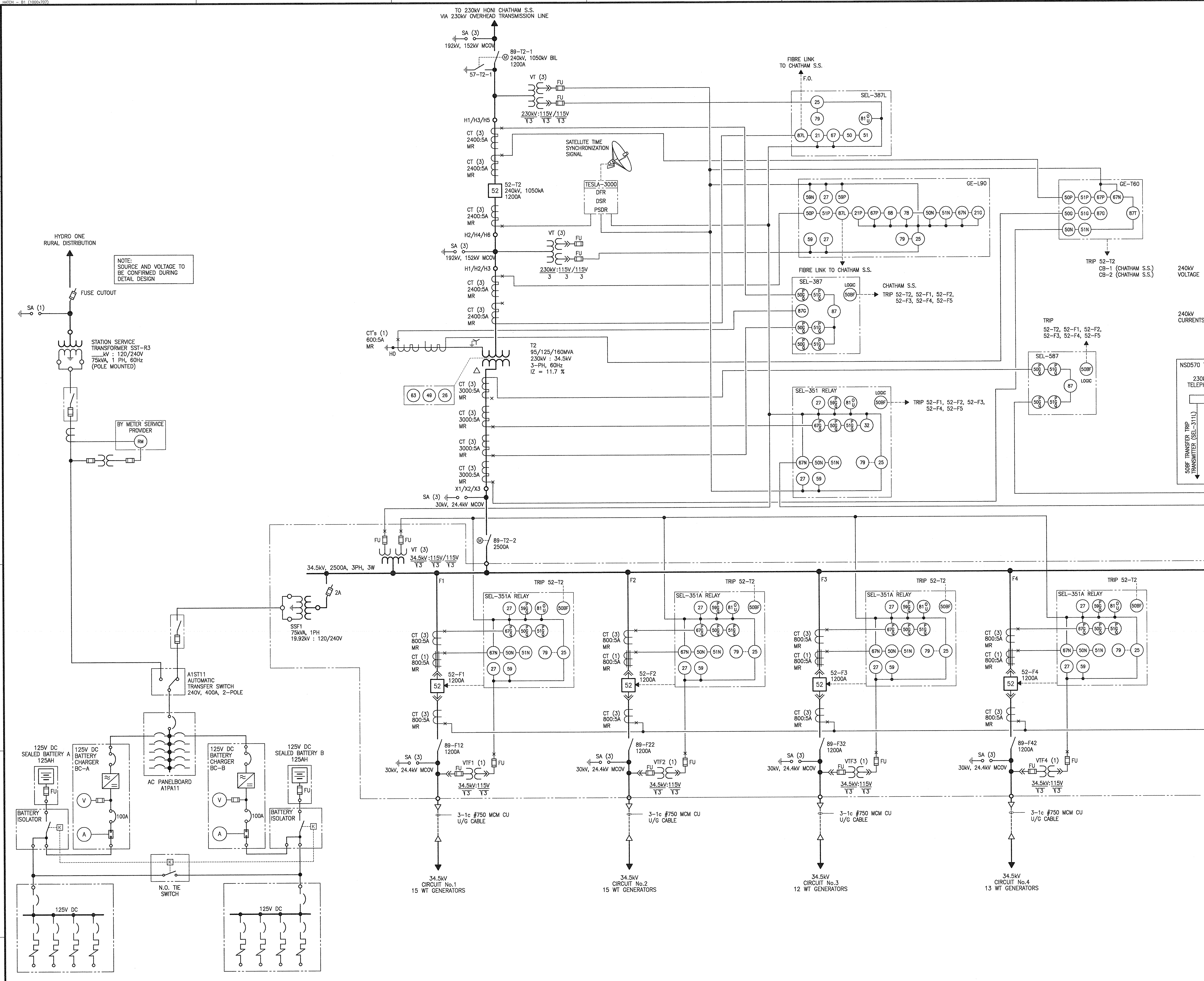
PATTERN ENERGY GROUP LP

SOUTH KENT WIND PROJECT

PATTERN ENERGY
149MW WIND FARM
230kV-34.5kV
RAILBED SUBSTATION
SINGLE LINE DIAGRAM

SCALE NONE | DRAWING NO. H335936-0000-70-082-0002 | REVISION G

Dec 08, 2010, 10:01am Login name: Mont109875 Layout: Layout1
Drawing Name: P:\PATTERN\335936\CAD\E\H335936-0000-70-082-0002.dwg



LEGEND:

21	– DISTANCE PROTECTION RELAY (LINE IMPEDANCE)	B	– BUS
25	– SYNCHRONIZING/SYNCHRO CHECK	BF	– BREAKER FAILURE
26	– TEMPERATURE INDICATOR (THERMAL DEVICE)	CT	– CURRENT TRANSFORMER
27	– UNDERVOLTAGE RELAY	CVT	– CAPACITANCE VOLTAGE TRANSFORMER
32	– DIRECTIONAL POWER PROTECTION	DFR	– DIGITAL FAULT RECORDER
46	– PHASE BALANCE RELAY	DSR	– DIGITAL SEQUENCE EVENT RECORDER
49	– TRANSFORMER WINDING THERMAL RELAY	F.O.	– FIBRE OPTIC
50	– INSTANTANEOUS OVERCURRENT PROTECTION	FU	– FUSE
51	– TIME OVERCURRENT PROTECTION	G	– GROUND
52	– CIRCUIT BREAKER	K	– INTERLOCK
57	– GROUND SWITCH	L	– LINE
59	– OVERVOLTAGE PROTECTION	SA	– SURGE ARRESTOR
60	– VOLTAGE BALANCE RELAY	M	– MOTOR
63	– TRANSFORMER GAS PRESSURE RELAY	MR	– MULTI-RATIO
67	– AC DIRECTIONAL OVERCURRENT RELAY	N	– NEUTRAL
68	– BLOCKING RELAY	O/U	– OVER/UNDER
78	– OUT-OF-STEP	P	– PHASE
79	– RECLOSING RELAY	PG	– PHASE/GROUND
81	– FREQUENCY RELAY	PGQ	– PHASE/GROUND/NEG SEQUENCE
87	– DIFFERENTIAL PROTECTION	PQ	– REAL/REACTIVE
89	– DISCONNECT SWITCH	PSDR	– POWER SWING DIGITAL RECORDER
		RM	– REVENUE METER
		ROW	– RIGHT OF WAY
		T	– TRANSFORMER
		ULTC	– UNDER LOAD TAP CHANGER
		V	– VOLTAGE
		VT	– VOLTAGE TRANSFORMER
		X	– TEST SWITCH

NOTES:

1. THE SELECTION OF RELAYS IS INTENDED TO INDICATE AVAILABLE FUNCTIONS, MANUFACTURER AND MODEL NUMBER AND SPECIFIC PROTECTION FUNCTIONS WILL BE CONFIRMED DURING DETAIL DESIGN.
2. THE NEED FOR REACTIVE COMPENSATION WILL BE EVALUATED FOLLOWING SIA/CIA REPORT AND REQUIRED EQUIPMENT WILL BE PROVIDED ACCORDINGLY.

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REFERENCE DRAWINGS

DRAWING NO.	DRAWING TITLE
H335936-0000-70-082-0002	PATTERN ENERGY WIND FARM, 230-34.5kV SUBSTN No.1, SINGLE LINE DIAG.
H335936-0000-70-082-0001	PATTERN ENERGY T.S. 230kV INTERCONNECTION, MAIN SINGLE LINE DIAGRAM

REVISIONS

NO.	DESCRIPTION	CHK'D	APP'D	DATE
G	REVISED 115kV TO 230kV	HW	GH	2010-12-08
D	REVISED STATION NAMES	HW	GH	2010-09-28

ISSUE AUTHORIZATION

REV.	ISSUE FOR	AUTH. BY		DATE
G	REISSUED FOR CIA/SIA	HW	GH	2010-12-08
F	REISSUED FOR CIA/SIA	HW	GH	2010-10-19
E	ISSUED FOR REVIEW	HW	GH	2010-10-04
D	REISSUED FOR CIA/SIA	HW	GH	2010-09-28
C	ISSUED FOR CIA/SIA	HW	GH	2010-09-02
B	REVISED TO CLIENTS COMMENTS	HW	GH	2010-08-26
A	ISSUED FOR CLIENT REVIEW	HW	GH	2010-08-24

LICENSED PROFESSIONAL ENGINEER K.B. SALMON 90327826 PROVINCE OF ONTARIO 10/12/08

HATCH

DESIGNED BY H. Witt DATE 10-08-13
DRAWN BY L. Montean DATE 10-08-13
CHECKED BY G. Holden DATE 10-08-16
DISCIP. ENGR. G. Holden DATE 10-08-16
PROJ. DES. COORD.
PROJ. ENGR.
PROJ. MGR. I. Shaw
PROJECT NUMBER H335936

PATTERN ENERGY GROUP LP
SOUTH KENT WIND PROJECT

PATTERN ENERGY 121MW WIND FARM 230kV–34.5kV SATTERN SUBSTATION SINGLE LINE DIAGRAM

SCALE NONE
DRAWING NO. H335936-0000-70-082-0003
REVISION G

Dec 09 , 2010 , 3:05pm Login name: mich150337 Layout: Layout1
Drawing Name: P:\PATTERN\335936\CAD\E\H335936-0000-70-082-0001.dwg

DWG. NO. H335936-0000-70-082-0001 REVISION H

LEGEND:

21	– DISTANCE PROTECTION RELAY (LINE IMPEDANCE)	B	– BUS
25	– SYNCHRONIZING/SYNCHRO CHECK	BF	– BREAKER FAILURE
26	– TEMPERATURE INDICATOR (THERMAL DEVICE)	CT	– CURRENT TRANSFORMER
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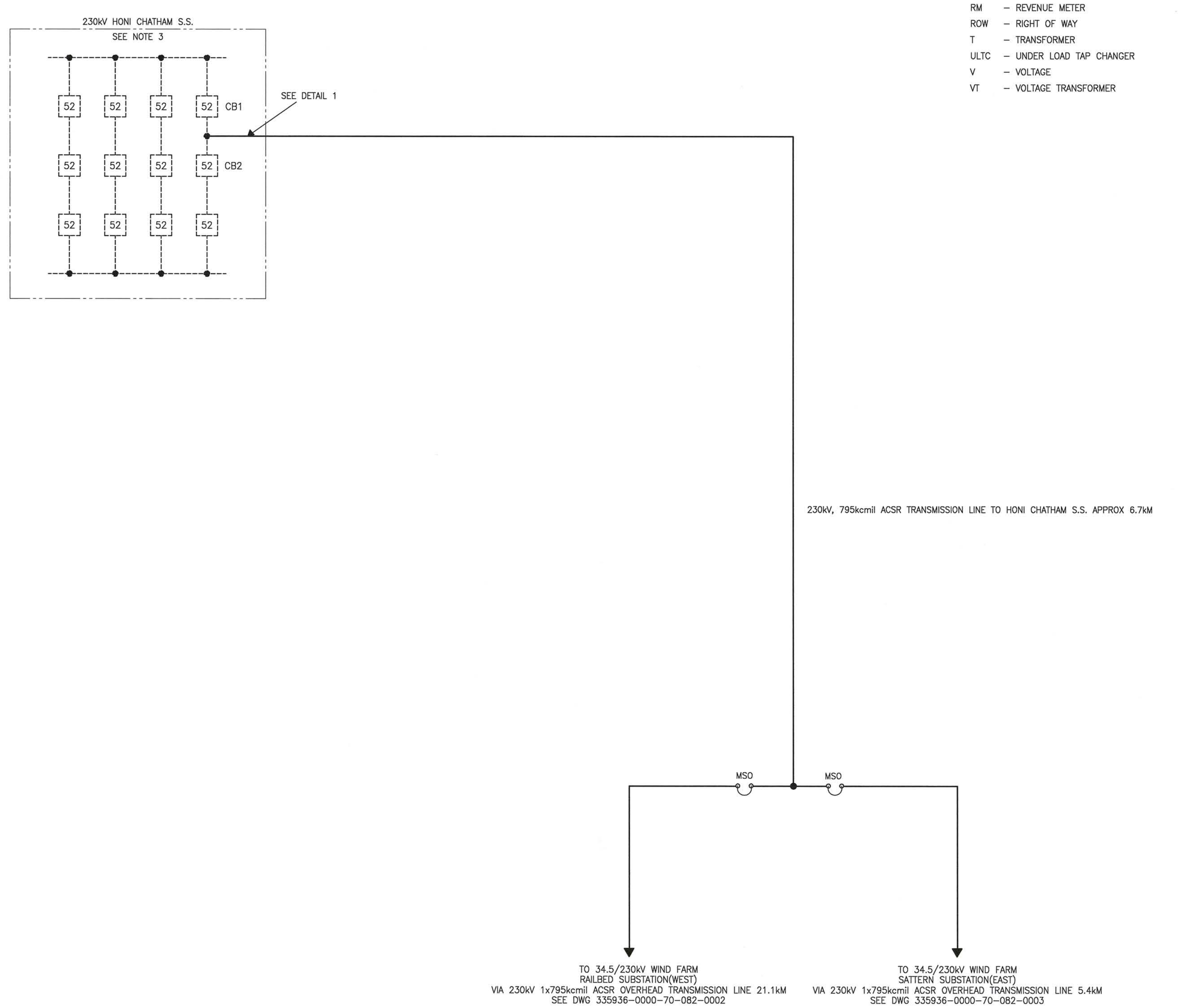
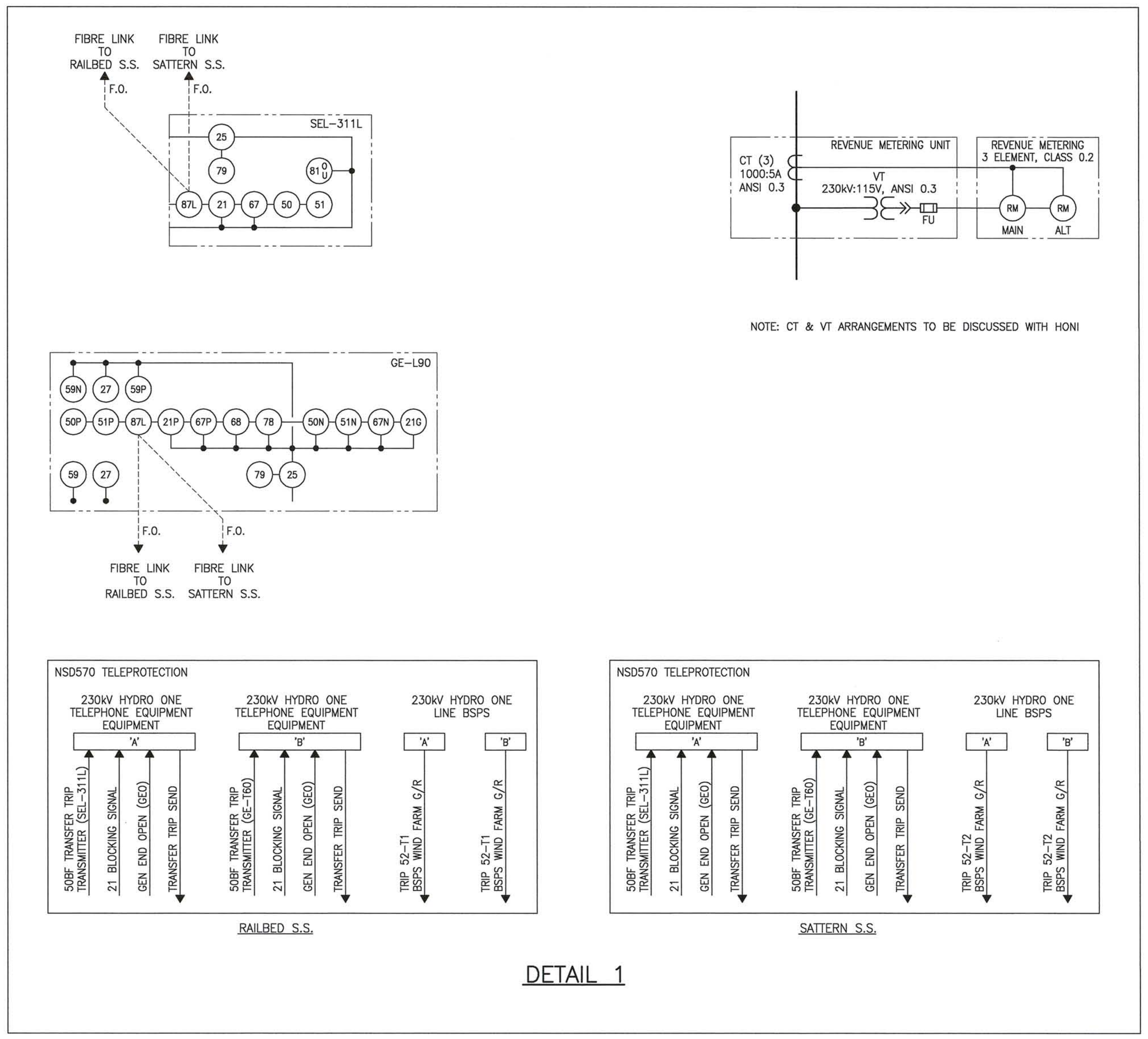
		V	– VOLTAGE
		VT	– VOLTAGE TRANSFORMER





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2. THE NEED FOR REACTIVE COMPENSATION WILL BE EVALUATED FOLLOWING CIA/SIA REPORT AND REQUIRED EQUIPMENT WILL BE PROVIDED ACCORDINGLY.
3. CONNECTION TO HONI CHATHAM S.S. IS TENTATIVE, NEW DIAMETER TO BE ADDED BY HONI.
4. TRANSFORMER CONFIGURATION TO BE DISSCUSSED WITH HONI DURING DETAIL DESIGN.

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DO NOT USE FOR CONSTRUCTION

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REFERENCE DRAWINGS

DRAWING NO.	DRAWING TITLE
H335936-0000-70-082-0003	230kV–34.5kV SUBSTATION No.2, SINGLE LINE DIAGRAM
H335936-0000-70-082-0002	230kV–34.5kV SUBSTATION No.1, SINGLE LINE DIAGRAM

REVISIONS

NO.	DESCRIPTION	CHK'D	APP'D	DATE
H	REVISED FO LINK FROM PATTERN TO RAILBED	HW	GH	2010-12-09
G	REMOVED PINEHURST T.S.	HW	GH	2010-12-08
D	REVISED STATION NAMES	HW	GH	2010-09-28

G. D. HOLDEN

ISSUE AUTHORIZATION

REV.	ISSUE FOR	AUTH.	BY	DATE
H	REISSUED FOR CIA/SIA	HW	GH	2010-12-09
G	REISSUED FOR CIA/SIA	HW	GH	2010-12-08
F	REISSUED FOR CIA/SIA	HW	GH	2010-10-19
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D	REISSUED FOR CIA/SIA	HW	GH	2010-09-28
C	ISSUED FOR CIA/SIA	HW	GH	2010-09-02
B	REVISED TO CLIENTS COMMENTS	HW	GH	2010-08-26
A	ISSUED FOR CLIENT REVIEW	HW	GH	2010-08-24

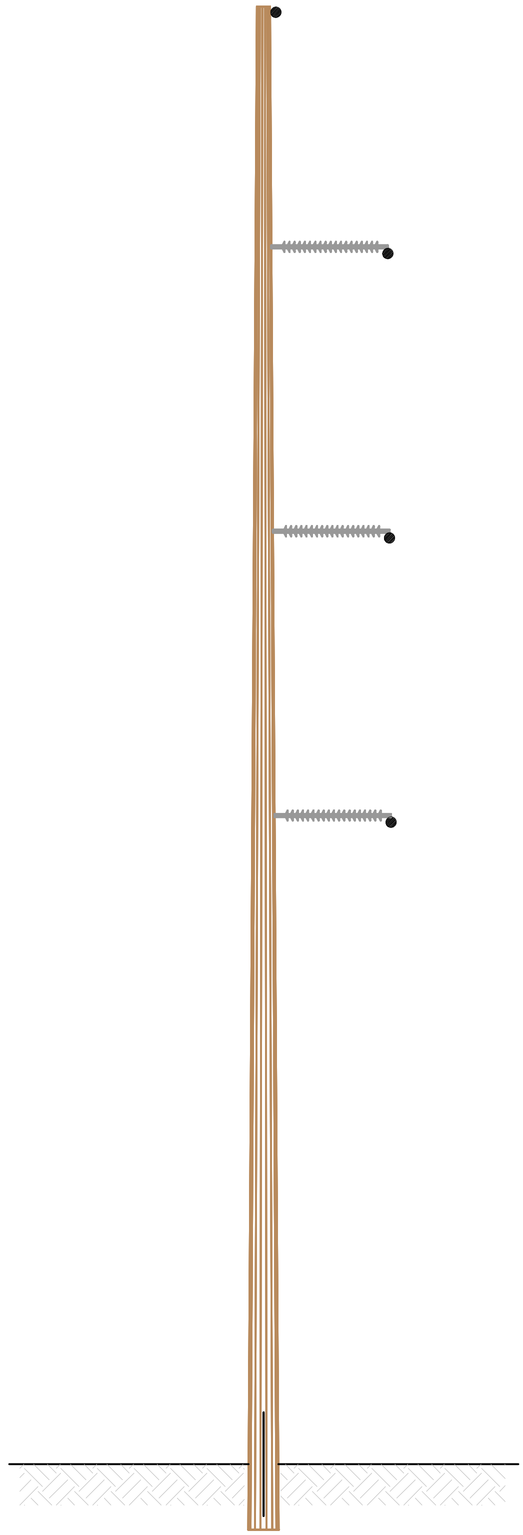
HATCH™

DESIGNED BY H. Witt, DATE 10–08–13
DRAWN BY L. Montean, DATE 10–08–13
CHECKED BY G. Holden, DATE 10–08–16
DISCIP. ENGR. G. Holden, DATE 10–08–16
PROJ. DES. COORD.
PROJ. ENGR.
PROJ. MGR. I. Shaw
PROJECT NUMBER H335936

PATTERN ENERGY GROUP LP
SOUTH KENT WIND PROJECT

230kV INTERCONNECTION TO
HONI CHATHAM SS
MAIN SINGLE LINE DIAGRAM

SCALE NONE
DRAWING NO. H335936–0000–70–082–0001
REVISION H



NOTE:

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DESIGNED BY F. LIU 04/MAR/11	DRAWN BY R. YUZON 04/MAR/11	HATCH	PATTERN ENERGY GROUP LP
CHECKED BY A. AFZAL 04/MAR/11	DISCIP. ENGR. DATE		SOUTH KENT WIND PROJECT
PROJ. MGR. A. O'MARA DATE	PROJ. ENGR. DATE	SCALE N.T.S	230kV TRANSMISSION LINE TYPICAL TANGENT POLE STRUCTURE OUTLINE DRAWING
			DRAWING NO. H335936-0000-70-015-0001
			REV. 0

<u>ROUTE FOR THE PROPOSED FACILITIES</u>

The proposed transmission project (the "Project") will be entirely located within the Municipality of Chatham-Kent. The route and land matters for each of the sections of the Project are described below.

i) The Corridor Line

As described at Exhibit B, Tab 3, Schedule 1, Page 1, the Project includes two 34.5/230 kV step-up collector substations. The westernmost substation is named the "Railbed Substation", and the other is named the "Sattern Substation" (collectively the "Collector Substations"). The portion of the Project that will run between the Collector Substations is referred to as the "Corridor Line". The Corridor Line will be approximately 27 km in length and will run within a 90-foot wide corridor, part of which is an active rail corridor and part of which is an abandoned rail corridor (the "Corridor"). The active Canadian Southern Railway Company ("CSR") part of the Corridor runs from Railbed Substation to Fargo Road. There are currently two railway tracks in the active portion of the Corridor. The northernmost track is no longer in use. The southern track remains active. CSR also owns the section of the Corridor between Fargo Road and Communications Road. This section of the Corridor has been abandoned and the track has been removed. CSR is in the process of abandoning the active railway line, which is why the Corridor is referred to in the Application as an "abandoned CSR corridor".

In regard to the portion of the Corridor from Communications Road west to the Railbed Substation (ie. the western portion of the Corridor), negotiations are underway with CSR to secure the necessary land rights for this portion of the Corridor. The form of land agreement for this portion of the Corridor will be filed as negotiations with CSR progress.

The Municipality of Chatham-Kent (the "Municipality") recently purchased the portion of the Corridor between Communication Road and Elgin County to the east. For this portion of the Corridor (ie. the eastern portion of the Corridor), the Municipality will grant an easement to

Chatham-Kent Transmission ("CKT") (ET-2010-0351). CKT, in turn, will grant a sub-easement to the Applicant for its transmission facilities. As described by CKT in its electricity transmitter licence application (EB-2010-0351), when construction of the Transmission Project is completed, the Applicant intends to sell the Transmission Project to CKT. As such, the Applicant expects to obtain the necessary sub-easement for this portion of the Corridor from CKT. The Applicant expects to be in a position to file the form of this easement within the next few weeks.

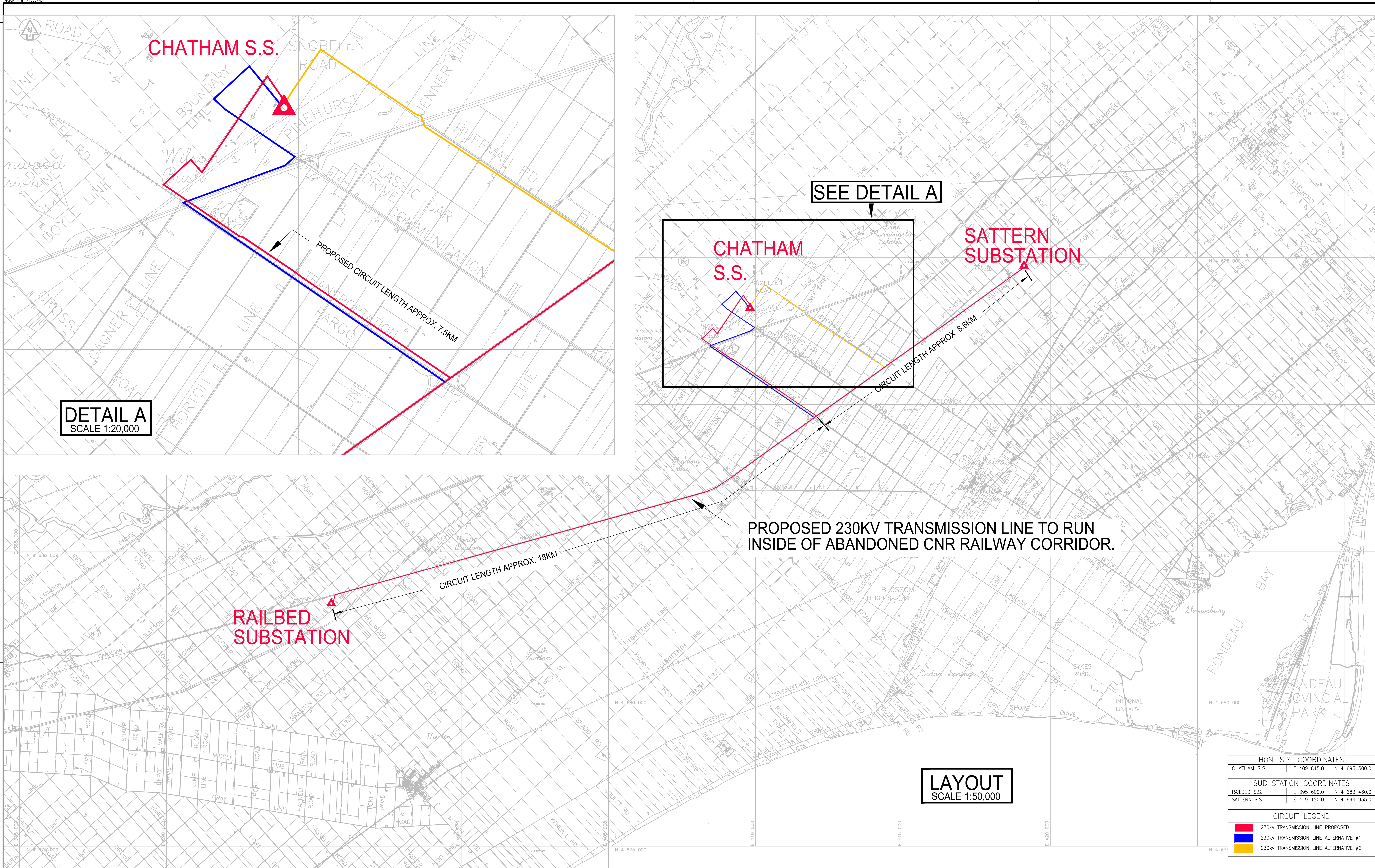
A Placeholder has been created in the pre-filed evidence at Exhibit B, Tab 4, Schedule 6(iii) for the forms of agreement pertaining to the Corridor.

ii) The Tie Line

The "Tie Line" refers to a 230 kV transmission line that will run from a tie-point on the Corridor Line to the Chatham switching station owned by Hydro One Networks Inc. Land ownership along the Tie Line is illustrated by the Landowner Map at Exhibit B, Tab 4, Schedule 3. A written description of the Tie Line route is provided below. We note that in selecting the route described below, the Applicant attempted to locate the transmission line on municipal rights-of-way wherever possible. However, various physical factors required the crossing of private land. Therefore, the route selected represents the minimal amount of impact on private landowners.

From the Corridor Line, the first part of the Tie Line will run for approximately 3.24 km north on seven privately owned properties (farms) to the Safety Village located at 21797 Fargo Road on the south side of Highway 401. From the south end of the Safety Village, the Tie Line will cross west over a railway line onto the municipal right-of-way ("ROW") and will continue north along the ROW for .76km, cross Highway 401, and then continue north on a private property for .35km. It will then turn approximately 90 degrees west and travel for .53km, then turn approximately 90 degrees south and travel for .35km, then turn approximately 90 degrees west and travel for .9km, crossing Communication Road to another private landowner, and continue for .5km to Hydro One’s Access Road where the Tie Line will turn one final time approximately 90 degrees south and travel for .26km to the Hydro One SS.

For the portions of the Tie Line that will require easements from private landowners, the form of easement agreement is at Exhibit B, Tab 4, Schedule 6(i). For the portion of the Tie Line that will run along the municipal ROW, the Applicant expects to be in a position to file the form of agreement within the next few weeks. A Placeholder has been created in the pre-filed evidence at Exhibit B, Tab 4, Schedule 6(ii) for this form of agreement.



HONI S.S. COORDINATES		
CHATHAM S.S.	E 409 815.0	N 4 693 500.0

SUB STATION COORDINATES		
RAILBED S.S.	E 395 600.0	N 4 683 460.0
SATTERN S.S.	E 419 120.0	N 4 694 935.0

CIRCUIT LEGEND

- (red) 230kV TRANSMISSION LINE PROPOSED
- (blue) 230kV TRANSMISSION LINE ALTERNATIVE #1
- (yellow) 230kV TRANSMISSION LINE ALTERNATIVE #2

0 1000 2000 3000 4000 5000 m
Scale: 1:50,000

0 500 1000 1500 2000 m
Scale: 1:20,000

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DO NOT USE FOR CONSTRUCTION

DRAWING NO.	DRAWING TITLE
REFERENCE DRAWINGS	

NO.	DESCRIPTION	CHK'D	APP'D	DATE
REVISIONS				

REV.	ISSUE FOR	AUTH.	BY	DATE
E	ISSUED FOR INFORMATION	GM	GDH	2011-06-01
D	ISSUED FOR INFORMATION	GM	GDH	2011-05-27
C	ISSUED FOR INFORMATION	GM	GDH	2011-04-11
B	ISSUED FOR INFORMATION	GM	GDH	2011-04-08
A	ISSUED FOR INFORMATION	GM	GDH	2011-02-25

ISSUE AUTHORIZATION

HATCH™

PATTERN ENERGY GROUP LP

SOUTH KENT WIND PROJECT

PROPOSED 230kV O/H TRANSMISSION LINE ROUTING

DESIGNED BY: G Michener	DRAWN BY: G. Michener
CHECKED BY:	DISCIP. ENGR.: G. Holden
PROJ. DES. COORD.:	PROJ. ENGR.: A. O'Mara
PROJ. MGR.: I. Shaw	PROJECT NUMBER: H335936

SCALE	DRAWING NO.	REVISION
AS SHOWN	H335936-0000-70-014-0002	E

DWG. NO. H335936-0000-70-014-0002 REVISION E

Jun 01, 2011 - 10:59am Login name: mich150337 Layout: 001
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LANDOWNER MAP/ILLUSTRATION

As noted at Exhibit B, Tab 4, Schedule 1, the Corridor is owned by both the Municipality of Chatham Kent and CNR. A map that shows the landowners along the Tie Line will be filed pursuant to the Board's *Practice Direction on Confidential Filings* in order to keep the names of the private landowners off the public record as requested by Board staff.

<u>ALTERNATIVE ROUTES CONSIDERED</u>

Most of the Transmission Project will be located within the soon to be abandoned CSR Corridor. The CSR Corridor is the optimal location for the Transmission Project for a number of reasons, including:

- there will be little or no impact on private landowners;
- the Corridor is far from houses;
- the Applicant will only have to enter into land agreements with two parties;
- the Corridor is expected to be abandoned, and even if it is not, it will be possible for rail and transmission use to co-exist, so the Transmission Project will not affect any existing land uses; and
- the Corridor has been used for industrial purposes for over 100 years.

An alternative route on private land parallel to the Corridor could be considered, however such a route would affect numerous private landowners. The CSR Corridor is the least invasive and most efficient route for the Transmission Project and was therefore chosen by the Applicant.

Alternative routes were, however, considered for the Tie Line portion of the Transmission Project (ie. the portion that runs from the tie-point on the Corridor Line to the Chatham SS owned by Hydro One Networks Inc.). Two alternatives for the Tie Line that were considered are illustrated on the map at Exhibit B, Tab 4, Schedule 2. Both of these alternatives were dismissed for the following reasons:

1. Alternative #1 (depicted in yellow on the map): This route was dismissed because of proximity to an existing high pressure gas line owned by Union Gas. After discussions with Union Gas, it was concluded that adequate distance could not be maintained between the transmission line and the underground gas pipeline to mitigate induction and fault current impacts.

2. Alternative #2 (depicted in blue on the map): This route was dismissed because the private landowner north of Highway 401 did not want a transmission line on his property that runs parallel to Highway along the 401. That landowner, however, is agreeable to the Tie Line being on his property as described for the proposed route. In addition there are already overhead facilities along Communications road that would interfere with the placement of the transmission facilities in the road right-of-way. Finally, there are mature trees along Boundary Line Road that would require harvesting in order to place a transmission line in the road right-of-way. For all these reasons, this alternative was rejected.

Ultimately, the proposed route for the Tie Line portion of the Transmission Project was found to be optimal because there are willing private land owners (5 of the 7 south of Highway 401 have indicated a willingness to grant an easement); and (ii) only a maximum of 9 private landowners will be affected.

LIST OF AFFECTED LANDOWNERS

The affected landowners include:

- Canadian National Railway ("CNR")
- The Municipality of Chatham-Kent
- Chatham-Kent Transmission
- 9 private landowners whose names will be filed pursuant to the Board's *Practice Direction on Confidential Filings*, as requested by Board staff.

TRANSMISSION EASEMENT

THIS TRANSMISSION EASEMENT ("**Grant**"), is executed effective this **_____** day of _______________, 2011, by and between **[Landowner]** ("**Grantor**") and **[Developer]** ("**Grantee**").

PREMISES

A. Grantor is the registered owner of an estate in fee simple composed of certain parcels or tracts of land and premises more particularly described on **Exhibit A** attached hereto and made a part hereof ("**Property**"); and

B. Grantor desires to grant, convey and transfer to Grantee an exclusive easement and right-of-way for the erection, installation and maintenance of certain facilities for the transmission of electric power over and across a certain portion of the Property.

IN CONSIDERATION of the foregoing and other good and valuable consideration, the receipt and adequacy of which are hereby acknowledged, the parties hereto agree as follows:

1. **Grant**. Grantor does hereby grant, convey and transfer to Grantee, an exclusive easement and right-of-way (the "**Transmission Easement**") approximately **______** metres in width in, on, over, across, along and under that portion of the Property more particularly described on **Exhibit B** ("**Easement Area**") attached hereto with such persons, vehicles and equipment necessary for the purposes of erecting, constructing, replacing, relocating, improving, enlarging, removing, maintaining, operating and utilizing, from time to time, a line or lines of towers and/or poles, with such wires and/or cables (whether above ground or buried), for the transmission of electrical energy, and all necessary and proper foundations, footings, cross arms and other appliances, facilities and fixtures for use in connection therewith including without limitation, vaults and junction boxes (whether above or below ground), manholes, handholes, conduit, fiber optics, cables, wires, lines and other conductors of any nature, multiple above or below ground control, communications, data and radio relay systems, and telecommunications equipment, including without limitation, conduit, fiber optics, cables, wires and lines (collectively, the "**Transmission Facilities**") in, on, over, across, along and under the Easement Area; together with the right of ingress to and egress from the Transmission Facilities over and along the Property.

In connection with the Transmission Easement, Grantor does hereby grant, convey and transfer to Grantee an exclusive easement, right and entitlement on, over, across and under the Property for any audio, visual, view, light, noise, vibration, air turbulence, wake, shadow flicker, electromagnetic, television reception and any other effect of any kind whatsoever, and for ice or other weather created hazards, resulting directly or indirectly from any operations conducted on, or any improvements or facilities now or hereafter located on the Property. Grantor, for itself, and its heirs, administrators, executors, successors and assigns, does hereby waive, remise and release any right, claim or cause of action now existing or hereafter arising as a direct or indirect result of any of the foregoing.

2. **<u>No Interference</u>**. Grantor covenants and agrees that it shall not construct, install, or permit to be constructed or installed, any improvements, fences, structures, buildings, foliage or vegetation, utility lines or other improvements of any type whatsoever upon or near the Easement Area which would inhibit or impair any of Grantee's rights or benefits as set forth in this Grant. Grantee shall have the right, without compensation to Grantor, to cut, prune and remove or otherwise dispose of any foliage or vegetation on or near the Easement Area that Grantee deems a threat or potential threat to Grantee's Transmission Facilities or its rights hereunder. Grantor shall not grant or permit any person or person(s) claiming through Grantor, other than Grantee, any right-of-way, encumbrance, easement or other right or interest in, to or affecting the Easement Area, without the prior written consent of Grantee in each instance, which consent Grantee may grant, withhold or deny in its sole, absolute and subjective discretion.

3. **<u>Construction of Transmission Facilities.</u>** Grantor acknowledges and agrees that during and in respect of the construction, installation, maintenance and repair of the Transmission Facilities in, or, over and through the Property, Grantee shall be entitled to access, occupy and use temporary staging and lay down areas within the Property reasonably proximate to the Easement Area. In performing such work, Grantor acknowledges that it may be necessary for existing utility facilities (i.e. telephone poles, electrical poles, underground utility lines, etc.) to be relocated to other portions of the Property. Grantor agrees upon the request of Grantee to consent to the relocation of such utilities and will execute such agreements as the applicable utility company may require in connection with the relocation of such utilities. All costs associated with the relocation of such utilities shall be to the sole account of Grantee.

4. **<u>Term</u>**. The term of this Grant shall commence on the date this Grant is executed and shall be for a permanent and indefinite term (the "**Term**") without expiry.

5. **<u>Authority</u>**. Grantor hereby represents and warrants to Grantee that it is the registered owner of the Property in fee simple subject to no liens or encumbrances registered in priority to this Transmission Easement and is fully authorized and empowered to grant the rights and benefits granted to Grantee in this Grant. Grantor shall notify Grantee promptly and in writing of any change in ownership and Grantee shall be entitled to continue to send notices to the existing Owner until satisfied of the status of the change of ownership of the Property. Grantor covenants and agrees that it shall obtain an assumption agreement in favour of Grantee from any transferee or mortgagee of Grantor's interest in the Property, pursuant to which such transferee or mortgagee agrees to be bound by the terms of this Transmission Easement. In the event that any mortgage, charge, financial encumbrance or other encumbrances that might interfere with Grantee's right to use the Property pursuant to this Transmission Easement is now or hereafter registered against title to the Property in priority to this Transmission Easement (each, a "**Prior Encumbrance**"), Grantor covenants and agrees, at the request of Grantee, to obtain from the holder of such Prior Encumbrance either: (i) an executed registrable postponement of such Prior Encumbrance to and in favour of this Transmission Easement (a "**Postponement**"); or (ii) an executed non-disturbance agreement or mutual co-existence agreement which is acceptable to Grantee, acting reasonably (an "**NDA**").

Grantee acknowledges that as of the date of this Transmission Easement, the Property may be subject to one or more charge/mortgages of land charging the Property (the "**Existing**

Mortgages"). The Existing Mortgages shall, notwithstanding anything to the contrary set forth herein, be permitted encumbrances under this Transmission Easement so long as: (i) the mortgagees under the Existing Mortgages shall have executed this Transmission Easement below; or (ii) Grantor has obtained, at its sole cost and expense, a Postponement or NDA in favour of Grantee from all such mortgagees.

6. **Indemnification and Insurance**. Grantee shall maintain liability insurance insuring Grantee and Grantor against loss caused by Grantee's use of the Property. The amount of insurance shall be not less than $3,000,000.00 of combined single limit liability coverage. Grantee shall indemnify and at its expense defend Grantor against liability for injuries and claims for direct damage to the extent that they are caused by Grantee's exercise of rights granted in this Grant. This indemnity does not cover losses of rent, business opportunities, crop production, and profits that may result from Grantor's loss of use of the Property and for greater certainty, Grantee shall only be liable for reasonably anticipated and foreseeable damages. Grantee shall name Grantor as an additional insured on the policy of liability insurance and the liability policy shall contain a "contractual liability" endorsement.

7. **Grantee's Property**. Notwithstanding that in constructing, maintaining and operating the Transmission Facilities, Grantee may install equipment and appurtenances in, on, over, along, under or across the Easement Area in such a manner that it or they become affixed to the Easement Area, the title to such equipment and appurtenances shall at all times remain the personal property of Grantee.

8. **Assignment by Grantor**. It will be a condition to any transfer or conveyance of the Property by Grantor that Grantor shall cause any purchaser of the Property to execute an agreement in favour of Grantee agreeing to be bound by the terms hereof to the same extent as if such purchaser had been an original party hereto. The purchaser shall also agree to extract a similar covenant from any future purchaser of the Property.

9. **Assignment by Grantee; Mortgage Rights**.

(a) Right to Mortgage & Assign. Grantee, upon notice to Grantor, but without Grantor's consent or approval shall have the right to mortgage, charge, collaterally assign, or otherwise encumber and grant security interests in all or any part of its interest in this Transmission Easement or the Easement Area, or the Transmission Facilities (collectively, its "**Facilities Assets**"). These various security interests in all or a part of the Facilities Assets are collectively referred to as "**Mortgages**" and the holders of the Mortgages, their designees, successors and assigns are referred to as "**Mortgagees**." Grantee's notice to Grantor shall include the name and address of each Mortgagee and/or Assignee. Grantee shall also have the right without Grantor's consent to sell, convey, lease, or assign all or any portion of its Facilities Assets on either an exclusive or a non-exclusive basis, or to grant sub-easements co-easements, separate easements, leases, licenses or similar rights, however denominated (collectively, "**Assignment**"), to one or more persons or entities (collectively, "**Assignees**"). Assignees and Mortgagees shall use the Facilities Assets only for the uses permitted under this Grant. Assignees and Mortgagees shall have all rights and remedies allowed them under then existing laws except as limited by their individual agreements with Grantee, provided that under no circumstances shall any Mortgagee or Assignee have any greater rights of ownership or use of the Property than the rights granted to Grantee in this Grant.

(b) Grantor Obligations: Grantor agrees to consent in writing to and to execute financing documents, including customary three party lender agreements, as may reasonably be required by Mortgagees. As a precondition to exercising any rights or remedies related to any alleged default by Grantee under this Grant, Grantor shall give written notice of the default to each Mortgagee and Assignee at the same time it delivers notice of default to Grantee, specifying in detail the alleged event of default and the required remedy. Each Mortgagee and Assignee shall have the same amount of time to cure the default as to Grantee's entire interest or its partial interest in the Facilities Assets as is given to Grantee and the same right to cure any default as Grantee or to remove any property of Grantee, Mortgagees or Assignees located on the Easement Area. The cure period for each Mortgagee and Assignee shall begin to run at the end of the cure period given to Grantee in this Grant, but in no case shall the cure period for any Mortgagee or Assignee be less than ninety (90) days after receipt of the default notice. Failure by Grantor to give a Mortgagee or Assignee notice of default shall not diminish Grantor's rights against Grantee, but shall preserve all rights of the Mortgagee or Assignee to cure any default and to remove any property of Grantee, the Mortgagee or Assignee located on the Easement Area.

(c) Mortgagee/Assignee Obligations. Any Mortgagee or Assignee that does not directly hold an interest in the Facilities Assets, or whose interest is held solely for security purposes, shall have no obligation or liability under this Grant prior to the time the Mortgagee or Assignee directly holds an interest in this Grant, or succeeds to absolute title to Grantee's interest. A Mortgagee or Assignee shall be liable to perform obligations under this Grant only for and during the period it directly holds such interest or absolute title. Any Assignment permitted under this Grant shall release Grantee or other assignor from obligations accruing after the date that liability is assumed by the Assignee.

(d) Right to Cure Defaults/Notice of Defaults/Right to New Transmission Easement.

(1) To prevent termination of this Grant, the Transmission Easement, or any partial interest in this Grant and the Transmission Easement, Grantee, any Mortgagee or Assignee shall have the right, but not the obligation, at any time to perform any act necessary to cure any default and to prevent the termination of this Grant or any interest in the Facilities Assets.

(2) In the event of an uncured default by the holder of Grantee's entire interest in this Grant, or in the event of a termination of this Grant by agreement, by operation of law or otherwise, each Mortgagee or Assignee of a partial interest in the Facilities Assets that is not in material default of its obligations shall have the right to have Grantor either recognize the Mortgagee's or Assignee's interest or, in the event of a termination, grant new easements substantially identical to this Grant and the Transmission Easement. Under the new easements, the Mortgagee or Assignee shall be entitled to, and Grantor shall not disturb, Mortgagee's or Assignee's continued use and enjoyment for the remainder of the Term, or such shorter term as an Assignee may otherwise be entitled pursuant to its Assignment.

(e) Extended Cure Period. If any default by Grantee under this Grant cannot be cured without obtaining possession of all or part of the Facilities Assets, then any such default shall be deemed remedied if a Mortgagee or Assignee: (a) within ninety (90) days after receiving notice from Grantor as set forth in Section 9(b), acquires possession of all or part of the Facilities Assets, or begins appropriate judicial or nonjudicial proceedings to obtain the same; (b) diligently prosecutes any such proceedings to completion; and (c) after gaining possession of all or part of the Facilities Assets cures defects that are reasonably capable of being cured and not otherwise personal to Grantor and performs all other obligations as and when the same are due in accordance with the terms of this Grant. If a Mortgagee or Assignee is prohibited by any court or by operation of any bankruptcy or insolvency laws from commencing or prosecuting the proceedings described above, the ninety (90) day period specified above for commencing proceedings shall be extended for the period of such prohibition.

(f) Certificates. Grantor shall execute estoppel certificates (certifying as to truthful matters, including without limitation that no default then exists under this Grant, if such be the case), consents to assignment, direct lender agreements and non-disturbance agreements as Grantee or any Mortgagee or Assignee may reasonably request from time to time. Grantor and Grantee shall cooperate in amending this Grant from time to time to include any provision that may be reasonably requested by Grantee or any Mortgagee or Assignee to implement the provisions contained in this agreement or to preserve a Mortgagee's security interest in the Facilities Assets.

10. **Mortgagee Protection**. Any Mortgagee, upon delivery to Grantor of notice of its name and address, for so long as its Mortgage is in existence shall be entitled to the following protections which shall be in addition to those granted elsewhere in this Grant:

(a) Mortgagee's Right to Possession, Right to Acquire and Right to Assign. A Mortgagee shall have the absolute right without Grantor's consent: (a) to assign its Mortgage; (b) to enforce its lien, including, to acquire title to all or any portion of the Facilities Assets by any lawful means; (c) to take possession of and operate all or any portion of the Facilities Assets and to perform all obligations to be performed by Grantee under this Grant, or to cause a receiver or a receiver and manager to be appointed to do so; and (d) to acquire all or any portion of the Facilities Assets by foreclosure, by an assignment in lieu of foreclosure or by quit claim and thereafter without Grantor's consent to assign or transfer all or any portion of the Facilities Assets to a third party. A Mortgagee which assigns or transfers Facilities Assets to a third party shall notify Grantor of the name and address of the Assignee or Transferee.

(b) Opportunity to Cure.

(1) During any period of possession of the Easement Area by a Mortgagee (or a receiver or receiver and manager requested by a Mortgagee) and/or while any foreclosure or other enforcement proceedings instituted by a Mortgagee are pending, the Mortgagee shall pay or cause to be paid the fees and all other monetary charges, if any, payable by Grantee under this Grant which have accrued and are unpaid at the commencement of the period and those which accrue thereafter during the period. Following acquisition of all or a portion of the Facilities Assets by the Mortgagee as a result of either foreclosure, acceptance of an assignment in lieu of foreclosure, quit claim or by a purchaser under a power of sale or judicial sale, this Grant shall

continue in full force and effect and the Mortgagee or party acquiring title to the Transmission Easement shall, as promptly as reasonably possible, commence the cure of all defaults under this Grant and thereafter diligently process such cure to completion, whereupon Grantor's rights relating to such default shall be deemed waived; provided, however, that the Mortgagee or party acquiring title to Grantee's Easement shall not be required to cure those defaults which are not reasonably susceptible of being cured or performed by such party ("**non-curable defaults**"). Non-curable defaults shall be deemed waived by Grantor upon completion of foreclosure proceedings or acquisition of Grantee's interest in this Grant under a power of sale or judicial sale.

(2) Any Mortgagee or other party who acquires Grantee's interest in the Facilities Assets pursuant to foreclosure, assignment in lieu of foreclosure, quit claim, under a power of sale or judicial sale or otherwise shall not be liable to perform the obligations imposed on Grantee by this Grant incurred or accruing after the party no longer has ownership or possession of the Facilities Assets.

(c) New Easement.

(1) If this Grant is terminated for any reason, if the Transmission Easement is foreclosed, or if this Grant is rejected, repudiated, resiliated or disaffirmed pursuant to bankruptcy law or other law affecting creditor's rights and, within ninety (90) days after such event, Grantee or any Mortgagee or Assignee shall have arranged to the reasonable satisfaction of Grantor for the payment of all fees or other charges due and payable by Grantee as of the date of such event, then Grantor shall execute and deliver to Grantee or such Mortgagee or Assignee or to a designee of one of these parties, as the case may be, a new easement to the Easement Area which (i) shall be for a term equal to the Term; (ii) shall contain the same covenants, agreements, terms, provisions and limitations as this Grant (except for any requirements that have been fulfilled by Grantee or any Mortgagee or Assignee prior to rejection, repudiation, resiliation or termination of this Grant); and, (iii) shall include that portion of the Facilities Assets in which Grantee or such other Mortgagee or Assignee had an interest on the date of rejection, repudiation, resiliation or termination.

(2) After the termination, repudiation, resiliation, rejection or disaffirmation of this Grant and during the period thereafter during which any Mortgagee shall be entitled to enter into new easements for the Easement Area, Grantor will not terminate the rights of any Assignee unless in default under its Assignment.

(3) If more than one Mortgagee makes a written request for a new easement pursuant to this provision, the new easements shall be delivered to the Mortgagee requesting such new easement whose Mortgage is prior in lien, and the written request of any other Mortgagee whose lien is subordinate shall be void and of no further force or effect.

(4) The provisions of this Section shall survive the termination, rejection, repudiation, resiliation or disaffirmation of this Grant and shall continue in full force and effect thereafter to the same extent as if this Section were a separate and independent contract made by Grantor, Grantee and each Mortgagee, and, from the effective date of such termination, rejection, repudiation, resiliation or disaffirmation of this Grant to the date of execution and delivery of

such new easements, such Mortgagee may use and enjoy the Easement Area without hindrance by Grantor or any person claiming by, through or under Grantor; provided that all of the conditions for the new easements as set forth above are complied with.

(d) Mortgagee's Consent to Amendment, Termination or Surrender. Notwithstanding any provision of this Grant to the contrary, the parties agree that so long as there exists an unpaid Mortgagee, this Grant shall not be modified or amended, and Grantor shall not accept a surrender, cancellation or release of all or any part of the Facilities Assets from Grantee without the prior written consent of the Mortgagee. This provision is for the express benefit of and shall be enforceable by each Mortgagee as if it were a party named in this Grant.

(e) No Merger. There shall be no merger of this Grant or of the Transmission Easement with the fee estate in the Easement Area by reason of the fact that this Grant or any interest in the Transmission Easement may be held, directly or indirectly, by or for the account of any person or persons who shall own any interest in the fee estate. No merger shall occur unless and until all persons at the time having an interest in the fee estate in the Easement Area and all persons (including each Mortgagee) having an interest in this Grant or in the estate of Grantor and Grantee shall sign and record a written instrument effecting such merger.

(f) Liens. On the commencement of the Term, title to the Easement Area shall be free and clear of all monetary liens other than those expressly approved by Grantee. With respect to any such liens approved by Grantee, Grantor shall nevertheless obtain non-disturbance agreements from the holders of such liens in favour of Grantee and this Transmission Easement, such agreements to be reasonably satisfactory to Grantee. Thereafter, any assignment of this Grant, mortgage, deed of trust or other monetary lien placed on the Easement Area by Grantor, or permitted by Grantor to be placed or to remain on the Easement Area, shall be subject to and subordinate to this Grant, to any Assignment or Mortgage then in existence on the Facilities Assets as permitted by this Grant, to Grantee's right to encumber the Facilities Assets, and to any and all documents executed or to be executed by Grantor in connection with Grantee's development of all or any part of the Easement Area. Grantor agrees to cause any monetary liens placed on the Easement Area by Grantor in the future to incorporate the conditions of this Section.

(g) Further Amendments. At Grantee's request, Grantor shall amend this Grant to include any provision which may reasonably be requested by a proposed Mortgagee; provided, however, that such amendment shall not impair any of Grantor's rights under this Grant or increase the burdens or obligations of Grantor under this Grant. Upon the request of any Mortgagee, Grantor shall execute any additional instruments reasonably required to evidence such Mortgagee's rights under this Grant.

11. **Legal Fees**. In the event of any controversy, claim or dispute arising out of or relating to the Transmission Easement or the enforcement or breach hereof, the prevailing party shall be entitled to recover from the losing party the prevailing party's reasonable costs, expenses and legal fees.

12. **Binding Effect; Governing Law**; This Grant shall be binding upon and shall inure to the benefit of both Grantor and Grantee, and their respective heirs, successors and

assigns, and shall be deemed a covenant running with the land for all purposes. The provisions hereof shall be governed by and construed in accordance with the laws of the Province of Ontario. Grantee agrees that this Transmission Easement and the rights, privileges and easements granted pursuant thereto shall be declared to be: (i) for the purposes of electricity transmission lines or electricity distribution lines within the meaning of Part VI of the *Ontario Energy Board Act*, 1998, and (ii) an easement in favour of a generator, transmitter or distributor for the purpose of generation, transmission or distribution within the meaning of Section 42.1 of the *Electricity Act*, 1998.

13. **Termination**. Upon full or partial termination of the Transmission Easement, Grantee shall remove all physical material pertaining to the Transmission Facilities and restore the area formerly occupied by the Transmission Easement to substantially the same physical condition that existed immediately before the installation of the Transmission Facilities. In the event of termination, Grantee has no right to recover any amounts previously paid to Grantor as consideration for this Grant.

14. **Severability**. If any term or provision of this Transmission Easement, or the application thereof to any person or circumstances shall, to any extent, be determined by judicial order or decision to be invalid or unenforceable, the remainder of this Transmission Easement or the application of such term or provision to persons or circumstances other than those as to which it is held to be invalid, shall be enforced to the fullest extent permitted by law.

15. **Counterparts**. This Transmission Easement may be executed in two or more counterparts, each of which will be deemed an original, but all of which together shall constitute one and the same instrument.

16. **Family Law Act**. Grantor represents and warrants to Grantee that if Grantor is an individual, Grantor is either not married, or if married, his or her spouse either comprises a Grantor hereunder or such spouse has consented to the grant of the Transmission Easement to Grantee pursuant to the terms herein by executing a copy of this Transmission Easement, and if Grantor is a corporation, the Easement Area has never been occupied by any of the directors, officers or shareholders of Grantor or the spouses of such directors, officers or shareholders and there are no shares in existence entitling the holders of such shares to occupation of the buildings. Accordingly, the Easement Area does not comprise a family residence within the meaning of the *Family Law Act*.

17. **Grantee's Statutory Rights**. This Transmission Easement shall not affect or prejudice Grantee's statutory rights to acquire the Easement Area under any laws, including, without limitation, Grantee's statutory rights under the *Ontario Energy Board Act*, 1998, which rights may be exercised at Grantee's discretion, in the event, Grantor being unable or unwilling for any reason to perform this Transmission Easement, or, give to Grantee a clear and unencumbered title to the easement and right-of-way herein granted.

18. **Planning Act**. This Transmission Easement and the provisions hereof which create, or, are intended to create an interest in the Easement Area shall be effective to create such an interest only if the subdivision control provisions of *The Planning Act*, R.S.O. 1990 c. P. 13, as amended are complied with.

19. **Registration**. Grantee shall be entitled, at its cost and expense, to register this Transmission Easement or a notice in respect thereof, and any required reference plans in the applicable Land Registry Office, and, Grantor agrees to execute, at no cost to Grantee, all necessary instruments, plans and documentation for that purpose.

[SIGNATURES FOLLOW]

EXECUTED effective the day and year first hereinabove written.

Grantor:

[LANDOWNER]

Per: ______________________________
Name:
Title:

Grantee:

[DEVELOPER]

Per: ______________________________
Name:
Title:

EXISTING MORTGAGES:

The undersigned, being the mortgagee pursuant to the instruments evidencing a charge/mortgage of land registered on title to the Property as Instrument No. _____ and Instrument No. _______ (the "**Mortgages**"), does hereby (i) consent to this Transmission Easement and hereby postpones and subordinates the Mortgages to this Transmission Easement; (ii) irrevocably authorizes and directs any solicitors acting for Grantee hereunder to register on title to the Property, for and on behalf of the undersigned, notice or other evidence of such consent, postponement and subordination, with the signature of the undersigned on this Transmission Easement being such solicitor's good and sufficient authority for so doing.

[MORTGAGEE]

Per: ______________________________
Name:
Title:
Per: ______________________________
Name:
Title:

EXHIBIT A

Legal Description of Property

[Insert Legal Description]

EXHIBIT B,

Depiction of Easement Area

[The Easement Area shall extend on a north-south line approximately 18 metres wide on the western side of the Property; provided that all portions of the Easement Area shall be set back from the outer walls of the existing livestock barn on the Property (as existed on the date of the grant of this Easement) by at least two hundred (200) metres.]

COMPENSATION

In consideration for granting a Transmission Easement to [Developer] ("**Grantee**"), [Landowner] ("**Grantor**") shall receive the following compensation in connection with the Transmission Easement:

1. The sum of **__________________** on or prior to the date which is thirty (30) days prior to the commencement of work on the Property in respect of the installation of the Transmission Facilities (as defined in the Transmission Easement). The Grantor agrees to provide the Grantee with at least sixty (60) days prior written notice of the commencement of such work.

2. A signing bonus of **_________________** if the Grantor signs this Transmission Easement **on or prior to ________________**. Such payment shall be made within sixty (60) days of mutual execution of this agreement.

Payment shall be distributed as follows:

100% to **[LANDOWNER]**
or as they may otherwise
direct to Grantee in writing.

Contacts: ____________________________

____

Phone: ____________________________

The Grantor and the Grantee hereby agree to the foregoing compensation terms.

[LANDOWNER]

Per: ____________________________________
Name:
Title:

[DEVELOPER]

Per: ____________________________________
Name:
Title:

FORM OF LAND AGREEMENT

Exhibit B, Tab 4, Schedule 6(ii)

Municipal Landowner (road allowance)

To be filed shortly.

FORM OF LAND AGREEMENT

Exhibit B, Tab 4, Schedule 6(iii)

(Corridor)

To be filed shortly.

COMMUNITY AND STAKEHOLDER CONSULTATION

Under the Renewable Energy Approval ("REA") Regulation (O.Reg. 359/09), public, municipal and Aboriginal consultation is stipulated. The REA consultation requirements and the Applicant's consultation efforts are described below.

1) Public Consultation:

At an early stage of project planning, an REA applicant must notify landowners of the project within 120 metres of the proposed project location and place a notice in a local newspaper. Applicants must also hold at least two community consultation meetings within the REA process. The first community consultation meeting takes place at the start of project planning and the second takes place after all reports are complete and confirmation letters from the Ministry of Natural Resources and Ministry of Tourism and Culture. At least 60 days before an REA application is made, the REA applicant must make available for public review the required project reports.

The Applicant held two-first public meetings on November 22, 2010 in Blenheim, and on November 23, 2010 in Tilbury. The notice for these meetings is set out at Exhibit B, Tab 5, Schedule 2. The second community consultation meeting(s) will be held when the Applicant has gathered all the information needed to make its REA application. The status of the REA information required is set out at Exhibit B, Tab 7, Schedule 1.

After sending the REA application and associated documentation to the Ministry of the Environment and after the Ministry of the Environment deems that application complete, all project reports for which an REA application has been submitted are posted on the Environmental Registry by the Ministry of the Environment for public comment In addition, if the Ministry of the Environment approves the project, the decision is posted on the Environmental Registry for 15 days and the public has an opportunity to request an appeal. As such, the public will have a further opportunity to comment on the Project through this process.

2) <u>Municipal Consultation</u>:

Municipal consultation is a mandatory requirement under the REA process. Consultation with the municipality in which the facility is to be located is required to take place throughout the REA process. The Ministry of the Environment provides REA applicants with the Municipal Consultation Form that outlines what needs to be addressed with municipal officials. The form requests municipal feedback on matters related to, for example:

- municipal services and infrastructure (such as the proposed road access);
- the rehabilitation of areas disturbed and/or municipal infrastructure damaged during construction; and
- emergency management procedures/safety protocols related to the on-going management of the facility.

In addition, the REA applicant must describe and document how any issues raised during municipal consultation were addressed.

The Applicant provided the Municipal Consultation Form to the Municipality of Chatham-Kent on October 14, 2010. Consultations with the Municipality are on-going.

3) <u>Aboriginal Consultation</u>:

Aboriginal consultation is mandatory for REA applicants.

An REA applicant must provide a Project Description Report to the Ministry of the Environment and in turn, the Ministry of the Environment will provide a list of Aboriginal communities that must be consulted with regarding the proposed project. This list is based on the Ministry of the Environment's interpretation of which communities may have a potential interest in the environmental effects of the project or Aboriginal or treaty rights that may be affected by it.

The REA regulation stipulates the consultation requirements. This includes giving notice of the project and providing project information to Aboriginal communities. The REA applicant must document the results of all consultation conducted. The documentation is also required to outline any potential adverse affects on Aboriginal or treaty rights identified by the community(ies) and how they have been addressed.

The Applicant has obtained from the Ministry of the Environment a list of Aboriginal communities that must be notified regarding the Project. This list is set out at Exhibit B, Tab 5, Schedule 3. To date, the Aboriginal communities have received a letter providing notification of the project, the Project Description Report and the two notices relating to the notification of the project and the first public meetings (set out at Exhibit B, Tab 5, Schedule 2). Three Aboriginal communities have responded: the Métis Nation of Ontario, the Aamjiwnaang First Nation and the Mohawk Council of Akwesasne. The Métis Nation of Ontario would like to meet and a meeting is tentatively scheduled for the end of June, 2011. The Aamjiwnaang First Nation sent a letter stating that they are going to review the information and let us know if they have any comments. The Mohawk Council of Akwesasne sent a letter stating that they have an interest in the archaeological assessments. Follow-up with these Aboriginal communities and the others are on-going.

NOTICE OF A PROPOSAL AND NOTICE OF A PUBLIC MEETING

By Samsung Renewable Energy Inc. and Pattern Energy to Engage in a Renewable Energy Project

Project Name: South Kent Wind Project
Project Location: The Project is located in the Municipality of Chatham-Kent, south of Highway 401 between the communities of Tilbury and Ridgetown.
Dated at the Municipality of Chatham-Kent this the 21st of October 2010

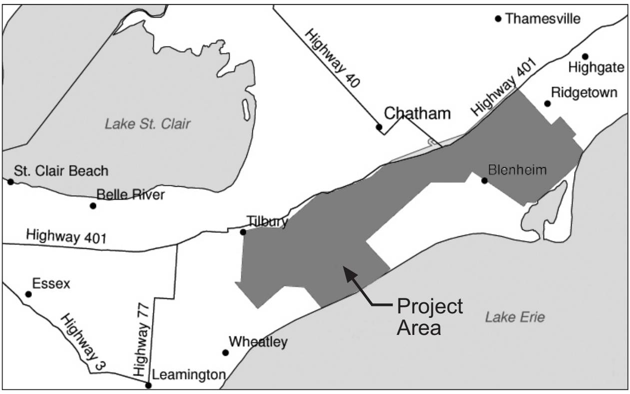
Samsung Renewable Energy Inc. and Pattern Energy are planning to engage in a renewable energy project in respect of which the issuance of a renewable energy approval is required. The distribution of this notice of a proposal to engage in this renewable energy project and the project itself are subject to the provisions of the *Environmental Protection Act (Act) Part V.0.1* and Ontario Regulation 359/09 (Regulation). This notice must be distributed in accordance with section 15 of the Regulation prior to an application being submitted and assessed for completeness by the Ministry of Environment.

Meeting Locations:
Date: Monday, November 22, 2010
Time: 5:00 pm to 9:00 pm
Place: Blenheim Golf Club, 439 Chatham Street South, Blenheim, ON

Date: Tuesday, November 23, 2010
Time: 5:00 pm to 9:00 pm
Place: Tilbury Arena, Ryder Hall, 55 Bond Street, Tilbury, ON

Project Description:
Pursuant to the *Act* and Regulation, the facility, in respect of which the project is to be engaged in, is considered to be a Class 4 wind facility. If approved, this facility would have a total maximum name plate capacity of up to 270 MW.

The Project area is shown in the map below:



This project is being proposed in accordance with the requirements of the *Act* and Regulation. The Draft Project Description Report for the *South Kent Wind Project* describes the facility as a Class 4 wind facility with a name plate capacity of up to 270 MW anticipated to consist of Siemens 101 (2.221 MW) turbines to generate electricity. A collector system, consisting of above and below ground cables, will connect each wind turbine to three (3) substations which will house transformers to step-up the voltage from 34.5 kV to 115 kV or 230 kV for transmission to the Chatham TS. A written copy of the Draft Project Description Report for the South Kent Wind Project is being made available for public inspection at www.southkentwind.ca and at your local municipal office.

Project Contacts and Information:
If you wish additional information on the proposed Project or have questions or concerns, please contact:

Kimberley Arnold, BSc, MES
Manager - Environmental Services,
Renewable Power
Hatch Ltd.
4342 Queen Street, Suite 500,
Niagara Falls, ON, L2E 7J7
Tel: 905-374-0701 ext. 5318
Fax: 905-374-1157
Email: karnold@hatch.ca

Keith Knudsen
Project Representative
BowArk Energy Ltd.
915, 530 8th Avenue SW
Calgary, Alberta T2P 3S8
Tel: 403-264-2259
Fax: 403-261-1708
Email: kknudsen@bowark.com

Information is also available online at www.southkentwind.ca

Ministry of the Environment
Environmental Assessment and Approvals Branch
2 St. Clair Avenue West
Floor 12A
Toronto ON M4V 1L5
Tel.: 416 314-8001
Fax: 416 314-8452

Ministère de l'Environnement
Direction des évaluations et des autorisations environnementales
2, avenue St. Clair Ouest
Étage 12A
Toronto ON M4V 1L5
Tél. : 416 314-8001
Téléc. : 416 314-8452

Ontario

September 23, 2010

MOE File #: SW-10-WF-0074

Ms. Kim Sachtleben
Pattern Energy
1600 Smith Street, Suite 4025
Houston, Texas, U.S.A

Dear Ms. Sachtleben:

RE: Director's Aboriginal Communities List - South Kent Wind Project

The Ontario Ministry of the Environment (Ministry) has reviewed the information provided in the *Draft of the Project Description Report* (PDR) received for the *South Kent Wind Project.* The Ministry has reviewed the anticipated environmental effects of the project (as described in the PDR) relative to its current understanding of the interests of aboriginal communities in the area.

In accordance with section 14 of Ontario Regulation 359/09 "Renewable Energy Approvals under Part V.0.1 of the Act" (O. Reg. 359/09) made under the *Environmental Protection Act*, please find below the list of aboriginal communities who, in the opinion of the Director:

i) have or may have constitutionally protected aboriginal or treaty rights that may be adversely impacted by the project (s.14(b)(i)):

Aboriginal Community Common Name: Reserve Name: Contact Information:
Caldwell First Nation P.O. Box 388 Leamington ON N8H 3W3 Phone (519) 678-3831 Fax (519) 322-1533
Bkejwanong Territory Walpole Island First Nation Walpole Island 46 RR 3 Wallaceburg ON N8A 4K9 Phone (519) 627-1481 Fax (519) 627-0440

Aamjiwnaang First Nation Sarnia 45 978 Tashmoo Avenue Sarnia ON N7T 7H5 Phone (519) 336-8410 Fax (519) 336-0382
Chippewas of the Thames First Nation Chippewas of the Thames 42 RR 1 Muncey ON N0L 1Y0 Phone (519) 289-5555 Fax (519) 289-2230
Chippewas of Kettle and Stony Point Kettle Point 44 RR 2 Forest ON N0N 1J0 Phone (519) 786-2125 Fax (519) 786-2108
Oneida Nation of the Thames Oneida 41 RR 2 Southwold ON N0L 2G0 Phone (519) 652-3244 Fax (519) 652-9287
Six Nations of the Grand River Six Nations (Part) 40 PO BOX 5000 Ohsweken ON N0A 1M0 Phone (519) 445-2201 Fax (519) 445-4208
Six Nations of the Grand River Haudenosaunee Confederacy Council RR2 Oshwken ON NOA 1MO Phone (519) 755-2769
Wahta Mohawks Wahta Mohawk Territory PO BOX 260 Bala ON P0C 1A0 Phone (705) 762-2354 Fax (705) 762-5744

Mohawks of the Bay of Quinte Tyendinaga Mohawks Tyendinaga Mohawk Territory RR 1 Deseronto ON K0K 1X0 Phone (613) 396-3424 Fax (613) 396-3627
Mohawks of Akwesasne Akwesasne (Part) 59 PO BOX 579 Cornwall ON K6H 5T3 Phone (613) 575-2250 Fax (613) 575-2181

OR

ii) otherwise may be interested in any negative environmental effects of the project (s.14(b)(ii)):

Aboriginal Community Common Name: Reserve Name: Contact Information:
Delaware Nation (Moravian of the Thames) Moravian 47 RR 3 Thamesville ON N0P 2K0 Phone (519) 692-3936 Fax (519) 692-5522
Munsee-Delaware Nation Munsee-Delaware Nation 1 RR 1, Muncey ON N0L 1Y0 Phone (519) 289-5396 Fax (519) 289-5156

<u>NOTE</u>: None of the foregoing should be taken to imply approval of this project or the contents of the PDR. This letter only addresses the requirement of the Director to provide a list of aboriginal commuities to you as required pursuant to section 14 of O. Reg. 359/09. You should also be aware that information upon which the above list of aboriginal communities is based is subject to change. Aborginal communities can make assertions at any time, and other developments, for example the discovery of

Aboriginal archaeological resources, can occur that may require additional aboriginal communities to be notified. Should this happen, the Ministry will contact you. Similarly, if you recieve any feedback from any aboriginal communities not included in this list, as part of your consultation, the Ministry would appreciate being notified.

Please contact Narren Santos at (416) 314-8442 should you have any questions or require additional information.

Sincerely,

Doris Dumais
Director
Environmental Assessment Approvals Branch
Ministry of Environment

cc: Mansoor Mahmood, Renewable Energy Team, Ministry of the Environment
Joe de Laronde, Aboriginal Affairs Branch, Ministry of the Environment

CONSTRUCTION AND IN-SERVICE SCHEDULE

A Gantt chart that illustrates the overall construction schedule for the proposed transmission facilities (the "Transmission Project") is attached at Appendix B, Tab 6, Schedule 2. As set out in the Gantt chart, construction is scheduled to commence in February of 2012, with an in-service date of September 2012.

The Transmission Project's completion timeline can be adversely affected by a number of factors including, but not limited to: approval delays; prolonged adverse conditions; availability of qualified contractors; and construction windows due to environmental constraints.

A 2-month float has been built into the Transmission Project schedule. This 2-month float can be utilized to compensate for unforeseen delays. If additional delays are encountered, the various transmission line segments can be started in parallel to reduce construction duration and therefore meet the in-service target date.

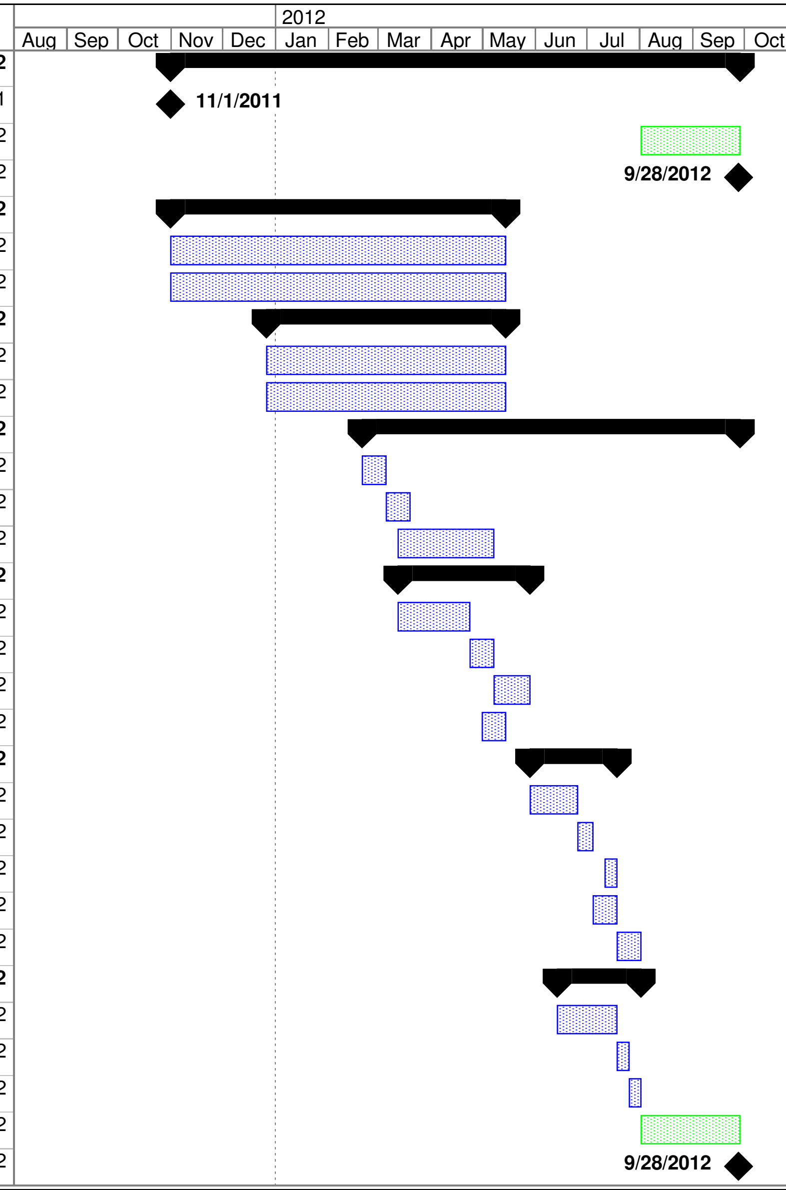
Most of the Transmission Project's route will run along an abandoned railway corridor and on municipal road allowances. This makes construction access easier. As well, compared to remote locations, construction will not be as susceptible to adverse weather conditions that could cause delays.

The Applicant does not expect to encounter a shortage of transmission line contractors, and is therefore confident that qualified contractors will be available to complete the Transmission Project on schedule.

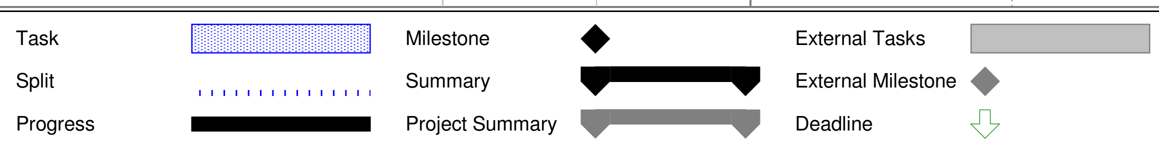
The construction schedule will consider any local and environmental restrictions pertaining to construction activities such as "half load season" to protect municipal roads from damage. Bird nesting season restrictions and warm water fish spawning restrictions on construction timing will be respected where applicable.

South Kent Wind Project
230 kV Interconnection with Chatham TS - Project Schedule

ID		Task Name	Start	Finish
1		**Project duration**	**Tue 11/1/11**	**Fri 9/28/12**
2		Project start	Tue 11/1/11	Tue 11/1/11
3		Float to allow for delays	Thu 8/2/12	Fri 9/28/12
4		In Service	Fri 9/28/12	Fri 9/28/12
5		**Engineering**	**Tue 11/1/11**	**Mon 5/14/12**
6		230 kV Transmission line	Tue 11/1/11	Mon 5/14/12
7		Chatham TS modification	Tue 11/1/11	Mon 5/14/12
8		**Procurement**	**Tue 12/27/11**	**Mon 5/14/12**
9		230 kV Transmission line	Tue 12/27/11	Mon 5/14/12
10		Chatham TS modification	Tue 12/27/11	Mon 5/14/12
11		**Construction**	**Tue 2/21/12**	**Fri 9/28/12**
12		Mobilization	Tue 2/21/12	Mon 3/5/12
13		Access road & staking	Tue 3/6/12	Mon 3/19/12
14		Concrete foundations for deadend poles and curing period	Tue 3/13/12	Mon 5/7/12
15		**Poles installation**	**Tue 3/13/12**	**Mon 5/28/12**
16		Railbed to T-junction	Tue 3/13/12	Mon 4/23/12
17		Sattern to T-junction	Tue 4/24/12	Mon 5/7/12
18		T-junction to Chatham TS	Tue 5/8/12	Mon 5/28/12
19		Steel poles on foundations	Tue 5/1/12	Mon 5/14/12
20		**Conductor & shieldwire stringing**	**Tue 5/29/12**	**Wed 7/18/12**
21		Railbed to T-junction	Tue 5/29/12	Mon 6/25/12
22		Sattern to T-junction	Tue 6/26/12	Wed 7/4/12
23		Highway crossing	Thu 7/12/12	Wed 7/18/12
24		T-junction to Chatham TS	Thu 7/5/12	Wed 7/18/12
25		Transmission line inspection and demob	Thu 7/19/12	Wed 8/1/12
26		**Modification at Chatham TS (Hydro One works)**	**Thu 6/14/12**	**Wed 8/1/12**
27		Civil works	Thu 6/14/12	Thu 7/19/12
28		Electrical installation	Thu 7/19/12	Thu 7/26/12
29		Commissioning	Thu 7/26/12	Wed 8/1/12
30		Float to allow for delays	Thu 8/2/12	Fri 9/28/12
31		In-Service	Fri 9/28/12	Fri 9/28/12



Prepared by: Hatch
Date: March 9, 2011
Rev: B (LTC Submission)



OTHER REGULATORY APPROVALS

i) Renewable Energy Approval

Ontario's new approach to approving renewable energy projects under the REA regulation (Ont. Regulation 359/09) reflects changes to regulations under the *Environmental Protection Act*, *Environmental Assessment Act* and *Environmental Bill of Rights*, *1993* (for which the Ministry of the Environment is responsible), the *Planning Act* (which is the responsibility of the Ministry of Municipal Affairs and Housing) and to policies and requirements set by the Ministry of Natural Resources, under various pieces of legislation and guidelines.

The differences between the new REA process and the previous approval process include:

- Renewable energy projects are no longer subject to the *Environmental Assessment Act* (except for waterpower and transition projects). However, the protections built into the Environmental Assessment process continue in the REA process.
- Rules regarding setback distances from residences where people reside and other sensitive receptors, as well as environmental features, now apply consistently across the province.
- Renewable energy projects are no longer subject to land-use planning instruments under the Planning Act (e.g. zoning by-laws and official plans).

As well, the Province has set-up the Renewable Energy Facilitation Office ("REFO"), for one-stop access to help developers obtain information on creating renewable energy projects in Ontario. The REFO can help navigate through the approvals by providing access to information, connecting applicants with the appropriate resources at partner ministries, agencies and governments and setting up a coordinated meeting to discuss project requirements.

Pursuant to the REA regulation, an applicant seeking approval for a project must complete and submit various reports depending on the project. The reports that are relevant to the Wind Farm and Transmission Project are:

1. Natural Heritage Records Review Report
2. Natural Heritage Site Investigation Report
3. Natural Heritage Evaluation of Significance Report
4. Natural Heritage Environmental Impact Study
5. Water Body Records Review Report
6. Water Body Site Investigation Report
7. Water Body Environmental Impact Study
8. Project Description Report
9. Stage 1 and 2 Archaeological Assessment
10. Noise Study
11. Construction Plan Report
12. Decommissioning Plan Report
13. Design and Operations Report
14. Consultation Report
15. Wind Turbine Specifications Report.

As of the date of this submission, the Applicant is currently completing the REA process. The first public meetings were held in November 2011 and all of the above noted reports are being prepared. It is anticipated that the REA application will be submitted to the Ontario Ministry of the Environment by October 1, 2011. REA approval is therefore anticipated by the winter of 2012.

ii) Other Permits and Approvals Required

The non-REA permits and approvals potentially required for the Transmission Project are set out in the following table:

Permit/Approval	**Government**	**Authority**	**Status**
Aeronautical Obstruction Clearance	Federal	Transport Canada	TBI
Land Use Proposal – Aviation safety	Federal	NAV Canada	TBI
Navigable Waters Protection Act Permit (water crossings)	Federal	Transport Canada	TBD
Endangered Species Act Permit	Provincial	Ministry of Natural Resources	TBD
Approval for Road Encroachment (Transmission Lines)	Provincial	Ministry of Transportation	TBD
Stage 3 & 4 Archaeological Assessment Clearance	Provincial	Ministry of Tourism and Culture	Stage 2 in process under REA process
Notice of Project (contractor)	Provincial	Ministry of Labour	
Waste Generator Licence (contractor)	Provincial	Ministry of the Environment	
Electrical Safety Authority (ESA) Review and Approval	Provincial	ESA	
Highway 401 Crossing	Provincial	Ministry of Transportation	TBI
Easement agreements of overhead or underground lines	Municipal	Chatham-Kent Municipality	TBD
Noise Bylaw (for night lifting and work)	Municipal	Chatham-Kent Municipality	TBD
Emergency Services Review and Approval	Municipal	Chatham-Kent Municipality	TBD
Railway Crossings	N/A	CSR	TBI

TBI = To Be Initiated
TBD = To Be Determined (if permit is required)

REPORT

System Impact Assessment Report

South Kent Wind Project

CONNECTION ASSESSMENT & APPROVAL PROCESS

Final Report

CAA ID 2010-405

Kent Centre Wind Farm Inc.

Market Facilitation Department

May 5, 2011

Document ID	IESO_REP_0716
Document Name	System Impact Assessment Report
Issue	1
Reason for Issue	First Issue
Effective Date	May 5, 2011

System Impact Assessment Report

South Kent Wind 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 System Impact Assessment of a new generation or load connection proposal.

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

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

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

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

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

Table of Contents

SOUTH KENT WIND GENERATION PROJECT

IESO SYSTEM IMPACT ASSESSMENT

SIA Findings

Kent Centre Wind Farm Inc. is developing a new 270 MW wind power generation farm, South Kent Wind Farm, in Chatham-Kent, Ontario. The project is one of the renewable energy developments resulted from the agreement between Ontario government and the Korean consortium. The new generation facility is expected to start commercial operation in December 2012.

Summary

This assessment examined the impact of injecting 270 MW of wind power generation to the provincial grid, via Chatham 230 kV SS, on the reliability of the IESO-controlled grid.

The following conclusions and recommendations were made:

Conclusions and Recommendations

Conclusions:

The analysis concluded that:

(1) The proposed wind farm does not have a material adverse impact on the reliability of the IESO-controlled grid.

(2) The proposed project does not cause new violations of existing circuit breaker interrupting capabilities on the IESO-controlled grid.

(3) Congestion is possible on the J3E/J4E circuits. The congestion is pre-existing and the proposed project will not make the situation worse. The congestion is currently well managed by the local SPS and will not have impact on the proposed project.

(4) For all contingency simulations tested with the proposed project in service, the voltage decline criteria are met.

(5) With the proposed project in service, none of the recognized contingencies cause any material adverse impact to the transient performance of the IESO-controlled grid.

(6) The reactive capability of the wind turbine generators along with the impedance between the wind turbine generators and the IESO controlled grid results in a reactive power deficiency at the connection point.

(7) Based on the information provided by the applicant, the fault ride through capability of the wind turbines is adequate.

Recommendations:

(1) It is recommended that ULTC step-up transformers be chosen to improve operational flexibility and save on the amount of required shunt capacitors. Since system voltage may vary from 220 kV to 250 kV South Kent will have to shut down the transformer if tap changing is required.

(2) Since the Wind Farm Management System (WFMS) must coordinate the voltage control process, it is recommended that all WTGs control voltage at the point of connection to a reference value and that reactive power compensation devices are automatically controlled/switched to regulate the overall WTGs' reactive power generation to around zero output. Once the WFMS description document is provided to the IESO, we will assess if the voltage control philosophy is acceptable.

IESO's Requirements for Connection

The following requirements for the incorporation of the proposed project have been identified.

Transmitter Requirements

The following requirements are applicable for Hydro One for the incorporation of the proposed project:

(1) The transmitter reviews the relay settings at Chatham SS to account for the effect of the wind farm.

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

Applicant Requirements

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

(1) The wind farm is required to have the capability to inject or withdraw reactive power continuously (i.e. dynamically) at a connection point up to 33% of its rated active power at all levels of active power output.

Based on the equivalent parameters for the WF provided by the connection applicant, the IESO's simulations resulted in the following:

- Static compensation devices (switched shunt capacitor banks) of 50 Mvar and 60 Mvar in steps no larger than 10 Mvar, installed at the collector buses at Railbed and Sattern TS, respectively, to compensate for the losses within the facility will satisfy the reactive power requirement. The capacitors will need to be auto-switched via the Wind Farm Management System.

The connection applicant has the obligation to ensure that the WF has the capability to meet the Market Rules requirement at the connection point and be able to confirm this capability during the commission tests. The required shunt capacitors are based on the information provided by the proponent. The IESO may re-do the assessment for the required static compensation devices if the final design of the feeder system is significant different.

(2) The applicant is required to provide a copy of the functionalities of the Wind Farm Management System (WFMS) to the IESO.

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

(1) The new generator must satisfy the Generator Facility Requirements in Appendix 4.2 of the Market Rules.

(2) All 230 kV equipment must have a maximum continuous voltage rating and the ability to interrupt fault current at a voltage of at least 250 kV.

(3) If revenue metering equipment is being installed as part of this project, it must comply with Chapter 6 of the IESO Market Rules.

(4) The new equipment must sustain increase fault levels due to future system enhancements. Should future system enhancements result in fault levels exceeding equipment capability, the applicant is required to replace equipment at its own expense with higher rated equipment, up to 63 kA as per the Transmission System Code for the 230 kV system.

(5) The 230 kV breakers must meet the required interrupting time of less than or equal to 3 cycles as per the Transmission System Code.

(6) The connection equipment must be designed such that adverse effects due to failure are mitigated on the IESO-controlled grid.

(7) The connection equipment must be designed for full operability in all reasonably foreseeable ambient temperature conditions.

(8) The facility must satisfy telemetry requirements as per Appendices 4.15 and 4.19 of the Market Rules. The determination of telemetry quantities and telemetry testing will be conducted during the IESO Facility Registration/Market entry process.

(9) Protection systems must satisfy requirements of the Transmission system code and specific requirements from the transmitter. New protection systems must be coordinated with existing protection systems.

(10) Protective relaying must be configured to ensure transmission equipment remains in service for voltages between 94% of minimum continuous and 105% of maximum continuous values as per Market Rules, Appendix 4.1.

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

(12) Protection systems within the generation facility must trip only the equipment required to isolate the fault. After the facility begins commercial operation, if an improper trip of the transmission facilities occurs due to events within the generation facility, the new facility may be required to be disconnected from the IESO-controlled grid until the problem is resolved.

(13) The autoreclosure of the new 230kV breakers must be blocked. Upon its opening for a contingency, they must be closed only after the IESO approval is granted. The IESO will require reduction of power generation prior to the closure of the breaker followed by gradual increase of power to avoid a power surge.

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

(15) A disturbance monitoring device must be installed. The *connection applicant* is required to provide disturbance data to the IESO upon request.

(16) Mathematical models and data, including any controls that would be operational, must be provided to the IESO through the IESO Facility Registration/Market Entry process at least seven months before energization from the IESO-controlled grid. That includes both PSS/E and DSA software compatible mathematical models representing the new equipment for further IESO, NPCC and NERC analytical studies. The *connection applicant* may need to contact the software manufacturers directly, in order to have the models included in their packages. If the data or assumptions supplied for the registration of the facilities materially differ from those that were used for the assessment, then some of the analysis might need to be repeated.

(17) The registration of the new facilities will need to be completed through the IESO's Market Entry process before IESO final approval for connection is granted and any part of the facility can be placed in-service. During the IESO's Market Entry process, the connection applicant will be required to demonstrate to the IESO that all requirements identified in this SIA report have been satisfied.

(18) As part of the IESO Facility Registration/Market Entry process, the *connection applicant* must provide evidence to the IESO confirming that the equipment installed meets the Market Rules requirements and matches or exceeds the performance predicted in this assessment. Until this evidence is provided and found acceptable to the IESO, the Facility Registration/Market Entry process will not be considered complete and the *connection applicant* must accept any restrictions the IESO may impose upon this project's participation in the IESO administered market or connection to the IESO-controlled grid. Failure to provide evidence may result in disconnection from the IESO-controlled grid.

(19) During the commissioning period, a set of IESO specified tests must be performed. The commissioning report must be submitted to the IESO within 30 days of the conclusion of commissioning. Field test results should be verifiable using the PSS/E models used for this SIA.

(20) The proposed facility must be compliant with applicable reliability standards set by the North American Electric Reliability Corporation (NERC) and the North East Power Coordinating Council (NPCC) prior to energization to the IESO controlled grid.

Notification of Conditional Approval

From the information provided, our review concludes that the proposed changes will not result in a material adverse impact on the reliability of the IESO-controlled grid.

It is recommended that a *Notification of Conditional Approval* be issued for South Kent Wind Farm subject to the implementation of the requirements listed in this report.

1. Project Description

Kent Center Wind Farm Inc. has proposed to develop a 270 MW wind farm located in Chatham-Kent, Ontario, known as South Kent Wind Farm.

The project is one of the renewable energy developments resulted from the agreement between Ontario government and the Korean consortium. The new generation facility is expected to start commercial operation in December 2012.

The proposed South Kent Wind Project will connect directly into Chatham SS from a new diameter via a new three terminal 230 kV transmission line of 6.7 km (to Chatham SS), 5.4 km (to new Sattern TS), and 21 km (to new Railbed TS) in length, as presented in Figure 1.

There will be a total of 123 wind turbines totaling 270 MW. The 34.5/230 kV Railbed Substation will consist of one 160 MVA, 34.5/230 kV transformer and five 34.5 kV collector buses with 68 wind turbines (totally 149 MW). The 34.5/230 kV Sattern Substation will consist of one 160 MVA, 34.5/230 kV transformer and four 34.5 kV collector buses with 55 wind turbines (total 121 MW).

The wind turbines will be of Siemens model SWT-2.3-101 asynchronous 2.221 MW unit. Two back-to-back AC/DC links and a 2.6 MVA, 0.06 pu reactance (on 2.6 MVA base), 0.69/34.5 kV transformer connects each generator to one of the nine 34.5 kV collector circuits. Each collector circuit will have the following number of generators:

Station	**Railbed**					**Sattern**			
Circuit ID	**C1**	**C2**	**C3**	**C4**	**C5**	**C1**	**C2**	**C3**	**C4**
Number of generators	14	14	15	13	12	15	15	12	13
Maximum MW	30.8	30.8	33	28.6	26.4	33	33	26.4	28.6

– End of Section –

2. General Requirements

Generators

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

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

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

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

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

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

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

Connection Equipment (Breakers, Disconnects, Transformers, Buses)

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

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

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

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

   The TSC requires that new equipment be designed to sustain the fault levels in the area where the equipment is installed. If any future system enhancement results in an increased fault level higher than the equipment's capability, the connection applicant is required to replace the equipment at their own expense with higher rated equipment capable of sustaining the increased fault level, up to the TSC's maximum fault level of 63 kA for the 230 kV system.

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

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

IESO Monitoring and Telemetry Data

In accordance with the telemetry requirements for a generation facility (see Appendices 4.15 and 4.19 of the Market Rules) the connection applicant must install equipment at this project with specific performance standards to provide telemetry data to the IESO. The data is to consist of certain equipment status and operating quantities which will be identified during the IESO Market Entry Process.

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

Protection Systems

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

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

3. The Applicant is required to have adequate provision in the design of protections and controls at

the facility to allow for future installation of Special Protection Scheme (SPS) equipment.

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

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

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

5. Protection systems within the generation facility must only trip the appropriate equipment required to isolate the fault.

Miscellaneous

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

2. Connection Applicant is required to install at the facility a disturbance recording device with clock synchronization that meets the technical specifications provided by Hydro One. The device will be used to monitor and record the response of the facility to disturbances on the 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.

Facility Registration/Market Entry Requirements

1. The registration of the new facilities will need to be completed through the IESO's Market Entry process before IESO final approval for connection is granted and any part of the facility can be placed in-service. During the IESO's Market Entry process, the connection applicant will be required to demonstrate to the IESO that all requirements identified in this SIA report have been satisfied.

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

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

IESO may impose upon this project's participation in the IESO administered market or connection to the IESO-controlled grid.

During the commissioning period, a set of IESO specified tests must be performed. The commissioning report must be submitted to the IESO within 30 days of the conclusion of commissioning. Field test results should be verifiable using the PSS/E models used for this SIA. Failure to provide evidence may result in disconnection from the IESO-controlled grid.

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

Reliability Standards

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

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

In support of the NERC standard EOP-005, the proponent/connection applicant may meet the restoration participant criteria. Please refer to section 3 of Market Manual 7.8 (Ontario Power System Restoration Plan) to determine its applicability to the proposed facility.
The IESO monitors and assesses market participant compliance with these standards as part of the IESO Reliability Compliance Program. To find out more about this program, visit the webpage referenced above or write to ircp@ieso.ca.

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

– End of Section –

3. Review of Connection Proposal

3.1 Proposed Connection Arrangement

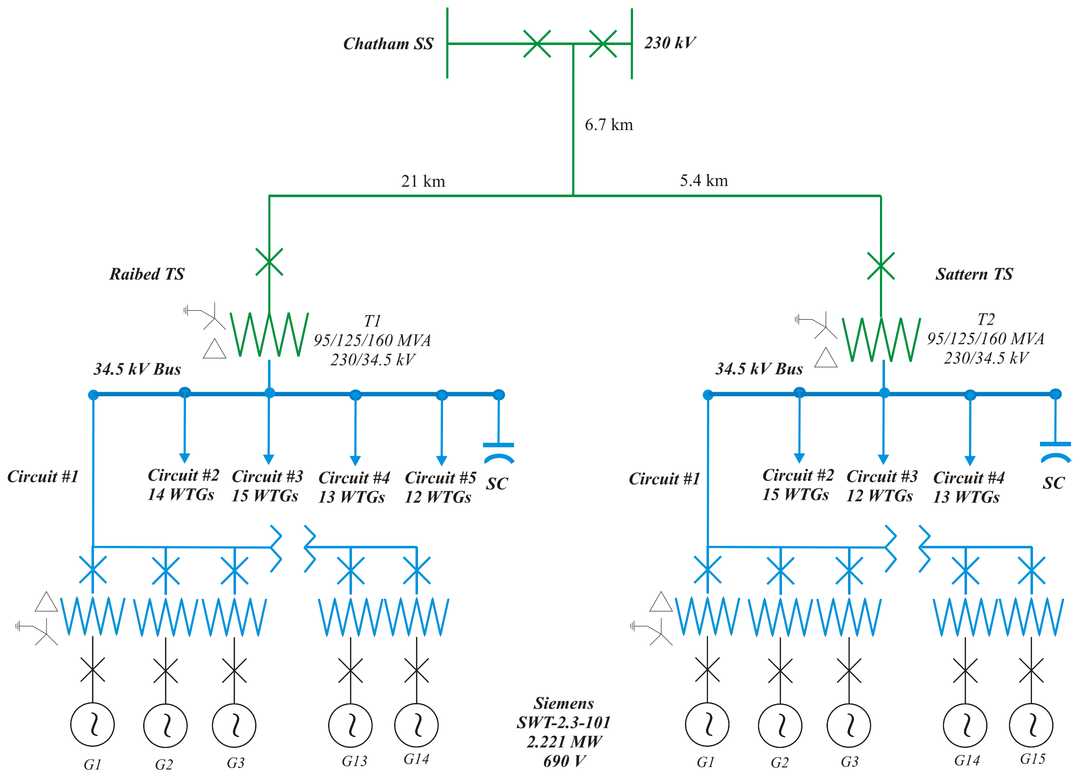


Figure 1: Proposed Connection Arrangement

3.2 Existing System

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

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

South Kent is proposed to connect to a new breaker diameter at the existing Chatham SS.

The graphs below display the MW flow out on Chatham SS and voltages on Chatham 230 kV bus. These are hourly average samples from Jan 1 to Dec 31, 2010 obtained from IESO real-time data. Positive values mean flow out of the station.

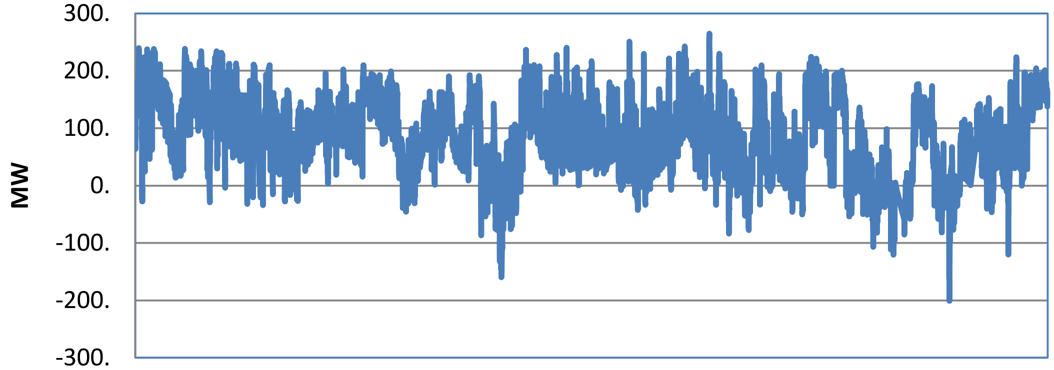


Figure 2: MW flow on C21J out of Chatham SS

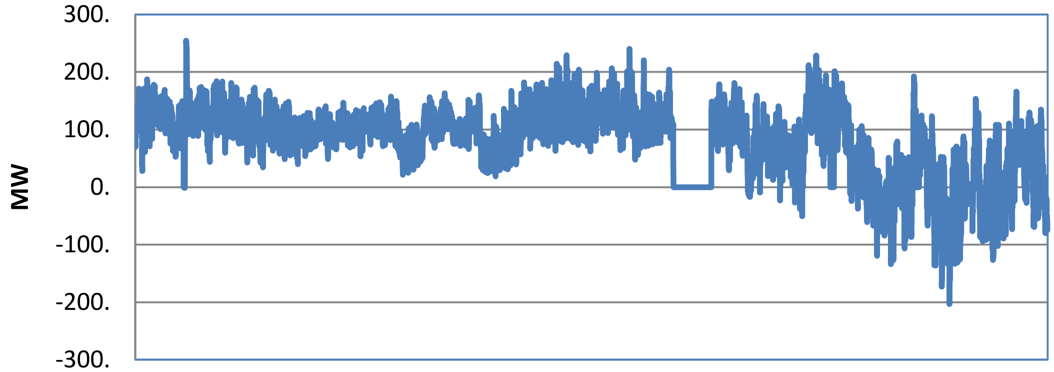


Figure 3: MW flow on C23Z out of Chatham SS

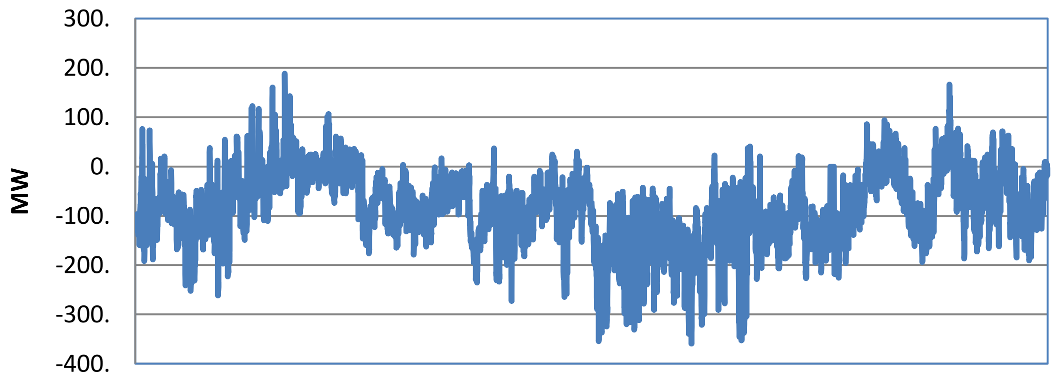


Figure 4: MW flow on L29C out of Chatham SS

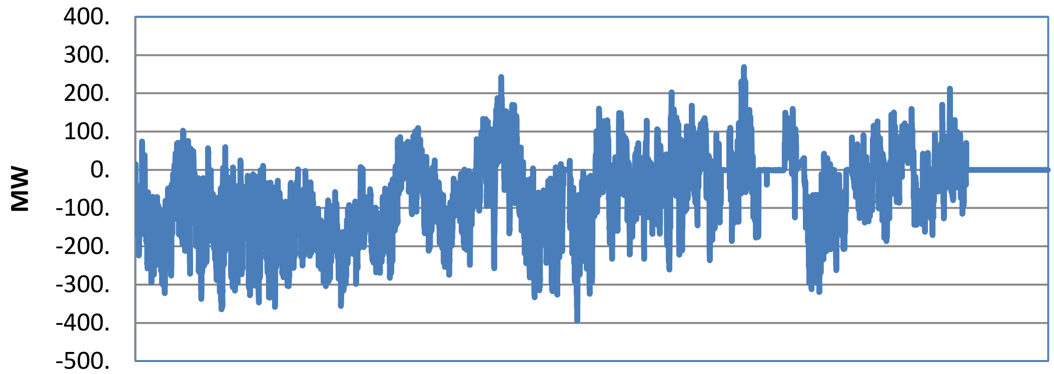


Figure 5: MW flow on W45LC out of Chatham SS

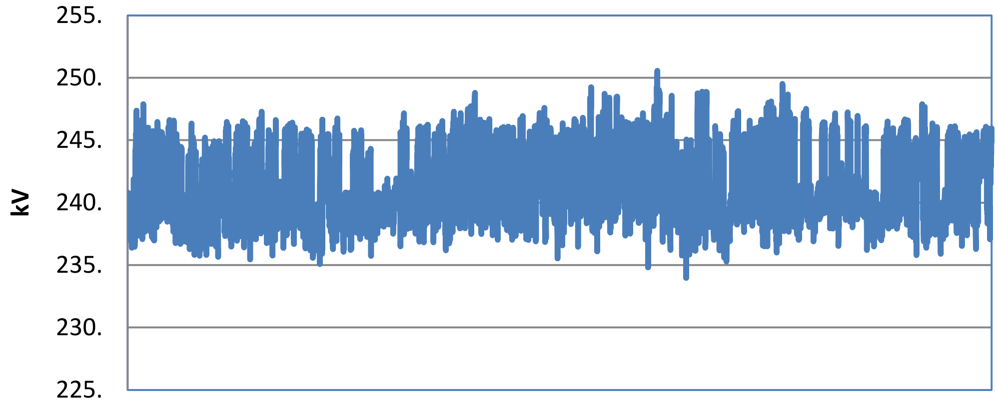


Figure 6: Voltages at Chatham SS

4. Data Verification

4.1 Tap Line

Specifications of the 230 tap line provided by the connection applicant are listed below.

Circuit	Chatham - Jct	Jct - Railbed	Jct - Sattern
Length (km)	6.7	21.1	5.4
Rating (A)	750	750	750
Impedance (Z)	0.000942+j0.0061	0.00297+j0.0193	0.000759+j0.0049
Charging (B)	0.0122	0.0385	0.00986

Impedance values are in pu, 100 MVA base.

4.2 Generator

Siemens Wind Power SWT-2.3.-101.
690V 3Φ 60Hz.

Transformation	0.69/34.5 kV
Rating	2.2MW
Impedance	0.0575 on a base of 2.6MVA
Configuration	3 phase, high side: Δ, low side: Y-grounded

4.3 Transformer

The two 34.5/230 kV step-up transformers at Railbed TS and Sattern TS are identical and the specifications are listed below.

Transformation	230/34.5 kV
Rating	95/125/160 MVA ONAN/ONAF/OFAF
Impedance	0.35+j11.7% pu based on 95 MVA
Configuration	3 phase, high side: Y-grounded, low side: Δ
Tapping	off-load tap changers at HV (226, 232, 238, 244, 250 kV)

4.4 Circuit Breakers and Switches

Specifications of the isolation devices provided by the connection applicant are listed below.

Breakers and switches	**HV**
Maximum Rated line-to-line voltage (kV)	260
Interrupting time (cycle)	3
Rated continuous current (A)	2000
Rated short circuit breaking current (kA)	63

4.5 Collector System

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

Station	Railbed					Sattern			
Circuit ID	**C1**	**C2**	**C3**	**C4**	**C5**	**C1**	**C2**	**C3**	**C4**
R	0.293	0.202	0.098	0.064	0.100	0.123	0.034	0.063	0.100
X	0.908	0.654	0.223	0.114	0.257	0.340	0.066	0.151	0.237
B	0.008	0.008	0.008	0.006	0.004	0.006	0.005	0.005	0.006

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

– End of Section –

5. Fault Level Assessment

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

Niagara, South West, West Zones:

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

Central, East Zones:

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

Northwest, Northeast Zones:

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

- Terrace Bay Pulp STG1 (embedded in Neenah paper)

Bruce Zone:

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

All constructed wind farms including:

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

New Generation Facilities:
Committed wind generation

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

Other committed generation projects

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

Transmission System Configuration

Existing system with the following upgrades:

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

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

System Assumptions

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

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

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

Bus	Before – wind farm o/s				After – wind farm in service				Lowest Breaker Ratings (kA) (at max operational voltage)	
	3-phase Fault (kA)		L-G Fault (kA)		3-phase Fault (kA)		L-G Fault (kA)			
	Sym.	Asym.	Sym.	Asym.	Sym.	Asym.	Sym.	Asym.	Sym.	Asym.
Lauzon 115	25.151	29.223	27.768	34.090	26.029	30.294	29.497	36.153	39.3	40.2
Chatham 230	25.231	29.324	18.101	21.089	27.704	32.995	24.736	31.790	40	42.1
Keith 230	22.520	31.879	24.405	35.403	23.035	32.534	24.907	36.082	41.1	46.2
Keith 115	27.220	32.500	32.114	41.563	27.709	33.002	32.594	42.107	39.3	45
Essex 115	25.796	31.074	26.850	32.355	26.438	31.785	27.465	33.000	39.3	45.5
Lambton 230	43.305	60.811	48.482	64.045*	43.482	61.041	48.653	64.239*	63	66.3
Longwood 230	37.439	45.749	44.815	57.989	37.696	46.059	43.014	56.017	63	68.9
Buchanan 230	31.711	37.120	26.992	34.335	31.930	37.367	27.104	34.476	39.3	45

*Branch contributions were considered

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

– End of Section –

6. System Impact Studies

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

6.1 Assumptions and Background

System Conditions & Modeling Assumptions

Since light load is not critical in Windsor area with low dispatchable gas generation output only peak load scenarios were studied. Summer 2013 peak load conditions were the starting point for this study, along with the following assumptions:

- All transmission system elements were in service unless specified otherwise.
- The 2013 forecasted west zonal demand was applied evenly throughout all the loads of the west zone. This resulted in a Windsor area demand (WAD) of only 940 MW. The WAD was then scaled up to its historical average of 1000MW to apply additional stress to the case. This represents an average from the actual peaks that have been recorded in previous summers.
- Loads are modeled as constant MVA pre and post-contingency, unless specified otherwise.
- J5D is either importing 150MW or exporting 400MW as specified. Actual 2010 J5D flows are plotted below. Positive values mean exporting power.

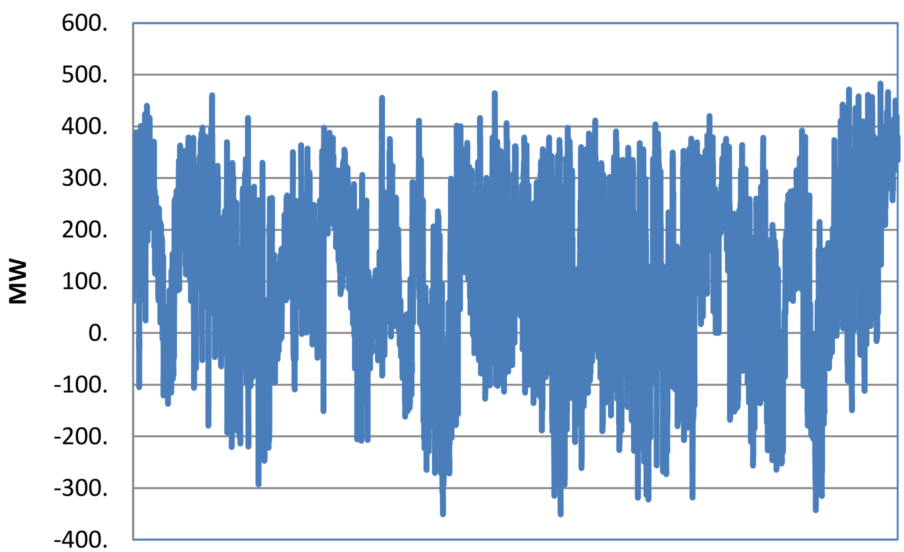


Figure 7: J5D flow in 2010

- Leamington station is in service (CAA: 2008-318).
- Tilsbury West is connected with dual supply (CAA: 2008-332)
- The Auto's at Keith have been upgraded to 250MVA each (CAA: 2008-318)
- Lauzon TS is NOT yet reconfigured (CAA: 2008-318).
- The J3E/J4E circuits are NOT upgraded (CAA: 2008-318).

- Contingency based SPS load rejection is in service as required at Kingsville.
- Keith capacitor is out of service.
- Raleigh, Port Alma I and II, South Kent and West are in service at full output.
- Pointe Aux Roches and Gosfield are at zero output to stress the studying cases.
- Comber East and West Wind projects are in service at full output.
- Transalta CGS is in service at full output and East Windsor CGS is out of service.

Study Scenarios

- J5D is either importing 150MW or exporting 400MW as specified. Adjustments were made to the J5D phase shifter and Brighton Beach generation to accommodate.

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

6.2 Protection Impact Assessment

A Protection Impact Assessment (PIA) was completed by Hydro One to examine the impact of the new generators on existing transmission system protections. The existing protections at Chatham SS were described in the PIA report and the proposed connection arrangements and protections were analyzed.

The IESO concluded that the proposed protection adjustments have no material adverse impact on the IESO-controlled grid. The PIA report is attached in Appendix C.

6.3 Special Protection System (SPS)

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

6.4 Reactive Power Compensation

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

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

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

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

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

6.4.1 Dynamic Reactive Power Compensation

The following summarizes the IESO required level of dynamic reactive power and the available capability of SWT-2.3.

	Active Power	Reactive Power Capability
IESO required	1.0 pu	$Q_{gen} = 2.22 \times \tan[\cos^{-1}(0.9)] = 1.08$ Mvar
		$Q_{abs} = 2.22 \times \tan[\cos^{-1}(0.95)] = 0.72$ Mvar
SWT-2.3 capability	1.0 pu	$Q_{gen} = 2.3 \times \tan[\cos^{-1}(0.9)] = 1.11$ Mvar
		$Q_{abs} = 2.3 \times \tan[\cos^{-1}(0.9)] = 1.11$ Mvar

The SWT-2.3 generators can deliver IESO required dynamic reactive power to the generator terminal at rated power and at rated voltage. Thus, the IESO has determined that there is no need to install any additional dynamic reactive power compensation device.

6.4.2 Static Reactive Power Compensation

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

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

The reactive power capability in lagging p.f. of the generation facility was assessed under the following assumptions:

- Low system voltage of 233 kV at the connection point;
- maximum active power output from the equivalent WTG;
- maximum acceptable collector voltage is 1.05
- the main step-up transformer OLTC is set at 244 kV

- Generator terminal voltage of 1.05pu.

The reactive power capability in leading p.f. of the generation facility was assessed under the following assumptions:

- typical voltage of 242 kV at the connection point;
- minimum (zero) active power output from the equivalent WTG;
- maximum reactive power consumption (leading power factor) from the equivalent WTG;
- minimum acceptable WTG voltage is 0.95
- the main step-up transformer OLTC is set at 244 kV.

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

Based on the equivalent parameters for the WF provided by the connection applicant, an amount of 50 Mvar and 60 Mvar of static reactive power compensation installed at the WF collector buses at Railbed and Sattern TS, respectively will meet the reactive power requirements at the connection point.

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

It is necessary to supply the static reactive compensation in small enough steps to have operational flexibility over the entire range of active power output from the wind turbines. The amount of static reactive power compensation should be shared in switchable shunt capacitors.

6.4.3 Static Reactive Power Switching

A switching study was carried out to investigate the effect of the new LV shunt capacitor banks / reactor on the voltage changes. The following table summarizes the study results (voltage in kV/voltage decline) for voltage change due to capacitor switching when L28C is out of service.

Bus	ICG connection point	LV bus voltage (Railbed)	LV bus voltage (Sattern)
Pre-switching	237	34.4	34.8
Switching 50 Mvar at Railbed	237.9/0.4%	36.3/5.5%	35.0/0.6%
Switching 10 Mvar at Railbed	237.2/0.1%	34.8/1.2%	34.9/0.3%
Switching 60 Mvar at Sattern	238.2/0.5%	34.6/0.6%	37.1/6.6%
Switching 10 Mvar at Sattern	237.2/0.1%	34.4/0.0%	35.2/1.1%

The IESO requires the voltage change on a single capacitor switching to be no more than 4 % at the any point in the IESO-controlled grid. The results show that switching a single capacitor of 50/60 Mvar produces more than 4 % voltage change at the LV bus.

It is necessary to supply the static reactive compensation in small enough steps to lower the voltage changes and have operational flexibility over the entire range of active power output from the wind turbines. Therefore, the static reactive power compensation should be composed of 10 Mvar switchable shunt capacitors.

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

6.5 Wind Farm Management System

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

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

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

Option #1

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

Option #2

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

P - overall WF active power output	Capacitor banks to be switched on
$0 < P < P_1$	(No capacitor)
$P_1 < P < P_2$	C_1
$P_2 < P < P_3$	C_1+C_2
……	……

$P_N < P < P_{MAX}$	$C_1+C_2+\ldots+C_N$

(2) All WTGs control the PCC voltage to a reference value. A control slope is applied for reactive power sharing among the WTGs as well as with adjacent generators.
(3) WF main transformer ULTC is adjusted to regulate the collector bus voltage (LT bus voltage) such that it is within normal range;

The proponent has chosen option #1 and must submit a description of the functionalities of the WFMS, including the coordination between the automatic capacitor switching and generator reactive power production to control the voltage at a desired point. This document also must contain the settings of the automatic capacitor switching scheme. If the WFMS is unavailable, the IESO requires each generator controls its own terminal voltage.

6.6 Thermal Analysis

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

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

As described in Section 6.1, two cases, importing (S1) and exporting (S2), were investigated in this assessment considering J5D is either importing 150MW or exporting 400MW as specified.

Pre-contingency flows for various circuits in Windsor area prior to and after the connection of South Kent were investigated. The load flow in percentage of continuous ratings at Chatham SS is summarized in the following table. All pre-contingency flows were found below the continuous ratings. It was also found that the addition of South Kent has little impact on the power flow for the 115 kV system in Windsor area and 230 kV circuits at Scott TS.

Circuit	S1 (% of Cont. Rating)	S2 (% of Cont. Rating)
C21J	19	35
C22J	24	44
C23Z	19	21
C24Z	20	16
L28C	24	32
L29C	37	46
W44LC	36	26
W45LC	36	26

Contingency analysis with South Kent in service was performed to ensure that transmission elements would remain within their emergency ratings. The following is a list of contingencies that were studied. This list was expanded and modified to represent the arming of Windsor's SPS's as necessary.

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

A summary of the thermal analysis results for both importing case (S1) and exporting case (S2) is presented in the tables below.

The results of the thermal analysis show that there are overloads on the J3E/J4E circuits that can be slightly reduced by South Kent. The overloading issue is currently relieved by Windsor Area SPS action. These concerns pre-exist the South Kent project and are temporary, as Hydro One has improvement plans in the area.

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

Detailed thermal results (Loading%LTE) for S1 (Importing Case)

from bus in bold face, to bus in normal face.	C21J	C21J_C22J	C22J	C23Z	C24Z	C24Z_C22J	C24Z_C23Z	C24Z_C23Z_LR	J3E	J4E	J4E_J3E	J4E_J3E_LR	L28C	L29C	L29C_L28C	W44LC	W44LC_W45LC	W45LC	Z1E	Z7E	Z7E_Z1E
CHATHAM_SS 220.00																					
LEAMINGJCT21220.00	0.0	0.0	34.3	27.1	26.3	38.3	33.0	28.8	22.4	22.4	10.5	12.6	21.1	20.8	18.3	25.2	28.3	25.2	24.1	24.1	21.8
LEAMINGJCT22220.00	48.5	0.0	0.0	38.2	37.1	0.0	46.5	40.5	31.5	31.5	14.8	17.8	29.7	29.3	25.8	35.5	39.8	35.5	33.9	33.9	30.6
LYNWOOD_JL28220.00	20.2	13.2	20.2	26.4	29.6	26.3	27.6	25.7	23.1	23.1	24.7	21.0	0.0	29.6	0.0	17.9	8.6	17.9	22.6	22.6	19.5
LYNWOOD_JL29220.00	26.0	19.3	26.0	31.4	34.3	31.5	32.3	30.5	28.6	28.6	30.1	26.7	30.7	0.0	0.0	23.8	14.9	23.8	28.1	28.1	25.1
ESSEX_TS 118.05																					
CHRYSLER_E8F118.05	9.3	9.3	9.3	9.3	9.3	9.3	9.2	9.3	9.4	9.4	9.4	9.4	9.3	9.3	9.3	9.3	9.3	9.3	9.4	9.4	9.3
CHRYSLER_E9F118.05	11.5	11.5	11.5	11.5	11.5	11.4	11.4	11.5	11.6	11.6	11.3	11.6	11.5	11.6	11.6	11.5	11.5	11.5	11.6	11.6	11.5
CRAWFRD_JJ3E118.05	32.4	26.4	32.5	60.3	64.5	60.1	86.8	62.7	0.0	66.3	0.0	0.0	41.4	41.7	44.4	37.7	35.2	37.7	39.5	39.6	20.6
CRAWFRD_JJ4E118.05	40.7	33.1	40.8	75.7	81.0	75.3	109.3	79.0	84.5	0.0	0.0	0.0	52.3	52.8	56.3	47.5	44.2	47.5	49.4	49.4	25.2
ESSEX_TS_JQ 27.600	39.9	39.9	39.8	39.9	39.8	40.1	40.3	40.2	39.6	39.6	39.6	40.2	39.9	39.9	40.0	39.8	39.8	39.8	39.6	40.2	40.4
W_TRANSALT_J118.05	11.9	6.2	12.0	38.5	42.6	38.1	63.8	40.9	13.1	13.1	20.3	19.6	20.8	21.2	24.0	17.1	14.5	17.1	0.0	37.0	0.0
WALKER_J_Z7E118.05	12.1	6.3	12.1	38.6	42.7	38.2	63.9	41.0	13.2	13.2	20.1	19.4	20.9	21.3	24.1	17.2	14.7	17.2	37.1	0.0	0.0
KEITH_TS 118.05																					
BRIGHTON_CGS118.05	43.5	42.8	43.4	45.8	47.0	47.3	47.4	43.6	43.1	43.2	42.9	42.8	42.8	42.7	42.5	43.0	43.3	43.0	43.4	43.5	43.0
CRAWFRD_JJ3E118.05	43.9	37.9	44.0	71.5	75.7	71.4	98.1	74.1	0.0	90.5	0.0	0.0	52.9	53.3	55.9	49.2	46.6	49.2	50.8	50.9	31.9
CRAWFRD_JJ4E118.05	56.8	49.2	56.9	92.5	97.8	92.5	126.4	95.5	115.5	0.0	0.0	0.0	68.2	68.6	71.8	63.6	60.3	63.6	65.9	66.0	41.9
KEITH_FWAPE 27.600	7.1	7.1	7.1	7.1	7.1	7.0	7.1	7.1	7.1	7.1	7.1	7.1	7.1	7.1	7.1	7.1	7.1	7.1	7.1	7.1	7.1
KEITH_TS 220.00	18.9	17.0	18.2	36.8	42.8	36.1	71.2	40.4	13.1	13.1	70.4	70.0	14.3	13.9	14.4	14.5	16.1	14.4	13.8	13.8	24.6
W_WIND_PWR_J118.05	81.9	79.5	81.7	83.1	83.2	83.7	83.9	82.2	80.8	80.9	80.2	79.5	79.5	79.1	78.0	80.5	81.4	80.5	81.7	82.0	80.4
KEITH_TS 220.00																					
BRIGHTON_J20220.00	53.8	53.6	53.8	53.6	53.7	54.0	53.8	53.6	53.6	53.6	53.6	53.6	53.6	53.6	53.6	53.7	53.7	53.7	53.6	53.6	53.6
KEITH_J5D_RG230.00	41.1	43.8	41.3	38.0	33.7	25.9	29.2	38.5	49.1	49.1	62.0	65.2	41.5	40.8	34.8	50.1	56.6	50.1	47.6	47.5	57.1
KEITH_TS 118.05	18.6	16.8	17.9	36.4	42.4	35.8	70.9	40.1	12.9	13.0	69.7	69.4	14.2	13.8	14.3	14.3	15.9	14.3	13.6	13.7	24.4
KEITH_TS_BY 27.600	43.9	44.3	43.9	44.2	44.1	43.6	43.8	44.3	44.2	44.2	44.1	44.3	44.2	44.2	44.4	44.1	44.0	44.1	44.1	44.1	44.3
MALDEN_JC21J220.00	0.0	0.0	12.7	16.2	15.0	15.8	24.3	18.4	9.5	9.5	8.0	5.1	7.7	7.1	3.8	13.5	18.0	13.5	11.9	12.0	8.3
MALDEN_JC22J220.00	14.0	0.0	0.0	16.3	15.1	0.0	24.2	18.4	9.6	9.6	7.8	4.8	7.9	7.2	3.5	13.6	18.0	13.6	12.0	12.1	8.3
KINGSVIL_K2Z118.05																					
GOSFIELDJCT 118.05	34.3	34.3	34.3	34.6	34.6	35.2	35.6	1.4	34.2	34.2	36.0	1.4	34.3	34.3	34.3	34.3	34.3	34.3	34.3	34.3	32.7
KINGSVIL_K6Z118.05																					
FIT_POINTE_A118.05	42.5	42.6	42.5	43.0	43.0	43.6	44.2	1.7	42.5	42.5	44.7	1.8	42.6	42.6	42.6	42.5	42.5	42.5	42.6	42.6	41.4
LAUZON_TS 118.05																					
JEFFERSN_JZ1118.05	23.4	28.4	23.3	9.9	13.6	9.1	34.4	15.4	23.1	23.1	55.5	53.3	17.8	18.2	18.9	19.5	20.9	19.5	0.0	37.3	0.0
JEFFERSN_JZ7118.05	23.4	28.4	23.3	9.9	13.6	9.1	34.4	15.4	23.1	23.1	55.5	53.3	17.9	18.2	18.9	19.5	20.9	19.5	37.1	0.0	0.0
LAUZON_J_K2Z118.05	40.2	40.2	40.2	40.7	40.6	41.2	41.8	13.9	40.1	40.1	42.2	13.8	40.2	40.2	40.3	40.2	40.2	40.2	40.3	40.2	38.3
LAUZON_J_K6Z118.05	35.1	35.1	35.0	35.4	35.4	35.9	36.4	11.0	35.0	35.0	36.8	11.0	35.1	35.1	35.1	35.0	35.0	35.0	35.1	35.1	33.8

Detailed thermal results (Loading%LTE) for S2 (Exporting Case)

from bus in bold face, to bus in normal face.	C21J	C21J_C22J	C22J	C23Z	C24Z	C24Z_C22J	C24Z_C23Z	C24Z_C23Z_LR	J3E	J4E	J4E_J3E	J4E_J3E_LR	L28C	L29C	L29C_L28C	W44LC	W44LC_W45LC	W45LC	Z1E	Z7E	Z7E_Z1E
CHATHAM_SS 220.00																					
LEAMINGJCT21220.00	0.0	0.0	19.3	15.7	15.1	23.0	20.8	16.2	11.0	10.9	4.4	4.0	10.7	10.5	9.5	14.3	18.1	14.3	12.7	12.8	8.8
LEAMINGJCT22220.00	27.5	0.0	0.0	22.1	21.3	0.0	29.3	22.9	15.5	15.4	6.2	5.8	15.1	14.8	13.5	20.2	25.5	20.2	18.0	18.0	12.4
LYNWOOD_JL28220.00	16.0	11.7	16.0	21.2	24.5	23.0	23.4	21.2	17.5	17.5	18.9	15.5	0.0	22.7	0.0	10.5	8.4	10.5	17.0	17.0	14.6
LYNWOOD_JL29220.00	21.9	17.5	21.9	26.5	29.5	28.2	28.2	26.1	23.3	23.3	24.7	21.5	24.6	0.0	0.0	16.5	5.1	16.6	22.8	22.8	20.1
ESSEX_TS 118.05																					
CHRYSLER_E8F118.05	9.4	9.4	9.4	9.4	9.3	9.3	9.3	9.3	9.3	9.3	9.5	9.5	9.4	9.4	9.4	9.4	9.4	9.4	9.3	9.3	9.4
CHRYSLER_E9F118.05	11.6	11.6	11.6	11.5	11.5	11.5	11.5	11.5	11.5	11.5	11.4	11.7	11.6	11.6	11.6	11.6	11.6	11.6	11.5	11.5	11.5
CRAWFRD_JJ3E118.05	42.3	43.6	42.3	63.7	68.0	65.4	85.4	62.5	0.0	77.6	0.0	0.0	47.3	47.5	49.1	43.9	40.6	43.9	45.3	45.4	20.6
CRAWFRD_JJ4E118.05	53.5	55.2	53.6	80.0	85.5	82.2	107.6	78.8	98.9	0.0	0.0	0.0	59.8	60.2	62.4	55.6	51.3	55.6	57.0	57.0	25.2
ESSEX_TS_JQ 27.600	39.9	39.9	39.9	39.9	39.9	39.8	39.5	40.1	39.7	39.7	39.7	40.2	39.9	39.9	40.0	39.9	39.8	39.9	39.6	40.2	40.3
W_TRANSALT_J118.05	21.8	23.1	21.8	41.8	46.0	43.5	62.9	40.8	18.7	18.7	20.2	19.5	26.6	26.9	28.7	23.3	20.0	23.3	0.0	48.7	0.0
WALKER_J_Z7E118.05	21.9	23.2	21.9	42.0	46.1	43.6	63.0	41.0	18.8	18.8	20.0	19.4	26.7	27.0	28.8	23.4	20.2	23.4	48.8	0.0	0.0
KEITH_TS 118.05																					
BRIGHTON_CGS118.05	15.4	14.4	15.3	18.6	19.9	24.3	26.8	16.4	15.1	15.1	14.7	14.5	14.6	14.4	14.2	14.7	15.0	14.7	15.6	15.8	14.8
CRAWFRD_JJ3E118.05	53.8	55.1	53.9	74.9	79.2	76.6	96.7	73.9	0.0	101.7	0.0	0.0	58.8	59.0	60.7	55.5	52.1	55.5	56.8	56.8	31.8
CRAWFRD_JJ4E118.05	69.3	70.9	69.4	96.7	102.2	99.0	124.5	95.3	129.7	0.0	0.0	0.0	75.6	75.8	77.9	71.4	67.2	71.4	73.3	73.4	41.8
KEITH_FWAPE 27.600	7.1	7.1	7.1	7.1	7.1	7.1	7.1	7.1	7.1	7.1	7.1	7.1	7.1	7.1	7.1	7.1	7.1	7.1	7.1	7.1	7.1
KEITH_TS 220.00	36.5	36.7	36.4	65.1	71.4	68.6	96.0	63.7	30.4	30.3	44.6	44.4	42.2	42.1	44.1	37.5	33.2	37.5	39.3	39.3	3.8
W_WIND_PWR_J118.05	78.8	77.8	78.7	81.8	83.1	83.1	83.1	79.7	78.5	78.6	78.2	77.9	78.0	77.7	77.8	78.2	78.5	78.2	79.0	79.2	78.2
KEITH_TS 220.00																					
BRIGHTON_J20220.00	14.5	14.7	14.5	14.7	14.6	14.5	14.6	14.9	14.7	14.7	14.6	14.8	14.6	14.8	15.0	14.6	14.5	14.6	14.7	14.7	15.0
KEITH_J5D_RG230.00	21.1	12.6	21.0	26.4	30.3	33.8	33.6	25.3	17.1	17.1	3.6	0.7	23.2	23.7	27.4	15.1	6.8	15.1	18.5	18.5	8.3
KEITH_TS 118.05	36.2	36.5	36.0	64.8	71.0	67.9	95.5	63.5	30.2	30.2	44.4	44.2	42.0	41.9	44.0	37.3	32.9	37.3	39.1	39.2	3.8
KEITH_TS_BY 27.600	43.9	44.1	43.9	44.1	44.1	43.8	44.1	44.2	44.1	44.1	44.1	44.2	44.1	44.2	44.3	44.1	44.0	44.1	44.1	44.1	44.3
MALDEN_JC21J220.00	0.0	0.0	18.8	1.1	1.1	14.6	7.3	2.8	7.2	7.2	27.6	24.9	7.5	8.0	10.9	2.1	3.5	2.1	4.4	4.4	11.5
MALDEN_JC22J220.00	19.3	0.0	0.0	0.3	1.0	0.0	7.2	2.1	6.9	6.9	27.0	24.3	7.3	7.6	10.4	2.2	3.9	2.2	4.2	4.2	11.1
KINGSVIL_K2Z118.05																					
GOSFIELDJCT 118.05	18.1	18.3	18.0	14.2	17.6	14.9	34.1	15.4	20.0	20.1	55.3	53.2	16.6	17.3	18.7	17.1	18.4	17.1	0.0	33.5	0.0
KINGSVIL_K6Z118.05	18.1	18.4	18.0	14.1	17.5	14.9	34.1	15.4	20.1	20.1	55.3	53.3	16.7	17.3	18.7	17.1	18.4	17.1	33.3	0.0	0.0
FIT_POINTE_A118.05	40.1	40.2	40.1	40.6	40.6	40.6	41.2	13.8	40.1	40.1	42.2	13.8	40.1	40.2	40.2	40.1	40.1	40.1	40.2	40.2	38.1
LAUZON_TS 118.05	35.0	35.0	35.0	35.4	35.4	35.4	35.9	11.0	34.9	34.9	36.8	11.0	35.0	35.0	35.1	35.0	35.0	35.0	35.0	35.0	33.9
JEFFERSN_JZ1118.05	4	12	4	34	16	6	4	34	16	15	5	21	5	38	41	20	3	12	3	22	14
JEFFERSN_JZ7118.05	5	12	5	34	15	5	5	34	15	15	5	21	5	38	42	21	2	12	3	23	15
LAUZON_J_K2Z118.05	41	41	41	41	14	41	41	41	14	27	41	14	41	37	15	14	0	0	79	0	25
LAUZON_J_K6Z118.05	35	35	35	35	11	36	35	35	11	23	36	11	36	32	12	11	79	48	0	0	0

6.7 Voltage Analysis

The assessment of the voltage performance in the Windsor area was done in accordance with the IESO's *Ontario Resource and Transmission Assessment Criteria.* The criteria states that with all facilities in service pre-contingency, 230 kV, 115 kV, 44-13.8kV system voltage declines following a contingency shall be limited to 10% before and after transformer tap changer action, and absolute maximums and minimums of 250-207kV, 127-108kV and 112%-88% of nominal, respectively. The 44-13.8kV system voltages are further limited to 5% voltage decline after tap changer action.

The voltage decline studies were performed with the South Kent facility in service. Excessive voltage decline can be seen for the losses associated with the K6Z, K2Z, J4E, J4E circuits. This problem pre-exists South Kent and there are plans in place to relief the loading at Kingsville TS by transferring load to Leamington TS. Results demonstrate that the Windsor Area SPS can remove concerns regarding post-contingency voltage violations.

Generally the incorporation of South Kent will improve voltage performance in Windsor area. The worst case for the voltage due to the addition of South Kent is the event of a fault involving a busbar or any breaker failure condition at Chatham SS which results in loss of shunt capacitor bank and South Kent WF with full output. For this case a summary of the voltage analysis results is presented in the table below.

Bus	Pre C.	Pre-ULTC	ΔV%	Post-ULTC	ΔV%
CHATHAM_SS 220	243.7	236.5	-3.0	236.3	-3.0
KEITH_TS 220	237.3	236.0	-0.5	235.9	-0.6
LAUZON 220	231.8	228.3	-1.5	228.2	-1.6
KINGSVILLE 27.6	27.6	27.2	-1.4	27.2	-1.4

The study results indicate that both declines of pre-ULTC and post-ULTC values are within the IESO's criteria of 10%. In conclusion, addition of the South Kent project does not result in material adverse impact on the voltage performance of the IESO-controlled grid.

6.8 Transient Analysis

Transient stability analysis was performed considering faults in Windsor area with the proposed project in-service. All contingencies studied were three-phase faults cleared with normal fault clearing times. Double circuit contingencies were simulated as three phase faults occurring on two circuits simultaneously. It should be noted that the simulations for double circuit contingencies are more onerous than required in Ontario Resource and Transmission Assessment Criteria so the study results are more conservative and acceptable. The contingencies that were studied for dynamic analysis as well as fault clearing time are listed in the table below.

ID	Contingency	Location	Fault Clearing Time (ms)	
			Near	Remote
SC1	C21J	Chatham SS	83	149
SC2	C21J	Keith TS	116	116
SC3	C24Z	Lauzon TS	116	116

SC4	L28C	Chatham SS	83	116
SC5	W45LC	Chatham SS	83	116
SC6	C21J/C22J	Chatham SS	83	149
SC7	C23Z/C24Z	Chatham SS	83	149
SC8	L28C/L29C	Chatham SS	83	116
SC9	W44LC/W45LC	Chatham SS	83	116

The transient simulation plots are shown in Appendix B. The transient simulation results show that none of the simulated contingencies caused transient instability or undamped oscillations. All results show gradual attenuation of the oscillations.

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

6.9 Low-voltage ride through capability

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

As any other generators, the Siemens WTG is expected to trip only for contingencies which remove the generator by configuration or abnormal conditions such as severe and sustained under-voltage, over-voltage, under-frequency, over-frequency etc**.** The severity of under-voltage seen by 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 causes the terminal voltage to drop.

The implementation of LVRT should not require any instant modification to under-voltage protection settings. In PSS/E model for MK II, the LVRT feature accompanies a change of under-voltage settings as shown below (From Siemens document “UserInputData-SMK223_InputData_SWT-2.3-101_VS_60 Hz_V1.3.xls”.

Voltage range	*Event*
1.00 – 0.85 pu	No trip
0.85 – 0.4 pu	Relay 1 trips in 3.05 sec
0.4 – 0.15 pu	Relay 2 trips in 1.65 sec
0.15 – 0.0 pu	Relay 3 trips in 0.90 sec

In order to test the adequacy of the LVRT capability, three phase faults on C21J, C23Z and L28C at Chatham SS with normal clearing time were simulated. These contingencies are electrically close to the proposed project, and have the greatest impact on its terminal voltage. Based on the plots we can see that the terminal voltages remain well within the LVRT capability.

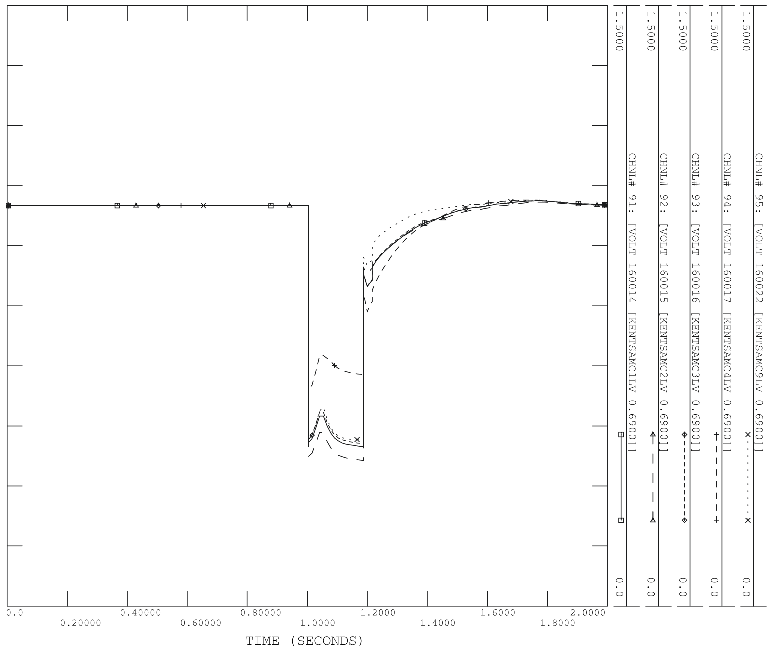


Figure 8: Terminal Voltage of Wind Generator during THREE PHASE FAULT Faults at Chatham SS

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

– End of Report –

Appendix A Market Rules: Appendix 4.2

Appendix 4.2 – Generation Facility Requirements

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

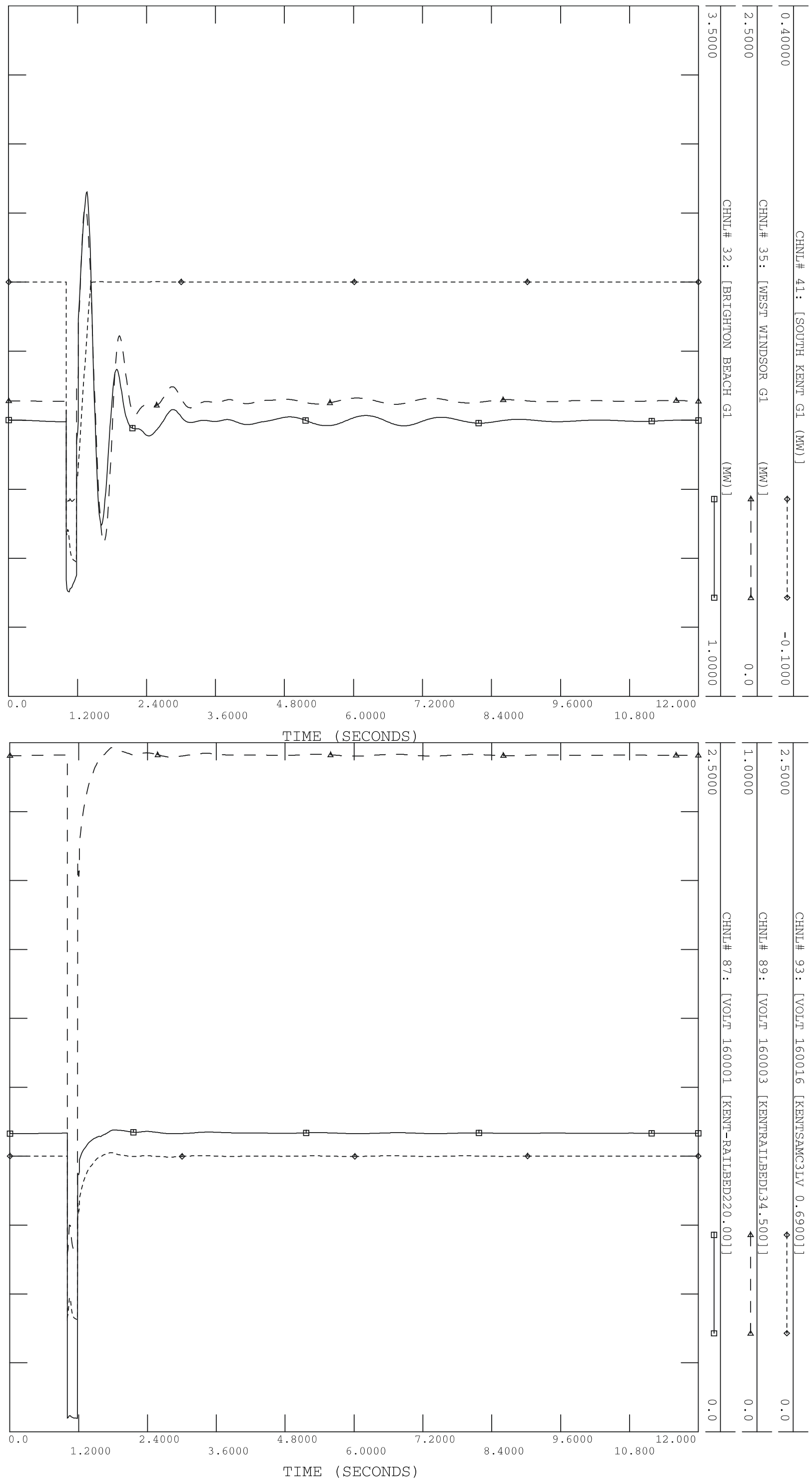
Each *generation facility* that was authorized to connect to the *IESO-controlled grid* prior to March 6, 2010 shall remain subject to the performance requirements in effect for each system at the time of its authorization to connect to the *IESO-controlled grid* was granted or as agreed to by the *market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

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

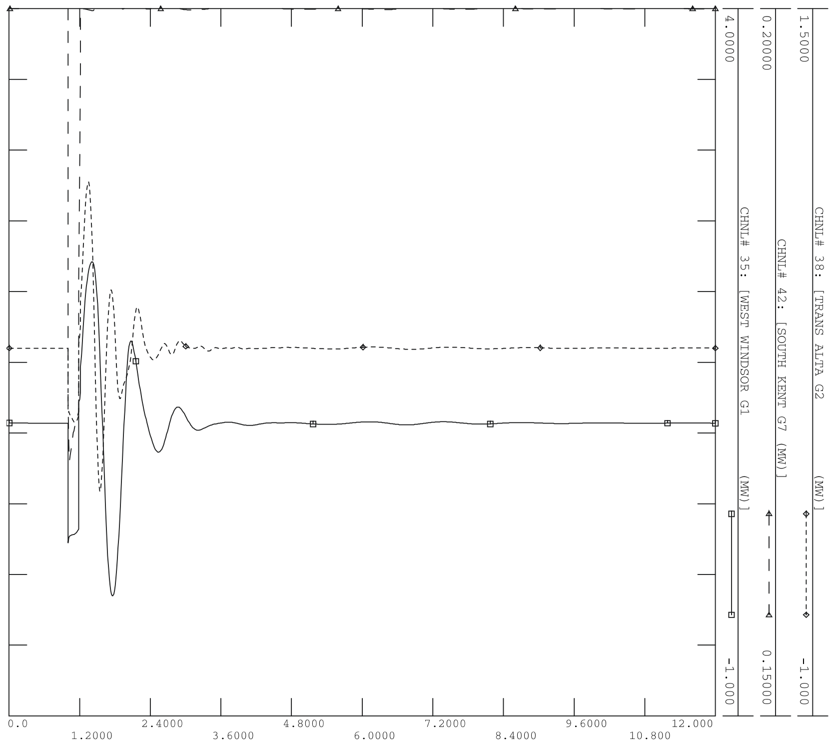
	13% based on generator rated apparent power is acceptable.
6. Automatic Voltage Regulator (AVR)	Regulate automatically voltage within ±0.5% of any set point within ±5% of rated voltage at a point whose impedance (based on rated apparent power and rated voltage) is not more than 13% from the highest voltage terminal. If the AVR target voltage is a function of reactive output, the slope ΔV /ΔQmax shall be adjustable to 0.5%. The equivalent time constants shall not be longer than 20 ms for voltage sensing and 10 ms for the forward path to the exciter output. AVR reference compensation shall be adjustable to within 10% of the unsaturated direct axis reactance on the unit side from a bus common to multiple units.
7. Excitation System	Provide (a) Positive and negative ceilings not less than 200% and 140% of rated field voltage at rated terminal voltage and rated field current; (b) A positive ceiling not less than 170% of rated field voltage at rated terminal voltage and 160% of rated field current; (c) A voltage response time to either ceiling not more than 50 ms for a 5% step change from rated voltage under open-circuit conditions; and (d) A linear response between ceilings. Rated field current is defined at rated voltage, rated active power and required maximum continuous reactive power.
8. Power System Stabilizer (PSS)	Provide (a) A change of power and speed input configuration; (b) Positive and negative output limits not less than ±5% of rated AVR voltage; (c) Phase compensation adjustable to limit angle error to within 30° between 0.2 and 2.0 Hz under conditions specified by the IESO, and (d) Gain adjustable up to an amount that either increases damping ratio above 0.1 or elicits exciter modes of oscillation at maximum active output unless otherwise specified by the *IESO*. Due consideration will be given to inherent limitations.
9. Phase Unbalance	Provide an open circuit phase voltage unbalance not more than 1% at a *connection point* and operate continuously with a phase unbalance as high as 2%.
10. Armature and Field Limiters	Provide short-time capabilities specified in IEEE/ANSI 50.13 and continuous capability determined by either field current, armature current, or core-end heating. More restrictive limiting functions, such as steady state stability limiters, shall not be enabled without *IESO* approval.
11. Performance Characteristics	Exhibit *connection point* performance comparable to an equivalent synchronous *generation unit* with characteristic parameters within typical ranges. Inertia, unsaturated transient impedance, transient time constants and saturation coefficients shall be within typical ranges (e.g. H > 1.2 Aero-derivative, H > 1.2 Hydraulic less than 20 MVA, H > 2.0 Hydraulic 20 MVA or larger, H > 4.0 Other synchronized units, X'd < 0.5, T'do > 2.0, and S1.2 < 0.5) except where permitted by the *IESO*.

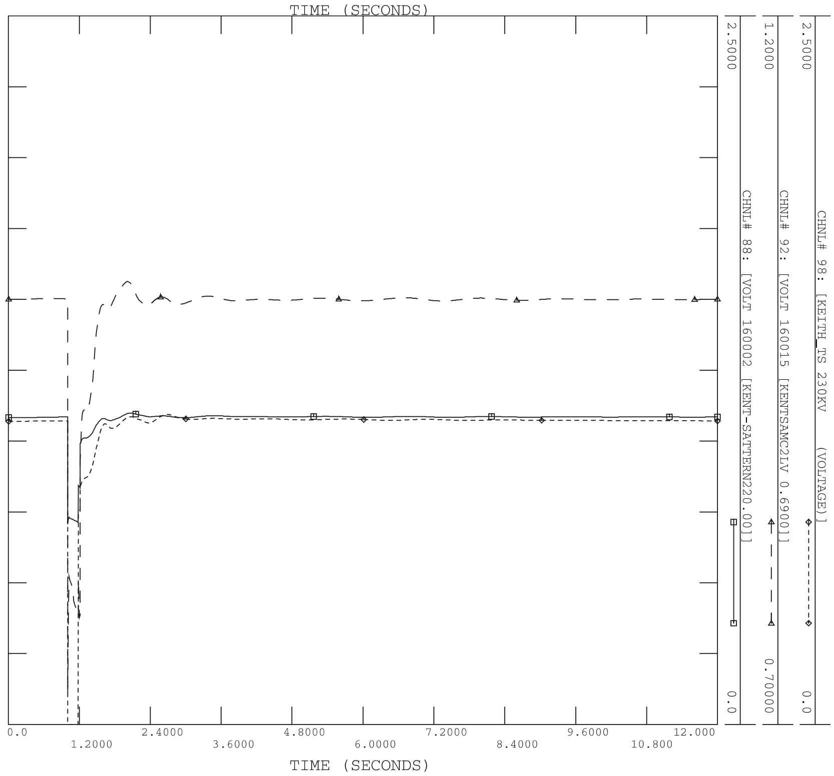
Appendix B Transient Simulation Plots

SC1: Three Phase Fault on C21J at Chatham

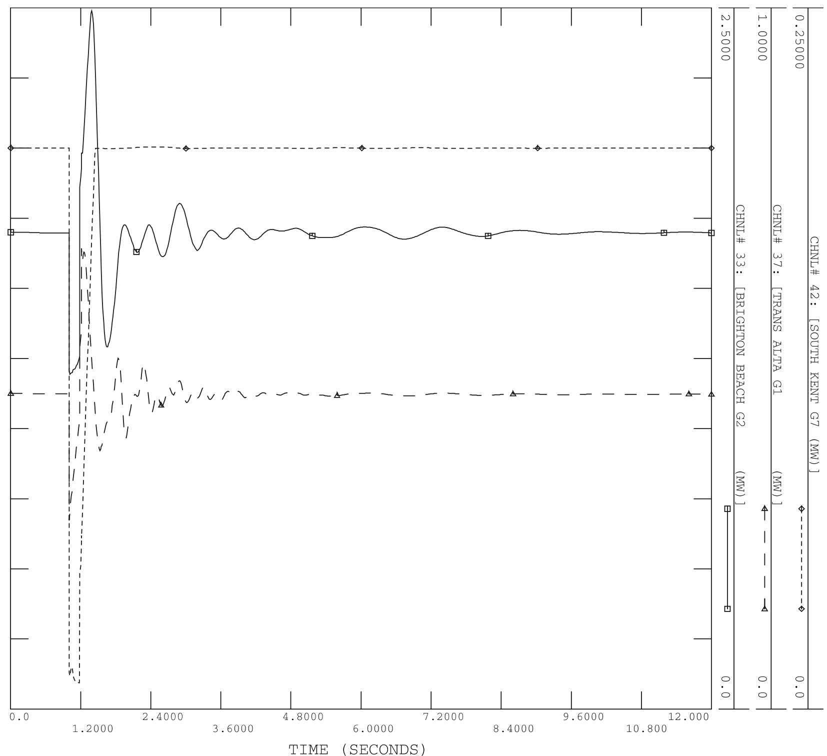


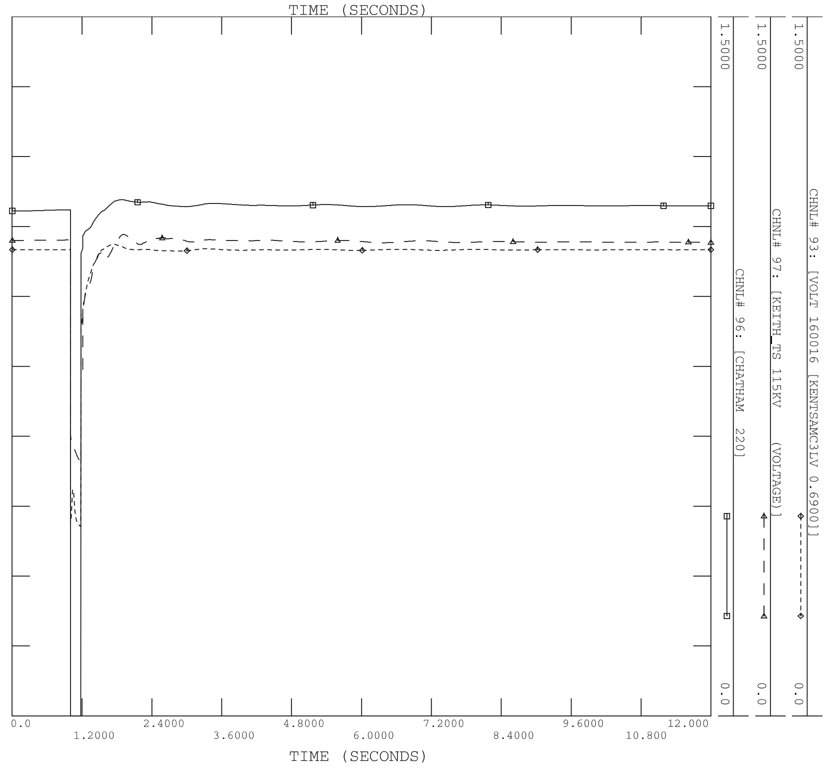
SC2: Three Phase Fault on C21J at Keith



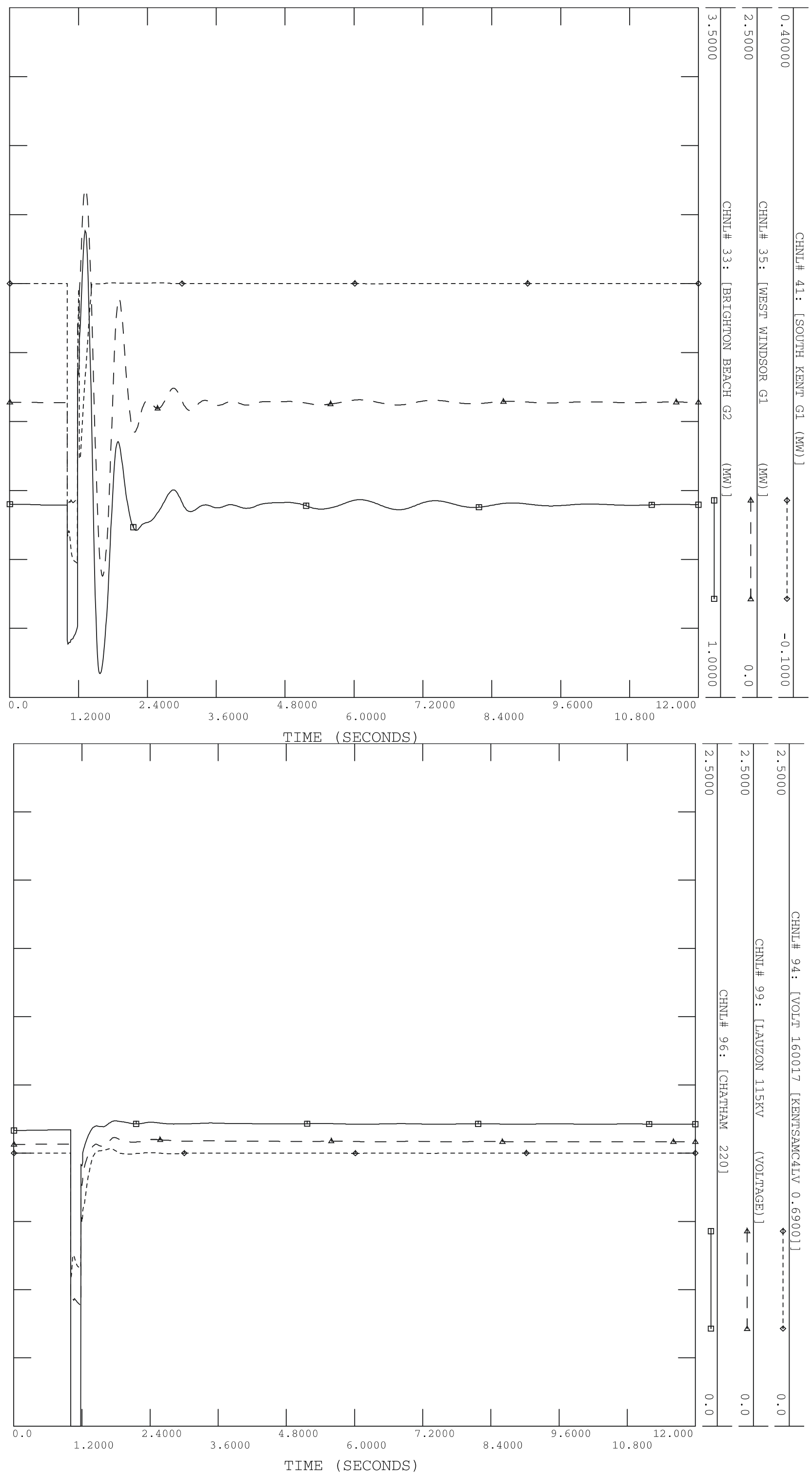


SC3: Three Phase Fault on C24Z at Lauzon

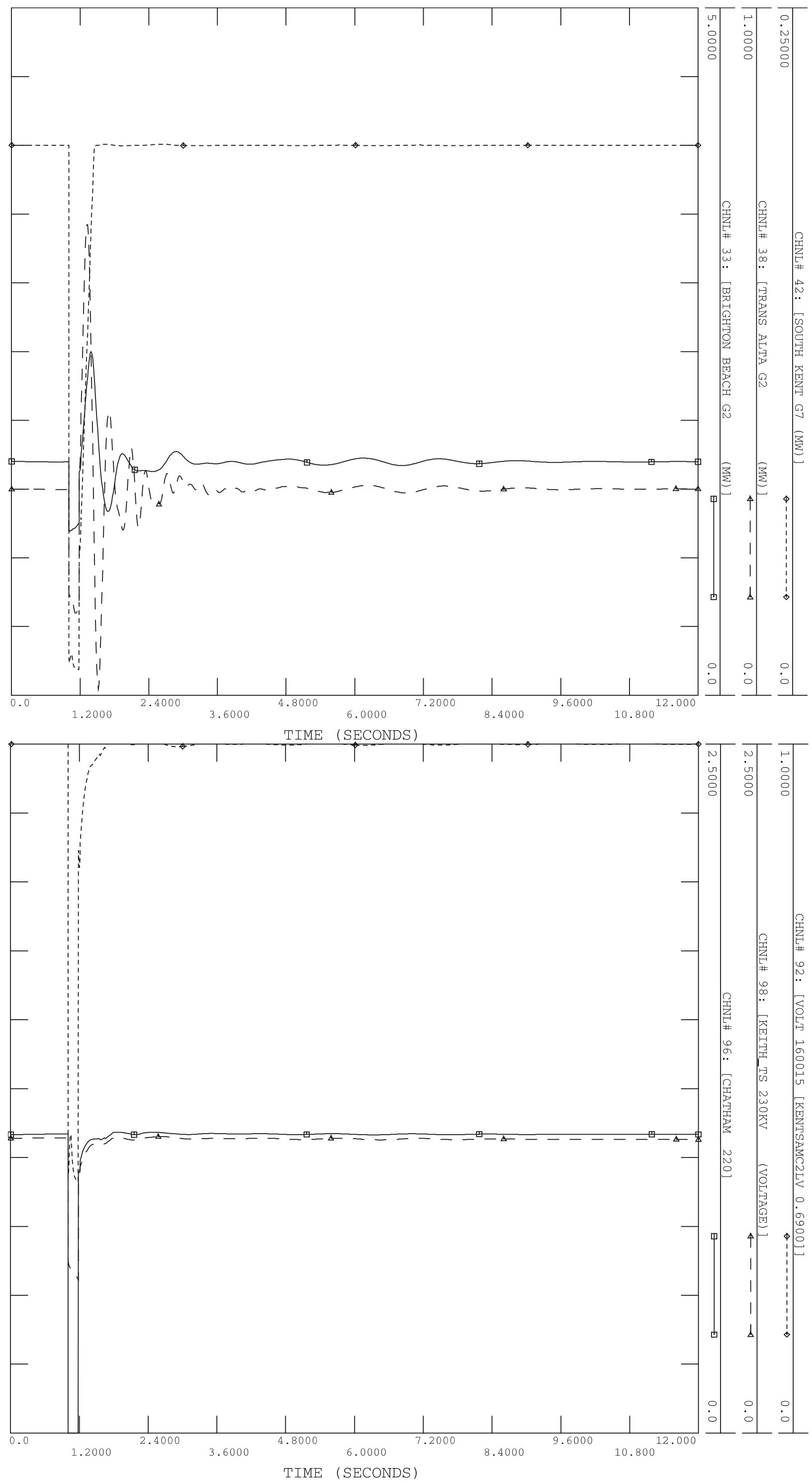




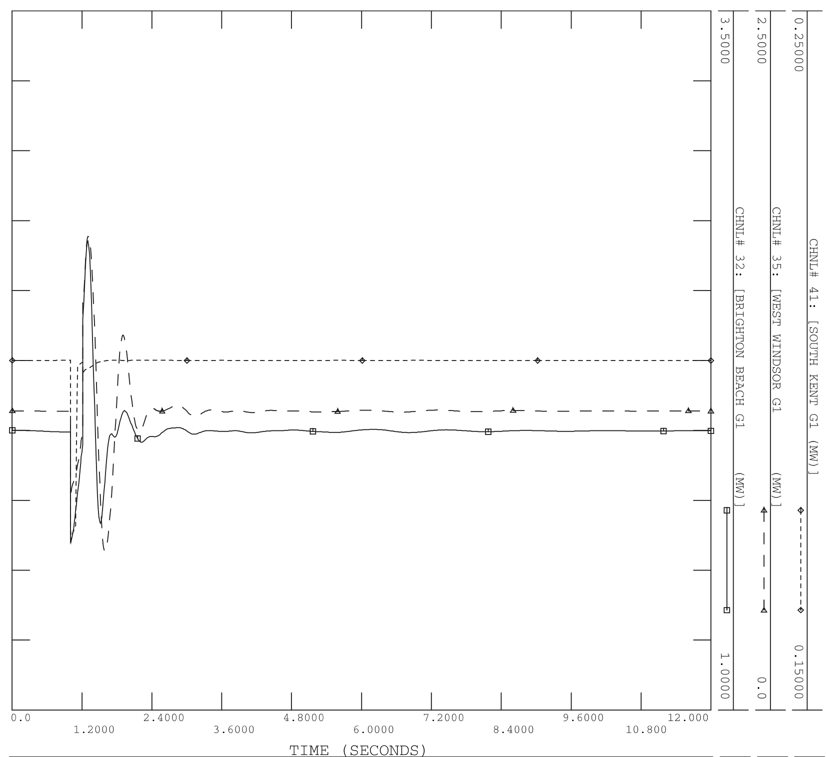
SC4: Three Phase Fault on L28C at Chatham

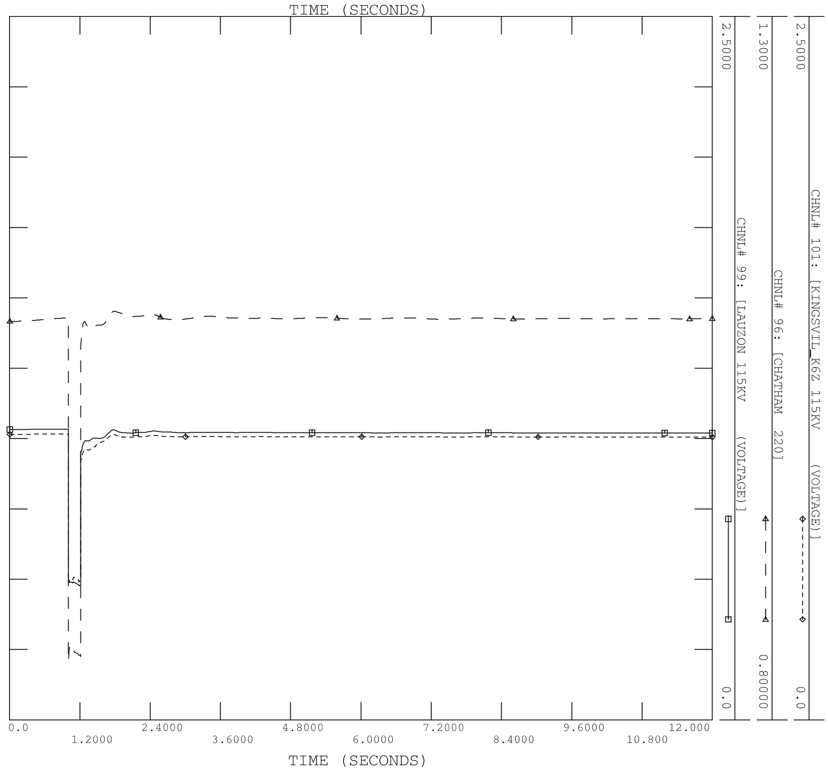


SC5: Three Phase Fault on W45LC at Chatham

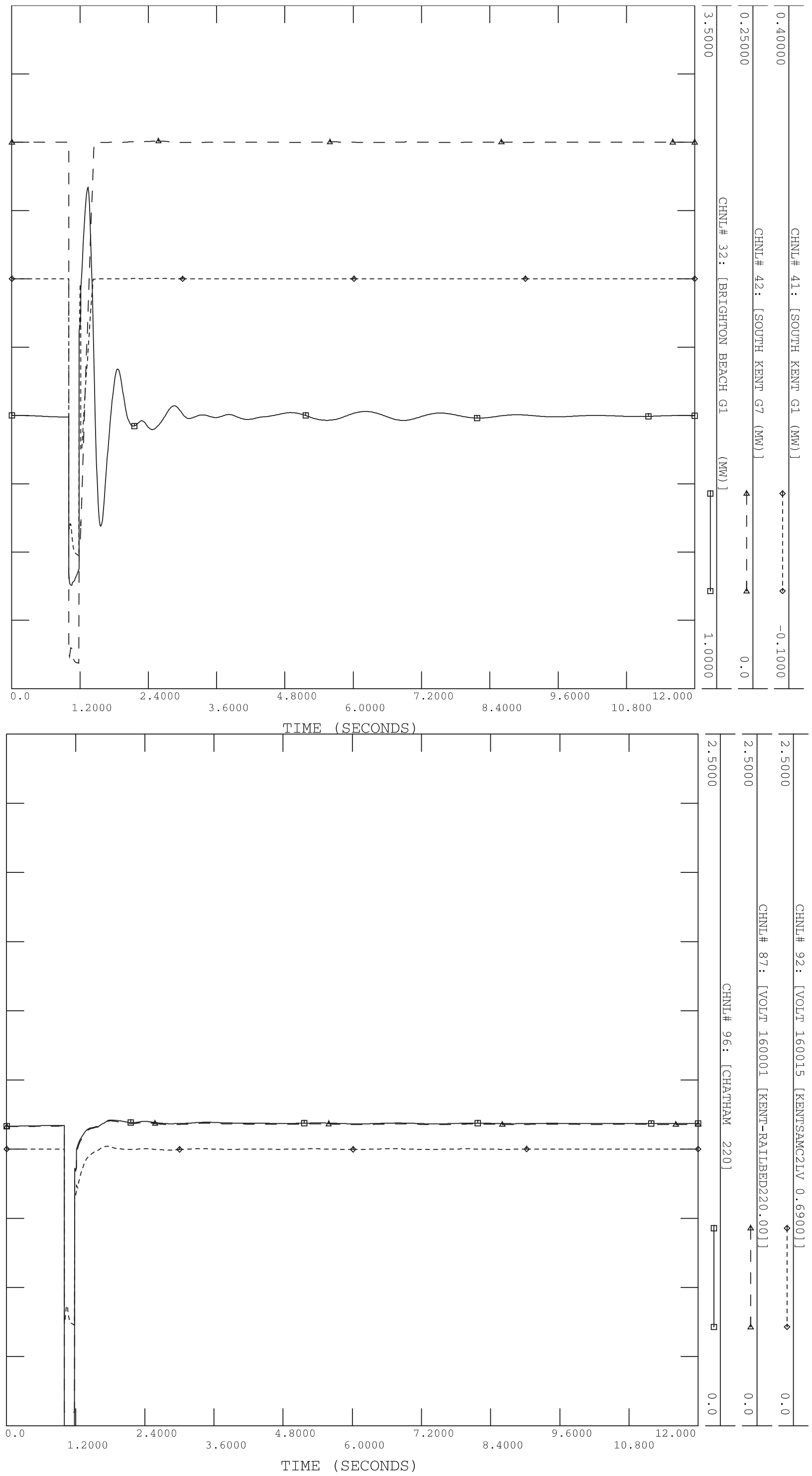


SC6: Three Phase Fault on C21J/C22J at Chatham

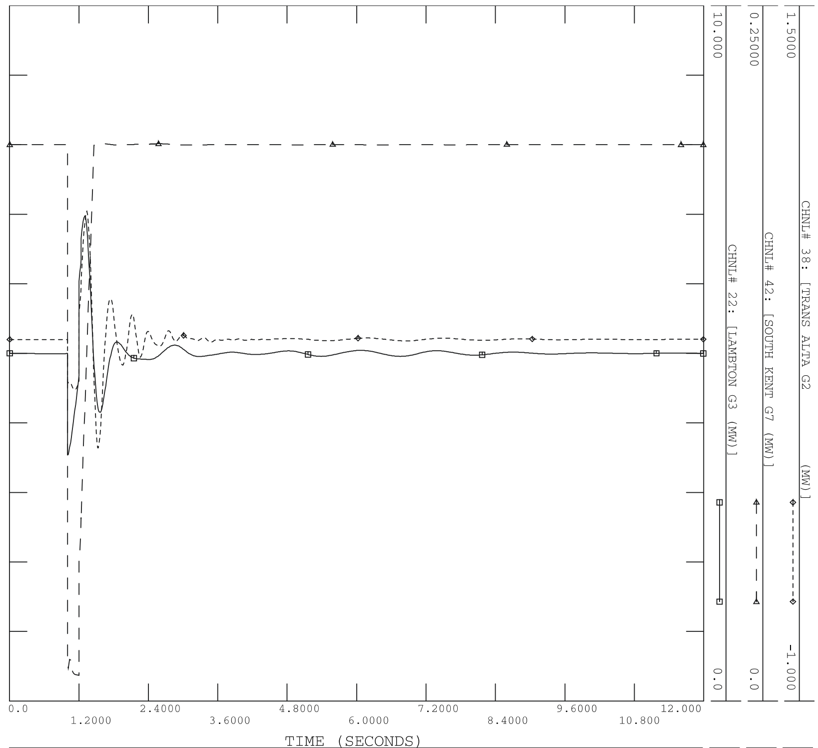


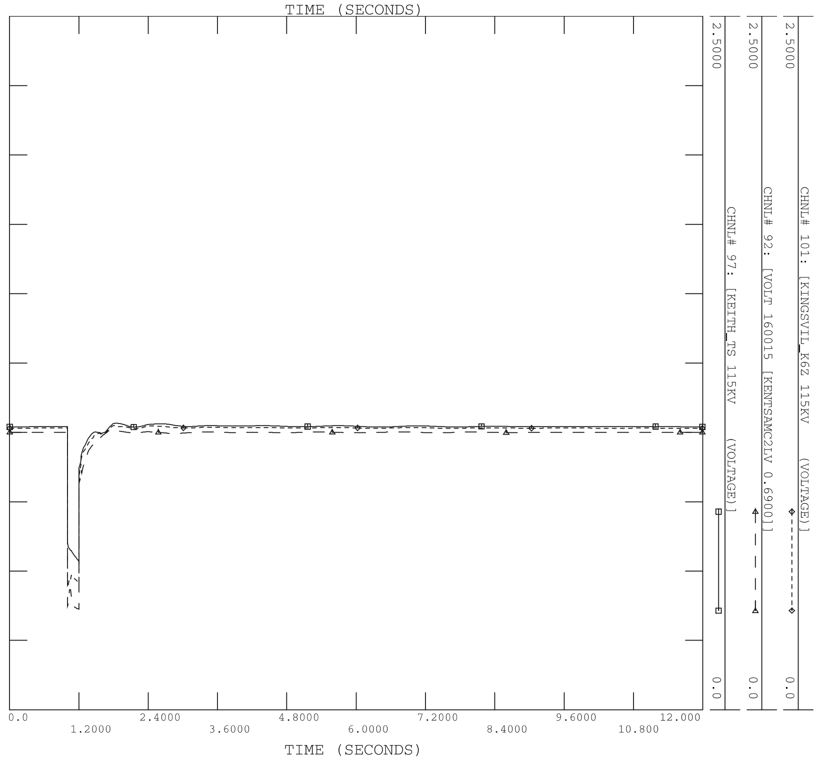


SC7: Three Phase Fault on C23Z/C24Z at Chatham

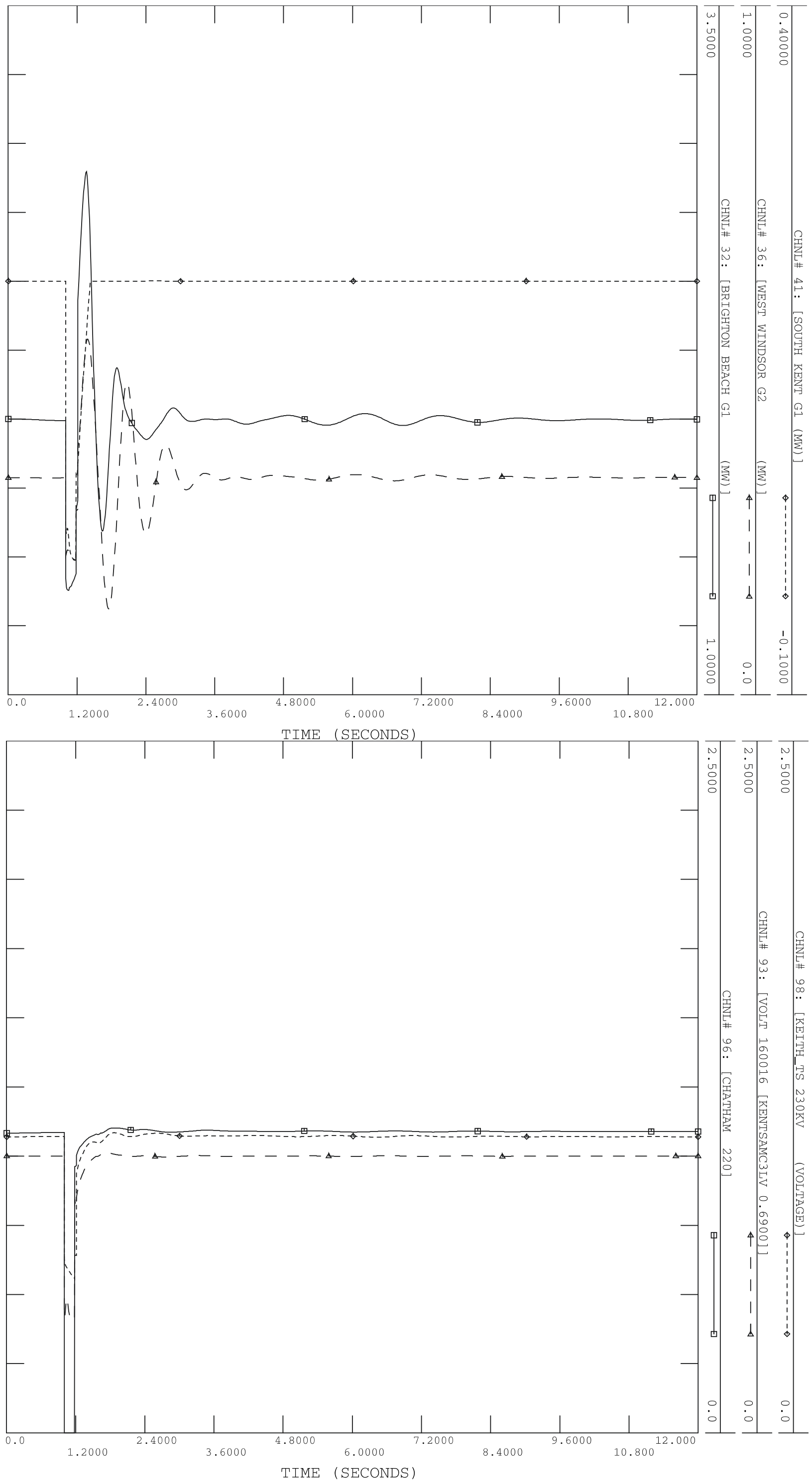


SC8: Three Phase Fault on L28C/L29C at Chatham





SC9: Three Phase Fault on W44LC/W45LC at Chatham



Appendix C Protection Impact Assessment

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

PROTECTION IMPACT ASSESSMENT

SOUTH KENT WF 270MW-SAMSUNG PROJECTS

Date: May 3, 2011
P&C Planning Group Project #: PCT-038-PIA

Prepared by:

Hydro One Networks Inc.

Disclaimer

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

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

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

Revision History

Revision	Date	Change
R0	January 21, 2011	Initial Draft
R1	March 16	Updating according to new SLD
R2	May 3, 2011	Making clear to use line differential for new 230kV circuit

PROTECTION IMPACT ASSESSMENT
SOUTH KENT WF 270MW-SAMSUNG PROJECTS

1.0 INTRODUCTION

1.1 Protection Impact Assessment

This PIA study is prepared for the IESO to assess the potential impact of the proposed 270MW on the existing transmission protection. The primary focus of this study is on protecting Hydro One system equipment while meeting IESO System Reliability Criteria.

1.2 Description of Proposed Connection to the Grid

Samsung plans to develop a 270 MW wind farm in the municipality of Chatham-Kent. The proposed South Kent Wind Farm will be connected to Chatham SS and consists of 105 x 2.2 MW and 18 x 2.1 MW (derated from 2.3 MW for noise) Siemens SWT 2.3 - 101, 690V asynchronous generator connected through a Four Quadrant Full Bridge Converter (AC/DC - DC/AC). The wind turbines will be arranged in two groups of 121 MW and 149 MW where each group will be connected by a combination of 34.5 kV underground cable and overhead collectors to two new 34.5 kV collector buses, *Sattern CGS and Railbed CGS.* The voltage at the CGSs will be stepped up to 230 kV via 2 x 95/125/160 MVA transformers for connection to Chatham SS as shown in Figure 1.

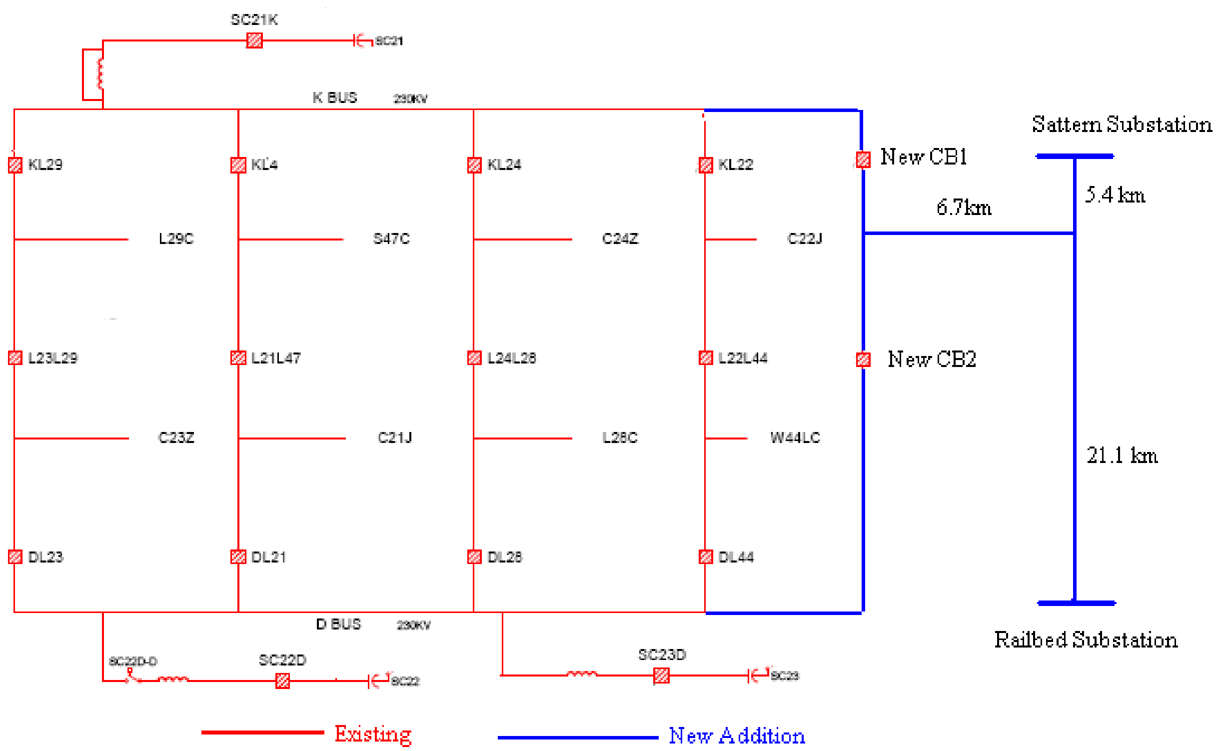


Figure 1 Proposed Generation Connection Scheme at Chatham TS

2.0 PROTECTION

2.1 General

Since there is not vacant position in existing bus diameters in Chatham SS, a new diameter must be built for the connection of 270MW WF generation.

The existing 230kV line protections from Chatham SS are not required for modification. However, the connection of the 270MW WF Generation will result in the need for revision of bus protections in Chatham SS.

'A' and 'B' groups of line current differential protections shall be installed to protect the new 230kV circuit.

2.2 Specific Protection Requirements

2.2.1 Modifications

2.2.1.1 230kV D and K Bus Protections

The 230kV bus protections will be revised to cover new generation connection.

2.2.1.2 CT Ratio

The connection of new generation results in the maximum short circuit current level exceeding 20 times of CT rating. The CT ratios should be increased. The settings of the bus protections should be modified accordingly.

2.2.1.3 Breaker Protections

Breaker Protections of breakers KL29, KL47, KL24, KL22, DL23, DL21, DL28, DL44 and SC21K, SC22D, SC23D should cover new 230kV breakers.

New 230kV breaker protections should trip the existing breakers KL29, KL47, KL24, KL22, DL23, DL21, DL28, DL44 and SC21K, SC22D, SC23D.

2.2.2 New Installations

New 'A' and 'B' line current differential protections will be installed for the 270MW generation connection.

'A' and 'B' groups of breaker protections shall be installed to protect two new breakers to supply new 230kV circuit.

The customer must have communications ('A' & 'B' redundant and physically separated) between the CGS and Chatham SS for the line protection schemes from both terminals. It is recommended that the customer establish the communication link with Chatham SS via fibre for one group of protection and digital microwave or other diversity of communication for another group of protection.

2.3 Tele-Protection

The modification is not required to the existing tele-protections of all lines from and to Chatham SS.

3.0 SCADA/RTU

It is beyond the scope of the PIA.

4.0 POWER SYSTEM MONITORING

It is beyond the scope of the PIA.

5.0 REVENUE METERING

It is beyond the scope of the PIA.

6.0 CYBER SECURITY

NERC's standards CIP-002 thru CIP-009 may apply.

7.0 STATION REQUIREMENTS

It is beyond the scope of the PIA.

8.0 UPDATE DATABASES AND DOCUMENTATION

It is beyond the scope of the PIA.

ieso
Power to Ontario.
On Demand.
Station A, Box 4474
Toronto, ON
M5W 4E5

May 4, 2011

Daniel M. Elkort
Vice President and General Counsel
c/o Pattern Energy Group, Pier 1, Bay 3
San Francisco, CA94111

Dear Mr. Elkort:

RE: South Kent Wind Project
Notification of Conditional Approval of Connection Proposal
CAA ID Number: 2010-405

The IESO has now had an opportunity to review and assess your company's proposed connection of the South Kent Wind Project as described in your System Impact Assessment application. The IESO has concluded that the proposed connection will not result in a material adverse impact on the reliability of the integrated power system. The IESO is therefore pleased to grant "conditional" approval as detailed in the attached System Impact Assessment report. Please note that any further material change to your proposed connection may require a re-assessment by the IESO and may result in a nullification of the conditional approval.

You may now initiate the IESO's "Market Entry" process. To do so, please contact Market Entry at market.entry@ieso.ca at least eight months prior to your expected energization date. The SIA report, attached hereto, details the requirements that your company must fulfill during this process, including demonstrating that the facility *as installed* will not be materially different from the facility *as approved* by the IESO. The document entitled **"External Guidelines for Connection to the IESO"** provided in the approval email describes the key steps in the Market Entry process.

Please also be advised that the Market Rules governing the connection of renewable generation facilities in Ontario are currently being reviewed through the SE-91 stakeholder initiative and, therefore, new connection requirements (in addition to those outlined in the attached SIA), may be imposed in the future. More details can be found through the following link:
http://www.ieso.ca/imoweb/consult/consult_se91.asp

When your company has successfully completed the IESO's "Market Entry" process, the IESO will provide you with a "final" approval, thereby confirming that the facility is fully authorized to connect to the IESO-controlled grid.

If you have any questions or require further information, please contact me.

Yours truly,

Michael Falvo
Manager – Market Facilitation
Telephone: *(905) 855-6209*
Fax: *(905) 855-6319*
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CUSTOMER IMPACT ASSESSMENTS FOR:

1. **Comber East and West Wind Farms**
2. **Pointe-Aux-Roches Wind Farm**
3. **South Kent Wind Farm**

Plan/Project # : **AR20470**
AR20472
AR20132

Revision: 1

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Issued by: **Transmission Planning Department**
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DISCLAIMER

This Customer Impact Assessment was prepared based on preliminary information available about the connection of the proposed three generating facilities for connections to Hydro One's transmission network systems. They are *Comber Wind Ltd. Partnership, Pointe-Aux-Roches Wind Inc. and South Kent Wind Farm Inc.* All four wind projects are located in the Chatham-Kent-Essex area and it is intended to highlight significant impacts, if any, to affected transmission and distribution customers early in the project development process and thus allow an opportunity for these parties to bring forward any concerns that they may have before line and station construction work are to start in 2011/12. Subsequent changes to the required modifications or the implementation plan may affect the impacts of the proposed connection identified in this Customer Impact Assessment Report. The results of this Customer Impact Assessment may be subject to change to accommodate the requirements of the Independent Electricity System Operator and other regulatory or municipal authority requirements.

Not included in the scope of the CIA Report is the impact due to ground potential rise/induction by Bell circuits.

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CUSTOMER IMPACT ASSESSMENTS FOR

1. **Pointe-Aux-Roches Wind Farm**
2. **Comber East and West Wind Farms**
3. **South Kent Wind Farm**

1.0 INTRODUCTION

1.1 Revision to Customer Impact Assessment (CIA) Report Dated October 29, 2010

A Draft copy of the CIA Report was issued to potentially impacted customers on March 31, 2011. From planning assumption changes and comments received, Revision 01 consists of the following updates:

- Samsung's Kent Centre Wind Farm has been renamed *South Kent* Wind Farm. The wind turbine generators will be arranged in two groups of 121 MW and 149 MW at *Sattern CGS and Railbed CGS* respectively and there they will be stepped up to 230 kV for connection to Chatham SS
- The CIA Report dated Ocober 29, 2010 considered Comber East and West Wind Farms going into service first. However Pointe-Aux-Roches Wind Farm has a single line-tap connection so that it will be going into service just ahead of Comber Wind Farms.
- The short-circuit fault level values given in tables 9 through 16 have been updated to reflect changes to planning assumptions including the deletion of a new substation at Sandwich Junction. This project will not be realized within the time frame of these three projects.

1.1 Background

On October 1, 2009, the Feed-in Tariff Program (**FIT**) was launched by the Ontario Power Authority (**OPA**) under the *Green Energy and Green Economy Act* in order to procure new renewable energy projects across the province. It provides standardized prices through multi-year contracts for energy generated from renewable sources, including biomass, biogas, landfill gas, on-shore and off-shore wind, solar photovoltaic (PV), and waterpower.

On April 8, 2010, the OPA awarded contracts through the FIT Program to 34 new transmission connecting projects totaling 1200 MW. Three (3) of those projects are in the Chatham-Kent-Essex area and they are:

- Pointe-Aux-Roches Wind Farm (48.6 MW) in the Township of Lakeshore, Essex County proposed by International Power Canada Inc.
- Comber East Wind Farm (82.8 MW) in the Township of Lakeshore, Essex County proposed by Comber Wind Ltd. Partnership
- Comber West Wind Farm (82.8 MW) in the Township of Lakeshore, Essex County proposed by Comber Wind Ltd. Partnership, and

The fourth wind farm that will be located in the Chatham-Kent-Essex area is the South Kent Wind Farm (270 MW) proposed by Samsung C&T Corporation Consortium. Although this Wind Farm is not part of the FIT program, its location in the Municipality of Chatham-Kent will impact on load flow and short-circuit studies. The CIA Report that was first issued in October 2010 is revised and updated to include generation from South Kent Wind Farm scheduled for connection to Chatham SS in 2013.

As part of the Connection Assessment and Approval (**CAA**) process, the Independent Electricity System Operator (**IESO**) will carry out System Impact Assessment (**SIA**) of the above Wind Turbine Generation (**WTG**) connections.

Hydro One Networks Inc (**Hydro One**) carries out a single Customer Impact Assessment (**CIA**) study covering all of the above four wind farms because they are located in the same municipality of Chatham-Kent-Essex and that they are expected to be in service at around the same time in 2012. The CIA studies therefore assess the impact all four wind farm connections may have on facilities owned by other load and generation customers in the study area in accordance with Market Rules (Chapter 4, Section 6) and IESO's CAA process.

1.2 Wind Farms

a) Pointe-Aux-Roches Wind Farm

The 48.6 MW Pointe-Aux-Roches (**PAR**) Wind Farm near the town of Leamington in Essex County in southwestern Ontario on Lake St. Clair is being developed by International Power Canada Inc. (**IPC**). The Wind Farm will consist of 27 V90 - 1.8 MW, 690V Vestas 6-pole doubly-fed asynchronous generator (DFAG) arranged in two (2) groups of 14 and 13 wind turbine units and connected by a combination of 34.5 kV underground cable and overhead collectors to a new *Pointe-Aux-Roches (PAR) CGS* collector bus and this is about 200 m from the *Pointe-Aux-Roches CSS* which is the line-tap connection substation. The generating facilities will be connected to Hydro One 115 kV Kent-Lauzon K6Z circuit located about 19 km from Lauzon TS via a 35/46/58 MVA, 34.5/122 kV transformer as shown in Fig 2.

b) Comber East and West Wind Farms

The Comber East and West Wind (**Comber**) projects are located near the Town of Comber in Essex County, Ontario. The 2 x 82.8 MW wind farms are being developed by Comber Wind Ltd. Partnership (**CWLP**) consisting of 2 x 36 Siemens SWT 2.3 MW, 690V asynchronous generator connected through a Four Quadrant Full Bridge Converter (AC/DC - DC/AC). These will be arranged in 2 x 3 groups of 12 wind turbine units connected by a combination of 34.5 kV underground cable and overhead collectors to 2 x 34.5 kV collector buses, *Comber East CGS* and *Comber West CGS.* These buses will be stepped up to 230 kV via 2 x 120/160/200 MVA, 34.5/230 kV T1 and T2 transformers for connections to 230 kV Chatham-Lauzon C24Z and C23Z circuits respectively at about 25 km from Lauzon TS as shown in Fig.1.

In addition, a 34.5 kV normally-open (N.O) circuit breaker separates Comber East CGS from Comber West CGS and each wind turbine is equipped with a 0.69/34.5 kV pad-mounted transformer at the tower base.

b) South Kent Wind Farm

Samsung C&T Corporation - Trading and Investment Group and the Korea Electric Power Corporation (**KEPCO**) plans to develop a 270 MW wind farm in the municipality of Chatham-Kent. The proposed South Kent Wind Farm will be located on approximately 1000 acres spanning the townships of Raleigh, Harwich and Howard, and consists of 105 x 2.2 MW and 18 x 2.1 MW (derated from 2.3 MW for noise) Siemens SWT 2.3 - 101, 690V asynchronous generator connected through a Four Quadrant Full Bridge Converter (AC/DC - DC/AC). The wind turbines will be arranged in two groups of 121 MW and 149 MW where each group will be connected by a combination of 34.5 kV underground cable and overhead collectors to two new 34.5 kV collector buses, *Sattern CGS and Railbed CGS.* The voltage at the CGSs will be stepped up to

230 kV via 2 x 95/125/160 MVA transformers prior to connecting them to Chatham SS as shown in Fig. 3.

1.3 Customer Lists

Table 1 lists all the customers impacted by the four Wind Farms when they get connected to Hydro One transmission network systems.

Table 1
Customer List

Wind Farms	*Transformer Station*	*Supply Circuits*	*Connected Customer*
1. Comber East & West Wind Farms	Lauzon TS	230 kV C23Z, C24Z	• E.LK. Energy Inc. • EnWin Utilities Ltd. • Essex Powerlines Corp. • Hydro One Networks Inc.
	Malden TS		• EnWin Utilities Ltd. • Essex Powerlines Corp. • Hydro One Networks Inc.
	Keith TS		• Essex Powerlines Corp. • EnWin Utilities Ltd. • Hydro One Networks Inc.
	Port Alma CGS		• Kruger Energy Port Alma Ltd. Partnership
	Dillon RWEC CGS		• Raleigh Wind Power Partnership
2. Pointe-Aux-Roches Wind Farm	Kingsville TS	115 kV K6Z	• Chatham-Kent Hydro Inc. • E.L.K. Energy Inc. • Essex Powerlines Corp. • Hydro One Networks Inc.
	Tilbury West TS		• Chatham-Kent Hydro Inc. • E.L.K. Energy Inc. • Hydro One Networks Inc.
	Tilbury TS		• Chatham-Kent Hydro Inc. • Hydro One Networks Inc.
	Kent TS		• Chatham-Kent Hydro Inc. • Hydro One Networks Inc.
	Belle River TS		• E.L.K Energy Inc. • Hydro One Networks Inc.
	Gosfield CGS		• Gosfield Wind Ltd. Partnership
3. South Kent Wind Farm	Chatham SS	230 kV C23Z, C24Z	• Kruger Energy Inc. • Renewable Energy Systems Canada Inc. • Invenergy Wind Canada ULC

2.0 METHODOLOGY & CRITERIA

2.1 Study Assumptions

Load flow and short-circuit studies assumed the following:

- Line Data – All transmission facilities in Hydro One system are assumed to be in-service.
- Transformer/Phase Shifter Data – All existing transformers, tie-lines and phase shifters are assumed to be in-service

- Generation Data – The short-circuit studies considered all existing generating stations in Ontario to be in-service as follows *:*

i. *Existing Generation Facilities*

a) *Niagara, Western and Southwestern Regions*

- All hydraulic generation
- Nanticoke (G2-G7)
- Lambton (G1-G2)
- Brighton Beach (J20B/J1B)
- Greenfield Energy Centre (Lambton SS)
- St. Clair Energy Centre (L25N & L27N)
- East Windsor Cogen (E8F & E9F) + existing Ford generation
- TransAlta Sarnia (N6S/N7S)
- Imperial Oil (N6S/N7S)
- Thorold GS (Q10P)

b) *Central and Eastern Regions*

- All hydraulic generation
- Pickering units (G1, G5-G8)
- Darlington units (G1-G4)
- Lennox units (G1-G4)
- GTAA (44 kV buses at Bramalea TS and Woodbridge TS)
- Sithe Goreway GS (V41H/V42H)
- Portlands GS (Hearn SS)
- Kingston Cogen
- TransAlta Douglas (44 kV buses at Bramalea TS)

c) *Northeastern and Northwestern Regions*

- All hydraulic generation
- Atikokan (G1)
- Thunder Bay (G1 – G2)
- NP Iroquois Falls
- AP Iroquois Falls
- Kirkland Lake
- West Coast (G2)
- Lake Superior Power
- Terrace Bay Pulp STG1 (embedded in Neenah Paper)

d) *Bruce Regions*

- Bruce (G1-G8)
- Bruce B Standby Generators (G1-G4)

ii. *Renewable Wind Generation*

a) *Request for Proposal (RFP) Program*

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

- Wolf Island (injecting into X4H)

b) *Renewable Energy Supply (RES) III Program*
- Greenwich Wind Farm (M23L and M24L)
- Gosfield Wind Project (K2Z)
- Kruger Energy Chatham Wind Project (C24Z)
- Raleigh/Dillon Wind Energy Centre (C23Z)
- Talbot/Spence Wind Farm (W45LC)

c) *New Generation (Additions/Modifications)*
- Bruce G1: Increase maximum capacity to 835 MW
- Beck 1 G9: Rehabilitation to increase capacity to 68.5 MVA
- Greenfield South GS (R24C)
- Halton Hills (T38B/T39B)
- York Energy Centre (B82V/B83V)
- Island Falls (H9K)
- TransCanada Oakville (B15C/B16C)
- Becker Cogeneration G1 (Embeded behind Manitouwadge TS)
- New Post Creek (C6T)
- Mattagami Lake Dam (T61S)
- Wawatay G4 (M2W)

- Machine Data
  - Machine data exist in the short-circuit study database for existing generators. These are in the form of X''_d (sub-transient reactance) in p.u. on machine rating.
  - The Siemens SWT-2.3-93 wind turbine reactive capability characteristics used in the studies are given in Appendix A.
  - Siemens SWT-2.3-101 2.3 MW and Vestas V90-1.8 MW wind turbine generator data are given in Appendixes B1 and B2.

- System Configuration

  i) *Bus-Tie Breakers*

  The short-circuit studies considered all transformer stations (TS's) in Ontario to operate with their bus-tie breakers close unless specified as follows:
  - Lambton TS 230 kV operated ***open***
  - Claireville TS 230 kV operated ***open***
  - Leaside TS 230 kV operated ***open***
  - Leaside TS 115 kV operated ***open***
  - Middleport TS 230 kV bus operated ***open***
  - Hearn SS 115 kV bus operated ***open***
  - Napanee TS 230 kV operated ***open***
  - Cherrywood TS North & South 230kV buses operated ***open***

  ii) *Shunt/Series Capacitor Banks and SVC's*

  All shunt capacitors are assumed in-service including the following:
  - 250 kV 250 Mvar shunt capacitor bank at Buchanan TS
  - LV shunt capacitor banks at Meadowvale TS
  - Nanticoke and Detweiler SVCs
  - Series capacitors at Nobel SS in each of the 500 kV circuits X503 & X504E to provide 50% compensation for the line reactance
  - Lakehead TS SVC
  - Porcupine TS & Kirkland Lake TS SVC

- Porcupine TS 2x125 MVAr shunt capacitors
- Essa TS 250 MVAr shunt capacitor
- Hanmer TS 149 MVAr shunt capacitor
- Pinard TS 2x30 MVAr LV shunt capacitors
- Fort Frances TS 22 MVAr moveable shunt capacitor

iii. *Transmission System Configuration and Upgrades*
All transmission facilities including tie-lines in Hydro One transmission network system are assumed to be in-service and that phase shifters are on neutral taps. However the following circuits are re-configured and/or upgraded:

- Bruce x Orangeville 230 kV circuits uprated
- Burlington TS: rebuild 115 kV switchyards
- Leaside TS x Birch JCT: new 115 kV cables from Birch to Bayfield
- Uprate circuits D9HS, D10S and Q11S
- Hurontario SS in-service with R19T+V41H open from R21T+V42H (230 kV circuits V41H and V42H extended and connected from Cardiff TS to Hurontario SS)
- Hurontario SS x Jim Yarrow 230 kV circuits in-service
- Cherrywood TS x Claireville TS: unbundling 500 kV C550VP and C551VP
- Allanburg x Middleport 230 kV Q35M and Q26M circuits in-service
- Claireville TS: reterminate circuit 230 kV V1RP to Parkway V71P and V72R to Cardiff V41H
- ON-QC 1250 MW HVDC line in-service
- Second 500kV Bruce-Milton double-circuit line in service. Double-circuit line from the Bruce Complex to Milton TS with one circuit originating from Bruce A and the other from Bruce B
- Upper Mattagami expansion
- Woodstock Area transmission reinforcement:
- Karn TS in service and connected to M31W & M32W at Ingersol TS
- W7W/W12W terminated at LFarge CTS
- Woodstock TS connected to Karn TS

2.2 Planning Criteria

To establish the adequacy of Hydro One transmission and distribution system incorporating the proposed RES III wind generating facilities, transmitters in Ontario utilize the following post-fault voltage change criteria:

- The loss of a single transmission circuit should not result in a voltage change greater than 10% for pre-transformer tap-changer action (including station loads) and 10% post-transformer tap changer action (5% for station loads)
- The loss of a double transmission circuit should not result in a voltage change greater than 10% for pre-transformer tap-changer action (including station loads) and 10% post-transformer tap changer action (5% for station loads)
- In general, with all planned facilities in service pre-contingency, system voltage changes in the period immediately following a contingency shall not result in a voltage decline greater than 10% for pre-transformer tap-changer action (including station loads less than 50kV) and 10% post-transformer tap-changer action (5% for station loads less than 50kV). In addition, the steady state voltage at station loads less than 50kV are to remain within 6% of the nominal voltage.

2.3 Power System Analysis

Power system analysis is an integral part of the transmission and distribution planning process. It is used by Hydro One to evaluate the capability of the existing network to deliver power and energy from generating stations to provide a reliable supply to customers.

a. Load Flow Studies: The Siemens PTI PSS/E™ AC load flow program was used to set up detailed base cases with FIT and South Kent generating facilities coming into full service in 2012 and 2013 respectively
b. Short-Circuit Studies: The Siemens PTI PSS/E™ AC load flow program with the "ANSI calculation module" was used to determine the impact of FIT and South Kent generating facilities on Chatham-Kent-Essex area customers.

3.0 VOLTAGE PERFORMANCE ANALYSIS

3.1 System Study Conditions

3.1.1 Chatham-Kent-Essex Area Transmission System

Load flow studies were carried out for FIT and South Kent generating facilities connected to 230 kV and 115 kV transmission network systems as shown in Figs. 1, 2 and 3.

The Chatham-Kent-Essex area encompasses two continuous 230 kV and 115 kV transmission paths between Keith TS and Lauzon TS and they are:

- 230 kV circuits C21J, C22J, C23Z and C24Z from Keith TS to Chatham SS
- 230 kV circuits W44LC and W45LC from Chatham SS to Buchanan TS
- 115 kV circuits J1B, J2N, J3E and J4E from Keith TS to Essex TS
- 115 kV circuits E8F, E9F, Z1E and Z7E from Essex TS to Lauzon TS
- 115 kV circuits K2Z and K6Z from Lauzon TS to Tilbury and Kent TS's
- Keith 230/115 kV T11 and T12 auto transformers, and
- Lauzon 230/115 kV T1 and T2 autotransformers.

The radial 115 kV path connects four automobile manufacturing plants (Ford EEP CTS, Chrysler MTS, MG Motors MTS and Ford Annex MTS) in Windsor and there are four customer-owned generating plants in the area (Brighton Beach CGS, West Windsor Power CGS, Windsor TransAlta CGS and East Windsor Cogeneration Centre CGS) with a combined generating capacity of about 925 MW. There are also two other wind generating facilities connected to the K2Z and K6Z circuits egressing from Lauzon TS and they are Gosfield and Pointe-Aux-Roches wind farms.

Voltage support is provided in the area by capacitor banks at 115 kV level at Keith TS and Lauzon TS, and at LV level at Crawford TS, Essex TS, Kingsville TS, Walker TS, Keith TS, Lauzon TS and Malden TS.

3.1.2 Special Protection System

Post-contingency thermal and voltage concerns exist in the Chatham-Kent-Essex area and these concerns are being addressed by a Special Protection System (SPS), the *Windsor Area Overload Protection and Load Rejection Scheme*.

The SPS manages thermal overload by splitting the bus at Essex or rejecting generation at Brighton Beach based on detection of pre-selected system connectivity that includes the loss of Keith x Essex J3E/J4E circuit, the loss of Essex x Lauzon Z1E/Z7E circuit, the loss of Keith

T11/T12 autotransformer, the loss of Keith x Chatham C21J/C22J circuit and the loss of Keith J5D interconnection to Michigan.

Voltage concerns are managed by the SPS by rejecting load following low voltage detection at 115 kV Kingsville TS or the loss of Chatham x Lauzon C23Z/C24Z circuit.

3.1.3 Load Rejection Scheme

There is a Load Rejection (LR) Scheme at Lauzon TS. This scheme is based on connectivity status of Lauzon 115 kV breakers or 230 kV disconnect switches. If the two Lauzon transformers or the two C23Z and C24Z circuits become disconnected at Lauzon TS, the contingency output signal is initiated to trip the K2Z circuit.

3.2 Load Flow Studies

3.2.1 Operating Scenarios

Local voltage impact was assessed using the 2010 winter peak load as a base case scaled to 2012 load when the four generating facilities under the FIT Program and South Kent Wind Farm will be coming into service (an average growth rate of 0.9% per year is assumed). Three operating scenarios were identified for the incorporation of Comber, PAR and Kent generations and they are:

- Scenario I: Normal operating condition with all FIT and South Kent generating facilities in service
- Scenario II: Maximum import from Michigan via J5D tie-line
- Scenario III: Maximum export from Michigan via J5D tie-line.

Load flow study cases are summarized in Table 2 below.

Table 2: Scenarios for Load Flow Studies

No.	*Scenario*	*System Configuration*	*Load Flow Study Cases*
1	Normal Operating Condition	All wind generating facilities in service: • Comber East Wind Farm • Comber West Wind Farm • Pointe-Aux-Roches Wind Farm • South Kent Wind Farm	1. Loss of FIT and South Kent generations 2. Loss of C24Z 3. Loss of Keith T11 autotransformer 4. Loss of Lauzon T1 autotransformer
2	Maximum Import from Michigan	Maximum generation from FIT and South Kent generating facilities	5. Loss of FIT and South Kent generations
3	Maximum Export to Michigan	Maximum generation from FIT and South Kent generating facilities	6. Loss of FIT and South Kent generations

3.2.2 Reactive Power Requirement

There will be two types of wind turbines at FIT and South Kent wind generating facilities:

- Siemens SWT 2.3 MW, 690V asynchronous generator, and
- V90 - 1.8 MW Vestas 6-pole doubly-fed asynchronous generator (DFAG).

i) Siemens SWT 2.3 MW Wind Turbine
Comber East and West and South Kent wind facilities have Siemens SWT-2.3-93, 60 Hz wind turbines and they are designed to operate with a power factor range of 0.9 lagging to 0.9 leading. However the generator is completely decoupled from the Grid through a fully-rated controlled rectifier/inverter (converter) system and therefore cannot be modeled in PSS/E as a conventional asynchronous machine.

The wind turbine power factor range is constant at each active power output level and the terminal voltage, under steady-state conditions, is balanced and in the range of 90 – 110% of nominal. Because of this abnormal variation of reactive power with the terminal voltage caused by limitations in the converter (see Appendix A), the 0.9 lag power factor at rated power and rated voltage cannot be met if operated at 0.95 - 1.05 p. u. voltage range. For IESO Market Rule compliance (0.95 leading to 0.90 lagging at one constant voltage), the wind turbine terminal voltage is reduced to 0.9 – 1.05 p. u. voltage range with the rated voltage set at 0.95 p. u. in load flow studies. These parameter settings will impact on added static capacitors or dynamic Var equipment required to react to sudden momentary dips in voltage commonly seen in gusty wind conditions which could in turn add stress to Hydro one transmission network system.

ii) V90 - 1.8 MW Vestas 6-pole doubly-fed asynchronous generator (DFAG)
Pointe-Aux-Roches (PAR) wind facility has Vestas V90 1.8 MW, 690V wind turbines designed to operate with a power factor range of 0.9 lagging (under-excited) to 0.9 leading (over-excited). These wind turbines were modeled in PSS/E as a conventional asynchronous machine.

Note: Load flow studies presented in this Report assumed wind turbines in FIT and South Kent generating facilities will operate at unity power factor without any added static capacitor banks or similar Var equipments in service. The IESO will determine if these capacitor banks will be entirely static or make up of a combination of static and dynamic shunt capacitors.

3.3 Scenario I: Normal Operating Condition

Study Assumptions:

- Load flow studies assumed the following wind generation connections in the study area:
  - Port Alma 1and 2 Wind Farms to 230 kV C24Z circuit
  - Dillon RWEC to 230 kV C23Z
  - Comber East to 230 kV C24Z
  - Comber West to 230 kV C23Z
  - Gosfield to 115 kV K2Z
  - Pointe-Aux-Roches to 115 kV K6Z
  - South Kent Wind Farm to 230 kV Chatham SS.
- The following bus-tie disconnect switches are assumed to be in the *Normally Open* (NO) position and that they follow the *break-before-make* sequence in which they will be mechanically interlocked by the Kirk Key system to preclude any possibility of paralleling two transmission circuits:
  - Port Alma 1 and 2 230 kV bus-tie disconnect switch connecting 230 kV C23Z and C24Z
  - Comber East and West 34.5 kV bus-tie disconnect switch connecting both wind farms to either 230 kV C23Z or C24Z
  - East Windsor G1 and G2 115 kV bus-tie disconnect switch connecting 115 kV E8F and E9F

- Load flow studies also assumed that East Windsor CGS 50 MW gas-turbine and Ford MTS 30 MW steam-turbine are connected to E8F circuit and the other East Windsor CGS 50 MW gas-turbine connected to E9F circuit
- The 115 kV circuits J3E and J4E between Keith TS and Essex TS are presently operating close to their continuous thermal line rating limits. A 150 MW import from Michigan on the J5D tie-line, for example, will increase the flows on Keith 115 MVA T11 and T12 autotransformers and the 115 kV J3E and J4E transmission paths between Keith TS and Essex TS. This results in J4E exceeding the continuous thermal line rating by 121%. This is a known problem and load flow studies assumed that plans are in place to upgrade these two circuits.

3.3.1 Case 1: Loss of FIT and South Kent Generations

The loss of the entire wind generation in the Chatham-Kent-Essex area totaling 486.2 MW is considered to be the most onerous condition that can be envisaged as the loss of the wind farms or multiples thereof will be within acceptable boundary case limits. Study results of this case are given in Table 3 below showing bus voltages at customer stations and the percentage voltage changes. A maximum voltage increase of 7.0 % is obtained at South Kent Sattern and Railbed 34.5 kV buses and these voltage increases are well within the voltage change guideline of less than 10% following the worst contingency. This is due to the largest single 270 MW loss at this customer generating station Before Under-Load Tap Changer (BULTC) action. Chatham-Kent-Essex area load customers will experience less than a 2.4 % voltage change.

Table 3
Case 1: Total Loss of FIT and South Kent Generations

No.	Station Bus	Base Case Condition (kV)	Loss of 486.2 MW from FIT & Sth Kent Ges. (kV)		Voltage Change (%)	
			BULTC	AULTC	BULTC	AULTC
1	Chatham 230 kV	243.9	249.4	248.6	2.3	1.9
2	Buchanan 230 kV	243.5	245.5	244.5	0.8	0.4
3	Longwood 230 kV	248.3	250.0	248.6	0.7	0.1
4	Edgeware W44LC 230 kV	242.6	244.5	243.6	0.8	0.4
	Edgeware W45LC 230 kV	242.6	244.6	243.7	0.8	0.4
	Edgeware B 27.6 kV	29.4	29.7	29.2	0.9	-0.7
	Edgeware Y 27.6 kV	29.3	29.5	29.1	0.9	-0.7
5	Keith 230 kV	235.0	236.4	236.2	0.6	0.5
	Keith 115 kV	123.4	124.1	124.0	0.6	0.5
	Keith BY 27.6 kV	29.6	29.8	29.4	0.6	-0.7
6	Essex 115 kV	122.3	123.3	123.2	0.8	0.7
	Essex B1-4 27.6 kV	29.3	29.5	29.5	0.8	0.7
7	Malden C21J 230 kV	235.1	236.7	236.5	0.7	0.6
	Malden C22J 230 kV	235.2	236.8	236.5	0.7	0.6
	Malden B 27.6 kV	29.3	29.5	29.5	0.7	0.6
	Malden Y 27.6 kV	29.4	29.6	29.6	0.7	0.6
8	Crawford J3E 115 kV	122.6	123.5	123.3	0.7	0.6
	Crawford J4E 115 kV	122.6	123.5	123.4	0.7	0.6
	Crawford EY 27.6 kV	28.6	28.8	28.8	0.8	0.6
9	Walker Z1E 115 kV	122.3	123.3	123.2	0.9	0.7
	Walker Z7E 115 kV	122.3	123.3	123.2	0.9	0.7
	Walker #1 EQ 27.6 kV	29.4	29.7	29.3	0.9	-0.6
	Walker #2 BY 27.6 kV	29.4	29.6	29.6	0.9	0.7
10	Ford EEP Z1E 115 kV	122.4	123.7	123.5	1.0	0.9

	Ford EEP Z7E 115 kV	122.4	123.7	123.5	1.0	0.9
	Ford EEP ESS 13.8 kV	14.8	14.9	14.7	1.0	-0.4
11	Ford E8F 115 kV	122.3	123.3	123.1	0.8	0.7
	Ford E9F 115 kV	122.4	123.3	123.2	0.8	0.7
	Ford WIN 27.6 kV	29.0	29.2	29.2	0.8	0.7
12	Ford Annex E8F 115 kV	122.3	123.3	123.2	0.8	0.7
	Ford Annex E9F 115 kV	122.4	123.4	123.2	0.8	0.7
	Ford Annex 13.8 kV	14.7	14.8	14.6	0.8	-0.1
13	GM Motors E8F 115 kV	122.3	123.3	123.2	0.8	0.7
	GM Motors E9F 115 kV	122.4	123.4	123.2	0.8	0.7
	GM Motors 27.6 kV	29.5	29.7	29.3	0.8	-0.5
14	Chrysler E8F 115 kV	122.3	123.3	123.2	0.8	0.7
	Chrysler E9F 115 kV	122.3	123.3	123.2	0.8	0.7
	Chrysler 27.6 kV	29.4	29.7	29.4	0.8	-0.1
15	East Windsor E8F 115 kV	122.3	123.2	123.1	0.8	0.7
	East Windsor E9F 115 kV	122.3	123.3	123.2	0.8	0.7
16	Lauzon C23Z 230 kV	232.0	236.0	235.4	1.7	1.5
	Lauzon C24Z 230 kV	231.4	235.2	234.7	1.6	1.4
	Lauzon 115 kV	122.5	123.8	123.7	1.1	0.9
	Lauzon BQ 27.6 kV	29.6	30.1	29.3	1.8	-0.9
	Lauzon EJ 27.6 kV	29.6	30.1	29.3	1.7	-0.9
17	Belle River K2Z 115 kV	122.6	123.9	123.7	1.1	0.9
	Belle River K6Z 115 kV	122.0	123.5	123.3	1.3	1.1
	Belle River 27.6 kV	28.9	29.2	28.8	1.1	-0.3
18	Kingsville K2Z 115 kV	117.8	118.7	118.6	0.8	0.7
	Kingsville K6Z 115 kV	120.0	121.6	121.4	1.3	1.2
	Kingsville 27.6 kV	28.6	29.0	28.9	1.1	1.0
19	Tilbury 115 kV	119.1	120.3	120.1	0.9	0.8
	Tilbury 27.6 kV	29.5	29.8	29.4	1.0	-0.4
	Tilbury West 115 kV	119.1	120.3	120.1	0.9	0.8
	Tilbury West WB1 27.6 kV	29.4	29.7	29.5	1.0	0.0
	Tilbury West WB2 27.6 kV	29.4	29.7	29.5	1.0	0.0
20	Port Alma 1/2 C24Z 230 kV	238.4	243.2	242.6	2.0	1.8
	Port Alma 1 34.5 kV	34.7	35.1	35.1	1.3	1.1
	Port Alma 2 34.5 kV	34.7	35.1	35.1	1.3	1.1
21	Dillon C23Z 230 kV	241.2	246.6	245.9	2.3	1.9
	Dillon 34.5 kV	35.9	36.6	36.5	2.1	1.7
22	Spence W45LC 230 kV	244.8	249.3	248.5	1.9	1.5
	Spence 34.5 kV	35.6	35.8	35.8	0.7	0.5
23	Gosfield K2Z 115 kV	118.2	119.1	119.0	0.8	0.6
	Gosfield 34.5 kV	34.2	34.4	34.3	0.5	0.4
24	Comber West C23Z 230 kV	236.5	241.7	241.1	2.2	1.9
	Comber West 34.5 kV	34.3	35.4	35.3	3.2	2.9
25	Comber East C24Z 230 kV	235.8	240.5	239.9	2.0	1.7
	Comber East 34.5 kV	34.3	35.3	35.2	2.9	2.7
26	Pointe-Aux-Roches K6Z 115 kV	121.8	123.4	123.2	1.3	1.1
	Pointe Aux Roches 34.5 kV	33.6	34.9	34.8	3.8	3.7
27	South Kent Wind Farm 230 kV	241.9	249.0	246.9	2.9	2.0
	Sth Kent Sattern 34.5 kV	37.4	39.4	37.4	5.3	0.1
	Sth kent Railbed 34.5 kV	37.9	40.5	37.8	7.0	0.0

Notes: (1) BULTC = Before *under-load tap-changer* (ULTC) operation to restore low tension-load bus voltages
(2) AULTC = After *under-load tap-changer* (ULTC) operation to restore low tension-load bus voltages
(3) Constant load model was used in the study.

3.3.2 Case 2: Loss of C24Z

The loss of 230 kV C24Z would shut down Port Alma 1 and 2 and Comber East Wind Farms totaling 285.2 MW. However these wind farms have the options to transfer their generating power onto C23Z by closing their disconnect switches as discussed in Section 3.3 above. This would result in power injected into C23Z from Port Alma 1 and 2, Dillon RWEC and Comber East and West. Load flow studies showed power flowing from Lauzon TS to Chatham SS causing the line section between Dillon RWEC Jct. to Chatham SS to attain 75 % of the line rating as summarized in Table 4 below.

However in the event that power flow is reversed (i.e. flowing from Chatham SS towards Lauzon TS), then total power injected into C23Z from the FIT program and South Kent generations must be limited to the line rating of 1,410 Amps or 561.7 MVA to avert thermal line overloading of this circuit.

Table 4
Thermal Loadings of 230 kV C23Z Circuit

No.	*C23Z Line Segments*	*Thermal Line Loadings (%)*
		C23Z Circuit
1	Chatham SS x Dillon RWEC Jct.	75
2	Dillon RWEC Jct x KEPA Wind Farm Jct.	62
3	KEPA Wind Farm Jct x Comber West Jct	18
4	Comber West Jct x Sandwich Jct.	14
5	Sandwich Jct. x Lauzon TS	13

Note: The 80.9 km, 230 kV Chatham-Lauzon C23Z circuit is strung with 1192.5 kcmil, 54/19 ACSR conductor. It has a continuous winter rating of 1,410 Amps at 4 km/hr wind, 0^oC and 97^oC operating temperature.

3.3.3 Case 3: Loss Keith T11 Autotransformer

The Chatham-Kent-Essex area encompasses two continuous 230 kV and 115 kV transmission paths between Keith TS and Lauzon TS as shown in Fig. 1. The incorporation of FIT and South Kent generations are seen to result in an increase in flows on Keith T11 and T12 and Lauzon T1 and T2 autotransformers because of the continuous 115 kV transmission path between Keith TS and Lauzon TS. There is no import/export to Michigan on the J5D (Keith TS x Waterman TS) tie-line in this study scenario.

Voltage declines are seen to be less than 1% following a single contingency loss of Keith T11 autotransformer as shown in Table 5. This is because MW and Mvar supports are provided at 115 kV by Brighton Beach Power, West Windsor Power, East Windsor Cogeneration, Pointe-Aux-Roches and Gosfield wind generations so that Keith and Lauzon autotransformers operate within their thermal ratings.

Table 5
Case 3: Loss of Keith T11 Autotransformer

No.	*Station Bus*	*Base Case Condition (kV)*	*Loss of Keith T11 Autotransformer*		*Voltage Change (%)*	
			BULTC	*AULTC*	*BULTC*	*AULTC*
1	Chatham 230 kV	243.9	243.9	243.9	0.0	0.0
2	Buchanan 230 kV	243.5	243.5	243.5	0.0	0.0
3	Longwood 230 kV	248.3	248.3	248.3	0.0	0.0

4	Edgeware W44LC 230 kV	242.6	242.6	242.6	0.0	0.0
	Edgeware W45LC 230 kV	242.6	242.7	242.7	0.0	0.0
	Edgeware B 27.6 kV	29.4	29.4	29.4	0.0	0.0
	Edgeware Y 27.6 kV	29.3	29.3	29.3	0.0	0.0
5	Keith 230 kV	235.0	235.6	235.6	0.3	0.3
	Keith 115 kV	123.4	122.9	122.9	-0.4	-0.4
	Keith BY 27.6 kV	29.6	29.7	29.5	0.3	-0.3
6	Essex 115 kV	122.3	122.0	122.0	-0.3	-0.3
	Essex B1-4 27.6 kV	29.3	29.2	29.2	-0.3	-0.3
7	Malden C21J 230 kV	235.1	235.7	235.7	0.2	0.2
	Malden C22J 230 kV	235.2	235.7	235.7	0.2	0.2
	Malden B 27.6 kV	29.3	29.4	29.4	0.3	0.3
	Malden Y 27.6 kV	29.4	29.5	29.5	0.3	0.3
8	Crawford J3E 115 kV	122.6	122.2	122.2	-0.3	-0.3
	Crawford J4E 115 kV	122.6	122.2	122.2	-0.3	-0.3
	Crawford EY 27.6 kV	28.6	28.5	28.5	-0.3	-0.3
9	Walker Z1E 115 kV	122.3	122.0	122.0	-0.3	-0.3
	Walker Z7E 115 kV	122.3	122.0	122.0	-0.3	-0.3
	Walker #1 EQ 27.6 kV	29.4	29.4	29.4	-0.3	-0.3
	Walker #2 BY 27.6 kV	29.4	29.3	29.3	-0.3	-0.3
10	Ford EEP Z1E 115 kV	122.4	122.2	122.2	-0.2	-0.2
	Ford EEP Z7E 115 kV	122.4	122.2	122.2	-0.2	-0.2
	Ford EEP ESS 13.8 kV	14.8	14.8	14.8	-0.2	-0.2
11	Ford E8F 115 kV	122.3	122.0	122.0	-0.3	-0.3
	Ford E9F 115 kV	122.4	122.0	122.0	-0.3	-0.3
	Ford WIN 27.6 kV	29.0	28.9	28.9	-0.3	-0.3
12	Ford Annex E8F 115 kV	122.3	122.0	122.0	-0.3	-0.3
	Ford Annex E9F 115 kV	122.4	122.0	122.0	-0.3	-0.3
	Ford Annex 13.8 kV	14.7	14.6	14.6	-0.3	-0.3
13	GM Motors E8F 115 kV	122.3	122.0	122.0	-0.3	-0.3
	GM Motors E9F 115 kV	122.4	122.0	122.0	-0.3	-0.3
	GM Motors 27.6 kV	29.5	29.4	29.4	-0.3	-0.3
14	Chrysler E8F 115 kV	122.3	122.0	122.0	-0.3	-0.3
	Chrysler E9F 115 kV	122.3	122.0	122.0	-0.3	-0.3
	Chrysler 27.6 kV	29.4	29.4	29.4	-0.3	-0.3
15	East Windsor E8F 115 kV	122.3	121.9	121.9	-0.3	-0.3
	East Windsor E9F 115 kV	122.3	122.0	122.0	-0.3	-0.3
16	Lauzon C23Z 230 kV	232.0	231.7	231.7	-0.1	-0.1
	Lauzon C24Z 230 kV	231.4	231.1	231.1	-0.1	-0.1
	Lauzon 115 kV	122.5	122.3	122.3	-0.2	-0.2
	Lauzon BQ 27.6 kV	29.6	29.6	29.6	-0.1	-0.1
	Lauzon EJ 27.6 kV	29.6	29.5	29.5	-0.1	-0.1
17	Belle River K2Z 115 kV	122.6	122.3	122.3	-0.2	-0.2
	Belle River K6Z 115 kV	122.0	121.7	121.7	-0.2	-0.2
	Belle River 27.6 kV	28.9	28.8	28.8	-0.2	-0.2
18	Kingsville K2Z 115 kV	117.8	117.6	117.6	-0.2	-0.2
	Kingsville K6Z 115 kV	120.0	119.8	119.8	-0.2	-0.2
	Kingsville 27.6 kV	28.6	28.6	28.6	-0.2	-0.2
19	Tilbury 115 kV	119.1	118.9	118.9	-0.2	-0.2
	Tilbury 27.6 kV	29.5	29.5	29.5	-0.2	-0.2
	Tilbury West 115 kV	119.1	118.9	118.9	-0.2	-0.2
	Tilbury West WB1 27.6 kV	29.4	29.4	29.4	-0.2	-0.2
	Tilbury West WB2 27.6 kV	29.4	29.4	29.4	-0.2	-0.2
20	Port Alma 1/2 C24Z 230 kV	238.4	238.4	238.4	0.0	0.0

	Port Alma 1 34.5 kV	34.7	34.7	34.7	0.0	0.0
	Port Alma 2 34.5 kV	34.7	34.7	34.7	0.0	0.0
21	Dillon C23Z 230 kV	241.2	241.2	241.2	0.0	0.0
	Dillon 34.5 kV	35.9	35.9	35.9	0.0	0.0
22	Spence W45LC 230 kV	244.8	244.8	244.8	0.0	0.0
	Spence 34.5 kV	35.6	35.6	35.6	0.0	0.0
23	Gosfield K2Z 115 kV	118.2	118.0	118.0	-0.2	-0.2
	Gosfield 34.5 kV	34.2	34.1	34.2	-0.1	-0.1
24	Comber West C23Z 230 kV	236.5	236.4	236.4	-0.1	-0.1
	Comber West 34.5 kV	34.3	34.3	34.3	0.0	0.0
25	Comber East C24Z 230 kV	235.8	235.7	235.7	-0.1	-0.1
	Comber East 34.5 kV	34.3	34.3	34.3	0.0	0.0
26	Pointe-Aux-Roches K6Z 115 kV	121.8	121.6	121.6	-0.2	-0.2
	Pointe Aux Roches 34.5 kV	33.6	33.5	33.5	-0.1	-0.1
27	South Kent Wind Farm 230 kV	241.9	242.0	242.0	0.0	0.0
	Sth Kent Sattern 34.5 kV	37.4	37.4	37.4	0.0	0.0
	Sth kent Railbed 34.5 kV	37.9	37.9	37.9	0.0	0.0

Notes: (1) BULTC = Before *under-load tap-changer* (ULTC) operation to restore low tension-load bus voltages
(2) AULTC = After *under-load tap-changer* (ULTC) operation to restore low tension-load bus voltages
(3) Constant load model was used in the study.

3.3.5 Case 4: Loss Lauzon T1 Autotransformer

The loss of Lauzon T1 autotransformer exhibit similar voltage declines and this contingency is studied and included in the Report for completeness (see Table 6).

Table 6
Case 4: Loss of Lauzon T1 Autotransformer

No.	*Station Bus*	*Base Case Condition (kV)*	*Loss of Lauzon T1 Autotransformer*		*Voltage Change (%)*	
			BULTC	*AULTC*	*BULTC*	*AULTC*
1	Chatham 230 kV	243.9	244.3	244.2	0.2	0.1
2	Buchanan 230 kV	243.5	243.6	243.6	0.0	0.0
3	Longwood 230 kV	248.3	248.4	248.4	0.0	0.0
4	Edgeware W44LC 230 kV	242.6	242.7	242.7	0.0	0.0
	Edgeware W45LC 230 kV	242.6	242.8	242.7	0.0	0.0
	Edgeware B 27.6 kV	29.4	29.4	29.4	0.0	0.0
	Edgeware Y 27.6 kV	29.3	29.3	29.3	0.0	0.0
5	Keith 230 kV	235.0	234.9	234.9	0.0	-0.1
	Keith 115 kV	123.4	123.0	123.0	-0.3	-0.3
	Keith BY 27.6 kV	29.6	29.6	29.6	0.0	-0.1
6	Essex 115 kV	122.3	121.7	121.7	-0.5	-0.5
	Essex B1-4 27.6 kV	29.3	29.1	29.1	-0.5	-0.5
7	Malden C21J 230 kV	235.1	235.0	235.0	0.0	-0.1
	Malden C22J 230 kV	235.2	235.1	235.0	0.0	-0.1
	Malden B 27.6 kV	29.3	29.3	29.3	0.0	-0.1
	Malden Y 27.6 kV	29.4	29.4	29.4	0.0	-0.1
8	Crawford J3E 115 kV	122.6	122.1	122.1	-0.4	-0.4
	Crawford J4E 115 kV	122.6	122.1	122.1	-0.4	-0.4
	Crawford EY 27.6 kV	28.6	28.5	28.5	-0.4	-0.4
9	Walker Z1E 115 kV	122.3	121.7	121.6	-0.5	-0.5

	Walker Z7E 115 kV	122.3	121.7	121.6	-0.5	-0.5
	Walker #1 EQ 27.6 kV	29.4	29.3	29.3	-0.5	-0.6
	Walker #2 BY 27.6 kV	29.4	29.2	29.2	-0.5	-0.5
10	Ford EEP Z1E 115 kV	122.4	121.7	121.6	-0.6	-0.6
	Ford EEP Z7E 115 kV	122.4	121.7	121.6	-0.6	-0.6
	Ford EEP ESS 13.8 kV	14.8	14.7	14.7	-0.6	-0.7
11	Ford E8F 115 kV	122.3	121.7	121.7	-0.5	-0.5
	Ford E9F 115 kV	122.4	121.8	121.7	-0.5	-0.5
	Ford WIN 27.6 kV	29.0	28.8	28.8	-0.5	-0.5
12	Ford Annex E8F 115 kV	122.3	121.7	121.7	-0.5	-0.5
	Ford Annex E9F 115 kV	122.4	121.8	121.7	-0.5	-0.5
	Ford Annex 13.8 kV	14.7	14.6	14.6	-0.5	-0.5
13	GM Motors E8F 115 kV	122.3	121.7	121.7	-0.5	-0.5
	GM Motors E9F 115 kV	122.4	121.8	121.7	-0.5	-0.5
	GM Motors 27.6 kV	29.5	29.3	29.3	-0.5	-0.5
14	Chrysler E8F 115 kV	122.3	121.7	121.7	-0.5	-0.5
	Chrysler E9F 115 kV	122.3	121.7	121.7	-0.5	-0.5
	Chrysler 27.6 kV	29.4	29.3	29.3	-0.5	-0.5
15	East Windsor E8F 115 kV	122.3	121.7	121.6	-0.5	-0.5
	East Windsor E9F 115 kV	122.3	121.7	121.7	-0.5	-0.5
16	Lauzon C23Z 230 kV	232.0	237.2	237.1	2.2	2.2
	Lauzon C24Z 230 kV	231.4	231.1	231.0	-0.1	-0.2
	Lauzon 115 kV	122.5	121.7	121.7	-0.7	-0.7
	Lauzon BQ 27.6 kV	29.6	29.9	29.5	1.1	-0.2
	Lauzon EJ 27.6 kV	29.6	29.9	29.5	1.0	-0.2
17	Belle River K2Z 115 kV	122.6	121.8	121.8	-0.7	-0.7
	Belle River K6Z 115 kV	122.0	121.2	121.2	-0.6	-0.6
	Belle River 27.6 kV	28.9	28.7	28.7	-0.6	-0.7
18	Kingsville K2Z 115 kV	117.8	117.2	117.2	-0.5	-0.5
	Kingsville K6Z 115 kV	120.0	119.2	119.2	-0.6	-0.6
	Kingsville 27.6 kV	28.6	28.5	28.5	-0.6	-0.6
19	Tilbury 115 kV	119.1	118.4	118.4	-0.6	-0.6
	Tilbury 27.6 kV	29.5	29.3	29.3	-0.6	-0.6
	Tilbury West 115 kV	119.1	118.4	118.4	-0.6	-0.6
	Tilbury West WB1 27.6 kV	29.4	29.3	29.3	-0.6	-0.6
	Tilbury West WB2 27.6 kV	29.4	29.3	29.3	-0.6	-0.6
20	Port Alma 1/2 C24Z 230 kV	238.4	238.5	238.5	0.1	0.0
	Port Alma 1 34.5 kV	34.7	34.7	34.7	0.0	0.0
	Port Alma 2 34.5 kV	34.7	34.7	34.7	0.0	0.0
21	Dillon C23Z 230 kV	241.2	242.2	242.2	0.4	0.4
	Dillon 34.5 kV	35.9	35.9	35.9	0.2	0.2
22	Spence W45LC 230 kV	244.8	245.1	245.0	0.1	0.1
	Spence 34.5 kV	35.6	35.6	35.6	0.0	0.0
23	Gosfield K2Z 115 kV	118.2	117.6	117.6	-0.5	-0.5
	Gosfield 34.5 kV	34.2	34.1	34.1	-0.3	-0.3
24	Comber West C23Z 230 kV	236.5	239.3	239.3	1.2	1.2
	Comber West 34.5 kV	34.3	34.6	34.6	0.8	0.8
25	Comber East C24Z 230 kV	235.8	235.8	235.7	0.0	0.0
	Comber East 34.5 kV	34.3	34.3	34.3	0.0	0.0
26	Pointe-Aux-Roches K6Z 115 kV	121.8	121.0	121.0	-0.6	-0.6
	Pointe Aux Roches 34.5 kV	33.6	33.5	33.4	-0.4	-0.4
27	South Kent Wind Farm 230 kV	241.9	242.3	241.9	0.2	0.0
	Sth Kent Sattern 34.5 kV	37.4	37.4	37.4	0.1	0.0
	Sth kent Railbed 34.5 kV	37.9	37.9	37.9	0.1	0.0

Notes: (1) BULTC = Before *under-load tap-changer* (ULTC) operation to restore low tension-load bus voltages
(2) AULTC = After *under-load tap-changer* (ULTC) operation to restore low tension-load bus voltages
(3) Constant load model was used in the study.

3.4 Scenario II: Maximum Import from Michigan

For Scenario II, the studies assumed zero generation from Brighton Beach Power, West TransAlta and West Windsor Power when importing 100 MW from Michigan on the J5D (Keith TS x Waterman TS) tie-line. Studies show that for the contingency loss of the entire FIT and South Kent generations, the post-contingency voltage declines for customers in the Chatham-Kent-Essex area are within acceptable levels as shown in Table 7. Pointe-Aux-Roches and Gosfield generations are seen to provide post-contingency voltage support to the 115 kV area-customers.

Table 7
Case 5: Loss of FIT and South Kent Generations

No.	*Station Bus*	*Base Case Condition (kV)*	*Loss of 486.2 MW from FIT & Sth Kent Gens (kV)*		*Voltage Change (%)*	
			BULTC	*AULTC*	*BULTC*	*AULTC*
1	Chatham 230 kV	244.9	250.5	252.1	2.3	2.9
2	Buchanan 230 kV	243.3	245.0	244.6	0.7	0.5
3	Longwood 230 kV	247.4	248.9	248.0	0.6	0.3
4	Edgeware W44LC 230 kV	242.3	244.1	243.7	0.7	0.6
	Edgeware W45LC 230 kV	242.4	244.2	243.8	0.7	0.6
	Edgeware B 27.6 kV	29.4	29.6	29.6	0.8	0.6
	Edgeware Y 27.6 kV	29.2	29.5	29.4	0.8	0.6
5	Keith 230 kV	234.8	237.8	243.0	1.3	3.5
	Keith 115 kV	123.9	125.9	128.1	1.6	3.4
	Keith BY 27.6 kV	29.4	29.8	29.5	1.3	0.6
6	Essex 115 kV	123.1	125.1	127.1	1.6	3.2
	Essex B1-4 27.6 kV	29.5	30.0	29.4	1.6	-0.2
7	Malden C21J 230 kV	235.1	238.3	243.2	1.4	3.5
	Malden C22J 230 kV	235.1	238.3	243.2	1.4	3.5
	Malden B 27.6 kV	29.3	29.8	29.3	1.4	0.0
	Malden Y 27.6 kV	29.4	29.8	29.4	1.4	0.0
8	Crawford J3E 115 kV	123.3	125.3	127.3	1.6	3.2
	Crawford J4E 115 kV	123.3	125.3	127.6	1.6	3.5
	Crawford EY 27.6 kV	28.8	29.3	29.0	1.7	0.6
9	Walker Z1E 115 kV	123.1	125.1	127.1	1.6	3.2
	Walker Z7E 115 kV	123.1	125.1	127.1	1.6	3.2
	Walker #1 EQ 27.6 kV	29.3	29.8	29.4	1.7	0.6
	Walker #2 BY 27.6 kV	29.5	30.0	29.4	1.6	-0.6
10	Ford EEP Z1E 115 kV	123.2	125.4	127.3	1.7	3.3
	Ford EEP Z7E 115 kV	123.2	125.4	127.3	1.7	3.3
	Ford EEP ESS 13.8 kV	14.7	15.0	14.6	1.8	-0.6
11	Ford E8F 115 kV	123.1	125.0	127.0	1.6	3.2
	Ford E9F 115 kV	123.1	125.1	127.1	1.6	3.2
	Ford WIN 27.6 kV	29.2	29.6	30.1	1.6	3.3
12	Ford Annex E8F 115 kV	123.1	125.1	127.0	1.6	3.2
	Ford Annex E9F 115 kV	123.1	125.1	127.1	1.6	3.2
	Ford Annex 13.8 kV	14.6	14.9	14.7	1.6	0.6

13	GM Motors E8F 115 kV	123.1	125.1	127.1	1.6	3.2
	GM Motors E9F 115 kV	123.2	125.1	127.1	1.6	3.2
	GM Motors 27.6 kV	29.5	30.0	29.5	1.6	0.0
14	Chrysler E8F 115 kV	123.1	125.1	127.1	1.6	3.2
	Chrysler E9F 115 kV	123.1	125.1	127.1	1.6	3.2
	Chrysler 27.6 kV	29.4	29.9	29.5	1.7	0.3
15	East Windsor E8F 115 kV	123.0	125.0	127.0	1.6	3.2
	East Windsor E9F 115 kV	123.1	125.0	127.0	1.6	3.2
16	Lauzon C23Z 230 kV	232.5	237.7	240.5	2.2	3.4
	Lauzon C24Z 230 kV	231.3	236.2	239.0	2.1	3.3
	Lauzon 115 kV	123.3	125.5	127.4	1.8	3.3
	Lauzon BQ 27.6 kV	29.6	30.3	29.6	2.3	-0.1
	Lauzon EJ 27.6 kV	29.6	30.3	29.6	2.2	-0.1
17	Belle River K2Z 115 kV	123.4	125.6	127.4	1.8	3.2
	Belle River K6Z 115 kV	122.7	125.2	126.4	2.0	3.0
	Belle River 27.6 kV	29.1	29.6	28.8	1.8	-1.0
18	Kingsville K2Z 115 kV	118.3	119.9	123.6	1.3	4.5
	Kingsville K6Z 115 kV	120.7	123.2	123.2	2.1	2.1
	Kingsville 27.6 kV	28.8	29.3	29.0	1.8	0.6
19	Tilbury 115 kV	119.8	121.7	124.4	1.6	3.9
	Tilbury 27.6 kV	29.3	29.8	29.4	1.6	0.1
	Tilbury West 115 kV	119.8	121.7	124.4	1.6	3.9
	Tilbury West WB1 27.6 kV	29.4	29.9	29.3	1.6	-0.2
	Tilbury West WB2 27.6 kV	29.4	29.9	29.3	1.6	-0.2
20	Port Alma 1/2 C24Z 230 kV	238.6	243.5	245.5	2.1	2.9
	Port Alma 1 34.5 kV	34.7	35.1	35.3	1.3	1.9
	Port Alma 2 34.5 kV	35.5	36.0	35.9	1.5	1.1
21	Dillon C23Z 230 kV	242.1	247.7	249.6	2.3	3.1
	Dillon 34.5 kV	35.9	36.8	37.1	2.4	3.3
22	Spence W45LC 230 kV	246.0	250.3	251.2	1.8	2.1
	Spence 34.5 kV	35.6	35.9	35.9	0.6	0.8
23	Gosfield K2Z 115 kV	118.7	120.3	123.8	1.3	4.2
	Gosfield 34.5 kV	34.3	34.6	35.6	0.8	3.8
24	Comber West C23Z 230 kV	237.2	243.0	245.3	2.5	3.5
	Comber West 34.5 kV	34.4	35.6	35.9	3.5	4.5
25	Comber East C24Z 230 kV	235.7	240.8	243.1	2.2	3.1
	Comber East 34.5 kV	34.3	35.3	35.7	3.1	4.1
26	Pointe-Aux-Roches K6Z 115 kV	122.5	125.0	126.1	2.0	2.9
	Pointe Aux Roches 34.5 kV	33.7	35.3	35.6	4.8	5.7
27	South Kent Wind Farm 230 kV	243.4	250.7	252.3	3.0	3.7
	Sth Kent Sattern 34.5 kV	35.8	-	-	-	-
	Sth kent Railbed 34.5 kV	35.3	-	-	-	-

Notes: (1) BULTC = Before *under-load tap-changer* (ULTC) operation to restore low tension-load bus voltages
(2) AULTC = After *under-load tap-changer* (ULTC) operation to restore low tension-load bus voltages
(3) Constant load model was used in the study.

3.5 Scenario III: Maximum Export to Michigan

When 100 MW of power is exported on J5D (Keith TS x Waterman TS) tie-line, the loss of FIT and South Kent generations will result in a post-contingency configuration that would leave all 115 kV customers to be supplied between Keith TS and Lauzon TS. Normally this contingency would initiate operation of the Windsor Overload Protection Scheme (**OPS**) and reject Kingsville and Tilbury loads. This is to ensure that the Windsor-area voltage is kept to within minimum continuous levels of 220 kV and 113 kV for the 230 kV and 115 kV systems (Ref. *Market Rules for the Ontario Electricity Market, Issue 6.2 – May 22, 2001, Appendix 4.1-1*). Studies showed that the Brighton Beach Power, West TransAlta, West Windsor Power, Pristine East Windsor Cogen, Pointe-Aux-Roches and Gosfield generations will prevent the Windsor OPS from operating as shown in Table 8 below.

Table 8
Case 6: Loss of FIT and South Kent Generations

No.	Station Bus	Base Case Condition (kV)	Loss of 486.2 MW from FIT & Sth Kent Gens (kV)		Voltage Change (%)	
			BULTC	AULTC	BULTC	AULTC
1	Chatham 230 kV	244.2	249.6	249.2	2.2	2.1
2	Buchanan 230 kV	243.3	245.2	244.3	0.7	0.4
3	Longwood 230 kV	247.5	249.1	247.8	0.6	0.1
4	Edgeware W44LC 230 kV	242.4	244.2	243.4	0.8	0.4
	Edgeware W45LC 230 kV	242.5	244.3	243.4	0.8	0.4
	Edgeware B 27.6 kV	29.4	29.6	29.5	0.8	0.4
	Edgeware Y 27.6 kV	29.2	29.5	29.4	0.8	0.4
5	Keith 230 kV	234.9	236.5	236.4	0.7	0.6
	Keith 115 kV	123.3	124.1	124.1	0.7	0.6
	Keith BY 27.6 kV	29.4	29.6	29.6	0.7	0.6
6	Essex 115 kV	122.4	123.4	123.3	0.8	0.8
	Essex B1-4 27.6 kV	29.3	29.5	29.5	0.8	0.8
7	Malden C21J 230 kV	235.1	236.9	236.7	0.7	0.7
	Malden C22J 230 kV	235.2	236.9	236.8	0.7	0.7
	Malden B 27.6 kV	29.3	29.6	29.6	0.8	0.7
	Malden Y 27.6 kV	29.4	29.6	29.6	0.8	0.7
8	Crawford J3E 115 kV	122.6	123.5	123.4	0.7	0.7
	Crawford J4E 115 kV	122.6	123.5	123.5	0.7	0.7
	Crawford EY 27.6 kV	28.6	28.8	28.8	0.8	0.7
9	Walker Z1E 115 kV	122.3	123.4	123.3	0.9	0.8
	Walker Z7E 115 kV	122.3	123.4	123.3	0.9	0.8
	Walker #1 EQ 27.6 kV	29.5	29.7	29.3	0.9	-0.5
	Walker #2 BY 27.6 kV	29.4	29.6	29.6	0.9	0.8
10	Ford EEP Z1E 115 kV	122.5	123.7	123.7	1.0	0.9
	Ford EEP Z7E 115 kV	122.5	123.7	123.7	1.0	0.9
	Ford EEP ESS 13.8 kV	14.6	14.8	14.8	1.0	1.0
11	Ford E8F 115 kV	122.3	123.4	123.3	0.8	0.8
	Ford E9F 115 kV	122.4	123.4	123.3	0.8	0.8
	Ford WIN 27.6 kV	29.0	29.2	29.2	0.9	0.8
12	Ford Annex E8F 115 kV	122.3	123.4	123.3	0.8	0.8
	Ford Annex E9F 115 kV	122.4	123.4	123.3	0.8	0.8
	Ford Annex 13.8 kV	14.7	14.8	14.7	0.8	-0.1
13	GM Motors E8F 115 kV	122.3	123.4	123.3	0.8	0.8
	GM Motors E9F 115 kV	122.4	123.4	123.4	0.8	0.8
	GM Motors 27.6 kV	29.3	29.5	29.3	0.8	0.2
14	Chrysler E8F 115 kV	122.4	123.4	123.3	0.8	0.8
	Chrysler E9F 115 kV	122.4	123.4	123.3	0.8	0.8
	Chrysler 27.6 kV	29.4	29.6	29.4	0.9	0.0
15	East Windsor E8F 115 kV	122.3	123.3	123.2	0.8	0.8
	East Windsor E9F 115 kV	122.3	123.4	123.3	0.8	0.8
16	Lauzon C23Z 230 kV	232.1	236.1	235.8	1.7	1.6

	Lauzon C24Z 230 kV	231.3	235.0	234.7	1.6	1.5
	Lauzon 115 kV	122.6	123.9	123.8	1.1	1.0
	Lauzon BQ 27.6 kV	29.6	30.1	29.4	1.8	-0.8
	Lauzon EJ 27.6 kV	29.6	30.1	29.3	1.7	-0.8
17	Belle River K2Z 115 kV	122.7	124.0	123.9	1.1	1.0
	Belle River K6Z 115 kV	122.0	123.6	123.5	1.3	1.2
	Belle River 27.6 kV	28.9	29.2	28.8	1.2	-0.3
18	Kingsville K2Z 115 kV	117.8	118.7	118.7	0.8	0.7
	Kingsville K6Z 115 kV	120.0	121.7	121.6	1.4	1.3
	Kingsville 27.6 kV	28.6	29.0	29.0	1.1	1.1
19	Tilbury 115 kV	119.2	120.3	120.2	1.0	0.9
	Tilbury 27.6 kV	29.5	29.8	29.4	1.0	-0.3
	Tilbury West 115 kV	119.2	120.3	120.2	1.0	0.9
	Tilbury West WB1 27.6 kV	29.5	29.7	29.5	1.0	0.1
	Tilbury West WB2 27.6 kV	29.5	29.8	29.5	1.0	0.1
20	Port Alma 1/2 C24Z 230 kV	238.1	242.7	242.5	1.9	1.9
	Port Alma 1 34.5 kV	34.6	35.0	35.0	1.2	1.2
	Port Alma 2 34.5 kV	35.5	36.0	35.7	1.4	0.8
21	Dillon C23Z 230 kV	241.4	246.8	246.4	2.2	2.1
	Dillon 34.5 kV	35.9	36.6	36.6	2.1	1.9
22	Spence W45LC 230 kV	245.0	249.4	248.9	1.8	1.6
	Spence 34.5 kV	35.6	35.8	35.8	0.6	0.6
23	Gosfield K2Z 115 kV	118.2	119.1	119.1	0.8	0.7
	Gosfield 34.5 kV	34.2	34.4	34.3	0.5	0.5
24	Comber West C23Z 230 kV	236.7	241.9	241.5	2.2	2.0
	Comber West 34.5 kV	34.3	35.4	35.4	3.2	3.0
25	Comber East C24Z 230 kV	235.5	240.0	239.8	1.9	1.8
	Comber East 34.5 kV	34.3	35.2	35.2	2.8	2.7
26	Pointe-Aux-Roches K6Z 115 kV	121.9	123.4	123.3	1.3	1.2
	Pointe Aux Roches 34.5 kV	33.6	34.9	34.9	3.8	3.8
27	South Kent Wind Farm 230 kV	242.7	249.8	249.4	2.9	2.8
	Sth Kent Sattern 34.5 kV	35.7	-	-	-	-
	Sth kent Railbed 34.5 kV	35.3	-	-	-	-

Notes: (1) BULTC = Before *under-load tap-changer* (ULTC) operation to restore low tension-load bus voltages
(2) AULTC = After *under-load tap-changer* (ULTC) operation to restore low tension-load bus voltages
(3) Constant load model was used in the study.

4. SHORT-CIRCUIT STUDY ANALYSIS

4.1 Present Hydro One Network Systems

Short-circuit studies were initially carried out to determine fault levels for Chatham-Kent-Essex area Customers before any FIT and South Kent generating facilities come into service starting in 2011 and 2013 respectively. The study results are summarized in Table 9 below, showing both symmetric and asymmetric fault currents in kA. These are studies that will be used to compare with subsequent studies to calculate the percentage increase in fault level contribution when FIT and South Kent generating facilities are connected to Hydro One transmission system.

Table 9: Existing Network Fault Levels

No.	Chatham-Kent-Essex Area Customer Station Bus	Fault Levels (kA)			
		Symmetrical		Asymmetrical	
		3-Phase	L-G	3-Phase	L-G
1	Chatham 230 kV	24.30	17.72	26.48	19.35
2	Buchanan 230 kV	31.64	26.96	34.52	31.27
3	Longwood 230 kV	37.35	44.73	42.05	52.85
4	Edgeware W44LC 230 kV	11.46	8.82	12.13	9.36
	Edgeware W45LC 230 kV	11.46	8.84	12.13	9.37
	Edgeware B 27.6 kV	11.85	9.54	15.46	13.34
	Edgeware Y 27.6 kV	11.82	9.53	15.42	13.33
5	Keith 230 kV	20.34	22.35	27.43	31.09
	Keith 115 kV	27.21	32.07	36.85	45.10
	Keith BY 27.6 kV	15.50	10.97	20.99	15.60
6	Essex 115 kV	23.72	25.21	28.48	30.40
	Essex B1-4 27.6 kV	14.95	10.45	19.81	14.74
7	Malden C21J 230 kV	16.56	16.24	19.33	17.94
	Malden C22J 230 kV	16.55	16.19	19.28	17.90
	Malden B 27.6 kV	14.10	10.45	18.55	14.49
	Malden Y 27.6 kV	12.82	9.96	17.06	13.91
8	Crawford J3E 115 kV	19.78	19.34	23.14	22.55
	Crawford J4E 115 kV	19.78	18.25	23.14	19.44
	Crawford EY 27.6 kV	15.32	11.32	20.20	15.31
9	Walker Z1E 115 kV	22.36	22.94	26.24	26.34
	Walker Z7E 115 kV	22.31	22.88	26.16	26.17
	Walker #1 EQ 27.6 kV	17.31	3.50	22.85	4.99
	Walker #2 BY 27.6 kV	14.84	9.38	18.74	12.81
10	Ford EEP Z1E 115 kV	19.14	19.28	21.27	21.01
	Ford EEP Z7E 115 kV	19.13	19.28	21.26	21.00
	Ford EEP ESS 13.8 kV	18.50	9.08	23.19	12.52
11	Ford E8F 115 kV	20.06	19.70	22.47	21.64
	Ford E9F 115 kV	20.06	19.70	22.54	21.67
	Ford WIN 27.6 kV	15.99	8.92	22.04	12.21
12	Ford Annex E8F 115 kV	21.07	21.05	23.89	22.95
	Ford Annex E9F 115 kV	21.07	21.05	23.95	22.97
	Ford Annex 13.8 kV	18.69	14.89	24.89	14.89
13	GM Motors E8F 115 kV	21.85	22.18	25.04	24.36
	GM Motors E9F 115 kV	21.85	22.18	25.09	24.38
	GM Motors 27.6 kV	12.32	8.06	15.56	10.67
14	Chrysler E8F 115 kV	23.32	24.57	27.63	28.91
	Chrysler E9F 115 kV	23.32	24.57	27.65	28.92
	Chrysler 27.6 kV	11.39	7.79	15.24	10.58
15	East Windsor E8F 115 kV	19.92	19.51	22.27	21.40
	East Windsor E9F 115 kV	19.99	19.60	22.43	21.54
16	Lauzon C23Z 230 kV	7.93	7.84	9.20	9.71
	Lauzon C24Z 230 kV	7.73	7.63	8.94	9.43
	Lauzon 115 kV	21.29	23.74	23.96	28.21
	Lauzon BQ 27.6 kV	14.06	10.55	18.02	14.59
	Lauzon EJ 27.6 kV	14.62	10.72	18.21	14.56
17	Belle River K2Z 115 kV	7.48	5.06	7.91	5.24
	Belle River K6Z 115 kV	8.28	5.33	8.74	5.51
	Belle River 27.6 kV	11.63	7.95	13.47	10.25
18	Kingsville K2Z 115 kV	4.869	4.00	5.11	4.28
	Kingsville K6Z 115 kV	4.629	2.28	4.81	2.30
	Kingsville 27.6 kV	16.45	11.76	17.29	13.38
19	Tilbury 115 kV	3.50	2.35	3.54	2.39
	Tilbury 27.6 kV	1.52	0.00	1.68	0.00
	Tilbury West 115 kV	3.50	2.35	3.54	2.39
	Tilbury West WB1 27.6 kV	2.87	3.10	3.11	3.51
	Tilbury West WB2 27.6 kV	2.65	2.94	2.88	3.33

20	Port Alma 1/2 C24Z 230 kV	9.83	9.30	11.19	11.24
	Port Alma 1 34.5 kV	27.16	0.00	35.42	0.00
	Port Alma 2 34.5 kV	25.11	0.00	33.89	0.00
21	Dillon C23Z 230 kV	19.60	15.98	21.47	18.01
22	Spence W44LC 230 kV	19.92	13.83	21.54	14.95
	Spence W45LC 230 kV	13.01	10.62	13.72	11.35
23	Gosfield K2Z 115 kV	5.17	4.79	5.45	5.33

Notes:
1. Base case assumes existing & committed facilities in-service
2. Pre-fault voltages of 250 kV, 127 kV, 29 kV and 14.2 kV are assumed at 230 kV, 115 kV, 27.6 kV and 13.8 kV stations respectively

Observations made from the short-circuit study results in Table 9 above may be summarized as follows:

- Base case short-circuit studies assumed existing generating facilities in-service and therefore excludes FIT program and South Kent generations
- Pre-fault voltages of 250 kV, 127 kV, 29 kV and 14.2 kV are assumed at 230 kV, 115 kV, 27.6 kV and 13.8 kV stations respectively
- Table 9 study results show fault level increases following the incorporation of four wind farms in the Renewable Energy Supply III (RES III) program. The fault levels for most Chatham-Kent-Essex area customers will be within the Transmission System Code (TSC) maximum symmetrical three-phase and single line-to-ground (SLG) fault level limits as summarized below:

Nominal Voltage (kV)	***Max. 3-Phase Fault (kA)***	***Max. SLG Fault (kA)***
230	63	80(1)
115	50	50
27.6 (4-wire)	17(2)	12(2)
13.8	21(2)	10(2)

Notes :
(1) – Usually limited to 63 kA
(2) – Effective September 1, 2010, Hydro One requires a 5 % margin on the acceptable TSC limits at voltage levels of <50kV to account for other sources of fault current on the distribution system such as unmodelled synchronous motors and data inaccuracies.

- However the fault levels for the following stations exceed the TSC acceptable limits:
  i. The symmetrical three-phase fault level at Walker #1 EQ 27.6 kV bus is 17.31 kA (see Table 9, Row #9) and this exceeds the TSC fault limit of 17 kA. A mitigating measure is being installed to limit the fault current to within the values specified in the TSC
  ii. The symmetrical SLG fault level at Ford Annex 13.8 kV bus is 14.89 kA (see Table 9, Row #12) exceeding the 10 kA TSC fault limit. This is attributed to the low transformer data value used in the calculation. However the customer station circuit breakers are rated higher at 28 kA
  iii. The symmetrical SLG fault level at Crawford EY 27.6 kV bus is 11.32 kA (see Table 9, Row #8) and this is 5.7% less than the TSC fault limit of 12 kA. However their circuit breakers are rated higher at 15.9 kA
  iv. The symmetrical three-phase fault level at Kingsville 27.6 kV bus is 16.45 kA (see Table 9, Row #18) and this is within 5% of the 17 kA TSC fault limit.
- The studies do not model induction motors connected at customer LV buses because induction motors do not contribute to steady-state fault currents, and
- Line-to-ground fault levels at some customer LV buses are low because of high ground resistance at their stations.

4.2 Incorporation of FIT and South Kent Generations

FIT program and South Kent generations plans coming fully into service in 2011 and 2013 respectively. A series of short-circuit studies were carried out using the same study conditions as before and the results are summarized in Tables 10 - 12 for the following operating conditions:

i. Table 10: Pointe-Aux-Roches in-service
ii. Table 11: As in (i) with Comber East and West in-service
iii. Table 12: As in (ii) with South Kent Wind Farm in-service

The results in the above Tables show new projected fault levels and percentage increases as new generations are incorporated under the FIT program. Since there is a fixed relationship between symmetric and asymmetric values for a given X/R ratio, only percentage increases in the symmetric fault level conditions were calculated.

4.2.1 Incorporation of PAR Generations

Short-circuit studies were carried out for all FIT and South Kent wind projects. PAR studies were studied first as they will be going into service in Q4 of 2011 These studies are intended to identify possible short-circuit level violations at customer buses and the results are summarized in Table 10 below.

Table 10
The Incorporation of PAR Generations

No.	Chatham-Kent-Essex Area Customer Station Bus	Fault Levels (kA)				Percentage Increase (%)	
		Symmetrical		Asymmetrical		Symmetrical	
		3-Phase	L-G	3_Phase	L-G	3-Phase	L-G
1	Chatham 230 kV	24.34	17.74	26.52	19.37	0.16	0.11
2	Buchanan 230 kV	31.65	26.96	34.52	31.28	0.03	0.00
3	Longwood 230 kV	37.36	44.74	42.05	52.86	0.03	0.02
4	Edgeware W44LC 230 kV	11.44	8.83	12.13	9.36	-0.17	0.11
	Edgeware W45LC 230 kV	11.44	8.84	12.13	9.37	-0.17	0.00
	Edgeware B 27.6 kV	11.85	9.54	15.46	13.34	0.00	0.00
	Edgeware Y 27.6 kV	11.82	9.53	15.42	13.33	0.00	0.00
5	Keith 230 kV	20.39	22.40	27.49	31.14	0.25	0.22
	Keith 115 kV	27.37	32.22	37.04	45.29	0.59	0.47
	Keith BY 27.6 kV	15.50	10.97	21.00	15.60	0.00	0.00
6	Essex 115 kV	24.06	25.50	28.83	30.69	1.43	1.15
	Essex B1-4 27.6 kV	14.99	10.47	19.86	14.75	0.27	0.19
7	Malden C21J 230 kV	16.59	16.26	19.36	17.97	0.18	0.12
	Malden C22J 230 kV	16.58	16.21	19.31	17.92	0.18	0.12
	Malden B 27.6 kV	14.11	10.46	18.55	14.49	0.07	0.10
	Malden Y 27.6 kV	12.82	9.97	17.06	13.91	0.00	0.10
8	Crawford J3E 115 kV	19.93	19.44	23.29	22.65	0.76	0.52
	Crawford J4E 115 kV	19.93	18.34	23.29	19.53	0.76	0.49
	Crawford EY 27.6 kV	15.34	11.33	20.23	15.32	0.13	0.09
9	Walker Z1E 115 kV	22.67	23.20	26.56	26.60	1.39	1.13
	Walker Z7E 115 kV	22.62	23.14	26.48	26.42	1.39	1.14
	Walker #1 EQ 27.6 kV	17.35	3.50	22.90	4.99	0.23	0.00
	Walker #2 BY 27.6 kV	14.88	9.38	18.78	12.82	0.27	0.00
10	Ford EEP Z1E 115 kV	19.45	19.60	21.59	21.32	1.62	1.66
	Ford EEP Z7E 115 kV	19.44	19.59	21.58	21.31	1.62	1.61
	Ford EEP ESS 13.8 kV	18.53	9.08	23.24	12.53	0.16	0.00
11	Ford E8F 115 kV	20.29	19.86	22.69	21.80	1.15	0.81
	Ford E9F 115 kV	20.30	19.87	22.77	21.84	1.20	0.86
	Ford WIN 27.6 kV	16.01	8.93	22.06	12.21	0.13	0.11

12	Ford Annex E8F 115 kV	21.33	21.24	24.14	23.14	1.23	0.90
	Ford Annex E9F 115 kV	21.33	21.25	24.20	23.16	1.23	0.95
	Ford Annex 13.8 kV	18.71	14.90	24.92	14.90	0.11	0.07
13	GM Motors E8F 115 kV	22.13	22.40	25.32	24.57	1.28	0.99
	GM Motors E9F 115 kV	22.13	22.40	25.37	24.59	1.28	0.99
	GM Motors 27.6 kV	12.34	8.06	15.58	10.67	0.16	0.00
14	Chrysler E8F 115 kV	23.64	24.84	27.97	29.18	1.37	1.10
	Chrysler E9F 115 kV	23.64	24.84	27.98	29.19	1.37	1.10
	Chrysler 27.6 kV	11.41	7.80	15.26	10.59	0.18	0.13
15	East Windsor E8F 115 kV	20.15	19.67	22.50	21.56	1.15	0.82
	East Windsor E9F 115 kV	20.22	19.76	22.66	21.70	1.15	0.82
16	Lauzon C23Z 230 kV	7.99	7.91	9.26	9.79	0.76	0.89
	Lauzon C24Z 230 kV	7.79	7.70	9.00	9.52	0.78	0.92
	Lauzon 115 kV	21.73	24.34	24.43	28.85	2.07	2.53
	Lauzon BQ 27.6 kV	14.09	10.56	18.07	14.61	0.21	0.09
	Lauzon EJ 27.6 kV	14.64	10.73	18.25	14.58	0.14	0.09
17	Belle River K2Z 115 kV	7.55	5.29	7.99	5.46	0.94	4.55
	Belle River K6Z 115 kV	8.77	7.14	9.27	7.71	5.92	33.96
	Belle River 27.6 kV	11.75	7.99	13.64	10.33	1.03	0.50
18	Kingsville K2Z 115 kV	4.91	4.02	5.14	4.29	0.84	0.50
	Kingsville K6Z 115 kV	4.76	2.71	4.94	2.75	2.83	18.86
	Kingsville 27.6 kV	16.65	11.83	17.50	13.46	1.22	0.60
19	Tilbury 115 kV	3.51	2.36	3.55	2.39	0.29	0.43
	Tilbury 27.6 kV	1.52	0.00	1.68	0.00	0.00	-
	Tilbury West 115 kV	3.51	2.36	3.55	2.39	0.29	0.43
	Tilbury West WB1 27.6 kV	2.87	3.10	3.12	3.51	0.00	0.00
	Tilbury West WB2 27.6 kV	2.65	2.94	2.89	3.33	0.00	0.00
20	Port Alma 1/2 C24Z 230 kV	9.85	9.31	11.21	11.25	0.20	0.11
	Port Alma 1 34.5 kV	27.17	0.00	35.43	0.00	0.04	-
	Port Alma 2 34.5 kV	25.12	0.00	33.90	0.00	0.04	-
21	Dillon C23Z 230 kV	19.65	16.01	21.52	18.03	0.26	0.19
	Dillon CGS 230 kV	19.54	15.94	21.34	17.93	-	-
	Dillon 34.5 kV	24.01	0.00	28.37	0.00	-	-
22	Spence W44LC 230 kV	19.94	13.84	21.56	14.96	0.10	0.07
	Spence W45LC 230 kV	13.01	10.62	13.73	11.35	0.00	0.00
	Spence 34.5 kV	30.08	0.00	31.33	0.00	-	-
23	Gosfield K2Z 115 kV	5.21	4.81	5.49	5.36	0.77	0.42
	Gosfield 34.5 kV	7.16	0.00	8.59	0.02	-	-
24	Comber West C23Z 230 kV	-	-	-	-	-	-
	Comber West 34.5 kV	-	-	-	-	-	-
25	Comber East C24Z 230 kV	-	-	-	-	-	-
	Comber East 34.5 kV	-	-	-	-	-	-
26	Pointe-Aux-Roches K6Z 115 kV	7.89	6.63	8.26	7.32	-	-
	Pointe Aux Roches 34.5 kV	8.13	0.00	9.33	0.00	-	-
27	Sth Kent Wind Farm 230 kV	-	-	-	-	-	-
	Sth Kent Sattern 34.5 kV	-	-	-	-	-	-
	Sth kent Railbed 34.5 kV	-	-	-	-	-	-

Notes:
1. Base case assumes existing & committed facilities in-service
2. Pre-fault voltages of 250 kV, 127 kV, 29 kV and 14.2 kV are assumed at 230 kV, 115 kV, 27.6 kV and 13.8 kV stations respectively
3. Percentage Increase (%) is defined as an increase from the exiting fault levels if Comber East and Comber West Wind Farms are not connected to Hydro One transmission network system.

Salient features obtained from short-circuit study results in Table 10 above may be summarized as follows:

- Table 10 study results show an overall increase in short circuit levels for all Chatham-Kent-Essex area customers due to fault contributions coming from new generations in the FIT and South Kent programs in general and from PAR tapping 115 kV, circuit K6Z in particular.

- The studies also show that fault level increases will be within the TSC maximum symmetrical three-phase and single line-to-ground (SLG) fault level limits. However the same customers that were identified in Section 4.2, Table 9 above and whose short-circuit levels exceed the TSC fault limits are also identified in Table 10 and they are:
  i. The symmetrical three-phase fault level at Walker #1 EQ 27.6 kV bus increases to 17.35 kA (see Table 10, Row #9) exceeding the 17 kA TSC fault limit. The mitigating measure that is put in place at this transformer station will lower the fault current to within the TSC limit
  ii. The symmetrical SLG fault level at Ford Annex 13.8 kV bus is 14.90 kA (see Table 10, Row #12) exceeding the 10 kA TSC fault limit
  iii. The symmetrical SLG fault level at Crawford EY 27.6 kV bus increases to 11.33 kA (see Table 10, Row #8) and this is about 6% below the TSC fault limit of 12 kA
  iv. The symmetrical three-phase fault level at Kingsville 27.6 kV bus is 16.65 kA (see Table 10, Row #18) and this is within 5% of the 17 kA TSC fault limit.
- Highest short circuit level increase was found to be at Lauzon TS and the short-circuit levels decrease as customers move further away from the point-of-connections in the transmission network systems. The fault increase drops to less than 1.0% at customer stations.

4.2.2 Incorporation of Pointes-Aux-Roches and Comber East/ West

The maximum short-circuit increase in Essex is in the incorporation of Pointes-Aux-Roches Wind Farm and Comber East/ West Wind Farm and the highest short circuit level increase is found to be at Kingsville 115 kV bus as summarized in Table 11 below.

Table 11
System Fault Levels Incorporating Pointes-Aux-Roches and Comber East/ West

No.	Chatham-Kent-Essex Area Customer Station Bus	Fault Levels (kA)				Percentage Increase (%)	
		Symmetrical		Asymmetrical		Symmetrical	
		3-Phase	L-G	3_Phase	L-G	3-Phase	L-G
1	Chatham 230 kV	24.59	17.87	26.77	19.49	1.19	0.82
2	Buchanan 230 kV	31.66	26.97	34.53	31.28	0.05	0.03
3	Longwood 230 kV	37.38	44.75	42.08	52.87	0.06	0.05
4	Edgeware W44LC 230 kV	11.44	8.83	12.13	9.36	0.02	0.01
	Edgeware W45LC 230 kV	11.44	8.84	12.13	9.37	0.02	0.01
	Edgeware B 27.6 kV	11.85	9.54	15.46	13.34	0.00	0.00
	Edgeware Y 27.6 kV	11.82	9.53	15.42	13.33	0.00	0.00
5	Keith 230 kV	20.47	22.50	27.58	31.26	0.63	0.68
	Keith 115 kV	27.56	32.41	37.27	45.53	1.29	1.06
	Keith BY 27.6 kV	15.51	10.97	21.01	15.60	0.07	0.04
6	Essex 115 kV	24.40	25.90	29.26	31.14	2.87	2.72
	Essex B1-4 27.6 kV	15.03	10.48	19.92	14.77	0.49	0.23
7	Malden C21J 230 kV	16.64	16.36	19.41	18.06	0.52	0.75
	Malden C22J 230 kV	16.63	16.31	19.37	18.01	0.52	0.71
	Malden B 27.6 kV	14.11	10.46	18.55	14.49	0.06	0.02
	Malden Y 27.6 kV	12.83	9.97	17.07	13.91	0.05	0.03
8	Crawford J3E 115 kV	20.08	19.56	23.46	22.78	1.55	1.14
	Crawford J4E 115 kV	20.09	18.45	23.46	19.64	1.55	1.10
	Crawford EY 27.6 kV	15.36	11.34	20.26	15.33	0.29	0.14
9	Walker Z1E 115 kV	22.99	23.56	26.95	26.99	2.81	2.72
	Walker Z7E 115 kV	22.94	23.50	26.86	26.81	2.81	2.72
	Walker #1 EQ 27.6 kV	17.39	3.50	22.95	4.99	0.46	0.06
	Walker #2 BY 27.6 kV	14.91	9.39	18.83	12.84	0.46	0.19
10	Ford EEP Z1E 115 kV	19.77	20.16	21.97	21.91	3.29	4.58
	Ford EEP Z7E 115 kV	19.76	20.16	21.96	21.89	3.29	4.58
	Ford EEP ESS 13.8 kV	18.57	9.09	23.31	12.54	0.39	0.13

11	Ford E8F 115 kV	20.53	20.08	22.94	22.01	2.34	1.93
	Ford E9F 115 kV	20.53	20.08	23.02	22.05	2.34	1.93
	Ford WIN 27.6 kV	16.02	8.93	22.08	12.22	0.20	0.08
12	Ford Annex E8F 115 kV	21.59	21.50	24.43	23.39	2.48	2.12
	Ford Annex E9F 115 kV	21.59	21.50	24.49	23.41	2.48	2.13
	Ford Annex 13.8 kV	18.74	14.91	24.96	14.91	0.28	0.14
13	GM Motors E8F 115 kV	22.41	22.69	25.64	24.86	2.60	2.29
	GM Motors E9F 115 kV	22.41	22.69	25.69	24.88	2.60	2.29
	GM Motors 27.6 kV	12.36	8.07	15.61	10.68	0.37	0.15
14	Chrysler E8F 115 kV	23.97	25.21	28.37	29.58	2.80	2.62
	Chrysler E9F 115 kV	23.97	25.21	28.38	29.59	2.80	2.62
	Chrysler 27.6 kV	11.43	7.81	15.29	10.60	0.33	0.15
15	East Windsor E8F 115 kV	20.39	19.88	22.74	21.77	2.32	1.91
	East Windsor E9F 115 kV	20.46	19.98	22.91	21.91	2.33	1.92
16	Lauzon C23Z 230 kV	8.27	8.80	9.62	10.80	4.27	12.26
	Lauzon C24Z 230 kV	8.07	8.62	9.36	10.55	4.38	12.92
	Lauzon 115 kV	22.18	25.50	25.03	30.25	4.17	7.40
	Lauzon BQ 27.6 kV	14.20	10.60	18.25	14.69	1.00	0.50
	Lauzon EJ 27.6 kV	14.75	10.77	18.43	14.65	0.95	0.46
17	Belle River K2Z 115 kV	7.60	5.35	8.05	5.52	1.60	5.76
	Belle River K6Z 115 kV	8.83	7.20	9.33	7.77	6.71	35.02
	Belle River 27.6 kV	11.77	8.00	13.68	10.34	1.21	0.54
18	Kingsville K2Z 115 kV	4.92	4.03	5.16	4.30	1.03	0.70
	Kingsville K6Z 115 kV	4.78	2.71	4.95	2.76	3.15	19.14
	Kingsville 27.6 kV	16.68	11.84	17.53	13.47	1.43	0.68
19	Tilbury 115 kV	3.52	2.37	3.56	2.40	0.66	0.64
	Tilbury 27.6 kV	1.52	0.00	1.68	0.00	0.07	-
	Tilbury West 115 kV	3.52	2.37	3.56	2.40	0.69	0.59
	Tilbury West WB1 27.6 kV	2.87	3.10	3.12	3.51	0.14	0.10
	Tilbury West WB2 27.6 kV	2.65	2.94	2.89	3.33	0.15	0.14
20	Port Alma 1/2 C24Z 230 kV	9.96	9.41	11.33	11.36	1.32	1.24
	Port Alma 1 34.5 kV	27.25	0.00	35.54	0.00	0.34	-
	Port Alma 2 34.5 kV	25.18	0.00	33.98	0.00	0.30	-
21	Dillon C23Z 230 kV	19.93	16.24	21.81	18.27	1.68	1.61
	Dillon CGS 230 kV	19.82	16.17	21.63	18.17	1.67	1.61
	Dillon 34.5 kV	24.03	0.00	28.39	0.00	0.07	-
22	Spence W45LC 230 kV	20.03	13.87	21.65	14.99	0.53	0.30
	Spence CGS 230 kV	13.05	10.64	13.76	11.37	0.32	0.21
	Spence 34.5 kV	30.09	0.00	31.33	0.00	0.03	-
23	Gosfield K2Z 115 kV	5.23	4.83	5.51	5.37	1.06	0.79
	Gosfield 34.5 kV	7.17	0.00	8.59	0.02	0.27	-
24	Comber West C23Z 230 kV	8.15	9.08	9.18	10.36	-	-
	Comber West 34.5 kV	19.38	0.00	22.10	0.00	-	0.00
25	Comber East C24Z 230 kV	7.88	8.78	8.76	9.92	-	-
	Comber East 34.5 kV	19.16	0.00	21.74	0.00	-	0.00
26	Pointe-Aux-Roches K6Z 115 kV	7.94	6.67	8.31	7.37	-	-
	Pointe Aux Roches 34.5 kV	8.14	0.00	9.34	0.00	-	0.00
27	Sth Kent Wind Farm 230 kV	-	-	-	-	-	-
	Sth Kent Sattern 34.5 kV	-	-	-	-	-	-
	Sth kent Railbed 34.5 kV	-	-	-	-	-	-

Notes:

4. Base case assumes existing & committed facilities in-service
5. Pre-fault voltages of 250 kV, 127 kV, 29 kV and 14.2 kV are assumed at 230 kV, 115 kV, 27.6 kV and 13.8 kV stations respectively
6. Percentage Increase (%) is defined as an increase from the exiting fault levels if Pointe-Aux-Roches Wind Farm is not connected to Hydro One transmission network system.

Table 11 identifies the following stations whose fault levels exceed or approach the TSC 3-phase and SLG fault limits:

i. The symmetrical three-phase fault level at Walker #1 EQ 27.6 kV bus is 17.39 kA (see Table 11, Row #9). The proposed mitigating measured will lower the fault level to below the 17 kA TSC fault limit
ii. The symmetrical SLG fault level at Crawford EY 27.6 kV bus increases to 11.34 kA (see Table 11, Row #8) and this is more than 5% below the TSC fault limit of 12 kA
iii. The symmetrical SLG fault level at customer-owned Ford Annex 13.8 kV bus increases to 14.91 kA (see Table 11, Row #12) and this exceeds the TSC fault limit of 10 kA
iv. The symmetrical three-phase fault level at Kingsville 27.6 kV bus increases to 16.68 kA (see Table 11, Row #18) and this is within 5 % of the 17 kA TSC fault limit. A mitigating measure will be required to limit the fault current to within 5% of the values specified in the TSC.

4.2.3 Incorporation of FIT and South Kent Wind Farm

As discussed in Section 1.1, South Kent Wind Farm is not part of the FIT program and since it is scheduled to connect to Chatham SS in 2012/13, the CIA Report is revised and updated to reflec these changes. This is the ultimate study conditions in which all generating facilities in the Chatham-Kent-Essex areas are incorporated and connected to Hydro One transmission and distribution network systems. The results are summarized in Table 12 below.

Table 12
Incorporating FIT and South Kent Generation

No.	Chatham-Kent-Essex Area Customer Station Bus	Fault Levels (kA)				Percentage Increase (%)	
		Symmetrical		Asymmetrical		Symmetrical	
		3-Phase	L-G	3_Phase	L-G	3-Phase	L-G
1	Chatham 230 kV	26.09	18.38	28.39	20.04	7.40	3.72
2	Buchanan 230 kV	31.74	27.00	34.61	31.32	0.29	0.17
3	Longwood 230 kV	37.49	44.87	42.20	52.99	0.37	0.30
4	Edgeware W44LC 230 kV	11.45	8.83	12.14	9.36	0.10	0.06
	Edgeware W45LC 230 kV	11.45	8.85	12.14	9.38	0.10	0.06
	Edgeware B 27.6 kV	11.85	9.54	15.46	13.34	0.02	0.01
	Edgeware Y 27.6 kV	11.83	9.53	15.43	13.33	0.02	0.01
5	Keith 230 kV	20.59	22.60	27.73	31.38	1.24	1.12
	Keith 115 kV	27.66	32.51	37.40	45.65	1.68	1.37
	Keith BY 27.6 kV	15.52	10.97	21.02	15.61	0.14	0.06
6	Essex 115 kV	24.51	25.97	29.36	31.21	3.30	3.03
	Essex B1-4 27.6 kV	15.04	10.48	19.93	14.78	0.58	0.26
7	Malden C21J 230 kV	16.74	16.42	19.51	18.12	1.09	1.12
	Malden C22J 230 kV	16.73	16.37	19.46	18.06	1.09	1.09
	Malden B 27.6 kV	14.12	10.46	18.56	14.50	0.11	0.05
	Malden Y 27.6 kV	12.84	9.97	17.08	13.92	0.12	0.06
8	Crawford J3E 115 kV	20.15	19.60	23.52	22.81	1.87	1.35
	Crawford J4E 115 kV	20.15	18.49	23.52	19.67	1.87	1.30
	Crawford EY 27.6 kV	15.37	11.34	20.27	15.33	0.35	0.17
9	Walker Z1E 115 kV	23.08	23.63	27.04	27.05	3.23	3.00
	Walker Z7E 115 kV	23.03	23.57	26.95	26.87	3.23	3.00
	Walker #1 EQ 27.6 kV	17.40	3.50	22.97	4.99	0.53	0.06
	Walker #2 BY 27.6 kV	14.92	9.40	18.84	12.84	0.53	0.22
10	Ford EEP Z1E 115 kV	19.85	20.22	22.06	21.96	3.72	4.88
	Ford EEP Z7E 115 kV	19.84	20.22	22.04	21.95	3.72	4.88
	Ford EEP ESS 13.8 kV	18.58	9.09	23.32	12.54	0.44	0.14
11	Ford E8F 115 kV	20.60	20.12	23.01	22.05	2.70	2.16
	Ford E9F 115 kV	20.61	20.13	23.09	22.09	2.70	2.16
	Ford WIN 27.6 kV	16.03	8.93	22.08	12.22	0.23	0.09
12	Ford Annex E8F 115 kV	21.67	21.55	24.51	23.44	2.86	2.38
	Ford Annex E9F 115 kV	21.67	21.55	24.57	23.46	2.86	2.38

	Ford Annex 13.8 kV	18.75	14.91	24.97	14.91	0.32	0.17
13	GM Motors E8F 115 kV	22.50	22.75	25.73	24.92	2.99	2.55
	GM Motors E9F 115 kV	22.50	22.75	25.77	24.93	2.99	2.55
	GM Motors 27.6 kV	12.37	8.07	15.62	10.68	0.41	0.17
14	Chrysler E8F 115 kV	24.07	25.29	28.47	29.65	3.23	2.92
	Chrysler E9F 115 kV	24.07	25.29	28.48	29.66	3.23	2.92
	Chrysler 27.6 kV	11.44	7.81	15.30	10.60	0.39	0.18
15	East Windsor E8F 115 kV	20.46	19.93	22.81	21.81	2.68	2.14
	East Windsor E9F 115 kV	20.53	20.02	22.98	21.96	2.69	2.15
16	Lauzon C23Z 230 kV	8.32	8.84	9.67	10.84	4.89	12.73
	Lauzon C24Z 230 kV	8.12	8.66	9.41	10.59	5.03	13.42
	Lauzon 115 kV	22.29	25.60	25.14	30.36	4.70	7.81
	Lauzon BQ 27.6 kV	14.22	10.61	18.28	14.70	1.15	0.58
	Lauzon EJ 27.6 kV	14.78	10.78	18.46	14.66	1.10	0.53
17	Belle River K2Z 115 kV	7.62	5.35	8.06	5.52	1.78	5.85
	Belle River K6Z 115 kV	8.85	7.20	9.35	7.78	6.89	35.13
	Belle River 27.6 kV	11.78	8.00	13.69	10.35	1.27	0.58
18	Kingsville K2Z 115 kV	4.92	4.03	5.16	4.31	1.11	0.72
	Kingsville K6Z 115 kV	4.78	2.72	4.96	2.76	3.22	19.18
	Kingsville 27.6 kV	16.69	11.85	17.54	13.47	1.48	0.71
19	Tilbury 115 kV	3.52	2.37	3.56	2.40	0.74	0.68
	Tilbury 27.6 kV	1.52	0.00	1.68	0.00	0.07	-
	Tilbury West 115 kV	3.52	2.37	3.56	2.40	0.74	0.64
	Tilbury West WB1 27.6 kV	2.87	3.10	3.12	3.51	0.14	0.10
	Tilbury West WB2 27.6 kV	2.65	2.94	2.89	3.33	0.15	0.14
20	Port Alma 1/2 C24Z 230 kV	10.09	9.49	11.46	11.44	2.66	2.08
	Port Alma 1 34.5 kV	27.34	0.00	35.66	0.00	0.67	-
	Port Alma 2 34.5 kV	25.26	0.00	34.08	0.00	0.59	-
21	Dillon C23Z 230 kV	20.73	16.58	22.64	18.64	5.73	3.77
	Dillon CGS 230 kV	20.60	16.51	22.45	18.54	5.69	3.75
	Dillon 34.5 kV	24.07	0.00	28.46	0.00	0.25	-
22	Spence W45LC 230 kV	20.55	14.04	22.20	15.17	3.17	1.50
	Spence CGS 230 kV	13.25	10.73	13.97	11.47	1.89	1.06
	Spence 34.5 kV	30.12	0.00	31.37	0.00	0.15	-
23	Gosfield K2Z 115 kV	5.23	4.83	5.51	5.37	1.14	0.84
	Gosfield 34.5 kV	7.17	0.00	8.59	0.02	0.28	-
24	Comber West C23Z 230 kV	8.20	9.12	9.24	10.41	-	-
	Comber West 34.5 kV	19.43	0.00	22.15	0.00	-	0.00
25	Comber East C24Z 230 kV	7.93	8.82	8.81	9.97	-	-
	Comber East 34.5 kV	19.21	0.00	21.78	0.00	-	0.00
26	Pointe-Aux-Roches K6Z 115 kV	7.95	6.68	8.32	7.37	-	-
	Pointe Aux Roches 34.5 kV	8.14	0.00	9.34	0.00	-	0.00
27	Sth Kent Wind Farm 230 kV	7.87	4.67	8.24	4.92	-	-
	Sth Kent Sattern 34.5 kV	19.61	18.19	22.47	22.41	-	-
	Sth kent Railbed 34.5 kV	18.72	17.67	20.80	21.02	-	-

Notes:

1. Base case assumes existing & committed facilities in-service
2. Pre-fault voltages of 250 kV, 127 kV, 29 kV and 14.2 kV are assumed at 230 kV, 115 kV, 27.6 kV and 13.8 kV stations respectively
3. Percentage Increase (%) is defined as an increase from the exiting fault levels if South Kent Wind Farm is not connected to Hydro One transmission network system.

Equivalent fault impedance at customer connection points with all generating facilities in-service is given in Appendix C.

Most notable fault level changes may be summarized as follows:

- Table 12 study results show, as expected, an overall increase in short-circuit levels for all customers connected to C23Z and C24Z circuits. The highest increase will be at Chatham SS and at Dillon CSS as this is electrically the closest distance to the South Kent Wind Farm.

The short-circuit levels decrease as the connection points move further away from the generating source.

- Table 12 also identifies the following stations whose fault levels exceed the TSC 3-phase and SLG fault limits. The fault levels increase slightly from those summarized in Table 11 from the previous studies:
  i. The symmetrical three-phase fault level at Walker #1 EQ 27.6 kV bus increases slightly to 17.40 kA (see Table 12, Row #9). The proposed mitigating measured will lower the fault level to below the 17 kA TSC fault limit
  ii. The symmetrical SLG fault level at Crawford EY 27.6 kV bus increases slightly to 11.34 kA (see Table 12, Row #8) and this is 5.3% below the TSC fault limit of 12 kA
  iii. The symmetrical SLG fault level at customer-owned Ford Annex 13.8 kV bus increases slightly to 14.91 kA (see Table 12, Row #12) and this exceeds the TSC fault limit of 10 kA
  iv. The symmetrical three-phase fault level at Kingsville 27.6 kV bus increases to 16.69 kA (see Table 12, Row #18) and this is within 5 % of the 17 kA TSC fault limit. A mitigating measure will be required to limit the fault current to within the values specified in the TSC.

From the short-circuit study results, it can be concluded that the incorporation of FIT and South Kent generations will impact on the present short-circuit levels for Chatham-Kent-Essex area customers and these are identified in the result discussions above.

4.3 Impact at Stations Mitigated for Fault Level

Customer Impact Assessment studies conducted for projects that have either previously connected or plan to connect prior to the connection date planned for this project have identified stations at less than 50kV where the fault level is within 5% of the values in Appendix 2 of the Transmission System Code (TSC); Hydro One requires connecting proponents who elevate fault levels within the 5% margin to contribute to the cost of installing mitigating measures to reduce the fault level below 95% of the TSC limit. Hydro One applies a 5% margin to maximum short circuit levels in the TSC to manage uncertainties in the calculation of expected short circuit levels. The TSC requires that any customer that benefits from such an installation that connects within five calendar years of the in-service date of the mitigation measure also contribute towards the cost of the measure, and that any such payments be refunded to the original contributing customer(s). This Section of this CIA report is to report on the impact that this project has at those previously mitigated stations to see if this project is required to financially contribute to the cost for any of those measures. Separate tables are presented for each of the projects covered by this report. The order of the tables is the same as the expected connection dates for the three projects. Other FIT projects not covered by this report may have connection dates forecast to be interspaced with the three projects covered by this report.

4.3.1 Pointe-Aux-Roches Project

Table 13
Impact of Pointe-Aux-Roches at Stations Mitigated for Fault Levels

Station	*3-Ph Fault level without this project (kA)*	*3-Ph Fault level with this project (kA)*	*Difference (kA)*
Windsor Walker TS #1	17.31	17.35	0.04
Kingsville TS	16.45	16.65	0.20
Caledonia TS (27.6kV)	16.51	16.51	0
Martindale TS (44 kV)	14.91	14.91	0

LG Fault levels

Station	LG Fault level without this project (kA)	LG Fault level with this project (kA)	Difference (kA)
Windsor Walker TS #1	3.50	3.50	0
Kingsville TS	11.76	11.83	0.07
Caledonia TS (27.6kV)	9.91	9.91	0
Martindale TS (44 kV)	19.78	19.78	0

The results of the fault levels studies shown on these tables above show that Pointe-Aux-Roches has a measureable (>= 0.01kA) impact at the fault level at Windsor Walker TS#1 and Kingsville TS and hence has to make a contribution towards the cost of the mitigation measures installed for this problem. If the Pointe-Aux-Roches project do not proceed to connection but the Comber projects do, they will be deemed to have triggered the need for mitigation measures at Kingsville TS and assessed with the cost of the measure(s).

4.3.2 Comber Projects

Table 14
Impact of Comber Projects at Stations Mitigated for Fault Levels

Station	3-Ph Fault level without this project (kA)	3-Ph Fault level with this project (kA)	Difference (kA)
Windsor Walker TS #1	17.35	17.39	0.04
Kingsville TS	16.65	16.68	0.03
Caledonia TS (27.6kV)	16.51	16.51	0
Martindale TS (44 kV)	14.88	14.88	0

LG Fault levels

Station	LG Fault level without this project (kA)	LG Fault level with this project (kA)	Difference (kA)
Windsor Walker TS #1	3.50	3.50	0
Kingsville TS	11.83	11.84	0.01
Caledonia TS (27.6kV)	9.91	9.91	0
Martindale TS (44 kV)	19.75	19.75	0

The results of the fault levels studies shown on these tables above show that the Comber projects have a measureable (>= 0.01kA) impact at the fault level at Windsor Walker TS#1 and Kingsville TS and hence has to make a contribution towards the cost of the mitigation measures installed for this problem. In the case of Kingsville TS, the Pointe-Aux-Roches project is deemed to have triggered the need for the mitigation measures and will be assessed the cost of the measure provided that the projects proceed to connection.

4.3.3 South Kent Wind Farm

Table15
Impact of the South Kent Wind Farm at Stations Mitigated for Fault Levels

Station	3-Ph Fault level without this project (kA)	3-Ph Fault level with this project (kA)	Difference (kA)
Windsor Walker TS #1	17.39	17.40	0.02
Kingsville TS	16.68	16.69	0.01
Caledonia TS (27.6kV)	16.51	16.51	0

Martindale TS (44 kV)	14.91	14.91	0

LG Fault levels

Station	***LG Fault level without this project (kA)***	***LG Fault level with this project (kA)***	***Difference (kA)***
Windsor Walker TS #1	3.50	3.50	0
Kingsville TS	11.84	11.85	0.01
Caledonia TS (27.6kV)	9.91	9.91	0
Martindale TS (44 kV)	19.78	19.78	0

The results of the fault levels studies shown on these tables above show that the South Kent Wind Farm has a measureable (>= 0.01kA) impact at the fault level at Windsor Walker TS#1 and Kingsville TS and hence has to make a contribution towards the cost of the mitigation measures installed for this problem. If neither the Comber projects nor the Pointe-Aux-Roches project do not proceed to connection but the South Kent Wind Farm does, it will be deemed to have triggered the need for mitigation measures at Kingsville TS and assessed with the cost of the measure(s).

5.0 FIT AND SOUTH KENT GENERATION CONNECTION REQUIREMENTS

5.1 Reactive Power

The IESO SIA study has determined that the incorporation of FIT and South Kent generations totaling 484.2 MW will require the following static and dynamic shunt capacitors:

i. Comber East: 20 Mvar
ii. Comber West: 20 Mvar
iii. Point-Aux-Roches:
   - Dynamic reactive compensation totalling -16/+23 Mvar consisting of an ±8.75 Mvar dynamic reactive power device, 4 x +5 Mvar static capacitor banks and 1 x -6 Mvar static reactor, and
   - Additional +5 Mvar static capacitor bank
iv. South Kent Wind Farm:
   - Sattern CGS: 60 Mvar
   - Railbed CGS: 50 Mvar

These capacitor banks will be used to offset reactive power losses within FIT generating facilities and to react to sudden momentary dips in voltage commonly seen in gusty wind conditions which could in turn add stress to Hydro one transmission network system.

5.2 Ride-Through Capabilities

To comply with Market Rule requirement (Chapter 4, Appendix 4.2, Item 7), FIT and South Kent generation customers are required to provide the ability to ride-through voltage, power swings and frequency events caused by power system disturbances outside of their generating facilities.

5.3 Start-Up / Shut-Down Sequences

Start-Up: Wind turbine generators consume reactive power (Var) from the Grid during starting or re-starting after a shut-down due to zero wind or high wind speeds. The start-up sequence should be staggered with a separation of at least 1.5 seconds between start-ups, or limited to a maximum step-voltage change of 3% separated by at least 70 seconds from a similar step. For a minimum step-voltage change of 0.4 %, for instance, the time interval could be reduced to 1 second between steps.

The voltage step limit will apply in all cases except the disconnection of FIT and South Kent Wind Farms as the result of a fault.

Shut-Down: With regards to shutting down individual wind farms, except for electrical faults, no more than 25% of FIT and South Kent generation's registered capacity may be tripped simultaneously.

High wind speeds should result in a phased reduction in output rather than the sudden loss of all wind turbines.

6.0 CONCLUSIONS AND RECOMMENDATIONS

This Customer Impact Assessment (**CIA**) Report presents results of voltage performance and short-circuit study analyses affected by the incorporation of FIT and South Kent generating facilities to be connected to Hydro One transmission network systems. These generating facilities are located in the same Chatham-Kent-Essex area so that they are studied together as a single package.

Load flow studies confirmed a strong 230 kV system between Chatham SS, Keith TS and Lauzon TS with no material change in the voltage performance indicating that the proposed generation does not provide post-contingency voltage support.

Short-circuit studies were carried out to determine new projected fault levels at customer transmission connection points. They showed minimal impact on present short-circuit levels for the majority of Chatham-Kent-Essex area customers. The Report identifies two transformer stations whose three-phase or single line-to-ground faults exceed or are within 5% ofthe Transmission System Code (TSC) fault level limits at 27.6 kV and 13.8 kV. Although these stations have circuit breakers with higher short-circuit ratings, nevertheless for the two cases in which the three-phase short-circuit level is within 5% of the TSC fault limit, the TSC requires that the transmitter install a suitable mitigating measure. The connecting Wind Farms are required to make a contribution towards the cost of short circuit mitigation measures because it elevates fault levels within the 5% margin.

For the Windsor Walker #1 TS case that has been identified in the RES III program, the mitigating measure is to install a 2-Ohm bus-tie reactor between 27.6 kV E- and Q-buses at Walker #1 TS. This will reduce the fault level to 15 kA, a decrease of about 11.8 %. In addition, each of these three projects further increases the fault level. Hence each of these three projects is required to contribute to the cost for the mitigating measures being installed at Windsor Walker #1 TS.

In the second case, Kingsville TS in which the short-circuit level is within 5% of the TSC limit, another mitigating measure will be required with the intent to reduce the short-circuit level in accordance with the TSC. Each of these three projects individually contributes to the fault level issue at Kingsville. Hence the Pointe-Aux-Roches project is deemed to have triggered the need for mitigation measures and that each of the other two projects must contribute to the cost.

The cost to install these mitigating measures will be assessed to the proponents of this CIA report and all other future proponents that connect within five years of the in-service of the mitigating measures that benefits from their installations will also be required to contribute to their costs. Any payments received from future proponents will be refunded to the original contributors.

Chatham-Kent-Essex area customers are recommended to use the fault levels contained in this Report to check the integrity of their facilities and equipment and safety of their personnel as the new generating facilities get fully incorporated in 2011/2012.

Hydro One shall update the CIA Report and advise Chatham-Kent- Essex area customers if other generating projects apply for connection to Hydro One transmission system.

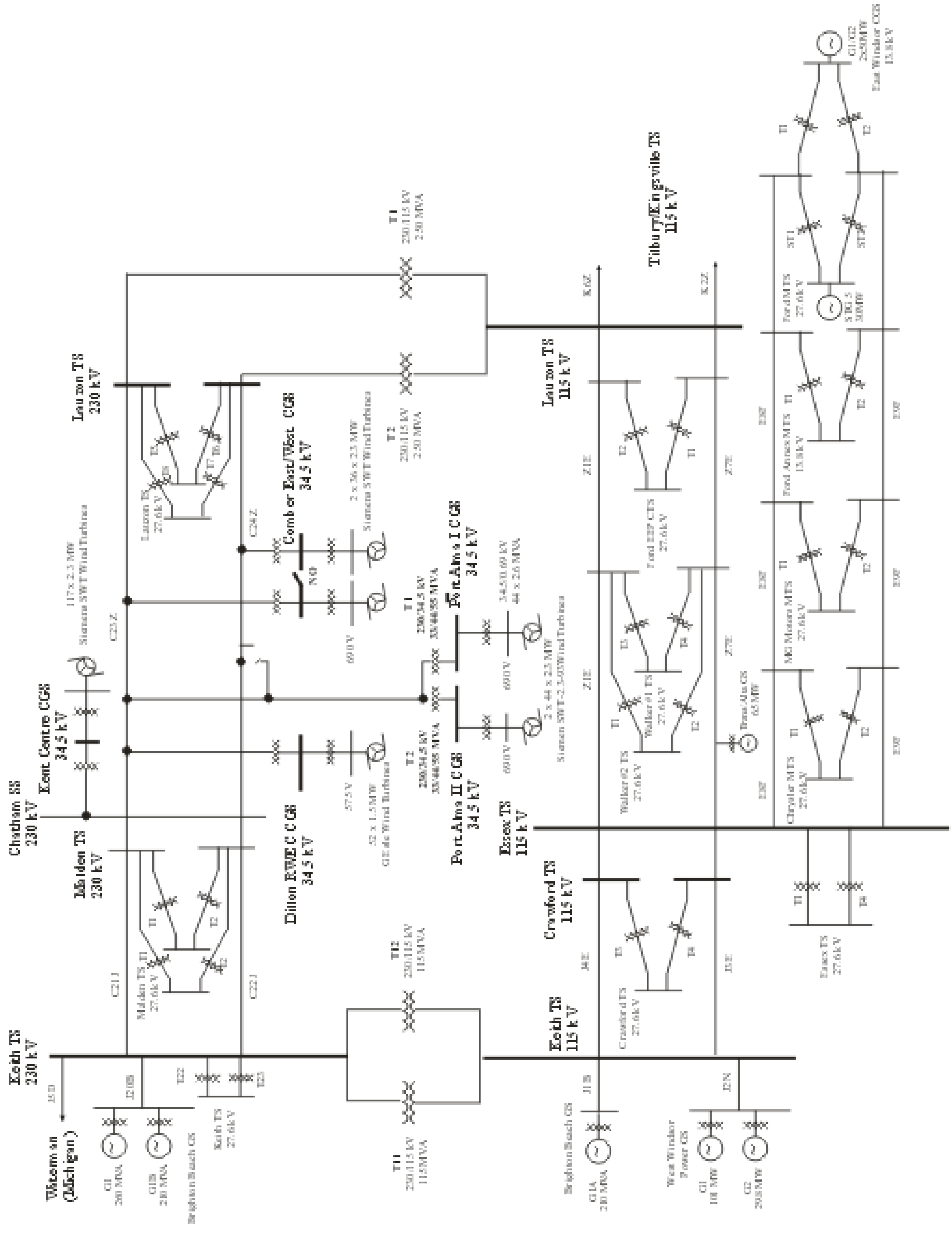


Fig. 1: Comber East, Comber West and Kent Centre Generation Connections

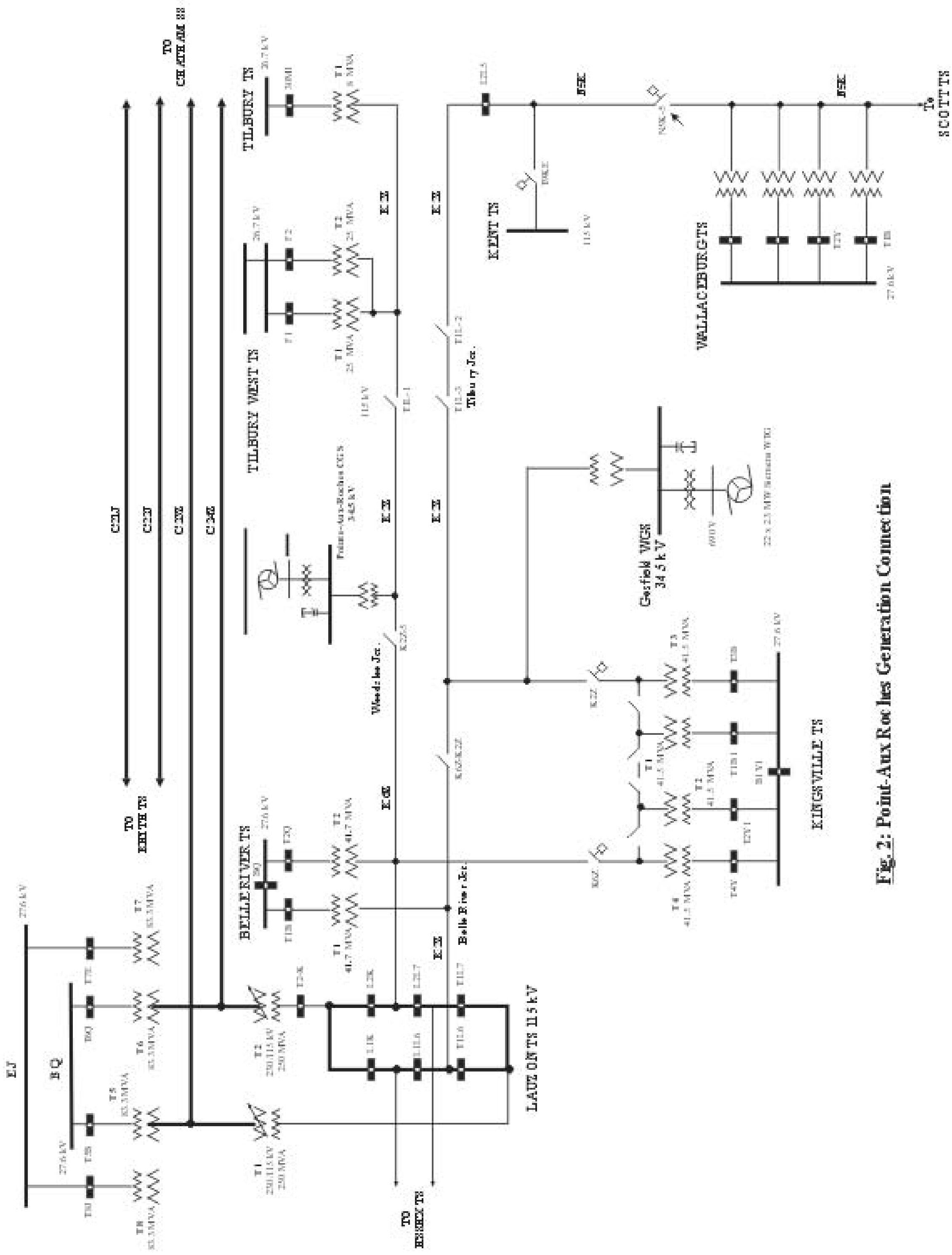


Fig. 2: Point-Aux Roches Generation Connection

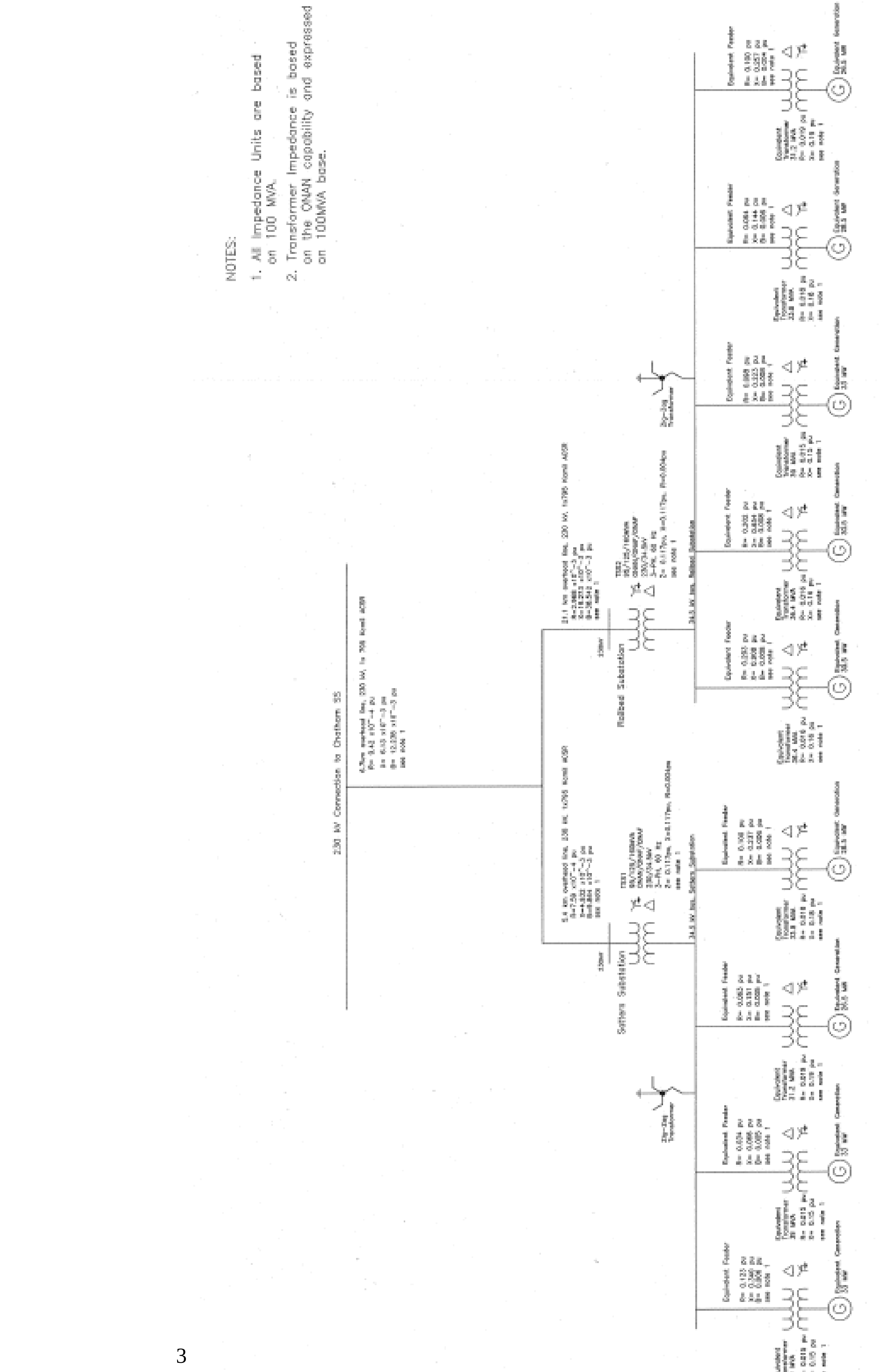
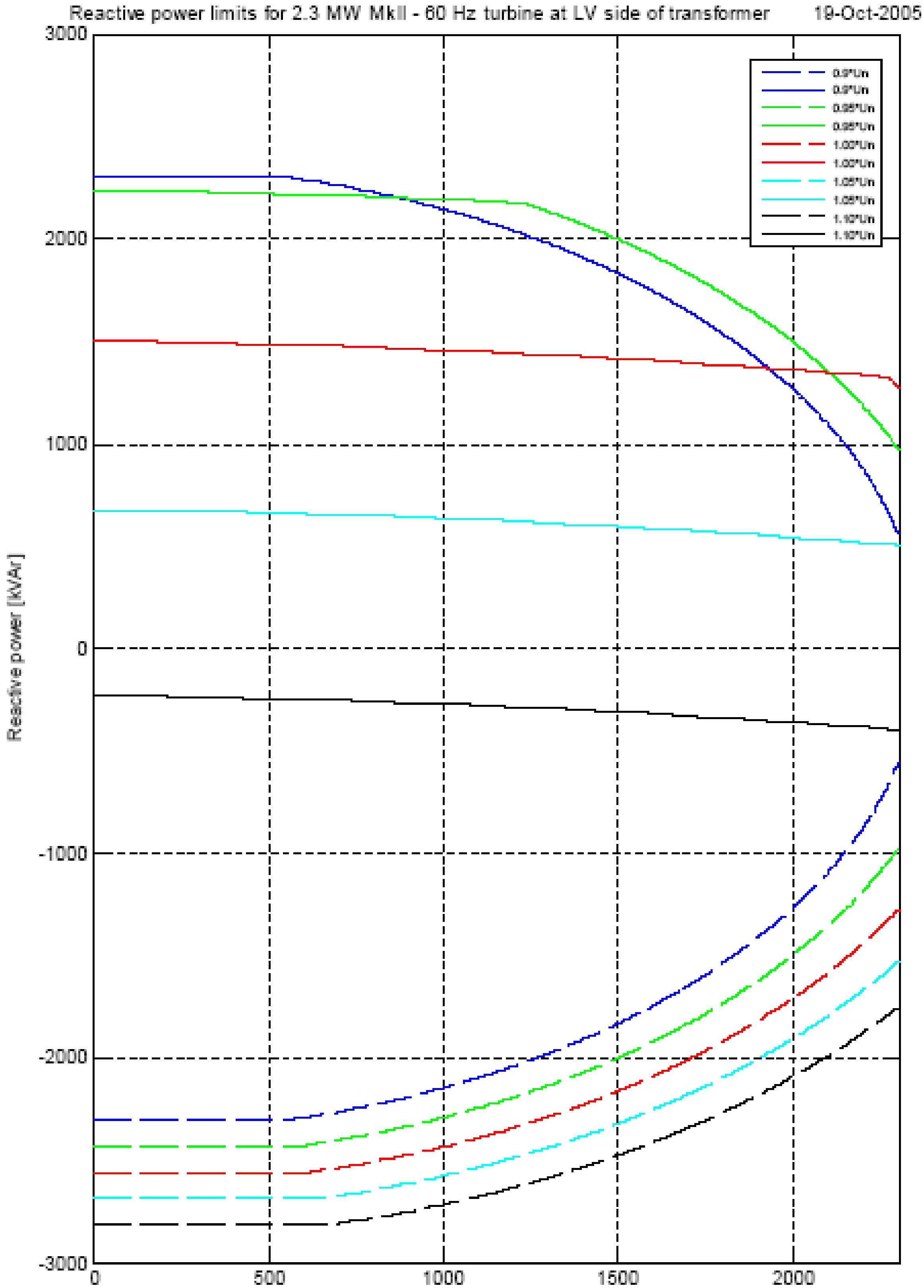


Fig. 3: South Kent Generation Connection

APPENDIX A

Siemens SWT-2.3-93 Wind Turbine Reactive Capability Characteristics



Appendix B1

Generator Technical Data

Siemens SWT-2.3-101 Wind Turbine Generator

Type	Asynchronous (with 4Q Full scale converter)
Rated power	2.3 MW
Voltage	U = 690 V
Frequency	f = 60 Hz
Power factor	0.9 cap. to 0.9 ind.
Stator resistance	R_1 = n/a
Stator leakage reactance	X_1 = n/a
Iron loss resistance	R_{Fe} = n/a
Magnetizing reactance	X_m = n/a
Rotor leakage reactance	X'_2 = n/a
Rotor resistance	R'_2 = n/a
Rotor res. external 1% slip	R'_{2ext} = n/a
Rotor res. external 10% slip	R'_{2ext} = n/a

Dynamics Data

Machine base (MVA)	2.556 MVA
Transient open-circuit time constant	T' = 0.033 sec
Sub-transient open-circuit time constant	T" = 0.033 sec
Inertia constant	H = n/a (generator only)
	H = n/a (generator + blades)
Synchronous reactance	X = 0.85 p.u.
Transient reactance	X' = 0.64 p.u.
Sub-transient reactance	X" = 0.64 p.u.
Leakage reactance	X_l = n/a
Saturation	E_l = 1.0
Saturation	$S(E_l)$ = n/a
Saturation	E_2 = 1.2
Saturation	$S(E_2)$ = n/a

APPENDIX B2

Generator Technical Data

Vestas V90-1.8 MW VCUS Wind Turbine Generator

Type	Asynchronous, doubly-fed
Rated power	1.8 MW
Voltage	U = 690 V
Frequency	f = 60 Hz
Power factor	0.95 cap. to 0.9 ind.
Stator resistance	R_1 = n/a
Stator leakage reactance	X_1 = n/a
Iron loss resistance	R_{Fe} = n/a
Magnetizing reactance	X_m = n/a
Rotor leakage reactance	X'_2 = n/a
Rotor resistance	R'_2 = n/a
Rotor res. external 1% slip	R'_{2ext} = n/a
Rotor res. external 10% slip	R'_{2ext} = n/a

Dynamics Data

Machine base (MVA)	2.0 MVA
Transient open-circuit time constant	T' = 1.264 sec
Sub-transient open-circuit time constant	T" = 0.0212 sec
Inertia constant	H = n/a (generator only)
	H = 12742 $lbft^2$ (generator + blades)
Synchronous reactance	X = 1.7337 p.u.
Transient reactance	X' = 0.0966 p.u.
Sub-transient reactance	X" = 0.0676 p.u.
Leakage reactance	X_l = 0.0401 p.u.
Saturation	E_l = 1.0
Saturation	$S(E_l)$ = n/a
Saturation	E_2 = 1.2
Saturation	$S(E_2)$ = n/a

APPENDIX C
Equivalent Fault Impedance at Chatham-Kent-Area Customer Connection Points

No.	Chatham-Kent-Essex area Customers	Equivalent Fault Impedance (p.u. on 100 MVA Base)			
		Positive Sequence		Zero Sequence	
		$R_1 + jX_1$	X_1/R_1	$R_0 + jX_0$	$\frac{(2X_1+X_0)}{(2R_1+R_0)}$
1	Chatham 230 kV	0.001 + j 0.0114	11.40	0.003 + j 0.0258	9.72
2	Buchanan 230 kV	0.0008 + j 0.0094	11.75	0.0006 + j 0.0143	15.05
3	Longwood 230 kV	0.0005 + j 0.008	16.00	0.0001 + j 0.004	18.18
4	Edgeware W44LC 230 kV	0.0029 + j 0.026	8.97	0.0073 + j 0.0492	7.73
	Edgeware W45LC 230 kV	0.0029 + j 0.026	8.97	0.0073 + j 0.049	7.71
	Edgeware B 27.6 kV	0.0056 + j 0.1855	33.13	0.0065 + j 0.3203	39.06
	Edgeware Y 27.6 kV	0.0056 + j 0.1859	33.20	0.0065 + j 0.3203	39.10
5	Keith 230 kV	0.0004 + j 0.0145	36.25	0.0003 + j 0.0106	36.00
	Keith 115 kV	0.0005 + j 0.019	38.00	0.0003 + j 0.0105	37.31
	Keith BY 27.6 kV	0.0033 + j 0.1417	42.94	0.0068 + j 0.3177	44.86
6	Essex 115 kV	0.001 + j 0.0215	21.50	0.0014 + j 0.0178	17.88
	Essex B1-4 27.6 kV	0.004 + j 0.1462	36.55	0.0072 + j 0.3369	41.40
7	Malden C21J 230 kV	0.001 + j 0.0178	17.80	0.0031 + j 0.0188	10.67
	Malden C22J 230 kV	0.001 + j 0.0178	17.80	0.0031 + j 0.019	10.71
	Malden B 27.6 kV	0.0044 + j 0.1557	35.39	0.0079 + j 0.3192	37.76
	Malden Y 27.6 kV	0.0045 + j 0.1713	38.07	0.0079 + j 0.3189	39.14
8	Crawford J3E 115 kV	0.0014 + j 0.0261	18.64	0.0026 + j 0.0283	14.91
	Crawford J4E 115 kV	0.0014 + j 0.0261	18.64	0.0079 + j 0.0331	7.97
	Crawford EY 27.6 kV	0.004 + j 0.143	35.75	0.0098 + j 0.2954	32.66
9	Walker Z1E 115 kV	0.0012 + j 0.0228	19.00	0.0025 + j 0.0212	13.63
	Walker Z7E 115 kV	0.0012 + j 0.0228	19.00	0.0026 + j 0.0213	13.38
	Walker #1 EQ 27.6 kV	0.0035 + j 0.1264	36.11	0.0341 + j 1.632	45.86
	Walker #2 BY 27.6 kV	0.0053 + j 0.1474	27.81	0.0096 + j 0.4072	34.75
10	Ford EEP Z1E 115 kV	0.002 + j 0.0265	13.25	0.0043 + j 0.0251	9.41
	Ford EEP Z7E 115 kV	0.002 + j 0.0265	13.25	0.0043 + j 0.0251	9.41
	Ford EEP ESS 13.8 kV	0.0087 + j 0.2367	27.21	0.0221 + j 0.9779	36.74
11	Ford E8F 115 kV	0.0018 + j 0.0255	14.17	0.004 + j 0.0274	10.32
	Ford E9F 115 kV	0.0018 + j 0.0255	14.17	0.004 + j 0.0274	10.32
	Ford WIN 27.6 kV	0.0028 + j 0.1372	49.00	0.0155 + j 0.4643	35.01
12	Ford Annex E8F 115 kV	0.0016 + j 0.0243	15.19	0.0044 + j 0.0247	9.64
	Ford Annex E9F 115 kV	0.0016 + j 0.0243	15.19	0.0044 + j 0.0247	9.64
	Ford Annex 13.8 kV	0.006 + j 0.2297	38.28	16.0606 + j 0.4069	0.05
13	GM Motors E8F 115 kV	0.0014 + j 0.0234	16.71	0.004 + j 0.0226	10.21
	GM Motors E9F 115 kV	0.0014 + j 0.0234	16.71	0.004 + j 0.0226	10.21
	GM Motors 27.6 kV	0.0064 + j 0.1777	27.77	0.0154 + j 0.4619	28.98
14	Chrysler E8F 115 kV	0.0011 + j 0.0219	19.91	0.0018 + j 0.0187	15.63
	Chrysler E9F 115 kV	0.0011 + j 0.0219	19.91	0.0018 + j 0.0187	15.63
	Chrysler 27.6 kV	0.0049 + j 0.1922	39.22	0.0153 + j 0.4603	33.65
15	East Windsor E8F 115 kV	0.0019 + j 0.0257	13.53	0.0041 + j 0.0278	10.03
	East Windsor E9F 115 kV	0.0018 + j 0.0256	14.22	0.0041 + j 0.0276	10.23
16	Lauzon C23Z 230 kV	0.002 + j 0.0358	17.90	0.0012 + j 0.0295	19.44
	Lauzon C24Z 230 kV	0.0021 + j 0.0367	17.48	0.0012 + j 0.0299	19.13
	Lauzon 115 kV	0.0016 + j 0.0236	14.75	0.0006 + j 0.0145	16.24
	Lauzon BQ 27.6 kV	0.0051 + j 0.1546	30.31	0.0064 + j 0.3124	37.45
	Lauzon EJ 27.6 kV	0.0056 + j 0.1488	26.57	0.0069 + j 0.3142	33.80
17	Belle River K2Z 115 kV	0.008 + j 0.0691	8.64	0.0355 + j 0.1568	5.73
	Belle River K6Z 115 kV	0.007 + j 0.0595	8.50	0.0102 + j 0.1002	9.06
	Belle River 27.6 kV	0.0106 + j 0.1911	18.03	0.0112 + j 0.4622	26.06
18	Kingsville K2Z 115 kV	0.0137 + j 0.1069	7.80	0.0201 + j 0.1777	8.24
	Kingsville K6Z 115 kV	0.0161 + j 0.1101	6.84	0.0928 + j 0.3613	4.65
	Kingsville 27.6 kV	0.0164 + j 0.1317	8.03	0.0098 + j 0.2934	13.07
19	Tilbury 115 kV	0.0335 + j 0.1493	4.46	0.0836 + j 0.3678	4.42
	Tilbury 27.6 kV	0.1138 + j 1.4441	12.69	-	-
	Tilbury West 115 kV	0.0335 + j 0.1494	4.46	0.0836 + j 0.368	4.43

	Tilbury West WB1 27.6 kV	0.0686 + j 0.766	11.17	0.0295 + j 0.5936	12.75
	Tilbury West WB2 27.6 kV	0.0727 + j 0.8287	11.40	0.0295 + j 0.5854	12.82
20	Port Alma 1/2 C24Z 230 kV	0.0019 + j 0.0296	15.58	0.0015 + j 0.0352	17.81
	Port Alma 1 34.5 kV	0.0018 + j 0.0612	34.00	-	-
	Port Alma 2 34.5 kV	0.0016 + j 0.0672	42.00	-	-
21	Dillon C23Z 230 kV	0.0012 + j 0.0144	12.00	0.002 + j 0.0252	12.27
	Dillon CGS 230 kV	0.0013 + j 0.0145	11.15	0.002 + j 0.0252	11.78
	Dillon 34.5 kV	0.0035 + j 0.0695	19.86	-	-
22	Spence W45LC 230 kV	0.0014 + j 0.0145	10.36	0.0043 + j 0.0347	8.97
	Spence CGS 230 kV	0.0027 + j 0.0225	8.33	0.0047 + j 0.0384	8.26
	Spence 34.5 kV	0.0077 + j 0.0556	7.22	-	-
23	Gosfield K2Z 115 kV	0.0122 + j 0.1006	8.25	0.0045 + j 0.1258	11.31
	Gosfield 34.5 kV	0.0109 + j 0.2335	21.42	-	-
24	Comber West C23Z 230 kV	0.0025 + j 0.0363	14.52	0.0024 + j 0.0254	13.24
	Comber West 34.5 kV	0.0054 + j 0.0862	15.96	-	-
25	Comber East C24Z 230 kV	0.0028 + j 0.0376	13.43	0.0025 + j 0.0262	12.52
	Comber East 34.5 kV	0.0056 + j 0.0871	15.55	-	-
26	Pointe-Aux-Roches K6Z 115 kV	0.0086 + j 0.0662	7.70	0.0048 + j 0.104	10.75
	Pointe Aux Roches 34.5 kV	0.0123 + j 0.2055	16.71	-	-
27	South Kent Wind Farm 230 kV	0.0043 + j 0.0334	7.77	0.0147 + j 0.102	7.24
	Sth Kent Sattern 34.5 kV	0.0052 + j 0.0853	16.40	0.0036 + j 0.1053	19.71
	Sth kent Railbed 34.5 kV	0.0067 + j 0.0894	13.34	0.0036 + j 0.1053	16.71

Note :

1. Based on Table 12 study conditions given in the Report
2. Negative sequence short-circuit impedance assumed equal to positive sequence short-circuit impedance.
3. X_1/R_1 is the X/R ratio for three-phase fault
4. $(2X_1 + X_0)/(2R_1 + R_0)$ is the X/R ratio for line-to-ground fault.