K2 WIND POWER PROJECT

APPLICATION
of
K2 WIND ONTARIO LIMITED PARTNERSHIP
for
LEAVE TO CONSTRUCT ELECTRICITY TRANSMISSION FACILITY

December 2012

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VIA ELECTRONIC FILING & COURIER

December 21, 2012

Ms. Kirsten Walli
Board Secretary
Ontario Energy Board
2300 Yonge Street
PO Box 2319, 27th Floor
Toronto, ON
M4P 1E4

Dear Ms. Walli:

Re: K2 Wind Ontario Limited Partnership;
Application for Leave to Construct ("Application")
Board File Number EB-2012-0458

We are writing on behalf of K2 Wind Ontario Limited Partnership to file three new documents for inclusion in the Application as Exhibits G-1-1, G-7-1 and G-8-1, respectively: Customer Impact Assessment Report, 2nd Addendum; System Impact Assessment Report, 2nd Addendum; and Notification of Addendum of Conditional Approval to Connection Proposal for the Project. We are also filing revisions to certain pages of Exhibit A-1-1 (Index), B-1-1 (Application) and G-1-1 (Interconnection Overview), to reflect the addition of the three new documents.

Five paper copies of the electronic documents filed today will follow in due course.

Yours very truly,

(signed) Helen T. Newland

Helen T. Newland

HTN/ko

Encls.

cc: Paul F. Wendelgass
K2 Wind Ontario Inc.

Boris de Jong
Capital Power LP

Colin Edwards
Pattern Renewable Holdings Canada ULC

Jeong Taek (JT) Lee
Samsung Renewable Energy Inc.

David Richmond
Ontario Energy Board

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LIST OF DEFINITIONS

Aboriginal Communities	The Initial Aboriginal Communities and the Additional Aboriginal Communities
ACW Township	The Township of Ashfield-Colborne-Wawanosh
Additional Aboriginal Communities	Chippewas of the Thames First Nation – Chippewas of the Thames 42; Aamjiwnaang First Nation – Sarnia 45; Bkejwanong Territory Walpole Island First Nation – Walpole Island 46; and Great Lakes Métis Council
Applicant or K2 Wind	K2 Wind Ontario Limited Partnership
Ashfield Switching Station	Proposed switching station that will be constructed by Hydro-One Networks Inc. to allow for the interconnection of the K2 Wind Power Project to a 500kV Hydro-One Networks Inc. transmission line
Board or OEB	Ontario Energy Board
CIA	Customer Impact Assessment Report
Collectors	34.5 kV lines comprising the K2 Collector System
Consultation Program	A comprehensive and inclusive stakeholder consultation program developed by K2 Wind[1]
GEIA	Green Energy Investment Agreement between the Korean Consortium (Samsung C&T Corp. and Korean Electric Power Corp.) and the Ministry of Energy and Infrastructure, signed on January 10, 2010 and amended on July 29, 2011
GEA	*Green Energy Act, 2009*, S.O. 2009 c. 12, Sched. A
IESO	Independent Electricity System Operator
Initial Aboriginal Communities	Chippewas of Kettle and Stony Point First Nation – Kettle Point 44; Chippewas of Nawash Unceded First Nation; Historic Saugeen Métis; the Métis Nation of Ontario; Saugeen First Nation; and Saugeen Ojibway Nation

[1] Please note that prior to the establishment of K2 Wind, consultations were undertaken by Capital Power.

K2 Substation	Transformer that will step up half of the 34.5 kV lines from the Projects wind turbine and the 230 kV K2 Transmission Line to 500 kV
K2 Collector System	A 34.5 kV collector system comprising ten, 34.5 kV circuits, each of which will be connected to between 13 and 16 turbines
K2 Transformer Station	Transformer that will step up half of the 34.5 kV lines from the Project's wind turbines to 230 kV
K2 Transmission Line	Underground 230 kV transmission line extending approximately 5.1 km from the K2 Transformer Station to the K2 Substation.
K2 Wind Ontario	K2 Wind Ontario Inc
km	kilometer
kV	kilovolts
Hydro One	Hydro-One Networks Inc.
MNR	Ontario Ministry of National Resources
MOE	Ontario Ministry of the Environment
MVA	megavolt amperes
MW	megawatts
OEB Act	*Ontario Energy Board Act, 1998*, S.O. 1998, c. 15, Sched. B
Project	K2 Wind Power Project, a 140 turbine, 270 MW wind plant
Proposed Facilities or Transmission Facilities	K2 Transformer Station, K2 Transmission Line, and K2 Substation
REA	Approval pursuant to Ontario Regulation 359/09: Renewable Energy Approvals Under Part V.0.1 of the *Environmental Protection Act*
SIA	System Impact Assessment Report
Switching Station	Ashfield Switching Station to be constructed by Hydro One adjacent to the K2 Substation

TAB B-1-1

ONTARIO ENERGY BOARD

IN THE MATTER OF the *Ontario Energy Board Act, 1998*, S.O. 1998, c. 15, Sch. B, as amended;

AND IN THE MATTER OF an Application by K2 Wind Ontario, LP for an order under section 92 and subsection 96(2) of the *Ontario Energy Board Act, 1998,* granting leave to construct an electricity transmission line and related transmission facilities.

APPLICATION FOR LEAVE TO CONSTRUCT

A. The Applicant

1. K2 Wind Ontario Limited Partnership ("**K2 Wind** or the **"Applicant**"), a limited partnership constituted under the laws of the Province of Ontario, is a partnership among CP K2 Holdings Inc., an Ontario corporation (33.33%); Pattern K2 LP Holdings LP, an Ontario limited partnership (33.33%); Samsung Renewable Energy Inc., an Ontario corporation, (33.33%); and K2 Wind Ontario Inc., an Ontario corporation, as the general partner of K2 Wind (0.01%).

2. CP K2 Holdings Inc. is an affiliate of Capital Power L.P. and both are wholly-owned subsidiaries of the Capital Power Corporation, headquartered in Edmonton, Alberta. Capital Power Corporation develops, acquires, operates, and optimizes power generation from a variety of energy sources. It owns more than 3,300 megawatts ("**MW**") of power generation capacity at 16 facilities across North America. An additional 487 MW of wind generation capacity is under

construction or in advanced development in British Columbia, Alberta, and Ontario.

3. Pattern K2 LP Holdings LP is an affiliate of Pattern Renewable Holdings Canada ULC and both are wholly-owned subsidiaries of the Pattern Energy Group LP, located in San Francisco. The Pattern Energy Group LP is actively engaged in the renewable energy business in Ontario and in other Canadian provinces. This activity includes the development, construction, operation and maintenance of wind plants.

4. Samsung Renewable Energy Inc. is a wholly owned subsidiary of Samsung C&T Corporation, an affiliate of the Samsung Group of Companies located in Seoul, Korea. The Samsung Group of Companies is at the forefront of renewable energy development in Ontario, including solar and wind turbine manufacturing.

5. K2 Wind Ontario Inc., ("**K2 Wind Ontario**") is owned by Capital Power Generation Services Inc., an Alberta corporation (25%); Pattern K2 GP Holdings Inc., an Ontario corporation (25%); and SRE Wind GP Holdings Inc., an Ontario corporation (50%). By Unanimous Shareholders' Agreement, the shareholders of K2 Wind Ontario have agreed that following completion of the K2 Wind Power Project, SRE Wind GP Holdings Inc. will transfer a portion of its shares to Capital Power Generation Services Inc. and Pattern K2 GP Holdings Inc. for nominal consideration, so that the shareholders will then hold shares in the general partner in proportion to their interests (including interests held by affiliates) in the Applicant.

6. A chart that depicts the underlying ownership structure of the Applicant, as described above, is included at Tab 2, of this Exhibit.

B. The Applied-for Transmission Facilities

7. The Green Energy Investment Agreement (the "**GEIA**") between the Korean Consortium (Samsung C&T Corp. and Korean Electric Power Corp.) and the Minister of Energy and Infrastructure for Ontario, on behalf of the Province of Ontario, was signed on January 10, 2010 and amended on July 29, 2011. Under the GEIA, the Korean Consortium will construct 2,500 megawatts of wind and solar power and will develop renewable energy manufacturing facilities in Ontario.

8. This application is in respect of the transmission facilities associated with one such project, the K2 Wind Power Project (the "**Project**"). This 140 turbine Project will contribute 270 MW of clean, renewable energy to Ontario's electricity grid and will further Ontario's objective of significantly increasing the amount of renewable electricity generated in the province. The Applicant signed a Power Purchase Agreement with the Ontario Power Authority on August 3, 2011 in respect of the Project.

9. The Applicant proposes to construct the following transmission facilities to connect the Project to the Independent Electricity System Operator ("**IESO**") – controlled transmission grid:

   (a) the K2 Wind Transformer Station (the "**K2 Transformer Station**"), comprising a 96/128/160 megavolt amperes ("**MVA**") transformer and associated facilities that will step up, to 230 kilovolt ("**kV**"), electricity conveyed by five of the ten 34.5 kV distribution lines ("**Collectors**") extending from the Project's wind turbines;

   (b) the K2 Wind Transmission Line (the "**K2 Transmission Line**"), comprising an underground 230 kV transmission line, extending from a point of interconnection with the K2 Transformer Station, approximately 5.1

kilometres ("**km**"), to a point of interconnection with the K2 Wind Substation (the "**K2 Substation**").

(c) the K2 Substation, comprising one 500/34.5 kV transformer rated at 105/140/175 MVA and one 500/230 kV transformer rated at 96/128/160 MVA, both of which will step up to 500 kV, the electricity conveyed by five of the ten, 34.5 kV Collectors and by the 230 kV K2 Transmission Line. The K2 Substation will be constructed adjacent to the Ashfield Switching Station ("**Switching Station**") that will be constructed by Hydro-One Networks Inc. ("**Hydro One**") The interconnection between the K2 Substation and the Switching Station will facilitate the transfer of electricity from the Project to an existing Hydro One 500 kV transmission line and, thus, into the IESO-controlled grid.

10. The above-described K2 transmission facilities (collectively, the "**Proposed Facilities**" or the "**Transmission Facilities**")[1] are more particularly described in Exhibit E.

11. The location of each component of the Proposed Facilities is more particularly described in Exhibit D.

12. Construction of the Proposed Facilities is scheduled to commence in mid to late 2013, with an in-service date scheduled for late 2014. Details of the project schedule, including a Gantt chart, are provided in Exhibit C, Tab 2, Schedule 1.

C. <u>Land Requirements</u>

13. The K2 Transmission Line will be located both within easements on private land in the Township of Ashfield-Colborne-Wawanosh ("**ACW Township**") and in the municipal right-of-way belonging to ACW Township. Maps indicating the route of

[1] The Proposed Facilities that are the subject of this applicant do not include the proposed Hydro One Switching Station that will be constructed by Hydro One or the existing Hydro One 500 kV transmission line.

the K2 Transmission Line and the locations of the K2 Transformer Station and K2 Substation are included at Exhibit D.

14. The Applicant has entered into Easement Option Agreements with relevant landowners with respect to the segments of the K2 Transmission Line that will be located on private land. The form of Easement Option Agreement and form of Grant of Easement Agreement are included at Exhibit F, Tab 3, Schedules 1 and 2, respectively.

15. The Applicant has negotiated a Road-Use Agreement with ACW Township with respect to the segments of the K2 Transmission Line that will be located within municipal right-of-ways. Final terms have been agreed upon and a draft agreement was forwarded to ACW Township on September 28, 2012 for its approval.

16. The K2 Transformer Station will be located on leased private land. K2 Wind has entered into an Option to Lease Agreement in respect of the subject property. This agreement is included at Exhibit F, Tab 2, Schedule 1.

17. Both the K2 Substation and the Hydro One Switching Station will be situated on land owned by the Applicant. K2 Wind has entered into an Option to Purchase Agreement in respect of the subject property and the form of this agreement is included at Exhibit F, Tab 2, Schedule 2. K2 Wind intends to sever and sell a portion of this property to Hydro One for the purpose of constructing and operating the Switching Station. K2 Wind will continue to own the property where the K2 Substation will be situated.

D. **Interconnection**

18. The process by which the Proposed Facilities will be connected to the transmission facilities of Hydro One is well underway. On February 24, 2012, the IESO issued its final System Impact Assessment ("**SIA**") Report and Hydro

One issued its final Customer Impact Assessment ("**CIA**") Report. The IESO issued a SIA Addendum on June 15, 2012.

19. As a result of subsequent changes to the configuration of the Project[2], K2 Wind applied to the IESO and to Hydro One on August 28, 2012 for amendments to the SIA and CIA. Hydro One issued the CIA 2nd Addendum on December 4, 2012. Hydro One's assessment confirmed that the Project can be incorporated without adverse impact on customers. The IESO issued the SIA 2nd Addendum on December 7, 2012. The IESO's assessment concluded that the proposed changes are expected to have no material adverse impact on the reliability of the integrated power system. On December 7, 2012 the IESO issued a *Notification of Addendum of Conditional Approval to Connection Proposal* for the Project, subject to implementation of the requirements outlined in the original SIA, the SIA Addendum and the SIA 2nd Addendum.

20. Versions of the SIA and CIA that were approved before the Project configuration changes are included in Exhibit G, Tabs 2 and 3, respectively. The SIA Addendum is included in Exhibit G, Tab 4. The SIA and CIA amendment applications, submitted by the Applicant to the IESO and Hydro One, are included at Exhibit G, Tab 5. The CIA 2nd Addendum and the SIA 2nd Addendum are included at Exhibit G, Tabs 6 and 7, respectively. The Notification of Addendum of Conditional Approval to Connection Proposal is included at Exhibit G, Tab 8.

21. In constructing the Project, the Applicant will adhere to the requirements stipulated in the final SIA, the SIA Addendum, the SIA 2nd Addendum, the final CIA and the SIA 2nd Addendum, as amended.

E. **Renewable Energy Approval**

[2] The configuration changes included changes to the number of turbines attached to various circuits which, in turn, changed the levels of impedance; changes to the length of some circuits; and a increase in the voltage of the K2 Transmission Line from 130 kV to 230 kV.

22. Pursuant to the *Green Energy Act, 2009*, the Project requires approval under Ontario Regulation 359/09 (Renewable Energy Approvals ("**REA**")) made pursuant to the *Environmental Protection Act*. The REA process consolidates approvals formerly required under the *Environmental Assessment Act,* the *Planning Act,* and the *Environmental Protection Act.*

23. On November 13, 2012, K2 Wind filed an application with Ministry of the Environment ("**MOE**") for its Class 4 wind facility REA. A decision is expected in mid-2013.

24. In accordance with the REA requirements, the Applicant has prepared a Project Description Report (November 2012) that is intended to provide the public, Aboriginal communities, municipalities, and regulatory agencies with an understanding of the Project, including any associated environmental effects. A copy of the Project Description Report is included at Exhibit H, Tab 1.

25. The Project Description Report described two transmission line routes: a preferred route and an alternate route. Both routes have similar environmental and technical characteristics. K2 Wind has decided to pursue the preferred route for the K2 Transmission Line since this route is adjacent to a larger number of Project participants.[3]

26. K2 Wind received the Archaeological Assessment final confirmation letter from the Ministry of Tourism, Culture and Sport, on October 16, 2012. It received the Natural Heritage Assessment final confirmation letter from the Ministry of Natural Resources ("**MNR**") on August 13, 2012. The assessments and the confirmation letters are available on the K2 Wind's website.

27. A table that lists all of the federal, provincial and municipal authorizations and permits that will be required by the Project (including by the Proposed Facilities) is included at Exhibit H, Tab 2, Schedule 1.

[3] "Project participants" are landowners who have entered into land agreements with K2 Wind.

F. Stakeholder Consultation

28. As part of the REA application process, the Applicant has conducted extensive consultation with stakeholders and potentially affected parties, including individuals, government agencies and Aboriginal peoples. An overview of consultation activities, to date, is included at Exhibit I, Tab 1, Schedule 1. Public notices regarding the Project and open house meetings are included at Exhibit I, Tab 2, Schedule 1. The display boards from the final public meeting are included at Exhibit I, Tab 2, Schedule 2. A list of stakeholder comments that have been received and the corresponding responses of K2 Wind are included at Exhibit I, Tab 3, Schedule 1. A map showing all properties within 550 m of the Proposed Facilities is included at Exhibit I, Tab 3, Schedule 2. A communications log of all consultations with Aboriginal peoples is included at Exhibit I, Tab 4, Schedule 1.

G. Applied-for Relief

29. In the result, the Applicant hereby applies to the Ontario Energy Board (the "**OEB**" or "**Board**") pursuant to the *Ontario Energy Board Act, 1998* (the "**OEB Act**") for:

    (i) leave to construct the Proposed Facilities Facilities pursuant to section 92 and subsection 96(1) of the OEB Act; and

    (ii) approval of the forms of lease, purchase and easement agreements (included in Exhibit F, Tab 2, Schedules 1, 2 and 3) pursuant to section 97 of the OEB Act.

30. The construction of the Proposed Facilities are in the overall public interest within the meaning of subsection 96(2) of the OEB Act because:

    (i) the Proposed Facilities will facilitate the transfer of 270 MW of clean, renewable energy to Ontario's electricity grid and will further

Ontario's objective of significantly increasing the amount of renewable electricity generated in the province;

(ii) the cost of the construction of the Proposed Facilities will be borne entirely by the Applicant and not by electricity ratepayers; and

(iii) the SIA (and the Addendum) and CIA Reports filed as part of this application support the conclusion that the interconnection of the Proposed Facilities with the IESO-controlled grid will not adversely affect the reliability and quality of electricity service in Ontario**.**

31. Pursuant to ss. 34.01 and 34.02 of the Board's Rules of Practice and Procedure, the Applicant requests that this proceeding be conducted through a written hearing.

32. The following are the names of K2 Wind's authorized representatives and its counsel for the purpose of serving documents on the Applicant in this proceeding:

(a) authorized representatives:

Paul F. Wendelgass
K2 Wind Ontario Inc.

Address for personal service and mailing address:	70 York Street, Suite 1720 Toronto, ON M5J 1S9
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Dated December 5, 2012 at Toronto, Ontario

K2 Wind Ontario, LP
by its counsel
Fraser Milner Casgrain LLP

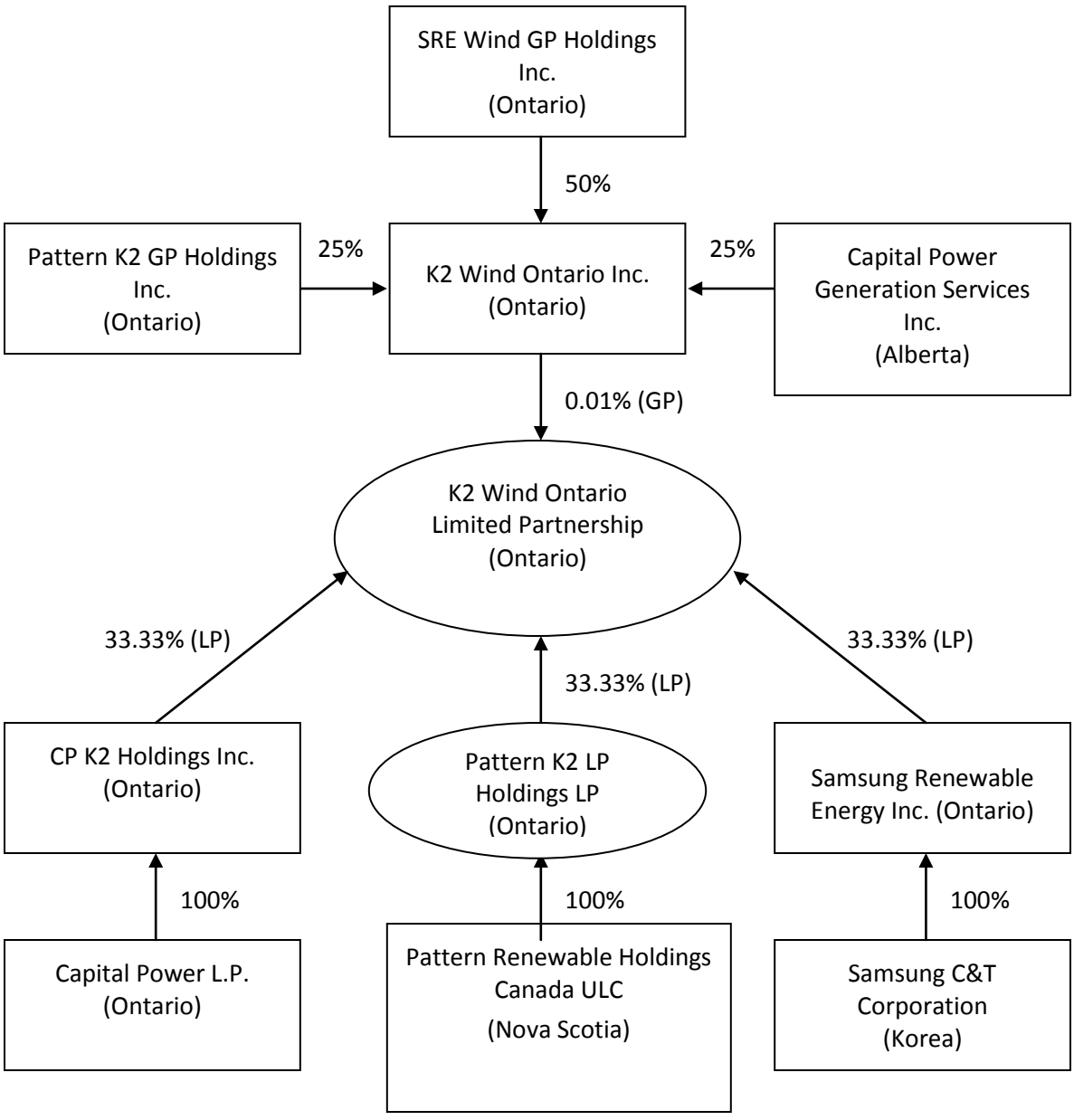
per: ***(signed) Helen T. Newland***

H.T. Newland

TAB B-2-1

APPLICATION – OWNERSHIP STRUCTURE CHART

Figure B-1: K2 Wind Ontario Limited Partnership Ownership Structure



TAB C-1-1

PROJECT OVERVIEW

A. Wind Plant and Related Facilities

The Applicant is proposing to construct and operate a 140 turbine, 270 MW wind plant on approximately 190 km^2 of private land in ACW Township as follows:

- 140 Siemens SWT-2.3 wind-powered turbines that have an individual nameplate capacity between 1.824 and 2.300 MW;
- padmount transformers on the ground adjacent to the tower of each wind turbine to step up the electricity generated in the nacelle to a standard operating power line voltage (i.e. 690 V to 34.5 kV);
- a 34.5 kV collector system comprising ten, 34.5 kV Collectors, each of which will be connected to between 13 and 16 turbines; five Collectors will connected to the K2 Substation and five Collectors will be connected to the K2 Transformer Station;
- three meterological towers free standing or supported by guy wires; and
- access roads connecting municipal roads to the turbine location.

The information set out above is included in the Application to provide context only and is not the subject of the relief sought herein.

B. Transmission and Related Facilities

The Proposed Facilities that are the subject of this application comprise:

- the K2 Transformer Station;
- the K2 Substation; and
- the K2 Transmission Line.

The K2 Transformer Station, which will step up electricity conveyed by five of the Collectors, will comprise a single 230/34.5 kV transformer rated at 96/128/160 MVA. The K2 Transformer Station will occupy approximately 0.5 hectares of the 4.05 hectare site. The 0.5 hectare K2 Transformer Station will be surrounded by a chain-link fence. The visual impact of the site will be mitigated by measures that may include the construction of a surrounding berm and strategic landscaping.

The K2 Transmission Line will comprise an underground, 230 kV transmission line that will extend approximately 5.1 km from a point of interconnection with the K2 Transformer Station to a point of interconnection with the K2 Substation. It will connect the K2 Transformer Station to the K2 Substation.

The K2 Substation, which will step up the electricity conveyed by five Collectors, as well as the electricity conveyed by the K2 Transmission Line, will comprise two transformers: a 500/34.5 kV transformer, rated at 105/140/175 MVA and a 500/230 kV transformer, rated at 96/128/160 MVA. The K2 Substation and the K2 Transformer Station will also house protection and control equipment as required by the *Transmission System Code*, the SIA and the CIA.

The K2 Substation will be constructed adjacent to the proposed Hydro One Switching Station so as to facilitate the interconnection with an existing 500 kV Hydro One transmission line. The interconnection between the K2 Substation and the Switching Station will be in a form acceptable to Hydro One, likely an above-ground busbar connection. Together, the K2 Substation and the proposed Hydro One Switching Station will compromise approximately 8 hectares of the 40 hectare property. The 8 hectares occupied by the K2 Substation and the proposed Hydro One Switching Station will be surrounded by a chain-link fence. The visual impact will be mitigated by measures that may include the construction of a surrounding berm and strategic landscaping.

Technical details of the transmission equipment are setout in Exhibit E, Tab 2, Schedule 2.

C. Project Schedule

The Project, including the associated Proposed Facilities, is scheduled to be in-service by late 2014. A Gantt chart detailing timelines for construction and approval of the Proposed Facilities is provided at Tab 2 of this Exhibit.

Although it is anticipated that construction will commence in mid to late 2013, with an in-service date of late 2014, a number of factors could affect this timeline. These include, but are not limited to: delays in obtaining required approvals, project materials or qualified contractors; delays in completing a connection and cost recovery agreement with Hydro One; limited construction windows due to environmental constraints; and other adverse conditions.

TAB C-2-1

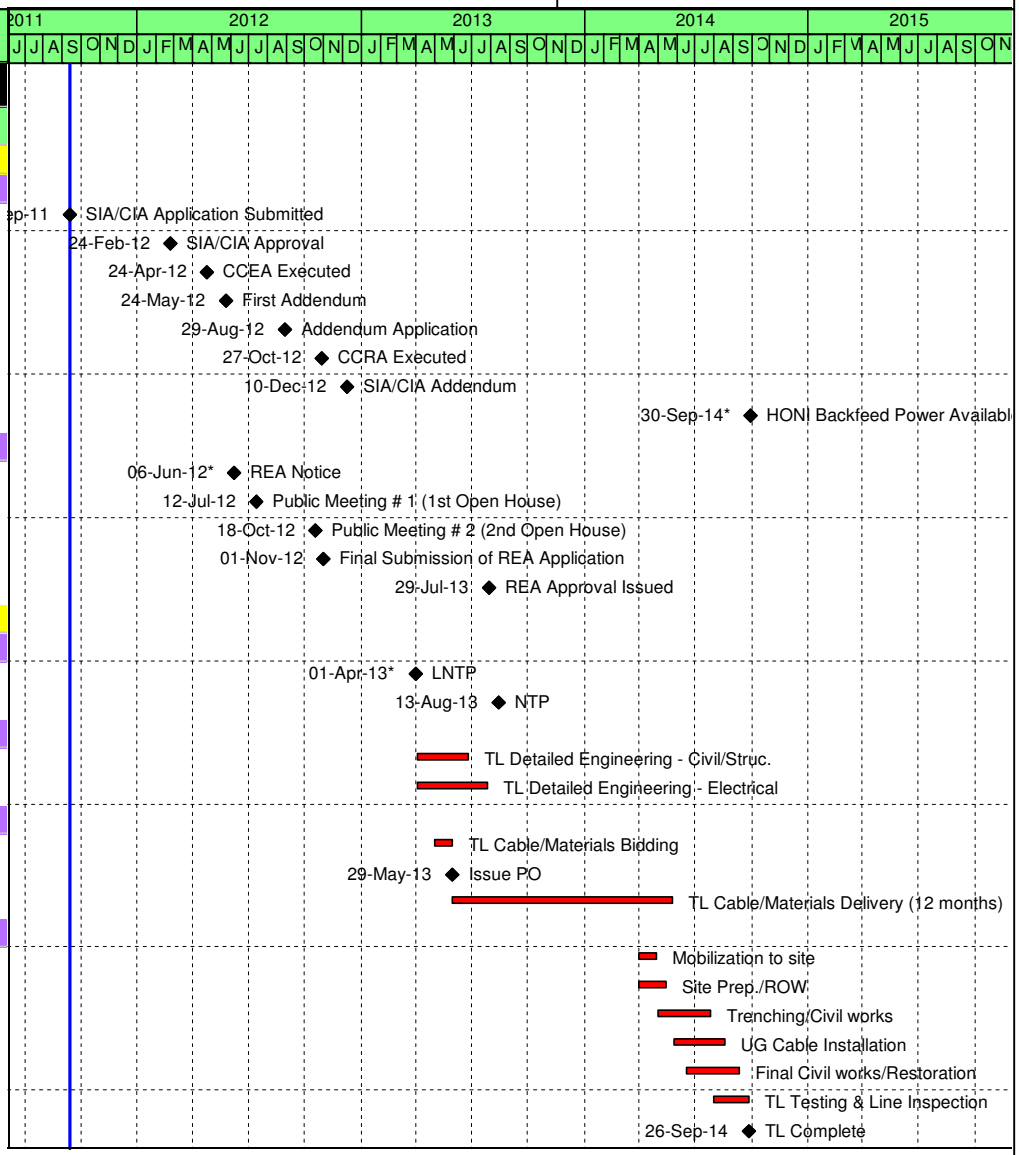
PROJECT SCHEDULE

K2 Wind Power Project, TL

Project Schedule

K2 Wind Ontario

Activity ID	Activity Name	Durati...	Start	Finish
K2 Wind Power Project 270 MW		1381D	12-Sep-11	30-Sep-14
Transmission Line (5.1 km)		1381D	12-Sep-11	30-Sep-14
Development Phase		1381D	12-Sep-11	30-Sep-14
SIA/CIA Process		1381D	12-Sep-11	30-Sep-14
2201-000	SIA/CIA Application Submitted	0D		12-Sep-11
2201-020	SIA/CIA Approval	0D		24-Feb-12
2201-030	CCEA Executed	0D		24-Apr-12
2201-040	First Addendum	0D		24-May-12
2201-050	Addendum Application	0D		29-Aug-12
2201-060	CCRA Executed	0D		27-Oct-12
2201-070	SIA/CIA Addendum	0D		10-Dec-12
2201-080	HONI Backfeed Power Available	0D		30-Sep-14*
REA (Renewable Energy Approval)		511D	06-Jun-12	29-Jul-13
2202-010	REA Notice	0D		06-Jun-12*
2202-020	Public Meeting # 1 (1st Open House)	0D		12-Jul-12
2202-030	Public Meeting # 2 (2nd Open House)	0D		18-Oct-12
2202-040	Final Submission of REA Application	0D		01-Nov-12
2202-050	REA Approval Issued	0D		29-Jul-13
EPC Construction Phase		679D	01-Apr-13	26-Sep-14
EPC Milestones		168D	01-Apr-13	13-Aug-13
5100-010	LNTP	0D		01-Apr-13*
5100-020	NTP	0D		13-Aug-13
Engineering		144D	02-Apr-13	25-Jul-13
5101-010	TL Detailed Engineering - Civil/Struc.	60D	02-Apr-13	26-Jun-13
5101-020	TL Detailed Engineering - Electrical	80D	02-Apr-13	25-Jul-13
Procurement		486D	01-May-13	24-May-14
5102-010	TL Cable/Materials Bidding	20D	01-May-13	29-May-13
5102-020	Issue PO	0D		29-May-13
5102-030	TL Cable/Materials Delivery (12 mon...	360D	30-May-13	24-May-14
Construction		224D	01-Apr-14	26-Sep-14
5103-020	Mobilization to site	20D	01-Apr-14*	29-Apr-14
5103-025	Site Prep./ROW	30D	01-Apr-14	13-May-14
5103-030	Trenching/Civil works	60D	01-May-14	25-Jul-14
5103-040	UG Cable Installation	60D	26-May-14	19-Aug-14
5103-050	Final Civil works/Restoration	60D	16-Jun-14	10-Sep-14
5103-060	TL Testing & Line Inspection	40D	31-Jul-14	26-Sep-14
5103-070	TL Complete	0D		26-Sep-14



Remaining Level of Effort

Remaining Work

14-Sep-12

File Name: K2 Wind TL

WO#: 161.973

Date	Revision	Chec...	Appro...
14-S...	Proposal Schedule R2	AA	

TAB D-1-1

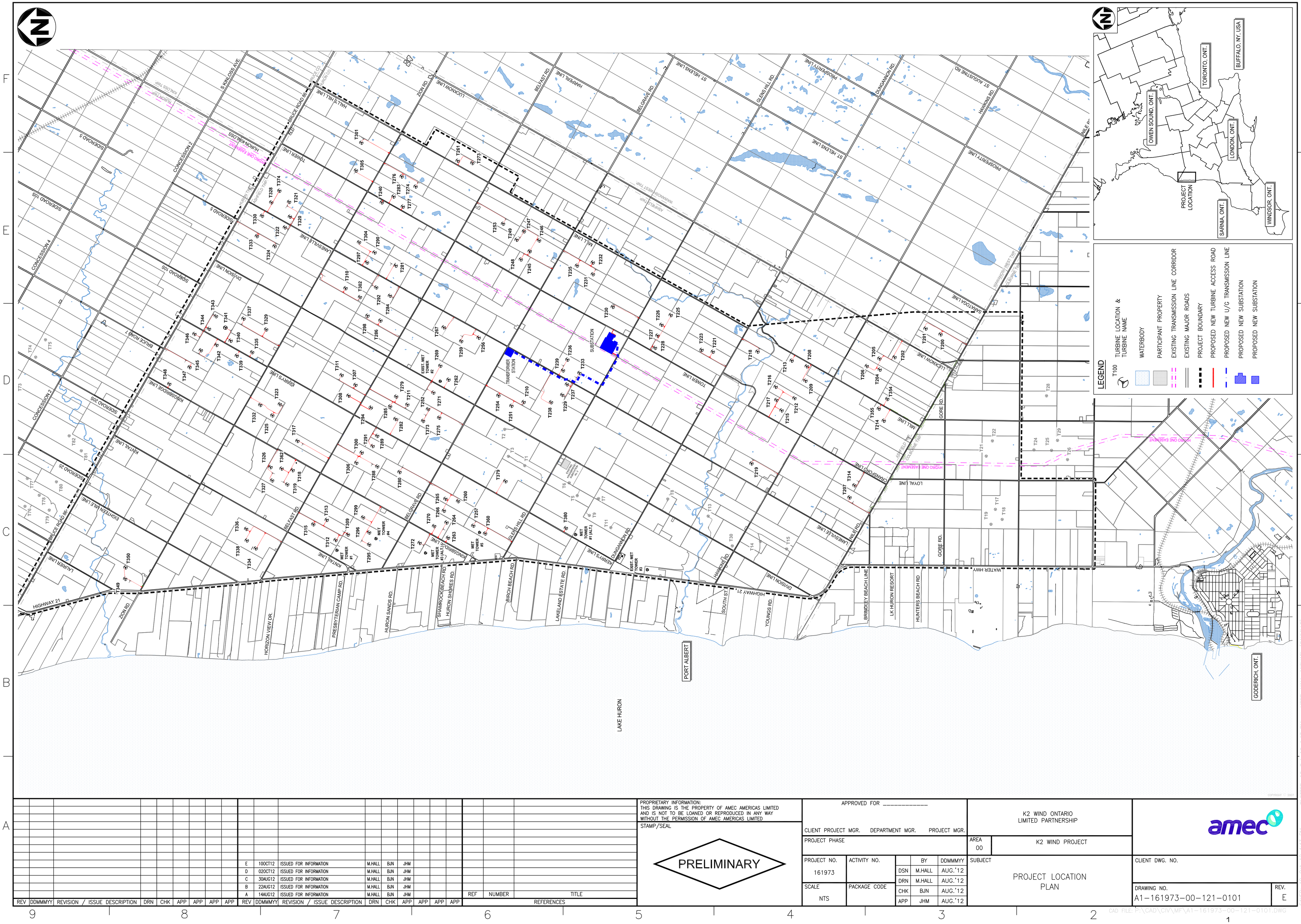
PROJECT LOCATION

The Project will be constructed on approximately 190 km^2 of private land in ACW Township. The project area is bounded by Bruce County Road 86 (Amberley Road) to the north; Bluewater Highway (Highway 21) to the west; Golf Course Road to the south, and Hall's Hills / Lucknow Line / Saratoga Line to the east.

A map that shows the location of the Project in a regional context is included at Exhibit D, Tab 1, Schedule 2.

TAB D-1-2

PROJECT MAP



REV	DDMMMYY	REVISION / ISSUE DESCRIPTION	DRN	CHK	APP	APP	APP	APP
E	10OCT12	ISSUED FOR INFORMATION	M.HALL	BJN	JHM			
D	02OCT12	ISSUED FOR INFORMATION	M.HALL	BJN	JHM			
C	30AUG12	ISSUED FOR INFORMATION	M.HALL	BJN	JHM			
B	22AUG12	ISSUED FOR INFORMATION	M.HALL	BJN	JHM			
A	14AUG12	ISSUED FOR INFORMATION	M.HALL	BJN	JHM			

REF	NUMBER	TITLE

REFERENCES

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PRELIMINARY

APPROVED FOR _____

CLIENT PROJECT MGR. DEPARTMENT MGR. PROJECT MGR.

PROJECT PHASE

PROJECT NO.	ACTIVITY NO.		BY	DDMMMYY
161973		DSN	M.HALL	AUG.'12
SCALE	PACKAGE CODE	DRN	M.HALL	AUG.'12
NTS		CHK	BJN	AUG.'12
		APP	JHM	AUG.'12

K2 WIND ONTARIO LIMITED PARTNERSHIP

AREA 00 — K2 WIND PROJECT

SUBJECT

PROJECT LOCATION PLAN

CLIENT DWG. NO.

DRAWING NO. A1-161973-00-121-0101

REV. E

CAD FILE: P:\CAD\CIV\MF\A1-161973-00-121-0101.DWG

PLOTTED: 10-Oct-12 4:47 PM BY: HALL, MICHAEL (OAKVILLE)

SAVED: 10-Oct-12 4:43 PM

TAB D-2-1

LOCATION OF PROPOSED FACILITIES

The K2 Substation will occupy approximately 3 hectares of the 40 hectare site, at the northwest corner of Glens Hill Road and Tower Line in ACW Township.

The K2 Transformer Station will occupy approximately 0.5 hectares of the 4.05 hectare site, at the southwest corner of Belgrave Road and Lanesville Line in ACW Township.

The K2 Transmission Line will be located entirely within ACW Township. It will extend, underground,[1] from the K2 Transformer Station, approximately 5.1 km, to the K2 Substation, as more particularly described as follows below:

- **Segment #1:** commencing at the K2 Transformer Station, 1.95 km in a southwesterly direction, on private land, parallel to and on the west side of Lanesville Line, to a stream crossing of Lanesville Line;

- **Segment #2:** 0.25 km in a southwesterly direction, on private land, parallel to and on the east side of Lanesville Line;

- **Segment #3:** 0.35 km in a southeasterly direction, on private land, perpendicular to Lanesville Line, close to the base of Turbine 233;

- **Segment #4:** 0.7 km in a southwesterly direction, on private land parallel to Lanesville Line and going beneath a small stream before crossing the ACW township municipal right-of-way to reach the south side of Glens Hill Road;

- **Segment #5:** 1.07 km in a southeasterly direction along Glens Hill Road, within the ACW Township municipal right-of-way, until entering the west corner of the K2 Substation property; and

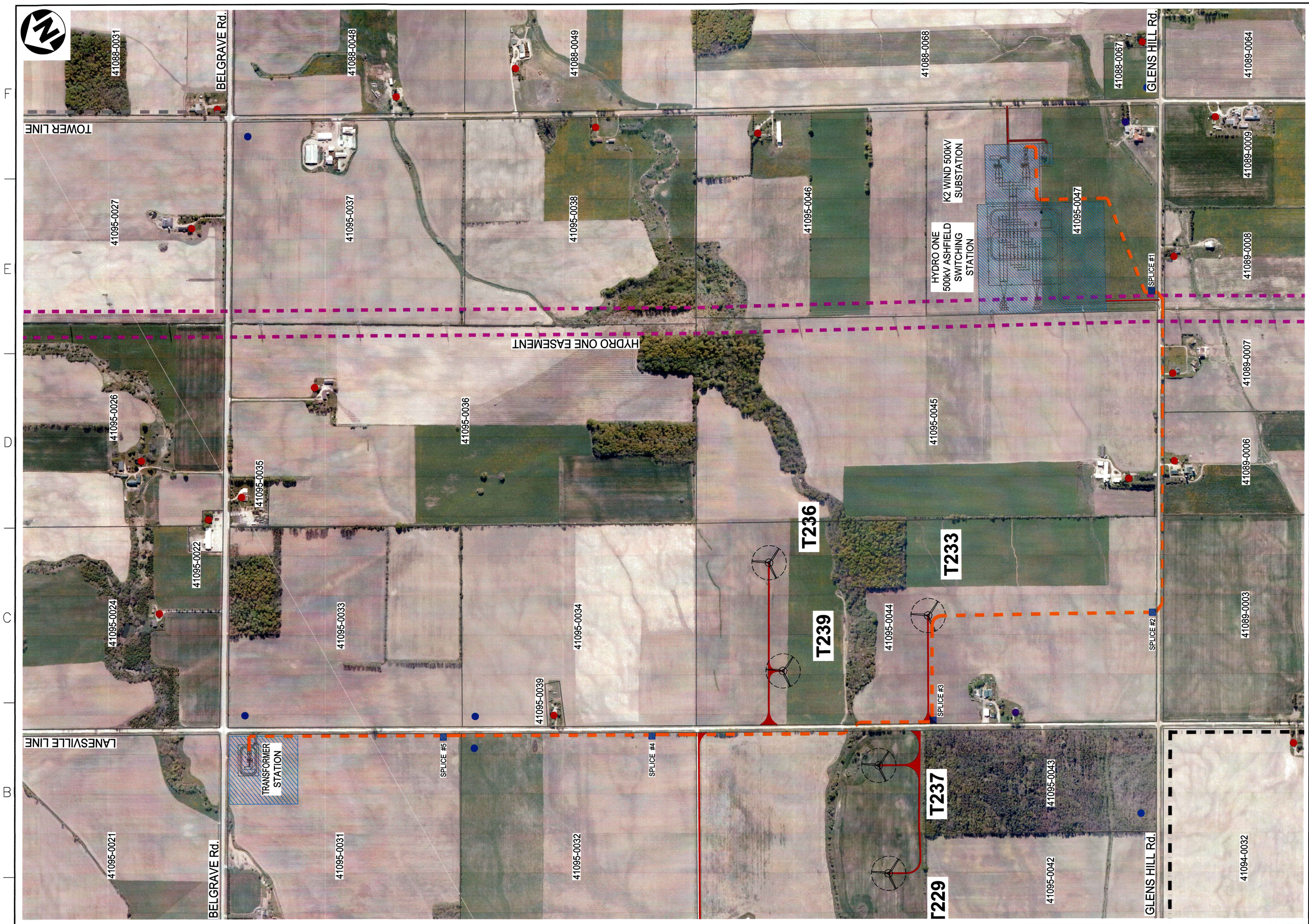
- **Segment #6:** 0.78 km in an easterly direction on the K2 Substation property to a point of interconnection with the K2 Substation.

[1] The K2 Transmission Line will be buried underground for the entire length of its 5.1 km route.

A detailed map showing the route of the K2 Transmission Line, the locations of the K2 Station and K2 Substation and the proposed Hydro One Switching Station is included at Exhibit D, Tab 2, Schedule 2.

TAB D-2-2

MAP OF PROPOSED FACILITIES



NOTES

1. GRID COORDINATES SHOWN ON THIS DRAWING ARE BASED ON UTM NAD 83, ZONE 17.
2. TOPOGRAPHIC INFORMATION AND TURBINE LOCATIONS WERE DERIVED FROM ONTARIO BASE MAPS.
3. TURBINE LOCATIONS WERE PROVIDED BY CAPITAL POWER. TURBINE LOCATIONS ARE BASED ON CAPITAL POWER LAYOUT #194.

LEGEND - EXISTING FEATURES

- EXISTING RECEPTOR
- PROJECT PARTICIPANT
- VACANT LOT RECEPTOR
- EXISTING 500kV TRANSMISSION LINE/ HYDRO ONE EASEMENT

LEGEND - PROPOSED PROJECT COMPONENTS

- T100 TURBINE LOCATION & TURBINE NAME
- PROPOSED TURBINE ACCESS ROAD
- PROPOSED TRANSMISSION LINE
- SUBSTATION/TRANSFORMER STATION
- SPLICE LOCATION

0m 100m 200m 300m 400m 500m

SCALE

REV	DDMMMYY	REVISION / ISSUE DESCRIPTION	DRN	CHK	APP	APP	APP	APP
C	02OCT12	ISSUED FOR INFORMATION	M.HALL	BJN	JHM			
B	17AUG12	ISSUED FOR INFORMATION	M.HALL	BJN	JHM			
A	17JUL12	ISSUED FOR INFORMATION	M.HALL	BJN	JHM			

REF	NUMBER	TITLE
1	161973-121-0101	PROJECT LOCATION PLAN

REFERENCES

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CLIENT PROJECT MGR. DEPARTMENT MGR. PROJECT MGR.

PROJECT PHASE

PROJECT NO.	ACTIVITY NO.
161973	
SCALE	PACKAGE CODE
NTS	

	BY	DDMMMYY
DSN	BJN	JUN.'12
DRN	M.HALL	JUN.'12
CHK	BJN	JUN.'12
APP	JHM	JUN.'12

K2 WIND ONTARIO LIMITED PARTNERSHIP

AREA 00 — K2 WIND POWER PROJECT

SUBJECT

TRANSMISSION LINE ROUTING –PLAN–

CLIENT DWG. NO.

DRAWING NO. A1-161973-00-141-0054

REV. C

amec

USER: HALL, MICHAEL (OAKVILLE)
PLOTTED: 02-Oct-12 10:33 AM
SAVED: 01-Oct-12 6:11 PM

TAB E-1-1

FACILITIES – OVERVIEW

K2 Transformer Station

The K2 Transformer Station will comprise one, 230/34.5 kV transformer rated at 96/128/160 MVA that will step up, to 230 kV, the electricity conveyed by five of the ten 34.5 kV Collectors extending from the Project's wind turbines. The K2 Transformer Station site will include a protection and control building.

A schematic showing the proposed layout of the K2 Transformer Station is included at Exhibit E, Tab 3, Schedule 1. A single-line diagram of the K2 Transformer Station is included at Exhibit E, Tab 3, Schedule 2.

K2 Transmission Line

The K2 Transmission Line is an underground, 230 kV transmission line that will extend approximately 5.1 km, from a point of interconnection with the K2 Transformer Station, to a point of interconnection with the K2 Substation. The line will connect to the K2 Transformer Station site on the east side of the property and to the K2 Substation site on the south side of the property.

Along its 5.1 km route, the K2 Transmission Line will cross two streams and three roads.[1] All crossings will be directionally drilled, with the transmission line installed inside a plastic conduit.

The K2 Transmission Line cable will be laid in trenches approximately 1.0 m wide by 1.2 m deep. The trenches will be excavated using backhoes, trenchers or tracked excavators. The cables will be bedded in crushed limestone (or similar bedding material) and the trench will be backfilled with the excavated native soil. Warning tape will be installed approximately 0.3 m above the cables and will run the length of the

[1] Note that for the crossing under Lanesville Line, the K2 transmission line will cross under a stream as well.

underground cables. The top 0.1 m of soil will be stripped and laid beside the trench to reinstate the original ground level immediately after the installation of the underground cables.

A cross-sectional diagram showing how the K2 Transmission Line will sit in the trench, relative to the road, is included at Exhibit E, Tab 5, Schedule 1.

K2 Substation

The K2 Substation will step up, to 500 kV, electricity conveyed to it by five of the 34.5 kV Collectors extending from the Project's wind turbines as well as by the 230 kV K2 Transmission Line. The K2 Substation building will house two main output transformers: the 500/34.5 kV transformer will be rated at 105/140/175 MVA and the 500/230 kV transformer will be rated 96/128/160 MVA.

The impedance of the two transformers will be selected to meet the short circuit requirements of the Hydro One transmission system and will be determined when the final SIA and CIA Reports, as amended, are issued. All switches and the breakers in the K2 Substation (as well as those in the K2 Transformer Station) will meet the technical specifications and requirements of the IESO Market Rules and the *Transmission System Code*.

The K2 Substation site will also include an operations and maintenance building, a protection and control building, a parking area, a stormwater management system, a septic system and a water well.

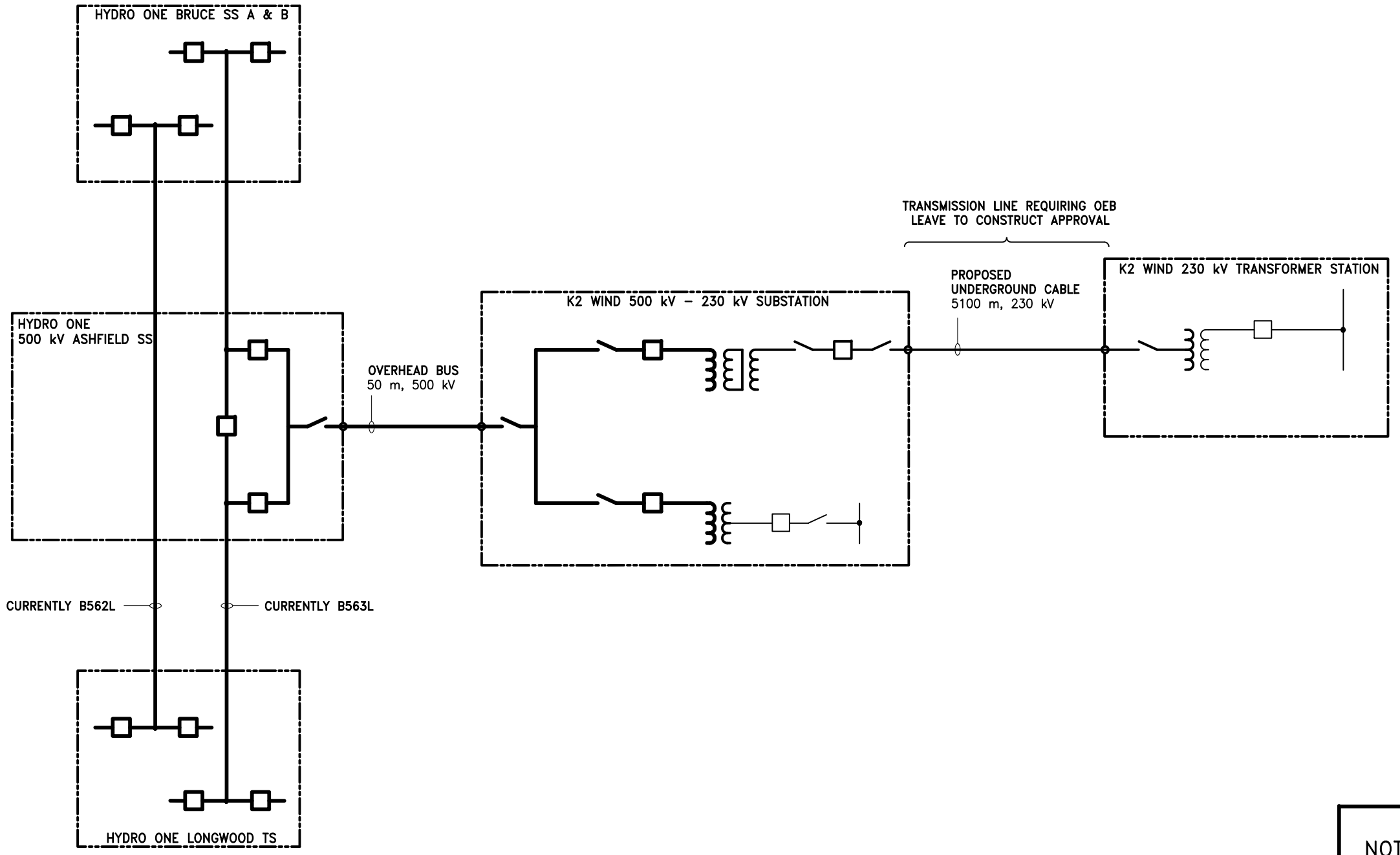
A schematic showing the proposed layout of the K2 Substation is included at Exhibit E, Tab 4, Schedule 1. A single-line diagram of the K2 Substation is included at Exhibit E, Tab 4, Schedule 2.

Applicable Standards and Codes

The Proposed Facilities will be constructed, operated and maintained in accordance with all applicable codes, standards and regulations. In addition, all electrical interconnections will be constructed, operated and maintained in accordance with the requirements stipulated in the final SIA Report and Addendum, as amended. A table that lists all applicable codes, standards and regulations is included at Exhibit E, Tab 6, Schedule 1.

TAB E-2-1

SCHEMATIC OF ELECTRICAL INTERCONNECTIONS



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REV	DDMMMYY	REVISION / ISSUE DESCRIPTION	DRN	CHK	APP	APP	APP	APP
A	11SEP12	ISSUED FOR INFORMATION	RY	BJN	BJN			

REF	NUMBER	TITLE
2	A1-161973-00-141-0656-002	230kV SUBSTATION SINGLE LINE DIAG SHT2/2
1	A1-161973-00-141-0656-001	500kV SUBSTATION SINGLE LINE DIAG SHT1/2

REFERENCES

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APPROVED FOR INFORMATION ONLY

CLIENT PM DEPT MGR PROJ MGR

	BY	DDMMMYY
DSN	BJN	10SEP12
DRN	RY	10SEP12
CHK	BJN	11SEP12
APP	BJN	11SEP12

PROJECT PHASE: LEAVE TO CONSTRUCT

PROJECT NO.: 161973 | ACTIVITY NO.:

SCALE: NTS | PACKAGE CODE:

K2 WIND ONTARIO LIMITED PARTNERSHIP

AREA: K2 WIND POWER PROJECT

SUBJECT: TRANSMISSION INTERCONNECTION DIAGRAM

CLIENT DWG. NO.:

DRAWING NO.: A3-161973-00-141-0658 REV.: A

DWG FILE: \\AMEC-FS01\PROJECTS\CAD FILES\MPC\161973-00-141-0658-001.DWG
SAVED: 11-Sep-12 3:25 PM PLOTTED: 11-Sep-12 4:01 PM USER: YAZDANIE, RABIA

TAB E-2-2

TECHNICAL SPECIFICATIONS OF MAJOR TRANSMISSION EQUIPMENT

MAJOR TRANSMISSION EQUIPMENT RATINGS

1. Transformers

Identification	T10
MVA	105 / 140 / 175
Voltage	530 / 34.5 kV
Basic Impulse Level	1800 kV / 200 kV
Winding connection	YNd1
Positive impedance	Z = 0.00156 + j0.075 on 105 MVA
Taps	OLTC (+/- 2.5% and +/- 5%)

Identification	T20
MVA	96 / 128 / 160
Voltage	530 / 230 kV
Basic Impulse Level	1800 kV / 1050 kV
Winding connection	YNynd1
Positive impedance	Z_{HS} = 0.0016 + j0.078 on 96 MVA
Taps	OLTC (+/- 2.5% and +/- 5%)

Identification	T21
MVA	96 / 128 / 160
Voltage	230 / 34.5 kV
Basic Impulse Level	1050 kV / 200 kV
Winding connection	D1yn
Positive impedance	Z = 0.0016 + j0.080 on 96 MVA
Taps	ULTC (207 kV to 253 kV in 21 steps)

2. Circuit Breakers

Identification	T10B0 and T20B0
Voltage – max.	575 kV
Basic Impulse Level	1800 kV
Current	2000 A
Interrupting current	63 kA rms. sym.
Interrupting time	33 msec
Interrupting media	SF6

Identification	T20L20
Voltage – max.	245 kV
Basic Impulse Level	1050 kV
Current	1200 A
Interrupting current	40 kA rms. sym.
Interrupting time	50 msec
Interrupting media	SF6

3. Disconnect Switches

Identification	B0-L1, T10B0-B0 and T20B0-B0
Voltage – max.	600 kV
Basic Impulse Level	1800 kV
Current	2000 A
Momentary Withstand	70 kA rms. sym.

Identification	T20L20-T20, T20L20-L20 and L20-T21
Voltage – max.	245 kV
Basic Impulse Level	1050 kV
Current	1200 A
Momentary Withstand	40 kA rms. sym.

4. Surge Arresters

Identification	SA0, SA10 and SA20
Class	Station
Type	ZnO
Voltage Rating	420 kV
MCOV	335 kV

Identification	SA21, SA22, SA23 and SA24
Class	Station
Type	ZnO
Voltage Rating	258 kV
MCOV	209 kV

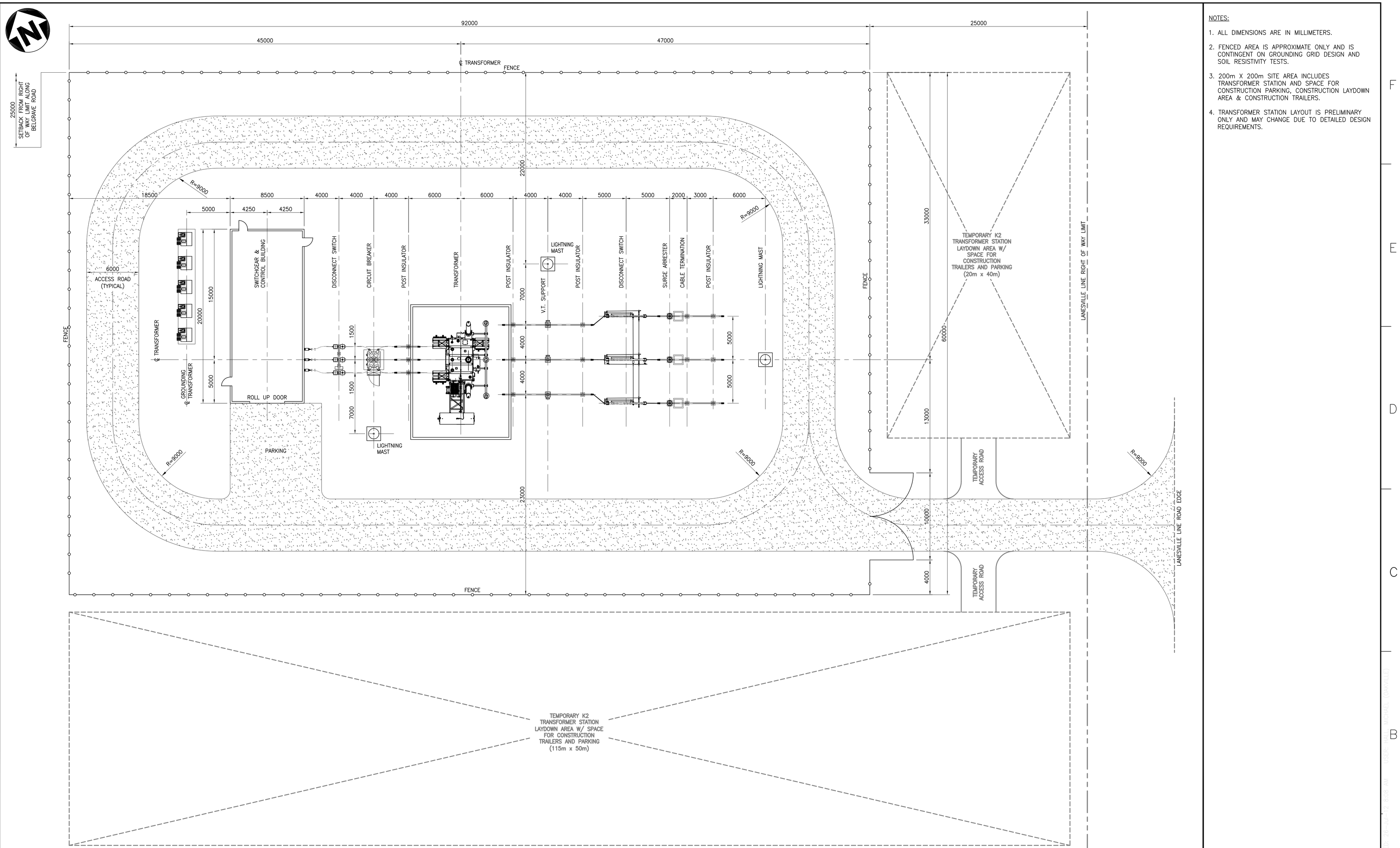
5. Transmission Lines

Identification	L1
Ampacity - continuous	3,000 A
Voltage Rating	575 kV
Basic Impulse Level	1800 kV
Installation	Overhead
Conductors per phase	1
Conductor material	Al tube
Conductor size	6” NPS
Circuit Length	50 meters - approximately
Geometry	Horizontal flat at 10 meter phase spacing 9.0 meter minimum height above grade

Identification	L20
Ampacity - continuous	500 A
Voltage Rating	245 kV
Basic Impulse Level	1050 kV
Installation	Underground cable
Conductors per phase	1
Conductor type	Compressed Al
Conductor size	1000 MCM
Insulation type	XLPE
Max Operating Temp	90°C
Circuit Length	5,100 meters - approximately
Geometry	Horizontal flat with 0.2 meter phase spacing
	Minimum burial depth 1.0 meters

TAB E-3-1

PROPOSED LAYOUT OF TRANSFORMER STATION



NOTES:

1. ALL DIMENSIONS ARE IN MILLIMETERS.
2. FENCED AREA IS APPROXIMATE ONLY AND IS CONTINGENT ON GROUNDING GRID DESIGN AND SOIL RESISTIVITY TESTS.
3. 200m X 200m SITE AREA INCLUDES TRANSFORMER STATION AND SPACE FOR CONSTRUCTION PARKING, CONSTRUCTION LAYDOWN AREA & CONSTRUCTION TRAILERS.
4. TRANSFORMER STATION LAYOUT IS PRELIMINARY ONLY AND MAY CHANGE DUE TO DETAILED DESIGN REQUIREMENTS.

REV	DDMMMYY	REVISION / ISSUE DESCRIPTION	DRN	CHK	APP	APP	APP	APP
I	26JUL12	REVISED & ISSUED FOR INFORMATION	M.HALL	BJN	JHM			
H	18JUL12	REVISED & ISSUED FOR INFORMATION	M.HALL	BJN	JHM			
G	17JUL12	GROUNDING TRANSFORMERS ADDED	M.HALL	BJN	JHM			
F	28JUN12	REVISED & ISSUED FOR INFORMATION	M.HALL	BJN	JHM			
E	22JUN12	REVISED & ISSUED FOR INFORMATION	M.HALL	BJN	JHM			
D	09MAR12	REVISED & ISSUED FOR INFORMATION	M.HALL	BJN	JHM			
C	15DEC11	ISSUED FOR INFORMATION	M.HALL	BJN	JHM			
B	13DEC11	ISSUED FOR INFORMATION	M.HALL	BJN	JHM			
A	12SEP11	ISSUED FOR INFORMATION	M.HALL	BJN	JHM			

REF	NUMBER	TITLE

REFERENCES

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CLIENT PROJECT MGR. DEPARTMENT MGR. PROJECT MGR.

PROJECT PHASE

K2 WIND ONTARIO LIMITED PARTNERSHIP

AREA 00

K2 WIND PROJECT

PROJECT NO.	ACTIVITY NO.		BY	DDMMMYY
161973		DSN	BJN	SEP.'11
		DRN	M.HALL	SEP.'11
SCALE	PACKAGE CODE	CHK	BJN	SEP.'11
1:200		APP	JHM	SEP.'11

SUBJECT

TRANSFORMER STATION LAYOUT –PLAN–

CLIENT DWG. NO.

DRAWING NO. A1-161973-00-141-0055

REV. I

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CAD FILE: P:\CAD\ELE\MF\A1-161973-00-141-0055.DWG

TAB E-3-2

SINGLE-LINE DIAGRAM OF TRANSFORMER STATION

CONTINUED ON SHEET 001

TRANSMISSION LINE L20
TO TRANSFORMER T21
IN 500kV SUBSTATION

TO
SEL 311L
IN 500kV SUBSTATION

TO
GE L90
IN 500kV SUBSTATION

SA23
STATION CLASS
DUTY 258kV
MCOV 209kV

L20-T21
245kV, 1200A
1050kV, 40kA

VT21

SA24
STATION CLASS
DUTY 258kV
MCOV 209kV

B87L-21-51
SEL 311L

A87L-21-51
GE L90

T21
96/128/160MVA
Φ65°C RISE
230-34.5kV
1050/200kV BIL
Z=8.0% ON
96 MVA BASE
ULTC ±10% IN 0.5% STEPS

RESISTOR

A87T-50-51
GE T60

SA25
STATION CLASS

B20T21
38kV, 3000A
200kV BIL, 31.5kA

A50BF-51
GE 060

DFR
TESLA 3000

B87T-50-51
SEL 487E

B20T21-B20
38kV, 3000A
200kV BIL, 120kA Mom.

VT20

SA26
STATION CLASS

38kV, 3000A, 150kV BIL, 31.5kA SWITCHGEAR BUS "B20"

B20F26 B20F27 B20F28 B20F29 B20F20 B20T22

FEEDER PROTECTION GE F60

FEEDER PROTECTION GE F35

87B-51
GE-B90

REV.METER (MAIN)

REV.METER (ALTERNATE)

TELEPHONE INTERFACE

CCT #6 CCT #7 CCT #8 CCT #9 CCT #10

NEXT WTG

WTG (TYPICAL)

T22
STATION SERVICE TRANSFORMER

ATS20

ATS21

REVENUE METER

"A" AC PANELBOARD

"B" AC PANELBOARD

"C" AC PANELBOARD

BC20 BATTERY CHARGER

BB20 BATTERY BANK

BB21 BATTERY BANK

BC21 BATTERY CHARGER

BC22 BATTERY CHARGER

BC23 BATTERY CHARGER

MTS20

"A" DC PANELBOARD

"B" DC PANELBOARD

T23

FROM HYDRO ONE DISTRIBUTION LINE

REV	DDMMMYY	REVISION / ISSUE DESCRIPTION	DRN	CHK	APP	APP	APP	APP
H	27AUG12	MINOR CHANGES - ISSUED TO IESO	RS	FC	BJN	JHM		
G	23AUG12	MINOR CHANGES - ISSUED TO IESO	RS	FC	BJN	JHM		
F	15AUG13	CHANGED 130kV TO 230kV	RS	FC	BJN	JHM		
E	27JUN12	CAPACITOR BANKS & STATCOM REMOVED	RS	FC	BJN	JHM		
D	29SEP11	MINOR CHANGES - ISSUED TO IESO	RS	FC	BJN	JHM		
C	22SEP11	MINOR CHANGES - ISSUED TO CLIENT	RS	FC	BJN	JHM		
B	16SEP11	MINOR CHANGES - RE-ISSUED FOR REVIEW	RS	FC	BJN	JHM		
A	26AUG11	ISSUED FOR REVIEW	RS	FC	BJN	JHM		

REF	NUMBER	TITLE

REFERENCES

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CLIENT PROJECT MGR. DEPARTMENT MGR. PROJECT MGR.

PROJECT PHASE

K2 WIND ONTARIO LIMITED PARTNERSHIP

AREA K2 WIND PROJECT

PROJECT NO. 161973

ACTIVITY NO.

SCALE NTS

PACKAGE CODE

	BY	DDMMMYY
DSN	B.J.N.	18AUG11
DRN	RS	19AUG11
CHK	F.C.	26AUG11
APP	J.H.M.	26AUG11

SUBJECT

230kV SUBSTATION
SINGLE LINE DIAGRAM
SHEET 2 OF 2

CLIENT DWG. NO.

DRAWING NO. A1-161973-00-141-0656-002

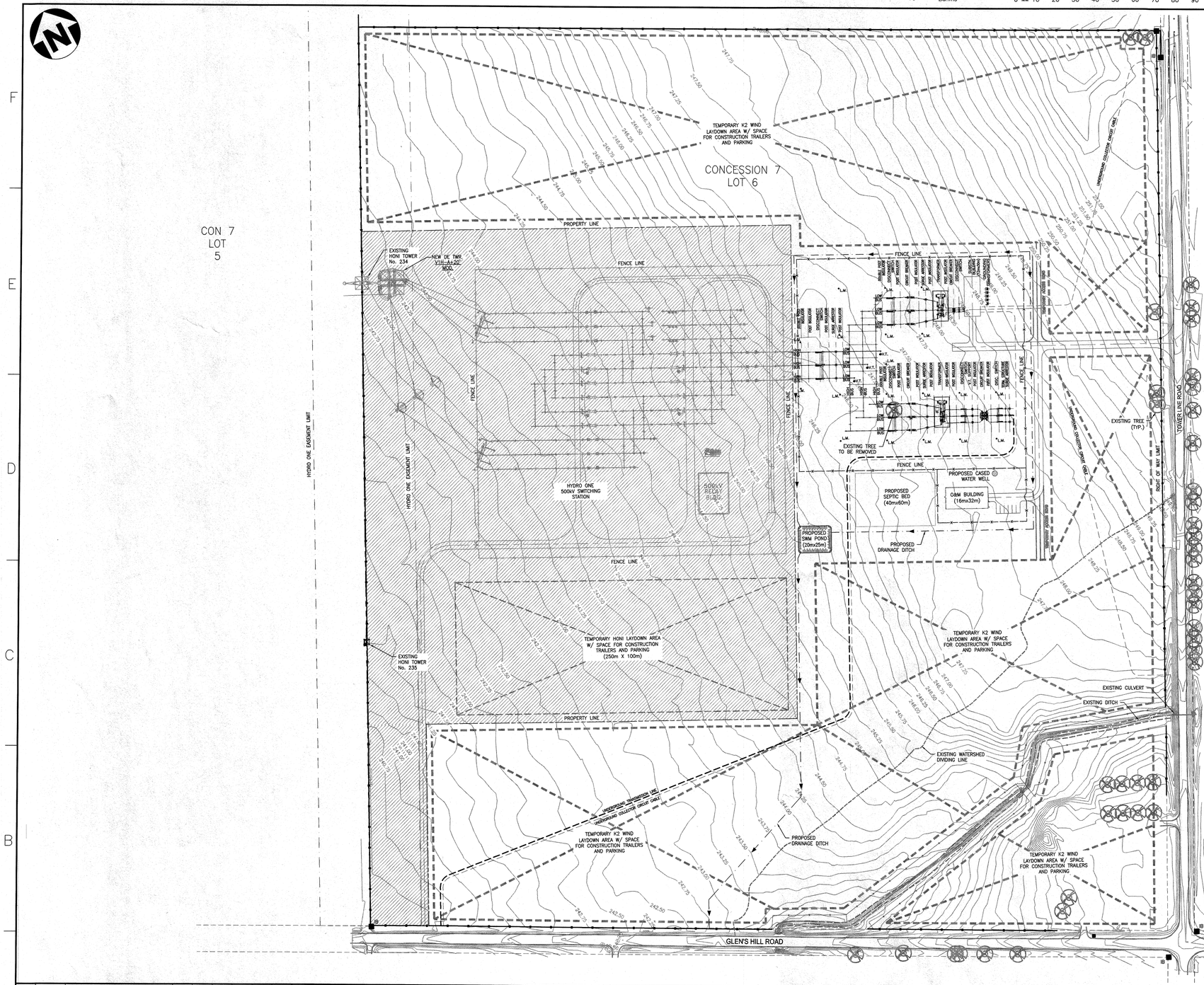
REV. H

CAD FILE: K:\CAD\161973\CAD\E\A1-161973-00-141-0656-002.dwg

PLOTTED: 06-Sep-12 3:44 PM USER: YAZDANIE, RABIA
SAVED: 27-Aug-12 9:48 AM

TAB E-4-1

PROPOSED LAYOUT OF SUBSTATION



NOTES:

1. ALL DIMENSIONS ARE IN MILLIMETERS.
2. FENCED AREA IS APPROXIMATE ONLY AND IS CONTINGENT ON GROUNDING GRID DESIGN AND SOIL RESISTIVITY TESTS.
3. PROPERTY AREA INCLUDES K2 SUBSTATION, HONI SWITCHING STATION AND SPACE FOR CONSTRUCTION PARKING, CONSTRUCTION LAYDOWN AREA & CONSTRUCTION TRAILERS.
4. SUBSTATION LAYOUT IS PRELIMINARY ONLY AND MAY CHANGE DUE TO DETAILED DESIGN REQUIREMENTS.

25m 0m 25m 50m 75m 100m

SCALE

REV	DDMMMYY	REVISION / ISSUE DESCRIPTION	DRN	CHK	APP	APP	APP	APP
Q	13NOV12	REVISED & ISSUED FOR INFORMATION	RS	BJN	JHM			
P	01AUG12	REVISED & ISSUED FOR INFORMATION	M.HALL	BJN	JHM			
O	30JUL12	REVISED & ISSUED FOR INFORMATION	M.HALL	BJN	JHM			
N	26JUL12	REVISED & ISSUED FOR INFORMATION	M.HALL	BJN	JHM			
M	18JUL12	REVISED & ISSUED FOR INFORMATION	M.HALL	BJN	JHM			
L	17JUL12	GROUNDING TRANSFORMERS ADDED	M.HALL	BJN	JHM			
K	06JUL12	REVISED & ISSUED FOR INFORMATION	M.HALL	BJN	JHM			
J	05JUL12	REVISED & ISSUED FOR INFORMATION	M.HALL	BJN	JHM			
I	28JUN12	REVISED & ISSUED FOR INFORMATION	M.HALL	BJN	JHM			
H	21JUN12	SWM ADDED & ISSUED FOR INFORMATION	M.HALL	BJN	JHM			
G	14JUN12	LAYDOWN AREAS ADDED & ISSUED FOR INFO	M.HALL	BJN	JHM			
F	29MAY12	REVISED & ISSUED FOR INFORMATION	M.HALL	BJN	JHM			
E	16MAY12	CONTOURS ADDED & ISSUED FOR INFO.	M.HALL	BJN	JHM			
D	27MAR12	DWG SCALE REVISED & ISSUED FOR INFO.	M.HALL	BJN	JHM			
C	13MAR12	REVISED & ISSUED FOR INFORMATION	M.HALL	BJN	JHM			
B	09MAR12	REVISED & ISSUED FOR INFORMATION	M.HALL	BJN	JHM			
A	25OCT11	ISSUED FOR INFORMATION	M.HALL	BJN	JHM			

REF	NUMBER	TITLE
REFERENCES		

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CLIENT PROJECT MGR. DEPARTMENT MGR. PROJECT MGR.

PROJECT PHASE

PROJECT NO.	ACTIVITY NO.
161973	
SCALE	PACKAGE CODE
1:1500	

	BY	DDMMMYY
DSN	BJN	OCT.'11
DRN	M.HALL	OCT.'11
CHK	BJN	OCT.'11
APP	JHM	OCT.'11

K2 WIND ONTARIO LIMITED PARTNERSHIP

AREA 00 — K2 WIND POWER PROJECT

SUBJECT: SUBSTATION SITE LAYOUT

CLIENT DWG. NO.

DRAWING NO. A1-161973-00-141-0053

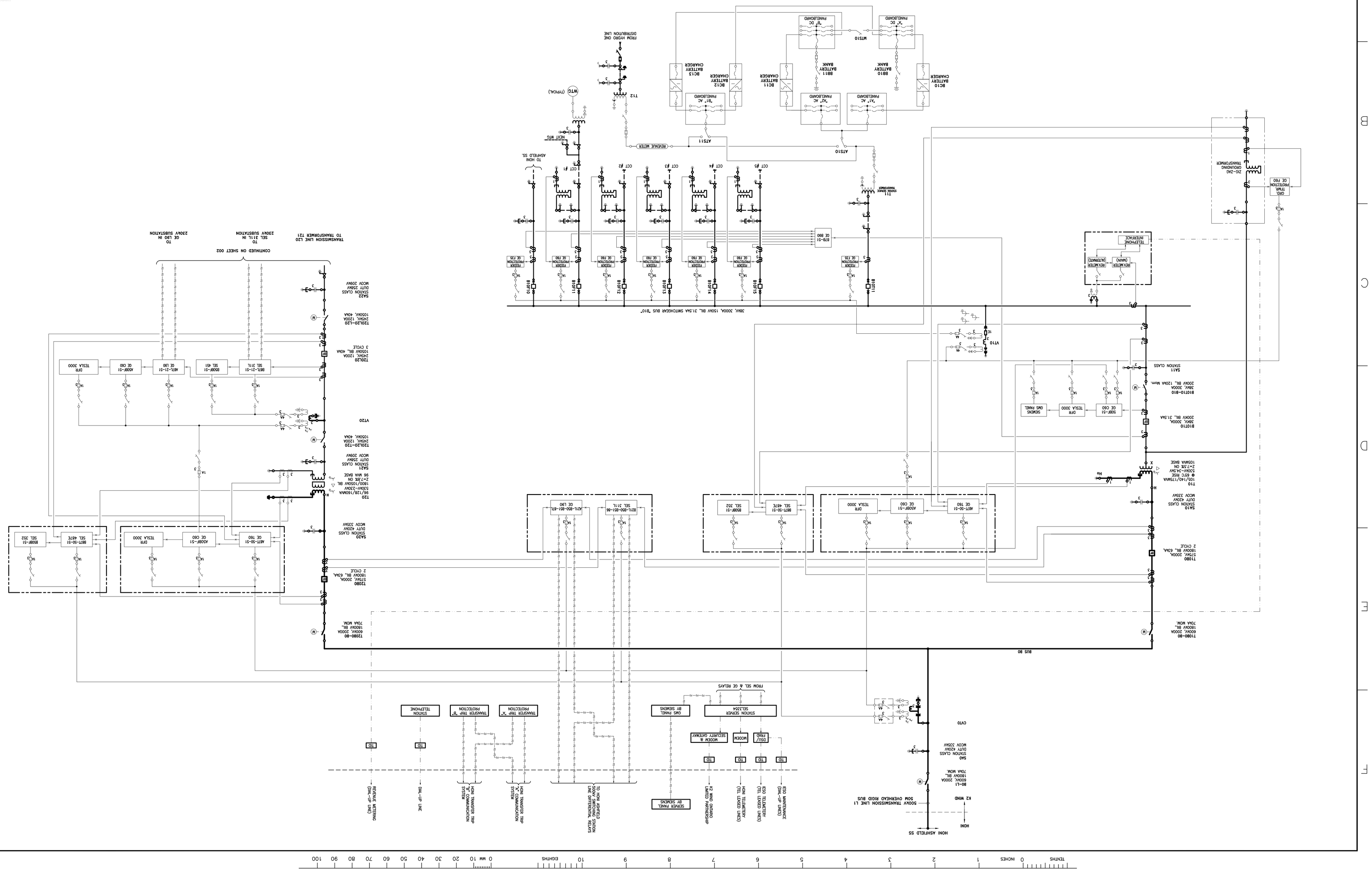
REV. Q

amec

CAD FILE: K2_SUBSTATION_LAYOUT_A1.DWG

TAB E-4-2

SINGLE-LINE DIAGRAM OF SUBSTATION


PRELIMINARY
PROPRIETARY INFORMATION.
THIS DRAWING IS THE PROPERTY OF AMEC AMERICAS LIMITED
AND IS NOT TO BE LOADED OR REPRODUCED IN ANY WAY
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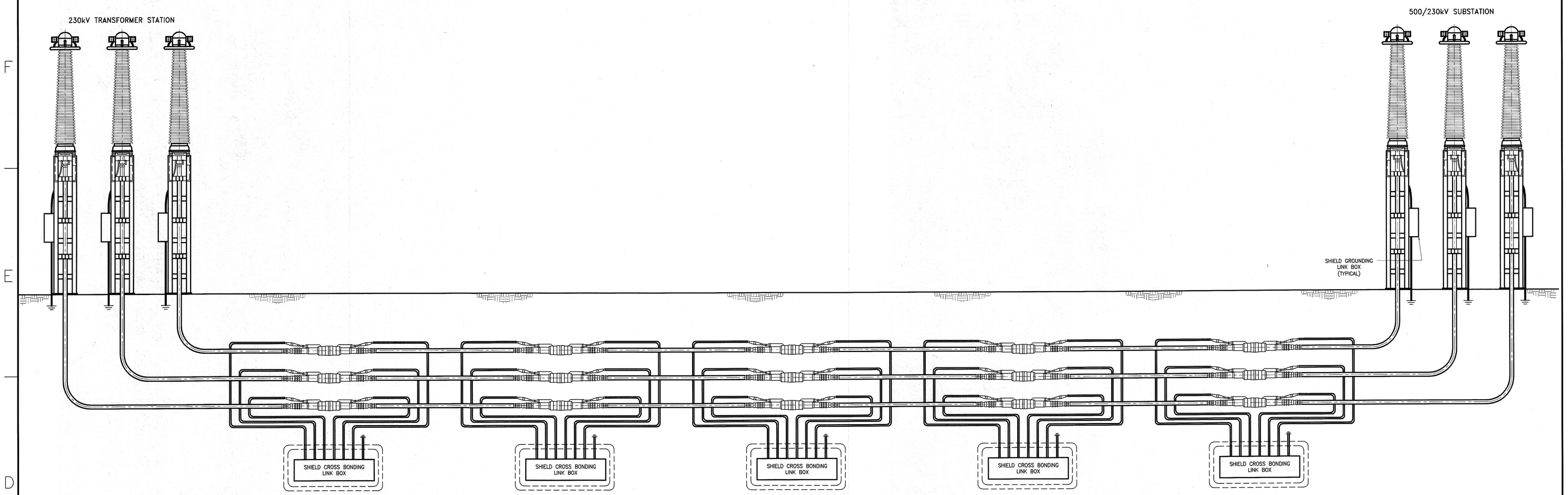
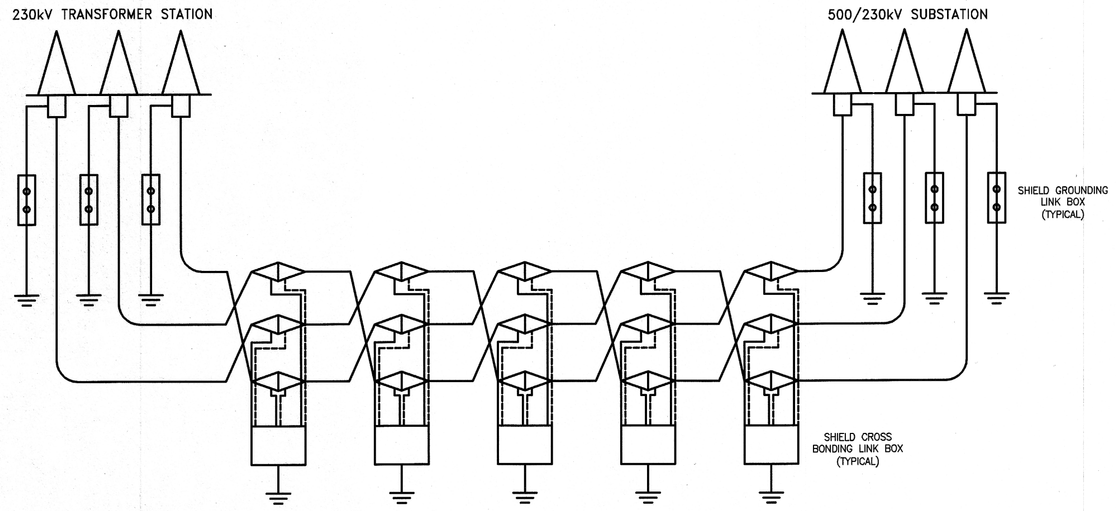
STAMP/SEAL
REFERENCES
REF
NUMBER
TITLE
REV
DD/MMM/YY
REVISION / ISSUE DESCRIPTION
DRN
CHK
APP
A
26AUG11
ISSUED FOR REVIEW
RS
FC
BJN
JHM
B
16SEP11
MINOR CHANGES - RE-ISSUED FOR REVIEW
C
22SEP11
MINOR CHANGES - ISSUED TO CLIENT
D
29SEP11
MINOR CHANGES - ISSUED TO IESO
E
05JUL12
CAPACITOR BANKS & STATCOM REMOVED
F
15AUG12
CHANGED 130kV TO 230kV
G
23AUG12
MINOR CHANGES - ISSUED TO IESO
H
22AUG12
MINOR CHANGES - ISSUED TO IESO
CLIENT PROJECT MGR.
DEPARTMENT MGR.
PROJECT MGR.
APPROVED FOR _____
PROJECT PHASE
AREA
PROJECT NO.
16197J
ACTIVITY NO.
SCALE
NTS
PACKAGE CODE
DSN
DRN
CHK
APP
BY
DD/MMM/YY
B.J.N.
18AUG11
R.S.
19AUG11
F.C.
26AUG11
J.H.M.
26AUG11
SUBJECT
500kV SUBSTATION
SINGLE LINE DIAGRAM
SHEET 1 OF 2
CLIENT DWG. NO.
DRAWING NO.
A1-16197J-00-141-0656-001
REV.
H
K2 WIND PROJECT
K2 WIND ONTARIO
LIMITED PARTNERSHIP
amec
SAVED: 27-Aug-12 9:40 AM
PLOTTED: 27-Aug-12 9:41 AM
USER: SHAHBAZIAN, RAZMIK
C:\00 FILE P:\CAD\DLE\WP\A1-16197J-00-141-0656-001.DWG
TENTHS
INCHES
EIGHTHS
0 MM 10 20 30 40 50 60 70 80 90 100
HONI ASHFIELD SS
500kV TRANSMISSION LINE L1
50W OVERHEAD RIGID BUS
K2 WIND
BK-L1
500kV, 2000A
1800kV BIL
70kA WCM.
CY10
SA9
STATION CLASS
OUTY 420kV
WCOV 330kV
BUS 80
T1080-80
600kV, 3000A
1800kV BIL
70kA WCM.
SA10
STATION CLASS
OUTY 420kV
WCOV 330kV
T110
105/140/175MVA
@ 65°C RISE
230kV-34.5kV
Z=7.5% ON
105MVA BASE
H6
H4
X
Y
SA11
STATION CLASS
200kV BIL 120kA WCM.
B10110-B10
38kV, 3000A
B10110
200kV BIL 31.5kA
SEWER GAS PANEL
TESLA 3000
DTR
AOSOF-51
GE C60
T1080
245kV, 2000A
1800kV BIL 63kA
Z CYCLE
SA12
STATION CLASS
OUTY 25kV
WCOV 20kV
T120
50/62/78/100MVA
230kV-25kV
Z=12% ON
50 MVA BASE
T120-120
245kV, 1200A
1050kV, 40kA
V120
T120L20
245kV, 1200A
1050kV BIL, 40kA
3 CYCLE
T120L20-120
245kV, 1200A
1050kV, 40kA
SA21
STATION CLASS
OUTY 25kV
WCOV 20kV
T120-80
600kV, 3200A
1800kV BIL
70kA WCM.
V110
T110-80
600kV, 3000A
1800kV BIL
70kA WCM.
SA20
STATION CLASS
OUTY 420kV
WCOV 330kV
ADTT-50-51
GE 160
AOSOF-51
GE C60
DTR
TESLA 3000
BRT-50-51
SEL 487E
BSOF-51
SEL 352
BRT-21-51
SEL 311L
BSOF-51
SEL 451
AOT-21-51
GE L90
AOSOF-51
GE C90
DTR
TESLA 3000
BZL-B50-B51-B52
GE L90
SEL 311L
BRT-50-51
SEL 487E
SEL 352
AOSOF-51
GE C60
DTR
TESLA 3000
ADTT-50-51
GE 160
BSOF-51
SEL 302
BRT-50-51
SEL 487E
AOSOF-51
GE C60
DTR
TESLA 3000
ADTT-50-51
GE 160
BSOF-51
SEL 352
BRT-50-51
SEL 487E

TAB E-5-1

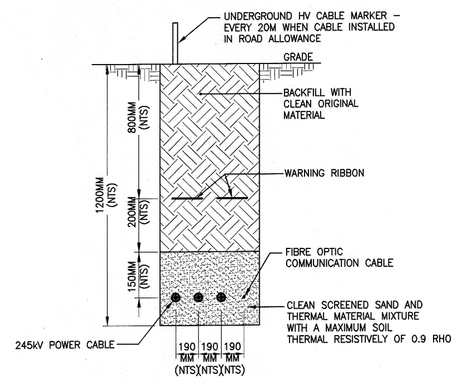
CROSS-SECTIONAL DIAGRAM OF THE TRANSMISSION LINE



230kV UNDERGROUND CABLE INSTALLATION PROFILE
N.T.S.



230kV UNDERGROUND CABLE SHIELD CONFIGURATION
N.T.S.



TYPICAL DIRECT BURIAL SECTION
N.T.S.

NOTES:
1. THE NUMBER OF SPLICES SHOWN ARE PRELIMINARY AND MAY CHANGE DURING FINAL DESIGN.
2. CABLE SHIELD BONDING SHOWN IS PRELIMINARY AND MAY CHANGE DURING FINAL DESIGN.

REV	DDMMMYY	REVISION / ISSUE DESCRIPTION	DRN	CHK	APP	APP	APP	APP
C	22NOV12	INCORPORATED CLIENT COMMENTS	RS	BJN	JHM			
B	15OCT12	ISSUED FOR CLIENT REVIEW	RS	BJN	JHM			
A	15OCT12	ISSUED FOR SQUAD CHECK	RS	BJN	JHM			

REF	NUMBER	TITLE
REFERENCES		

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STAMP/SEAL

PRELIMINARY

CLIENT PROJECT MGR. DEPARTMENT MGR. PROJECT MGR.

PROJECT PHASE

PROJECT NO.	ACTIVITY NO.
161973	
SCALE	PACKAGE CODE
NTS	

	BY	DDMMMYY
DSN	K.B.	12OCT12
DRN	R.S.	12OCT12
CHK	B.J.N.	12OCT12
APP	J.H.M.	12OCT12

K2 WIND ONTARIO LIMITED PARTNERSHIP

AREA: K2 WIND POWER PROJECT

SUBJECT: 245kV UNDERGROUND CABLE INSTALLATION DETAILS

amec

CLIENT DWG. NO.

DRAWING NO. A1-161973-00-141-0660-001

REV. C

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USER: SHAHBAZIAN, RAZMIK
PLOTTED: 22-Nov-12 11:33 AM
SAVED: 22-Nov-12 11:24 AM
CAD FILE: T:\CAD\SLE\MPLAT-TS_A3-00-141-0660-001.DWG

TAB E-6-1

TABLE OF APPLICABLE CODES, STANDARDS AND REGULATIONS

CSA C22.1	Canadian Electrical Code Part I – Safety Standards for Electrical Installations
CSA C22.2	Canadian Electrical Code Part II – General Requirements (Including Grounding and Bonding)
CSA C22.3	Canadian Electrical Code Part III –Electricity Distribution and Transmission Systems
ESA	Ontario Electrical Safety Code
OHSA	Occupational Health and Safety Act and Regulations
AEIC	Association of Edison Illuminating Companies; Pertinent Standards and Guides
ASTM	American Society for Testing and Materials; Pertinent Codes
IEEE	Institute of Electrical and Electronic Engineers; Pertinent Standards and Guides

TAB F-1-1

LAND RIGHTS - OVERVIEW

The K2 Transmission Line will be located underground, within easements on private land in ACW Township and underground, within municipal right-of-way belonging to ACW Township, all in the County of Huron, in the Province of Ontario. K2 Wind has entered into Easement Option Agreements with all relevant landowners with respect to the segments of the K2 Transmission Line that will be located on private land. The form of Easement Option Agreement and the form of Grant of Easement Agreement are included at Exhibit F, Tab 3, Schedules 1 and 2, respectively.

The Applicant is in the process of negotiating a Road-Use Agreement with ACW Township with respect to the segments of the K2 Transmission Line that will be located within municipal right-of-ways belonging to ACW Township.

The K2 Transformer Station will be located on 4.05 hectares of leased private land located at the southwest corner of Belgrave Road and Lanesville Line in ACW Township. K2 Wind has entered into an Option to Lease Agreement in respect of the subject property. This agreement, as well as the form of Lease, are included at Exhibit F, Tab 2, Schedule 1.

Both the K2 Substation and the Hydro One Switching Station will be situated on 40 hectares of land owned by K2 Wind, located on the northwest corner of Glens Hill Road and Tower Line. K2 Wind has entered into an Option to Purchase Agreement in respect of the subject property. The form of this agreement, as well as the form of the Purchase Agreement, are included at Exhibit F, Tab 2, Schedules 2. K2 Wind intends to sever and sell a portion of this property to Hydro One for the purpose of constructing and operating the Switching Station.

Table F-1, following, summarizes the land rights that are described above and that are required in respect of the Transmission Facilities. A map showing the K2 Transmission

Line and each of the private properties through which the K2 Transmission Line will run is included at Exhibit F, Tab 4, Schedule 1.

TABLE F-1 REQUIRED LAND RIGHTS

Facility	Land Interest Required	Description	Status of Acquisition
K2 Substation	• fee simple, held by K2 Wind	• 40 hectares (100 acres) located at the northwest corner of Glens Hill Road and Tower Line in ACW Township	• Option to Purchase Agreement, executed January 25, 2010 and Letter Agreement, dated December 1, 2011, extending Option Term to January 25, 2013.
K2 Transformer Station	• leased on private land	• 4.05 hectares (10 acres) located at the southwest corner of Belgrave Road and Lanesville Line in ACW Township	• Option to Lease Agreement executed September 13, 2011; Option Term of 5 years.
K2 Transmission Line	• Segment 1[1]: easement on private land	• 15m-wide strip, 1.95 km in length in ACW Township	• 3 separate Easement Option Agreements, executed with 3 private landowners; Option Term of 3 years.
	• Segment 2:[1] easement on private land	• 15m-wide strip, 0.25 km in length in ACW Township	• 1 Easement Option Agreement, executed with 1 private landowner; Option Term of 3 years.
	• Segment 3:[1] easement on private land	• comprising 15m-wide strip, 0.35 km in length in ACW Township	• 1 Easement Option Agreement, executed with 1 private landowner; Option Term of 3 years.
	• Segment 4:[1] easement on private land	• 15m-wide strip, 0.7 km in length in ACW Township	• 1 Easement Option Agreement, executed with 1 private landowner; Option Term of 3 years.
	• Segment 5:[1] municipal right-of-way[2]	• installation within municipal right-of-way belonging to ACW Township	• Road Use Agreement under negotiation with ACW Township.
	• Segment 6:[1] K2 Substation property owned by K2 Wind	• 15m-wide strip, totalling 0.78 km in length, located on K2 Substation property, in ACW Township	• Option to Purchase Agreement, executed January 25, 2010 and Letter Agreement, dated December 1, 2011, extending Option Term to January 25, 2013.

[1] Segments 1-6 of the linear utility easement required for the K2 Transmission Line are more particularly described in Exhibit D, Tab 2, Schedule 1.

[2] Pursuant to section 41(1) of the *Electricity Act, 1998*, K2 Wind has the statutory right to install the K2 Transmission Line (and the Collectors) in, under or on any "public street or highway," including the municipal right-of-way of ACW Township.

TAB F-2-1

OPTION TO LEASE LAND FOR TRANSFORMER STATION

OPTION AGREEMENT

THIS AGREEMENT is made as of the 13th day of September, 2011

BETWEEN:

[redacted]

(referred to in this Agreement as "Landowner")

– and –

K2 WIND ONTARIO INC., an Ontario corporation, acting as general partner of and on behalf of K2 WIND ONTARIO LIMITED PARTNERSHIP, a limited partnership formed under the laws of the Province of Ontario with an office at 1301 – 200 University Avenue, Toronto, Ontario M5H 3C6

(referred to in this Agreement as "K2 WIND")

WHEREAS Landowner is the registered owner of the lands described in Schedule A (the "Lands"); and

WHEREAS K2 WIND wishes to acquire an option to lease part of the Lands for the purpose of constructing, installing, using, operating, maintaining, changing, replacing and retiring a transformer station and related structures, equipment, materials, cables and grounding grid; and

WHEREAS Landowner has agreed to lease a portion of the Lands as set out in Schedule A to K2 WIND for that purpose (the "Premises");

NOW THEREFORE in consideration of $2.00 paid by K2 WIND to Landowner, the receipt of which is acknowledged, and the mutual agreements set out in this Agreement, Landowner and K2 WIND (the "Parties") agree as follows:

1. Option

(a) Landowner hereby grants K2 WIND the exclusive option (the "Option") to lease the Premises for the purpose stated above. The lease resulting from the exercise of the Option shall be in the form attached as Schedule B (the "Lease").

(b) Provided that K2 WIND is not then in default, the Option may be exercised by K2 WIND at any time during the 5 year period following the date of this Agreement (the "Option Term") by giving written notice (the "Exercise Notice") to Landowner at its address for notices set out in Schedule A together with three (3) duly executed copies of the Lease. Landowner shall duly execute and deliver 2 copies of the Lease to K2 WIND no later than 10 days after receipt of the Exercise Notice. The Lease shall be dated as of the date of the Exercise Notice.

(c) K2 WIND shall have no obligation to exercise the Option and may terminate this Agreement at any time on written notice to Landowner. Any such termination shall not relieve either Party of any obligations accrued up to the date of termination.

2. Compensation

K2 WIND shall pay Landowner [redacted] by cheque within sixty (60) days of the date of this Agreement, and on or before the first, second, third and fourth anniversaries of the date of this Agreement, unless this Agreement is earlier terminated.

3. License to Conduct Tests and Studies

Landowner hereby grants K2 WIND and its employees, contractors and consultants the right to enter on the Lands at any time or times during the Option Term, but on reasonable notice to Landowner, to conduct surveys, tests and investigations on the Lands, as required by K2 WIND in its sole discretion, including soil tests and environmental, geotechnical, noise and archaeological studies (including ploughing). This shall not include the right to install wind monitoring towers or other structures, or to commence construction.

4. Landowner's Covenants

(a) *Incompatible Uses.* Landowner covenants that it shall not use, and shall not grant any other person the right or any option to acquire the right to use, any part of the Lands for any use that is incompatible with the use to be made of the Premises by K2 WIND.

(b) *Title.* Landowner covenants that it has good title to the Lands subject only to any registered encumbrances and has the right and power to enter into this Agreement and to grant to K2 WIND the rights and interests given to it in this Agreement.

(c) *Cooperation.* If requested by K2 WIND, and at the cost of K2 WIND (such cost to include reasonable professional and legal fees incurred by the Landowner for reviewing requested documents), Landowner shall cooperate with and provide support and assistance to K2 WIND, and execute such documents as K2 WIND may reasonably require, in respect of any regulatory or legal proceedings relating to the purposes of this Agreement, including applications for (i) rezoning of the Lands to allow the use contemplated herein, (ii) consent to lease the Premises for a term exceeding the period allowed under the Planning Act, (iii) site plan approval, (iv) building permits, and (v) entry permits for municipal roads.

5. K2 WIND's Covenants

(a) *Payments.* K2 WIND shall pay the payments provided for in this Agreement in a timely manner.

(b) *Repairs and Compensation for Damage.* K2 WIND shall repair or compensate Landowner for any physical damage it causes during the Option Term to crops, drainage tiles, structures, merchantable timber, fences and other property of Landowner on the Lands in conducting surveys, tests and investigations pursuant to section 3. Compensation for crop damage shall be based on the last local market prices for the crops prevailing before the time the crops were damaged.

(c) *Environmental Damage and Contamination.* K2 WIND shall remediate all contamination and other environmental damage to the Lands caused by it or its agents, contractors, invitees or licensees during the Option Term in conducting surveys, tests and investigations, to the standard required by applicable law.

(d) *Indemnity.* Subject to the more specific provisions of this Agreement dealing with compensation for physical damage, K2 WIND shall indemnify and save harmless Landowner from and against all actions, claims, liabilities and damages resulting from surveys, tests or investigations conducted by K2 WIND on the Lands, except to the extent that any such actions, claims, liabilities and damages result from or are contributed to by the negligence or willful misconduct of Landowner, its agents, contractors, invitees or licensees.

(e) *Construction Liens.* K2 WIND shall remove or cause to be removed any lien arising from K2 WIND's operations that may be filed against the Lands under the Construction Lien Act, within 20 days of receiving notice of such lien.

(f) *Insurance.* Before commencing surveys, tests or investigations on the Lands, K2 WIND shall obtain, and maintain liability insurance in an amount of not less than $5,000,000,

covering Landowner as an additional insured. K2 WIND shall provide proof of such insurance to Landowner upon written request by Landowner.

6. Other Terms and Conditions

The following provisions contained in the form of Lease attached as Schedule B are incorporated into this Agreement by reference and shall apply as though they were set out in this Agreement in full, provided that they shall be read with such changes and interpreted in such manner as may be necessary in the context of this Agreement.

SECTION	HEADING
1	Definitions
6	Goods and Services Tax
9	Default
10	Sale or Mortgage of Lands by Landowner
11	Assignment by K2 WIND
12	Dispute Resolution
13	Notices
14	Payments
15	Non-resident Withholding Tax
16	Further Assurances
17	Pre-existing Contaminants
19	Interpretation
20	Invalidity
21	Entire Agreement
22	Amendment

7. Planning Act

This Agreement is entered into subject to the express condition that it shall be effective only if the provisions of the Planning Act are complied with. If a severance consent is required under the Planning Act for this Agreement to be effective, until such consent is obtained the Term shall be deemed to be limited to such period as may be allowed without obtaining a severance consent. Pursuant to paragraph 50(3)(d) of the Planning Act, K2 Wind hereby declares that it is entering into this Agreement for the purpose of an electricity distribution line or an electricity transmission line, or both, within the meaning of Part VI of the Ontario Energy Board Act, 1998. For greater certainty, the facilities will include transformers, plant, equipment, electric interconnections and related structures that will comprise a transformer station. Despite this declaration, if, in the sole discretion of K2 Wind, severance consent should be required or advisable, then K2 Wind shall have the right and is hereby given the authority to execute all such documents as may be necessary for K2 Wind to obtain any necessary consent from the local Land Division Committee or Committee of Adjustments and the Landowner agrees to co-operate in any such application for consent.

8. Registration

K2 WIND may register this Agreement or a notice of this Agreement in the appropriate Land Registry Office. K2 WIND shall withdraw or discharge any such registrations within a reasonable time after the expiry or termination of this Agreement.

9. Family Law Act

Landowner warrants that no person other than Landowner has rights to any matrimonial home on the Lands under the Family Law Act and that spousal consent is not necessary for the grant

of this Agreement.

IN WITNESS WHEREOF Landowner and K2 WIND have executed this Agreement to be effective as of the date first above written.

[redacted]

K2 WIND ONTARIO INC.

By: _____

Name: COLIN EDWARDS

Title: DIRECTOR

I have authority to bind the Corporation

SCHEDULE A

Landowner:

[redacted]

Lands:

N ½ LT 3 CON 8 ED ASHFIELD, EXCEPT PT 5, 22R3021, TOWNSHIP OF ASHFIELD-COLBORNE-WAWANOSH (P.I.N. 41095-0031)

Premises:

That part of the Lands included within a boundary described as follows:

COMMENCING at the northeastern corner of the Lands at the intersection of Belgrave Road and Lanesville Line;

THENCE southwesterly 200 metres along the southeastern boundary of the Lands abutting the Road allowance for Lanesville Line;

THENCE northwesterly 200 metres at right angles to the southeastern boundary of the Lands;

THENCE northeasterly 200 metres parallel to the southeastern boundary of the Lands to a point on the northeastern boundary of the Lands abutting the road allowance for Belgrave Road;

THENCE southeasterly to the point of commencement;

COMPRISING approximately 10 acres, more or less.

Landowner's address for notices:

[redacted]

Landowner's GST number (if applicable):

SCHEDULE B

Form of Lease

LEASE

THIS AGREEMENT is made as of the ___ day of _____ , 20__ (the "Effective Date")

BETWEEN:

[redacted]

(referred to in this Agreement as "Landowner")

– and –

K2 WIND ONTARIO INC., an Ontario corporation, acting as general partner of and on behalf of K2 WIND ONTARIO LIMITED PARTNERSHIP, a limited partnership formed under the laws of the Province of Ontario with an office at 1301 – 200 University Avenue, Toronto, Ontario M5H 3C6

(referred to in this Agreement as "K2 WIND")

WHEREAS Landowner is the registered owner of the lands described in Schedule A as the "Lands"; and

WHEREAS K2 WIND wishes to lease that part of the Lands that is described in Schedule A as the "Premises" for the purposes and on the terms and conditions set out in this Agreement;

NOW THEREFORE, in consideration of $2.00 paid by K2 WIND to Landowner, the receipt of which is acknowledged, and the mutual agreements set out in this Agreement, Landowner and K2 WIND (the "Parties") agree as follows:

1. Definitions

In this Agreement the capitalized terms below have the following meanings:

"Arbitration Notice" is defined in paragraph 12(a);

"Business Day" is defined in paragraph 13(d);

"K2 Wind Secured Lender" is defined in paragraph 11(b);

"K2 Wind Secured Lender Cure Notice" is defined in paragraph 11(c);

"K2 Wind Security Interest" is defined in paragraph 11(b);

"Consumer Price Index" or "CPI" is defined in paragraph 4(d);

"Dispute" is defined in paragraph 12(a);

"Effective Date" means the date of this Agreement first above written;

"Encumbrance" is defined in paragraph 10(c);

"Force Majeure" is defined in paragraph 9(a);

"GST" is defined in section 6;

"Lands" means those lands described as such in Schedule A;

"Lease Year" means a year of the Term, the first Lease Year commencing on the Effective Date and successive Lease Years commencing on each anniversary of the Effective Date during the Term;

"Notice" is defined in paragraph 11(c);

"Parties" means Landowner and K2 WIND;

"Premises" means those parts of the Available Lands described as such in Schedule A;

"Term" is defined in paragraph 3(a);

2. Grant of Lease

(a) Landowner hereby leases the Premises to K2 WIND for the purpose of constructing, installing, using, operating, maintaining, changing, replacing and retiring a transformer station and related structures, equipment, materials, cables and grounding grid. K2 Wind shall have exclusive possession of the Premises.

(b) K2 WIND may fence the Premises or any part of the Premises and may erect signage identifying it as the owner and operator of the transformer station and showing emergency contact information.

(c) K2 WIND may from time to time repair, replace and, when not in default hereunder, remove any cables, equipment, structures and materials. K2 WIND may store vehicles, equipment and materials on the Premises in connection with its operations.

(d) K2 WIND may authorize its consultants, contractors and agents to enter the Premises in connection with its operations and may from time to time allow visitors to enter the Premises for site tours or for other reasons.

(e) Landowner may, at its own risk, in consultation with K2 WIND, conduct farming operations on those parts of the Premises outside any fenced areas that are not then being used by K2 WIND for its purposes, provided that K2 WIND shall not be required to compensate Landowner for damage to any crops grown on the Premises.

(f) Notwithstanding any rule of law, all equipment and other structures and installations placed on the Premises by K2 WIND shall remain the personal property of K2 WIND even though they may be attached to the Premises.

3. Term

(a) This Agreement shall commence on the Effective Date and, subject to paragraph (b) below, shall continue in effect for a period of 35 years (the "Term") unless it is terminated earlier.

(b) K2 WIND may surrender and terminate this Agreement as to all or any part of the Premises at any time by giving notice to Landowner. There shall be no refund to K2 WIND of any rental that may have been paid in advance.

(c) Provided that it is not in default hereunder, K2 WIND shall have the right at all times during the Term and for a reasonable period thereafter to remove from the Premises, and any part of the Premises that has been surrendered, any or all of its structures, equipment and materials. Following any such removal, K2 WIND shall restore the Premises as provided in paragraph 8(f).

4. Rent

(a) K2 WIND shall pay Landowner an annual rent of [redacted], adjusted pursuant to paragraph 4(c). For greater certainty, such rent shall be payable only until this Agreement terminates or is surrendered.

(b) The rental payment for the first Lease Year shall be payable within 60 days after the Effective Date and rent for the following Lease Years shall be payable in advance on or before each anniversary of the Effective Date.

(c) The rent shall be adjusted on the fifth anniversary of the Effective Date and at the end of each following five year period based on the percentage change in the Consumer

Price Index during the immediately preceding five year period; however, rentals shall never be less than the initial amounts set out herein.

(d) For purposes of this Agreement, "Consumer Price Index" (CPI) means the 12 month Consumer Price Index (All Items) for Ontario published by Statistics Canada or any successor authority, or if that index is no longer published in the future, a substantially similar index that may be published by Statistics Canada or any successor authority.

5. Adverse Effects

Subject to the other terms and conditions of this Agreement, Landowner accepts the rent and other compensation payable under this Agreement in full satisfaction and compensation for any damage to the Premises, the severance of the Premises from the Lands, and any inconvenience, disturbance or nuisance resulting from K2 WIND's wind energy operations on or off the Premises that may affect the use of the Lands or that may affect Landowner, members of Landowner's family or other invitees of Landowner residing on or working on the Lands, provided that K2 WIND's operations are conducted in compliance with all applicable laws and regulatory requirements.

6. Goods and Services Tax

K2 WIND shall be responsible for Goods and Services Tax (GST) under the Excise Tax Act (Canada) that may be applicable to payments under this Agreement and any similar Ontario value-added tax that may be harmonized with the GST or that may apply separately. If Landowner is registered for GST purposes and produces verification of such registration, K2 WIND shall pay the applicable GST to Landowner and Landowner shall remit such taxes to the proper governmental authorities as and when required.

7. Landowner's Covenants

(a) *Quiet Enjoyment*. Landowner covenants that it has good title to the Lands subject only to any registered encumbrances or instruments and has the right and power to enter into this Agreement and to grant to K2 WIND the rights and interests given to it in this Agreement; and that K2 WIND, upon observing and performing the covenants and conditions on K2 WIND's part contained in this Agreement, shall and may peaceably possess and enjoy the Premises and the rights and privileges hereby granted during the Term without any interruption or disturbance from or by Landowner or any other person, subject only to any registered encumbrances or instruments.

(b) *Landowner's Interest in Lands*. If Landowner is not the absolute owner of the Lands, this Agreement shall nevertheless bind Landowner to the full extent of its interest, and shall also extend to any after-acquired interest, but all monies payable under this Agreement shall be paid to Landowner only in the proportion that its interest in the Lands bears to the entire interest.

(c) *Landowner's Taxes*. Landowner will promptly pay all taxes and assessments that may be assessed or levied against the Lands except for taxes and assessments assessed or levied against K2 WIND directly or specifically against the Premises. If Landowner does not pay such taxes and assessments and Landowner remains in default for a period of 30 days or more, K2 WIND shall have the right to pay them and set such payments off against payments due to Landowner under this Agreement. K2 WIND shall have a lien against the Lands for any remaining balance of taxes and assessments paid by it.

(d) *Assessment Notices and Tax Bills*. Landowner will promptly provide to K2 WIND copies of all tax assessments, re-assessments and all other notices and correspondence received by Landowner in respect of any taxes or assessments.

(e) *Cooperation*. If requested by K2 WIND, and at the cost of K2 WIND (such cost to include reasonable professional and legal fees incurred by the Landowner for reviewing requested documents), Landowner shall cooperate with and provide support and assistance to K2 WIND, and execute such documents as K2 WIND may reasonably require, in respect of any regulatory or legal proceedings relating to the purposes for

which the Premises are leased to K2 WIND, including applications for (i) rezoning of the Premises to allow the use contemplated herein, (ii) consent to lease the Premises for a term exceeding the period allowed under the Planning Act, (iii) site plan approval, (iv) building permits, and (v) entry permits for municipal roads.

(f) *Indemnity*. Landowner agrees to indemnify and save harmless K2 WIND from and against all actions, claims, liabilities and damages resulting from the entry on the Premises by Landowner, its agents, contractors, invitees or licensees, including the use of access roads and the conduct of farming operations on the Premises, except to the extent that any such actions, claims, liabilities and damages result from or are contributed to by the negligence of K2 WIND, its agents, contractors, invitees or licensees.

8. K2 WIND's Covenants

(a) *Payment of Rent*. K2 WIND shall pay the rent and other payments provided for in this Agreement in a timely manner.

(b) *K2 WIND's Taxes*. K2 WIND shall pay all taxes and assessments that may be assessed or levied in respect of the Premises and equipment, structures and works placed by K2 WIND on or under the Premises. If there is no separate assessment or allocation for the Premises, K2 WIND shall make a reasonable apportionment of the taxes between the Premises and the rest of the Lands (advising Landowner of such apportionment) and shall pay its share of the taxes to Landowner within 30 days of receiving a copy of the tax bill for the Lands from Landowner.

(c) *Indemnity*. K2 WIND shall indemnify and save harmless Landowner from and against all actions, claims, liabilities and damages resulting from K2 WIND's operations on the Premises, except to the extent that any such actions, claims, liabilities and damages result from or are contributed to by the negligence or willful misconduct of Landowner, its agents, contractors, invitees or licensees.

(d) *Construction Liens.* K2 WIND shall remove or cause to be removed any lien arising from K2 WIND's operations that may be filed against the Lands under the Construction Lien Act, within 20 days of receiving notice of such lien.

(e) *Insurance*. Before the Commencement of Construction, K2 WIND shall obtain, and maintain for the balance of the Term, liability insurance in an amount of not less than $5,000,000, covering Landowner as an additional insured. K2 WIND shall provide proof of such insurance to Landowner upon written request by Landowner.

(f) *Restoration of Premises*. Within a reasonable time after the expiry or termination of this Agreement or the surrender or abandonment of the Premises, K2 WIND shall remove all structures, material and equipment from the Premises and restore the surface of the Premises to the same condition, so far as practicable, as existed before K2 WIND's entry, except that concrete bases, cables and grounding grid components may be left in place provided that they (or the remaining parts) are at least 1 metre below the surface. K2 WIND shall remediate all contamination and other environmental damage to the Premises caused by it or its agents, contractors, invitees or licensees in conducting its operations, to the standard required by applicable law. This paragraph shall survive the expiry or termination of this Agreement until K2 WIND's restoration obligations have been fully performed and completed.

(g) *Topsoil.* K2 WIND shall strip and separate all topsoil from subsoil and shall use all reasonable efforts not to mix topsoil with subsoil. Topsoil shall be left on the Premises and shall remain available to K2 WIND for the eventual restoration of the Premises.

9. Default

(a) K2 WIND shall not be considered in default in the performance of its obligations under this Agreement to the extent that the performance of such obligations or any of them is delayed by a cause beyond K2 WIND's reasonable control ("Force Majeure"), provided

that: (i) Force Majeure shall not relieve K2 WIND from its obligations under paragraph 8(c) (Indemnity) or any obligation to make monetary payments; (ii) K2 WIND shall notify Landowner of the nature and expected duration of the Force Majeure; and (iii) K2 WIND shall take all commercially reasonable measures to remove or mitigate the Force Majeure.

(b) K2 WIND shall not be considered to be in default under this Agreement unless and until Landowner has by written notice notified K2 WIND of such default, specifying in detail the alleged event of default and the required cure, and K2 WIND (i) has failed to cure such default within 10 days after such notification in the case of a monetary default, or (ii) in all other cases, has failed to commence to cure such default within 30 days after such notification and thereafter has failed to diligently continue such cure; provided that if the dispute resolution process provided for in section 12 has been initiated, or if the provisions of this Agreement require that a matter be resolved in accordance with the provisions of section 12, then the process provided for in section 12 shall be the exclusive forum for the resolution of the Dispute and Landowner shall take no steps in respect of an alleged default by K2 WIND until such process has been concluded.

(c) Subject to paragraph 12(d), Landowner shall be entitled to its reasonable costs, including its legal costs on a full indemnity basis, relating to any default on the part of K2 WIND, and the exercise of its rights and remedies in respect thereof.

10. Sale or Mortgage of Lands by Landowner

(a) If Landowner sells the Lands, all payments to be made to Landowner under this Agreement, whether relating to a period before or after the date of sale, may be made to the new owner of the Lands. Landowner shall promptly give notice of any sale of the Lands to K2 WIND, identifying the buyer and giving the buyer's address.

(b) Landowner may charge the Lands, including the Premises, and/or assign its interest in this Agreement and in all payments due or to become due hereunder as security. K2 WIND shall not unreasonably refuse to postpone its interest in the Premises under this Agreement to the interest of Landowner's mortgagee, provided that the mortgagee enters into a non-disturbance agreement with K2 WIND that is satisfactory to K2 WIND, acting reasonably. Unless otherwise agreed between K2 WIND and Landowner's mortgagee, K2 WIND shall provide a Postponement and Non-Disturbance Agreement substantially in the form attached as Schedule B.

(c) If power of sale or foreclosure proceedings are commenced under any charge, mortgage, lien or other encumbrance against the Lands (each, an "Encumbrance") or a court order is issued for a sale of the Lands to satisfy payments due under an Encumbrance, and such proceedings or order affect K2 WIND's rights under this Agreement, then after giving at least 5 days' written notice to Landowner, K2 WIND may pay all or part of any amount owing under such Encumbrance and in that case (i) K2 WIND shall be subrogated to the rights of the holder of such Encumbrance to the extent of such payment, and (ii) K2 WIND may set off the amount so paid against payments due to Landowner under this Agreement.

11. Assignment by K2 WIND

(a) K2 WIND may assign all or any of its rights under this Agreement or sublet all or any part of the Premises on notice to Landowner but without requiring the consent of Landowner, provided that all payments due pursuant to the provisions hereof have been satisfied and, in the event of assignment, the assignee agrees to fulfill all of the covenants, agreements, terms, provisions and to abide by all limitations as set forth in this Agreement and in the case of a subletting, provided that K2 WIND continues to be bound by all of the terms hereof. Notwithstanding any assignment and the assumption by the assignee of K2 WIND's obligations under this Agreement, K2 WIND shall continue to be liable for the discharge of construction liens as provided in paragraph 8(d).

(b) K2 WIND may, upon notice in writing to Landowner, but without requiring Landowner's consent or approval, mortgage, charge, collaterally assign, or otherwise encumber and

grant security interests in all or any part of its interest in this Agreement and the Premises. (Each such security interest is referred to as a "K2 Wind Security Interest" and each holder of a K2 Wind Security Interest of which the Landowner has been notified in writing is referred to as a "K2 Wind Secured Lender.")

(c) In the event that the Landowner intends to exercise any rights or remedies related to any alleged default by K2 WIND under this Agreement, Landowner shall give written notice of the default (a "Notice"), in substantially the same form as the notice of default given to K2 WIND, to each K2 Wind Secured Lender at the same time it delivers notice of default to K2 WIND, specifying in detail the alleged event of default and the required remedy. Each K2 Wind Secured Lender shall have: (i) during the cure period given to K2 WIND, the right to advise the Landowner in writing that it intends to cure the default (the "K2 Wind Secured Lender Cure Notice") and (ii) in the event that a K2 Wind Secured Lender Cure Notice is given to the Landowner on a timely basis, a period of 10 days thereafter to cure any monetary default and in all other cases a period of 30 days thereafter to commence to cure the default. If required to cure a non-monetary default, the K2 Wind Secured Lender or its representative, whether appointed privately or by the Court, will be given access to the Premises for the purposes of undertaking same provided that the K2 Wind Secured Lender or its appointee irrevocably acknowledges to the Landowner its agreement to be bound by paragraph 8(d) hereof and irrevocably agrees to proceed diligently to cure the non-monetary default.

(d) Landowner shall execute and shall use its best efforts to cause its mortgagees and other holders of rights in the Lands to execute any estoppel certificates (certifying as to truthful matters, including without limitation that no default then exists under this Agreement, if such be the case), consents to assignment, non-disturbance agreements and acknowledgements as K2 WIND or any K2 Wind Secured Lender may reasonably request from time to time, including any agreement with a K2 Wind Secured Lender which incorporates the provisions contained herein relating to the rights afforded to K2 Wind Secured Lenders.

(e) A K2 Wind Secured Lender shall have the absolute right: (i) to assign its security interests; (ii) to enforce its security interests and to succeed to the interest of K2 WIND in the Premises by any lawful means; (iii) to take possession of the Premises for the purposes set forth herein and to perform all obligations to be performed by K2 WIND under this Agreement, or to cause a receiver or receiver-manager to be appointed to do so; and (iv) to acquire all or any portion of K2 WIND's interest in the Premises by foreclosure or by an assignment in lieu of foreclosure and thereafter upon notice to but otherwise without Landowner's consent, to assign or transfer all or any portion of K2 WIND's interest in the Premises to a third party provided all existing defaults have been cured and the proposed assignee or transferee, as the case may be, agrees to fulfill all of the covenants, agreements, terms, provisions and to abide by all limitations as set forth in this Agreement.

(f) Any K2 WIND Secured Lender who acquires K2 WIND's interest in the Premises pursuant to foreclosure or assignment in lieu of foreclosure shall not be liable to perform the obligations imposed on K2 WIND by this Agreement which are incurred or accruing after such K2 Wind Secured Lender has assigned or transferred K2 WIND's interest in the Premises in accordance with paragraph (e) above. Subject to paragraph (c) above, a K2 Wind Secured Lender shall have the absolute right, but not the obligation, to substitute itself for K2 WIND and perform the duties of K2 WIND hereunder for purposes of curing a default under this Agreement. Landowner expressly consents to such substitution, agrees to accept such performance, and authorizes each K2 Wind Secured Lender (or its employees, agents, representatives or contractors) to enter upon the Premises to complete such performance with all of the rights and privileges of K2 WIND hereunder.

(g) If the interest of K2 WIND in the Premises is foreclosed upon or there is an assignment in lieu of foreclosure, or if K2 WIND's interest in this Agreement is surrendered or abandoned pursuant to bankruptcy laws or other laws affecting creditor's rights and, within 45 days after such event, K2 WIND or any K2 Wind Secured Lender or other purchaser shall have arranged to the reasonable satisfaction of Landowner for the

payment of all outstanding compensation or other charges due and payable by K2 WIND as of the date of such event, then Landowner shall execute and deliver to K2 WIND or such K2 Wind Secured Lender or other purchaser, or to a designee of one of these parties, as the case may be, a new lease ("New Lease") which (i) shall be for a term equal to the remainder of the Term (or renewal term, if applicable) before giving effect to such surrender or abandonment; (ii) shall contain the same covenants, agreements, terms, provisions and limitations as this Agreement (except for any requirements that have been fulfilled by K2 WIND or any K2 Wind Secured Lender or other purchaser prior to surrender or abandonment of this Agreement); and (iii) shall include that portion of the Premises in which K2 WIND or such K2 Wind Secured Lender or other purchaser had an interest on the date of the surrender or abandonment. If more than one K2 Wind Secured Lender makes a written request for a New Lease pursuant to this provision, the New Lease shall be delivered to the K2 Wind Secured Lender requesting such New Lease whose security interest has priority, and the written request of any other K2 Wind Secured Lender whose lien is subordinate shall be void and of no further force or effect. The provisions of this paragraph shall survive the termination, surrender or abandoning of this Agreement and shall continue in full force and effect thereafter to the same extent as if this paragraph were a separate and independent agreement made by Landowner, K2 WIND and each K2 Wind Secured Lender, and, from the effective date of such termination, surrender or abandoning of this Agreement to the date of execution and delivery of such New Lease, such K2 Wind Secured Lender or other purchaser may, subject to the terms and conditions to be included in the New Lease as provided above, use and enjoy the Premises without hindrance by Landowner or any person claiming by, through or under Landowner; provided that all of the pre-conditions to the execution of the New Lease as set forth above are complied with.

(h) Notwithstanding any provision of this Agreement to the contrary, Landowner and K2 WIND agree that so long as there exists a K2 Wind Secured Lender of which Landowner has notice, this Agreement shall not be modified or amended, and Landowner shall not accept a surrender, abandonment, cancellation or release of all or any part of this Agreement or the Premises from K2 WIND, prior to expiration of the Term (or any renewal term, if applicable), without the prior written consent of the K2 Wind Secured Lender. This provision is for the express benefit of and shall be enforceable by each K2 Wind Secured Lender as if it were a party named in this Agreement.

12. Dispute Resolution

(a) In the event that either Party provides the other Party with written notice of a dispute arising under this Agreement (the "Dispute") then both Parties shall use their best efforts to settle the Dispute by consulting and negotiating with each other in good faith to reach a solution satisfactory to both Parties. However, if the Parties do not resolve the Dispute within 30 days following such notice, then either Party may provide written notice to the other Party (the "Arbitration Notice") requiring resolution by arbitration and thereafter the Dispute shall be referred to arbitration in accordance with the provisions of the Arbitration Act, 1991.

(b) The arbitration tribunal shall consist of one arbitrator appointed by mutual agreement of the Parties or, if the Parties fail to agree on an arbitrator within 10 days after receipt of the Arbitration Notice, then either Party may apply to a judge of the Superior Court of Justice to appoint an arbitrator. The arbitrator shall be qualified by education and training to pass upon the matter to be decided.

(c) The arbitration shall be conducted in English and shall take place in Goderich, Ontario or another place mutually agreed upon by the Parties.

(d) The arbitration award shall be given in writing and shall address the question of costs of the arbitration and all related matters. The arbitration award shall be final and binding on the Parties as to all questions of fact and shall be subject to appeal only with respect to matters of law or jurisdiction.

(e) Landowner's statutory and common law rights and remedies as a landlord, including its right to terminate this Agreement, re-enter the Premises or to distrain against K2 WIND's personal property, shall be suspended pending the resolution of a Dispute in accordance with this section.

(f) Except to the extent that a matter is specifically the subject of a Dispute, both Parties shall continue to observe and perform the terms and conditions of this Agreement pending the resolution of a Dispute.

13. Notices

(a) Any notice required or permitted to be given to a Party under this Agreement or for the purposes of this Agreement shall be in writing and shall be sufficiently given if delivered or sent by prepaid registered mail, in the case of K2 WIND to its address set forth at the beginning of this Agreement and, in the case of Landowner, to its address set forth in Schedule A.

(b) A Party may change its address for notices by notice given in accordance with this section.

(c) A notice that is personally delivered shall be deemed to have been given and received on the day it is so delivered at a Party's specified address, provided that if that day is not a Business Day then the notice shall be deemed to have been given and received on the next Business Day. Any notice sent by registered mail shall be deemed to have been given and received on the fifth Business Day following the date of mailing in Ontario.

(d) For the purposes of this section, the term "Business Day" means every day except Saturdays, Sundays and statutory holidays in the Province of Ontario.

14. Payments

Any payments to be made by K2 WIND under this Agreement may be made by cheque, mailed by regular mail to Landowner's address for notices. Interest on overdue amounts shall be payable by K2 WIND both before and after default or termination of this Agreement at the prime rate quoted by Royal Bank of Canada from time to time plus 2% a year, calculated and compounded on the last day of each month, provided that any overdue realty taxes shall bear interest at the rate charged by the municipality for overdue taxes.

15. Non-resident Withholding Tax

Landowner warrants that it is not a non-resident of Canada within the meaning of the Income Tax Act (Canada). If Landowner becomes a non-resident of Canada at any time, it shall forthwith notify K2 WIND and any payments to be made by K2 WIND to Landowner under this Agreement shall then be subject to the withholding requirements of the Income Tax Act.

16. Further Assurances

Landowner and K2 WIND hereby agree that they will each do and perform all such acts and things and execute all such deeds, documents and writings and give all such assurances as may be necessary to give effect to this Agreement. If compliance with the provisions of the Planning Act should be required, in the sole discretion of K2 WIND, then Landowner hereby appoints K2 WIND or its authorized agent to execute such applications, consents or authorizations as may be necessary for K2 WIND to obtain any required consent from the local Land Division Committee or Committee of Adjustment and Landowner agrees to cooperate in any such applications for consent. K2 WIND shall pay all expenses and costs associated therewith including all reasonable professional and legal expenses incurred by Landowner.

17. Pre-Existing Contaminants

Landowner warrants that to the best of its knowledge and belief (i) the Premises do not now contain and never have contained any pollutant, contaminant, or hazardous, dangerous or toxic substances or materials, including refined petroleum products, and (ii) no notice of violation of

any environmental law has ever been issued in respect of the Premises by any governmental agency. K2 WIND shall notify Landowner of any discovery of any such substances during any excavation or assessment work done by K2 WIND on the Premises. Unless any such substances result from K2 WIND's operations, K2 WIND shall not be liable for and Landowner hereby releases, discharges and indemnifies K2 WIND from and against any claims or costs that may arise as a consequence of the discovery of any such substances.

18. Registration

K2 WIND may register this Agreement or a notice of this Agreement in the appropriate Land Registry Office. K2 WIND shall withdraw or discharge any such registrations within a reasonable time after the termination of this Agreement.

19. Interpretation

The section headings in this Agreement have been inserted for ease of reference only and shall not affect the construction or the interpretation of this Agreement. This Agreement shall be read with all changes in number and gender as may be required by the context.

20. Invalidity

If any provision of this Agreement is determined to be invalid or unenforceable in whole or in part, such invalidity or unenforceability shall attach only to such provision (or part thereof) and everything else in this Agreement shall continue in full force and effect.

21. Entire Agreement

This Agreement constitutes the entire agreement between the Parties with respect to the subject matter of this Agreement. Each of the Parties acknowledges that there is no representation, warranty, agreement or understanding between them, whether express or implied, which has induced it to enter into this Agreement, except as expressly stated in this Agreement.

22. Amendment

No change to or modification of this Agreement shall be valid unless it is in writing and signed by the Party to be bound.

23. Planning Act

This Agreement is entered into subject to the express condition that it shall be effective only if the provisions of the Planning Act are complied with. If a severance consent is required under the Planning Act for this Agreement to be effective, until such consent is obtained the Term shall be deemed to be limited to such period as may be allowed without obtaining a severance consent. Pursuant to paragraph 50(3)(d) of the Planning Act, K2 Wind hereby declares that it is entering into this Agreement for the purpose of an electricity distribution line or an electricity transmission line, or both, within the meaning of Part VI of the Ontario Energy Board Act, 1998. For greater certainty, the facilities will include transformers, plant, equipment, electric interconnections and related structures that will comprise a transformer station. Despite this declaration, if, in the sole discretion of K2 Wind, severance consent should be required or advisable, then K2 Wind shall have the right and is hereby given the authority to execute all such documents as may be necessary for K2 Wind to obtain any necessary consent from the local Land Division Committee or Committee of Adjustments and the Landowner agrees to co-operate in any such application for consent.

24. Survival

Section 18 shall survive the expiry or termination of this Agreement and the following provisions shall survive the expiry or termination of this Agreement until K2 WIND has fully performed its obligations under paragraph 8(f) (Restoration of Premises): 7(d), 7(f), 8(b), 8(c), 8(d), 9, 10, 11, 12, 13 and 16.

25. Family Law Act

Landowner warrants that no person other than Landowner has rights to any matrimonial home on the Lands under the Family Law Act and that spousal consent is not necessary for the grant of this Agreement.

IN WITNESS WHEREOF Landowner and K2 WIND have executed this Agreement to be effective as of the Effective Date.

K2 WIND ONTARIO INC.

By: _____

Name:
Title:
I have authority to bind the Corporation

SCHEDULE A

Landowner:

[redacted]

Lands:

N ½ LT 3 CON 8 ED ASHFIELD, EXCEPT PT 5, 22R3021, TOWNSHIP OF ASHFIELD-COLBORNE-WAWANOSH (P.I.N. 41095-0031)

Premises:

That part of the Lands included within a boundary described as follows:

COMMENCING at the northeastern corner of the Lands at the intersection of Belgrave Road and Lanesville Line;

THENCE southwesterly 200 metres along the southeastern boundary of the Lands abutting the Road allowance for Lanesville Line;

THENCE northwesterly 200 metres at right angles to the southeastern boundary of the Lands;

THENCE northeasterly 200 metres parallel to the southeastern boundary of the Lands to a point on the northeastern boundary of the Lands abutting the road allowance for Belgrave Road;

THENCE southeasterly to the point of commencement;

COMPRISING approximately 10 acres, more or less.

Landowner's address for notices:

[redacted]

Landowner's GST number (if applicable):

SCHEDULE B

Form of Postponement and Non-Disturbance Agreement referred to in paragraph 10(b)

POSTPONEMENT and NON-DISTURBANCE AGREEMENT

This Agreement is made effective as of the ____ day of _____ , 20___

BETWEEN:

_____ (the "Mortgagee")

and

K2 WIND ONTARIO INC., an Ontario corporation, acting as general partner of and on behalf of K2 WIND ONTARIO LIMITED PARTNERSHIP, a limited partnership formed under the laws of the Province of Ontario, with an office at 200 University Avenue, Toronto ON M5H 3C6

("K2 WIND")

WHEREAS Mortgagee is the holder of a mortgage dated _____ , given by _____ (the "Landowner") in respect of the lands described in Schedule A (the "Lands"), which mortgage was registered on _____ as Instrument No. _____ (the "Mortgage"); and

WHEREAS K2 WIND is the holder of a lease of parts of the Lands as described in Schedule B ("Leased Premises") dated _____ , notice of which lease was registered on _____ as Instrument No. _____ (the "Lease"); and

WHEREAS Mortgagee has asked K2 WIND to postpone its rights under the Lease to the rights of Mortgagee under the Mortgage and K2 WIND is willing to do so on the terms and conditions contained in this Agreement;

NOW THEREFORE, in consideration of the mutual covenants and agreements herein contained, Mortgagee and K2 WIND hereby agree as follows:

1. K2 WIND hereby postpones its interest under the Lease to the rights of Mortgagee under the Mortgage, to the intent that the Mortgage shall have validity, priority and effect as if it were executed, delivered and recorded before the grant of the Lease.

2. Mortgagee agrees that so long as K2 WIND is not in default under the Lease (beyond any period given in the Lease to cure a default), (i) K2 WIND's rights under the Lease shall not be diminished or interfered with by Mortgagee and K2 WIND's occupancy of the Leased Premises shall not be disturbed during the term of the Lease and any extensions or renewals thereof; and (ii) Mortgagee will not join K2 WIND as a party defendant in any action or proceeding for the purpose of terminating K2 WIND's interest and estate under the Lease because of any default of Landowner under the Mortgage.

3. If the interest of Landowner in the Lands shall be transferred to Mortgagee by reason of foreclosure or other similar proceedings brought by Mortgagee and Mortgagee thereby succeeds to the interest of Landowner under the Lease, K2 WIND shall be bound to Mortgagee under all of the terms, covenants and conditions of the Lease for the balance of the term of the Lease and any extensions or renewals thereof; provided, however, that K2 WIND shall be under no obligation to Mortgagee until it receives written notice that Mortgagee has succeeded to the interest of Landowner under the Lease in accordance with the notice provisions of the Lease, together with such evidence thereof as it may reasonably require.

4. If Mortgagee succeeds to the interest of Landowner under the Lease by reason of foreclosure or other similar proceedings, Mortgagee shall be bound to K2 WIND under all of the terms, covenants and conditions of the Lease for the balance of the term of the Lease and any extensions or renewals thereof and K2 WIND shall have the same remedies against Mortgagee for the breach of an agreement contained in the Lease that it might have had against

Landowner if Mortgagee had not succeeded to the interest of Landowner; provided, however, that Mortgagee shall not be (i) liable for any prior act or omission of Landowner, or (ii) subject to any set-off or defence that K2 WIND might have against Landowner, or (iii) bound by any rent paid by K2 WIND to Landowner for more than the current lease year.

5. K2 WIND certifies that the term of the Lease has commenced, that the Lease is currently in full force and effect, that the Lease has not been amended except as may be set out in Schedule C, that K2 WIND has accepted possession of the Leased Premises, and that as of this date K2 WIND has no charge, lien, claim or set-off, under the Lease or otherwise, against the rents and other payments due or to become due thereunder.

6. This Agreement may be amended only by an instrument in writing signed by the party to be bound.

7. This Agreement shall enure to the benefit of and be binding upon the parties hereto and their successors and assigns.

IN WITNESS WHEREOF the parties have caused this Agreement to be executed by their respective officers duly authorized in that behalf, to be effective as of the date first above written.

[Mortgagee]

By: _____
Name:
Title:
I have authority to bind the Corporation

K2 WIND ONTARIO INC.

By: _____
Name:
Title:
I have authority to bind the Corporation

TAB F-2-2

LAND MATTERS – OPTION TO PURCHASE LAND FOR SUBSTATION WITH EXTENSION LETTER

OPTION AGREEMENT

THIS AGREEMENT is made as of the 25th day of January, 2010

B E T W E E N:

CAPITAL POWER DEVELOPMENT MANAGEMENT INC.,
as general partner of **CAPITAL POWER (ONTARIO) LIMITED PARTNERSHIP**, a limited partnership formed under the laws of the Province of Ontario

(hereinafter referred to as "CAPITAL POWER")

-and-

[redacted]

(together herein referred to as the "Landowners")

WHEREAS the Landowners are the owners, subject to any registered encumbrances, of those certain lands in the Township of Ashfield-Colborne-Wawanosh, in the County of Huron, in the Province of Ontario, described as follows:

Part of Lot 6, Concession 7 ED, Ashfield, as in R26622,
now known as PIN 41095-0047 (comprising about 100 acres, more or less)
(the "Land");

AND WHEREAS the Landowners have agreed to grant CAPITAL POWER an option to purchase the Land, subject to and in accordance with the terms of this Agreement;

NOW THEREFORE THIS AGREEMENT WITNESSES that in consideration of the mutual covenants and agreements herein contained, the parties covenant and agree as follows:

OPTION

1. (1) The Landowners hereby grant to CAPITAL POWER an option to purchase the Land (the "Option") for the Purchase Price set out below. The Option may be exercised by CAPITAL POWER at any time during the two (2) year period commencing on the date hereof and thereafter during such extended period as may be applicable pursuant to paragraph 1(2) below (such period, as potentially extended, is referred to herein as the "Term").

(2) CAPITAL POWER shall pay the Landowners, within 20 days of the date hereof, the sum of [redacted], and the Landowners agree that such payment shall be accepted as compensation in full for the grant of the Option in respect of the first two years of the Term. CAPITAL POWER shall have the option to extend the Term by one year (potentially resulting in a total Term of 3 years) by giving notice to the Landowners before the second anniversary of this Agreement, together with a cheque payable to the Landowners in the amount of [redacted], which shall be accepted by the Landowners as compensation in full for the grant of the Option in respect of the third year of the Term.

(3) The Purchase Price shall be [redacted].

(4) The Option may be exercised by CAPITAL POWER giving written notice to the Landowners, provided that the Landowners receive or are deemed to have received such written notice prior to the expiry of the Term.

(5) The Option shall be irrevocable by the Landowners and may be exercised by CAPITAL POWER at any time during the Term. The completion of the purchase and sale of the Land shall occur on the first business day that is

(a) 30 days after CAPITAL POWER has exercised the Option, or

(b) if a variance, rezoning or other permits, consents or approvals are required with respect to CAPITAL POWER's planned use of the Land for purposes of a transformer substation and switchyard ("Approvals"), 30 days after the date all Approvals have been granted or 30 days after the date that

CAPITAL POWER gives the Landowners notice that it will complete the purchase of the Land despite not having all Approvals,

whichever is later, or on such other date as the parties may agree (the "Purchase Date").

(6) In the event of and upon the exercise of the Option, the transaction shall be completed in accordance with the terms and conditions contained in the standard Agreement of Purchase and Sale attached hereto as Schedule "A". In the case of a conflict or inconsistency between a term, condition or provision in Schedule "A" and a term, condition or provision contained in the body of this Agreement, the latter will govern.

(7) It is understood and agreed that CAPITAL POWER has no obligation to purchase the Land and if CAPITAL POWER fails to give the notice referred to herein with respect to exercising the Option, then the Option shall, at the expiration of the Term, become null, void and of no effect and the parties hereto shall be released from all obligations relating to the Option.

(8) In the event an Approval remains outstanding such that the transaction of purchase and sale is not completed within 365 days of the exercise of the Option by CAPITAL POWER ("Approval Period"), either party shall be entitled to terminate the transaction, and the parties hereto shall be released from all obligations relating to the Option and the purchase. Notwithstanding the foregoing, if an Approval remains outstanding such that the transaction is not completed within 365 days of the exercise of the Option but CAPITAL POWER is in the process of appealing a decision relating to an Approval, then the Approval Period shall be extended to a date which is thirty (30) days following the determination of the appeal, provided that CAPITAL POWER shall diligently pursue such appeal.

PLANNING ACT

2. The parties agree that this Option Agreement is subject to the condition that it shall be effective only if the provisions of section 50 of the *Planning Act* (Ontario) are complied with.

REZONING and OTHER APPROVALS

3. If rezoning of the Land or other permits or approvals (including without limitation site plan approval, a building permit and an entrance permit for the access road) should be required to enable the use of the Land for the purpose set out in clause 1(5)(b) above, the Landowners agree that they shall support such rezoning, permit or variance applications as may be required or as may be deemed advisable by CAPITAL POWER and shall execute all such consents and other documents as may be reasonably required by CAPITAL POWER, both before and after the Purchase Date, with all costs for same being the responsibility of CAPITAL POWER.

SURVEYS

4. (1) The Landowners hereby grant CAPITAL POWER, its employees, agents, contractors and consultants, the right to enter the Land before the Purchase Date, on notice to the Landowners, to conduct surveys, tests and soil examinations, provided that CAPITAL POWER shall restore or compensate the Landowners for any damage caused to the Land or tiles, fences or crops thereon, and for the loss related to future crops.

(2) CAPITAL POWER shall maintain public liability insurance in respect of its activities on the Land prior to the Purchase Date in an amount not less than $5,000,000.00 per occurrence, and shall provide proof of same to the Landowners, if requested.

(3) CAPITAL POWER covenants and agrees to indemnify and save harmless the Landowners from any and all claims arising from its activities on the Land prior to the Purchase Date except for any claims arising out of the negligence or wilful act or omission of the Landowners, their agents or employees.

CONTAMINATION

5. The Landowners warrant that to the best of their knowledge and belief, the Land do not contain any materials defined as hazardous waste, hazardous recyclable material, or prescribed non-hazardous waste pursuant to the *Canadian Environmental Protection Act, 1999* (Canada) or as hazardous waste under the General Regulation - Waste Management made under the *Environmental Protection Act* (Ontario).

CROP DAMAGE

6. Until the Purchase Date, the Landowners may continue to farm the Land in the normal course. If a crop is standing on the Land on the Purchase Date, the Landowners shall be entitled to enter the Land to harvest the crop subject to first obtaining the consent of CAPITAL POWER and complying with any conditions required by CAPITAL POWER to ensure that there is no interference with CAPITAL POWER's construction operations. CAPITAL POWER shall compensate the Landowners for the value of any standing crops that it damages or that cannot be harvested by the Landowners. The value of any crop shall be the market price for such crop on the date 30 days after such damage, or September 30 of the year of damage, at the Landowners' option. Yield shall be based on the Landowners' historic or actual yields, or the average used for crop insurance purposes, at the Landowners' option. Damages shall be paid in full within 14 days after the value of the crop is determined.

LEASE AFTER CLOSING

7. Subject to the Landowners entering into a lease with CAPITAL POWER on terms acceptable to CAPITAL POWER, acting reasonably, the Landowners shall be entitled to continue to occupy and use the dwelling on the Land and surrounding outbuildings for a period of 90 days after the Purchase Date as tenants of CAPITAL POWER, for a rental of $2.00.

CHATTELS AND FIXTURES

8. All chattels on the Land shall remain the property of the Landowners and shall be removed from the Land within 90 days of the Purchase Date, failing which CAPITAL POWER may dispose of any chattels left on the Land, by sale or otherwise, with no further obligation to the Landowners. If CAPITAL POWER intends to demolish any buildings or structures on the Land within one year of the Purchase Date, it shall give the Landowners a reasonable opportunity to salvage and remove any fixtures and materials that CAPITAL POWER does not need.

TAXES

9. CAPITAL POWER shall be responsible for provincial land transfer taxes and federal Goods and Services Tax (GST), if applicable. The Landowners shall be responsible for any income taxes that may be assessed against them as a result of this Option Agreement or the sale of the Land. The Landowners confirm they are registered for GST and their GST number is [redacted].

NOTICES

10. Any notice, demand or request which any party shall give to any other party shall be in writing and may be delivered or mailed by registered mail and shall be deemed:

(a) in the case of delivery to have been given when the same is personally delivered to the addressee at the address set forth below; and

(b) in the case of dispatch by registered mail, except during a postal disruption, to have been duly given at 5:00 in the afternoon (local time to the sender) on the second (2nd) day after the day the same was deposited in a public post box or post office (on the first business day thereafter if such second day is not a business day), if addressed to such party at its address set forth below.

to the Landowners as follows:

[redacted]

and to CAPITAL POWER as follows:

200 University Avenue
Suite 1301
Toronto, ON M5H 3C6

Attention: Manager, Business Development

Any party may change its address for notices by notice given as aforesaid.

SEVERABILITY

11. If any covenant, obligation or agreement in this Agreement or the application thereof to any person or circumstance shall, to any extent, be invalid or unenforceable, the remainder of this Agreement or the application of such covenant, obligation or agreement to persons or circumstances other than those as to which it is held invalid or unenforceable, shall not be affected thereby and each covenant, obligation and agreement in this Agreement shall be separately valid and enforceable to the fullest extent possible.

HEADINGS

12. The section headings in this Agreement have been inserted for convenience of reference only shall not be referred to in the interpretation of this Agreement.

APPLICABLE LAW

13. This Agreement shall be construed in accordance with the laws of the Province of Ontario and no action or other proceeding shall be brought to construe or enforce this Agreement except in those courts having jurisdiction in the Province of Ontario.

REGISTRATION

14. It is understood and agreed that CAPITAL POWER shall be entitled to register a notice of this Agreement on title to the Land, recording the fact that CAPITAL POWER has an option to purchase the Land.

ASSIGNMENT

15. CAPITAL POWER shall on notice to the Landowners have the right at any time and from time to time to assign or convey to other persons or corporations, all or any of the powers, rights and interests obtained by or granted to it hereunder.

ENTIRE AGREEMENT

16. Except for a prior Option Agreement dated March 16, 2009, granted by the Landowners to EPCOR Power Development Corporation in respect of a portion of the Land, this Agreement represents the entire agreement between CAPITAL POWER and the Landowners relating to the Land and supersedes all prior agreements, representations, undertakings and understandings between CAPITAL POWER and the Landowners relating to the Land.

FURTHER ASSURANCES

17. The Landowners and CAPITAL POWER agree that they will each do and perform all such acts and things and execute all such deeds, documents and writings and give all such assurances as may be necessary to give effect to this Agreement.

ADDITIONAL PROVISIONS

18. (1) The Landowners shall have the following documentation deleted from the title to the Land prior to the Purchase Date:

(a) [redacted]

(b)

(2) The Landowners further agree to have the Charge/Mortgage of Land in favour of [redacted] deleted from the title to the Land prior to the Purchase Date or in the alternative cause their solicitors to provide an undertaking to have the Charge/Mortgage deleted from title within a reasonable time after closing.

SURVIVAL

19. The provisions of paragraphs 3, 4(3), 5, 6, 7, 8, 9, 10, 17 and 18 hereof shall survive closing of the transaction on the Purchase Date.

ENUREMENT

20. This Agreement shall run with the Land and shall enure to the benefit of and be binding upon the parties hereto and their respective heirs, executors, administrators, successors and assigns, as the case may be.

IN WITNESS WHEREOF the parties hereto have executed this Agreement.

SIGNED, SEALED & DELIVERED)
[redacted])
)
)
)
)
)
)
)
)
)

[redacted]

CAPITAL POWER DEVELOPMENT MANAGEMENT INC., as general partner of CAPITAL POWER (ONTARIO) LIMITED PARTNERSHIP

By: _____

Name: Glenn Hubbers

Title: Business Development Manager

I have authority to bind the Corporation

Schedule "A"

Agreement of Purchase and Sale
Commercial

Form 500
for use in the Province of Ontario

This Agreement of Purchase and Sale dated this..... day of ..... 20.....

BUYER,....., agrees to purchase from
(Full legal names of all Buyers)

SELLER,....., the following
(Full legal names of all Sellers)

REAL PROPERTY:

Address..... fronting on the ..... side

of..... in the .....

and having a frontage of ..... more or less by a depth of ..... more or less

and legally described as .....

..... (the "property").
(Legal description of land including easements not described elsewhere)

PURCHASE PRICE: Dollars (CDN$).....

.....Dollars

DEPOSIT: Buyer submits .....
(Herewith/Upon Acceptance/as otherwise described in this Agreement)

..... Dollars (CDN$).....

by negotiable cheque payable to..... "Deposit Holder" to be held in trust pending completion or other termination of this Agreement and to be credited toward the Purchase Price on completion. For the purposes of this Agreement, "Upon Acceptance" shall mean that the Buyer is required to deliver the deposit to the Deposit Holder within 24 hours of the acceptance of this Agreement. The parties to this Agreement hereby acknowledge that, unless otherwise provided for in this Agreement, the Deposit Holder shall place the deposit in trust in the Deposit Holder's non-interest bearing Real Estate Trust Account and no interest shall be earned, received or paid on the deposit.

Buyer agrees to pay the balance as more particularly set out in Schedule A attached.

SCHEDULE(S) A.....**attached hereto form(s) part of this Agreement.**

1. **IRREVOCABILITY:** This Offer shall be irrevocable by ..... until .....a.m./p.m. on
(Seller/Buyer)
the ..... day of ..... 20....., after which time, if not accepted, this Offer shall be null and void and the deposit shall be returned to the Buyer in full without interest.
2. **COMPLETION DATE:** This Agreement shall be completed by no later than 6:00 p.m. on the ..... day of ....., 20..... . Upon completion, vacant possession of the property shall be given to the Buyer unless otherwise provided for in this Agreement.
3. **NOTICES:** Seller hereby appoints the Listing Brokerage as Agent for the purpose of giving and receiving notices pursuant to this Agreement. **Only if the Co-operating Brokerage represents the interests of the Buyer in this transaction,** the Buyer hereby appoints the Co-operating Brokerage as Agent for the purpose of giving and receiving notices pursuant to this Agreement. Any notice relating hereto or provided for herein shall be in writing. This offer, any counter offer, notice of acceptance thereof, or any notice shall be deemed given and received, when hand delivered to the address for service provided in the Acknowledgement below, or where a facsimile number is provided herein, when transmitted electronically to that facsimile number.

FAX No. ..... (For delivery of notices to Seller) FAX No. ..... (For delivery of notices to Buyer)

INITIALS OF BUYER(S): ( ) **INITIALS OF SELLER(S):** ( )

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4. **CHATTELS INCLUDED:**.....

.

5. **FIXTURES EXCLUDED:**.....

.

6. **RENTAL ITEMS:** The following equipment is rented and **not** included in the Purchase Price. The Buyer agrees to assume the rental contract(s), if assumable: .....

7. **GST: If this transaction is subject to Goods and Services Tax (GST), then such tax shall be in addition to the Purchase Price.** The Seller will not collect GST if the Buyer provides to the Seller a warranty that the Buyer is registered under the Excise Tax Act ("ETA"), together with a copy of the Buyer's ETA registration, a warranty that the Buyer shall self-assess and remit the GST payable and file the prescribed form and shall indemnify the Seller in respect of any GST payable. The foregoing warranties shall not merge but shall survive the completion of the transaction. If this transaction is not subject to GST, Seller agrees to certify on or before closing, that the transaction is not subject to GST.

8. **TITLE SEARCH:** Buyer shall be allowed until 6:00 p.m. on the ..... day of....., 20....., (Requisition Date) to examine the title to the property at his own expense and until the earlier of: (i) thirty days from the later of the Requisition Date or the date on which the conditions in this Agreement are fulfilled or otherwise waived or; (ii) five days prior to completion, to satisfy himself that there are no outstanding work orders or deficiency notices affecting the property, that its present use (.....) may be lawfully continued and that the principal building may be insured against risk of fire. Seller hereby consents to the municipality or other governmental agencies releasing to Buyer details of all outstanding work orders affecting the property, and Seller agrees to execute and deliver such further authorizations in this regard as Buyer may reasonably require.

9. **FUTURE USE:** Seller and Buyer agree that there is no representation or warranty of any kind that the future intended use of the property by Buyer is or will be lawful except as may be specifically provided for in this Agreement.

10. **TITLE:** Provided that the title to the property is good and free from all registered restrictions, charges, liens, and encumbrances except as otherwise specifically provided in this Agreement and save and except for (a) any registered restrictions or covenants that run with the land providing that such are complied with; (b) any registered municipal agreements and registered agreements with publicly regulated utilities providing such have been complied with, or security has been posted to ensure compliance and completion, as evidenced by a letter from the relevant municipality or regulated utility; (c) any minor easements for the supply of domestic utility or telephone services to the property or adjacent properties; and (d) any easements for drainage, storm or sanitary sewers, public utility lines, telephone lines, cable television lines or other services which do not materially affect the use of the property. If within the specified times referred to in paragraph 8 any valid objection to title or to any outstanding work order or deficiency notice, or to the fact the said present use may not lawfully be continued, or that the principal building may not be insured against risk of fire is made in writing to Seller and which Seller is unable or unwilling to remove, remedy or satisfy or obtain insurance save and except against risk of fire in favour of the Buyer and any mortgagee, (with all related costs at the expense of the Seller), and which Buyer will not waive, this Agreement notwithstanding any intermediate acts or negotiations in respect of such objections, shall be at an end and all monies paid shall be returned without interest or deduction and Seller, Listing Brokerage and Co-operating Brokerage shall not be liable for any costs or damages. Save as to any valid objection so made by such day and except for any objection going to the root of the title, Buyer shall be conclusively deemed to have accepted Seller's title to the property.

11. **CLOSING ARRANGEMENTS:** Where each of the Seller and Buyer retain a lawyer to complete the Agreement of Purchase and Sale of the Property, and where the transaction will be completed by electronic registration pursuant to Part III of the Land Registration Reform Act, R.S.O. 1990, Chapter L4 and the Electronic Registration Act, S.O. 1991, Chapter 44, and any amendments thereto, the Seller and Buyer acknowledge and agree that the exchange of closing funds, non-registrable documents and other items (the "Requisite Deliveries") and the release thereof to the Seller and Buyer will (a) not occur at the same time as the registration of the transfer/deed (and any other documents intended to be registered in connection with the completion of this transaction) and (b) be subject to conditions whereby the lawyer(s) receiving any of the Requisite Deliveries will be required to hold same in trust and not release same except in accordance with the terms of a document registration agreement between the said lawyers. The Seller and Buyer irrevocably instruct the said lawyers to be bound by the document registration agreement which is recommended from time to time by the Law Society of Upper Canada. Unless otherwise agreed to by the lawyers, such exchange of the Requisite Deliveries will occur in the applicable Land Titles Office or such other location agreeable to both lawyers.

INITIALS OF BUYER(S): ( ) **INITIALS OF SELLER(S):** ( )

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12. **DOCUMENTS AND DISCHARGE:** Buyer shall not call for the production of any title deed, abstract, survey or other evidence of title to the property except such as are in the possession or control of Seller. If requested by Buyer, Seller will deliver any sketch or survey of the property within Seller's control to Buyer as soon as possible and prior to the Requisition Date. If a discharge of any Charge/Mortgage held by a corporation incorporated pursuant to the Trust And Loan Companies Act (Canada), Chartered Bank, Trust Company, Credit Union, Caisse Populaire or Insurance Company and which is not to be assumed by Buyer on completion, is not available in registrable form on completion, Buyer agrees to accept Seller's lawyer's personal undertaking to obtain, out of the closing funds, a discharge in registrable form and to register same, or cause same to be registered, on title within a reasonable period of time after completion, provided that on or before completion Seller shall provide to Buyer a mortgage statement prepared by the mortgagee setting out the balance required to obtain the discharge, and, where a real-time electronic cleared funds transfer system is not being used, a direction executed by Seller directing payment to the mortgagee of the amount required to obtain the discharge out of the balance due on completion.
13. **INSPECTION:** Buyer acknowledges having had the opportunity to inspect the property and understands that upon acceptance of this Offer there shall be a binding agreement of purchase and sale between Buyer and Seller.
14. **INSURANCE:** All buildings on the property and all other things being purchased shall be and remain until completion at the risk of Seller. Pending completion, Seller shall hold all insurance policies, if any, and the proceeds thereof in trust for the parties as their interests may appear and in the event of substantial damage, Buyer may either terminate this Agreement and have all monies paid returned without interest or deduction or else take the proceeds of any insurance and complete the purchase. No insurance shall be transferred on completion. If Seller is taking back a Charge/Mortgage, or Buyer is assuming a Charge/Mortgage, Buyer shall supply Seller with reasonable evidence of adequate insurance to protect Seller's or other mortgagee's interest on completion.
15. **PLANNING ACT:** This Agreement shall be effective to create an interest in the property only if Seller complies with the subdivision control provisions of the Planning Act by completion and Seller covenants to proceed diligently at his expense to obtain any necessary consent by completion.
16. **DOCUMENT PREPARATION:** The Transfer/Deed shall, save for the Land Transfer Tax Affidavit, be prepared in registrable form at the expense of Seller, and any Charge/Mortgage to be given back by the Buyer to Seller at the expense of the Buyer. If requested by Buyer, Seller covenants that the Transfer/Deed to be delivered on completion shall contain the statements contemplated by Section 50(22) of the Planning Act, R.S.O.1990.
17. **RESIDENCY:** Buyer shall be credited towards the Purchase Price with the amount, if any, necessary for Buyer to pay to the Minister of National Revenue to satisfy Buyer's liability in respect of tax payable by Seller under the non-residency provisions of the Income Tax Act by reason of this sale. Buyer shall not claim such credit if Seller delivers on completion the prescribed certificate or a statutory declaration that Seller is not then a non-resident of Canada.
18. **ADJUSTMENTS:** Any rents, mortgage interest, realty taxes including local improvement rates and unmetered public or private utility charges and unmetered cost of fuel, as applicable, shall be apportioned and allowed to the day of completion, the day of completion itself to be apportioned to Buyer.
19. **TIME LIMITS:** Time shall in all respects be of the essence hereof provided that the time for doing or completing of any matter provided for herein may be extended or abridged by an agreement in writing signed by Seller and Buyer or by their respective lawyers who may be specifically authorized in that regard.
20. **TENDER:** Any tender of documents or money hereunder may be made upon Seller or Buyer or their respective lawyers on the day set for completion. Money may be tendered by bank draft or cheque certified by a Chartered Bank, Trust Company, Province of Ontario Savings Office, Credit Union or Caisse Populaire.
21. **FAMILY LAW ACT:** Seller warrants that spousal consent is not necessary to this transaction under the provisions of the Family Law Act, R.S.O.1990 unless Seller's spouse has executed the consent hereinafter provided.
22. **UFFI:** Seller represents and warrants to Buyer that during the time Seller has owned the property, Seller has not caused any building on the property to be insulated with insulation containing ureaformaldehyde, and that to the best of Seller's knowledge no building on the property contains or has ever contained insulation that contains ureaformaldehyde. This warranty shall survive and not merge on the completion of this transaction, and if the building is part of a multiple unit building, this warranty shall only apply to that part of the building which is the subject of this transaction.
23. **LEGAL, ACCOUNTING AND ENVIRONMENTAL ADVICE:** The parties acknowledge that any information provided by the brokerage is not legal, tax or environmental advice, and that it has been recommended that the parties obtain independent professional advice prior to signing this document.
24. **CONSUMER REPORTS: The Buyer is hereby notified that a consumer report containing credit and/or personal information may be referred to in connection with this transaction.**
25. **AGREEMENT IN WRITING:** If there is conflict or discrepancy between any provision added to this Agreement (including any Schedule attached hereto) and any provision in the standard pre-set portion hereof, the added provision shall supersede the standard pre-set provision to the extent of such conflict or discrepancy. This Agreement including any Schedule attached hereto, shall constitute the entire Agreement between Buyer and Seller. There is no representation, warranty, collateral agreement or condition, which affects this Agreement other than as expressed herein. For the purposes of this Agreement, Seller means vendor and Buyer means purchaser. This Agreement shall be read with all changes of gender or number required by the context.

INITIALS OF BUYER(S): ( ) **INITIALS OF SELLER(S):** ( )

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26. **SUCCESSORS AND ASSIGNS:** The heirs, executors, administrators, successors and assigns of the undersigned are bound by the terms herein.

SIGNED, SEALED AND DELIVERED in the presence of: IN WITNESS whereof I have hereunto set my hand and seal:

.....

.....
(Witness) (Buyer/Authorized Signing Officer) (Seal) DATE.....

.....
(Witness) (Buyer/Authorized Signing Officer) (Seal) DATE.....

I, the Undersigned Seller, agree to the above Offer. I hereby irrevocably instruct my lawyer to pay directly to the Listing Brokerage the unpaid balance of the commission together with applicable Goods and Services Tax (and any other taxes as may hereafter be applicable), from the proceeds of the sale prior to any payment to the undersigned on completion, as advised by the Listing Brokerage to my lawyer.

SIGNED, SEALED AND DELIVERED in the presence of: IN WITNESS whereof I have hereunto set my hand and seal:

.....

.....
(Witness) (Seller/Authorized Signing Officer) (Seal) DATE.....

.....
(Witness) (Seller/Authorized Signing Officer) (Seal) DATE.....

SPOUSAL CONSENT: The Undersigned Spouse of the Seller hereby consents to the disposition evidenced herein pursuant to the provisions of the Family Law Act, R.S.O.1990, and hereby agrees with the Buyer that he/she will execute all necessary or incidental documents to give full force and effect to the sale evidenced herein.

.....
(Witness) (Spouse) (Seal) DATE.....

CONFIRMATION OF ACCEPTANCE: Notwithstanding anything contained herein to the contrary, I confirm this Agreement with all changes both typed and written was finally accepted by all parties at..... a.m./p.m. this.....day of....., 20..... .

..... (Signature of Seller or Buyer)

INFORMATION ON BROKERAGE(S)

Listing Brokerage..... Tel.No.....

.....

Co-op/Buyer Brokerage..... Tel.No.....

.....

ACKNOWLEDGEMENT

I acknowledge receipt of my signed copy of this accepted Agreement of Purchase and Sale and I authorize the Agent to forward a copy to my lawyer.

..... DATE.....
(Seller)

..... DATE.....
(Seller)

Address for Service.....

.....Tel.No.....

Seller's Lawyer.....

Address.....

....
Tel.No. FAX No.

I acknowledge receipt of my signed copy of this accepted Agreement of Purchase and Sale and I authorize the Agent to forward a copy to my lawyer.

..... DATE.....
(Buyer)

..... DATE.....
(Buyer)

Address for Service.....

.....Tel.No.....

Buyer's Lawyer.....

Address.....

....
Tel.No FAX No.

FOR OFFICE USE ONLY

COMMISSION TRUST AGREEMENT

To: Co-operating Brokerage shown on the foregoing Agreement of Purchase and Sale:
In consideration for the Co-operating Brokerage procuring the foregoing Agreement of Purchase and Sale, I hereby declare that all moneys received or receivable by me in connection with the Transaction as contemplated in the MLS® Rules and Regulations of my Real Estate Board shall be receivable and held in trust. This agreement shall constitute a Commission Trust Agreement as defined in the MLS® Rules and shall be subject to and governed by the MLS® Rules pertaining to Commission Trust.

DATED as of the date and time of the acceptance of the foregoing Agreement of Purchase and Sale. Acknowledged by:

....
(Authorized to bind the Listing Brokerage) (Authorized to bind the Co-operating Brokerage)

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Schedule A
Agreement of Purchase and Sale – Commercial

This Schedule is attached to and forms part of the Agreement of Purchase and Sale between:

BUYER,....., and

SELLER,.....

for the purchase and sale of .....

..... dated the ..... day of ....., 20..... .

Buyer agrees to pay the balance as follows:

This form must be initialed by all parties to the Agreement of Purchase and Sale.

INITIALS OF BUYER(S): ( ) **INITIALS OF SELLER(S):** ( )

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December 1, 2011

[redacted]

Re: Option Agreement dated January 25, 2010, between yourselves and Capital Power Development Management Inc. as general partner of Capital Power (Ontario) Limited Partnership with respect to Part of Lot 6, Conc 7 ED, Ashfield (P.I.N. 41095-0047) – File #83

As previously advised, Capital Power Development Management Inc. assigned its interest in the referenced agreement to K2 Wind Ontario Inc. as general partner of K2 Wind Ontario Limited Partnership ("K2 Wind") on August 3, 2011; however, Capital Power continues to administer this agreement on behalf of K2 Wind.

The option granted by this agreement will expire on January 25, 2012, but the term of the agreement may be extended by one year upon payment of a further [redacted], pursuant to section 2(2) of the agreement. Capital Power, on behalf of K2 Wind, hereby gives notice that K2 Wind is electing to extend the term of the agreement to January 25, 2013. A cheque in the amount of [redacted] is enclosed.

Please note that Capital Power has moved offices. Our new address is: 1720 – 70 York Street, Toronto ON M5J 1S9. This address may be used for notices to both Capital Power and K2 Wind.

Yours truly,

Glenn Hubbers
Business Development Manager

TAB F-3-1

LAND MATTERS – FORM OF EASEMENT OPTION AGREEMENT FOR THE TRANSMISSION LINE

EASEMENT OPTION

MADE as of this ____ day of _____, 2012.

BETWEEN:

as joint tenants (together referred to herein as the "**Owner**")

and

K2 WIND ONTARIO INC., an Ontario corporation, as general partner of **K2 WIND ONTARIO LIMITED PARTNERSHIP**, a limited partnership formed pursuant to the laws of the Province of Ontario
(referred to herein as "**K2 Wind**")

WHEREAS Owner is the registered owner of the lands described in Exhibit 1 hereto (the "**Lands**"); and

WHEREAS Owner has agreed to grant K2 Wind an option to acquire an easement over part of the Lands for underground data and high voltage electrical cables and related equipment and structures, including without limitation junction and splice boxes;

NOW THEREFORE in consideration of the mutual covenants set out in this agreement and other good and valuable consideration, Owner and K2 Wind agree as follows:

1. Owner hereby grants K2 Wind an option (the "**Option**") to acquire an easement, in the form attached hereto as Exhibit 3 (the "**Grant of Easement**"), over and under a 15 metre wide strip of the Lands, the location of which is approximately indicated on the sketch attached hereto as Exhibit 2 (the "**Right-of-Way**"). The exact location of the Right-of-Way shall be determined by K2 Wind in its sole discretion. K2 Wind shall survey the location of the Right-of-Way and prepare a reference plan, which shall be deposited in the Land Titles Office. The Right-of-Way shall be described in the Grant of Easement with reference to such reference plan. The annual payment payable under the Grant of Easement for the first 5 years of the term of the Grant of Easement shall be $_____ plus an amount calculated by multiplying the length of the Right-of-Way in metres by $_____ per metre, which amount shall be determined following completion of the reference plan. The annual payment so determined shall be inserted in paragraph 4(a) of the Grant of Easement and shall be adjusted every five years as provided therein.

2. This agreement shall remain in effect for a period of three (3) years commencing on the date first above written and expiring on the third anniversary of such date. K2 Wind shall have the right to exercise the Option at any time during such period, whereupon Owner shall grant an easement in favour of K2 Wind, in the form of the Grant of Easement attached as Exhibit 3, the term of which shall commence on the Exercise Date determined in accordance with paragraph 3 below.

3. The Option may be exercised by delivering, or mailing by registered mail, a notice addressed to Owner in accordance with paragraph 11 below. Any such notice shall be conclusively deemed to have been given when it is delivered or, if mailed by registered mail, on the fifth day after such notice is mailed (the "**Exercise Date**").

4. As compensation for the granting of the Option, K2 Wind shall pay to Owner the sum of $ _____ within 30 days of the date of execution of this agreement. Such payment may be made by cheque mailed to Owner's address set out below. In addition to compensation for the Option, such payment shall comprise compensation in full for nuisance, inconvenience, adverse effect and any loss of use of the Lands during the term of the Option, subject to the obligations of K2 Wind to pay for any crop damage and restore or compensate Owner for any damage as provided in paragraph 5 below.

5.(a) Owner hereby grants K2 Wind, its employees, agents, contractors and consultants, the right to enter the Lands prior to the Exercise Date, on reasonable notice to Owner, to conduct surveys, tests and soil examinations, including ploughing for archaeological surveys, provided

that K2 Wind shall restore or compensate Owner for any damage caused to the Lands or tiles, fences or crops thereon. The value of any crop shall be the market price for such crop on the date 30 days after such damage, or September 30 of the year of damage, at the Owner's option unless Owner has entered into an arm's length sales contract for such crops before the crops were damaged, in which case the prices in such contract shall be used. Yield shall be based on Owner's historic or actual yields, or the average used for crop insurance purposes, at Owner's option. Damages shall be paid in full within 14 days after the value of the crop is determined.

(b) K2 Wind shall maintain public liability insurance in respect of its activities on the Lands prior to the Exercise Date in an amount not less than $5,000,000 per occurrence, and shall provide proof of such insurance to Owner upon Owner's written request.

(c) K2 Wind covenants and agrees to indemnify and save harmless Owner from any and all claims arising from its activities on the Lands prior to the Exercise Date except for any claims arising out of the negligence or wilful acts or omissions of Owner, its agents or employees.

6.(a) Owner warrants that to the best of its knowledge and belief (i) the Lands do not now contain and never have contained any pollutant, contaminant, or hazardous, dangerous or toxic substances or materials, including refined petroleum products, and (ii) no notice of violation of any environmental law has ever been issued in respect of the Lands by any governmental agency. K2 Wind shall notify Owner of any discovery of any such substances during any excavation or assessment work done by K2 Wind on the Lands. Unless any such substances result from K2 Wind's operations, K2 Wind shall not be liable for and Owner hereby releases, discharges and indemnifies K2 Wind from and against any claims or costs that may arise as a consequence of the discovery of any such substances.

(b) K2 Wind shall remediate all contamination and other environmental damage to the Lands caused by it or its agents, contractors, invitees or licensees, to the standard required by applicable law.

7. Owner represents and warrants that except as shown on the Land Titles parcel register for the Lands, Owner has not entered into and will not enter into any agreement or otherwise do anything that would restrict or inhibit the ability of K2 Wind to use the Right-of-Way for the purposes contemplated by the Grant of Easement. Owner further covenants to obtain from any existing encumbrancer, chargee, lienholder, tenant or occupier of the Lands a postponement of interest in a form reasonably acceptable to K2 Wind. K2 Wind shall have the right to obtain such postponements on behalf of Owner, at K2 Wind's expense, and Owner shall execute any consents or authorizations as may be necessary for K2 Wind to obtain such postponements.

8. The parties agree that this agreement is subject to the condition that it shall be effective only if the provisions of section 50 of the *Planning Act* are complied with. Pursuant to paragraphs 50(3)(d) and (d.1) of the *Planning Act*, K2 Wind hereby declares that it is entering into this agreement and, if the Option is exercised, will be acquiring the easement, for the purpose of an electricity distribution line or an electricity transmission line within the meaning of Part VI of the *Ontario Energy Board Act, 1998* and for the purpose of a renewable energy generation facility within the meaning of the *Electricity Act, 1998* or a renewable energy project within the meaning of the *Green Energy Act, 2009*. Despite this declaration, if, in the sole discretion of K2 Wind, severance consent should be required or advisable, then K2 Wind shall have the right and is hereby given the authority to execute all such documents as may be necessary for K2 Wind to obtain any necessary consent from the local Land Division Committee or Committee of Adjustments and Owner agrees to co-operate in any such application for consent, provided that K2 Wind shall be responsible for all costs.

9. K2 Wind shall have the right to assign or transfer its rights hereunder in whole or in part without the consent of Owner. Owner agrees that notice of this agreement and the Option may be registered on the title to the Lands.

10. This agreement and the Option shall run with the Lands and shall enure to the benefit of and be binding upon the heirs, executors, administrators, successors and assigns of the parties. If Owner sells the Lands, all payments to be made to Owner under this agreement, whether relating to a period before or after the date of sale, may be made to the new owner of the Lands. Owner shall promptly give notice of any sale of the Lands to K2 Wind, identifying the buyer and giving the buyer's address

11. All notices to be given hereunder shall be in writing and may be given by letter delivered or mailed by prepaid registered post and addressed to Owner at _____ or to K2 Wind c/o Pattern Renewable Holdings Canada ULC, 100 Simcoe Street, Suite 105, Toronto, ON M5H 3G2, with a copy to Capital Power Corporation, 1720 – 70 York Street, Toronto, ON M5J 1S9, or such other addresses as either party from time to time may specify by notice. A notice sent by registered mail shall be deemed to have been received by the addressee five (5) days after it is mailed.

12. If the spousal consent at the end of this agreement has not been executed, Owner warrants that no person other than Owner has rights to any matrimonial home on the Lands under the *Family Law Act* and that spousal consent is not necessary for this agreement, the grant of the Option or the Grant of Easement.

IN WITNESS WHEREOF the parties hereto have executed and delivered these presents as of the day and year first above written.

WITNESS:

_____

WITNESS:

_____

K2 WIND ONTARIO INC., acting as general partner of
K2 WIND ONTARIO LIMITED PARTNERSHIP

By: _____
Name:
Title:

"I have authority to bind the Corporation"

I, being married to _____ or otherwise having rights to a matrimonial home on the Lands under the *Family Law Act*, hereby consent to this agreement and agree to execute all additional documents that may be required to give full force and effect to this agreement and to register this agreement or a notice thereof against the Lands.

_____	_____	_____
Witness	Spouse	Date

EXHIBIT 1

the “Lands”

EXHIBIT 2

Sketch of Right-of-Way

EXHIBIT 3

Form of Grant of Easement

TAB F-3-2

LAND MATTERS – FORM OF GRANT OF EASEMENT AGREEMENT FOR THE TRANSMISSION LINE

GRANT OF EASEMENT

MADE as of the ____ day of _____, 20__

BETWEEN:

as joint tenants (together referred to herein as the "**Owner**")

and

K2 WIND ONTARIO INC., an Ontario corporation, as general partner of **K2 WIND ONTARIO LIMITED PARTNERSHIP**, a limited partnership formed pursuant to the laws of the Province of Ontario
(referred to herein as "**K2 Wind**")

WHEREAS Owner is the registered owner of the lands described in Part I of Schedule A attached hereto (the "**Lands**"); and

WHEREAS Owner has agreed to grant K2 Wind an easement over that portion of the Lands described in Part II of Schedule A (the "**Right-of-Way**") for underground data and high voltage electrical cables and related equipment and structures, including without limitation junction and splice boxes ("**Transmission Facilities**"), forming part of the K2 Wind Power Project (the "**Project**") being developed by K2 Wind; and

WHEREAS pursuant to section 42.1 of the *Electricity Act, 1998*, an easement in favour of a generator, transmitter or distributor for the purpose of generation, transmission or distribution (as defined in that Act) does not have to be appurtenant or annexed to or for the benefit of any specific parcel of land to be valid;

NOW THEREFORE the parties agree as follows:

1. Owner hereby grants K2 Wind an interest in the Lands in the nature of an easement over, under and through the Right-of-Way for the purpose of constructing, installing, operating, maintaining, inspecting, removing, replacing and repairing Transmission Facilities (the "**Easement**"). The Easement shall run with and bind the Lands for the benefit of K2 Wind, its successors and assigns.

2.(a) The Easement shall include the right to cross other portions of the Lands to gain access to the Right-of-Way and the right to use as temporary working space from time to time reasonable portions of the Lands beside and along the Right-of-Way for purposes incidental to the Easement. K2 Wind's rights under the Easement may be exercised by its employees, agents, contractors and licensees, using such vehicles and equipment as they may deem necessary or convenient.

(b) Owner hereby grants K2 Wind and its employees, contractors and consultants the right to enter on the Right-of-Way at any time or times during the Term, but on reasonable notice to Owner, to conduct surveys, tests and investigations, as required by K2 WIND in its sole discretion, including soil tests and environmental, geotechnical, noise and archaeological studies (including ploughing). K2 WIND and its employees, contractors and consultants are also granted the right to enter on the rest of the Lands at any time or times during the Term, but on reasonable notice to Owner, to take noise measurements, locate survey marks, do surveys and conduct environmental investigations that do not involve excavations, bore holes or otherwise disturb the Lands.

3. This agreement shall be effective from the date first above written and shall continue for a period of thirty (30) years (the "**Term**") provided that K2 Wind shall have the right to surrender the Easement, or any part thereof, at any time.

4.(a) Owner acknowledges receipt of $_____ as payment in full for the use of the Easement by K2 Wind for the first year of the Term. On or before the first anniversary of the date hereof and on or before each subsequent anniversary, K2 Wind shall pay Owner an annual payment for its use of the Easement during the next-following year. The annual payment shall

initially be $_____. The annual payment shall be adjusted every five years, commencing with the payment due on the fifth anniversary, to reflect any increase in the Consumer Price Index for Ontario (All Items) published by Statistics Canada or any successor organization, during the preceding five years.

(b) Any payment required to be made to Owner by K2 Wind hereunder may be made by sending a cheque or draft by prepaid post to Owner's address, as stated below (or such other address as Owner may designate from time to time). Interest on overdue amounts shall be payable by K2 Wind both before and after default or termination of this agreement at the prime rate quoted by the Royal Bank of Canada from time to time plus 2% a year, calculated and compounded on the last day of each month, provided that any overdue realty taxes shall bear interest at the rate charged by the municipality for overdue taxes.

(c) Owner warrants that it is not a non-resident of Canada within the meaning of the *Income Tax Act* (Canada). If Owner becomes a non-resident of Canada at any time, it shall forthwith notify K2 Wind and any payments to be made by K2 Wind to Owner under this Easement shall then be subject to the withholding requirements of the *Income Tax Act*.

(d) Owner acknowledges that, because the Transmission Facilities form part of the Project, the normal setback requirements and maximum noise limits applicable to the Project will not apply with respect to residences or other buildings or locations on the Lands, if any, considered to be "noise receptors" for purposes of Ontario Regulation 359/09 made under the Environmental Protection Act. Owner accepts the compensation payable under this agreement in full satisfaction and compensation for the severance of the Right-of-Way from the Lands and any inconvenience, disturbance, nuisance or adverse effect resulting from the Project or K2 Wind's occupation or use of the Right-of-Way, provided that K2 Wind's operations are conducted in compliance with all applicable laws and regulatory requirements.

5.(a) K2 Wind shall pay any taxes and assessments that may be assessed or levied in respect of the Right-of-Way and the Transmission Facilities. If there is no separate assessment or allocation for the Right-of-Way or the Transmission Facilities, K2 Wind shall make a reasonable apportionment of the taxes and shall pay its share of the taxes to Owner within 30 days of receiving a copy of the tax bill for the Lands from Owner.

(b) Owner shall promptly pay all taxes and assessments that may be assessed or levied against the Lands except for taxes and assessments assessed or levied against K2 Wind directly. If Owner does not pay such taxes and assessments and Owner remains in default for a period of 30 days or more, K2 Wind shall have the right to pay them and set such payments off against payments due to Owner under this agreement. K2 Wind shall have a lien against the Lands for any remaining balance of taxes and assessments paid by it.

(c) Owner will promptly provide to K2 Wind copies of all tax assessments, re-assessments and all other notices and correspondence received by Owner in respect of any taxes or assessments.

6.(a) In exercising its rights under this agreement, K2 Wind shall act in a prudent and reasonable manner so as to minimize interference with Owner's use of the Lands as much as practicable. If K2 Wind damages the Lands or any improvement thereon, K2 Wind shall at its sole expense repair the damage and restore the property.

(b) Owner may, at its own risk, continue to farm portions of the Right-of-Way not occupied by surface equipment, provided that Owner does not interfere with the Transmission Facilities or K2 Wind's operations and subject to any reasonable notice requirements or safety conditions that may be required by K2 Wind from time to time. Owner shall not excavate, trench or dig in the vicinity of the Right-of-Way without first contacting K2 Wind to determine the location of the Transmission Facilities and then only in the presence of and under the direction of a representative K2 Wind, if so required by K2 Wind.

(c) K2 Wind shall compensate Owner for the value of any standing crops that it damages or that cannot be harvested by Owner. The value of any crop shall be the local market price for such crop on the date 30 days after such damage or September 30 of the year of damage, at Owner's option, unless Owner has entered into an arm's length sales contract for such crops before the crops were damaged, in which case the prices in such contract shall be used. Yield shall be based on Owner's historic or actual yields, or the average used for crop insurance purposes, at Owner's option. Damages shall be paid in full within 30 days after the value of the

crop is determined.

(d) Repairs or replacements of drainage tiles damaged by K2 Wind shall be completed at K2 Wind's expense by a licensed drainage contractor. The locations of all drainage repairs and replacements shall be mapped using GPS equipment and Owner shall be provided with a copy of a drawing showing such locations. If applicable, K2 Wind and Owner shall discuss the feasibility of replacing or re-routing drainage tiles prior to the commencement of construction.

(e) K2 Wind shall not fence any portion of the Right-of-Way. If Owner maintains or constructs a fence across any portion of the Right-of-Way, K2 Wind may require Owner to install gates in the fence of sufficient width to allow the passage of vehicles. Owner shall provide K2 Wind with keys for any gates.

(f) K2 Wind may erect warning signs along the Right-of-Way indicating the presence of the Transmission Facilities, identifying itself, and providing emergency numbers.

7.(a) K2 Wind shall indemnify Owner against all claims, actions, damages and costs which may be brought or made against Owner or which Owner may pay or incur by reason of the negligence of K2 Wind, its employees, agents, contractors or other persons for whom K2 Wind is responsible in law, in the exercise of its rights under this agreement.

(b) Before the commencement of construction K2 Wind shall obtain and maintain for the balance of the Term, liability insurance in respect of its activities on the Right-of-Way in an amount not less than $5,000,000 per occurrence, and shall provide proof of such insurance to Owner upon Owner's written request.

(c) K2 Wind shall remove or cause to be removed any lien arising from its operations that may be filed against the Lands under the *Construction Lien Act*, within 20 days of receiving notice of such lien.

8.(a) Owner warrants that to the best of its knowledge and belief (i) the Lands do not now contain and never have contained any pollutant, contaminant, or hazardous, dangerous or toxic substances or materials, including refined petroleum products, and (ii) no notice of violation of any environmental law has ever been issued in respect of the Lands by any governmental agency. K2 Wind shall notify Owner of the discovery of any such substances during any excavation or assessment work done by K2 Wind on the Lands. Unless any such substances result from K2 Wind's operations, K2 Wind shall not be liable for and Owner hereby releases, discharges and indemnifies K2 Wind from and against any claims or costs that may arise as a consequence of the discovery of any such substances.

(b) K2 Wind shall remediate all contamination and other environmental damage to the Lands caused by it or its agents, contractors, invitees or licensees in conducting its operations, to the standard required by applicable law.

9.(a) Notwithstanding any rule of law or equity, any Transmission Facilities constructed or installed by K2 Wind shall remain the personal property of K2 Wind even though they may be affixed to the land. K2 Wind shall have the right to remove the Transmission Facilities or any part of them at any time.

(b) Within a reasonable time after the termination or surrender of the Easement, K2 Wind shall, if requested by Owner, restore the surface of the Right-of-Way to the same condition, so far as practicable, as existed before K2 Wind's entry on the Right-of-Way. K2 Wind may abandon in place any Transmission Facilities or parts thereof that are one metre or more below the surface. K2 Wind shall similarly restore the surface of any temporary working space from time to time within a reasonable time after completion of the operation for which it was used. This paragraph shall survive the expiry or termination of this agreement until K2 Wind's restoration obligations have been fully performed and completed.

(c) K2 Wind shall strip and separate all topsoil from subsoil and shall use all reasonable efforts not to mix topsoil with subsoil. Topsoil shall be left on the Lands and shall remain available to K2 Wind for the eventual restoration of the Right-of-Way and temporary working space, provided that any topsoil that is not required to complete construction shall be spread or piled as directed by Owner. Any subsoil and clay remaining after installation of the Transmission

Facilities will be removed from the Lands unless otherwise agreed with Owner or unless it is contaminated through no fault of K2 Wind or its contractors.

10.(a) The parties agree that this agreement is subject to the condition that it shall be effective only if the provisions of section 50 of the *Planning Act* are complied with. Pursuant to paragraphs 50(3)(d) and (d.1) of the *Planning Act*, K2 Wind hereby declares that it is acquiring the Easement for the purpose of an electricity distribution line or an electricity transmission line within the meaning of Part VI of the *Ontario Energy Board Act, 1998* and for the purpose of a renewable energy generation facility within the meaning of the *Electricity Act, 1998* or a renewable energy project within the meaning of the *Green Energy Act, 2009.*

(b) Despite this declaration, if, in the sole discretion of K2 Wind, severance consent should be required or advisable, then K2 Wind shall have the right and is hereby given the authority to execute all such documents as may be necessary for K2 Wind to obtain any necessary consent from the local Land Division Committee or Committee of Adjustments and Owner agrees to co-operate in any such application for consent, provided that K2 Wind shall be responsible for all costs.

(c) If requested by K2 Wind, and at the cost of K2 Wind (such cost to include reasonable professional and legal fees incurred by the Owner for reviewing requested documents), Owner shall cooperate with and provide support and assistance to K2 Wind, and execute such documents as K2 Wind may reasonably require, in respect of any applications or regulatory or legal proceedings in connection with the Easement, including applications for entry permits for municipal roads.

11. Owner covenants that:

(a) Owner has good title to the Lands and the right to grant the Easement to K2 Wind and has not done, omitted or permitted anything whereby the Right-of-Way is or may be encumbered, except as disclosed in the records of the appropriate land registry office;

(b) K2 Wind shall have quiet enjoyment of the Easement without hindrance or interruption from Owner or any person claiming through or under Owner;

(c) Owner shall not alter the surface grade level of the Right-of-Way or construct, place or plant any trees, buildings, structures, improvements, equipment or other things on, over or under the Right-of-Way without the written consent of K2 Wind, which consent may be withheld if, in the reasonable opinion of K2 Wind, this may interfere with the Transmission Facilities; and

(d) Owner shall not use the Right-of-Way in any manner which may conflict with the rights of K2 Wind under the Easement.

12. K2 Wind shall not be considered to be in default under this agreement unless and until Owner has by written notice notified K2 Wind of such default, specifying in detail the alleged event of default and the required cure, and K2 Wind (i) has failed to cure such default within 15 days after such notification in the case of a monetary default, or (ii) in all other cases, has failed to commence to cure such default within 30 days after such notification and thereafter has failed to diligently continue such cure.

13.(a) If Owner sells the Lands, all payments to be made to Owner under this agreement, whether relating to a period before or after the date of sale, may be made to the new owner of the Lands. Owner shall promptly give notice of any sale of the Lands to K2 Wind, identifying the buyer and giving the buyer's address.

(b) Owner may charge the Lands, including the Right-of-Way, or assign its interest in payments due or to become due hereunder as security. K2 Wind shall not unreasonably refuse to postpone its interest under this Easement to the interest of Owner's mortgagee, provided that the mortgagee enters into a non-disturbance agreement with K2 Wind that is satisfactory to it, acting reasonably.

(c) If power of sale or foreclosure proceedings are commenced under any charge, mortgage, lien or other encumbrance against the Lands (each, an "**Encumbrance**") or a court order is issued for a sale of the Lands to satisfy payments due under an Encumbrance, and such

proceedings or order affect K2 Wind's rights under this agreement, then after giving at least 5 days' written notice to Owner, K2 Wind may pay all or part of any amount owing under such Encumbrance and in that case (i) K2 Wind shall be subrogated to the rights of the holder of such Encumbrance to the extent of such payment, and (ii) K2 Wind may set off the amount so paid against payments due to Owner under this agreement.

14.(a) K2 WIND may, upon notice in writing to Owner, but without requiring Owner's consent or approval, assign or transfer all or any of its rights under this agreement.

(b) K2 WIND may, upon notice in writing to Owner, but without requiring Owner's consent or approval, mortgage, charge, collaterally assign, or otherwise encumber and grant security interests in this agreement and the Right-of-Way. (Each such security interest is referred to herein as a "**K2 Wind Security Interest**" and each holder of a K2 Wind Security Interest of which the Owner has been notified in writing is referred to herein as a "**K2 Wind Secured Lender**.")

(c) In the event that the Owner intends to exercise any rights or remedies related to any alleged default by K2 WIND under this agreement, Owner shall give written notice of the default in substantially the same form as the notice of default given to K2 WIND, to each K2 Wind Secured Lender at the same time it delivers notice of default to K2 WIND, specifying in detail the alleged event of default and the required remedy. Each K2 Wind Secured Lender shall have: (i) during the cure period given to K2 WIND, the right to advise the Owner in writing that it intends to cure the default and (ii) if such a notice is given to the Owner on a timely basis, a period of 15 days thereafter to cure any monetary default and in all other cases a period of 30 days thereafter to commence to cure the default.

(d) Owner shall execute and shall use its best efforts to cause its mortgagees and other holders of rights in the Lands to execute any estoppel certificates (certifying as to truthful matters, including without limitation that no default then exists under this agreement, if such be the case), consents to assignment, non-disturbance agreements and acknowledgements as K2 Wind or any K2 Wind Secured Lender may reasonably request from time to time, including any agreement with a K2 Wind Secured Lender which incorporates the provisions contained herein relating to the rights afforded to K2 Wind Secured Lenders.

(e) A K2 Wind Secured Lender shall have the absolute right to (i) assign its security interests and (ii) to enforce its security interests and to succeed to the interest of K2 Wind in this agreement by any lawful means and thereafter, upon notice to but otherwise without Owner's consent, to assign or transfer all or any portion of K2 Wind's interest in this agreement to a third party provided all existing defaults have been cured and the proposed assignee or transferee, as the case may be, agrees to fulfill all of the covenants, agreements, terms, provisions and to abide by all limitations set forth in this agreement.

(f) Any K2 Wind Secured Lender who acquires K2 Wind's interest in this agreement shall not be liable to perform the obligations imposed on K2 Wind by this agreement which are incurred or accruing after such K2 Wind Secured Lender has assigned or transferred K2 Wind's interest in this agreement in accordance with paragraph (e) above. Subject to paragraph (c) above, a K2 Wind Secured Lender shall have the absolute right, but not the obligation, to substitute itself for K2 Wind and perform the duties of K2 Wind hereunder for purposes of curing a default under this agreement. Owner expressly consents to such substitution, agrees to accept such performance, and authorizes each K2 Wind Secured Lender (or its employees, agents, representatives or contractors) to enter upon the Lands to complete such performance with all of the rights and privileges of K2 Wind hereunder.

(g) If the interest of K2 Wind in the Easement is foreclosed upon or there is an assignment in lieu of foreclosure, or if K2 Wind's interest in the Easement is surrendered or abandoned pursuant to bankruptcy laws or other laws affecting creditor's rights and, within 45 days after such event, K2 Wind or any K2 Wind Secured Lender or other purchaser shall have arranged to the reasonable satisfaction of Owner for the payment of all outstanding compensation or other charges due and payable by K2 Wind as of the date of such event, then Owner shall execute and deliver to K2 Wind or such K2 Wind Secured Lender or other purchaser, or to a designee of one of these parties, as the case may be, a new easement ("**New Easement**") which (i) shall be for a term equal to the remainder of the Term (or renewal term, if applicable) before giving effect to such surrender or abandonment; and (ii) shall contain the same covenants, agreements, terms, provisions and limitations as this agreement (except for any requirements that have been fulfilled by K2 Wind or any K2 Wind Secured Lender or other purchaser prior to surrender or

abandonment of the Easement). If more than one K2 Wind Secured Lender makes a written request for a New Easement pursuant to this provision, the New Easement shall be delivered to the K2 Wind Secured Lender requesting such New Easement whose security interest has priority, and the written request of any other K2 Wind Secured Lender whose lien is subordinate shall be void and of no further force or effect. The provisions of this paragraph shall survive the termination, surrender or abandoning of this Easement and shall continue in full force and effect thereafter to the same extent as if this paragraph were a separate and independent agreement made by Owner, K2 Wind and each K2 Wind Secured Lender, and, from the effective date of such termination, surrender or abandoning of this Easement to the date of execution and delivery of such New Easement, such K2 Wind Secured Lender or other purchaser may, subject to the terms and conditions to be included in the New Easement as provided above, use and enjoy the Right-of-Way without hindrance by Owner or any person claiming by, through or under Owner; provided that all of the pre-conditions to the execution of the New Easement as set forth above are complied with.

(h) Notwithstanding any provision of this agreement to the contrary, Owner and K2 Wind agree that so long as there exists a K2 Wind Secured Lender of which Owner has notice, this agreement shall not be modified or amended, and Owner shall not accept a surrender, abandonment, cancellation or release of all or any part of the Easement from K2 Wind, prior to expiration of the Term (or any renewal term, if applicable), without the prior written consent of the K2 Wind Secured Lender. This provision is for the express benefit of and shall be enforceable by each K2 Wind Secured Lender as if it were a party named in this agreement.

15.(a) K2 Wind may register this agreement or a notice of this agreement in the appropriate Land Registry Office. K2 Wind shall withdraw or discharge any such registrations within a reasonable time after the termination of this agreement.

(b) K2 Wind shall have the right to obtain and register, at its own expense, an instrument of postponement from any party with an interest in or a claim to the Lands, whereby such interest or claim is subordinated to the interest of K2 Wind under this agreement. Owner agrees to execute such consents or authorizations as may be necessary for K2 Wind to obtain such postponements.

16. If any provision of this agreement is determined to be invalid or unenforceable in whole or in part, such invalidity or unenforceability shall attach only to such provision (or part thereof) and everything else in this agreement shall continue in full force and effect.

17. This agreement constitutes the entire agreement between the parties with respect to the subject matter of this agreement. Each of the parties acknowledges that there is no representation, warranty, agreement or understanding between them, whether express or implied, which has induced it to enter into this agreement, except as expressly stated in this agreement.

18. No change to or modification of this agreement shall be valid unless it is in writing and signed by the party to be bound.

19. All notices to be given hereunder shall be in writing and may be given by letter delivered or mailed by prepaid registered post and addressed to Owner at_____ _____ or to K2 Wind c/o Pattern Renewable Holdings Canada ULC, 100 Simcoe Street, Suite 105, Toronto, ON M5H 3G2, with a copy to Capital Power Corporation, 1720 – 70 York Street, Toronto, ON M5J 1S9, or such other addresses as either party from time to time may specify by notice. A notice sent by registered mail shall be deemed to have been received by the addressee five (5) days after it is mailed.

20. If the spousal consent at the end of this agreement has not been executed, Owner warrants that no person other than Owner has rights to any matrimonial home on the Lands under the *Family Law Act* and that spousal consent is not necessary for the grant of this Easement.

21. This agreement and shall run with the Lands and shall enure to the benefit of and be binding upon the heirs, executors, administrators, successors and assigns of the parties.

IN WITNESS WHEREOF the parties hereto have executed and delivered these presents to be effective as of the day and year first above written.

WITNESS:

_____

WITNESS:

_____

K2 WIND ONTARIO INC., acting as general partner of
K2 WIND ONTARIO LIMITED PARTNERSHIP

By: _____
Name:
Title:

"I have authority to bind the Corporation"

I, being married to _____ or otherwise having rights to a matrimonial home on the Lands under the *Family Law Act*, hereby consent to this agreement and agree to execute all additional documents that may be required to give full force and effect to this agreement and to register this agreement or a notice thereof against the Lands.

_____	_____	_____
Witness	Spouse	Date

SCHEDULE "A"

PART I

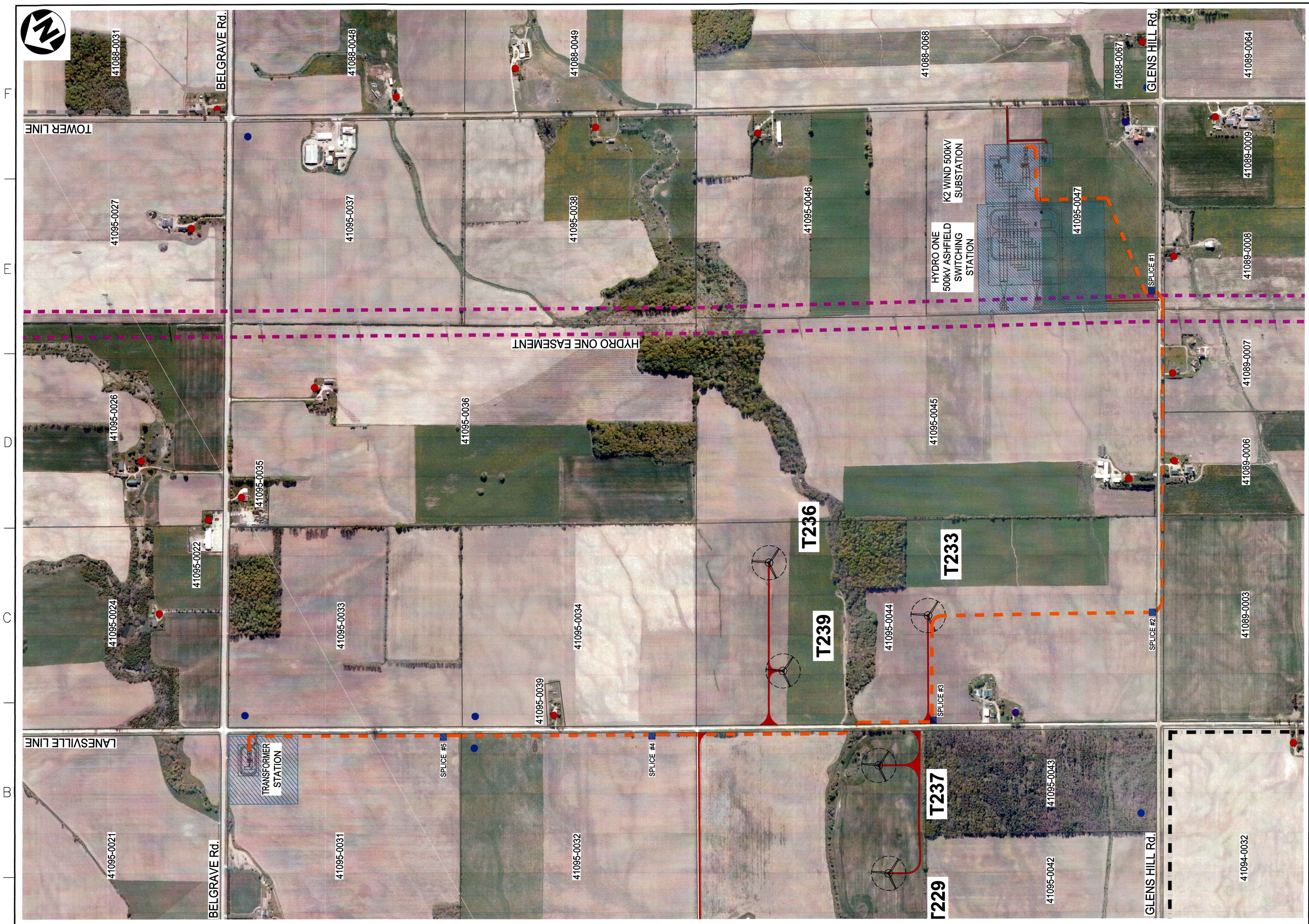
Lands

PART II

Right-of-Way

TAB F-4-1

LAND MATTERS – MAP OF TRANSMISSION LINE AND PRIVATE PROPERTIES



NOTES

1. GRID COORDINATES SHOWN ON THIS DRAWING ARE BASED ON UTM NAD 83, ZONE 17.
2. TOPOGRAPHIC INFORMATION AND TURBINE LOCATIONS WERE DERIVED FROM ONTARIO BASE MAPS.
3. TURBINE LOCATIONS WERE PROVIDED BY CAPITAL POWER. TURBINE LOCATIONS ARE BASED ON CAPITAL POWER LAYOUT #194.

LEGEND - EXISTING FEATURES

- EXISTING RECEPTOR
- PROJECT PARTICIPANT
- VACANT LOT RECEPTOR
- EXISTING 500kV TRANSMISSION LINE/ HYDRO ONE EASEMENT

LEGEND - PROPOSED PROJECT COMPONENTS

- T100 TURBINE LOCATION & TURBINE NAME
- PROPOSED TURBINE ACCESS ROAD
- PROPOSED TRANSMISSION LINE
- SUBSTATION/TRANSFORMER STATION
- SPLICE LOCATION

0m 100m 200m 300m 400m 500m

SCALE

REV	DDMMMYY	REVISION / ISSUE DESCRIPTION	DRN	CHK	APP	APP	APP	APP
C	02OCT12	ISSUED FOR INFORMATION	M.HALL	BJN	JHM			
B	17AUG12	ISSUED FOR INFORMATION	M.HALL	BJN	JHM			
A	17JUL12	ISSUED FOR INFORMATION	M.HALL	BJN	JHM			

REF	NUMBER	TITLE
1	161973-121-0101	PROJECT LOCATION PLAN

REFERENCES

PROPRIETARY INFORMATION:
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STAMP/SEAL

PRELIMINARY

APPROVED FOR _____

CLIENT PROJECT MGR. DEPARTMENT MGR. PROJECT MGR.

PROJECT PHASE

PROJECT NO.	ACTIVITY NO.
161973	
SCALE	PACKAGE CODE
NTS	

	BY	DDMMMYY
DSN	BJN	JUN.'12
DRN	M.HALL	JUN.'12
CHK	BJN	JUN.'12
APP	JHM	JUN.'12

K2 WIND ONTARIO LIMITED PARTNERSHIP

AREA 00 — K2 WIND POWER PROJECT

SUBJECT

TRANSMISSION LINE ROUTING –PLAN–

CLIENT DWG. NO.

DRAWING NO. A1-161973-00-141-0054

REV. C

amec

USER: HALL, MICHAEL (OAKVILLE)
PLOTTED: 02-Oct-12 10:33 AM
SAVED: 01-Oct-12 6:11 PM

TAB G-1-1

INTERCONNECTION – OVERVIEW

The process by which the Proposed Facilities will be connected to the transmission facilities of Hydro One is well underway. The IESO issued the final SIA Report and Hydro One issued the final CIA Report, both on February 24, 2012. Subsequently, on June 15, 2012, the IESO issued an Addendum to the final SIA Report**.** The Addendum discussed proposed upgrades to the equipment in the Hydro One Switching Station that address concerns expressed by the IESO, in the final SIA Report, to the effect that voltages at the station could exceed the 550 kV maximum continuous rating of the proposed station equipment under certain circumstances.

In the Addendum, the IESO concluded that the proposed changes would have no material adverse impact on the reliability of the integrated power system. The IESO recommended that a *Notification of Conditional Approval for Connection* be issued for the Project, subject to implementation of the requirements outlined in the original SIA Report and in the Addendum.

As a result of subsequent changes to the configuration of the Project[1], K2 Wind applied to the IESO and Hydro One, on August 24, 2012, for amendments to the SIA and CIA Reports. Hydro One issued the CIA 2nd Addendum on December 4, 2012. Hydro One's assessment confirmed that the Project can be incorporated without adverse impact on customers.

The IESO issued the SIA 2nd Addendum on December 7, 2012. In the 2nd Addendum, the IESO's assessment concluded that the proposed changes are expected to have no material adverse impact on the reliability of the integrated power system. On December 7, 2012 the IESO issued a *Notification of Addendum of Conditional Approval to Connection Proposal* for the Project, subject to implementation of the requirements outlined in the original SIA, the SIA Addendum and the SIA 2nd Addendum.

[1] The configuration changes included changes to the number of turbines attached to various circuits which, in turn, changed the levels of impedance; changes to the length of some circuits; and a increase in the voltage of the K2 Transmission Line from 130 kV to 230 kV.

In constructing the Project, the Applicant will adhere to the requirements stipulated in the final SIA, the SIA Addendum, the SIA 2nd Addendum, the final CIA and the SIA 2nd Addendum, as amended.

Versions of the SIA and CIA that were approved before the Project configuration changes are included in Exhibit G, Tabs 2 and 3, respectively. The SIA Addendum is included in Exhibit G, Tab 4. The SIA and CIA amendment applications that were submitted to the IESO and to Hydro One, are included at Exhibit G, Tab 5.[2] The CIA 2nd Addendum and the SIA 2nd Addendum are included at Exhibit G, Tabs 6 and 7, respectively. The Notification of Addendum of Conditional Approval to Connection Proposal is included at Exhibit G, Tab 8.

[2] Page 5 of the SIA and CIA amendment application does not list the correct document versions that were sent to the IESO and Hydro One. Several documents erroneously refer to Rev F (revision F) when Revision H was included in the SIA and CIA amendment application. Further, the date for the document K2 Wind – WTG Layout 194 and Rated Power should read as 2012-08-29, not 2012-05-04.

TAB G-2-1

SYSTEM IMPACT ASSESSMENT REPORT

REPORT

Power to Ontario.
On Demand.

System Impact Assessment Report

CONNECTION ASSESSMENT & APPROVAL PROCESS

Final Report

CAA ID: **2011-452**
Project: **K2 Wind**
Applicant: **K2 Wind Ontario Limited Partnership**

Market Facilitation Department
Independent Electricity System Operator

Date: February 24, 2012

Document ID	IESO_REP_0769
Document Name	System Impact Assessment Report
Issue	Final Report
Reason for Issue	First Issue
Effective Date	February 24, 2012

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System Impact Assessment Report

Acknowledgement

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

Disclaimers

IESO

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

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

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

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

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

Hydro One

The results reported in this report are based on the information available to Hydro One, at the time of the study, suitable for a System Impact Assessment of this 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 facilities on load and generation customers.

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

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

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

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Executive Summary

Project Description

K2 Wind Ontario Limited Partnership (the "connection applicant") is developing a new 270 MW wind power generation farm, K2 Wind (the "project"), in Huron County, Ontario. The project will be connected to Ashfield SS, a new switching station that will be built by sectionalizing circuit B563L, about 61.5 km from Bruce B SS. The project is one of the renewable energy developments that resulted from the agreement between the Ontario government and the Korean Consortium. The scheduled project in-service date is May 1, 2014.

Findings

The following conclusions were derived from the study results:

1. The proposed connection arrangement of Ashfield SS is not acceptable to the IESO due to the fact that the reactor and the project can be lost upon a single contingency resulting in overvoltages at Ashfield SS. An alternative connection arrangement shown in Figure 2 of this report is recommended. Hydro One is still investigating other alternatives of connection arrangement at Ashfield SS for this project.
2. The asymmetrical fault current at Bruce A 230 kV switchyard before and after the incorporation of the project will exceed the interrupting capability of the existing breakers. Hydro One has planned to replace the Bruce 230 kV breakers to improve fault current interrupting capability in the long term. Before the circuit breakers are replaced, temporary operational mitigation measures have been developed by Hydro One in collaboration with the IESO.
3. The project is connecting in the Bruce Area where transmission connected generation projects participate in the Bruce Special Protection Scheme (BSPS).
4. The reactive power capability of the wind turbine generators (WTGs) along with the impedance between the WTGs and the IESO controlled grid results in a small amount of reactive power deficiency at the connection point.
5. The features of the proposed wind farm control system meet the requirements in the Market Rules except that the inertia emulation control function is commercially unavailable at the time that this report was written. The IESO reserves the right to ask the connection applicant to install this function in the future when the function is available for the proposed type of WTG.
6. Under some outage conditions, i.e. the project out of service, the voltage at the 500 kV Ashfield SS may exceed the maximum voltage levels specified in the Ontario Resource and Transmission Assessment Criteria. This can be mitigated by connecting a reactor at the Ashfield SS bus. The reactor would control voltage by automatically switching in service upon detection of a high voltage condition. Alternate solutions to manage the high voltage concern may be acceptable upon the approval of the IESO and the transmitter.
7. Circuit S2S will be required to operate open-loop under certain conditions after the integration of the committed generation in the Bruce Area to prevent thermal overloading.
8. The WTGs of the project and the power system are expected to be transiently stable following recognized fault conditions.
9. The proposed WTGs are expected to remain connected to the grid for recognized system contingencies which do not remove the project by configuration.

10. Protection adjustments identified by the Hydro One in the Protection Impact Assessment (PIA) to accommodate the project have no adverse impact on the reliability of IESO-controlled grid.
11. The relay margins on the affected circuits after the incorporation of the project conform to the Market Rules' requirements.
12. In the event of high flows eastward towards Toronto, there is a low probability of congestion that may require the connection applicant to curtail its output.

IESO Requirements for Connection

Transmitter Requirements

The following requirements are applicable for the transmitter for the incorporation of the project:

(1) Hydro One is required to review the relay settings of the 500 kV sectionalized circuits of B563L and any other circuits affected by the project, as per solutions identified in the PIA.

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.

(2) The transmitter shall modify the existing BSPS to incorporate the new project.

(3) A reactor of at least 120 Mvar @ 500 kV is required to be installed at Ashfield SS to control voltages at the new station under certain operating scenarios

The reactor shall be connected through a circuit switcher or a circuit breaker to allow for automatic switching. Switching of the reactor shall be controlled based on the voltage at the stations and in coordination with the capacitor switching (if applicable) at the 34.5 kV bus at K2 Wind. The applicant and the transmitter shall work together on appropriate high voltage settings and timings for reactive device switching control to avoid damage to any equipment. These settings shall be provided to the IESO for approval. Note, alternate solutions to manage the high voltage concern other than the reactor may also be acceptable upon the approval of the IESO and the transmitter.

(4) If a reactor is installed at Ashfield SS to help mitigate excessive voltages, the connection arrangement at Ashfield should be designed to prevent the simultaneous loss of the reactor and project for a single contingency.

Applicant Requirements

Specific Requirements: The following *specific* requirements are applicable for the incorporation of the 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) This project will be required to participate in the Bruce Special Protection Scheme (BSPS). Special protection system facilities must be installed at the project to accept a single pair (A & B) of G/R signals from the BSPS, and disconnect the project from the system with no intentional time delay when armed for G/R following a triggering contingency. These special protection system facilities must also comply with the NPCC Reliability Reference Directory #7 for Type 1 special protection systems. In particular, if the SPS is designed to have 'A' and 'B' protection at a single location for redundancy, they must be on different non-adjacent vertical mounting assemblies or enclosures. Two independent trip coils are required on the breakers selected for G/R. The applicant

must provide two dedicated communication channels, separated physically and geographically diverse, between the project and the Bruce NGS.

To disconnect the project from the system for G/R, simultaneous tripping of the 500 kV breakers T10B0 and T20B0, 115 kV breaker T20L20, and 34.5 kV breaker B10T10 shall be initiated, with no breaker failure response. After being tripped by the BSPS, the closing of the breakers is not permitted until approval is obtained from the IESO. Alternative solutions to disconnect the project from the system for G/R may be acceptable upon the approval of the IESO.

(2) The project 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 collector impedance parameters provided by the connection applicant, a static compensation device of at least 7 Mvar@ 34.5 kV installed at the 34.5 kV bus B20 would satisfy the reactive power requirement. As the required amount of reactive power compensation is quite small as compared with the project's reactive capability and it makes its installation impractical, the IESO consider that the reactive power requirements are satisfactorily met without the additional 7 Mvar capacitor bank.

The main transformer ULTC shall be adjusted, manually or automatically, to regulate the collector bus voltage such that it is within normal range and close to about 1 pu. The IESO may require automatic control for this ULTC if manual adjustment is too slow.

The connection applicant must be able to confirm its reactive capability as studied in this SIA during the commission tests.

(3) The wind farm voltage control system shall be designed as per the philosophy described in Section 6.4. The connection applicant is required to provide a finalized copy of the functional description of the wind farm control systems for the IESO's approval before the project is allowed to connect.

(4) The applicant shall work with the transmitter on appropriate high voltage settings and timings for reactive device switching control to avoid damage to any equipment.

General Requirements: The connection applicant shall satisfy all applicable requirements and standards specified in the Market Rules and the Transmission System Code. The following requirements summarize some of the general requirements that are applicable to the proposed project, and presented in detail in section 2 of this report.

(1) The connection applicant shall ensure that the project has 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 project 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%. The generation project shall respond to system frequency decline by temporarily boosting its active power output for some time (i.e. 10 s) by recovering energy from the rotating blades, if this technology is available.

(2) The connection applicant shall ensure that the project has the capability to supply continuously all levels of active power output for 5% deviations in terminal voltage.

The proposed project shall 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.

The proposed project shall have the capability to 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 $\Delta V/\Delta Q_{max}$ shall be adjustable to 0.5%. The response of the generation project for voltage changes shall be similar or better than that of a generation project with a synchronous generation unit and an excitation system that meets the requirements of Appendix 4.2.

(3) The generation project shall have the capability 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.

(4) The connection applicant shall ensure that the 500 kV equipment is capable of continuously operating between 490 kV and 550 kV. Protective relaying must be set to ensure that transmission equipment remains in-service for voltages between 94% of the minimum continuous value and 105% of the maximum continuous value specified in Appendix 4.1of the Market Rules.

(5) The connection applicant shall ensure that the connection equipment is designed to be fully operational in all reasonably foreseeable ambient temperature conditions. The connection equipment must also be designed so that the adverse effects of its failure on the IESO-controlled grid are mitigated. This includes ensuring that all circuit breakers fail in the open position.

(6) The connection applicant shall install at the project a disturbance recording device with clock synchronization that meets the technical specifications provided by the transmitter.

(7) The connection applicant shall ensure that the new equipment at the project be designed to sustain the fault levels in the area. If any future system changes results in an increased fault level higher than the equipment's capability, the connection applicant is required to replace the equipment with higher rated equipment capable of sustaining the increased fault level, up to maximum fault level specified in Appendix 2 of the Transmission System Code.

Fault interrupting devices must be able to interrupt fault currents at the maximum continuous voltage of 550 kV.

(8) Appendix 2 of the Transmission System Code states that the maximum rated interrupting time for the 500kV breakers must be 2 cycles or less. Thus, the connection applicant shall ensure that the installed breakers meet the required interrupting time specified in the Transmission System Code.

(9) The connection applicant shall ensure that the new protection systems at the project are designed to satisfy all the requirements of the Transmission System Code and any additional requirements identified by the transmitter.

As currently assessed, the projects are not part of the Bulk Power System (BPS). However, being 500 kV connected facilities, the projects are designated as essential to the power system by the IESO and as such must meet the TSC requirements for essential elements.

The protection systems within the generation project must only trip the appropriate equipment required to isolate the fault.

The autoreclosure of the high voltage breakers at the connection point must be blocked. Upon its opening for a contingency, the high voltage breaker must be closed only after the IESO approval is granted.

Any modifications made to protection relays 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.

(10) The connection applicant shall ensure that the telemetry requirements are satisfied as per the applicable Market Rules requirements. The determination of telemetry quantities and telemetry testing will be conducted during the IESO Facility Registration/Market Entry process.

(11) If revenue metering equipment is being installed as part of this project, the connection applicant should be aware that revenue metering installations must comply with Chapter 6 of the IESO

Market Rules. For more details the connection applicant is encouraged to seek advice from their Metering Service Provider (MSP) or from the IESO metering group.

(12) The proposed project must be compliant with applicable reliability standards set by the North American Electric Reliability Corporation (NERC) and the North East Power Coordinating Council (NPCC) that are in effect in Ontario as mapped in the following link: http://www.ieso.ca/imoweb/ircp/orcp.asp.

(13) The connection applicant will be required to be a restoration participant. Details regarding restoration participant requirements will be finalized at the Facility Registration/Market Entry Stage.

(14) 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 at least seven months before energization to the IESO-controlled grid. This includes both PSS/E and DSA software compatible mathematical models. The models and data may be shared with other reliability entities in North America as needed to fulfill the IESO's obligations under the Market Rules, NPCC and NERC rules.

The connection applicant must also 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. The evidence must be supplied to the IESO within 30 days after completion of commissioning tests. 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.

(15) 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 SIA), may be imposed in the future. The connection applicant is encouraged to follow developments and updates through the following link: http://www.ieso.ca/imoweb/consult/consult_se91.asp.

Notification of Conditional Approval

The proposed connection of the K2 Wind operating up to 270 MW, subject to the requirements specified in this report, is expected to have no material adverse impact on the reliability of the integrated power system.

It is recommended that a *Notification of Conditional Approval for Connection* be issued for K2 Wind subject to the implementation of the requirements outlined in this report.

– End of Section –

1. Project Description

K2 Wind Ontario Limited Partnership has proposed to develop a 270 MW wind farm located in Huron County to be known as K2 Wind. The project is one of the renewable energy developments that resulted from the agreement between the Ontario government and the Korean consortium. It is expected that full commercial operation will start on May 1, 2014.

Wind Turbine

This project will use Siemens SWT-2.3-101 wind turbines. The Siemens SWT-2.3-101 wind turbine generator is rated approximately 2.3 MW, 690 V using full load frequency converter system and inner and outer loop controls designed to supply reactive power to the grid so as to regulate and stabilize the voltage. The Siemens SWT-2.3-101 turbine is capable of operating at a power factor of 0.9 inductive to 0.9 capacitive at rated voltage. Each turbine generator is equipped with a pad mounted generator step-up (GSU) transformer rated at 2.6 MVA and 690 V/34.5 kV Wye/Delta with an impedance of 6%.

To achieve a total project output of 270 MW with 142 turbines, the maximum continuous rating of each turbine will be de-rated by design to an output less than 2.3 MW. Table 1 provides a summary of the maximum continuous ratings of the wind turbines at this project:

Table 1: Summary of wind turbine maximum continuous ratings

Maximum Continuous Rating (MW)	# of turbines	Total Output (MW)
1.824	27	49.2
1.903	104	197.9
2.030	7	14.2
2.126	3	6.3
2.221	1	2.2
	142 (total)	270 (total)

Grouping and Collector System

The proposed wind park is composed of 142 wind turbines, totaling 270 MW. The turbine generators will be arranged among 10 feeders, each consisting of 11 to 16 turbines.

The GSU transformers are connected to a collector system composed of underground power cables or overhead lines. The collector circuits for each group of wind turbines will be protected by a circuit breaker and connected to either the B10 or B20 34.5 kV bus. The B10 34.5 kV bus will be connected to a 34.5/500 kV step-up transformer via a 34.5 kV breaker, while the B20 34.5 kV bus will be connected to a 34.5/138 kV step up transformer via a 34.5 kV breaker.

Proposed Transmission Facilities

To accommodate the project, circuit B563L will be sectionalized via a newly built 3 breaker ring switching station called Ashfield SS, located approximately 61.5 km from Bruce B SS. K2 Wind will be connected to Ashfield SS via a 0.05 km long transmission line.

The project will consist of one 500/34.5 kV transformer and one 500/138 kV transformer. The 500/138 kV transformer is connected in series with a 138 kV breaker, a 5.1 km long 138 kV underground cable and a 138/34.5 kV transformer. Each 500 kV transformer is isolated from the connection point by a 500 kV breaker. Five feeder circuits will be connected directly to the 500/34.5 kV transformer, and 5 feeder circuits will be connected directly to the 138/34.5 kV transformer.

The 500/34.5 kV transformer is rated 105/140/175 MVA, Wye grounded/delta and has a 7.5% impedance on a 105 MVA base. The 500/138 kV transformer is rated 96/128/160 MVA, Wye-grounded, Wye-grounded, with a buried delta tertiary and has a 8% impedance on a 96 MVA base. The 138/34.5 kV

transformer is rated 96/128/160 MVA, delta, wye-grounded with a buried delta tertiary, 8% on a 96 MVA base.

The single-line diagram of the proposed project and the transmission system within the vicinity is shown in Figure 1 and Figure 3, respectively, in Appendix A. Note, the nomenclature of the new circuits resulting from the sectionalization of B563L have been assumed to be B563A and A563L for the purposes of this SIA. There are also plans to sectionalize the adjacent circuit B562L. For the purposes of this SIA, the new circuits resulting in the sectionalization of B562L have been assumed to be B562E and E562L.

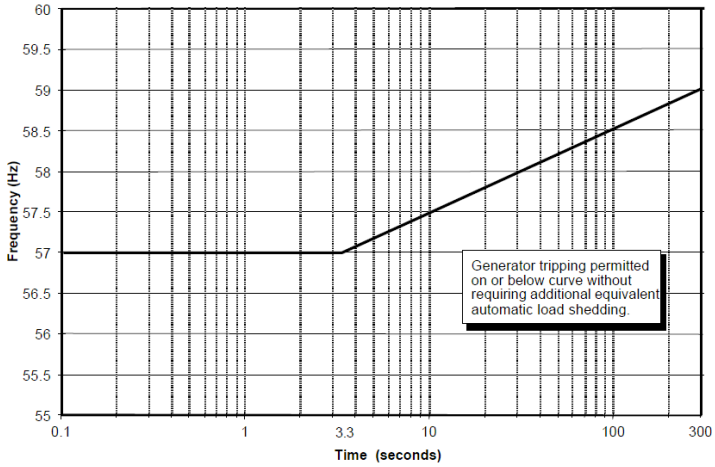
– End of Section –

2. General Requirements

The connection applicant shall satisfy all applicable requirements and standards specified in the Market Rules and the Transmission System Code. The following sections highlight some of the general requirements that are applicable to the proposed project.

2.1 Frequency/Speed Control

As per Appendix 4.2 of the Market Rules, the connection applicant shall ensure that the generation project has the capability to 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), as shown in the following figure.



The project 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%. The generation project shall respond to system frequency decline by temporarily boosting its active power output for some time (i.e. 10 s) by recovering energy from the rotating blades. This usually refers to “inertia emulation control” function within the wind farm control system. It is not required for wind facilities to provide a sustained response to system frequency decline. The connection applicant will need to indicate to the IESO whether the function of inertia emulation control is commercially available for the proposed type of wind turbine generator at the time when the wind farm comes into service. If this function is available, the connection applicant is required to implement it before the new project can be placed in-service. If this function is commercially unavailable, the IESO reserves the right to ask the connection applicant to install this function in the future, once it is commercially available for the proposed type of wind turbine generator.

2.2 Reactive Power/Voltage Regulation

The generation project is directly connected to the IESO-controlled grid, and thus, the connection applicant shall ensure that the project has the 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;

- 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 project in excess of the maximum allowable losses. If generators do not have dynamic reactive power capabilities, dynamic reactive compensation devices must be installed to make up the deficient reactive power;
- 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 $\Delta V/\Delta Q_{max}$ shall be adjustable to 0.5%. The response of the generation project for voltage changes shall be similar to or better than the response of a generation project with a synchronous generation unit and an excitation system that meets the requirements of Appendix 4.2.

2.3 Voltage Ride Though Capability

The generation project shall have the capability 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.

2.4 Voltage

Appendix 4.1 of the Market Rules states that under normal operating conditions, the voltages in the 500 kV system are maintained within the range of 490 kV to 550 kV. Thus, the IESO requires that the 500 kV equipment in Ontario must have a maximum continuous voltage rating of at least 550 kV.

2.5 Connection Equipment Design

The connection applicant shall ensure that the connection equipment is designed to be fully operational in all reasonably foreseeable ambient temperature conditions. The connection equipment must also be designed so that the adverse effects of its failure on the IESO-controlled grid are mitigated. This includes ensuring that all circuit breakers fail in the open position.

2.6 Disturbance Recording

The connection applicant is required to install at the project a disturbance recording device with clock synchronization that meets the technical specifications provided by the transmitter. The device will be used to monitor and record the response of the project to disturbances on the 500 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 the transmitter.

2.7 Fault Level

The Transmission System Code requires the new equipment to be designed to sustain the fault levels in the area where the equipment is installed. Thus, the connection applicant shall ensure that the new equipment at the project is designed to sustain the fault levels in the area. If any future system changes results in an increased fault level higher than the equipment's capability, the connection applicant is required to replace the equipment with higher rated equipment capable of sustaining the increased fault level, up to maximum fault level specified in the Transmission System Code. Appendix 2 of the Transmission System Code establishes the maximum fault levels for the transmission system. For the 500

kV system, the maximum 3 phase and single line to ground symmetrical fault levels are 80 kA (usually limited to 63 kA).

Fault interrupting devices must be able to interrupt fault currents at the maximum continuous voltage of 550 kV.

2.8 Breaker Interrupting Time

Appendix 2 of the Transmission System Code states that the maximum rated interrupting time for the 500 kV breakers must be 2 cycles or less. Thus, the connection applicant shall ensure that the installed breakers meet the required interrupting time specified in the Transmission System Code.

2.9 Protection System

The connection applicant shall ensure that the protection systems are 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 the existing protection systems.

Facilities that are essential to the power system must be protected by two redundant protection systems according to section 8.2.1a of the TSC. These redundant protections systems must satisfy all requirements of the TSC, and in particular, they must not use common components, common battery banks or common secondary CT or PT windings. As currently assessed by the IESO, this project is not on the current Bulk Power System list, however it is considered essential to the power system due to its 500 kV connection and as such must meet the TSC requirements for essential elements.

The protection systems within the generation project must only trip the appropriate equipment required to isolate the fault. After the project begins commercial operation, if an improper trip of the 500 kV circuits emanating from Ashfield SS occurs due to events within the project, the project may be required to be disconnected from the IESO-controlled grid until the problem is resolved.

The autoreclosure of the high voltage breakers at the connection point must be blocked. Upon its opening for a contingency, the high voltage breaker must be closed only after the IESO approval is granted.

Any modifications made to protection relays 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

2.10 Telemetry

According to Section 7.3 of Chapter 4 of the Market Rules, the connection applicant shall provide to the IESO the applicable telemetry data listed in Appendix 4.15 of the Market Rules on a continual basis. As per Section 7.1.6 of Chapter 4 of the Market Rules, the connection applicant shall also provide data to the IESO in accordance with Section 5 of Market Manual 1.2, for the purposes of deriving forecasts of the amount of energy that the project is capable of producing. The determination of telemetry quantities will be completed during the IESO Facility Registration/Market Entry process.

The data shall be provided with equipment that meets the requirements set forth in Appendix 2.2, Chapter 2 of the Market Rules and Section 5.3 of Market Manual 1.2, in accordance with the performance standards set forth in Appendix 4.19 subject to Section 7.6A of Chapter 4 of the Market Rules.

As part of the IESO Facility Registration/Market Entry process, the connection applicant must 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.

2.11 Revenue Metering

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

2.12 Reliability Standards

Prior to connecting to the IESO controlled grid, the proposed project must be compliant with the applicable reliability standards established by the North American Electric Reliability Corporation (NERC) and reliability criteria established by the Northeast Power Coordinating Council (NPCC) that are in effect in Ontario. A mapping of applicable standards, based on the proponent's/connection applicant's market role/OEB license can be found here: http://www.ieso.ca/imoweb/ircp/orcp.asp

This mapping is updated periodically after new or revised standards become effective in Ontario.

The current versions of these NERC standards and NPCC criteria can be found at the following websites:
http://www.nerc.com/page.php?cid=2|20
http://www.npcc.org/documents/regStandards/Directories.aspx

The IESO monitors and assesses market participant compliance with a selection of applicable reliability standards each year as part of the Ontario Reliability Compliance Program. To find out more about this program, write to orcp@ieso.ca or visit the following webpage: http://www.ieso.ca/imoweb/ircp/orcp.asp

Also, to obtain a better understanding of the applicable reliability compliance obligations and 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 by contacting rssc@ieso.ca. The RSSC webpage is located at:
http://www.ieso.ca/imoweb/consult/consult_rssc.asp.

2.13 Restoration Participant

According to the Market Manual 7.8 which states restoration participant criteria and obligations, the connection applicant will be required to be a restoration participant. Details regarding restoration participant requirements will be finalized at the Facility Registration/Market Entry Stage.

2.14 Facility Registration/Market Entry

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 includes both PSS/E and DSA software compatible mathematical models representing the new equipment for further IESO, NPCC and NERC analytical studies. The models and data may be shared with other reliability entities in North America as needed to fulfill the IESO's obligations under the Market Rules, NPCC and NERC rules. The connection applicant may need to contact the software manufacturers directly, in order to have the models included in their packages. This information should be submitted at

least seven months before energization to the IESO-controlled grid, to allow the IESO to incorporate this project into IESO work systems and to perform any additional reliability studies.

As part of the IESO Facility Registration/Market Entry process, the connection applicant must provide evidence to the IESO confirming that the equipment installed meets the Market Rules requirements and matches or exceeds the performance predicted in this assessment. This evidence shall be either type tests done in a controlled environment or commissioning tests done on-site. In either case, the testing must be done not only in accordance with widely recognized standards, but also to the satisfaction of the IESO. Until this evidence is provided and found acceptable to the IESO, the Facility Registration/Market Entry process will not be considered complete and the connection applicant must accept any restrictions the IESO may impose upon this project's participation in the IESO-administered markets or connection to the IESO-controlled grid. The evidence must be supplied to the IESO within 30 days after completion of commissioning tests. Failure to provide evidence may result in disconnection from the IESO-controlled grid.

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

2.15 Other Connection Requirements

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 SIA), may be imposed in the future. The connection applicant is encouraged to follow developments and updates through the following link: http://www.ieso.ca/imoweb/consult/consult_se91.asp

-End of Section-

3. Data Verification

3.1 Connection Arrangement

The original connection arrangement of Ashfield SS and the project shown in Figure 1, Appendix A, is subject to the simultaneous loss of the project and the reactor for a single contingency. Study results in Section 6.3 shows the reactor is needed to control the voltage at Ashfield SS for the loss of the project. Thus, the connection arrangement of Ashfield SS in Figure 1 is not acceptable. To avoid any post-contingency over voltage situations at Ashfield SS, an alternative arrangement has been proposed as shown in Figure 2, Appendix A. Hydro One is still investigating other alternatives of connection arrangement at Ashfield SS for this project.

3.2 Siemens SWT-2.3-101 WTG

The Siemens SWT-2.3-101 WTG is a three bladed, variable pitch, variable speed, and full conversion wind turbine generator system. Its specifications are shown in Table 2. Reactive capabilities of the WTG are continuous ratings at rated terminal voltage. The reactive capability curve of the WTG is shown in **Figure 4**.

Table 2: Specifications of Siemens SWT-2.3-101 WTG

Type	Rated Voltage	Rated MVA	Rated MW	Transformer			Q_{max} (Mvar)	Q_{min} (Mvar)	X_d" (pu)
				MVA	R	X			
Siemens SWT-2.3-101	690 V	2.55	2.3	2.6	0.8%	6%	1.223	-1.155	0.64

Voltage Ride-Through Capability

The Siemens SWT-2.3-101 wind turbine provides a voltage ride-through option. During a voltage drop/raise, the minimum time for a WTG to remain online is shown in Table 3. The proposed turbines will use this option.

Table 3: WTG voltage ride-through capability

Voltage Range (% of base voltage)	Minimum time for WTGs to Remain Online (s)
V<15	0.85
15<V<40	1.6
40<V<70	2.6
70<V<85	11
85 < V < 90	200
110 < V < 120	1

V>120	0

The voltage ride-through capability of the proposed WTGs was verified by performing transient stability studies as detailed in Section 6.9.

Frequency Ride-Through Capability

The Siemens SWT-2.3-101 wind turbine could remain online continuously for the frequency range of 57.0 Hz to 62.0 Hz.

The Market Rules state that the generation project directly connecting to the IESO-controlled grid shall 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 frequency ride-through capability of the proposed WTGs meets the Market Rules' requirements.

3.3 Step-Up Transformers

Table 4: 500 kV step-up transformer data

Unit	Transformation	Rating (MVA) (ONAN/ONAF/ONAF)	Positive Sequence Impedance (pu)	Configuration			Zero Sequence Impedance (pu)	Tap
				H	X	Y		
T10	530/34.5 kV	105/140/175MVA	0.00156+j0.075 S_B= 105 MVA	Yg	Delta	N/A	0.001+j0.066 S_B= 105 MVA	OLTC 543.25kV
T20	530/138 kV	96/128/160 MVA	0.0016+j0.08 S_B= 96 MVA	Yg	Yg	Delta	0.001+j0.065 S_B= 96 MVA	OLTC 543.25kV

Table 5: 138 kV step-up transformer data

Unit	Transformation	Rating (MVA) (ONAN/ONAF/ONAF)	Positive Sequence Impedance (pu) S_B= 96 MVA	Configuration			Zero Sequence Impedance (pu) S_B= 96 MVA	Tap
				H	X	Y		
T21	138/34.5 kV	96/128/160MVA	0.016+j0.08	Delta	Yg	N/A	0.010+j0.0757	ULTC@HV: 40 steps, 0.5% each

3.4 Collector System

Table 6: Equivalent impedance of collectors

Circuit	Unit	MW	Positive-Sequence Impedance (pu, S_B=100MVA)			Zero-Sequence Impedance(*) (pu, S_B=100MVA)		
			R	X	B	R	X	B
C1	G1	28.5	0.0215	0.0197	0.0341	-	-	-
C2	G2	26.4	0.0282	0.0288	0.0349	-	-	-
C3	G3	24.9	0.0212	0.0185	0.0212	-	-	-
C4	G4	28.9	0.0154	0.0143	0.0334	-	-	-
C5	G5	28.7	0.0346	0.0375	0.0443	-	-	-
C6	G6	28.5	0.0408	0.0370	0.0403	-	-	-
C7	G7	29.4	0.0303	0.0319	0.0361	-	-	-
C8	G8	26.6	0.0266	0.0281	0.0332	-	-	-
C9	G9	26.8	0.0112	0.0115	0.0197	-	-	-
C10	G10	21.2	0.0165	0.0129	0.0148	-	-	-

(*) Zero-sequence impedance has not been provided. Typical data was assumed during the SIA. The applicant needs to provide these data during the IESO Market Entry process.

3.5 Intermediate Transmission Line

A 5.1 km 138 kV underground cable will be connected in series between the 500/138 kV transformer and 138/34.5 kV transformer. The parameters of the line are shown in Table 7.

Table 7: Impedance of 138 kV transmission line

Circuit 138 kV	Positive Sequence Impedance (pu, S_B=100 MVA)			Zero Sequence Impedance (pu, S_B=100 MVA)		
	R	X	B	R	X	B
L20	0.000677	0.00356	0.076176	0.007299	0.004337	0.076176

3.6 Connection Equipment

3.6.1 500 kV Switches

Table 8: Specifications of 500 kV switches

Identifier	Maximum Voltage Rating	Continuous Current Rating	Short Circuit Symmetrical Rating
B0L1-L1	600 kV	2000 A	63 kA

T10B0-B0	600 kV	2000 A	63 kA
T20B0-B0	600 kV	2000 A	63 kA

3.6.2 138 kV Switches

Table 9: Specifications of 138 kV switches

Identifier	Maximum Voltage Rating	Continuous Current Rating	Short Circuit Symmetrical Rating
T20L20-T20	145 kV	600 A	25 kA
T20L20-L20	145 kV	600 A	25 kA
L20-T21	145 kV	600 A	25 kA

3.6.3 500 kV Circuit Breakers

Table 10: Specifications for 500 kV circuit breakers

Identifier	Maximum Voltage Rating	Interrupting time	Continuous Current Rating	Short Circuit Symmetrical Rating
T10B0	575 kV	33 ms	2000 A	63 kA
T20B0	575 kV	33 ms	2000 A	63 kA

3.6.4 138 kV Circuit Breakers

Table 11: Specifications for 138 kV circuit breakers

Identifier	Maximum Voltage Rating	Interrupting time	Continuous Current Rating	Short Circuit Symmetrical Rating
T20L20	145 kV	50 ms	1200 A	20 kA

3.6.5 Tap Line

The tap line from the project to the connection point at Ashfield TS consists of an overhead circuit about 0.05 km long. The parameters of the line are shown in Table 12.

Table 12: Parameters of tap line

Circuit 500 kV	Conductor	Positive Sequence Impedance (pu, S_B=100 MVA)			Zero Sequence Impedance (pu, S_B=100 MVA)		
		R	X	B	R	X	B
L1	Al Tube 6” NPS	~ 0	~ 0	~ 0	~ 0	~ 0	~ 0

3.7 Wind Farm Control System

The proposed wind farm will be equipped with the Siemens Remote Control and Monitoring System. This control system is designed to interface with each WTG in the wind farm for regulating system voltage, and real and actual power for the entire wind farm.

The proposed wind farm will also be equipped with a separate PLC to help coordinate and control fixed reactor and capacitor banks within the wind farm.

Voltage Control

- Voltage, VAR and Power Factor Control

The voltage control of the wind farm is managed by an outer and inner control loop. The HV system voltage is controlled by the outer loop managed by the Siemens Remote Control and Monitoring system. A feedback of the HV system voltage is received by the Siemens Remote Control and Monitoring system and voltage references are sent to each wind turbine controllers at the individual wind turbines. By way of the wind turbine controllers, the terminal voltages are controlled via the inner loop control.

The Siemens SWT-2.3-101 does not have power factor or reactive power regulation.

- Fixed Reactor and Cap Bank Control and Coordination

Reactors or capacitors installed within the wind farm will be controlled by an independent Programmable Logic Control (PLC). Reactive devices will be switched with the objective to minimize wind farm reactive output while ensuring that the terminal voltages of each turbine are within operational limits.

The voltage control functions enable the proposed wind farm to operate in voltage control mode and control voltage at a point whose impedance (based on rated apparent power and voltage of the project) is not more than 13% from the connection point. Thus, it is acceptable to the IESO.

The function of voltage control meets the requirements of the Market Rules.

Frequency Control

The Siemens Remote Control and Monitoring system has a function of frequency droop control which controls the wind farm power output based upon the grid frequency. This function is similar to governor droop control for a conventional rotating generator. The function of frequency control meets the requirements of the Market Rules.

At this time, Siemens has indicated that the inertial control is still in development. The applicant has been made aware that it will need to implement the inertial control once this function becomes commercially available.

-End of Section-

4. Short Circuit Assessment

Fault level studies were completed by the transmitter to examine the effects of the project on fault levels at existing facilities in the surrounding area. Studies were performed to analyze the fault levels with and without the project and other recently committed generation projects in the system.
The short circuit study was carried out with the following primary system assumptions:

(1) Generation Facilities In-Service

East

Lennox	G1-G4	Chenaux	G1-G8
Kingston Cogen	G1-G2	Mountain Chute	G1-G2
Wolf Island	300 MW	Stewartville	G1-G5
Arnprior	G1-G2	Brockville	G1
Barrett Chute	G1-G4	Havelock	G1
Chats Falls	G2-G9	Saunders	G1-G16
Cardinal Power	G1, G2		

Toronto

Pickering units	G1, G4-G8	Sithe Goreway	G11-13, G15
Darlington	G1-G4	TransAlta Douglas	G1-G3
Portlands GS	G1-G3	GTAA	G1-G3
Algonquin Power	G1, G2	Brock west	G1
Whitby Cogen	G1		

Niagara

Thorold GS	GTG1, STG2	Beck 2	G11-G26
Beck 1	G3-G10	Beck 2 PGS	G1-G6
Decew	G1, G2, ND1		

South West

Nanticoke	G1, G2, G5-G8	Kingsbridge WGS	39.6 MW
Halton Hills GS	G1-G3	Amaranth WGS	199.5 MW

Bruce

Bruce A	G1-G4	Ripley WGS	76 MW
Bruce B	G5-G8	Underwood WGS	198 MW
Bruce A Standby	SG1		

West

Lambton units	G3-G4	Imperial Oil	G1
Brighton Beach	G1, G1A, G1B	Kruger Port Alma WGS	101.2 MW
Greenfield Energy Centre	G1-G4	Gosfield Wind Project	50.6 MW
St. Clair Energy Centre	CTG3, STG3, CTG4, STG4	Kruger Energy Chatham WF	101 MW
East Windsor Cogen	G1-G2	Raleigh Wind Energy Centre	78 MW
TransAlta Sarnia	G861, G871, G881, G891	Talbot Wind Farm	98.9 MW
Ford Windsor CTS	STG5	Dow Chemicals	G1, G2, G5
TransAlta Windsor	G1, G2	Port Burwell WGS	99 MW
West Windsor Power	G1, G2	Fort Chicago London Cogen	23 MVA
		Great Northern Tri-Gen Cogen	15 MVA

(2) Previously Committed Generation Facilities

- Bruce G1, G2
- Big Eddy GS and Half Mile Rapids GS
- White Pines Wind Farm
- Amherst Island
- York Energy Centre
- Conestogo Wind Energy Centre 1
- Dufferin Wind Farm
- Summerhaven Wind Farm
- Port Dover and Nanticoke
- Grand Renewable Energy
- Greenfield South
- Comber East C24Z
- Comber West C23Z
- Pointe-Aux-Roches Wind
- South Kent Wind Farm

(3) Recently Committed Generation Facilities

- Bluewater Wind Energy Centre
- Jericho Wind Energy Centre
- Bornish Wind Energy Centre
- Goshen Wind Energy Centre
- Cedar Point Wind Power Project Phase II
- Adelaide Wind Energy Centre
- Grand Bend Wind Farms
- Grand Valley Wind Farms (Phase 3)
- Erieau Wind
- East Lake St. Clair Wind
- Adelaide Wind Power Project
- Gunn's Hill Wind Farm
- Silvercreek Solar Park
- K2 wind
- Armow
- 300 MW wind at Orangeville
- 100 MW wind at S2S

(4) Existing and Committed Embedded Generation

- Essa area: 264 MW
- Ottawa area: 90 MW
- East area: 580 MW
- Toronto area: 168 MW
- Niagara area: 52 MW
- Southwest area: 348 MW
- Bruce area: 26 MW
- West area: 585 MW

(5) Transmission System Upgrades

- Leaside - Bridgman reinforcement: Leaside TS to Birch JCT: new 115 kV circuit (CAA2006-238);
- St. Catherines 115 kV circuit upgrade: circuits D9HS, D10S and Q11S (CAA2007-257);
- Tilbury West DS second connection point for DESN arrangement using K2Z and K6Z (CAA2008-332);
- Second 500kV Bruce-Milton double-circuit line (CAA2006-250);
- Woodstock Area transmission reinforcement (CAA2006-253);
  - Karn TS in service and connected to M31W & M32W at Ingersol TS
  - W7W/W12W terminated at LFarge CTS
  - Woodstock TS connected to Karn TS
- Lower Mattagami expansion - H22D line extension from Harmon to Kipling (CAA2006-239);
- Rodney (Duart) TS DESN connected to W44LC and W45LS 230 kV circuits (CAA2007-260)

(6) System Operation Conditions

- 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*
- Cherrywood TS north & south 230kV buses operated ***open***
- Richview TS 230 kV bus operated ***open***
- All tie-lines in service and phase shifters on neutral taps
- Maximum voltages on the buses

Table 13 summarizes the fault levels at facilities near the project with and without the project and other recently committed generation projects.

Table 13: Fault levels at facilities near the project

Station	Before the Project		After the Project and other committed projects		Lowest Rated Circuit Breaker (kA)
	3-Phase	L-G	3-Phase	L-G	
*Symmetrical Fault (kA)**					
Bruce A 230 kV	42.97	54.36	44.63	56.15	60**
Bruce B 500 kV	36.97	41.6	38.0	42.7	60
Longwood 500 kV	20.10	21.0	21.11	22.46	63
Longwood 230 kV	37.45	44.8	38.74	46.55	63
Ashfield 500 kV	-	-	16.18	12.69	Unknown*****
K2 500 kV	-	-	16.18	12.69	63
K2 138 kV	-	-	5.503	5.231	25
*Asymmetrical Fault (kA)**					
Bruce A 230 kV	57.65	78.45**	59.73	80.81**	72.6***
Bruce B 500 kV	54.32	63.58	55.80	65.09	95.1
Longwood 500 kV	24.43	26.74	25.81	28.73	68.9
Longwood 230 kV	45.82	58.05	47.74	60.59	78
Ashfield 500 kV	-	-	19.95	15.68	Unknown*****
K2 500 kV	-	-	19.95	15.68	63****
K2 138 kV	-	-	7.395	7.163	25 ****

* Based on a pre-fault voltage level of 550 kV for 500 kV buses, 250 kV for 230 kV buses, and 127 kV for 115 kV buses.

**The asymmetrical fault level is based on a breaker contact parting time of 44 ms.

***Three lower rated Bruce A 230 kV breakers (D1L81, K1L82 and L23T25) are scheduled to be replaced by December 2012 (see CAA ID#2010-EX511). The listed lowest rated circuit breaker value for Bruce A 230 kV assumes these breakers being replaced.

****The symmetrical rating was used as the asymmetrical rating was not provided by the applicant.

***** The transmitter to provide the asymmetrical rating of the 500 kV circuit breakers during the IESO Market Entry process.

As shown, the interrupting capability of the 500 kV and 138 kV circuit breakers of the project are adequate for the anticipated fault levels.

The results also show that the line-to-ground asymmetrical fault current at Bruce A 230 kV before and after the incorporation of the project and other committed projects will exceed the interrupting capability of the existing breakers. This issue has been investigated in the 2nd SIA addendum for the project of Bruce G1 and G2 restart (CAA ID 2004-163), where the IESO has identified a requirement to replace all the Bruce 230 kV breakers with higher fault current interrupting capability and assessed potential mitigation measures for this issue until these circuit breakers are replaced. Hydro One has planned to replace the Bruce 230 kV breakers.

With the exception of Bruce A 230 kV, the interrupting capability of the lowest rated circuit breakers near the project will not be exceeded after the incorporation of the project.

-End of Section-

5. 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. Proposed protection changes were included in the system impact studies.

Protection Changes

Permissive overreaching schemes will be implemented as part of this project. The changes to the existing transmission protection systems for incorporating the project have been proposed in the PIA report (Appendix B), as shown in Table 14.

Table 14: Proposed B563L Protection Changes

Station	Zone	Existing Reach (km)	Revised Reach (km)	Comments
Bruce B SS	1	150	46	Set at 80% of the line impedance to Ashfield SS
	2	240	73	Set at 125% of the ZMA for a fault at Ashfield SS
Longwood TS	1	150	104	Set at 80% of the line impedance to Ashfield SS
	2	240	162	Set at 125% of the ZMA for a fault at Ashfield SS
Ashfield SS to Bruce B SS	1	-	46	Set at 80% of the line impedance to Bruce B SS
	2	-	73	Set at 125% of the ZMA for a fault at Bruce B SS
Ashfield SS to Longwood TS	1	-	104	Set at 80% of the line impedance to Longwood TS
	2	-	162	Set at 125% of the ZMA for a fault at Longwood TS

The PIA identified a potentially long fault clearing time scenario in the event that one 500 kV circuit emanating from Ashfield SS is opened and a fault occurs close to the Ashfield SS during low wind farm infeed. Hydro One has indicated that they will implement a solution that will help minimize the fault clearing time under this situation.

Protection Hardware Upgrades

The PIA indicated that the relays at Bruce B and Longwood TS will need to be upgraded and new protection relays will need to be installed at Ashfield SS.

Telecommunication Requirements

The PIA indicated that new digital microwave and PLC (main and alternate) communication facilities will need to be installed at Ashfield with links to Bruce TS and Longwood TS. These communication links are to be redundant and fully separated with geographic path diversity. Signal exchange is required between Ashfield SS and the project's step-up station.

The PIA concluded that it is feasible for the connection applicant to connect the project at the proposed location as long as the proposed changes to the transmission configuration, protection hardware, protection settings, and telecommunications are made.

-End of Section-

6. System Impact Studies

The technical studies focused on identifying the impact of the new generation station on the reliability of the IESO-controlled grid. It includes thermal loading assessment of transmission lines, system voltage performance assessment of local buses, transient stability assessment of the proposed and major surrounding generation units, ride-through capability of the project. The section also investigates the performance of the proposed control system and identifies the impact of the project on existing SPS schemes. In addition, the reactive power capability of the project is assessed and compared to the Market Rules requirements.

6.1 Study Assumptions

In this assessment, the 2014 summer base cases were used with the following assumptions:

(1) **Transmission facilities**: All existing and committed major transmission facilities with 2014 in-service dates or earlier were assumed in service. The committed facilities primarily include:

- Second 500kV Bruce-Milton double-circuit line (CAA2006-250);
- Buchanan TS: one 250 Mvar shunt capacitor;
- Nanticoke and Detweiler SVCs;

(2) **Generation facilities:** All existing and committed major generation facilities with 2013 in-service dates or earlier were assumed in service. The primary committed generation facilities are outlined in the assumptions for short circuit study, Section 4.

(3) **Connection arrangement:** The connection arrangement presented in Figure 2 of this report was assumed for the study.

(4) **Basecases:** Three basecases in terms of load level were used in this SIA studies: peak load, shoulder load, and light load. The generation dispatch philosophies for the three cases are as follows:

Peak load basecase

- All committed and existing generation in the Southwest and Bruce areas were maximized, including 8 units at Bruce;
- Gas generation, in conjunction with maximum wind generation, in the West area was dispatched to achieve a NBLIP transfer of approximately 2000MW;
- Generation in the North areas was dispatched to achieve a Flow South transfer of approximately 1250MW;
- Generation in the Greater Toronto Area included two Pickering units, four Darlington units and four Sithe Goreway units;
- Incorporation of the project into the system;

Shoulder load basecase

- All committed and existing generation in the Bruce area was maximized;
- Renewable and minimum level gas generation in the West was dispatched to achieve an NBLIP transfer of approximately 986MW;
- Generation in the North areas was dispatched to achieve a Flow North transfer of approximately 500MW;
- Generation in the Greater Toronto Area included two Pickering units and four Darlington units;
- Generation in the Southwest area was then dispatched to balance the load;
- Incorporation of the project into the system;

Light load basecase

- All dispatchable gas units out of service;
- Minimum hydraulic generation;
- Nuclear generation limited to three Pickering units, two Darlington units and five Bruce units;
- Existing Southwest, West and Bruce area wind generation in service;
- Incorporation of the project into the system;

The system demand and the primary interface flows after the incorporation of the project are listed in Table 15.

Table 15: System demand and primary interface flows for basecases (MW)

Basecase	System Demand	NBLIP*	FABC*	FETT*	QFW*	FS*	FIO*
Peak Load	26880	2023	6412	6913	1146	1250	1585
Shoulder Load	20716	986	6404	6707	1055	-488	1309
Light Load	11621	643	3845	906	34	-1048	746

(*) This interface is defined in the Ontario Transmission System document.

(http://www.ieso.ca/imoweb/pubs/marketReports/OntTxSystem_2011may.pdf)

6.2 Special Protection System (SPS)

The BSPS is a collection of special protection systems installed at the Bruce B switching station (SS) and other stations which perform pre-defined control actions, including generation rejection, load rejection and reactor switching. These control actions are initiated by recognized contingencies by monitoring the electrical connection between nodes in southern Ontario. The primary purpose of the BSPS is to allow increased pre-contingency transfers on the existing transmission facilities emanating from the Bruce nuclear generation station (NGS).

The BSPS is classified as a "Type 1 Special Protection System", and conforms to criteria and guidelines specified in the Northeast Power Coordinating Council (NPCC) Reliability Reference Directory #7.

The IESO has identified a requirement that wind generation stations connecting near the Bruce NGS must connect to and participate in the BSPS, as detailed in the SIA report and addendum for Hydro One BSPS modifications (CAA ID 2005-EX222), the incorporation of wind generation rejection (G/R) to the BSPS is considered a new BSPS control action. This new control action will provide the IESO with increased operating flexibility during transmission outage conditions.

Special protection system facilities must be installed at the project to accept a single pair (A & B) of G/R signals from the BSPS, and disconnect the project from the system with no intentional time delay when armed for G/R following a triggering contingency. These special protection system facilities must also comply with the NPCC Reliability Reference Directory #7 for Type 1 special protection systems. In particular, if the SPS is designed to have 'A' and 'B' protection at a single location for redundancy, they must be on different non-adjacent vertical mounting assemblies or enclosures. Two independent trip coils are required on the breakers selected for G/R. The applicant must provide two dedicated communication channels, separated physically and geographically diverse, between the project and the Bruce NGS.

To disconnect the project from the system for G/R, simultaneous tripping of the 500 kV breakers T10B0 and T20B0, 115 kV breaker T20L20, and 34.5 kV breaker B10T10 shall be initiated with no accompany breaker failure response. After being tripped by the BSPS, the closing of the breakers is not permitted until approval is obtained from the IESO.

Alternative solutions to disconnect the project from the system for G/R may be acceptable upon the approval of the IESO.

6.3 Reactive Power Compensation

The 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 impedance between the generator and the connection point not greater than 13% based on rated apparent power provides the required range of dynamic reactive capability at the connection point.

Dynamic reactive compensation (e.g. D-VAR or SVC) is required for a generating project which cannot provide a reactive power range of 0.90 lagging power factor and 0.95 leading power factor at rated active power. For a wind farm with impedance between the generator and the connection point greater than 13% based on rated apparent power, provided the WTGs have 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 that the wind farm compensates for excessive reactive losses in the collector system of the project with static shunts (e.g. capacitors and reactors).

The SIA proposed a solution for the project to meet the reactive power capability requirements in the Market Rules. However, the applicant can deploy any other solutions which result in its compliance with the Market Rules. The applicant shall be able to confirm this capability during the commission tests.

Dynamic Reactive Power Capability

Table 16 summarizes the IESO required level of dynamic reactive power and the available capability of SWT-2.3-101 turbine as shown in **Figure 4**.

Table 16: SWT-2.3-101 reactive power capability at rated power and terminal voltage

	Terminal Voltage	Active Power	Reactive Power Capability/Turbine
IESO Required	690 V	2.3 MW	$Q_{gen} = \frac{2.3}{0.9} \times \sin[\cos^{-1}(0.9)] = 1.11$ Mvar
			$Q_{abs} = \frac{2.3}{0.95} \times \sin[\cos^{-1}(0.95)] = 0.76$ Mvar
SWT-2.3-101 Capability	690 V	2.3 MW	$Q_{gen} = 1.223$ Mvar
			$Q_{abs} = 1.155$ Mvar

The SWT-2.3-101 WTGs can deliver IESO required dynamic reactive power at rated power and at rated terminal voltage. Thus, there is no need to install additional dynamic reactive power device.

Static Reactive Power Capability

In addition to the dynamic reactive power requirement identified above, the project has to compensate for the reactive power losses within the project 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 static reactive compensation, based on the equivalent parameters provided by the connection applicant for the project.

The reactive power capability in lagging power factor of the project was assessed under the following assumptions:

- typical low voltage of 545 kV at the connection point;
- maximum active power output from the equivalent WTG;

- maximum reactive power output (lagging power factor) from the equivalent WTG, unless limited by the maximum acceptable WTG terminal voltage. The reactive capability is adjusted based on the terminal voltage as per **Figure 4**.
- maximum WTG voltage is 1.05;
- 500/34.5 kV and 500/138 kV transformers on 543.25 kV fixed tap position;
- 0.690/34.5 kV GSU transformers on Feeders 1 to 5 on 1.025 pu fixed tap position;
- 0.690/34.5 kV GSU transformers on Feeders 6 to 10 on 1.05 pu fixed tap position;
- the 138/34.5 kV step-up transformer ULTC is available to adjust the LV voltage as close as possible to 1 pu voltage;

The reactive power capability in leading power factor of the project was assessed under the following assumptions:

- typical high voltage of 550 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, unless limited by the minimum acceptable WTG terminal voltage; The reactive capability is adjusted based on the terminal voltage as per **Figure 4**.
- minimum acceptable WTG voltage is 0.9, as per WTG voltage capability;
- 500/34.5 kV and 500/138 kV transformers on 543.25 kV tap position;
- 0.690/34.5 kV GSU transformers on Feeders 1 to 5 on 1.025 pu tap position;
- 0.690/34.5 kV GSU transformers on Feeders 6 to 10 on 1.05 pu tap position;
- the 138/34.5 kV step-up transformer ULTC is available to adjust the LV voltage as close as possible to 1 pu voltage;

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 WTGs are not limited in their capability to produce active and reactive power due to terminal voltage limits or other project 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.

Table 17 summarizes the required reactive power injection/withdrawal capability for this project, based on its rated active power of 270 MW. A breakdown of the required capabilities are also shown for the generation associated with Transformer T10 (G1-G5) and Transformers T20 and T21 (G6-G10).

Table 17: Reactive power requirements for K2 Wind

Operation	Reactive Power Injection Required (Mvar) at Connection Point		
	G1-G5 (137.4 MW)	G6-G10 (132.4 MW)	Total (270 MW)
Lagging PF	45.3 Mvar	43.7 Mvar	89 Mvar
Leading PF	-45.3 Mvar	-43.7 Mvar	-89 Mvar

Based on the equivalent parameters for the project provided by the connection applicant, 7 Mvar at 34.5 kV of static reactive power compensation installed at the K2 Wind collector bus B20 would meet the reactive power requirements at the connection point. No reactor would be required to meet the reactive power withdrawal requirement. A detailed summary of the results with reactive power compensation is provided Table 18.

Table 18: K2 Wind reactive power capability at the connection point with 7 Mvar of static reactive compensation

Operation	Collector Bus Voltage (pu)		LV bus Voltage of 500/138 kV transformer (pu)	Generator Terminal Voltage (pu)		Reactive Power Injection at Connection Point (Mvar)			500 kV Bus Voltage (kV)
	Bus B10	Bus B20		Max (G1-G5)	Max (G6-G10)	From G1-G5	From G6-G10	Total	
Lagging PF*	1.04	1.00	1.047	1.05	0.993	48.4	40.8	89.2	545 kV
Leading PF**	0.98	1.02	0.975	0.93	0.95	-49.1	-45.8	-94.9	550 kV

*138/34.5 kV transformer tap required to be at the 151.8 kV position.
** 138/34.5 kV transformer tap required to be at the 126.27 kV position.

As the required amount of reactive power compensation is quite small as compared with the project's reactive capability and it makes its installation impractical, the IESO consider that the reactive power requirements are satisfactorily met without the additional 7 Mvar capacitor bank.

The connection applicant needs to provide "as-built" data during the IESO Market Entry process. The IESO will review the required amount of static reactive power compensation at that time. Should the amount of static reactive compensation significantly differs from what was determined in this SIA, the IESO may require the connection applicant to install additional static reactive devices.

The capability of the project to provide the full range of reactive capability will require the ULTC tap positions of the 138/34.5 kV transformer to be changed in response to system conditions. Thus, the IESO requires that the 138/34.5 kV transformer ULTC be adjusted, manually or automatically, to regulate the collector bus voltage such that it is within its normal range and close to about 1 pu. This would facilitate the WTG's ability to provide full reactive support in response to system conditions. The IESO may require automatic control for this ULTC if manual adjustment is too slow.

Overvoltage Control at Ashfield SS

While no reactor has been identified for the project to meet reactive capability requirements, a reactor may be a required to mitigate excessive high voltages under scenarios such as the WTGs being out-of-service.

Table 19 summarizes the 500 kV post-contingency bus voltages at Bruce B, Ashfield and Longwood for various contingencies without reactor compensation under peak load conditions. It shows that voltages at Ashfield SS may exceed maximum levels as per the ORTAC under certain operating scenarios.

Table 19: Voltage analysis results without reactor compensation under peak load conditions

Bus Voltage	All elements in service	Loss of K2* (Breaker B10T10 O/S, Loss of Breaker B20T21)		B563A O/S*+ Loss of K2 (Breaker T10B0 and T20BO O/S)		A563L O/S*+Loss of A563L (Breaker T10B0 and T20BO O/S)	
		Pre-ultc (kV)	Post-ultc (kV)	Pre-ultc (kV)	Post-ultc (kV)	Pre-ultc (kV)	Post-ultc (kV)
Bruce B SS	549	549.8	550	547.4	547.4	548.5	548.5
Ashfield SS	550	553.3	553.7	553.9	553.9	551.7	551.7
Longwood TS	548.2	548.2	548.8	548.8	548.8	546.4	546.4

*Studies assumed the complete disconnection of the collector system from the grid. Studies were also performed under scenarios in which the wind was assumed to reach cut off speeds. In this case, the connection applicant indicated that the generators would produce no active power, however, would be able to still be able to output reactive power to control voltages. In these cases, voltages at Ashfield SS did not exceed 550 kV.

Table 20 summarizes the 500 kV post-contingency bus voltages for various contingencies with a new reactor rated at 120 Mvar@500 kV at Ashfield SS. It shows that the post-contingency switching of a 120 Mvar reactor will address the overvoltage concern at Ashfield SS. This reactor is depicted in the single line diagram of Figure 2. The reactor shall be connected to the system through a circuit switcher or a circuit breaker to allow for the automatic switching. The switching of the reactor shall be controlled based on the voltage at the connection point and in coordination with capacitor switching in the wind farm, if applicable. The applicant and the transmitter shall work together on appropriate high voltage settings and timings for reactor/capacitor switching control to avoid damage to any equipment. These settings must be submitted to the IESO for approval. Note, alternate solutions other than the reactor to manage high voltage concern may be acceptable upon the approval of the IESO and transmitter.

Table 20: Voltage analysis results with reactor compensation under peak load conditions

Bus Voltage	All elements in service	Loss of K2 (Breaker B10T10 O/S, Loss of Breaker B20T21)		B563A O/S+ Loss of K2 (Breaker T10B0 and T20BO O/S)		A563L O/S+ Loss of K2 (Breaker T10B0 and T20BO O/S)	
		Pre-ultc (kV)	Post-ultc (kV)	Pre-ultc (kV)	Post-ultc (kV)	Pre-ultc (kV)	Post-ultc (kV)
Bruce B SS	549	549	549.2	547.2	547.2	547.1	547.1
Ashfield SS	550	548.4	548.8	542.9	542.9	543.4	543.4
Longwood TS	548.2	547.1	547.8	546.6	546.6	546.2	546.2

Static Reactive Power Switching

The IESO requires the voltage change on a single capacitor or reactor switching to be no more than 4 % at the any point in the IESO controlled grid. A switching study was carried out to investigate the effect of 120 Mvar reactor at Ashfield SS on the voltage changes. To reflect a reasonably restrictive system condition, the voltage change study for reactor switching was studied under light load conditions and assumed circuit B561M out of service.

Table 21 shows that switching a single reactor of 120 Mvar results in less than 4 % voltage change at Ashfield TS, therefore meeting the Market Rules' requirement.

Table 21: Voltage Changes due to switching of 120 Mvar reactor at Ashfield TS

Reactor at 500 kV bus	Collector Bus Voltage		Intermediate 138 kV bus voltage	Ashfield 500 kV voltage
	B10 voltage	B20 voltage		
Pre-switching	33.5 kV	33.9 kV	131.3 kV	547.5 kV
Post-switching	33.1 kV	33.6 kV	129.9 kV	541.1 kV
ΔV	-1.2 %	-0.88%	-1.07%	-1.17%

6.4 Wind Farm Voltage Control System

As per the Market Rules' requirements, the wind farm shall operate in voltage control mode by using all voltage control methods available within the project. The overall automatic voltage regulation philosophy for the project is summarized as follow:

(1) All WTGs control the voltage at a point whose impedance (based on rated apparent power and voltage of the project) is not more than 13% from the connection point. Appropriate control slope is adopted for reactive power sharing among the WTGs as well as with adjacent generators. The reference voltage will be specified by the IESO during operation.

(2) Capacitor banks, if part of the project, are automatically switched in/out to regulate the overall WTGs' reactive generation to around zero output. The dead band for capacitor switching will be set to about ±60% size of the smallest capacitor to avoid control hunting.

(3) The main transformer ULTC is adjusted, manually or automatically, to regulate the collector bus voltage such that it is within normal range and close to about 1 pu. The IESO may require automatic control for this ULTC if manual adjustment is too slow.

In this control system, the voltage control by WTGs and the overall WTGs' reactive control by capacitor banks, if applicable, need to be coordinated by using different time constants.

In the event that the wind farm voltage control becomes unavailable, the IESO requires that each WTG be in reactive power control and maintain its reactive power output to the value prior to the loss of signal from the wind farm voltage control. Depending on system conditions, further action such as curtailing the output of the project may be required for reliability purposes.

The IESO understands that the reactive power control or power factor control is not provided at each WTG level for the project and the proposed WTGs can only operate in terminal voltage control. Thus, in the event of a loss of signal from the wind farm voltage control, the IESO will require that the setting of terminal voltage control of each WTG be manually adjusted so that the reactive power output of each WTG is within a range between 0 Mvar (unity power factor) and the reactive power level attained prior to the loss of signal.

6.5 Thermal Analysis

The *Ontario Resource and Transmission Assessment Criteria* requires that all line and equipment loads be within their continuous ratings with all elements in service, and within their long-term emergency ratings with any element out of service. Immediately following contingencies, lines may be loaded up to their short-term emergency ratings where control actions such as re-dispatch, switching, etc. are available to reduce the loading to the long-term emergency ratings.

In the thermal analysis, the continuous ratings for the conductors were calculated at the lowest of the sag temperature or 93°C operating temperature, with a 35°C ambient temperature and 4 km/h wind speed. The long term emergency ratings (LTE) for the conductors were calculated at the lowest of the sag temperature or 127°C operating temperature, with a 35°C ambient temperature and 4 km/h wind speed. The short-term emergency ratings (STE) for the conductors were calculated at the sag temperature, with a 35°C ambient temperature, 4 km/h wind speed and 100% continuous preload.

System Overview

The return of Bruce G1 and G2 combined with the addition of new Bruce and Southwest Ontario generation results in a higher flow eastward from Bruce. This naturally increases the flow along the 115 kV path of circuit S2S from Owen Sound TS to Stayner TS when circuit S2S is operated close-loop. Table 22 shows the pre-contingency thermal results with S2S operated close-loop under the defined shoulder load condition. It indicates the overloading of both circuit S2S from Meaford TS to Stayner TS and Stayner T1. To prevent the thermal overloading, circuit S2S will be required to operate open-loop under certain conditions after the integration of the committed generation projects in the area of Bruce and Southwest Ontario. Hydro One has investigated mitigation action and is in agreement with it.

Table 22: Pre-contingency thermal results with 115 kV circuit S2S closed-loop under shoulder load conditions

Circuit	Pre-Contingency Flow	Summer Continuous Rating	Loading (%)
S2S (Meaford-Stayner)	650 A	590 A	**110**
Stayner T1	136 MVA	125 MVA	**109**

Due to the fact that the opening of circuit S2S results in increased flows on the parallel 230 kV and 500 kV circuits emanating from Bruce, circuit S2S was assumed open-loop at Owen Sound for the rest SIA study in this report.

The impact of the projects on the overall system, in conjunction with other committed projects, was examined to identify if any system congestion issues exist in Central and Southwest Ontario due to 230 kV circuit or 500 kV auto-transformer thermal constraints. The studies concluded that under exceptionally high power transfers towards Toronto, generating stations in Bruce and Southwest Ontario may be required to curtail their outputs to relieve congestion. However, the flow into Toronto at the levels examined is not expected to materialize for the next several years. Future planning assessments for the west Greater Toronto Area (GTA) are currently being undertaken by the agencies.

With the addition of new committed generation projects in Bruce and Southwest Ontario, flows east into Toronto were maximized to reach 6913 MW under the defined peak load basecase, representing a high stress case for the west of GTA equipment. Under this high flow scenario, the additional new generation projects contributed to overloading some limiting elements in the central area. Table 23 and Table 24 show the thermal results of limiting circuits and transformers in Central area under peak load conditions after the integration of new committed generation projects. It shows both pre-contingency and post-contingency overloading of the limiting elements. Additional simulation results based on the defined shoulder load basecase show post-contingency overloading on circuits E8V/E9V for the loss of the

companion circuit. If flows were to reach these high levels, the generating plants in the Bruce and Southwest Ontario may be required to curtail their outputs.

Table 23: Thermal results of limiting 230 kV circuits in central area under peak-load conditions

Circuit	Contingency	Pre-Cont. Flow (A)	Continuous Rating (A)	Pre-Cont. Loading (%)	Post-Cont. Flow (A)	LTE Rating (MVA)	Post-Cont. Loading (%)
R14T (Trafalgar-Erindale)	R17T	1059	1110	95	1577	1460	108
R17T (Trafalgar-Erindale)	R14T	1063	1110	96	1576	1460	108
R19TH (Erindale-Hanlan)	R14T+R17T	792	840	94	1131	1090	107

Table 24: Thermal Results of limiting transformers in central area under peak-load conditions

Transformer	Pre-Cont. Flow (MVA)	Summer Continuous Rating (MVA)	Pre-Cont. Loading (%)	LTE Rating (MVA)	Loss of Trafalgar T15	
					Post-Cont. Flow(MVA)	Post-Cont. Loading (%)
Trafalgar T14	858.84	750	114.51	1004	1078.02	107.37
Trafalgar T15	830.20	750	110.69	1132	0.00	0.00
Claireville T13	782.34	750	104.31	988	846.71	85.70
Claireville T14	796.55	750	106.21	995	861.85	86.62
Claireville T15	789.09	750	105.21	995	853.96	85.83

Local 500 kV Transmission

The effects of the project on the thermal loadings of the local transmission system in the Bruce area were examined. The defined shoulder load basecase was used for local thermal studies as it was tested to be the most limiting for area thermal loadings. The thermal ratings for summer weather conditions of all monitored circuits are summarized in Table 25.

Table 25: Circuit section ratings and lengths of 500 kV circuits in Bruce area

Circuit	From	To	Length (km)	Continuous Rating (A)	LTE Rating (A)
B563A	BRUCE B SS	BRUCE JCT	2.8	3760	4920
	BRUCE JCT	WILLOW CREEK JCT	15.7	2820	3660
	WILLOW CREEK JCT	ASHFIELD JCT	42.9	2820	3660
A563L	ASHFIELD JCT	LONGWOOD TS	127.5	2820	3660
B562E	BRUCE A TS	BRUCE JCT	2.6	3410	4450
	BRUCE JCT	WILLOW CREEK JCT	15.5	3760	4170
	WILLOW CREEK JCT	EVERGREEN	136	2820	3660
E562L	EVERGREEN	LONGWOOD TS	34.5	2820	3660
B560V	BRUCE A TS	BRUCE JCT	2.6	3410	4450
	BRUCE JCT	WILLOW CREEK JCT	15.7	2820	3660
	WILLOW CREEK JCT	MILTON SS	157.1	2820	3620
	MILTON SS	CLAIREVILLE	33.8	2820	3660
B561M	BRUCE B SS	BRUCE JCT	2.8	3760	4170
	BRUCE JCT	WILLOW CREEK JCT	15.5	3760	4170
	WILLOW CREEK JCT	MILTON SS	157.4	2820	3620
N582L	LONGWOOD TS	NANTICOKE TS	158.1	2820	3660
B501M	BRUCE B SS	BRUCE JCT	2.9	3140	4080

	BRUCE JCT	MILTON SS	172.5	2820	3660
B502M	BRUCE A TS	BRUCE JCT	2.9	3140	4080
	BRUCE JCT	MILTON SS	172.5	2820	3660

Table 26 shows the pre-contingency flows for the monitored circuits prior to and after the connection of the project. The pre-contingency results of the circuits include current flow in ampere and loading in percentage of continuous rating.

Table 26: Pre-contingency thermal analysis

Circuit	From	To	Continuous Rating (A)	The Project Out of Service		The Project In-Service	
				Amps	Cont %	Amps	Cont %
B563A	BRUCE B SS	BRUCE JCT	3760	388.5	10.3	249.0	6.6
	BRUCE JCT	WILLOW CREEK JCT	2820	386.5	13.7	245.5	8.7
	WILLOW CREEK JCT	ASHFIELD JCT	2820	376.4	13.3	227.3	8.1
A563L	ASHFIELD JCT	LONGWOOD TS	2820	356.3	12.6	449.1	15.9
B562E	BRUCE A TS	BRUCE JCT	3410	315.6	9.3	317.3	9.3
	BRUCE JCT	WILLOW CREEK JCT	3760	313.2	8.3	314.9	8.4
	WILLOW CREEK JCT	EVERGREEN	2820	300.7	10.7	302.6	10.7
E562L	EVERGREEN	LONGWOOD TS	2820	656.3	23.3	659.5	23.4
B560V	BRUCE A TS	BRUCE JCT	3410	1424.0	41.8	1460.6	42.8
	BRUCE JCT	WILLOW CREEK JCT	2820	1424.4	50.5	1461.0	51.8
	WILLOW CREEK JCT	MILTON SS	2820	1426.5	50.6	1463.2	51.9
	MILTON SS	CLAIREVILLE	2820	1440.1	51.1	1476.7	52.4
B561M	BRUCE B SS	BRUCE JCT	3760	1425.4	37.9	1467.9	39.0
	BRUCE JCT	WILLOW CREEK JCT	3760	1425.9	37.9	1468.4	39.1
	WILLOW CREEK JCT	MILTON SS	2820	1428.2	50.6	1470.8	52.2
N582L	LONGWOOD TS	NANTICOKE TS	2820	1065.7	37.8	1120.8	39.7
B501M	BRUCE B SS	BRUCE JCT	3140	1422.4	45.3	1464.7	46.6
	BRUCE JCT	MILTON SS	2820	1422.8	50.5	1465.2	52.0
B502M	BRUCE A TS	BRUCE JCT	3140	1411.6	45.0	1451.4	46.2
	BRUCE JCT	MILTON SS	2820	1412.0	50.1	1451.8	51.5

The study results show that the project tends to reduce the thermal loading on all the sections on B563A, while increase the thermal loading on all sections on A563L. All other monitored 500 kV circuits show a varying degree of increased thermal loading within their continuous ratings.

Using the study scenario with the project in-service, contingency studies were performed to identify potential post-contingency thermal violations. Table 27 summarizes the post-contingency flows for the monitored circuits. The post-contingency results of the circuits include current flow in ampere, and loading in percentage of LTE rating.

Table 27: Post-contingency thermal assessment results

Circuit	To	From	Pre-Cont Flow (A)	LTE Rating (A)	Loss of A563L+E562L		Loss of A563L		Loss of E562L		Loss of B560V+B561M	
					Post-cont Flow (A)	Post-Cont Loading (%)	Post-cont Flow (A)	Post-Cont Loading (%)	Post-cont Flow (A)	Post-Cont Loading (%)	Post-cont Flow (A)	Post-Cont Loading (%)
B563A	BRUCE B SS	BRUCE JCT	249.0	4920	311.2	6.3	308.2	6.3	494.3	10.0	605.0	12.3
	BRUCE JCT	WILLOW CREEK JCT	245.5	3660	301.2	8.2	298.5	8.2	492.9	13.5	603.2	16.5
	WILLOW CREEK JCT	ASHFIELD JCT	227.3	3660	283.7	7.8	282.1	7.7	485.7	13.3	593.6	16.2
A563L	ASHFIELD JCT	LONGWOOD TS	449.1	3660	0.0	0.0	0.0	0.0	748.4	20.4	838.6	22.9
B562E	BRUCE A TS	BRUCE JCT	317.3	4450	428.6	9.6	492.9	11.1	424.6	9.5	689.8	15.5
	BRUCE JCT	WILLOW CREEK JCT	314.9	4170	418.6	10.0	491.8	11.8	414.9	9.9	688.5	16.5
	WILLOW CREEK JCT	EVERGREEN	302.6	3660	390.1	10.7	485.9	13.3	389.6	10.6	681.0	18.6
E562L	EVERGREEN	LONGWOOD TS	659.5	3660	0.0	0.0	870.4	23.8	0.0	0.0	1035.1	28.3
B560V	BRUCE A TS	BRUCE JCT	1460.6	4450	1695.9	38.1	1512.2	34.0	1540.8	34.6	0.0	0.0
	BRUCE JCT	WILLOW CREEK JCT	1461.0	3660	1696.4	46.4	1512.6	41.3	1541.2	42.1	0.0	0.0
	WILLOW CREEK JCT	MILTON SS	1463.2	3620	1699.4	46.9	1515.0	41.9	1543.8	42.6	0.0	0.0
	MILTON SS	CLAIREVILLE	1476.7	3660	1711.2	46.8	1528.1	41.8	1557.0	42.5	0.0	0.0
B561M	BRUCE B SS	BRUCE JCT	1467.9	4170	1725.1	41.4	1531.6	36.7	1545.4	37.1	0.0	0.0
	BRUCE JCT	WILLOW CREEK JCT	1468.4	4170	1725.7	41.4	1532.2	36.7	1546.0	37.1	0.0	0.0
	WILLOW CREEK JCT	MILTON SS	1470.8	3620	1728.9	47.8	1534.8	42.4	1548.7	42.8	0.0	0.0
N582L	LONGWOOD TS	NANTICOKE TS	1120.8	3660	542.8	14.8	997.7	27.3	934.7	25.5	1607.6	43.9
B501M	BRUCE B SS	BRUCE JCT	1464.7	4080	1721.3	42.2	1528.3	37.5	1542.1	37.8	2439.5	59.8
	BRUCE JCT	MILTON SS	1465.2	3660	1721.9	47.0	1528.8	41.8	1542.6	42.1	2440.6	66.7
B502M	BRUCE A TS	BRUCE JCT	1451.4	4080	1708.4	41.9	1506.6	36.9	494.3	10.0	2421.7	59.4
	BRUCE JCT	MILTON SS	1451.8	3660	1709.0	46.7	1507.1	41.2	492.9	13.5	2422.9	66.2

The contingency study results show no post-contingency thermal overloads on the monitored circuits in the local area. Therefore, there are no local area pre-contingency or post-contingency thermal overload issues after the incorporation of the proposed project.

6.6 Voltage Analysis

The *Ontario Resource and Transmission Assessment Criteria (ORTAC)* states that with all facilities in service pre-contingency, the following criteria shall be satisfied:

- The pre-contingency voltage on 500 kV buses must not be less than 490 kV and no greater than 550 kV, 230 kV buses must not be less than 220 kV and no greater than 250 kV, and voltages on 115kV buses cannot be less than 113 kV and no greater than 127 kV;
- The post-contingency voltage on 500 kV buses must not be less than 470 kV and no greater than 550 kV, 230 kV buses must not be less than 207 kV and no greater than 250 kV and voltages on 115V buses cannot be less than 108 kV and no greater than 127 kV; and
- The voltage drop following a contingency must not exceed 10% pre-ULTC and 10% post-ULTC.

The voltage performance of the IESO-controlled grid was evaluated by examining if pre- and post-contingency voltages and post-contingency voltage declines remain within criteria at various facilities. Contingencies were simulated with both peak load base case and light load base case, however, only the results for the peak load base case are provided as the results are more limiting. The most impactive contingencies with respect to voltage changes were found to be the (i) loss of B560V+B561M, (ii) loss of A563L+E562L and (iii) loss of K2. For the loss of K2, the base case was modified to have the project withdraw maximum reactive power at the connection point at the maximum continuous voltage of 550 kV to yield a greater voltage change.

Results are summarized in Table 28 and Table 29 below.

The study results indicate that all voltage declines are within the IESO's criteria of 10%. Note, however, the voltages at Ashfield SS for the loss of K2 may result in voltages as high as 553 kV which would exceed the maximum post-contingency voltage as specified in the ORTAC . As shown in Section 6.3 of this report, the switching of a reactor at Ashfield SS would help reduce voltages to below 550 kV. Alternate solutions other than the switching of a reactor at Ashfield SS may also be acceptable, upon the approval of the IESO and transmitter.

Table 28: Voltage analysis results – Loss of B560 V+B561M and Loss of A563L+E562L

Monitored Busses		Pre-Cont Voltage kV	***Loss of B560V+B561M***				***Loss of A563L+E562L***			
Bus Name	Base kV		Pre-ULTC		Post-ULTC		Pre-ULTC		Post-ULTC	
			kV	%	kV	%	kV	%	kV	%
CLAIREVILLE	500	527	508	-3.66	514	-2.55	523	-0.65	524	-0.63
MILTON SS	500	529	506	-4.46	511	-3.39	525	-0.81	525	-0.78
NANTICOKE	500	542	524	-3.37	529	-2.49	540	-0.51	540	-0.46
DETWEILER	230	245	244	-0.36	244	-0.36	244	-0.36	244	-0.36
PARKHILL	500	550	550	-0.09	550	-0.09	550	-0.09	550	-0.09
BRUCE A TS	500	548	545	-0.69	546	-0.50	545	-0.54	545	-0.53
BRUCE B SS	500	549	545	-0.72	546	-0.53	546	-0.54	546	-0.54
ASHFIELD TS	500	550	548	-0.42	549	-0.23	545	-0.90	545	-0.89
BRUCE A TS	230	247	250	1.04	250	1.15	246	-0.35	246	-0.34
LONGWOOD	500	548	549	0.16	550	0.40	539	-1.66	540	-1.58
LONGWOOD	230	244	250	1.99	250	2.32	241	-1.42	241	-1.34

*Loss of K2 assumes the collector system disconnected from the IESO-controlled grid.

Table 29: Voltage analysis results – Loss of K2 with maximum reactive power withdrawal

Monitored Busses		Pre-Cont Voltage kV	***Loss of K2****			
Bus Name	Base kV		Pre-ULTC		Post-ULTC	
			kV	%	kV	%
CLAIREVILLE	500	527	527	0.11	527	0.17
MILTON SS	500	529	529	0.14	530	0.21
NANTICOKE	500	542	542	0.07	543	0.18
DETWEILER	230	245	245	-0.03	245	0.13
PARKHILL	500	550	550	-0.09	550	-0.09
BRUCE A TS	500	548	548	0.10	548	0.14
BRUCE B SS	500	548	549	0.11	549	0.15
ASHFIELD TS	500	550	553**	-0.38	553**	-0.45
BRUCE A TS	230	247	247	0.06	247	0.09
LONGWOOD	500	548	548	-0.04	549	0.08
LONGWOOD	230	244	244	-0.20	244	0.05

*Loss of K2 assumes the collector system disconnected from the IESO-controlled grid.

6.7 Steady-State Voltage Stability

The *Ontario Resource and Transmission Assessment Criteria (ORTAC)* states that the maximum acceptable pre-contingency power transfer must be 10% lower than the voltage instability point of the pre-contingency P-V curve, and 5% lower than the voltage instability point of the post-contingency P-V curve.

The voltage performance of the IESO-controlled grid was evaluated by examining if the FABC transfer after the incorporation of the project meets the above requirement based on pre- and post-contingency and post-contingency P-V curves under peak load conditions. The contingency of simultaneous loss of B560V+561M was selected for studying the post-contingency steady-state voltage stability as it is the worst-case contingency in terms of system voltage stability. For this recognized contingency, two post-contingency scenarios, either tripping the reactors at Bruce and Longwood or no tripping of these reactors are investigated. Only the voltage responses at Claireville 500kV were recorded as it is the most critical point in the system in terms of system voltage stability performance.

Figure 5 shows the steady-state voltage responses at Claireville 500kV as the FABC transfer increases under the pre-contingency scenario and two post-contingency scenarios. It indicates that the maximum FABC transfer under the pre-contingency scenario, post-contingency reactor tripping scenario, and post-contingency no reactor tripping scenario are 8748 MW, 7256 MW, and 6766 MW, respectively. The pre-contingency FABC transfer is 6412 MW. Thus, the pre-contingency FABC transfer is 10% lower than the voltage instability point of the pre-contingency P-V curve, and 5% lower than the voltage instability point of the post-contingency P-V curve, under either reactor tripping or no reactor tripping scenario. It can be concluded that the steady-state voltage stability of the system after the incorporation of the project conforms to the Market Rules' requirement.

6.8 Transient Stability Performance

Transient stability simulations were completed to determine if the power system will be transiently stable with the incorporation of the project for recognized fault conditions in the vicinity of the project. In particular, rotor angles of generators at Bruce GS, Greenfield GS, Saunders GS and YEC GS were monitored. The peak load base case was used to perform the transient analysis.

The contingencies that were simulated are summarized in Table 30. The protection changes proposed in the PIA were part of the assumptions for this analysis.

Table 30: Simulated contingencies for transient stability

ID	Contingency	Location	Fault Type	Fault Clearing Time (ms)		BRS/ LRSS (ms)*	Reclosure Time (ms)
				Local	Remote		
SC1	B560V+B561M	Willow Creek	LLG	66	91	124	10s for B560V 15s for B561M
SC2	B563A	Bruce	3 ph	66	91		15 s
SC3	A563L	Ashfield	3 ph	66	100		15 s
SC4	A563L	Longwood	3 ph	75	91		15 s
SC5	A563L+E562L	Longwood	LLG	75	91		10 for E562L 15 for A563L
SC6	B563A+B563E	Bruce	LLG	66	91		10 for B563E 15 for B563A
SC7	LV side of 500/34.5 kV transformer	K2	3 ph	Un-cleared		N/A	N/A
SC8	LV side of 500/138 kV transformer	K2	3 ph	Un-cleared		N/A	N/A

*Denotes the Bruce Reactor Switching and Longwood Reactor Switching Schemes.

Figure 6 to Figure 21 in Appendix A show the transient responses of the rotor angles and bus voltages. The transient responses show that the generators remain synchronized to the power system and the oscillations are sufficiently damped following all simulated contingencies. It can be concluded that, with K2 Wind Farm on-line, none of the simulated contingencies caused transient instability or un-damped oscillations.

It can be also concluded that the protection adjustments proposed in the PIA report have no material adverse impact on the IESO-controlled grid in terms of transient stability.

6.9 Voltage Ride-Through Capability

The IESO requires that the wind turbine generators and associated equipment with the project be able to withstand transient voltages and remain connected to the IESO-controlled grid following a recognized contingency unless the generators are removed from service by configuration. This requirement is commonly referred to as the voltage ride-through (VRT) capability.

The voltage ride through capability of the SWT-2.3-101 wind turbines is shown in Table 3.

The LVRT capability of the WTGs was assessed based on the terminal voltages of the WTGs under simulated contingencies in Table 31. These contingencies result in the lowest transient voltages at the project.

Table 31: Simulated contingencies for LVRT

Contingency	Location	Fault Type	Fault Clearing Time(ms)		BRS/ LRSS (ms)*	Reclosure Time
			Local	Remote		
B560V+B561M	Willow Creek	LLG	66	91	124	10s for B560V 15s for B561M
B563A	Ashfield	3 ph	66	91		15 s
A563L	Ashfield	3 ph	66	100		15 s
B563A+B562E	Bruce	LLG	66	91		10s for B562E 15s for B563A
B563A	Bruce	LG+BF at H5L563	179	91		N/A
Longwood T3	Longwood	LG+BF at HL563	203	98		N/A

*Denotes the Bruce Reactor Switching and Longwood Reactor Switching Schemes.

Figure 22, Appendix A shows the terminal voltages of the WTG at collector C1 under simulated contingencies. It shows that at worst, the terminal voltages of the WTGs drop as low as 0.084 pu and recovers to 0.9 pu in about 160 ms after the fault inception. As compared with the voltage ride through capability of the SWT-2.3-101, the proposed WTGs are able to remain connected to the grid for recognized system contingencies that do not remove the project by configuration.

However, when the project is incorporated into the IESO-controlled grid, if actual operation shows that the WTGs trip for contingencies for which they are not removed by configuration, the IESO will require the voltage ride-through capability be enhanced by the applicant to prevent such tripping.

The voltage ride-through capability must also be demonstrated during commissioning by monitoring several variables under a set of IESO specified field tests and the results should be verifiable using the PSS/E model.

6.10 Relay Margin

The Market Manual 7.4 Appendix B.3.2 requires that following fault clearance or the loss of an element without a fault, the margin on all instantaneous and timed distance relays that affect the integrity of the IESO-controlled grid, including generator loss of excitation and out-of-step relaying at major generating stations, must be at least 20 and 10 percent, respectively.

Relay margin analysis was performed on the shoulder base case to determine if circuits B563A and A563L will trip for out of zone faults due to the addition of the K2 Wind Farm. Shoulder load base case was used due to the higher flow on circuit B563A and A563L.

The contingencies listed in Table 32 were simulated with the results shown from Figure 23 to Figure 34 in Appendix A.

Table 32: Simulated contingencies for relay margin

Contingency	Location	Fault Type	Fault Clearing Time (ms)		BRS/ LRSS (ms)*	Reclose Time
			Local	Remote		
B560V+B561M	Bruce	LLG	66	91	124	10s for B560V 15s for B561M
B562E	Bruce	3 phase	66	91		10s
E562L	Longwood	3 phase	66	100		10s

*Denotes the Bruce Reactor Switching and Longwood Reactor Switching Schemes.

The relay margin plots show that the impedance trajectory on circuits B563A and A563L do not penetrate the relay characteristic and has a margin of greater than 20%, thereby meeting the Market Manual requirement. The relay margin analysis was repeated using the shoulder load base case with the project out-of-service for the defined contingencies. Simulation results also show that the relay margins of circuit B563A and A563L are within Market Manual requirement.

It can be also concluded that the protection adjustments proposed in the PIA report have no material adverse impact on the IESO-controlled grid in terms of relay margin.

-End of Section-

Appendix A: Figures

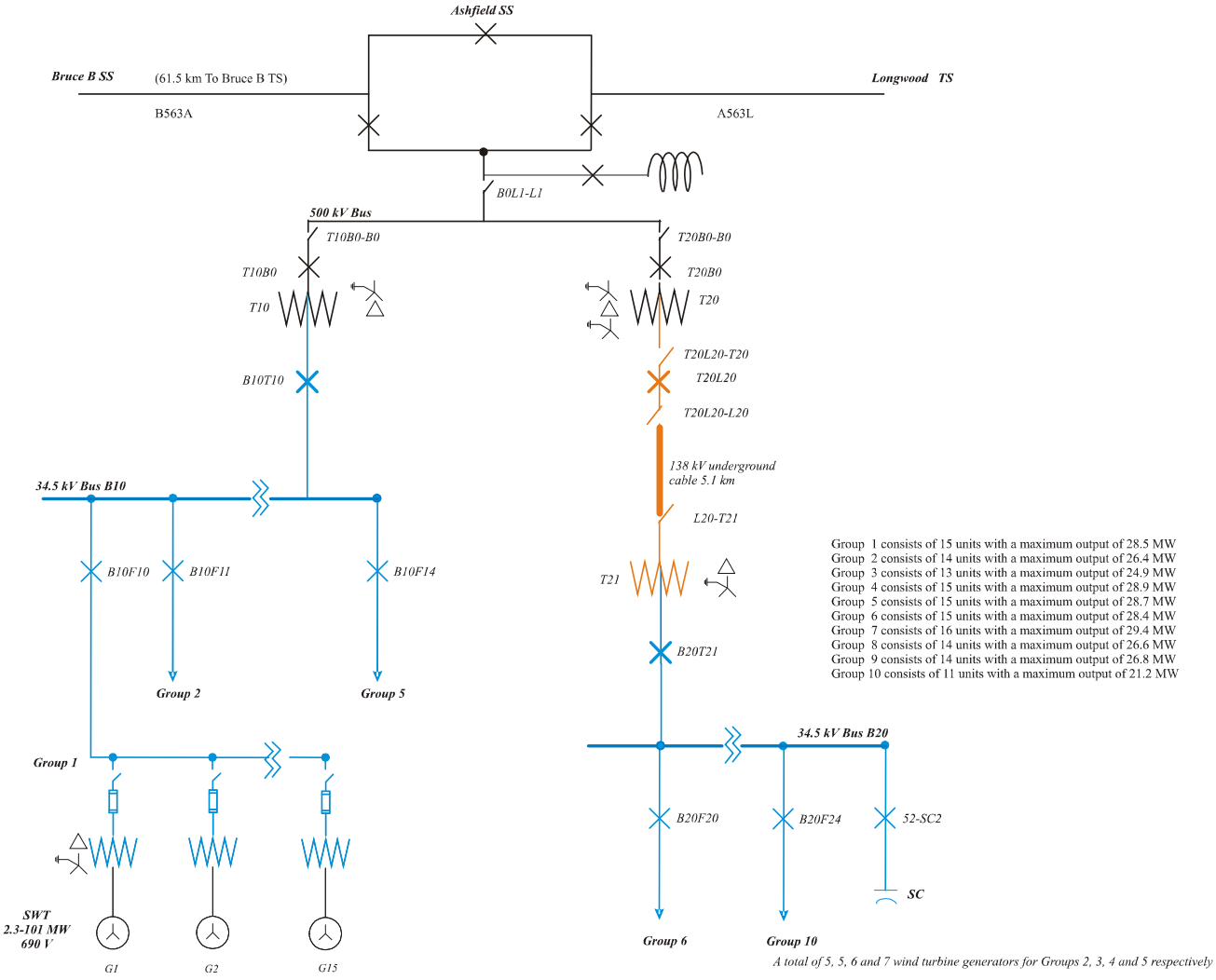


Figure 1: Single-line diagram of proposed Ashfield SS and K2 Wind arrangement

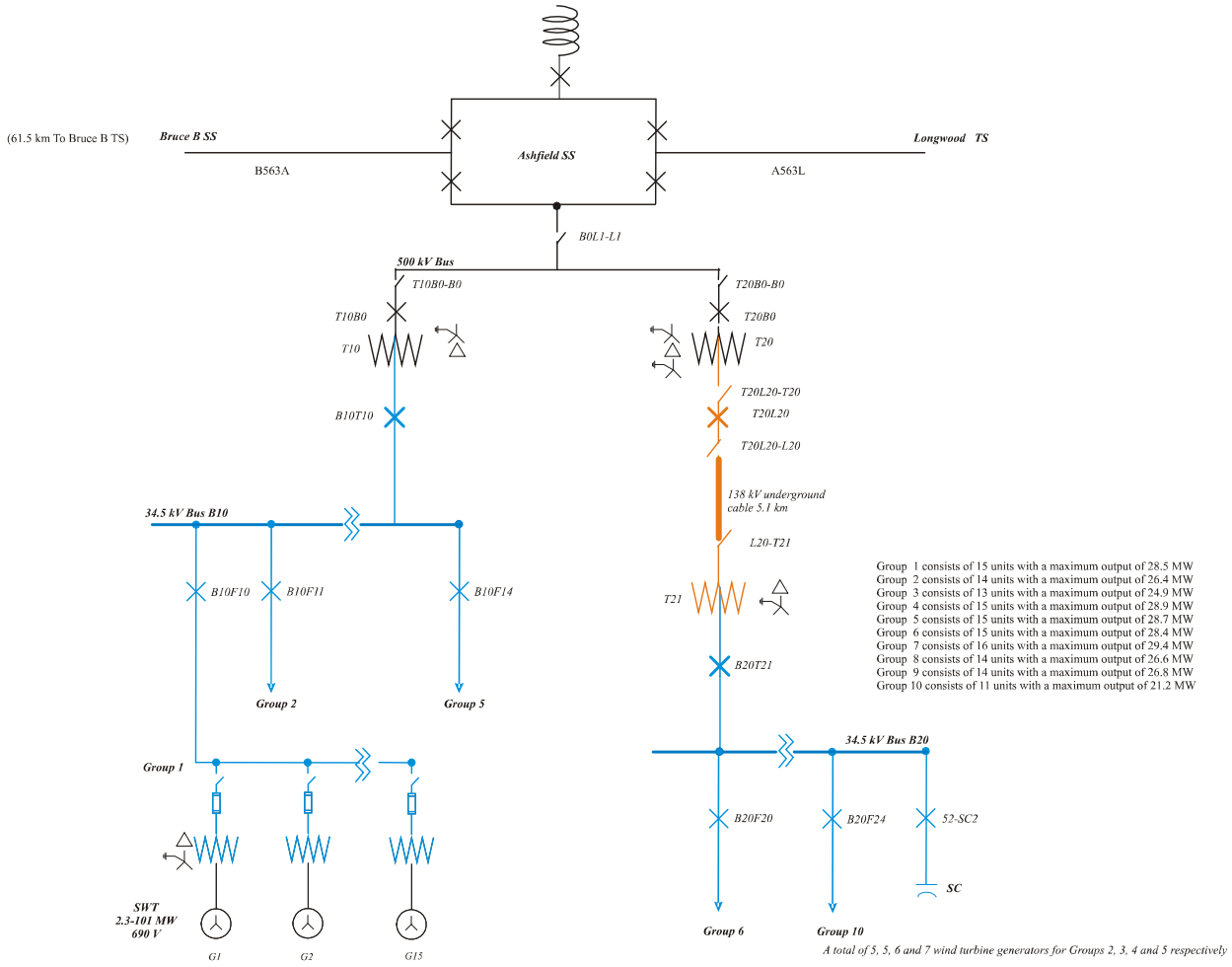


Figure 2 Single-line diagram of alternative Ashfield SS and K2 Wind arrangement

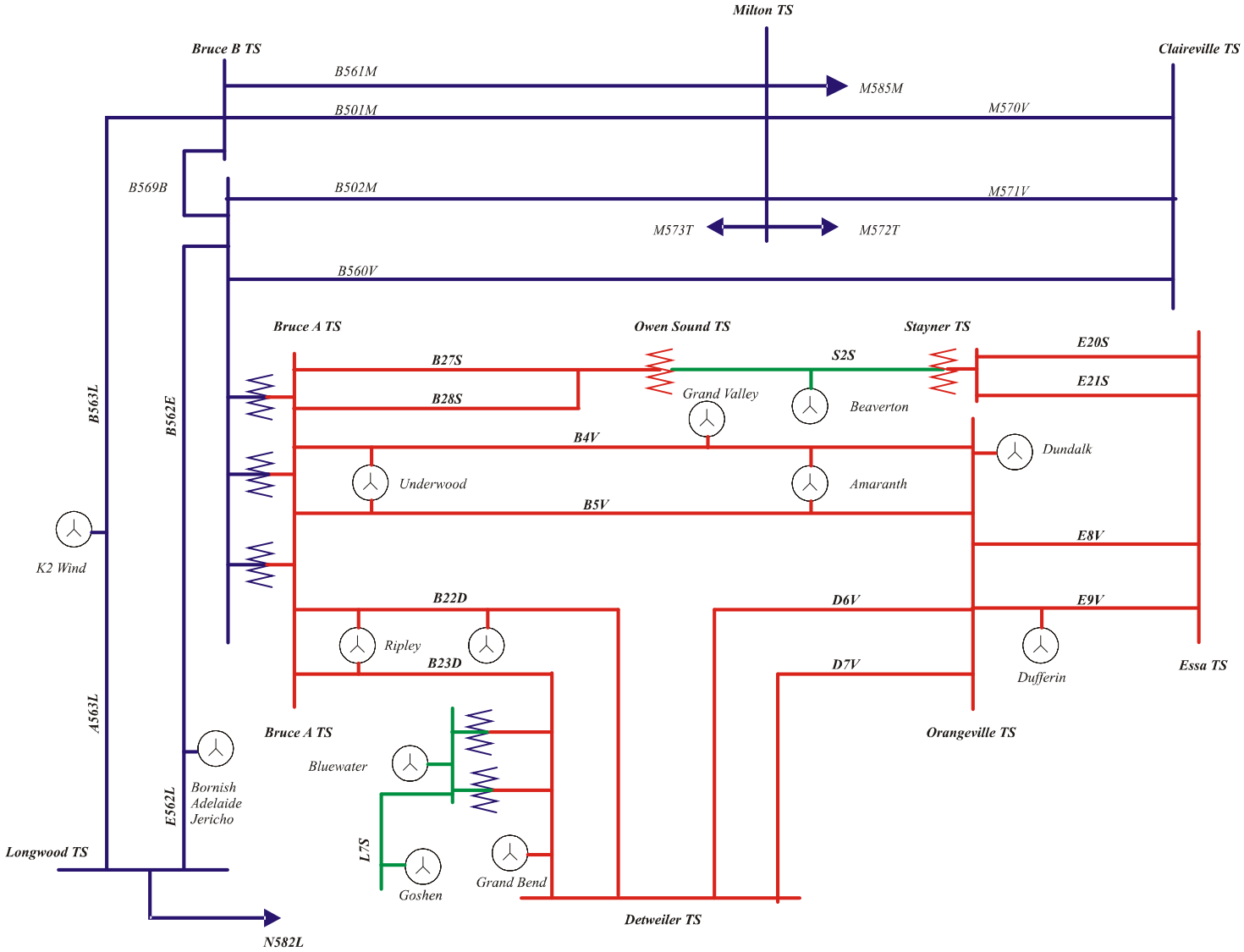


Figure 3: Transmission system near K2 wind farm

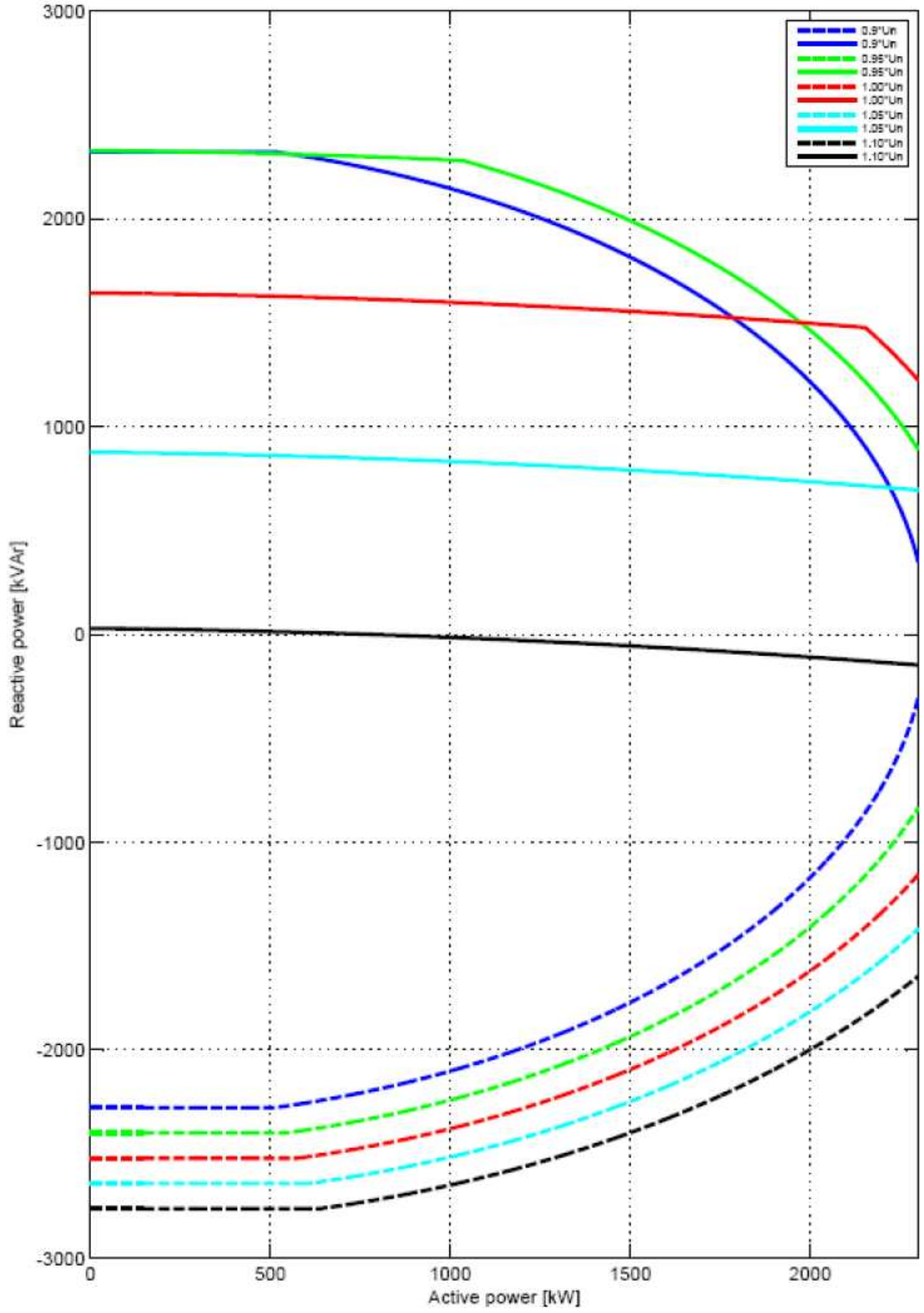


Figure 4: Reactive power limits curves for the SWT-2.3 VS 60 Hz wind turbines at LV side of wind turbine transformer. The curves are valid for active power above 0 kW (P > 0 kW).

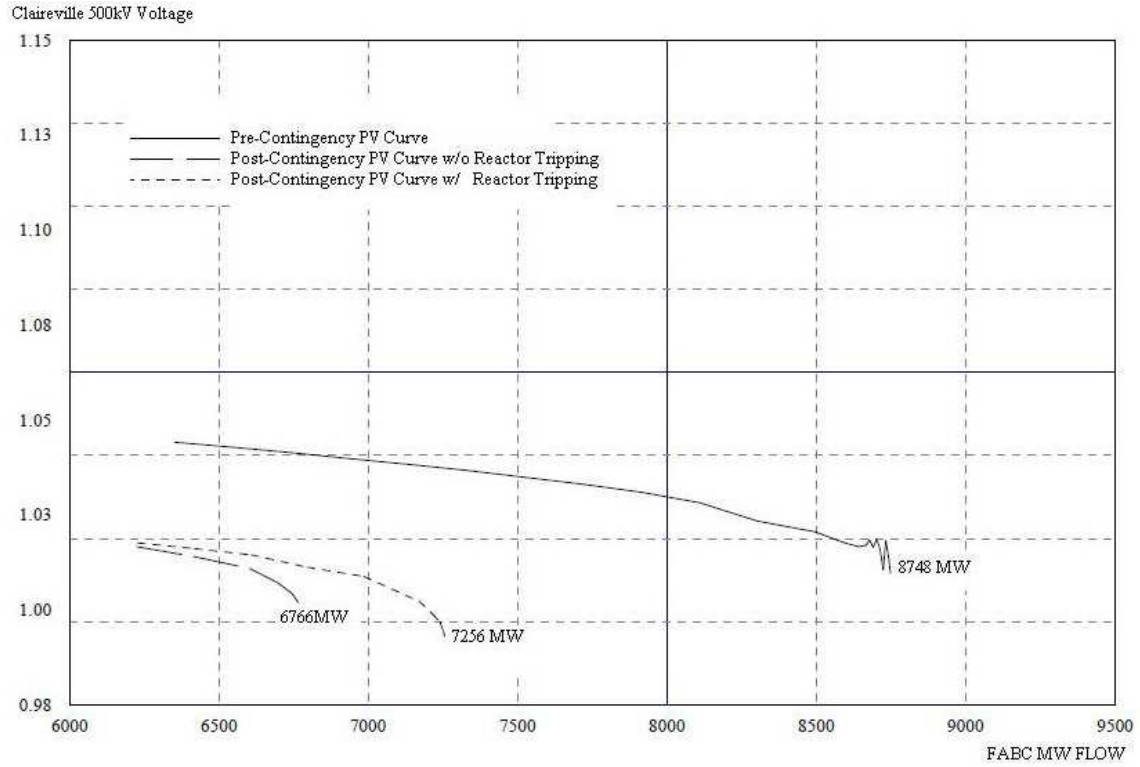


Figure 5: Voltage responses at Claireville 500kV vs. FABC transfer under defined scenarios

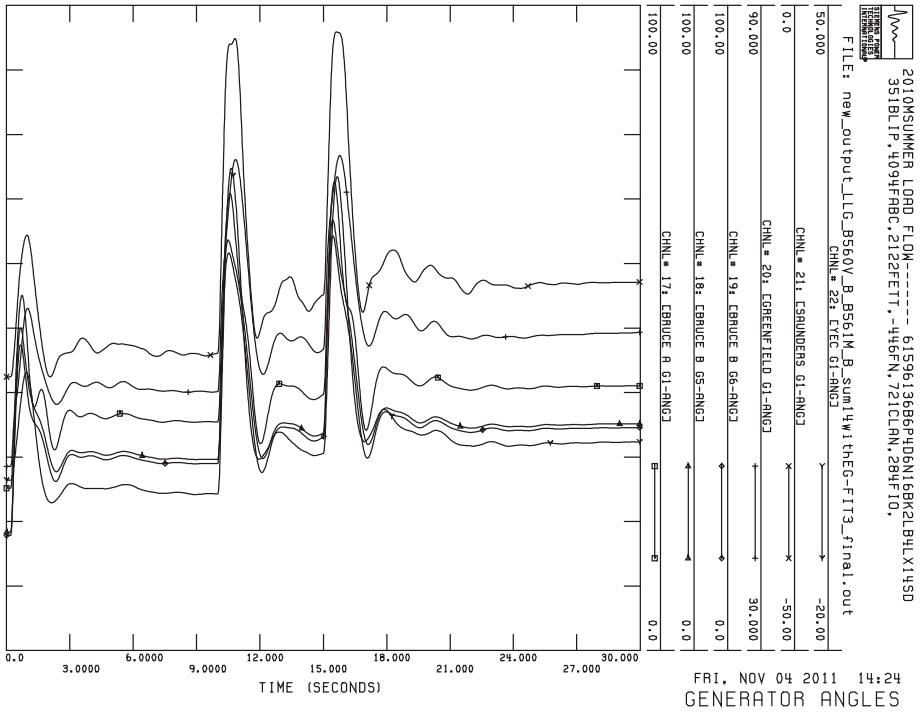


Figure 6 Major generator angle responses following a LLG fault on circuits B560V and B561M at Willow Creek Junction – with reclosure

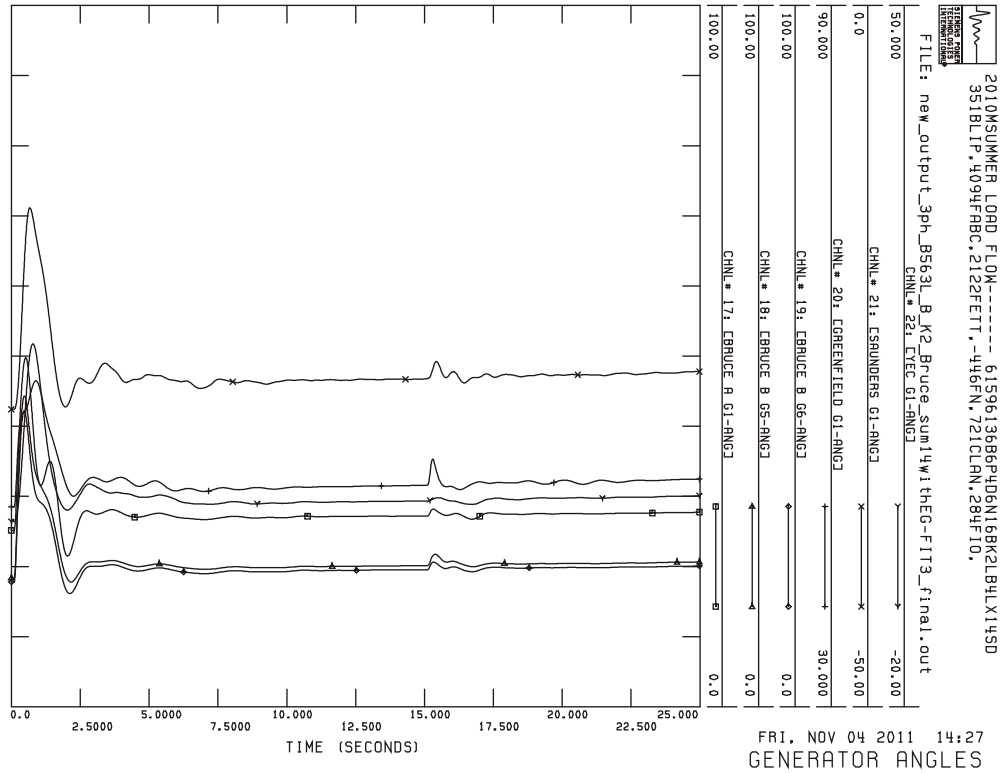


Figure 7 Major generator angle responses following a 3 phase fault on circuit B563A at Bruce– with reclosure

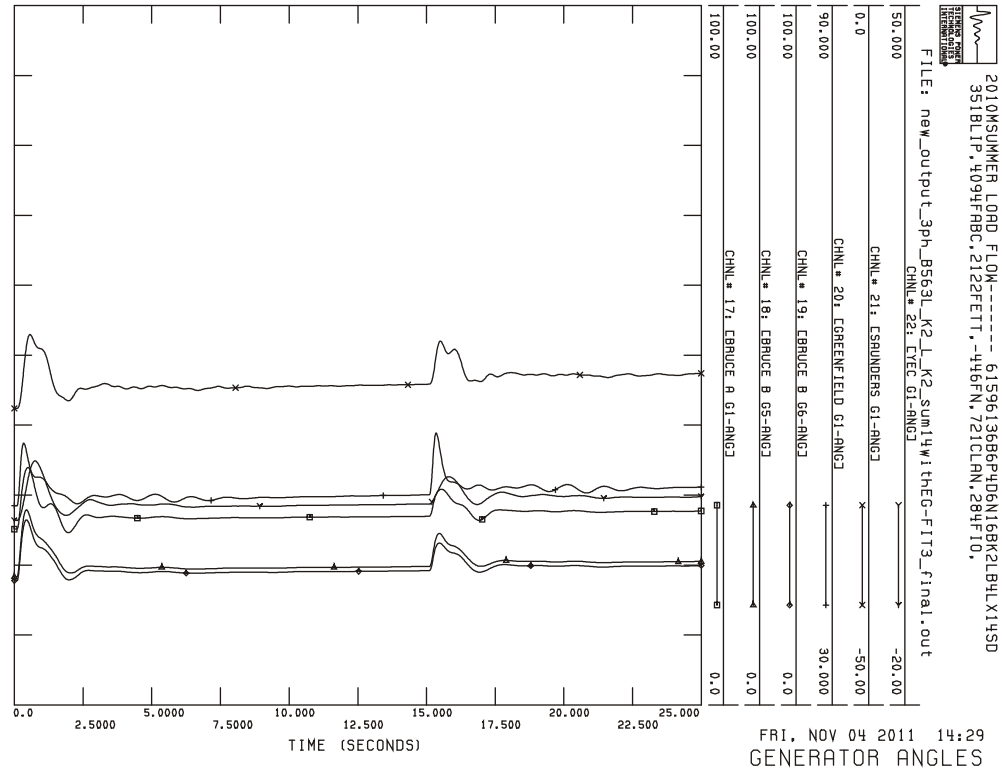


Figure 8 Major generator angle responses following a 3 phase fault on circuit A563L at Ashfield– with reclosure

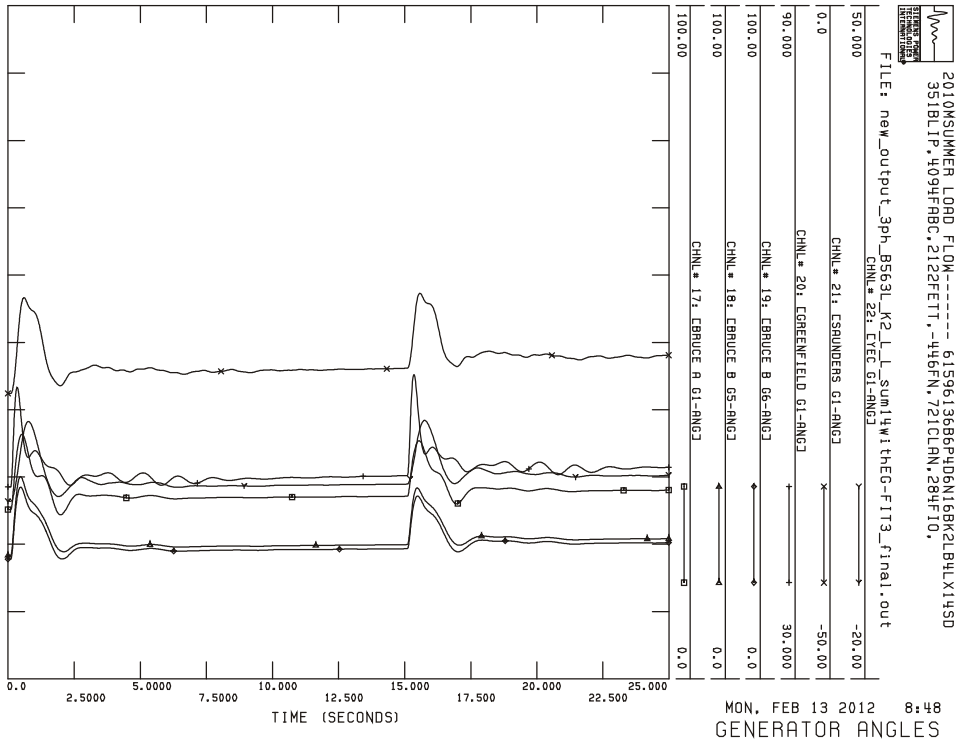


Figure 9 Major generator angle responses following a 3 phase fault on circuit A563L at Longwood– with reclosure

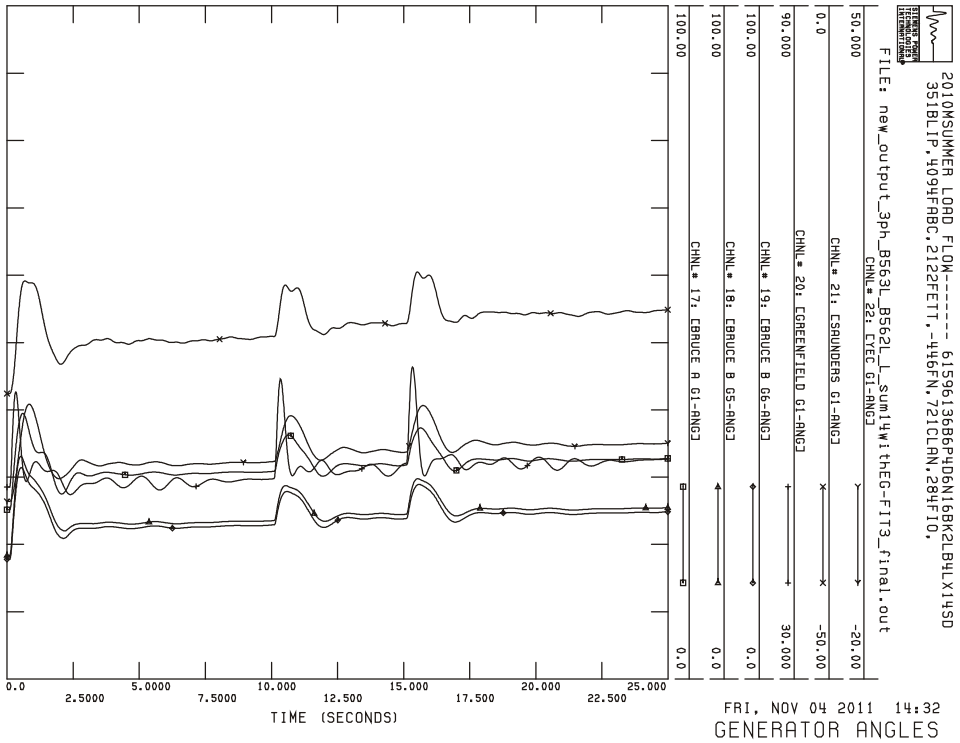


Figure 10 Major generator angle responses following a LLG fault on circuits A563L+E562L at Longwood– with reclosure

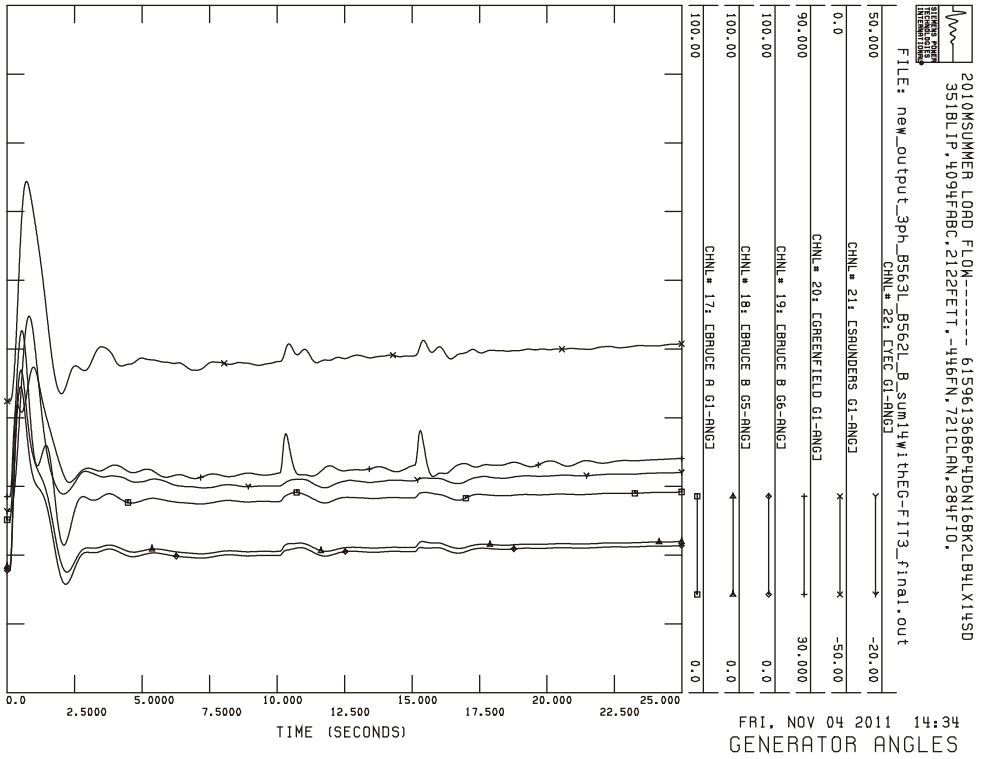


Figure 11 Major generator angle responses following a LLG fault on circuits B563A+B562E at Bruce– with reclosure

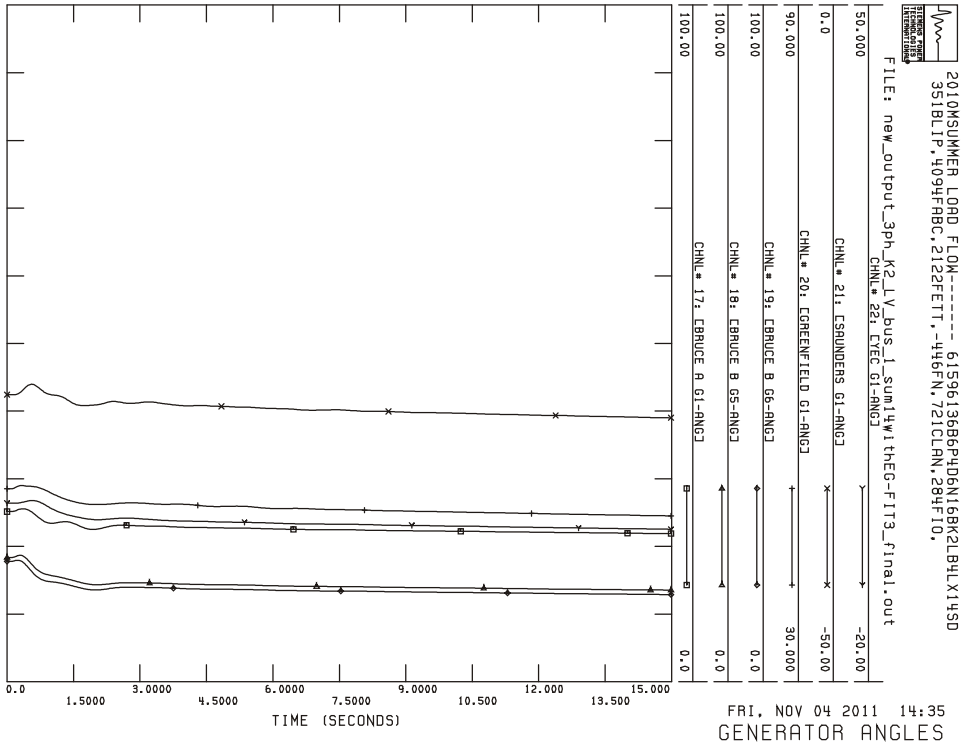


Figure 12 Major generator angle responses following an uncleared LLG fault on LV side of 500/34.5 kV transformer at K2– with no reclosure

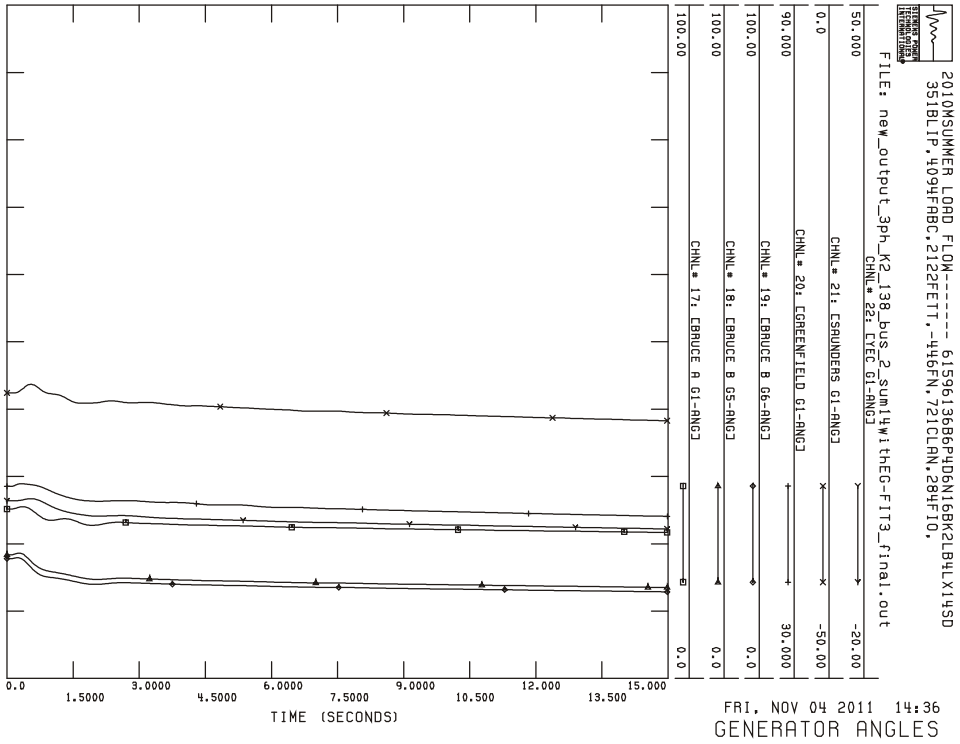


Figure 13 Major generator angle responses following a 3 phase uncleared fault on LV side of 500/138 kV transformer at K2

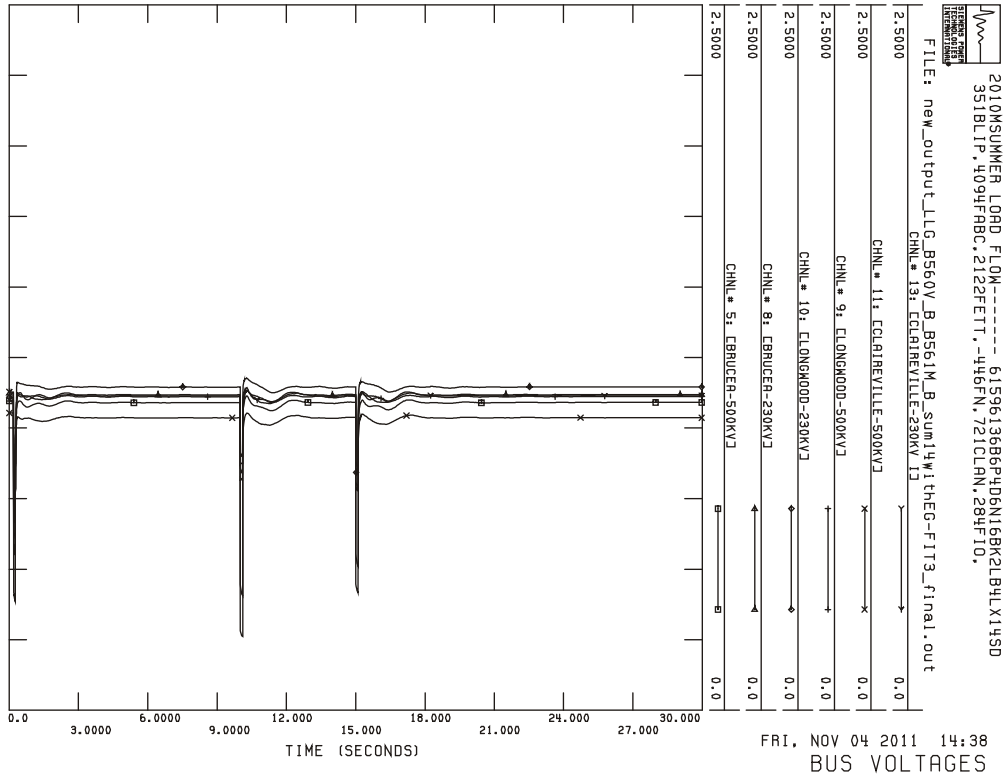


Figure 14 Voltage responses following a 3 phase fault on circuits B560V and B561M at Willow Creek Junction – with reclosure

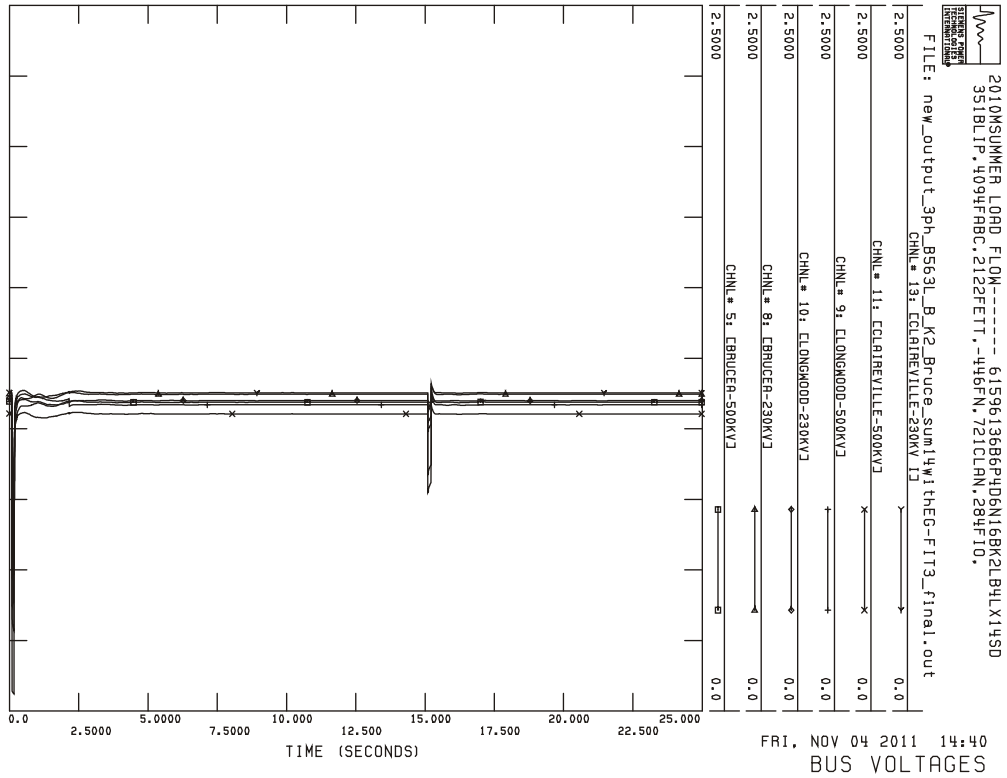


Figure 15 Voltage responses following a 3 phase fault on circuit B563A at Bruce – with reclosure

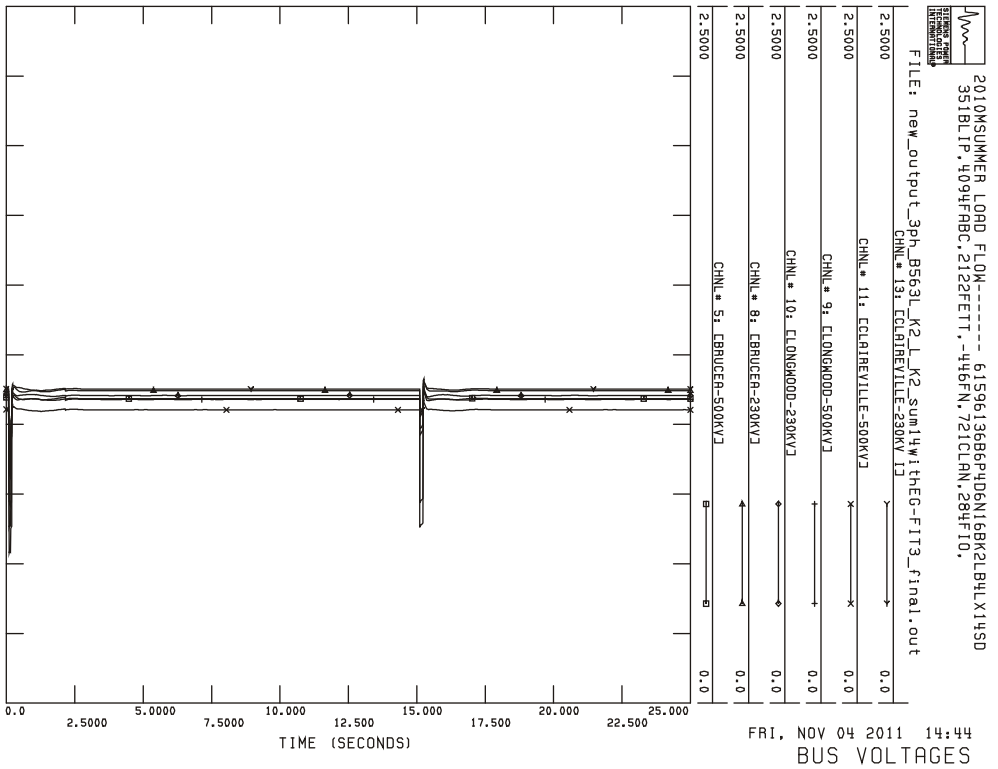


Figure 16 Voltage responses following a 3 phase fault on circuit A563L at Ashfield– with reclosure

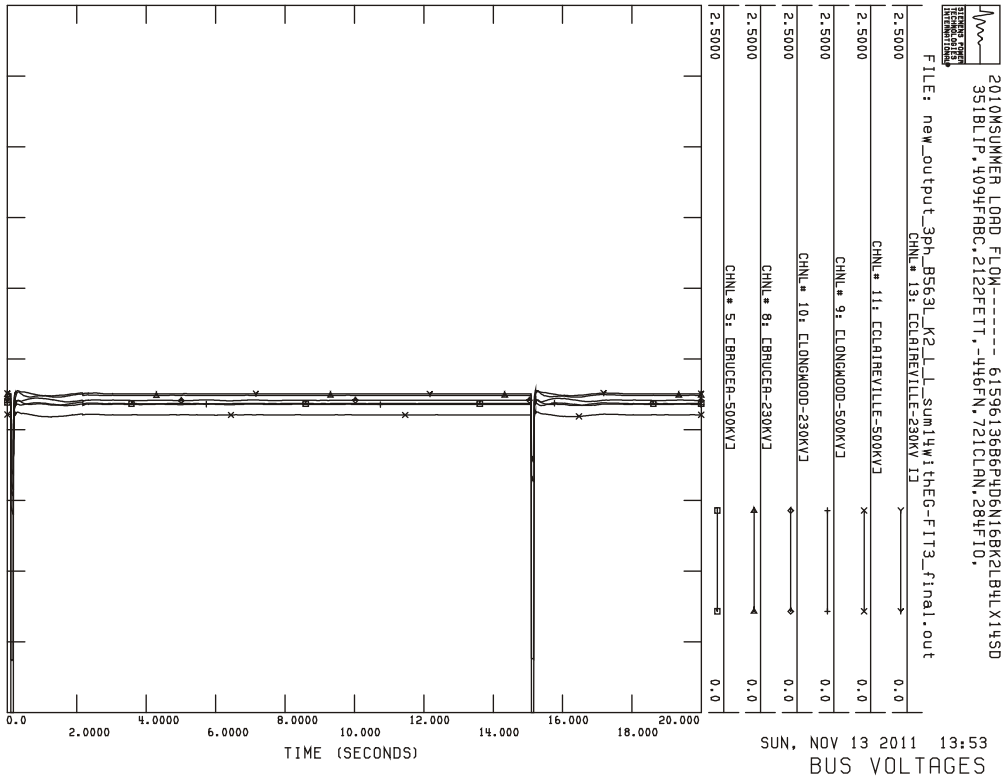


Figure 17 Voltage responses following a 3 phase fault on circuit A563L at Longwood– with reclosure

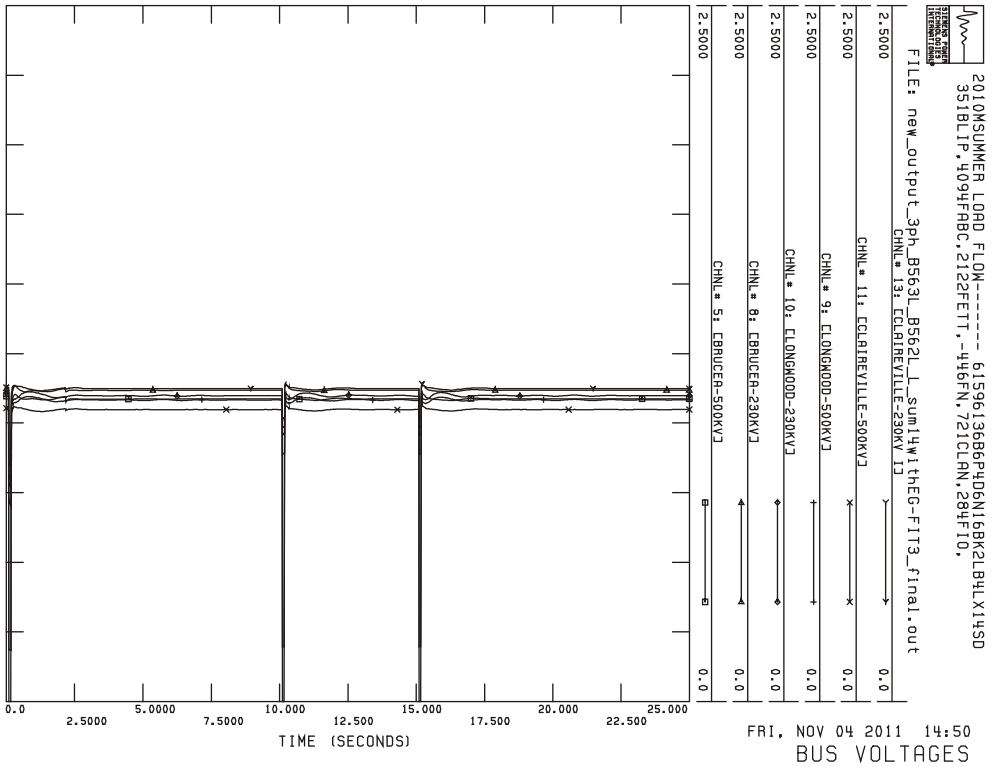


Figure 18 Voltage responses following a LLG phase fault on circuits A563L+E562L at Longwood– with reclosure

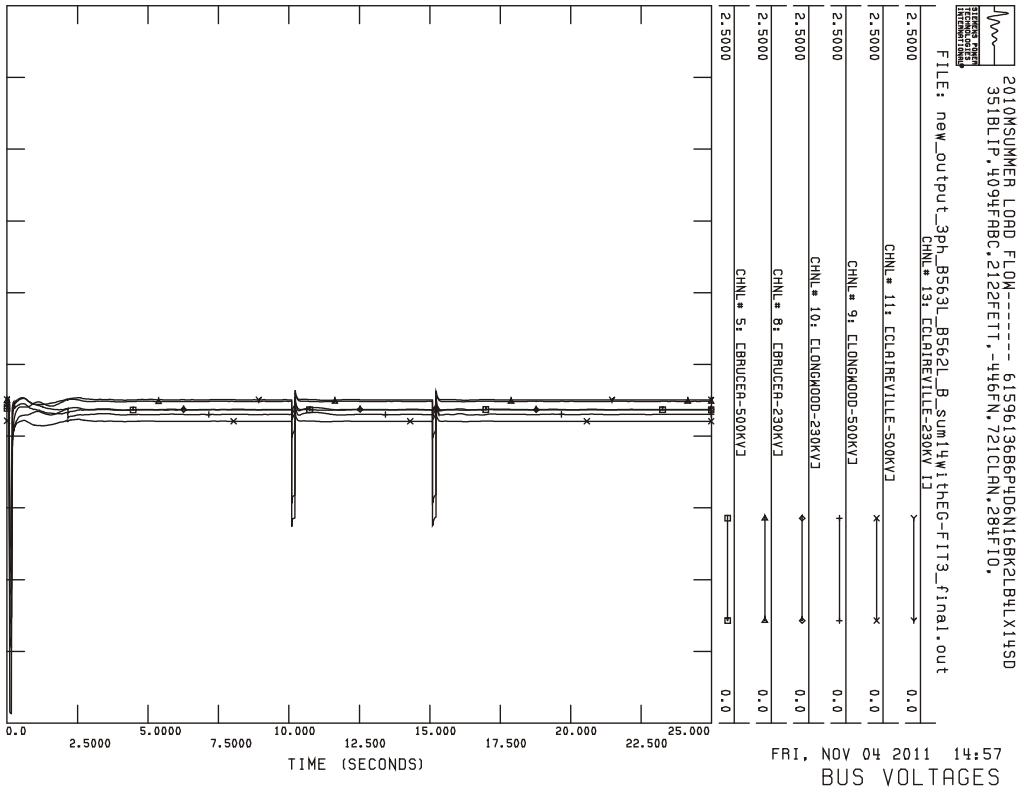


Figure 19 Voltage responses following a LLG phase fault on circuits B563A+B562E at Bruce– with reclosure

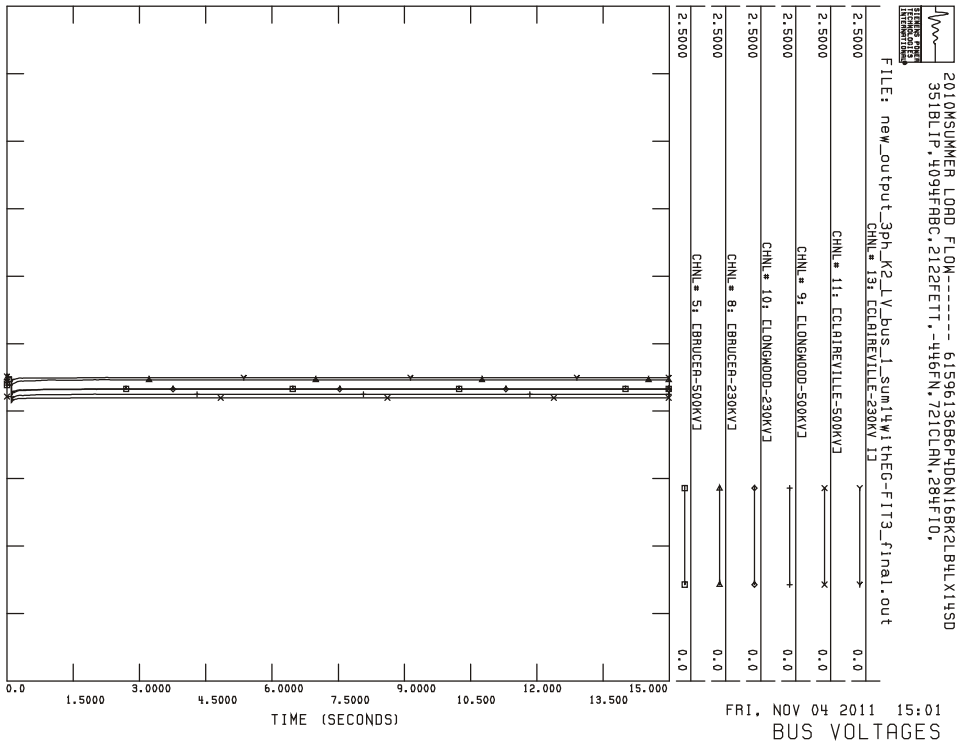


Figure 20 Voltage responses following a 3 phase uncleared fault at the LV side of the 500/34.5 kV transformer at K2

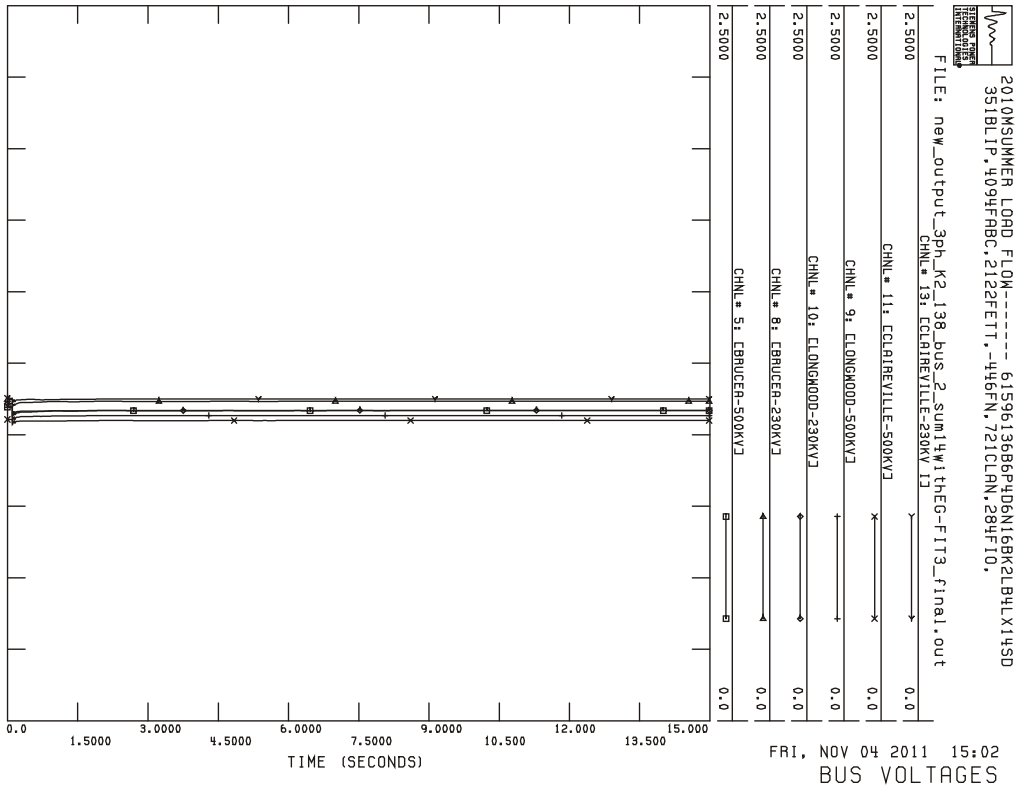


Figure 21 Voltage responses following a 3 phase uncleared fault at the LV side of the 500/138 kV transformer of K2

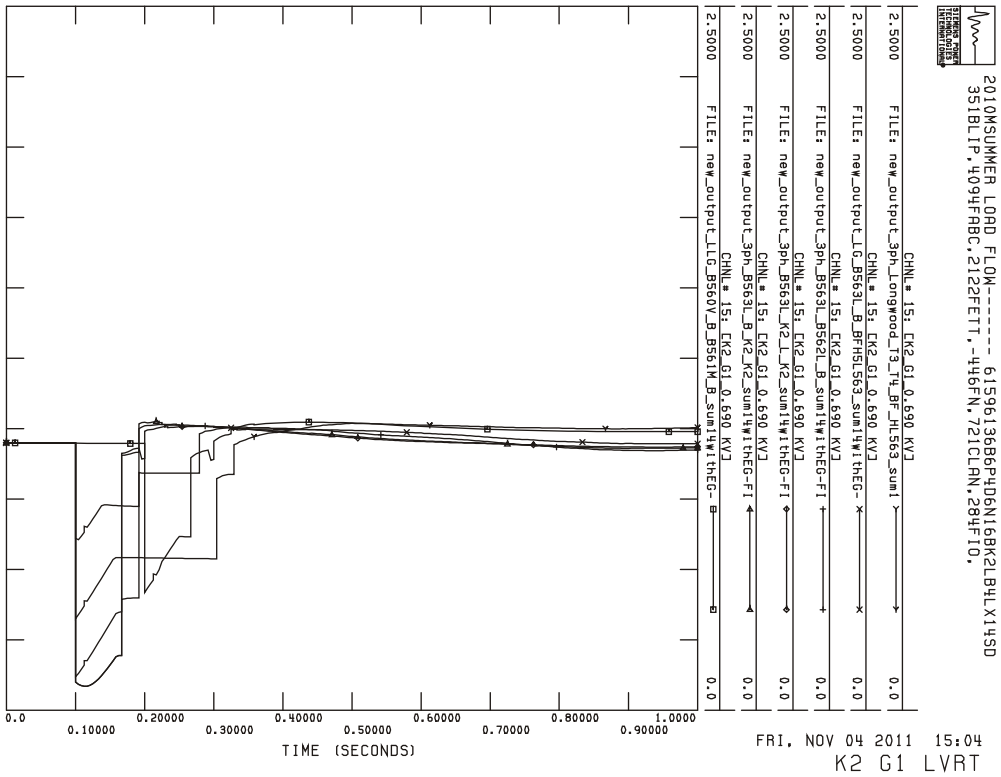


Figure 22 K2 WTG Feeder 1 generation terminal voltages for studied contingencies

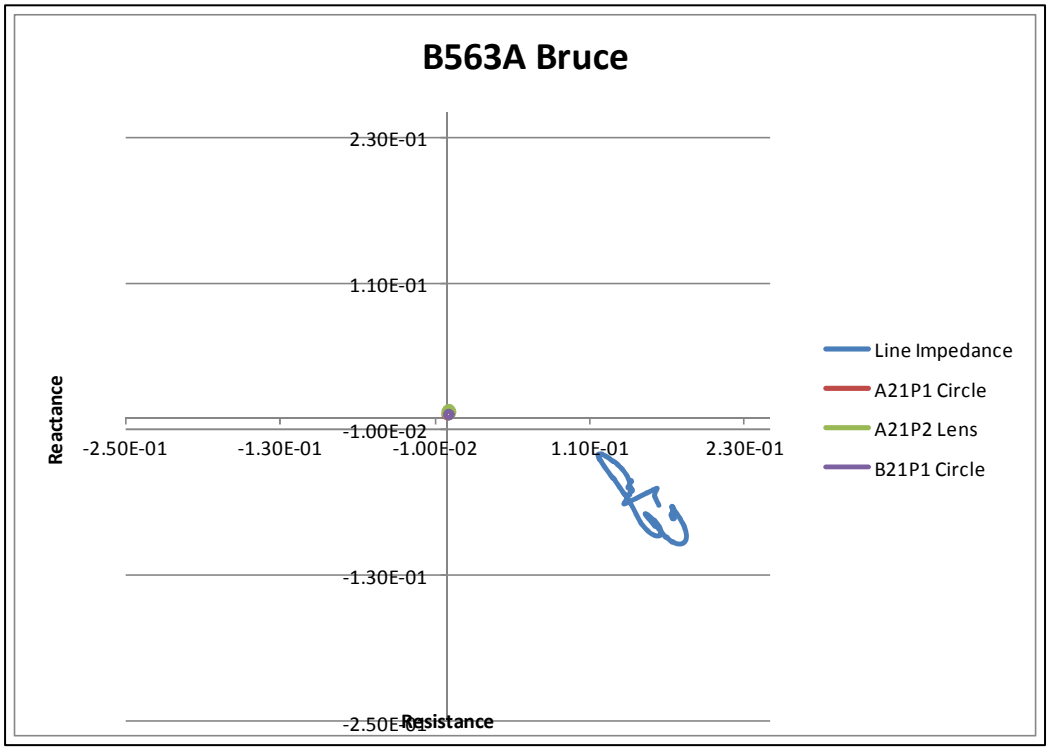


Figure 23 Impedance trajectory of B563A at Bruce TS following a LLG fault on circuits B560V and B561M at Willow Creek Junction

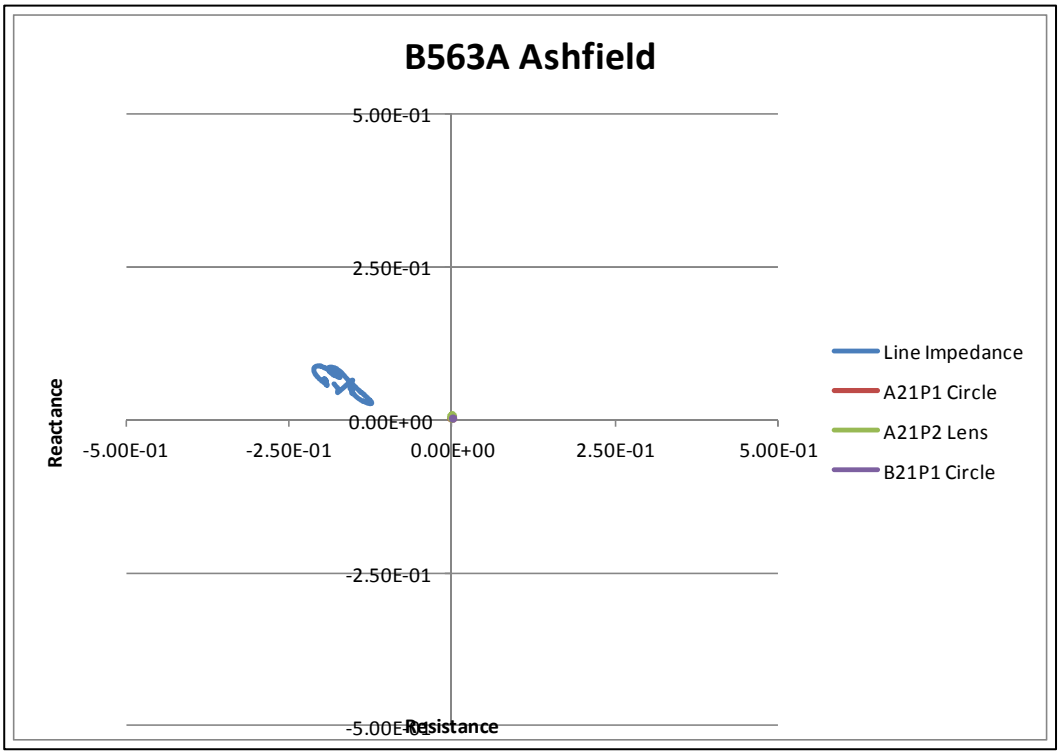


Figure 24 Impedance trajectory of B563A at Ashfield SS following a LLG fault on circuits B560V and B561M at Willow Creek Junction

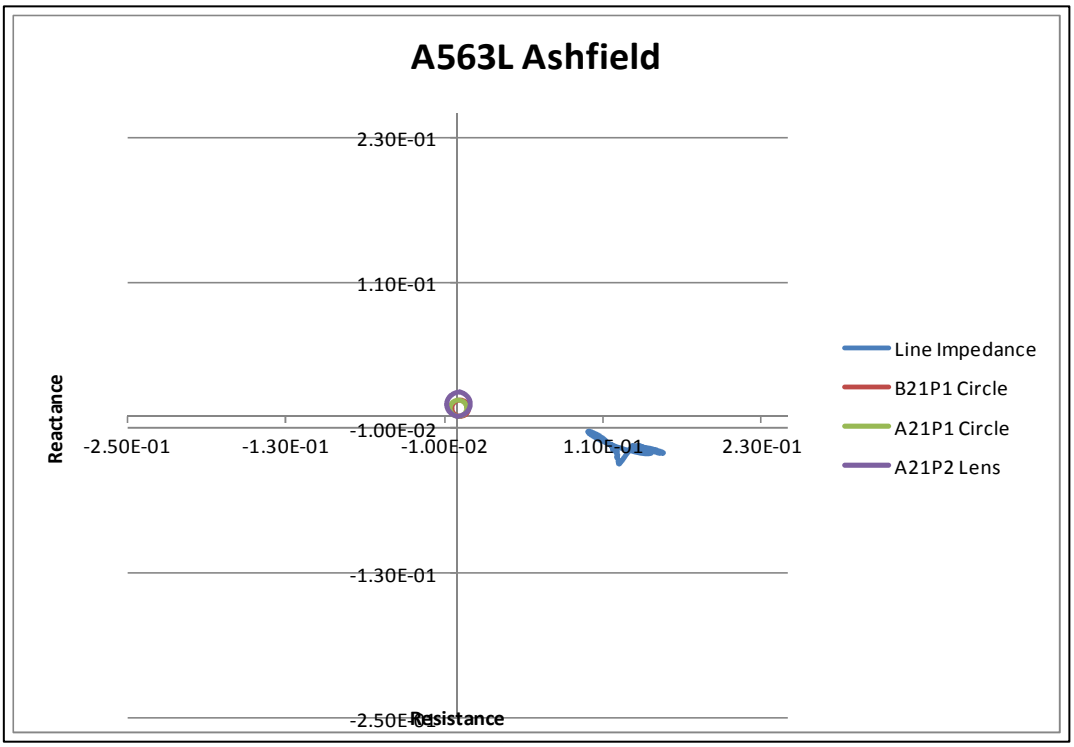


Figure 25 Impedance trajectory of A563L at Ashfield SS following a LLG fault on circuits B560V and B561M at Willow Creek Junction

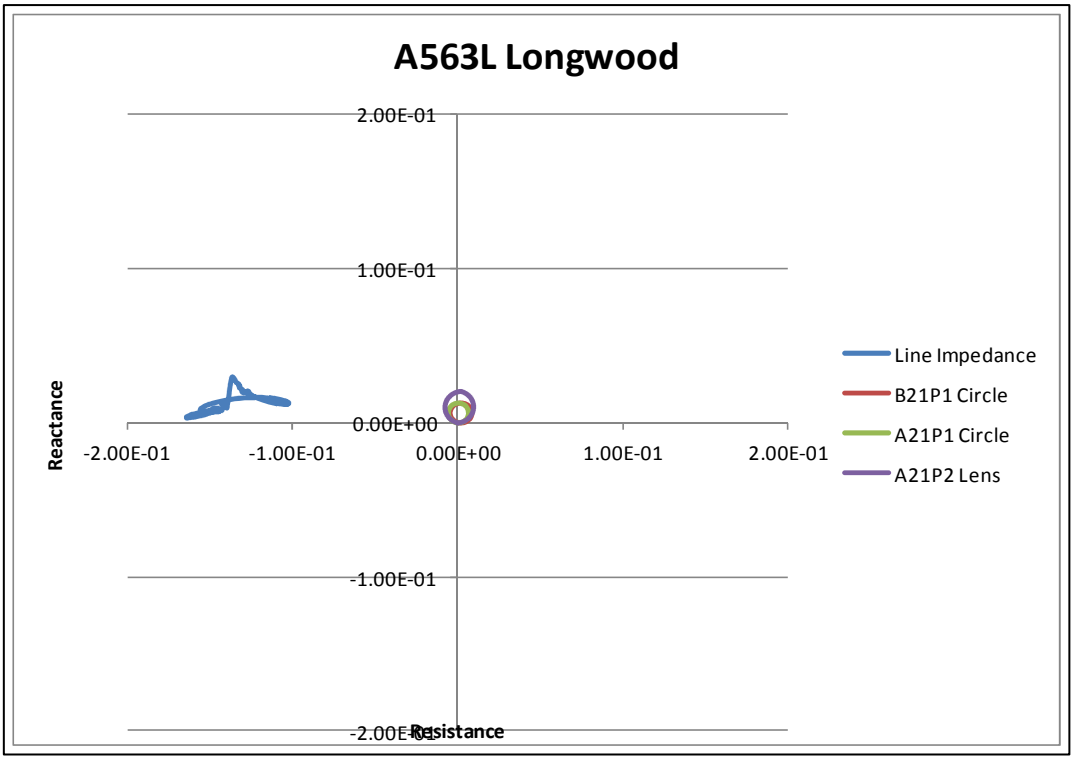


Figure 26 Impedance trajectory of A563L at Longwood TS following a LLG fault on circuits B560V and B561M at Willow Creek Junction

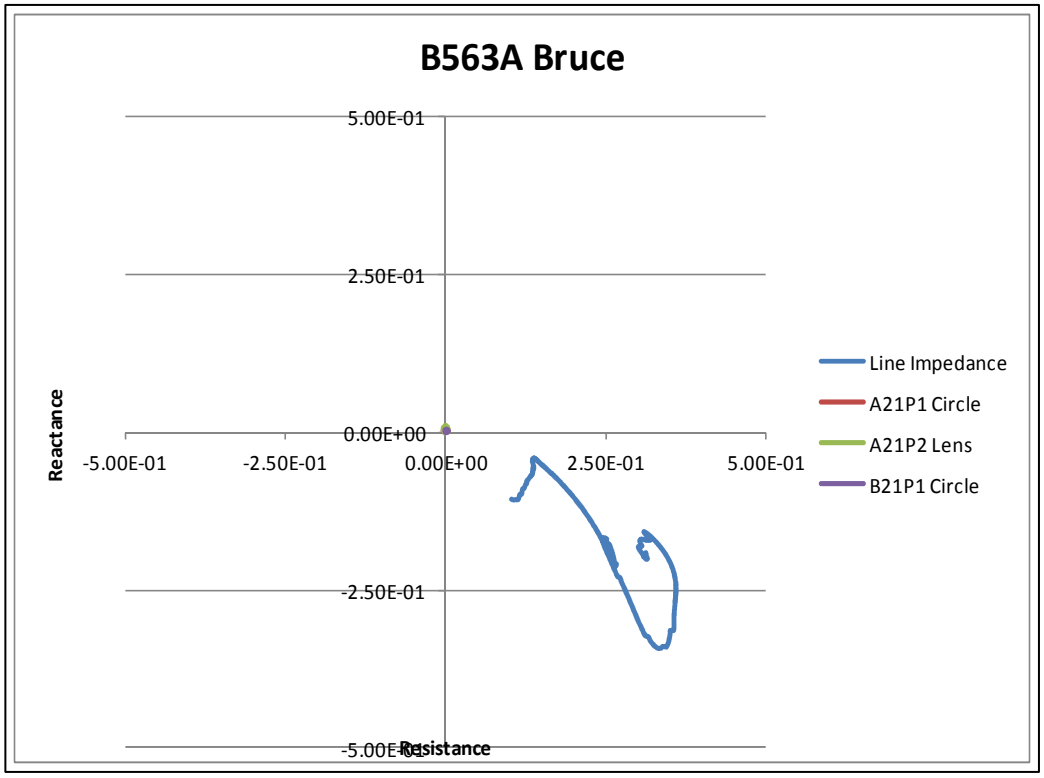


Figure 27 Impedance trajectory of B563A at Bruce TS following a 3 phase fault on circuit B562E at Bruce

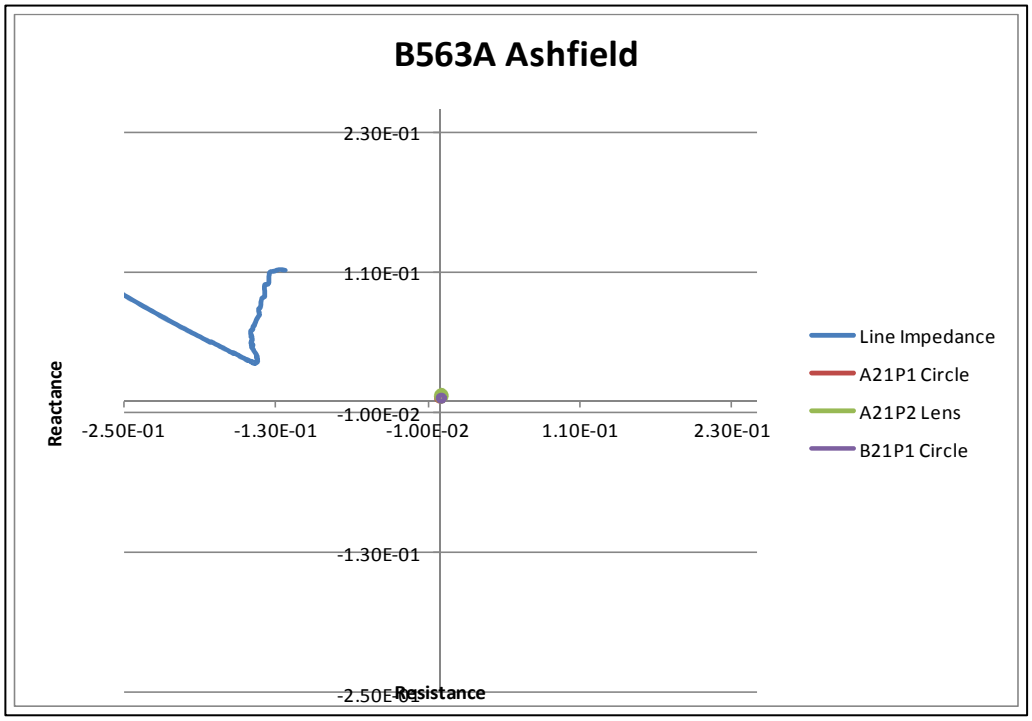


Figure 28 Impedance trajectory of B563A at Ashfield SS following a 3 phase fault on circuit B562E at Bruce

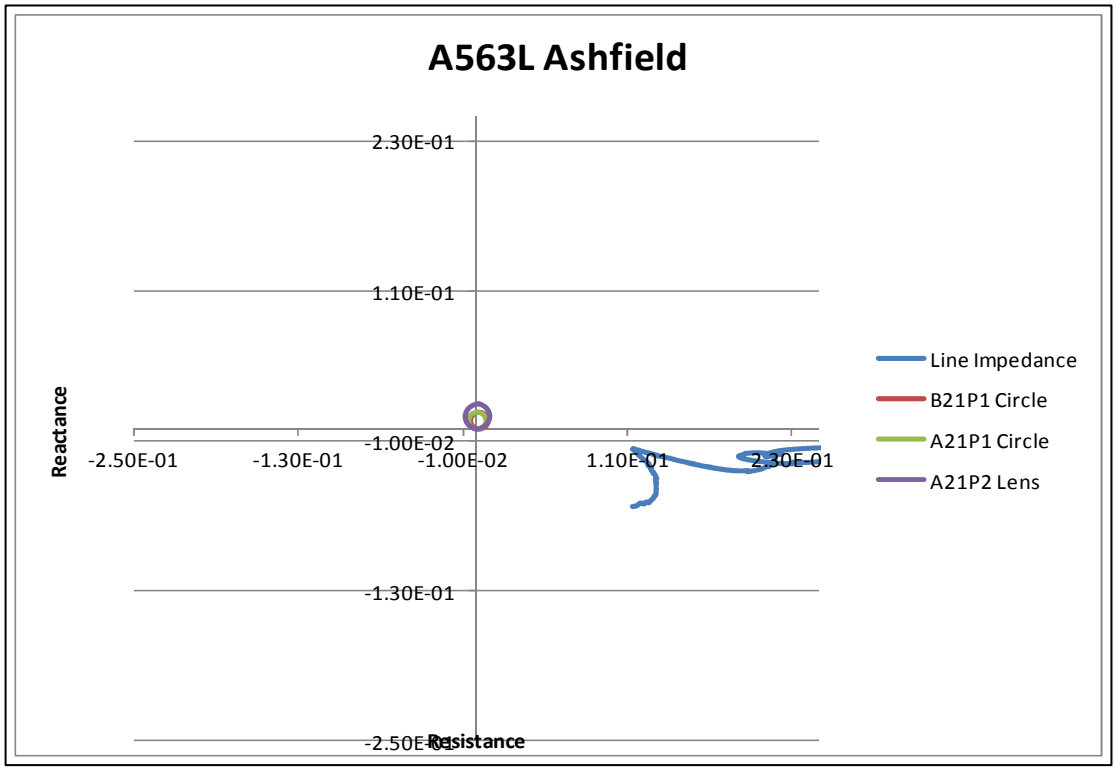


Figure 29 Impedance trajectory of A563L at Ashfield SS following a 3 phase fault on circuit B562E at Bruce

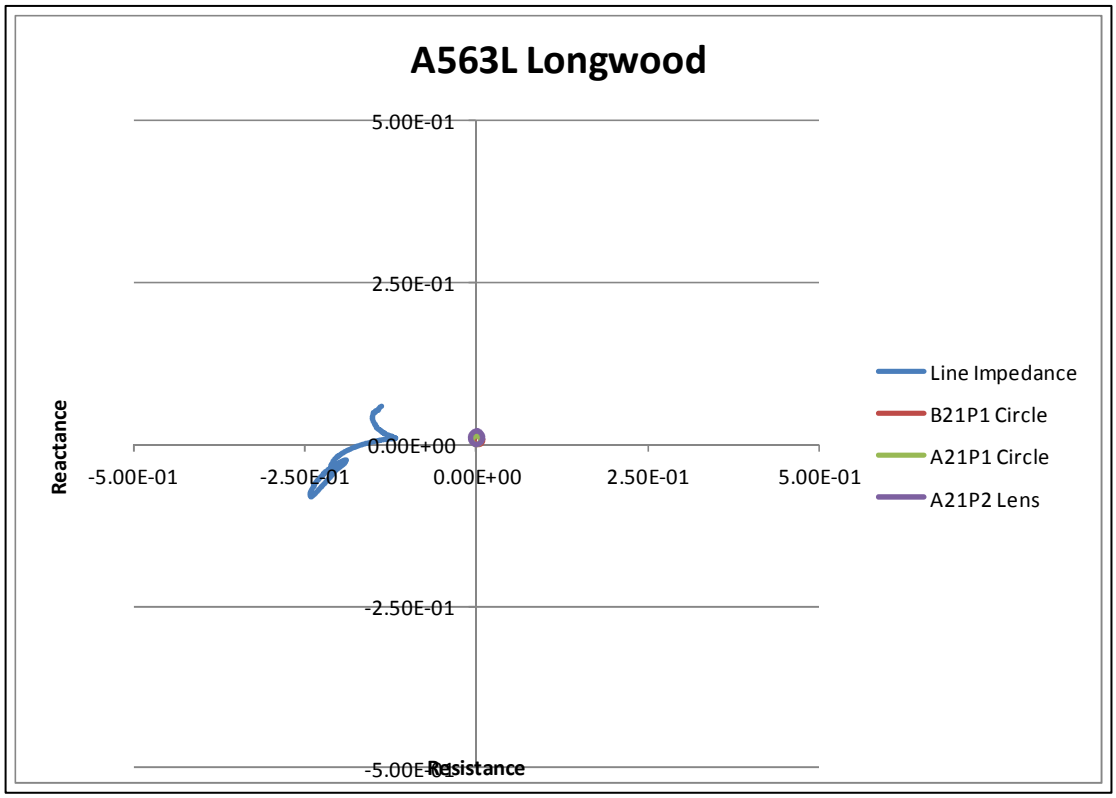


Figure 30 Impedance trajectory of A563L at Longwood TS following a 3 phase fault on circuit B562E at Bruce

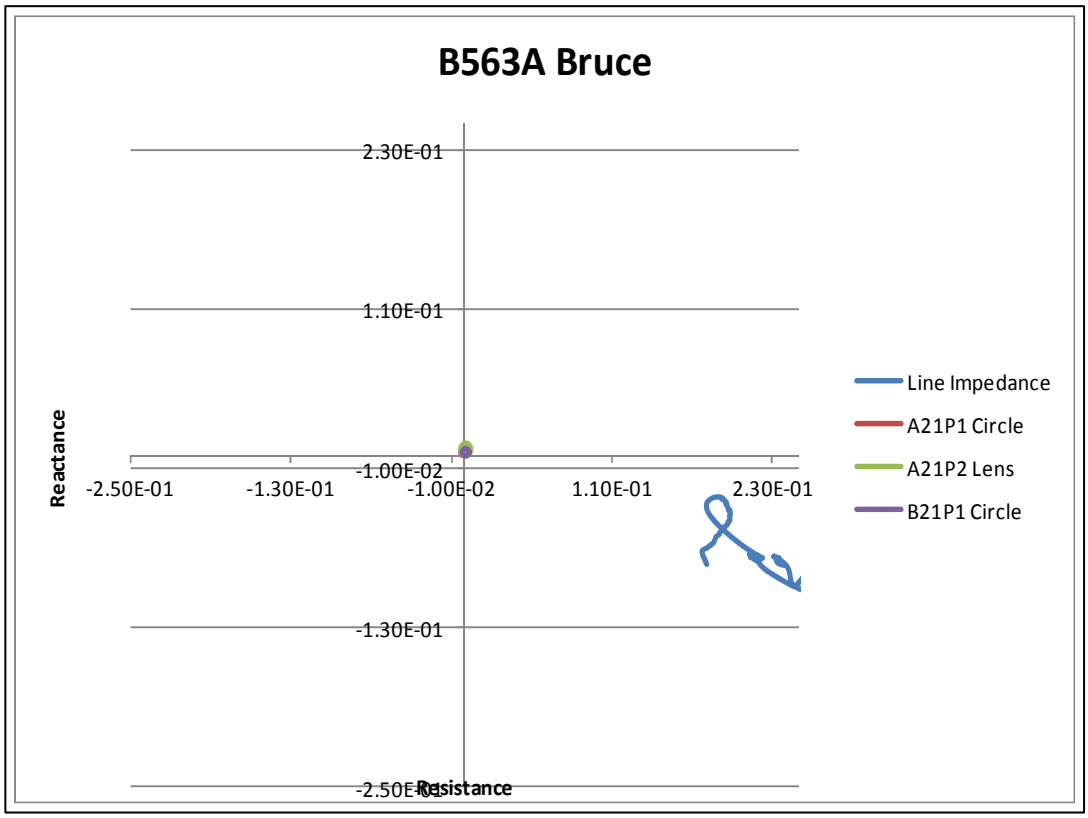


Figure 31 Impedance trajectory of B563A at Bruce TS following a 3 phase fault on circuit E562L at Longwood

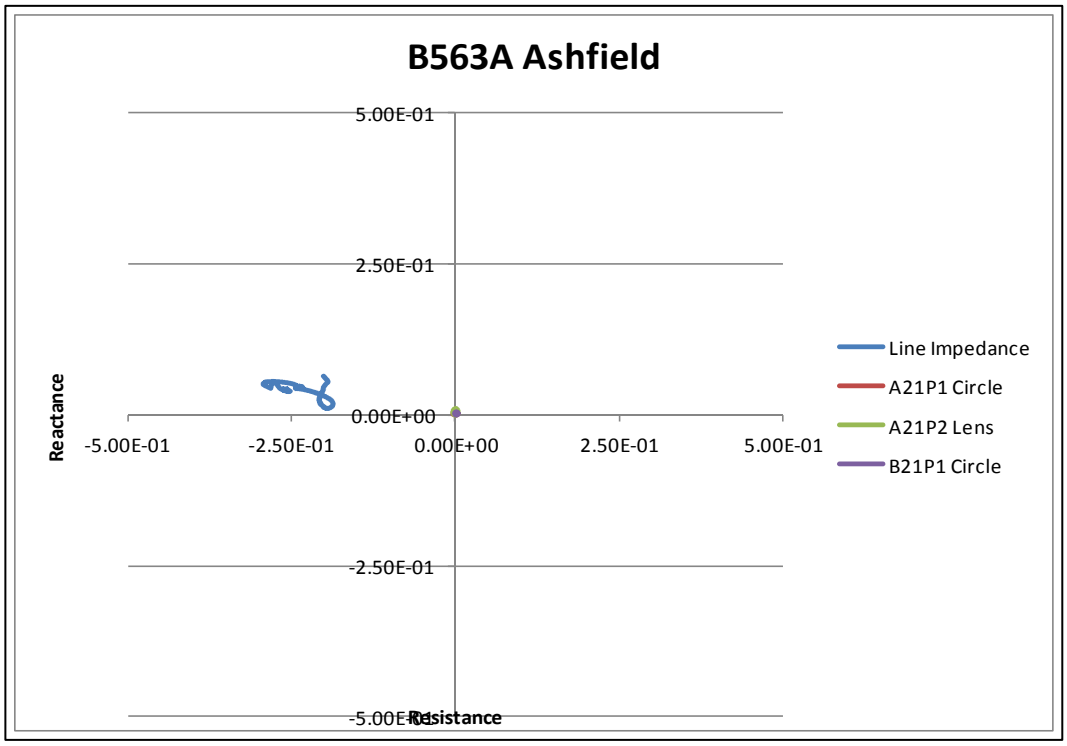


Figure 32 Impedance trajectory of B563A at Ashfield SS trajectory following a 3 phase fault on circuit E562L at Longwood

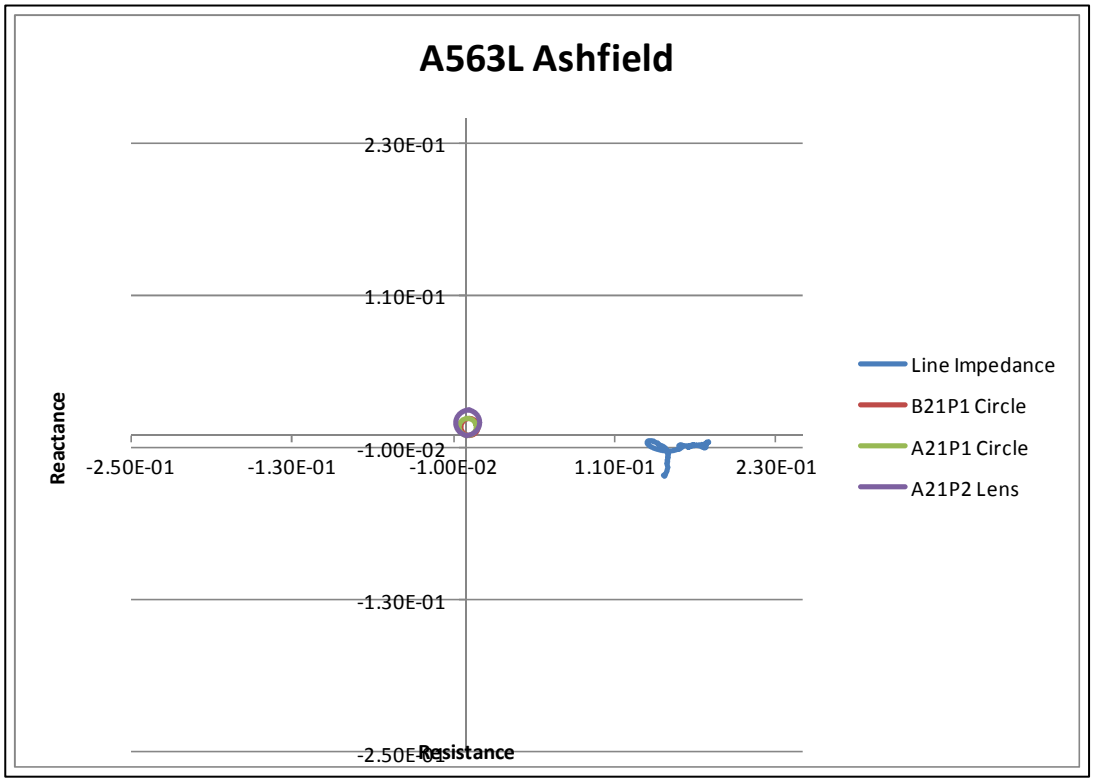


Figure 33 Impedance trajectory of A563L at Ashfield SS following a 3 phase fault on circuit E562L at Longwood

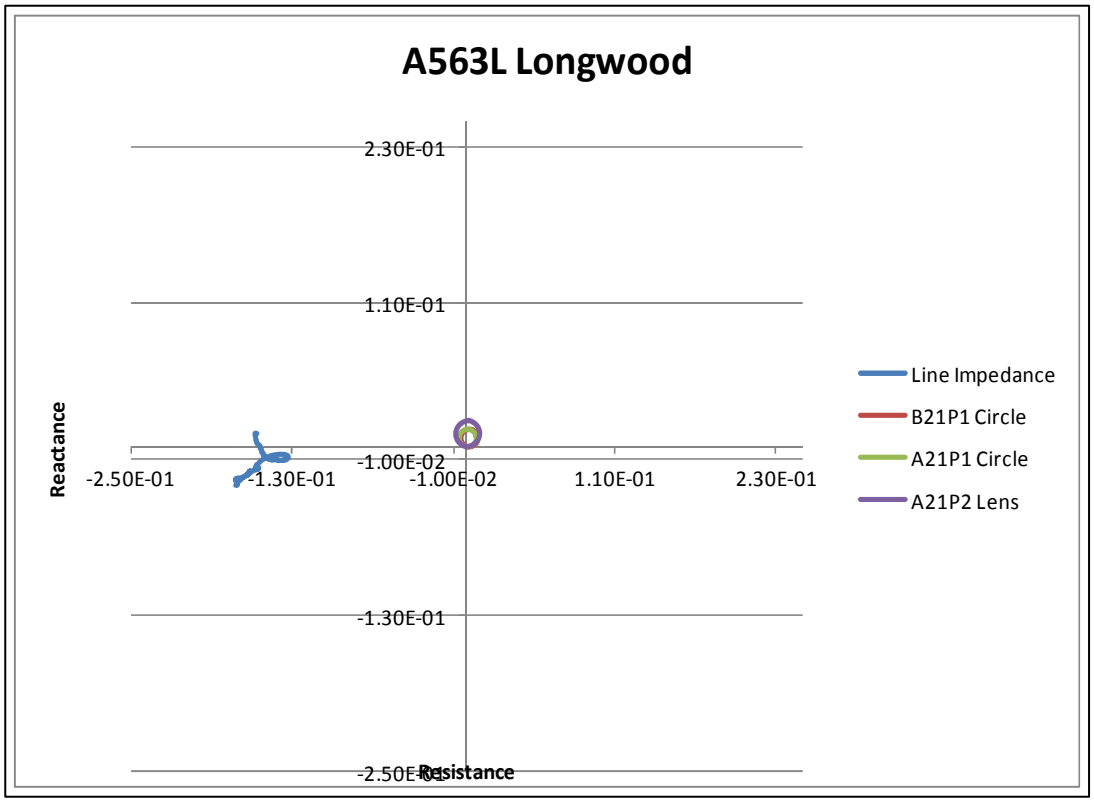


Figure 34 Impedance trajectory of A563L at Ashfield SS following a 3 phase fault on circuit E562L at Longwood

Appendix B: PIA Report

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

PROTECTION IMPACT ASSESSMENT

K2 WIND FARM PROJECT

270 MW WIND FARM GENERATION CONNECTION

Date: February 1, 2012
P&C Planning Group Project #: PCT-291-PIA

Prepared by

Hydro One Networks Inc.

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Disclaimer

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

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

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

Revision History

Revision	Date	Change
R0	October 5, 2011	First draft
R1	November 7, 2011	Change in requirements to address case of low infeed from the WF.
R2	February 1, 2012	Revised Figure 1. Revised the name of new HONI SS (to Ashfield SS).

EXECUTIVE SUMMARY

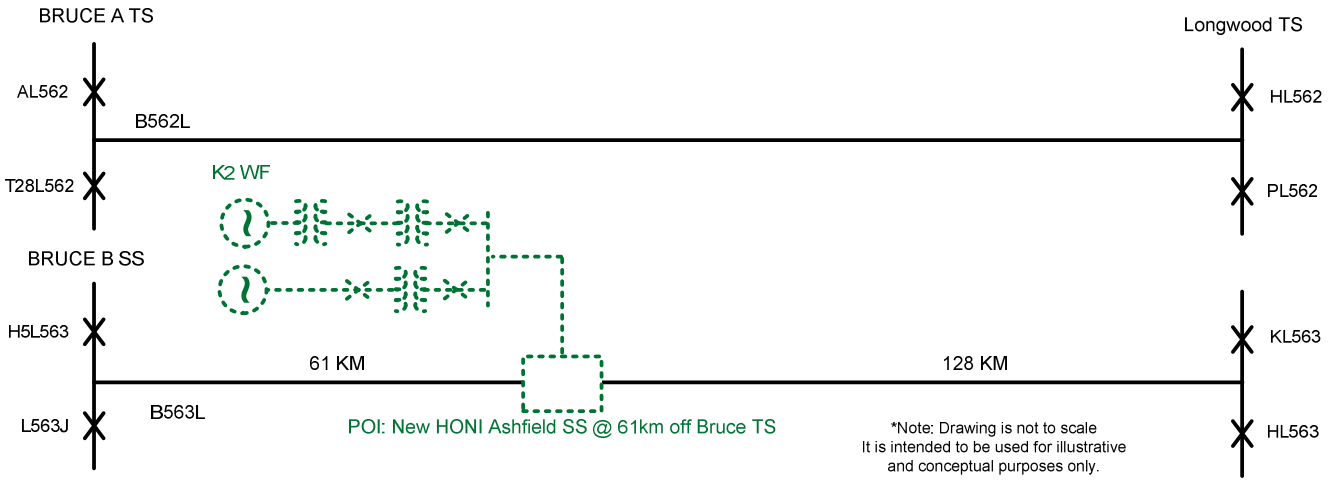

Figure 1: K2 WF Connection to HONI Transmission System

It is feasible for K2 to connect the proposed 270 MW generation project at the location shown in Figure 1.

LINE SECTIONALIZATION

Line B563L will be sectionalized by a ring bus at the location shown in Figure 1. Line segment between Bruce B SS and the New HONI SS (Ashfield SS) will be approximately 61 km. Line segment between Ashfield SS and Longwood TS will be approximately 128 km. It is recommended to protect both the new line segments by using a line distance scheme.

PROTECTION HARDWARE

The present relays at Bruce B SS and Longwood TS shall be upgraded to standard line distance relays meeting NPCC D4 separation requirements. This will trigger upgrading the 4 breaker (2 in each Bruce B SS and Longwood TS) failure protections, which will also be subject to NPCC requirements. New standard line protection relays will also have to be installed at Ashfield SS.

PROTECTION SETTINGS

Permissive Overreaching Schemes shall be implemented in both new line segments (previously part of B563L). New settings will be required for both Bruce B SS and Longwood TS as the new Ashfield SS sectionalizes the line.

For the case where one of the line segments is open and the infeed from the wind farm is low, if a fault occurs close to Ashfield SS it will not be seen by Ashfield SS due to low infeed nor by the terminal station Zone 1 due to the fault location being within only Zone 2 reach, resulting in potentially long fault clearing time (up to 400ms). This scenario will require implementation of a relay logic design for the weak infeed solution which will be elaborated in the planning document in preparation of the detailed design.

New settings will also be required for relays at Ashfield SS. Essentially, the protection over B563L will have to be modified to protect two new line segments.

TELECOMMUNICATIONS

The telecommunication media between Bruce B SS and Longwood TS are digital Microwave (Main) and PLC (alternate) in both 'A' and 'B' groups. New digital MW and PLC (main and alternate) facilities shall be installed at Ashfield SS in order to establish necessary connections for teleprotection. The links shall be established to both Bruce TS and Longwood TS.

In addition, the proponent is responsible for establishing the communication links ('A' & 'B' redundant and fully separated with geographic path diversity) to Ashfield SS. The proponent is also responsible for establishing the communication links to IESO and HONI control centers for SCADA.

K2 RESPONSIBILITIES

The customer shall be responsible to reliably disconnect their equipment for a fault within their system in case of a single contingency in their equipment. New protection hardware and settings shall be provided at Ashfield SS as described above. Teleprotection shall comply with the described above.

TAB G-3-1

CUSTOMER IMPACT ASSESSMENT REPORT

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

CUSTOMER IMPACT ASSESSMENT

K2 WIND

270 MW WIND TURBINE GENERATION CONNECTION

FINAL

Revision: 0

Date: February 24, 2012

Issued by: **Transmission System Development Division**
Hydro One Networks Inc.

Prepared by:

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Hydro One Networks Inc.

Reviewed by:

John Sabiston, P.Eng
Manager, Transmission Planning
Transmission System Development
Hydro One Networks Inc.

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Disclaimer

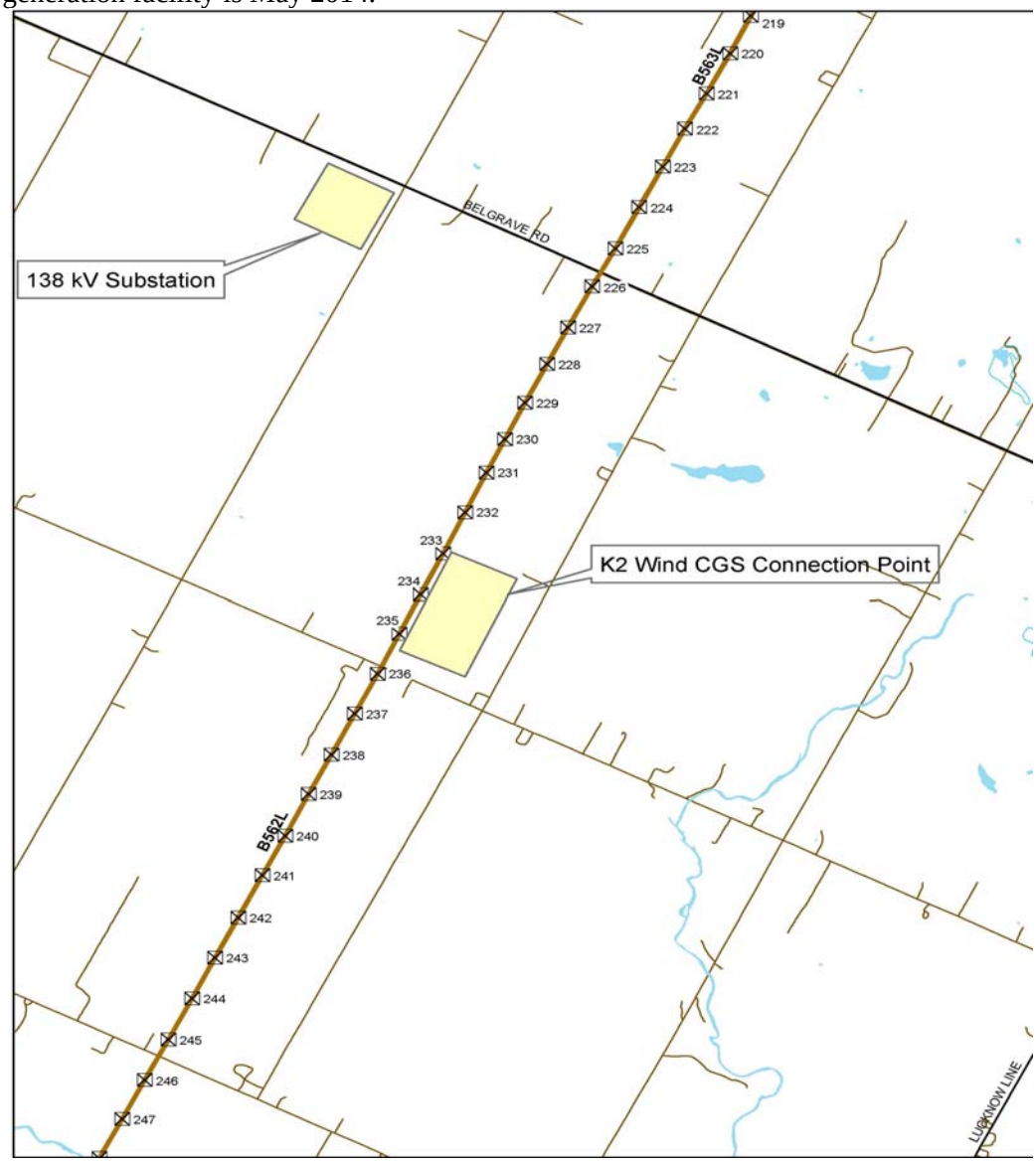
This Customer Impact Assessment was prepared based on information available about the connection of the proposed K2 Wind Ontario L.P. – K2 Wind project. It is intended to highlight significant impacts, if any, to affected transmission customers early in the project development process and thus allow an opportunity for these parties to bring forward any concerns that they may have. Subsequent changes to the required modifications or the implementation plan may affect the impacts of the proposed connection identified in Customer Impact Assessment. The results of this Customer Impact Assessment are also subject to change to accommodate the requirements of the IESO and other regulatory or municipal authority requirements.

Hydro One shall not be liable to any third party which uses the results of the Customer Impact Assessment under any circumstances whatsoever for any indirect or consequential damages, loss of profit or revenues, business interruption losses, loss of contract or loss of goodwill, special damages, punitive or exemplary damages, whether any of the said liability, loss or damages arises in contract, tort or otherwise. Any liability that Hydro One may have to K2 Wind in respect of the Customer Impact Assessment is governed by the Agreement between K2 Wind Ontario L.P. and Hydro One dated December 7, 2011.

CUSTOMER IMPACT ASSESSMENT
K2 WIND
270 MW WIND TURBINE GENERATION CONNECTION

1.0 INTRODUCTION

K2 Wind Ontario L.P. is to develop a 270 MW wind energy generation facility. The wind energy facility, known as K2 Wind, will be constructed in the Municipalities of Ashfield-Colborne and Wawanosh, Ontario. The interconnection station to Hydro One will be located in the Municipality of Ashfield. K2 Wind is proposing to connect to Hydro One's transmission system through two new step-up transformers via a new 500 kV switching station that will sectionalize circuit B563L, approximately 61.5 km from Bruce B SS. The switching station will be called Ashfield Switching Station (SS). Ashfield SS interconnection station will be located just east and adjacent to Hydro One's B562/563L Right-Of-Way (ROW) as shown in Map 1. The earliest expected in-service date of the generation facility is May 2014.



Map 1: K2 Wind connection to Hydro One's Network (circuit B563L is on the East side of the ROW)

In accordance with section 6 of the Ontario Energy Board's Transmission System Code, Hydro One Networks Inc (Hydro One) is to carry out a Customer Impact Assessment (CIA) study to assess the impact of the proposed generator connection on existing customers in the affected area.

A Draft version of this report was issued to potentially impacted customers on January 19, 2012. All applicable comments received were incorporated into this report.

This study does not evaluate the overall impact of the K2 Wind project on the bulk electricity system. The impact of the new generator on the bulk electricity system is the subject of the System Impact Assessment (SIA) issued by the Independent Electricity System Operator (IESO).

The study does not evaluate the impact of the K2 Wind project on the network Protection and Control facilities. Protection and Control aspects are reviewed during the Protection Impact Assessment, which is part of the SIA. Protection and Control aspects are again reviewed, in detail, during the preparation of the connection cost estimate and will be reflected in the Connection and Cost Recovery Agreement.

1.2 Proposed Connection: K2 Wind

1.2.1 Wind Farm

The proposed K2 Wind project consists of 142 Siemens 2.3 MW Wind Turbine Generators (WTG). The maximum output of the WTG will be curtailed to a total generation output capability of 270 MW. Appendix A, Figures 1 & 2 shows an overview of the proposed connection arrangement.

The K2 Wind project consists of 10 groups of eleven to sixteen WTG. Each group of wind turbines is placed on a 34.5 kV feeder. Each feeder is protected by a circuit breaker before connecting onto a 34.5 kV bus at either K2 Wind Customer Generation Station (CGS) or the intermediate 138 kV substation.

Five 34.5 kV feeders will connect onto a 34.5 kV bus at K2 Wind CGS while the other five feeders will connect onto a 34.5 kV bus at the intermediate 138 kV substation. At the 138 kV substation, the power will be transformed to 138 kV via one 138/34.5 kV, 96/128/160 MVA transformer. From the 138 kV substation, a new 5.1 km, customer-owned 138 kV underground cable will connect into K2 Wind CGS.

At K2 Wind CGS the power will be transformed to 500 kV via two transformers: (1) 530/34.5 kV, 105/140/175 MVA transformer and (2) 530/138 kV, 96/128/160 MVA transformer. The 500 kV bus at K2 Wind CGS will connect to a new Hydro One 500 kV switching station to be named Ashfield SS. Please see Appendix A, Figure 3.

The wind farm's dynamic Var compensation is provided via their Siemens 2.3 MW WTG. The WTG are designed to supply or absorb reactive power to or from the transmission grid to regulate and stabilize the voltage. In addition, it was determined in the System Impact Assessment that this project is slightly deficient in static VAr compensation. A shunt capacitor bank rated 7 MVAr at 34.5 kV located at the K2 Wind 138 kV substation was utilized in this Customer Impact Assessment. Although a shunt capacitor is not specifically required, the generator must be able to confirm its reactive capability meets the IESO market rule requirement during commission tests.

1.2.2 Connection to Hydro One's 500 kV Transmission System

K2 Wind will connect its generated power via 500 kV Hydro One owned interconnection station called Ashfield SS. The K2 Wind CGS 530/34.5 kV and 530/138 kV transformers will connect via 2-500 kV breakers and 3 motorized disconnect switches onto a 500 kV ring bus at Ashfield SS, Appendix A, Figure 3. This ring bus will split Hydro One's existing 500 kV circuit B563L from Bruce B SS to Longwood TS into 2 sections: Bruce B SS x Ashfield SS and Ashfield SS x Longwood TS. This sectionalizing will occur approximately 61.5 km from Bruce B SS, near tower numbers 234 and 235 of existing B563L. Both Ashfield SS and K2 Wind CGS will be adjacent or as close as possible to Hydro One's existing ROW to limit the additional exposure to Hydro One's 500 kV system. In addition, it was determined in the System Impact Assessment that this project will require a shunt reactor to be located at Ashfield SS to limit overvoltage during certain system configurations. It was also determined that the reactor and the generator must not both be lost upon a single contingency.

1.3 Customers in the Study Area

The primary focus of this study was on customers supplied from stations directly connected to existing circuit B563L and in the local area. Affected customers are show in Table 1.

Table 1: Transmission customers connected in the study area

Station	Customer
Bruce A TS	Bruce Power L.P.
Bruce B SS	Bruce Power L.P.
Bruce Heavy Water Plant B TS	Bruce Power L.P.
Douglas Point TS	Hydro One Networks Inc. (Distribution) Westario Power Inc.
Longwood TS	Hydro One Networks Inc. (Distribution) Middlesex Power Distribution Corp.

2.0 METHODOLOGY & CRITERIA

2.1 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. Two relevant aspects of Power System Analysis were used for this assessment, namely:

a. Load Flow Studies: An AC load flow program was used to set up a base case with K2 Wind.

b. Short-Circuit Studies: A Short Circuit Analysis program was used to determine the impact of K2 Wind on customers at their points of connection to Hydro One.

2.2 Study Assumptions

Summer 2014 conditions were assumed in this study, along with the following assumptions.

- Load Data – study area demand scaled to its 2014 peak & operating at historical power factors
- Transmission Data – all transmission system elements in-service; new Bruce x Milton double circuit line in-service; Nanticoke TS & Detweiler TS SVC's in-service
- Generation Data – all new committed embedded and transmission connected renewable generation as part of the Feed-In-Tariff (FIT) program including Samsung phase 1, 2 and 3 projects; all 8 Bruce GS units in-service; all existing Bruce area wind at 100% rating output.

Note: Load flow base cases provided by IESO

2.3 Planning Criteria

2.3.1 Voltage Limitations

To establish the adequacy of Hydro One transmission system for the incorporation of the proposed K2 Wind generation facilities, the following post-fault voltage criteria were applied. As per "IESO Ontario Resource and Transmission Assessment Criteria", Issue 5.0 (ORTAC)

http://www.ieso.ca/imoweb/pubs/marketAdmin/IMO_REQ_0041_TransmissionAssessmentCriteria.pdf

- The loss of a single power system element 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 or 2nd power system element 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) ;
- Voltages below 50 kV shall be maintained in accordance with Canadian Standard Association document CAN-3-C235-83.

2.3.2 Short Circuit Limitations

Appendix 2 of the Transmission System Code (TSC) specifies the maximum symmetrical three phase and single line to ground short circuit levels. These limits are summarized in Table 2. Short circuit levels were compared to the TSC limits and also to existing breaker ratings at effected stations to ensure equipment capability.

Table 2: Transmission System Code Symmetrical Short Circuit Limits

Nominal Voltage (kV)	Max. 3 Phase Fault (kA)	Max. SLG Fault (kA)
500	80(1)	80(1)
230	63	80(1)
115	50	50
44	20(3)	19(2,3)
27.6 (4-wire)	17(3)	12(3)
27.6 (3-wire)	17(3)	0.45(3)
13.8	21(3)	10(3)

Notes:

(1) Usually limited to 63kA

(2) Usually limited to 8 kA

(3) 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 un-modeled synchronous motors and data inaccuracies.

In order to reflect realistic operating conditions, short circuit studies are run assuming the following conditions:

- Base case assumes existing & committed generating facilities in-service.
- Pre-fault voltage of 550.00 kV at 500 kV stations
- Pre-fault voltage of 250.00 kV at 220 kV stations
- Pre-fault voltage of 127.00 kV at 115 kV stations
- Pre-fault voltage of 46.00 kV at 44 kV stations
- Pre-fault voltage of 29.00 kV at 27.6 kV stations
- Pre-fault voltage of 14.2 kV at 13.8 kV stations

2.4 Operating Conditions

Normal operating conditions are such that K2 Wind will solely generate onto sectionalized circuit B563L (into Ashfield SS). When K2 Wind 500 kV transformer breakers T10B0 and T20B0 that connect to the 500 kV ring bus at Ashfield SS are taken out service, K2 Wind will not generate onto Hydro One's systems, transmission nor distribution.

3.0 SHORT CIRCUIT RESULTS

Short-circuit studies were carried out to assess the fault contribution when the 270 MW K2 Wind generating facility is connected and generating into Ashfield SS.

The study results are summarized in Tables 3 and 4 below showing both symmetric and asymmetric fault currents in kA, respectively. The anticipated fault levels after the incorporation of all committed and proposed generation in the Bruce area are shown in Table 5.

Table 3: K2 Wind impact on symmetrical fault levels

Station	Sym. Fault Level without K2 Wind* (kA)		Sym. Fault Level with K2 Wind (kA)		% Difference	
	3-Phase	L-G	3-Phase	L-G	3-Phase	L-G
Bruce B SS 500 kV	36.96	41.58	37.29	42.05	0.89	1.13
Bruce A TS 500 kV	37.17	41.76	37.47	42.12	0.81	0.86
Bruce A TS 230 kV	42.96	54.36	43.08	54.50	0.28	0.26
BHWP B TS 13.8 kV A	19.77	1.98	19.77	1.98	0.00	0.00
BHWP B TS 13.8 kV B	19.75	1.98	19.75	1.98	0.00	0.00
Douglas Point TS 44 kV	14.37	6.89	14.38	6.89	0.07	0.00
Longwood TS 500 kV	20.05	20.96	20.20	21.13	0.75	0.81
Longwood TS 230 kV	37.36	44.74	37.60	45.02	0.64	0.63
Longwood TS 27.6 kV	15.41	10.79	15.42	10.79	0.06	0.00

* Includes existing and committed generation projects up to the award of FIT3 and Samsung Phase 2 & 3 contracts

Table 4: K2 Wind impact on asymmetrical fault levels

Station	Asym. Fault Level without K2 Wind* (kA)		Asym. Fault Level with K2 Wind (kA)		% Difference	
	3-Phase	L-G	3-Phase	L-G	3-Phase	L-G
Bruce B SS 500 kV	54.32	63.67	54.79	64.22	0.87	0.86
Bruce A TS 500 kV	54.46	63.20	54.88	63.70	0.77	0.79
Bruce A TS 230 kV	57.64	**78.44**	57.79	**78.62**	0.26	0.23
BHWP B TS 13.8 kV A	23.04	1.98	23.04	1.98	0.00	0.00
BHWP B TS 13.8 kV B	22.33	1.98	22.34	1.98	0.04	0.00
Douglas Point TS 44 kV	16.34	8.83	16.35	8.83	0.06	0.00
Longwood TS 500 kV	24.37	26.68	24.56	26.90	0.78	0.82
Longwood TS 230 kV	45.71	57.94	46.02	58.31	0.68	0.64
Longwood TS 27.6 kV	21.54	15.67	21.56	15.67	0.09	0.00

*Includes existing and committed generation projects up to the award of FIT3 and Samsung Phase 2 & 3 contracts

Table 5: Anticipated Fault Levels Resulting from FIT3 and Samsung Phase 2 & 3 contracts*

Station	Symmetrical Fault Level (kA)		Asymmetrical Fault Level (kA)	
	3-Phase	L-G	3-Phase	L-G
Bruce B SS 500 kV	38.01	42.67	55.80	65.09
Bruce A TS 500 kV	38.27	42.82	56.01	64.68
Bruce A TS 230 kV	44.64	56.16	59.74	**80.83**
BHWP B TS 13.8 kV A	19.80	1.98	23.07	1.98
BHWP B TS 13.8 kV B	19.79	1.98	22.37	1.98
Douglas Point TS 44 kV	14.93	6.98	17.02	8.95
Longwood TS 500 kV	21.06	22.32	25.73	28.46
Longwood TS 230 kV	38.70	46.44	47.63	60.38
Longwood TS 27.6 kV	15.45	10.80	21.61	15.70

*Includes existing, committed and proposed generation projects in the Bruce Transmission Area as per applications received by October 2011

Observations made from the short-circuit study results in Tables 3 & 4 above may be summarized as follows:

- Table 3 shows that fault levels are below the maximum symmetrical three-phase and single line-to-ground fault values set out in Appendix 2 of the *Transmission System Code* (TSC).

- Table 3 shows that although there is a 1.13 % increase in the symmetrical short-circuit level at Bruce B SS 500 kV bus, the fault levels are well below the allowable 500 kV fault limits and are acceptable to Hydro One.

- Table 4 shows that although there is a 0.87% increase in the asymmetrical short-circuit level at Bruce B SS 500 kV bus, the fault levels are within Hydro One's asymmetrical breaker ratings** and are acceptable to Hydro One.

It can be observed from Table 5 that the anticipated fault levels at the stations shown are below the maximum symmetrical three-phase and single line-to-ground fault values set out in Appendix 2 of the TSC. In addition, with the exception of Bruce A TS 230 kV bus**, the anticipated fault levels are within Hydro One's breaker ratings.

**Note: The asymmetrical fault current at Bruce A 230 kV before and after the incorporation of the projects will exceed the interrupting capability of the existing breakers. To address this issue in the long term, Hydro One has planned to replace the Bruce 230 kV breakers to improve fault current interrupting capability. Before the circuit breakers are replaced, temporary operational mitigation measures have been developed by Hydro One in collaboration with the IESO. K2 Wind has no impact on this issue.

Conclusion

The short-circuit level increases at Bruce A TS, Bruce B SS, BHWP B TS, Douglas Point TS and Longwood TS are acceptable to Hydro One and are below Hydro One's 5 % TSC margin limit.

4.0 VOLTAGE ANALYSIS

Load flow studies were carried out to analyze the impact of the new facilities on the voltage performance of Hydro One customers in the affected area.

Local voltage impact was assessed using load flow contingency analysis. The incorporation of K2 Wind at full output was used to assess voltage change during peak summer loading conditions.

The following contingencies were used to assess the voltage impact:

a) A single contingency loss of K2 Wind generation
b) A single contingency loss of Bruce B SS x Ashfield SS 500 kV circuit
c) A single contingency loss of Ashfield SS x Longwood TS 500 kV circuit
d) A double contingency loss of Ashfield SS x Longwood TS circuit and K2 Wind generation (due to Breaker Failure B/F), with Evergreen SS x Longwood TS 500 kV circuit out of service pre-contingency
e) A double contingency loss of Bruce B SS x Ashfield SS circuit and K2 Wind generation (due to Breaker Failure B/F), with Bruce A TS x Evergreen SS 500 kV circuit out of service pre-contingency

Basic Assumptions:

- New 500 kV switching station Evergreen SS will sectionalize companion circuit B562L approximately 36.5 km from Longwood TS to incorporate another wind energy project known as Adelaide/Bornish/Jericho Wind Energy Centre(s)/Cedar Point Wind Power Project.
- A shunt reactor will be installed at Ashfield SS to control post-contingency voltages as per the IESO System Impact Assessment requirement hence a 120 MVAr at 500 kV shunt reactor was used in this study.
- This generation project is slightly deficient in static VAr compensation as per the IESO System Impact Assessment hence a 7 MVAr at 34.5 kV shunt capacitor located at the K2 Wind intermediate 138 kV substation was used in this study.
- ULTC – Under Load Tap Changer
- For the period of time labeled "After ULTC", the switching of reactive devices such as reactors and capacitors is implemented.

Results are shown in Appendix A, Tables 1 – 5 and summarized below:

- Table A1: For the loss of the proposed generator the maximum voltage change is 0.40% at Ashfield SS 500 kV bus before ULTC operation and is -0.50% at Ashfield SS 500 kV bus after ULTC operation. Note the voltage at the Ashfield SS 500 kV bus will exceed the maximum voltage of 550 kV as per the ORTAC. To mitigate this, the shunt reactor is expected to be switched into service automatically upon detection of voltages greater than 550 kV.

- Table A2: For the loss the 500 kV circuit between Bruce B SS and Ashfield SS the maximum voltage change is -0.13% at Bruce B SS 500 kV bus before ULTC operation and is -0.13% at Bruce B SS 500 kV bus after ULTC operation.

- Table A3: For the loss of the 500 kV circuit between Ashfield SS and Longwood TS, the maximum voltage change is -0.99% at Longwood TS 500 kV bus before ULTC operation and is -1.33% at Longwood TS 500 kV bus after ULTC operation.

- Table A4: Given the 500 kV circuit from Evergreen SS to Longwood TS is out of service, for the loss of the 500 kV circuit between Ashfield SS and Longwood TS with a breaker failure at Ashfield SS which disconnects the wind farm, the maximum voltage change is -2.43% at Longwood TS 500 kV bus before ULTC operation and is -3.94% at Longwood TS 500 kV bus after ULTC operation.

- Table B5: Given the 500 kV circuit from Bruce A TS to Evergreen SS is out of service, for the loss of the 500 kV circuit between Bruce B SS and Ashfield SS with a breaker failure at Ashfield SS which disconnects the wind farm, the maximum voltage change is -0.76% at Ashfield SS 500 kV bus before ULTC operation and is -0.61% at Ashfield SS 500 kV bus after ULTC operation.

Conclusion
Load flow studies thus confirmed that the incorporation of 270 MW of wind generation between Bruce B SS and Longwood TS will not result in substantial change in the voltage profile of customers supplied from these stations and in the local electrical area. Following the worst contingency, the voltage changes are well within the voltage decline guideline for customer buses of less than 10% and 5% voltage change before- and after- transformer tap-changer operation. Note the voltage level at Ashfield SS is highly dependent on the connection of the wind turbine generators as they stabilize the 500 kV station voltage within the maximum permissible voltage level. When the wind farm is unavailable (disconnected from Ashfield SS), mitigation measures such as a shunt reactor are required.

5.0 TRANSMITTER REQUIREMENTS

BACKGROUND ON FERRORESONANCE

In general, ferroresonance is defined as an electrical oscillation between system capacitance (as offered by a transmission line/cable) and non-linear inductance (transformer magnetizing branch). More specifically, ferroresonance is a term to describe electrical resonance in a circuit which includes a saturating magnetic device (i.e. a transformer or magnetic potential transformer).

The criteria for ferroresonance to be possible on an isolated section of the transmission system includes:

a) An iron core device (i.e. power transformer, autotransformer, potential transformer) not shunted by a low impedance such as a load or a ground source

b) Circuit capacitance, as required to establish electric resonance in an otherwise inductive circuit. The capacitance may be in series, or in parallel with the non-linear inductance representing an iron-cored device. An un-energized transmission circuit on a double circuit transmission line that is in close proximity to a live circuit can provide this capacitance.

c) An adequate energy source, in order for ferroresonance to be sustained, capable of supplying sufficient power to overcome losses. The amount of energy is dependent on the distance of the coupling. Ferroresonance has been observed on double circuit transmission lines as short as 13.5 km.

Ferroresonance cannot be established as long as the (iron) core of the magnetic device does not saturate. Ferroresonance is frequently associated with one or more open conductors. Typically, a disturbance involving a switching operation on a device is required to saturate the core, possibly initiating ferroresonance, providing the criteria listed above are satisfied.

Initially, the onset of ferroresonance may be associated with large transient voltages. Consequences include an increased personnel safety hazard and possible apparatus failure (e.g. circuit breaker) due to extreme dielectric stress.

If a sustained ferroresonant condition is established, the core of the magnetic device saturates repeatedly, causing core overheating. Permanent thermal damage may result to the core laminations and to winding insulation. Another consequence of ferroresonance could be damage to the transmitter's circuit breakers and other equipment at either terminal station (e.g. Bruce B SS and Longwood TS) requiring an extended outage to replace equipment which could then result in congestion. For this reason, ferroresonance must be mitigated.

Helpful online references include:

http://www.ece.mtu.edu/faculty/bamork/FR_WG/Panel/paper03gm0984.pdf
http://www.studiecd.dk/cahiers_techniques/Ferroresonance.pdf

MITIGATION PLAN

It is expected that the K2 Wind 500 kV interconnection transformers could be subjected to a ferroresonance configuration. The most prominent configuration is shown in Figure 4 of Appendix A. Referring to the scenario shown in Figure 4, if a 500 kV interconnection breaker is not provided for the K2 Wind 500 kV transformers, a breaker failure at the Hydro One interconnection point would result in the generator's transformers "dangling" in series with a capacitive circuit.

To mitigate the occurrence of a ferroresonant condition, at least one 500 kV breaker is required between the generator's interconnection transformers at K2 Wind CGS and the connection to Hydro One, specially, Ashfield SS. In the case of K2 Wind, their proposed connection arrangement shown in Figures 1 of Appendix A includes the additional breaker(s) (one breaker for each transformer) and no extra breakers are required for ferroresonant mitigation. Figure 3 of Appendix A highlights these additional breakers.

6.0 CONNECTION RELIABILITY

The incorporation of the new generator facilities will add a new 500 kV switching station named Ashfield SS that will sectionalize existing 500 kV circuit B563L from Bruce B SS to Longwood TS into two new circuits, Bruce B SS x Ashfield SS and Ashfield SS x Longwood TS. The sectionalizing of the existing circuit reduces the impact on connection reliability for the existing transmission customers and provides optimal connection reliability for the new generator customer.

The switching station will contain a 4-breaker ring bus thus providing the new generator customer and the shunt reactor with their own switching position. This will optimize the reliability for the generator by enabling it to generate while one of the line sections is out of service and avoid the simultaneous loss of both the generator and the reactor for a single contingency. With respect to power system protection, the use of a sectionalizing station to connect the generator will have no impact to the reliability and speed of the protection systems.

The new generator customer will add one very short 500 kV line tap from their motorized disconnect switch inside K2 Wind CGS to the new Ashfield SS. The additional circuit exposure is very small and is not expected to materially reduce the performance of Hydro One's system.

7.0 PRELIMINARY OUTAGE IMPACT ASSESSMENT

The work required to connect K2 Wind to circuit B563L will involve outages to this circuit and possibly the companion circuit, B562L. These outages will be coordinated with existing transmission customers. These outages will be identified when a detailed construction schedule is established in consultation with K2 Wind Ontario L.P. during the detailed engineering phases of the project development.

It is expected that the construction of the new 500 kV Bruce by Milton circuits will be completed before the new generator is connected, and therefore outages to circuits from the Bruce by Longwood station will be less impactive.

In addition, there is no expected outage associated with the construction/installation of the new wind turbine units.

7.0 CONCLUSIONS AND RECOMMENDATIONS

This Customer Impact Assessment (CIA) presents results of short-circuit and voltage performance study analyses. The report has confirmed that K2 Wind can be incorporated without adverse impact on customers supplied from Bruce B SS and Longwood TS and in the local electrical area provided that the required facilities are installed. In addition to the facilities required by the IESO by issue of the SIA, K2 Wind is required to install the following facilities as part of their connection:

- A Transfer Trip (T/T) scheme to ensure fault clearance if K2 Wind exhibits breaker failure of their 500 kV transformer breakers.
- Fully duplicated protection and telecommunication systems must be installed as outlined in the Transmission System Code.
- SCADA facilities to allow transmission of generation facility components: i.e. status, measurement quantities & alarms, as outlined in the IESO's SIA and Hydro One's planning specification for the connection of K2 Wind.
- The 500 kV 4-breaker ring bus connection arrangement is acceptable to Hydro One however; space must be allocated within the new Ashfield SS such that the 4-breaker ring bus can be expanded to an 8-breaker ring bus to sectionalized companion circuit B562L if required.
- The installation of at least one 500 kV interconnection breaker between the high voltage terminal of the K2 Wind 500 kV interconnection transformers and its connection to Ashfield SS to mitigate the occurrence of a ferroresonant condition. The proposed two 500 kV breakers at K2 Wind CGS meet this requirement.
- The installation of a shunt reactor at Ashfield SS to mitigate over voltage conditions. The reactor would control voltage by automatically switching in service upon detection of a high voltage condition. Alternate solutions to mitigate or manage the high voltage concern may be acceptable upon the approval of Hydro One and the IESO.

Facilities to permit the above work must be provided.

All customers are required to check to ensure that the equipment and grounding system at their stations/facilities meet the expected increase in fault level.

APPENDIX A:

VOLTAGE PERFORMANCE RESULTS

Table 1: Loss of K2 Wind

Bus	Initial Voltage (kV)	Before ULTC (kV)	% Change	After ULTC (kV)	% Change
Bruce A TS 500 kV	548.28	549.03	0.14	548.05	-0.04
Bruce A TS 230 kV	247.14	247.33	0.08	247.09	-0.02
Bruce B SS 500 kV	549.00	549.81	0.15	548.72	-0.05
BHWP B TS 13.8 kV A bus	14.53	14.54	0.08	14.53	-0.02
BHWP B TS 13.8 kV B bus	14.52	14.53	0.08	14.51	-0.02
Douglas Point TS 44 kV	46.13	46.17	0.08	46.12	-0.02
Ashfield SS 500 kV	550.00	552.20**	0.40	547.26*	-0.50
Longwood TS 500 kV	546.14	546.29	0.03	544.07	-0.38
Longwood TS 230 kV	245.01	244.67	-0.14	246.06	0.43
Longwood TS 27.6 kV	29.06	29.02	-0.15	29.19	0.44

* The 120 MVAr shunt reactor was switched into service to lower the voltage below 550 kV
** When implemented, the reactor is expected to be switched into service automatically upon detection of voltages that exceed 550 kV (maximum permissible voltage)

Table 2: Loss of Bruce B SS x Ashfield SS

Bus	Initial Voltage (kV)	Before ULTC (kV)	% Change	After ULTC (kV)	% Change
Bruce A TS 500 kV	548.28	547.66	-0.11	547.67	-0.11
Bruce A TS 230 kV	247.14	246.99	-0.06	246.99	-0.06
Bruce B SS 500 kV	549.00	548.30	-0.13	548.30	-0.13
BHWP B TS 13.8 kV A bus	14.53	14.52	-0.06	14.52	-0.06
BHWP B TS 13.8 kV B bus	14.52	14.51	-0.06	14.51	-0.06
Douglas Point TS 44 kV	46.13	46.10	-0.06	46.10	-0.06
Ashfield SS 500 kV	550.00	550.00*	0.00	550.00	0.00
Longwood TS 500 kV	546.14	545.85	-0.05	545.91	-0.04
Longwood TS 230 kV	245.01	244.89	-0.05	244.93	-0.03
Longwood TS 27.6 kV	29.06	29.04	-0.05	29.05	-0.03

* Wind Turbine Generators will assist in controlling the voltage at the 500 kV bus (as per the turbine reactive power capability curves provided in the generator application)

Table 3: Loss of Ashfield SS x Longwood TS

Bus	Initial Voltage (kV)	Before ULTC (kV)	% Change	After ULTC (kV)	% Change
Bruce A TS 500 kV	548.28	547.38	-0.17	547.25	-0.19
Bruce A TS 230 kV	247.14	246.90	-0.10	246.88	-0.11
Bruce B SS 500 kV	549.00	548.16	-0.15	548.06	-0.17
BHWP B TS 13.8 kV A bus	14.53	14.52	-010	14.52	-0.11
BHWP B TS 13.8 kV B bus	14.52	14.50	-0.10	14.50	-0.11
Douglas Point TS 44 kV	46.13	46.09	-0.10	46.08	-0.11
Ashfield SS 500 kV	550.00	550.00*	0.00	550.00	0.00
Longwood TS 500 kV	546.14	540.73	-0.99	538.89	-1.33
Longwood TS 230 kV	245.01	242.98	-0.83	244.20	-0.33
Longwood TS 27.6 kV	29.06	28.81	-0.86	28.96	-0.34

* Wind Turbine Generators will assist in controlling the voltage at the 500 kV bus (as per the turbine reactive power capability curves provided in the generator application)

Table 4: Loss of Ashfield SS x Longwood TS & 270 MW of K2 Wind while Evergreen SS x Longwood TS Out-of-Service

Bus	Initial Voltage (kV)	Before ULTC (kV)	% Change	After ULTC (kV)	% Change
Bruce A TS 500 kV	546.83	545.57	-0.23	545.57	-0.23
Bruce A TS 230 kV	246.77	246.42	-0.14	246.44	-0.13
Bruce B SS 500 kV	547.73	546.45	-0.23	546.45	-0.23
BHWP B TS 13.8 kV A bus	14.51	14.49	-0.14	14.49	-0.13
BHWP B TS 13.8 kV B bus	14.49	14.47	-0.14	14.48	-0.13
Douglas Point TS 44 kV	46.06	45.99	-0.14	46.00	-0.14
Ashfield SS 500 kV	550.00	548.18	-0.33	548.17	-0.33
Longwood TS 500 kV	541.41	528.25	-2.43	520.08	-3.94
Longwood TS 230 kV	245.10	239.62	-2.23	244.72	-0.16
Longwood TS 27.6 kV	29.07	28.40	-2.32	29.02	-0.16

Table 5: Loss of Bruce B SS x Ashfield SS & 270 MW of K2 Wind while Bruce A TS x Evergreen SS Out-of-Service

Bus	Initial Voltage (kV)	Before ULTC (kV)	% Change	After ULTC (kV)	% Change
Bruce A TS 500 kV	547.06	546.07	-0.18	546.23	-0.15
Bruce A TS 230 kV	246.84	246.59	-0.10	246.63	-0.08
Bruce B SS 500 kV	547.97	546.86	-0.20	547.01	-0.17
BHWP B TS 13.8 kV A bus	14.51	14.50	-0.10	14.50	-0.08
BHWP B TS 13.8 kV B bus	14.50	14.48	-0.10	14.49	-0.08
Douglas Point TS 44 kV	46.07	46.03	-0.10	46.04	-0.08
Ashfield SS 500 kV	550.00	545.82	-0.76	546.67	-0.61
Longwood TS 500 kV	540.85	538.54	-0.43	539.38	-0.27
Longwood TS 230 kV	244.92	243.62	-0.53	246.23	0.54
Longwood TS 27.6 kV	29.05	28.89	-0.55	29.21	0.56

Figure 1: K2 Wind Project: Interconnection Station, K2 Wind CGS (drawing from generator)

Figure 1 for reference only.

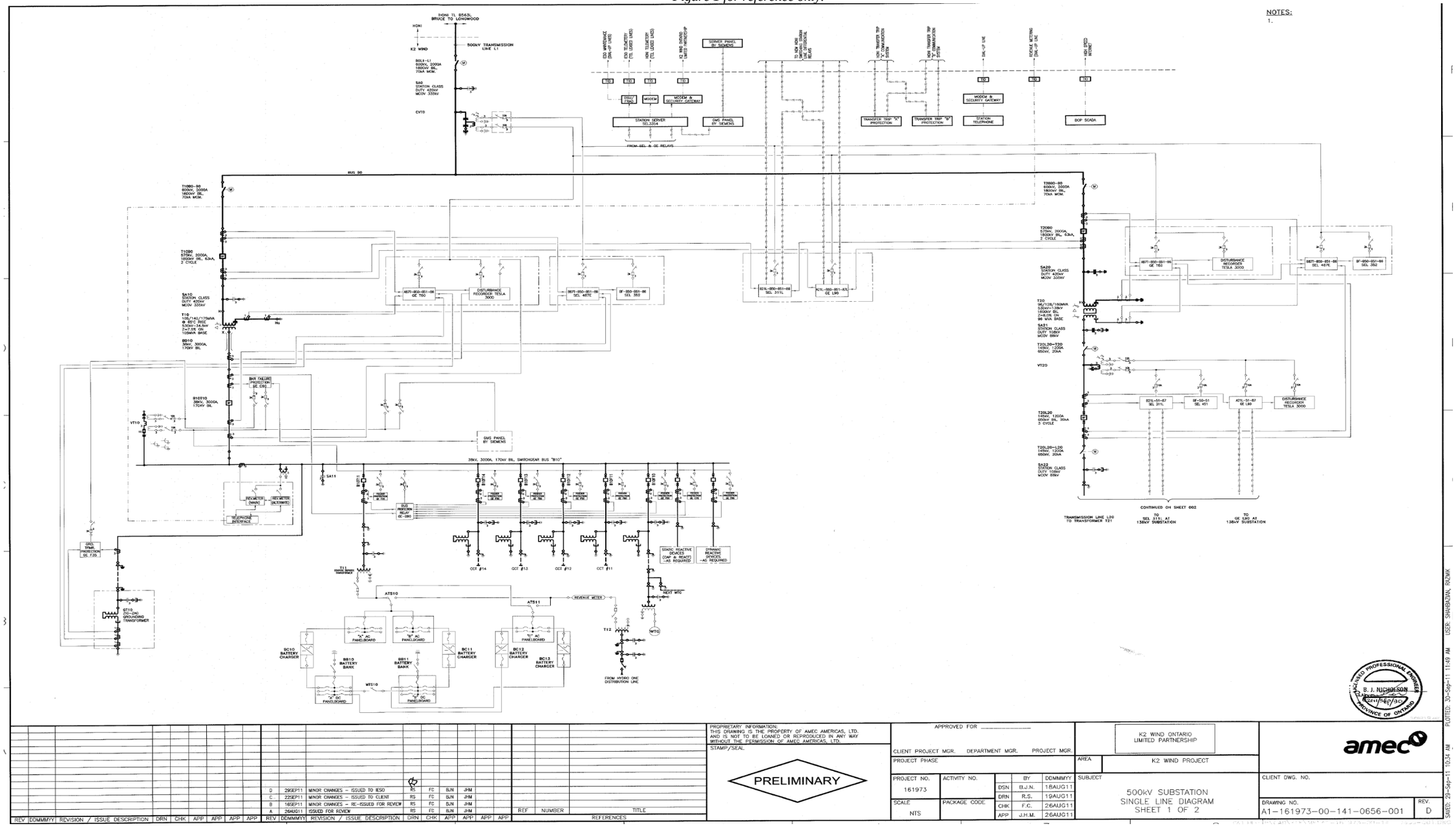
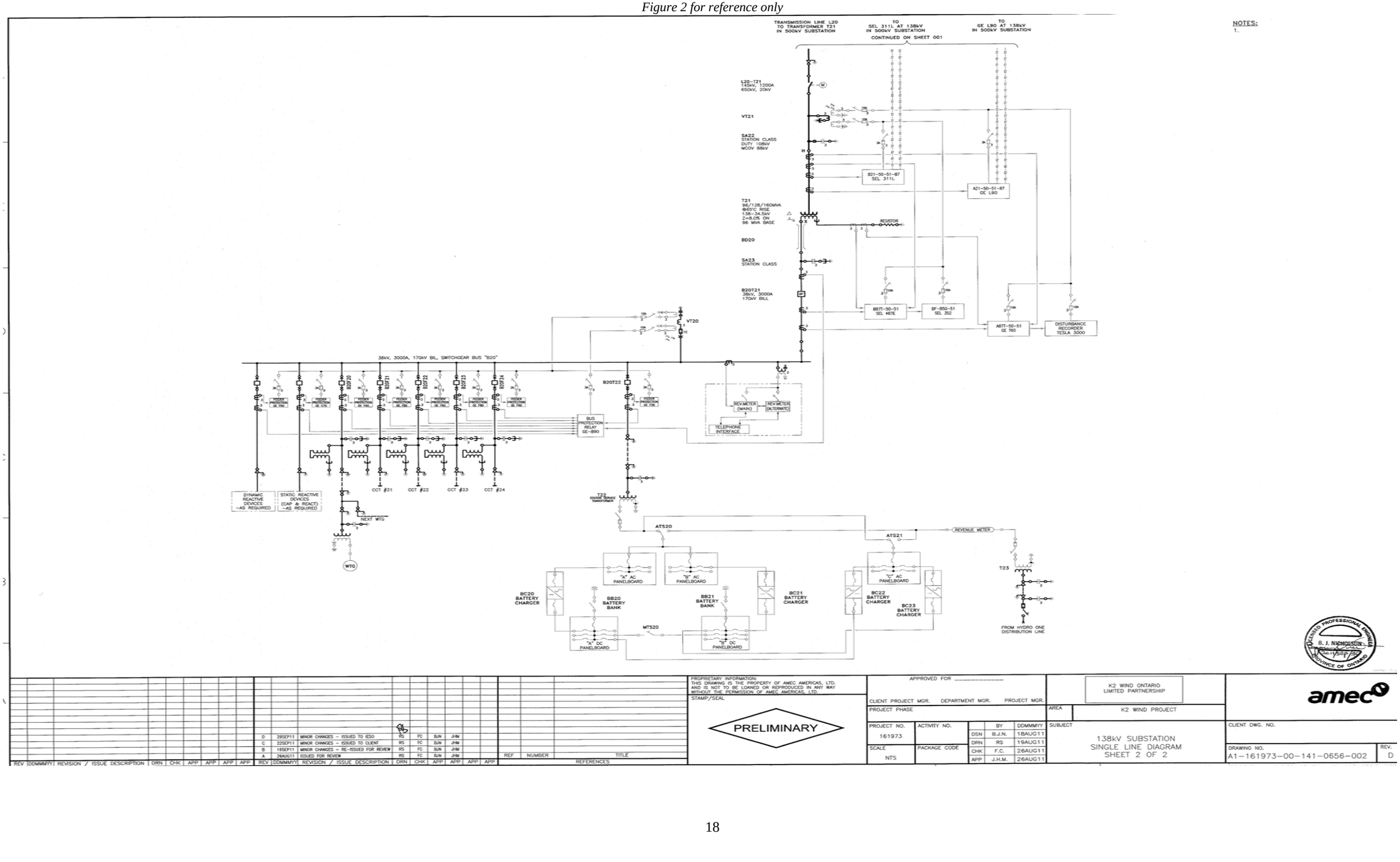


Figure 2: K2 Wind Project: Intermediate 138 kV substation (drawing from generator)

Figure 2 for reference only



REV	DD/MM/YY	REVISION / ISSUE DESCRIPTION	DRN	CHK	APP	APP	APP	APP
D	29SEP11	MINOR CHANGES – ISSUED TO IESO	RS	FC	BJN	JHM		
C	22SEP11	MINOR CHANGES – ISSUED TO CLIENT	RS	FC	BJN	JHM		
B	16SEP11	MINOR CHANGES – RE-ISSUED FOR REVIEW	RS	FC	BJN	JHM		
A	26AUG11	ISSUED FOR REVIEW	RS	FC	BJN	JHM		

REF	NUMBER	TITLE
REFERENCES		

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STAMP/SEAL

PRELIMINARY

APPROVED FOR _____

CLIENT PROJECT MGR. DEPARTMENT MGR. PROJECT MGR.

PROJECT PHASE

PROJECT NO.	ACTIVITY NO.
161973	
SCALE	PACKAGE CODE
NTS	

	BY	DD/MM/YY
DSN	B.J.N.	18AUG11
DRN	RS	19AUG11
CHK	F.C.	26AUG11
APP	J.H.M.	26AUG11

K2 WIND ONTARIO LIMITED PARTNERSHIP

AREA: K2 WIND PROJECT

SUBJECT: 138kV SUBSTATION SINGLE LINE DIAGRAM SHEET 2 OF 2

CLIENT DWG. NO.

DRAWING NO. A1-161973-00-141-0656-002

REV. D

amec

Figure 3: Ashfield Switching Station

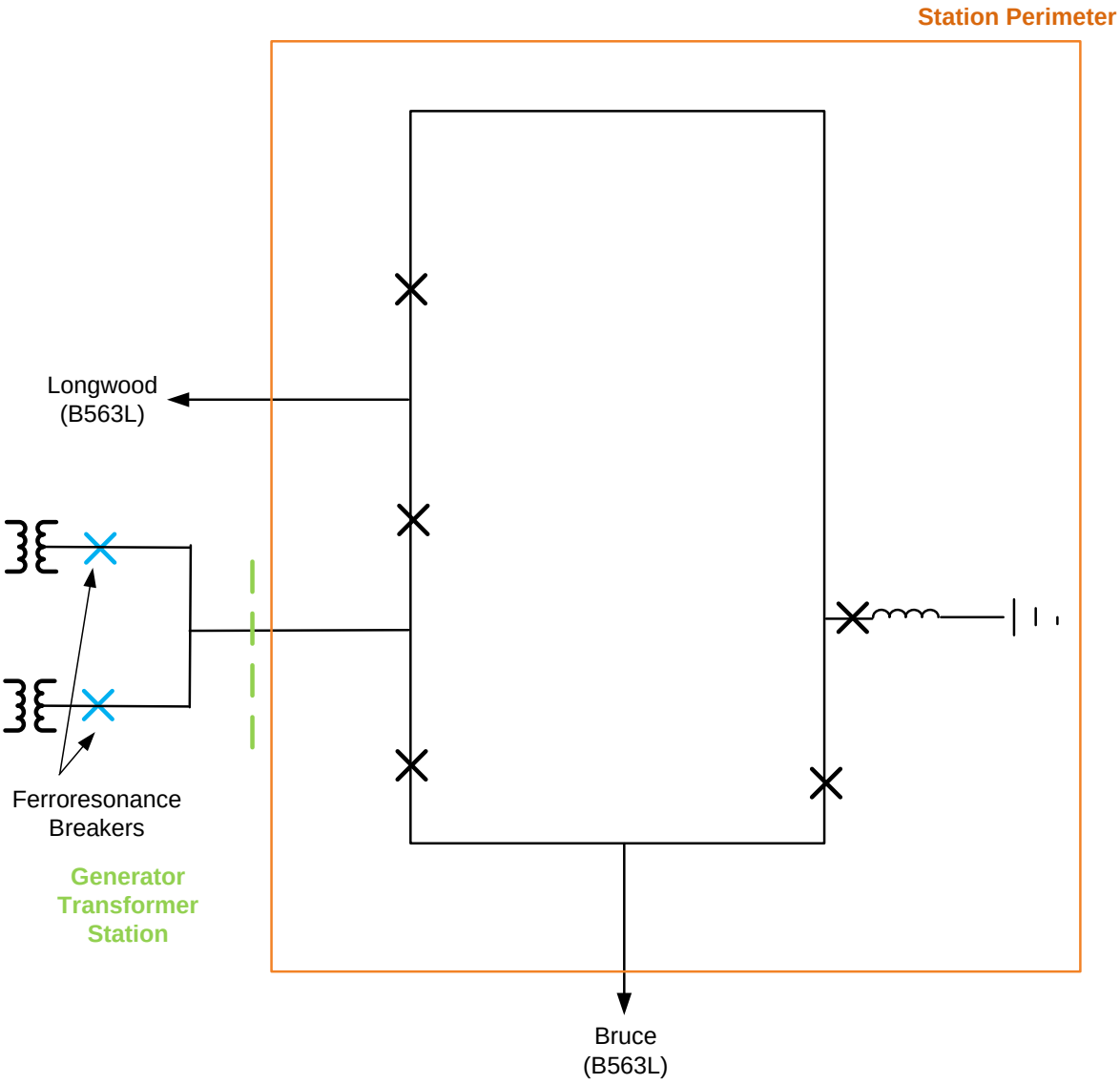
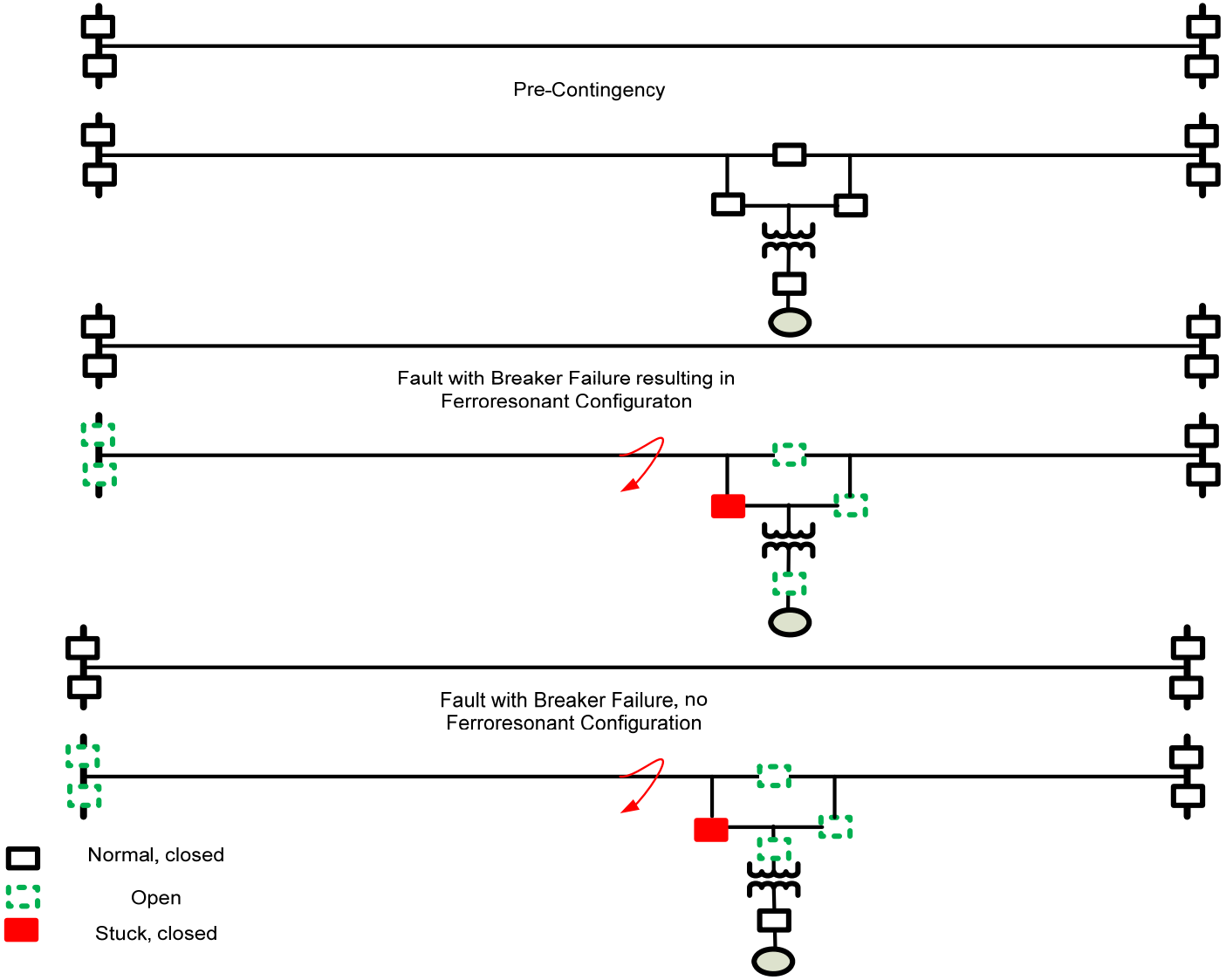


Figure 4: Ferroresonant Configuration

(diagram to illustrate the need for a ferroresonant breaker only, does not represent K2 Wind specific connection arrangement)



TAB G-4-1

SYSTEM IMPACT ASSESSMENT REPORT (ADDENDUM)

REPORT

Power to Ontario.
On Demand.

System Impact Assessment Report (Addendum)

CONNECTION ASSESSMENT & APPROVAL PROCESS

Final Report

CAA ID: **2011-452**
Project: **K2 Wind**
Applicant: **K2 Wind Ontario Limited Partnership**

Market Facilitation Department
Independent Electricity System Operator

Date: June 15, 2012

Document ID	IESO_REP_0769
Document Name	System Impact Assessment Report(Addendum)
Issue	Final Report
Reason for Issue	First Issue
Effective Date	June 15, 2012

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System Impact Assessment Report

Acknowledgement

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

Disclaimers

IESO

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

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

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

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

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

Hydro One

The results reported in this report are based on the information available to Hydro One, at the time of the study, suitable for a System Impact Assessment of this 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 facilities on load and generation customers.

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

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

The additional facilities or upgrades which are required to incorporate the proposed facilities have been identified to the extent permitted by a System Impact Assessment under the current IESO Connection Assessment and Approval process. Additional project 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.

1. Notification of Conditional Approval

Ashfield SS is a proposed switching station to facilitate the connection of K2 Wind (the "project") to the 500 kV line B563L between Bruce B and Longwood transmission stations. In the original SIA report for the project proposed by K2 Wind Ontario Limited Partnership (the "connection applicant"), it was found that the voltage at Ashfield SS could be as high as 554 kV in the event that the wind farm is lost, which exceeds 550 kV of the maximum continuous rating of the proposed station equipment. Thus, the SIA suggested a 500 kV reactor to be installed to ensure that voltage does not exceed 550 kV at Ashfield SS.

Hydro One and the connection applicant are proposing an alternative solution to manage the high voltage concern at Ashfield SS. Rather than installing a reactor, equipment at Ashfield SS will be upgraded to ensure that a maximum continuous operating voltage of at least 570 kV can be sustained.

This assessment concludes that the proposed changes are expected to have no material adverse impact on the reliability of the integrated power system. Therefore, the IESO recommends that a *Notification of Conditional Approval for Connection* be issued for the K2 Wind project subject to implementation of the requirements outlined in this report and the original SIA report.

2. IESO Requirements for Connection

Transmitter Requirements

The following requirements are applicable for the transmitter for the incorporation of the project:

1) Equipment at Ashfield SS must be able to sustain a maximum continuous rating greater than 554 kV. Fault interrupting devices at Ashfield SS must be able to interrupt fault currents at voltages as high as 554 kV.

   This requirement supersedes transmitter requirements (3) and (4) in the Executive Summary of the original SIA report.

2) The circuit breakers at Ashfield will have a short circuit symmetrical rating of at least 50 kA at its maximum continuous operating voltage. This rating is sufficient in meeting the short circuit levels at Ashfield SS as presented in the original SIA. If any future system changes results in an increased fault level higher than the capability of the fault interrupting devices, these fault interrupting devices must be replaced with higher rated equipment capable of sustaining the increased fault level up to the maximum fault level specified in Appendix 2 of the Transmission System Code.

   This is an additional transmitter requirement to the Executive Summary of the original SIA report.

3) The transmitter shall modify the existing Bruce Special Protection Scheme (BSPS) to incorporate the new project and the new switching station. The BSPS shall be expanded to recognize the disconnection of the circuits in the Bruce x Longwood corridor. A description of the modifications to the BSPS has to be provided to the IESO in a timely manner to allow for the required approvals of the BSPS to be obtained. A Facility Description Document (FDD) describing the functionality of the expanded BSPS has to be provided to the IESO during the market entry /facility registration process.

This requirement supersedes and adds clarity to transmitter requirement (2) in the Executive Summary of the original SIA report.

Applicant Requirements

Specific requirements:

1) The connection applicant shall ensure that the equipments within the facility have the capability to operate under the condition when the voltage at Ashfield SS is as high as 554 kV.

   This requirement supersedes the applicant's specific requirement (4) in the Executive Summary of the original SIA report.

General Requirements:

1) The connection applicant shall ensure that the 500kV equipment is capable of continuously operating between 490 kV and a maximum continuous voltage of 554 kV. Protective relaying must be set to ensure that transmission equipment remains in-service for voltages between 94% of the minimum continuous value and 105% of the maximum continuous value.

   This requirement supersedes general requirement (4) in the Executive Summary of the original SIA report.

2) The connection applicant shall ensure that all equipment within their facility has the capability to sustain the fault levels in the area. If any future system changes results in an increased fault level higher than the equipment's capability, the connection applicant is required to replace the equipment with higher rated equipment capable of sustaining the increased fault level, up to maximum fault level specified in Appendix 2 of the Transmission System Code.

   Fault interrupting devices must be able to interrupt fault currents at voltages as high as 554 kV.

   The requirement supersedes general requirement (7) in the Executive Summary of the original SIA report.

3. Assessment

In the original System Impact Assessment for K2 Wind it was found that the voltage at Ashfield SS could be as high as 554 kV in the event that the wind farm is lost. This would exceed the 550 kV maximum continuous rating of the proposed station equipment. The SIA suggested that a 500 kV reactor be installed and switched automatically to ensure that voltages do not exceed 550 kV at Ashfield SS. However, it also mentioned that other solutions to manage the high voltage concern may be acceptable upon the approval of the IESO and Hydro One.

Hydro One and the connection applicant are proposing an alternative solution to manage the high voltage concern at Ashfield SS. Rather than installing a reactor, equipments at Ashfield SS will be upgraded to ensure that a maximum continuous voltage of at least 570 kV can be sustained. As a result this will eliminate the need for a four breaker ring bus at Ashfield SS and would allow for a three bus arrangement as shown in Figure 1.

Equipment Data

The following are the technical specifications of the equipment at Ashfield SS provided by Hydro One:

- Circuit breakers at Ashfield will have a maximum continuous rating of 765 kV;
- Circuit breakers at Ashfield will have a short circuit symmetrical rating of at least 50 kA at its maximum continuous operating voltage. This rating is sufficient in meeting the short circuit levels at Ashfield SS as presented in the original SIA. Note the typical limited maximum 3 phase and single line to ground symmetrical fault levels allowed by the Transmission System Code on the 500 kV system is 63 kA ;
- Circuit breakers at Ashfield will have a interrupting time less than or equal to 2 cycles;
- All other equipments at Ashfield will have a maximum continuous operating voltage of at least 570 kV.

The connection applicant has also indicated that 500 kV equipments within K2 Wind will also have a maximum continuous rating of at least 570 kV.

The study results in the original SIA report indicated that the highest voltage in the event of loss of the wind farm is 554 kV, thus, the IESO accepts the proposed solution to manage the high voltage concern at Ashfield SS. As the reactor is removed, Ashfield SS arrangement will be modified from a four breaker switching station to a three breaker ring bus arrangement as shown in Figure 1, which is acceptable to the IESO.

Therefore, it is concluded that the proposed changes are expected to have no material adverse impact on the reliability of the integrated power system.

The connection applicant shall ensure that the equipment within the facility have the capability to operate under the condition when the connection point of the project is as high as 554 kV.

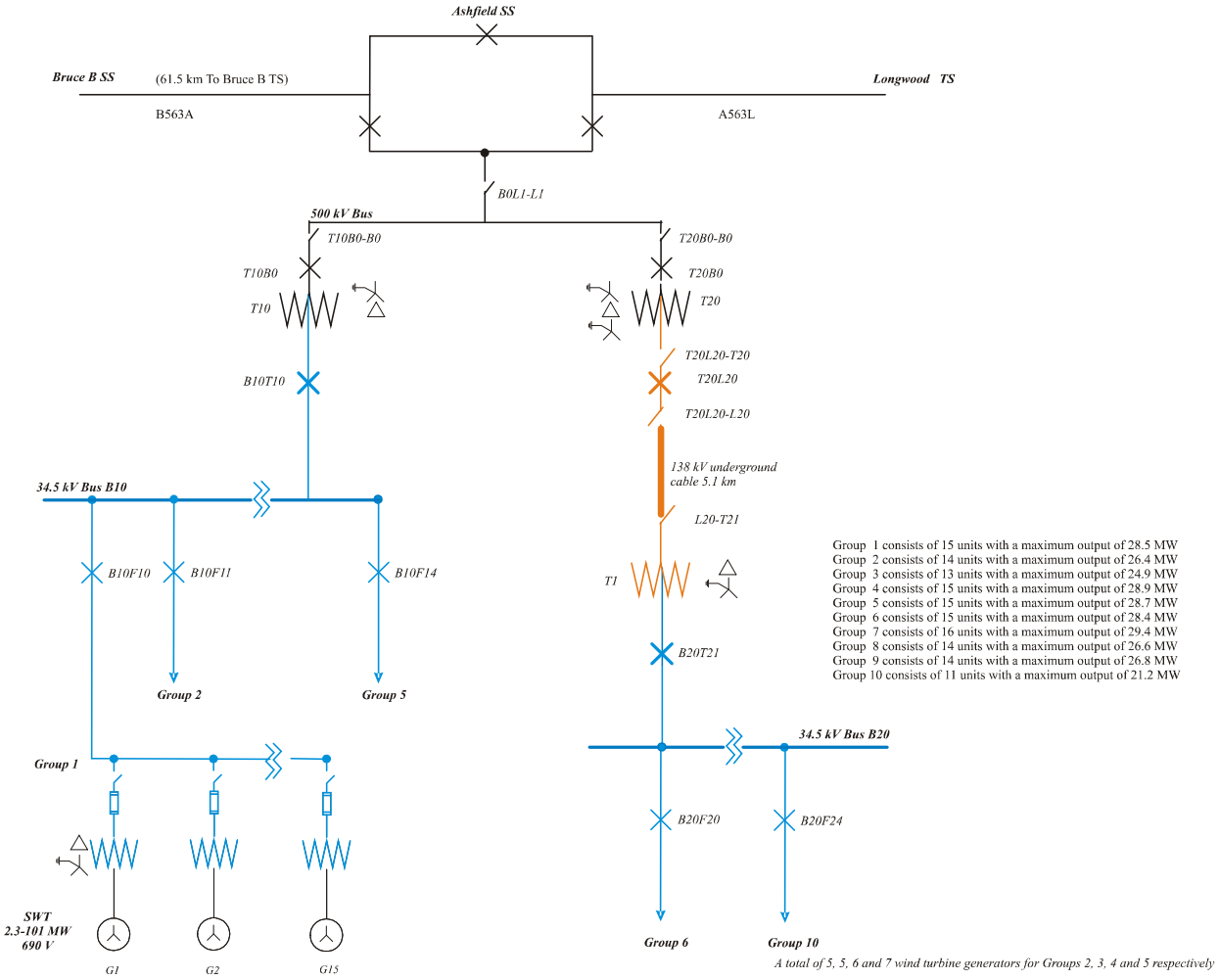

Figure 1: Modified Ashfield SS Configuration

- End of Document -

TAB G-5-1

SYSTEM IMPACT ASSESSMENT AND CUSTOMER IMPACT ASSESSMENT AMENDMENT APPLICATION

ieso
Power to Ontario.
On Demand.

hydro one

Renewable Energy Generation Facility
Application to Request a Connection Assessment

THIS IS AN APPLICATION TO THE INDEPENDENT ELECTRICITY SYSTEM OPERATOR ("*IESO*") AND TO YOUR TRANSMITTER ("*HYDRO ONE*") REQUESTING A CONNECTION ASSESSMENT FOR YOUR PROPOSED NEW OR MODIFIED CONNECTION TO THE *IESO*-CONTROLLED GRID. THIS IS NOT AN APPLICATION FOR AN LDC CONNECTION IMPACT ASSESSMENT.

This *application* streamlines the connection assessment process for renewable energy generation facilities. It is considered complete when:

- ☑ The *IESO* is in receipt of your **System Impact Assessment** ("*SIA*") and **Customer Impact Assessment** ("*CIA*") questionnaires, attached hereto, completed with all necessary data;
- ☑ The *IESO* and *Hydro One* are in receipt of your impact assessment payments;
- ☑ The *IESO* is in receipt of your executed *SIA* agreement which will be provided to you within two business days of the IESO receiving this application;
- ☑ If you are an electricity LDC applying on behalf of a generator, your LDC connection impact assessment report has been received by the *IESO*; and
- ☑ If you have retained a consultant to perform the SIA studies on your behalf, the consultant's studies have been received by the *IESO* in their final form and satisfactory to the *IESO*.

Note: Did you retain a consultant to perform the SIA studies? Yes ☐ No ☐

Upon completing this *application* form, please send it to the *IESO*:

By Email to: connection.assessments@ieso.ca

By Courier to: Independent Electricity System Operator
655 Bay Street, Suite 410 P.O. Box 1
Toronto ON M5G 2K4
Attn: Connection Assessments

By Fax to: (905) 855-6319

About Your Connection Assessment

Your connection assessment will consist of a system impact assessment to be performed by the *IESO* in accordance with the *IESO's market rules* and a customer impact assessment to be performed by *Hydro One* in accordance with the Ontario Energy Board's Transmission System Code.

The *IESO* will provide you with the final connection assessment for your proposed new or modified renewable generation facility (the "*project*") within 150 days of receiving your completed *application*. The *IESO* will promptly advise you of the date on which your *application* is considered to be "complete".

To ensure that your connection assessment is carried out within the prescribed time, the *IESO* and *Hydro One* intend to work closely with you.

SIA and CIA Questionnaires

The SIA and CIA questionnaires included in this *application* form identify the specific pieces of data that the *IESO* and *Hydro One* consider essential (and those that are considered not essential) prior to undertaking the connection assessment for your *project*. Your *application* will not be considered complete until all essential data pertaining to your *project* is provided.

If, at the time you file your *application*, you do not have the actual values for your *project* for the pieces of data that are considered not essential, the *IESO* or *Hydro One*, as applicable, will use typical (and generally conservative) values as a proxy. In such instances, it will be your responsibility to ensure that the *project* (and, specifically, the equipment that is eventually installed) meets or exceeds the typical values.

Use of Information

The information that you submit with this *application* will be used by the *IESO* and *Hydro One* in support of their obligations under the *Electricity Act, 1998*, the *Ontario Energy Board Act, 1998,* the *IESO*'s *market rules*, the Transmission System Code and their respective licenses. Your information will be treated in accordance with the standards, procedures, and confidentiality policies of the *IESO* and *Hydro One*.

By submitting this *application*, you consent to the sharing of your information between the *IESO* and *Hydro One* and agree to the posting of such information on the *IESO's* website in accordance with the *market rules*.

Next Steps

The *IESO* and *Hydro One* intend to work closely with you. Please take note of the following key next steps in your connection assessment process.

i. Within two business days from receiving your *application*, the *IESO* will provide you with an *SIA* agreement (you can find the template of the *SIA* agreement on the FIT page of the *IESO* web site - www.ieso.ca/fit). You will be required to execute the *SIA* agreement and promptly return it to the *IESO*.

ii. Your *application* will be reviewed by the *IESO* and *Hydro One* for completeness. Within ten days of having received your *application*, the *IESO* will contact you to confirm whether it is complete or incomplete. If it is considered incomplete, the *IESO* will also provide you with the details of the incomplete piece(s) of data. If significant data is missing, the *IESO* may require that you submit a new *SIA* and *CIA* questionnaire(s) containing all of the essential information. **In the event that you submit new or modified data subsequent to the filing of your *application*, your *application* will be deemed complete effective as of the date that the last relevant document or material change is received by the *IESO*.**

iii. Within 75 days from having received your complete *application*, the *IESO* will provide a list of *SIA* requirements to *Hydro One*, who shall then be in a position to proceed with the *CIA*. You will be required to have an executed *CIA* Agreement with *Hydro One* in place as of that date.

PART 1 – GENERAL INFORMATION

Provide the following information about the connection assessment *applicant*:
Applicant's Full Legal Name:K2 Wind Ontario Limited Partnership
Applicant's Short Name: (Maximum 12 keystrokes) K2 Wind
Name of the Renewable Generation Facility (the "*Project*"): K2 Wind
OPA Reference Number: TBD
Location of the *Project*: Huron County

Provide the following information about the individual authorized to apply and transact on behalf of the *applicant*:	
Full Name of Authorized Representative: Colin Edwards	
Position/Title: Director	
Company: K2 Wind Ontario Limited Partnership	
Address: 100 Simcoe, Suite 105	
City/Town: Toronto	
Province/State: Ontario	
Postal/Zip Code: M5H 3G2	Country: Canada
Telephone No.: 416 - 263 - 8025	Fax No.: 416 - 979 - 8424
Email Address: colin.edwards@patternenergy.com	
Hydro One Account Number: NA (Only for existing customers intending to install generation for load displacement.)	

Provide the following information about the *applicant's* technical representative (for example, this may be an employee or a consultant*):	
Name: Stan Gray	
Position/Title: Senior Developer	
Company: Pattern Energy Group LP	
Address: 800 NE Tenney Rd., Suite 110-132	
City/Town: Vancouver	
Province/State: Washington	
Postal/Zip Code: 98685	Country: USA
Telephone No.: 360 - 314 - 4235	Fax No.: None
E-mail Address: stan.gray@patternenergy.com	

PART 2 – PAYMENT OF APPLICABLE DEPOSIT ($30,000 FOR TRANSMISSION CONNECTED FACILITY OR $20,000 FOR EMBEDDED GENERATION FACILITY) TO IESO FOR SYSTEM IMPACT ASSESSMENT (SIA)

Method of Payment (choose one)

☐ Certified cheque payable to the *IESO*	☐ Attached
☐ Deposit to *IESO* Account	☐ Receipt Attached
☒ Electronic Wire Payment to *IESO* Account	☐ Receipt Attached

Purchase Order # (if applicable)

For direct deposit or electronic wire payments, reference the following *IESO* account:

TD Bank, Institution ID # 0004, Transit # 10202, Account # 0690-0429444

PART 3 – PAYMENT OF $15,000 (PLUS HST) FEE TO HYDRO ONE FOR CUSTOMER IMPACT ASSESSMENT (CIA)

Method of Payment (choose one)

☐ Certified cheque payable to *Hydro One Networks Inc.*	☐ Attached
☐ Deposit to *Hydro One* Account	☐ Receipt Attached
☒ Electronic Wire Payment to *Hydro One* Account	☐ Receipt Attached

Purchase Order # (if applicable)

For direct deposit or electronic wire payments, reference the following *Hydro One* account:

TD Bank, Toronto, Institution ID # 0004, Transit # 10202, Account # 0690-5202411, SWIFT code TDOMCATTTOR

PART 4 – CERTIFICATION

The *applicant* has read, understands and agrees with the foregoing and hereby declares that the information submitted in this *application* is complete and accurate to the best of the *applicant's* knowledge. By signing below, the undersigned represents having the authority to make this *application* on behalf of the *applicant*.

Name (Please Print) Colin Edwards Title Director

Signature Date August 24, 2012

PART 5 – FOR IESO USE ONLY

Received by:_____	Date Received:_____
Payment Received with *Application* (Y/N):	CAA ID Number:_____

Generic Information

Bold-Italic	Essential
Bold	Essential for *Hydro One* - to be provided prior to Connection
	Typical values will be assumed if data not provided
	Only required upon request

Facility Type	***Specify if generation facility will be registered as self-scheduled, intermittent or dispatchable.***	Intermittent
Intent of Generation	***Specify if the facility will be used as load displacement or for sale of electricity.***	**Sale of Electricity**
***Project* Dates**	***Start of construction***	**2012, November**
	Electrical backfeed (energized stations)	2013,August
	In-service dates (first synchronization of each unit)	2013, September
	Commercial in-service date	2013, December
Protection System Description	***An overview of the protective relaying schemes to be employed together with an explanation of the manner in which they are to be deployed.*** ***A simplified tripping matrix as per schedule E, exhibit E-2 of the Transmission System Code (TSC), appendix 1 for generator customers.***	See attached "Protection and Operating Description - Rev 08"
Operating Philosophy	***An overview explaining how the facility will be operated outlining possible operating modes. Include details on start-up and maintenance outages.***	See "Protection and Operating Description - Rev 08"
Detailed Single-Line Diagram(s)	***A detailed single-line diagram showing the equipment and the protection and telemetry points. The locations of the proposed connections on to existing lines, or into existing transformer/switching stations, are also to be included.*** ***Details are to be included of any existing facilities that are to be replaced or removed from service. Out-of-service dates are to be provided whenever these do not coincide with the in-service dates for the new facilities.*** ***Provide details of LDCs between the generator and the transmission system.***	See "A1-161973-00-141-0656-001 Rev F" & "A1-161973-00-141-0656-002 Rev F"
Geographic Map including GPS Coordinates	***A large-scale map or drawing showing the location of the exact point of the proposed interconnection with Hydro One facilities (or other transmitters including lot number and concession number for the project).*** ***Attachments for wind farm projects must include the configuration and grouping of individual units, including GPS coordinates of each turbine, physical dimensions and turbine nomenclature.***	See "A1-161973-00-141-0064 Rev F" & file "K2 Wind - WTG Layout 194 and Rated Power - 2012-05-04"
Collector System	***a. Does your project require you to establish joint use on Hydro One poles? (i.e. generator's collector lines attached to Hydro One poles on municipal right of way, to the PCC)?*** ***b. If you answer No to "a" above, is your project going to own poles + wires on municipal right of way?***	Yes ☐ No ☒ Yes ☒ No ☐
Control Schemes	***Describe any control schemes that are to be used to automatically change the tap positions for any of the transformers, or to automatically switch into-service or out-of-service any reactive compensation devices.***	See "Protection and Operating Description - Rev 08"

All files and diagrams provided as attachments are to be signed and sealed by a Professional Engineer.

Generation Facilities

Bold-Italic	Essential
Bold	Essential for *Hydro One* - to be provided prior to Connection
	Typical values will be assumed if data not provided
	Only required upon request

Unit Data Complete one table for each different type of generator	***Number and identifier of identical units (e.g., 3 units - G1, G2, G3)***							"K2 Wind - WTG Layout	
	Manufacturer							Siemens / SWT-2.3-101	
	Type (e.g. salient pole, round rotor, induction, inverter based, e.g. solar)							Inverter based	
	Frequency (Hz)							60	
	Speed (RPM)							600 to 1800	
	Machine base (MVA)							2.55	
	Rated voltage (kV)							0.69	
	Power Factor							+0.9 to -0.9	
	Maximum Continuous Rating (MCR)	***(MW) - summer at 35°C[1]***						"K2 Wind - WTG Layout	
		(MW) - winter at 10°C						194 and Rated Power - 2012-05-04"	
	Capability above MCR (MW), sustainability per event (hrs)							None	Not Applic
	NERC Unit type	Refer to the link on next page						WT	
	NERC Status							OP	
	NERC Cooling Water Source							Not Applicable	
	NERC Fuel Type (primary, alternate)	Refer to the link on next page						WND	None
	NERC Fuel Transportation (primary, alternate)							Not Applic	Not Applic
	NERC primary fuel heat rate at full load (BTU/kWh)							Not Applicable	
	Unsaturated reactances in pu based on machine base (Xo required only if unit transformer provides a zero sequence path)								
	Xd	***X'd***	***X''d***	***Xq***	***X'q***	***Xl***	***X_2***	***Xo***	
	Siemens_	WT4_	Generic	_PSSE_	Dynami	_Model_	V06_	10.zip	
	Open circuit time constants (s)								
	T'do		***T''do***		***T'qo***		***T''qo***		
	Siemens_WT4_		Generic_PSSE_		Dynamics_Model_		V06_10.zip		
	Station load (MW, Mvar)							3.0, 1.5 - Max Total	
	Minimum power (MW)							1.0 Total WF	
	Normal loading and unloading ramp rates (MW/min)							Not Appl	Not Applic
	Emergency loading and unloading ramp rates (MW/min)							Not Appl	Not Applic
	Armature (Ra) and field resistance (Rfd[2]) (Ohms)							See	attached
	Total rotational inertia of generator and turbine(s)							Siemens_WT4_Generic	
	Saturation at rated voltage (S1.0) and 20% above (S1.2)							PSSE_	Dynamics_
	Damping							Model_V06_10.zip	
	Base field current (A)							ditto	
	Base field voltage (volts)							ditto	
	Losses at 1.0 and 0.9 power factor (MW)							Later	Later
Characteristics (must be provided for each different type of generator)	***Open circuit saturation curve***							SWT_2M3_3M6-and 3M0A1	
	Short circuit curve							See PG-R3-40-0000-0243-01	
	V curves							Not applicable	
	Capability curve							See SWT-2.3 MW 60Hz	

All files and diagrams provided as attachments are to be signed and sealed by a Professional Engineer.

[1] If the location of the *project* is north of the City of Barrie, then provide summer ratings based on 30°C and 0 to 4 km/hr wind speed

[2] Field resistance should be specified at 75ºC for hydro-electric units and at 100ºC for thermal units.

Additional information required for protection impact assessment

The following data is required for all doubly-fed induction generators and full inverter interfaced generators.

Maximum current contribution to symmetrical 3-phase fault at HV side of Generator Step-Up (GSU) Transformer

	Specify start and end times (cycles or ms)		***Positive sequence current, I_1*** *(A or per unit – if in pu specify base)*	***I_1 Angle*** *(range in degrees with respect to phase voltage)*	***Negative sequence current, I_2*** *(range in % of I_1)*	***Zero sequence current, I_0 `*** *(range in % of I_1)*
Time Period 1	0	10 ms	700 A rms	40 to 87 Lag	N/A	N/A
Time Period 2	10	100 ms	625 A rms	30 to 85 Lag	N/A	N/A
Time Period 3	100	3000 ms	380 A rms	60 to 85 Lag	N/A	N/A

Maximum current contribution to asymmetrical fault at HV side of GSU transformer

Time Period 1	0	10 ms	1980 A pk	40 to 87 Lag	0%	0%
Time Period 2	10	100 ms	1625 A pk	30 to 85 Lag	0%	0%
Time Period 3	100	3000 ms	630 A pk	60 to 85 Lag	0%	0%

Current contribution in scenarios other than the maximum scenario above: *For example, current contribution vs. grid residue voltage curve or the effect of pre-fault load level. Data shall be provided for all the three periods above.*	See SWT Short Circuit Current Information - 2006-11-22
Decrement curves (minimum of 100 ms) *Time-domain three phase current waveforms for symmetrical and single-phase-to-ground faults at HV side of GSU transformer.*	See SWT Short Circuit Current Information -
Current contribution at 30 cycles *For symmetrical and singe-phase-to-ground faults at HV side of GSU transformer.*	See SWT Short Circuit Current Information
Description of inverter operation during fault conditions: *For example, rotor side crow-bar action or converter blocking.*	See SWT Short Circuit Current
Results of the short circuit study for the facility	Later

EXCITATION SYSTEM MODEL

A block diagram* suitable for stability studies or an IEEE standard model type with all in-service parameter values for the exciter. Models for stabilizers, under-excitation limiters and over-excitation limiters shall be provided where applicable.	Generation facility directly connected to the *IESO-controlled grid*

GOVERNOR AND PRIME MOVER SYSTEM MODEL

A block diagram* suitable for stability studies or an IEEE standard model type with all in service parameters values for the governor and prime mover (turbine). More detailed models would be required if off-nominal frequency or shaft torsional studies are required.	Generation facility directly connected to the IESO-*controlled grid*, generation facility greater than 50 MW, or generation unit greater than 10 MW

FACILITY MODEL - EQUIVALENT

An equivalent model representing the proposed facility as being connected to the low voltage bus of the transmission connection facility, operated at the nominal voltage level of the low voltage bus, to be used by IESO and Hydro One for steady state and transient simulations (attach files).	For generation facilities comprised of multiple small size units (such as wind farms, solar PV) and distribution connected generation

LINK TO NERC UNIT TYPE, STATUS, FUEL TYPE AND FUEL TRANSPORTATION TABLE:

http://www.ieso.ca/imoweb/pubs/marketEntry/me_f1111_NERC_Fields.doc

* The block diagram must be compatible with PSS/E model libraries. Please check with the IESO regarding the software version currently in use.

Connection (Transmission) Facilities

Bold-Italic	Essential
Bold	Essential for *Hydro One* - to be provided prior to Connection
	Typical values will be assumed if data not provided
	Only required upon request

If the connection from the generator to the transmitter consists of different sections, then the applicant must complete a table for each overhead circuit section and for each underground circuit section.

Provide a detailed single line diagram of the connection facilities.

Transmission connection	***Point of connection to IESO controlled grid:*** ***- circuit operating nomenclature or terminal station name***	B563L		
	- circuit section	61.5 km from Bruce		
	- tower number	between towers 234 and 235		
	- GPS coordinates	43.895, -81.624		
Overhead circuit section Complete one table for each overhead circuit section	***Identifier (to be provided on drawing)***	L1		
	Voltage (kV)	500 Nominal		
	Length (km)	0.05		
	Phase conductor size (kcmil)	6" NPS		
	Phase conductor type (ASC, ACSR, ACSS, ACCR, etc)[3]	Al tube		
	Phase conductor stranding (# of Al strands/ # of Steel strands)	Not applicable	Not applicable	
	Phase conductors per bundle, spacing if more than one (mm)	1	Not applicable	
	Geometry of all phase and sky wires for each tower type (m)	Horizontal flat at 10m spacing		
	Ground resistivity (ohm-meters)	55		
	Skywire size (kcmil)	Lightning masts		
	Skywire type (Alumoweld, EHS, HS)[4]	Lightning masts		
	Skywire stranding (# of Al strands/ # of Steel strands)	Not applicable	Not applicable	
	Skywire number if more than one	Not applicable		
	Positive sequence impedance *R, X in ohms and B in mhos* *if in per unit specify bases*	**R in ohms**	**X in ohms**	**B in mhos**
		0.0004	Minimal	Minimal
		R in pu	**X in pu**	**B in pu**
	Zero sequence impedance *Ro, Xo in ohms and Bo in mhos* *if in per unit specify bases*	**Ro in ohms**	**Xo in ohms**	**Bo in mhos**
		Minimal	Minimal	Minimal
		Ro in pu	**Xo in pu**	**Bo in pu**
	Mutual Impedance (parallel circuit identifier) *Rm, Xm in ohms and Bo in mhos* *if in per unit specify bases*	**Rm in ohms**	**Xm in ohms**	**Bm in mhos**
		Not appl	Not appl	Not appl
		Rm in pu	**Xm in pu**	**Bm in pu**
	Base Voltage V_B (Applicable to positive & zero sequences and mutual impedances) ***All values in per km***	500		
	Base MVA_B (Applicable to positive & zero sequences and mutual impedances) ***All values in per km***	100		

[3] If the conductor type is new then additional information may be required.
[4] If the conductor type is new then additional information may be required.

Connection (Transmission) Facilities (continued)

Bold-Italic	Essential
Bold	Essential for *Hydro One* - to be provided prior to Connection
	Typical values will be assumed if data not provided
	Only required upon request

Overhead circuit section cont'd	***Winter thermal ratings: Continuous, Long-term, Short-term (A)*** ***(see table below for rating assumptions)***	5000	6000	6000
Complete one table for each overhead circuit section	***Summer thermal ratings: Continuous, Long-term, Short-term (A)*** ***(see table below for rating assumptions)***	3000	3600	3600

Overhead Transmission Lines - Rating Assumptions for System Impact Assessment studies

Rating	Conductor Temperature	Pre-load	Ambient Temp	Wind Speed
Continuous	93°C (or sag temperature if lower)	N/A	**Summer** 35°C South of Barrie & 30°C North of Barrie **Winter** 10°C	0 to 4 km/hr 15 km/hr within 50 km of wind farm
Long-Term Emergency (Limited to 50 hr/year on all conductors)	127°C (or sag temperature if lower)	N/A		
Short-Term Emergency (15-minute limited-time rating)	150°C (or sag temperature if lower) (Limited to 127°C for High Aluminum Content (HAC) conductors)	Continuous Rating at 93°C		

Connection (Transmission) Facilities (continued)

Bold-Italic	Essential
Bold	Essential for *Hydro One* - to be provided prior to Connection
	Typical values will be assumed if data not provided
	Only required upon request

Underground Circuit Section Complete one table for each underground circuit section	***Identifier (to be provided on drawing)***		L20		
	Voltage (kV)		230 Nominal		
	Length (km)		5.1		
	BIL rating		1050 kV		
	Phase conductor size (kcmil)		1000		
	Distance from the "from" terminal (km)		0		
	Maximum operating temperature (°C)		90		
	Phase conductor type[5]		Compressed Al		
	Insulation type		XLPE		
	Semiconductor shield type		Later		
	Shield grounding		Later		
	Metallic sheath type		Later		
	External layer type		Later		
	Geometry of all phases		Later		
	Ground resistivity (ohms-meters)		Later		
	Cable construction		Later		
	Installation type (e.g. direct buried, in duct, etc.)		Direct buried		
	Positive sequence impedance (R, X in ohms, B in mhos or if in per unit specify bases)		0.395	1.253	0.0003
	Zero sequence impedance (Ro, Xo in ohms, Bo in mhos or if in per unit specify bases)		0.894	0.536	0.0003
	Continuous, 15-Minute and 24-Hour thermal ratings (A)	***Winter***	500	500	500
		Summer	500	500	500
Main Buses Complete one table for each bus	Identifier (to be provided on drawing)		B0		
	Station		K2 Wind CGS		
	Voltage (kV)		500 Nominal		
	Summer continuous (A)		3000		
	Winter continuous (A)		5000		
	Maximum operating temperature (°C)		70		
	Conductor size (kcmil)		6" NPS		
	Conductor type (ASC, ASCR, Al tube)		Al tube		
Surge Arresters	Identifier		SA0, SA10, & SA20		
	Station		K2 Wind CGS		
	Manufacturer		Later		
	Serial number		Later		
	Voltage rating (kV)		420		
	Type (e.g. ZnO, SiC)		ZnO		
	Class (e.g. secondary, distribution, intermediate, station)		Station		

[5] If the conductor type is new then additional information may be required

Connection (Transmission) Facilities (continued)

Bold-Italic	Essential
Bold	Essential for *Hydro One* - to be provided prior to Connection
	Typical values will be assumed if data not provided
	Only required upon request

Underground Circuit Section Complete one table for each underground circuit section	***Identifier (to be provided on drawing)***				
	Voltage (kV)				
	Length (km)				
	BIL rating				
	Phase conductor size (kcmil)				
	Distance from the "from" terminal (km)				
	Maximum operating temperature (°C)				
	Phase conductor type[5]				
	Insulation type				
	Semiconductor shield type				
	Shield grounding				
	Metallic sheath type				
	External layer type				
	Geometry of all phases				
	Ground resistivity (ohms-meters)				
	Cable construction				
	Installation type (e.g. direct buried, in duct, etc.)				
	Positive sequence impedance (R, X in ohms, B in mhos or if in per unit specify bases)				
	Zero sequence impedance (Ro, Xo in ohms, Bo in mhos or if in per unit specify bases)				
	Continuous, 15-Minute and 24-Hour thermal ratings (A)	***Winter***			
		Summer			
Main Buses Complete one table for each bus	Identifier (to be provided on drawing)				
	Station				
	Voltage (kV)				
	Summer continuous (A)				
	Winter continuous (A)				
	Maximum operating temperature (°C)				
	Conductor size (kcmil)				
	Conductor type (ASC, ASCR, Al tube)				
Surge Arresters	Identifier				SA21, 22, 23 & 24
	Station				K2 Wind 230kV CGS
	Manufacturer				Later
	Serial number				Later
	Voltage rating (kV)				258
	Type (e.g. ZnO, SiC)				ZnO
	Class (e.g. secondary, distribution, intermediate, station)				Station

[5] If the conductor type is new then additional information may be required

Connection (Transmission) Facilities (continued)

Bold-Italic	Essential
Bold	Essential for *Hydro One* - to be provided prior to Connection
	Typical values will be assumed if data not provided
	Only required upon request

Transformers Complete one table for each transformer	***Number and Identifier of identical units (e.g., 3 units - T1, T2, T3)***			T10			
	Station			K2 Wind CGS			
	Serial Number (must be provided prior to Connection)			12170-01			
	Manufacturer			ABB			
	Configuration (e.g. 3 phase unit or three single phase units)			3 phase			
	Phase Location if single phase (e.g. R, W, B)			NA			
	Cooling types (e.g. ONAN, ONAF, OFAF)			ONAN	ONAF	ONAF	
	Associated Thermal Rating for each cooling type (MVA)			105	140	175	
	Winter (10°C) continuous, 10-DAY and 15-MIN thermal ratings	(A)		212	212 Min.	212 Min.	
		(MVA)		195	195 Min.	195 Min.	
	Summer (35°C) continuous, 10-DAY and 15-MIN thermal ratings[6]	(A)		191	191 Min.	191 Min.	
		(MVA)		175	175 Min.	175 Min.	
	Connection for each winding H, X, Y (e.g. wye, delta, zig-zag)			Wye	Delta	NA	
	Rated voltage for each winding, e.g. HV, LV, tertiary (kV)			530	34.5	NA	
	Rated capability for tertiary winding, if applicable (A, MVA)			NA	NA		
	Impedance to ground for each winding H, X, Y (ohms) **(U – Ungrounded; R – Resistance; X – Reactance, e.g. 16 R)**			0 R	U	NA	
	Off–load taps (kV)		556.50	543.25	530.00	516.75	503.50
	In-service off-load tap position (kV)			543.25			
	Under-load taps: max tap (kV), min tap (kV), number of steps			None	NA	NA	
Positive Sequence Impedance	(see IEEE C57.12.90 for measurement techniques)	***Positive Sequence Impedance (%)***		***HX***	***HY***	***XY***	
		R		0.156	NA	NA	
		X		7.50	NA	NA	
		Base MVA		105	530 kV	NA	
Zero Sequence Impedance (only required for transformers with 1 or 2 external neutrals)	H winding energized all others open	Closed Tertiary		H	X	HX	XH
		R		0.1	NA	NA	NA
		X		6.6	NA	NA	NA
		Base MVA		105	530 kV	NA	NA
	H winding energized X winding shorted	Open Tertiary		H	X	HX	XH
		R		Later	NA	NA	NA
		X		Later	NA	NA	NA
		Base MVA		105	530 kV	NA	NA

[6] If the location of the *project* is north of the City of Barrie, then provide summer ratings based on 30°C and 0 to 4 km/hr wind speed

Connection (Transmission) Facilities (continued)

Bold-Italic	Essential
Bold	Essential for *Hydro One* - to be provided prior to Connection
	Typical values will be assumed if data not provided
	Only required upon request

Transformers Complete one table for each transformer	***Number and Identifier of identical units (e.g., 3 units - T1, T2, T3)***		T20				
	Station		K2 Wind CGS				
	Serial Number (must be provided prior to Connection)		Later				
	Manufacturer		Later				
	Configuration (e.g. 3 phase unit or three single phase units)		3 phase				
	Phase Location if single phase (e.g. R, W, B)		NA				
	Cooling types (e.g. ONAN, ONAF, OFAF)		ONAN	ONAF	ONAF		
	Associated Thermal Rating for each cooling type (MVA)		96	128	160		
	Winter (10°C) continuous, 10-DAY and 15-MIN thermal ratings	(A)	190	190 Min.	190 Min.		
		(MVA)	175	175 Min.	175 Min.		
	Summer (35°C) continuous, 10-DAY and 15-MIN thermal ratings[6]	(A)	174	174 Min.	174 Min.		
		(MVA)	160	160 Min.	160 Min.		
	Connection for each winding H, X, Y (e.g. wye, delta, zig-zag)		Wye	Wye	Delta		
	Rated voltage for each winding, e.g. HV, LV, tertiary (kV)		530	230	Manuf choice		
	Rated capability for tertiary winding, if applicable (A, MVA)		per Manuf	32 on ONAN			
	Impedance to ground for each winding H, X, Y (ohms) **(U – Ungrounded; R – Resistance; X – Reactance, e.g. 16 R)**		0 R	0 R	U		
	Off–load taps (kV)		556.50	543.25	530.00	516.75	503.50
	In-service off-load tap position (kV)		543.25				
	Under-load taps: max tap (kV), min tap (kV), number of steps		None	NA	NA		
Positive Sequence Impedance	(see IEEE C57.12.90 for measurement techniques)	***Positive Sequence Impedance (%)***	***HX***	***HY***	***XY***		
		R	0.16	Buried Y	Buried Y		
		X	7.80	Buried Y	Buried Y		
		Base MVA	96	530 kV			
Zero Sequence Impedance (only required for transformers with 1 or 2 external neutrals)	H winding energized all others open	Closed Tertiary	H	X	HX	XH	
		R	0.1	0.1	0.15	0.15	
		X	6.4	0.6	7.6	7.6	
		Base MVA	96	530 kV	NA	NA	
	H winding energized X winding shorted	Open Tertiary	H	X	HX	XH	
		R	Later	Later	Later	Later	
		X	Later	Later	Later	Later	
		Base MVA	96	530 kV	NA	NA	

[6] If the location of the *project* is north of the City of Barrie, then provide summer ratings based on 30°C and 0 to 4 km/hr wind speed

Connection (Transmission) Facilities (continued)

Bold-Italic	Essential
Bold	Essential for *Hydro One* - to be provided prior to Connection
	Typical values will be assumed if data not provided
	Only required upon request

Transformers Complete one table for each transformer	***Number and Identifier of identical units (e.g., 3 units - T1, T2, T3)***			T21			
	Station			K2 Wind 230 kV CGS			
	Serial Number (must be provided prior to Connection)			Later			
	Manufacturer			Later			
	Configuration (e.g. 3 phase unit or three single phase units)			3 phase			
	Phase Location if single phase (e.g. R, W, B)			NA			
	Cooling types (e.g. ONAN, ONAF, OFAF)			ONAN	ONAF	ONAF	
	Associated Thermal Rating for each cooling type (MVA)			96	128	160	
	Winter (10°C) continuous, 10-DAY and 15-MIN thermal ratings	(A)		190	190 Min.	190 Min.	
		(MVA)		175	175 Min.	175 Min.	
	Summer (35°C) continuous, 10-DAY and 15-MIN thermal ratings[6]	(A)		174	174 Min.	174 Min.	
		(MVA)		160	160 Min.	160 Min.	
	Connection for each winding H, X, Y (e.g. wye, delta, zig-zag)			Delta	Wye	NA	
	Rated voltage for each winding, e.g. HV, LV, tertiary (kV)			230	34.5	NA	
	Rated capability for tertiary winding, if applicable (A, MVA)			NA	NA		
	Impedance to ground for each winding H, X, Y (ohms) **(U – Ungrounded; R – Resistance; X – Reactance, e.g. 16 R)**			U	0 R	NA	
	Off–load taps (kV)		None	NA	NA	NA	NA
	In-service off-load tap position (kV)			NA			
	Under-load taps: max tap (kV), min tap (kV), number of steps			253	207	21	
Positive Sequence Impedance	(see IEEE C57.12.90 for measurement techniques)	***Positive Sequence Impedance (%)***		***HX***	***HY***	***XY***	
		R		0.16	NA	NA	
		X		8.00	NA	NA	
		Base MVA		96	530 kV	NA	
Zero Sequence Impedance (only required for transformers with 1 or 2 external neutrals)	H winding energized all others open	Closed Tertiary		H	X	HX	XH
		R		0.1	NA	NA	NA
		X		7.0	NA	NA	NA
		Base MVA		96	230 kV	NA	NA
	H winding energized X winding shorted	Open Tertiary		H	X	HX	XH
		R		Later	NA	NA	NA
		X		Later	NA	NA	NA
		Base MVA		96	230 kV	NA	NA

[6] If the location of the *project* is north of the City of Barrie, then provide summer ratings based on 30°C and 0 to 4 km/hr wind speed

Connection (Transmission) Facilities (continued)

Bold-Italic	Essential
Bold	Essential for *Hydro One* - to be provided prior to Connection
	Typical values will be assumed if data not provided
	Only required upon request

Shunt Capacitors Complete one table for each type of shunt capacitor	***Identifier***	Later - If Capacitor is required
	Station	K2 Wind CGS
	Manufacturer	Later - If Capacitor is required
	Serial number (must be provided prior to Connection)	Later - If Capacitor is required
	Rated voltage (kV)	Later - If Capacitor is required
	Rated capability (Mvar)	Later - If Capacitor is required
	Discharge time (ms)	Later - If Capacitor is required
	Current limiting reactor (mH or Ω)	Later - If Capacitor is required
	Bank arrangement (e.g. delta, wye, double-wye, etc)	Later - If Capacitor is required
	Surge capacitor (μF)	Later - If Capacitor is required
	Description of automatic switching	Later - If Capacitor is required
	Anticipated switching restrictions	Later - If Capacitor is required
Shunt Reactors Complete one table for each type of shunt reactor	***Identifier***	Later - If Reactor is required
	Station	K2 Wind CGS
	Manufacturer	Later - If Reactor is required
	Serial number (must be provided prior to Connection)	Later - If Reactor is required
	Rated voltage (kV)	Later - If Reactor is required
	Rated capability (Mvar)	Later - If Reactor is required
	Winding configuration (e.g. delta, wye)	Later - If Reactor is required
	Description of automatic switching	Later - If Reactor is required
	Description of anticipated switching restrictions	Later - If Reactor is required

All files and diagrams provided as attachments are to be signed and sealed by a Professional Engineer.

Connection (Transmission) Facilities (continued)

Bold-Italic	Essential
Bold	Essential for *Hydro One* - to be provided prior to Connection
	Typical values will be assumed if data not provided
	Only required upon request

Circuit Breakers Complete one table for each type of circuit breaker	***Identifier***	T10B0 and T20B0
	Station	K2 Wind CGS
	Manufacturer	Later
	Serial number (must be provided prior to Connection)	Later
	Maximum continuous rated voltage (kV)	575
	Interrupting time (ms)	33
	Interrupting media (e.g. air, oil, SF_6)	SF6
	Rated continuous current (A)	2000
	Rated symmetrical and asymmetrical short circuit capability (3 second rating in kA)	63 / 82
Circuit Switchers Complete one table for each type of circuit switcher	***Identifier***	None
	Station	NA
	Manufacturer	NA
	Serial number (must be provided prior to Connection)	NA
	Maximum continuous rated voltage (kV)	NA
	Interrupting time (ms)	NA
	Interrupting media (e.g. air, oil, SF_6)	NA
	Rated continuous current (A)	NA
	Rated symmetrical short circuit capability (3 sec rating in kA)	NA
Disconnect Switches Complete one table for each type of disconnect switch	***Identifier***	BOL1-L1, T10B0-B0 & T20B0-
	Station	K2 Wind CGS
	Manufacturer	Later
	Serial number (must be provided prior to Connection)	Later
	Maximum continuous rated voltage (kV)	600
	Continuous current rating (amps) (Non-Ground Switches only)	2000
	Rated symmetrical short circuit capability (3 sec rating in kA)	63
Wavetraps	Identifier	None
	Station	NA
	Manufacturer	NA
	Serial number (must be provided prior to Connection)	NA
	Continuous current rating (amps)	NA
DC Lines	***Identifier***	None
	Complete steady state (loadflow) parameters and dynamic	NA
FACTS Devices (e.g., dynamic reactive devices, series compensation, etc.)	***Identifier***	Later - if FACTS is required
	Complete steady state (loadflow) parameters and dynamic parameters	See "SWT-2.3 MW 60Hz Reactive Power Capability Rev 06"

Connection (Transmission) Facilities (continued)

Bold-Italic	Essential
Bold	Essential for *Hydro One* - to be provided prior to Connection
	Typical values will be assumed if data not provided
	Only required upon request

Circuit Breakers Complete one table for each type of circuit breaker	***Identifier***	T20L20
	Station	K2 Wind 230kV CGS
	Manufacturer	Later
	Serial number (must be provided prior to Connection)	Later
	Maximum continuous rated voltage (kV)	245
	Interrupting time (ms)	50
	Interrupting media (e.g. air, oil, SF_6)	SF6
	Rated continuous current (A)	1200
	Rated symmetrical and asymmetrical short circuit capability (3 second rating in kA)	20 / 26
Circuit Switchers Complete one table for each type of circuit switcher	***Identifier***	
	Station	
	Manufacturer	
	Serial number (must be provided prior to Connection)	
	Maximum continuous rated voltage (kV)	
	Interrupting time (ms)	
	Interrupting media (e.g. air, oil, SF_6)	
	Rated continuous current (A)	
	Rated symmetrical short circuit capability (3 sec rating in kA)	
Disconnect Switches Complete one table for each type of disconnect switch	***Identifier***	T20L20-T20, T20L20-L20, L20-
	Station	K2 Wind 230kV CGS
	Manufacturer	Later
	Serial number (must be provided prior to Connection)	Later
	Maximum continuous rated voltage (kV)	245
	Continuous current rating (amps) (Non-Ground Switches only)	1200
	Rated symmetrical short circuit capability (3 sec rating in kA)	40 kA
Wavetraps	Identifier	
	Station	
	Manufacturer	
	Serial number (must be provided prior to Connection)	
	Continuous current rating (amps)	
DC Lines	***Identifier***	
	Complete steady state (loadflow) parameters and dynamic	
FACTS Devices (e.g., dynamic reactive devices, series compensation, etc.)	***Identifier***	
	Complete steady state (loadflow) parameters and dynamic parameters	

LDC Facilities for Embedded Generation

Bold-Italic	Essential
Bold	Essential for *Hydro One* - to be provided prior to Connection
	Typical values will be assumed if data not provided
	Only required upon request

Provide the following information for each LDC existing between the new facility point of connection and the transmitter facilities.

Provide a detailed single line diagram of the connection facilities.

Transmission connection	***Point of connection to Transmitter:*** ***- circuit operating nomenclature or terminal station name***				
	- tower number				
	- GPS coordinates				
Overhead circuit section Complete one table for each section	***Identifier (to be provided on drawing)***				
	Voltage (kV)				
	Length (km)				
	Positive sequence impedance (R, X, B) (R, X in ohms, B in mhos or if in per unit specify bases)				
	Zero sequence impedance (Ro, Xo, Bo) (Ro, Xo in ohms, Bo in mhos or if in per unit specify bases)				
	Mutual Impedance (parallel circuit identifier, Rm, Xm in ohms or if in per unit specify bases)				
Underground Circuit Section Complete one table for each underground circuit section	***Identifier (to be provided on drawing)***				
	Voltage (kV)				
	Length (km)				
	BIL rating				
	Phase conductor size (kcmil)				
	Distance from the "from" terminal (km)				
	Maximum operating temperature (°C)				
	Phase conductor type[7]				
	Insulation type				
	Semiconductor shield type				
	Shield grounding				
	Metallic sheath type				
	External layer type				
	Geometry of all phase				
	Ground resistivity (ohms)				
	Cable construction				
	Installation type (e.g. direct buried, in duct, etc.)				
	Positive sequence impedance (R, X, B) (R, X in ohms, B in mhos or if in per unit specify bases)				
	Zero sequence impedance (Ro, Xo, Bo) (Ro, Xo in ohms, Bo in mhos or if in per unit specify bases)				
	Continuous, 15-Minute and 24-Hour thermal ratings (A)	***Winter***			
		Summer			

[7] If the conductor type is new then additional information may be required.

LDC Facilities for Embedded Generation (continued)

Bold-Italic	Essential
Bold	Essential for *Hydro One* - to be provided prior to Connection
	Typical values will be assumed if data not provided
	Only required upon request

Transformers Complete one table for each transformer	***Number and Identifier of identical units (e.g., 3 units - T1, T2, T3)***						
	Station						
	Serial Number (must be provided prior to Connection)						
	Manufacturer						
	Configuration (e.g. 3 phase unit or three single phase units)						
	Phase Location if single phase (e.g. R, W, B)						
	Cooling types (e.g. ONAN, ONAF, OFAF)						
	Associated Thermal Rating for each cooling type (MVA)						
	Winter (10°C) continuous, 10-Day and 15-Minute thermal ratings	(A)					
		(MVA)					
	Summer (35°C) continuous, 10-Day and 15-Minute thermal ratings[8]	**(A)**					
		(MVA)					
	Connection for each winding H, X, Y (e.g. wye, delta, zig-zag)						
	Rated voltage for each winding, e.g. HV, LV, tertiary (kV)						
	Rated capability for tertiary winding, if applicable (A, MVA)						
	Impedance to ground for each winding H, X, Y (ohms)						
	Off–load taps (kV)						
	In-service off-load tap position (kV)						
	Under-load taps: max tap (kV), min tap (kV), number of steps						
Positive Sequence Impedance	(see IEEE C57.12.90 for measurement techniques)	***Positive Sequence Impedance (%)***	***HX***	***HY***	***XY***		
		R					
		X					
		Base MVA					
Zero Sequence Impedance (only required for transformers with 1 or 2 external neutrals)	H winding energized all others open	Closed Tertiary	H	X	HX	XH	
		R					
		X					
		Base MVA					
	H winding energized X winding shorted	Open Tertiary	H	X	HX	XH	
		R					
		X					
		Base MVA					

[8] If the location of the *project* is north of the City of Barrie, then provide summer ratings based on 30°C and 0 to 4 km/hr wind speed

K2 WIND

PROTECTION AND OPERATING DESCRIPTION

REVISION 08
2012-August-17

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1.0 INTRODUCTION

The following is the preliminary protection and operating philosophy for K2 Wind. The protection system will be revised as required in order to be integrated into the existing Hydro One Network Inc. ("HONI") protection and control systems and to meet the mandated requirements established by Independent Electricity System Operator ("IESO"), Ontario Energy Board's (OEB) Transmission System Code (TSC), the Northeast Power Coordinating Council (NPCC), and the North American Electric Reliability Council (NERC) requirements.

The protection systems will be designed to meet the following criteria:

- Prevent and minimize the chance of injury to personnel,
- Prevent and minimize equipment damage,
- Minimize the duration of a power system outage, and
- Minimize the effect of a disturbance on the power system network.

2.0 GENERAL DESCRIPTION

K2 Wind is a 270 MW wind generation facility that will be constructed in the Municipalities of Ashfield-Colborne and Wawanosh, Ontario. K2 Wind will consist of 142 Siemens 2.3 MW Wind Turbine Generators (WTGs). The maximum generation capacity will be permanently curtailed to a total of 270 MWs by using various de-rated MW output nameplates based on noise compliance requirements. The WTGs will be connected to ten (10) separate 34.5 kV collector feeders, which will have between 13 and 16 WTGs connected to them. Five of the collector circuits will be connected directly into the K2 Wind 500 kV Substation and the other five collector circuits will be connected into an intermediate 230 kV substation and then connected to the K2 Wind 500 kV Substation via an underground cable and then transformed to 500 kV.

K2 Wind will be connected to the Hydro One Network Inc. (HONI) 500 kV transmission line B563L at a new HONI Switching Station (SS), to be named Ashfield SS, located between Bruce GS and Longwood TS, between Tower numbers 234 and 235, which is approximately 61.5 km from Bruce GS. The K2 Wind CGS (Customer Generating Station) will be located adjacent to the new HONI 500 kV Ashfield SS.

The K2 Wind 500 kV CGS consists of three (3) 500 kV motorized disconnect switches, two (2) 500 kV SF6 outdoor circuit breakers, one (1) 500 kV outdoor dual secondary CVT, one (1) 105/140/175 MVA, 530-34.5 kV power transformer, one (1) 96/128/160 MVA, 530-230 kV power transformer, a 500 kV outdoor switchyard including three (3) sets of station class surge arresters, two (2) 230 kV motorized disconnect switches, one (1) 230 kV SF6 outdoor circuit breaker, one (1) 230 kV outdoor dual secondary CVT, a 230 kV outdoor switchyard including two (2) sets of station class surge arresters and a control building, which houses 34.5 kV indoor switchgear, 500 kV and 230 kV redundant protection panels, transfer trip panels, station batteries and battery chargers, inverters, panel boards, SCADA, telemetry equipment, etc. It is anticipated that the 500 kV connection to the HONI transmission line B563L will be a bus bar connection to the new HONI 500 kV SS, which will consist of three circuit breakers in a ring bus configuration that is immediately adjacent to the K2 Wind 500 kV CGS.

The remotely located K2 Wind intermediate 230 kV Substation consists of one (1) 230 kV motorized disconnect switch, one (1) 230 kV outdoor dual secondary CVT, a 230 kV outdoor switchyard including one (1) set of station class surge arresters and a control building, which houses 34.5 kV indoor switchgear, 230 kV redundant protection panels, transfer trip panels, station batteries and battery chargers, inverters, panel boards, SCADA, telemetry equipment, etc. A 230 kV underground cable will connect the K2 Wind 500 kV CGS to the K2 Wind 230 kV Substation.

Bi-directional revenue metering to IESO standards will be provided in both of the 34.5 kV switchgears.

Redundant “A” and “B” protection systems will be provided using protection relays from two different manufacturers or with different algorithms from the same manufacturer in order to reduce the possibility of common mode failures. The redundant protection systems will be physically separated from each other.

The WTG’s are rated 2.3 MW, 690 V, 3 Ph, 60 Hz and the generators are an asynchronous type with full ac-dc-ac conversion. Ten (10) 34.5 kV collector circuits (feeders B10F11 to B1015 and B20F26 to B20F29 and B20F20), will collect the power from the WTGs. Refer the following drawing for details.

A1-161973-00-141-0064 Rev F	Site Plan, Underground Collector Layout, Siemens SWT 2.3 MW, 140 Turbines
A1-161973-00-141-0656-001 Rev F	500 kV Substation, Single Line Diagram, Sheet 1 of 2
A1-161973-00-141-0656-002 Rev F	230 kV Substation, Single Line Diagram, Sheet 2 of 2

3.0 PROTECTION SYSTEM DESCRIPTION

3.1 500 kV Line L1 Protection

The protection system of the 500 kV connection between K2 Wind and the new HONI 500 kV Ashfield SS will be designed to isolate itself from the grid for all faults within the new 500 kV connection L1. K2 Wind protection system is not expected to provide backup protection for the new HONI Ashfield SS.

It is assumed that K2 Wind will use fully redundant line differential protection systems that cover the entire connection between the K2 Wind 500 kV substation and the new HONI 500 kV Ashfield SS. Both “A” and “B” protection systems will also include non-directional phase and neutral over current (51), non-directional phase and neutral high set overcurrent (50) as back-up protection for tripping the local K2 Wind 500 kV circuit breakers T10B0 and T20B0.

The K2 Wind CGS protection system will trip the 500 kV circuit breakers T10B1 and T20B0 simultaneously and initiate their individual circuit breaker failure protection.

Facility monitoring will be integrated into one of the protection relays. The relays will be programmed to functions as master trip (86). This function collects all relevant trip signals electronically and provides a trip signal to the circuit breakers, for redundancy. The relay includes a Sequence of Events Recorder (SER), that time stamps relay element status as well as input and output status.

3.2 Transfer Trip Protection

Redundant transfer trip protection will be provided between K2 Wind and HONI.

The transfer trip signals will be received through two physically separate channels at K2 Wind CGS. Redundant “A” & “B” equipment specified by HONI will be provided at K2 Wind CGS for this purpose.

Transfer trip signals will initiate instantaneous tripping of the both 500 kV circuit breakers T10B0 and T20B0 as well as initiating their circuit breaker failure protections.

A “Generator End Open” (GEO) signal will be transmitted to HONI through both transfer trip communication systems, when either both 500 kV circuit breakers T10B0 and T20B0 are open, or when the 500 kV motorized disconnect switch B0L1-B0 is open, or when both 500 kV motorized disconnect switches T10B0-B0 and T20B-B0 are open, or when transformer secondary circuit breakers B10T10 and B20L20 are both open or a combination of the above that ensures that all generators are disconnected from the grid.

3.3 Special Protection System (SPS) and Generation Rejection (GR)

K2 Wind Generation Rejection (GR) will be initiated when a SPS GR signal is received from HONI via either of the redundant communication circuits.

The GR protection system will be a fully redundant generation scheme in compliance with requirements established by IESO and HONI.

The GR signals will trip all of the 34.5 kV collector lines circuit breakers (B10F10 to B10F14 and B20F20 to B20F24) as well as initiating their circuit breaker failure protections.

The GR protection system will include a circuit breaker failure protection that monitors all of the collector circuit breakers and if one of them fails to trip then the associated transformer secondary circuit breaker B10T10 or B20T21 will be tripped.

3.4 500 kV Circuit Breakers T10B0 and T20B0 Failure Protection

The 500 kV circuit breakers T10B0 and T20B0 will each be provided with redundant circuit breaker failure protection systems. The circuit breaker failure protection will be initiated from all protection signals that trip the circuit breaker, except from other circuit breaker failure protections. The circuit breaker failure relays will also issue an early trip signal to the circuit breaker being tripped. The circuit breaker failure signal will sealed in for 45 seconds.

A 500 kV transformer circuit breaker failure will send a transfer trip (circuit breaker failure) signal through both transfer trip communication systems to HONI's new Ashfield SS, as well as initiate opening of the other 500 kV transformer circuit breaker, initiate opening of the failed 500 kV circuit breaker motorized disconnect switch T10B0-B0 or T20B0-B0 and initiate opening of the associated transformer secondary circuit breaker B10T10 or T20L20.

The 500 kV circuit breakers will be provided with dual trip coils with supervision of both trip coil circuits.

3.5 500 kV Power Transformers T10 and T20 Protection

The two (2) power transformers, T10 and T20, will be provided with fully redundant ("A" and "B") protection systems. Both protection systems will include differential protection (87T) with non-directional phase and neutral over current (51) and non-directional phase and neutral high set overcurrent (50) as back-up. Restricted earth fault protection for all grounded wye windings is included in both "A" & "B" protection relays.

The 500 kV transformer protections will trip the associated 500 kV circuit breaker T10B0 or T20B0 and associated transformer secondary circuit breaker B10T10 or T20L20, as well as initiate the corresponding circuit breaker failure protections in both the 500 kV and transformer secondary circuit breakers.

Facility monitoring will be integrated into one of the protection relays. These relays will be connected to the Station Logic Relay for remote trips and other logic controls. The relays will be programmed to functions as master trip (86) for the respective feeder. This function collects all the relevant trip signals electronically and provides trip signal to the circuit breakers.

The relay includes a Sequence of Events Recorder (SER) and is capable of providing system disturbance reports that include voltage and current pre- and post-fault waveforms, relay element status as well as input and output status. The disturbance reports will be retrievable for oscillographic presentation and evaluation from a front connected PC or remotely through the communication system.

3.6 230 kV Circuit Breaker T20L20 Failure Protection

The 500 kV transformer T20 230 kV secondary circuit breaker T20L20 will be provided with redundant circuit breaker failure protection systems. On detection of a circuit breaker failure it will trip both the associated 500 kV circuit breaker T20B0 and the transformer T21 secondary circuit breaker B20T21 via a transfer trip system.

The circuit breaker failure relay will also issue an early trip signal to the circuit breaker T20L20.

The relay includes a Sequence of Events Recorder (SER) and is capable of providing system disturbance reports that include voltage and current pre- and post-fault waveforms, relay element status as well as input and output status. The disturbance reports will be retrievable for oscillographic presentation and evaluation on front connected PC or remotely through the communication system.

3.7 230 kV Transmission Line L20 Protection

The protection system for the 230 kV underground cable transmission line L20 between K2 Wind 500 kV substation and the intermediate 230 kV substation will be designed to isolate itself for all faults within the transmission line.

The 230 kV transmission line protection will consist of fully redundant line differential protection systems that cover the entire 230 kV transmission line between K2 Wind 500 kV substation and the intermediate 230 kV substation. The protection will trip the 230 kV circuit breaker T20L20 and transformer T21's 34.5 kV secondary circuit breaker B20T21 immediately and simultaneously initiate their individual circuit breaker failure protection systems. Both "A" and "B" protection systems will also include non-directional phase and neutral over current (51), non-directional phase and neutral high set overcurrent (50) as back-up protection for tripping the local K2 Wind 230 kV circuit breaker T10L20 and transformer T21's secondary circuit breaker B20T21.

Facility monitoring will be integrated into one of the protection relays. The relays will be programmed to functions as master trip (86). This function collects all relevant trip signals electronically and provides a trip signal to the circuit breakers, for redundancy. The relay includes a Sequence of Events Recorder (SER), that time stamps relay element status as well as input and output status.

3.8 230 kV Power Transformer T21 Protection

The 230 kV power transformer T21 will be provided with fully redundant "A" and "B" protection systems. Both protection systems will include differential protection (87T) with non-directional phase and neutral over current (51) and non-directional phase and neutral high set overcurrent (50) as back-up. Restricted earth fault protection for all grounded wye windings is included in both "A" & "B" protection relays.

The 230 kV transformer protection systems will trip the associated 230 kV circuit breaker T20L20 via redundant transfer trip systems and T21 transformer secondary circuit breaker B20T21, as well as initiate the corresponding circuit breaker failure protections in both the 230 kV and 34.5 kV transformer secondary circuit breakers.

Facility monitoring will be integrated into one of the protection relays. These relays will be connected to the Station Logic Relay for remote trips and other logic controls. The relays will be programmed to functions as master trip (86) for the respective feeder. This function collects all the relevant trip signals electronically and provides trip signal to the circuit breakers.

The relay includes a Sequence of Events Recorder (SER) and is capable of providing system disturbance reports that include voltage and current pre- and post-fault waveforms, relay element status as well as

input and output status. The disturbance reports will be retrievable for oscillographic presentation and evaluation from a front connected PC or remotely through the communication system.

3.9 34.5 kV Transformer Secondary Circuit Breakers B10T10 and B20T21 Failure Protection

The transformer secondary circuit breakers will each be provided with a non-redundant circuit breaker failure protection system. On detection of a circuit breaker failure it will trip either the associated 500 kV or 230 kV circuit breaker T10B0 or T20L20 and all of the associated 34.5 kV collector circuit breakers or the T21 transformer secondary circuit breaker B20T21.

The circuit breaker failure relay will also issue an early trip signal to the circuit breaker B10T10 or T20L20.

The relay includes a Sequence of Events Recorder (SER) and is capable of providing system disturbance reports that include voltage and current pre- and post-fault waveforms, relay element status as well as input and output status. The disturbance reports will be retrievable for oscillographic presentation and evaluation on front connected PC or remotely through the communication system.

3.10 34.5 kV Buses B10 and B20 Protection

The 34.5 kV busses will be provided with differential protection (87B) and back up non-directional phase and neutral over current protection. This differential protection is instantaneous and will trip the associated transformer secondary circuit breaker B10T10 or B20T21, initiate its circuit breaker failure protection, as well as trip the associated 34.5 kV bus feeder circuit breakers and reactive device circuit breakers, if installed.

3.11 34.5 kV Zig-Zag Grounding Transformer GT10 Protection

Zig-Zag grounding transformer GT10 will be protected by non-directional phase over current (51), non-directional phase high set definite time (50) and non-directional restricted neutral over current (51N). The over current settings will be coordinated with the downstream protection relays.

The protection will trip the associated 500 kV circuit breaker (T10B0), the associated 34.5 kV transformer secondary circuit breaker B10T10 and initiate corresponding 500 kV and 34.5 kV circuit breaker failure protections.

3.12 Station Auxiliary Transformers T11 and T22 Protection

The 34.5 kV circuit breakers for the station auxiliary transformers at K2 Wind CGS will be equipped with non-directional phase over current (51), non-directional phase high set definite time (50) and non-directional residual neutral over current (51N) protections. The over current settings will be coordinated with the downstream protection. The circuit breakers will be provided with a trip circuit supervision facility.

3.13 WTG Collector Circuit Breakers B10F11 to B10F15 and B2F26 to B20F29 and B20F20 Protection

The 34.5 kV circuit breakers for WTG collector feeder lines and dedicated feeder grounding transformers at K2 Wind will be equipped with non-directional phase over current (51), non-directional phase high set definite time (50) and non-directional residual neutral over current (51N) protections. The over current settings will be coordinated with the downstream protection. The circuit breakers will be provided with a trip circuit supervision facility.

3.14 Reactive Device Circuit Breaker Protection

If reactive devices or capacitor banks are required, then their 34.5 kV circuit breakers will be equipped with non-directional phase over current (51), non-directional phase high set definite time (50), non-directional residual neutral over current (51N) and capacitor bank unbalance current protections. The over current settings will be coordinated with the downstream protection. The circuit breakers will be provided with a trip

circuit supervision facility.

Capacitors will be provided with fast acting, current limiting fuses. Single fuse failure will be alarmed and a second fuse failure will trip the capacitor bank circuit breaker.

Reactive device circuit breakers will be tripped when a HONI transfer trip or GR signal is received, in addition to transformer and bus protection trips.

3.15 Interlocks

The following protection features / interlocks will be provided for the disconnect switches (DS) / circuit breakers:

- The disconnect switches B0L1-L1, T10B0-B0, T20B0-B0 and L20-T20 will be mechanically interlocked with the associated circuit breakers, such that the DS can be operated only if the associated circuit breaker(s) is (are) open. However, this interlock is bypassed during circuit breaker failure, to open the motorized disconnect switch.
- If capacitor banks are provided, their grounding switches will be mechanically interlocked with the associated upstream circuit breaker. Grounding switches can be operated only when the circuit breaker is in disconnected position. Capacitor bank circuit breakers can be racked in or out of the operate position only after opening the grounding switch.

3.16 Circuit Breaker Auto-Reclosure

Automatic circuit breaker reclosing will not be implemented for the 500 kV circuit breakers, the 230 kV circuit breaker or the 34.5 kV circuit breakers.

3.17 Wind Turbine Generators

The WTGs are Induction type generators, having the following details / specifications.

Make: Siemens
Model: Mk ll
Rating: Nominal 2.3 MW, 690 V, 60 Hz, with each WTG having a permanent noise de-rating per document “K2 Wind – WTG Layout 194 and Rated Power – 2012-05-04.xls”.

Each WTG includes the following minimum protections:

- Under and over voltage protection
- Under and over frequency protection, and
- Overcurrent

3.18 Communication

Two fibre optic cables, routed via two different physical routes, will be installed between the new HONI 500 kV Ashfield SS and the K2 Wind 500 kV CGS for transfer trip protection between K2 Wind CGS and HONI, or using other means as requested by HONI.

IESO will provide leased telephone lines for their telemetry at K2 Wind CGS. Dial-up or cellular lines will be provided for IESO Revenue Metering and FRAD maintenance.

Telemetry signals to HONI OGCC will be provided via either a separate fibre optic cable between K2 Wind 500 kV CGS and the new HONI 500 kV Ashfield SS, or via a leased S4T4 telephone line directly between K2 Wind and HONI OGCC.

HONI and IESO telemetry will use DNP protocol, unless otherwise directed.

K2 Wind will utilize IEC 61850 and Modbus over TCP/IP protocols for trips and communication over the internal LAN system, or other similar automation systems and protocols.

Additional telephone lines will be provided for K2 Wind voice and SCADA services.

Two fibre optic cables, routed within the same trench, will be installed between the K2 Wind 500 kV CGS and the intermediate 230 kV substation for transfer trip protection as well as for SCADA and other functions.

3.19 HONI / IESO Telemetry

The following minimum parameters will be provided to HONI & IESO for telemetry:

500 kV:	MW, MVAr, kV
34.5 kV:	kV
Status:	500 kV and 230 kV motorized line disconnect switches, 500 kV and 230 kV circuit breakers, and 34.5 kV transformer secondary circuit breakers.

3.20 Disturbance Recorder

A disturbance recorder will be provided in accordance with HONI requirements for detection, monitoring and recording of power system disturbances. The disturbance recorder triggering parameters will include 500 kV voltage, 230 kV voltages, 34.5 kV voltages, 500 kV current and 500 kV frequency.

The disturbance recorder will record all three single phase voltages, currents, as well as frequency and status of the 500 kV, 230 kV and 34.5 kV system equipment.

3.21 DC Auxiliary Supplies

Redundant dc auxiliary supplies will be provided, each with one dc panel board, one battery and two battery chargers that are supplied from different ac panel boards. The dc system will also include a manual transfer switch to connect the two dc panel boards. The “A” and “B” dc systems will be kept physically separate and only supply the associated “A” or “B” protection systems.

4.0 OPERATING SYSTEM DESCRIPTION

4.1 General

K2 Wind will generally be operated as an unmanned substation. Remote monitoring of the station and generation, alarming and limited control of the facilities will be provided through a dedicated high speed T1 line to the Pattern Energy control center located in Houston Texas. Communication between K2 Wind System Operators, IESO and HONI will be carried out as required, in normal day-to-day operation of K2 Wind.

In order to fulfill the requirements for response to local operation, Ontario licensed operator(s), located in the area will be retained as the “on call” operator(s). The trained operator will be available on short notice to inspect the station and perform switching operations. There will also be maintenance crews available during normal working hours.

An operation agreement, in accordance with HONI requirements, and the Standard Protection Code, will detail the lockout/tag out and switching procedures, provide contact information, telephone call out numbers, and similar information.

Pattern Energy will establish operation and training standards for the Wind Farm project in accordance with

the applicable NERC standards. Pattern has a trained operations staff manning a 24 hour operations center that will be monitoring the project station and generators. The experienced operations manager and his staff are responsible for NERC compliance on all of the Pattern generation projects including this joint Samsung/Pattern K2 Wind project. All Pattern projects will be operated and maintained to ensure compliance with NERC requirements.

4.2 Operational Control

The WTGs will be controlled via the Siemens Remote Control and Monitoring system.

The 500 kV motorized disconnect switches and 500 kV, 230 kV and 34.5 kV circuit breakers will be normally operated closed.

The K2 Wind CGS main 34.5 kV bus voltages will be automatically maintained by the Siemens Remote Control and Monitoring system. The voltage control of the wind farm is managed by two Siemens control loops. The inner loop controls the 690 V on each WTG LV bus and is carried out by each individual wind turbine controller. The outer loop controls the 34.5 kV systems and is carried out by the Siemens Remote Control and Monitoring system. This system receives feedback of the bus voltage and is compared to the target levels for the wind farm controller and voltage references are distributed to the wind turbine controllers at the individual wind turbines. This means that the wind turbine controller responds to the latest reference from the Siemens Remote Control and Monitoring system and will maintain this on the 690 V systems. New IESO voltage set points will be inputted remotely into the Siemens Control and Monitoring system by the K2 Wind operators.

4.3 Reactive Power Devices and Capacitor Bank Control (if required)

If one or more reactive power devices or capacitor banks are required in order to meet IESO reactive power requirements, then they would be automatically controlled by an independent PLC that would monitor the K2 Wind reactive power output and would automatically control the reactive devices and the capacitor banks. The reactive devices and capacitor bank control logic would be based on minimizing the WTG steady state reactive power output, as well as ensuring that the voltage within each Siemens WTG 690 V system remains within its operational limit. The automatic control system would include a timer in order to prevent the capacitor banks from being re-energized before they have fully discharged, as well as a manual over-ride of the automatic control.

In the event that the PLC system becomes unavailable, the reactive devices and capacitor bank protective relays will maintain the bus voltage to a current value.

4.4 Maintenance

Wind turbine maintenance has been contracted to Siemens for a period of 2 years. The project will maintain a maintenance building and facility in the area of the project with critical Balance of Plant and wind turbine spare parts either on site or contracted to be quickly available.

General maintenance of the substation equipment will be contracted to a qualified high voltage electrical maintenance firm. A stock of spare parts will be maintained in the area. Pattern site management personnel will be high voltage trained and capable of switching activities as required.

Protection circuits will be tested and certified at the time periods outlined in the connection agreement by a qualified electrical testing firm. All electrical maintenance will be carried out in accordance with the Pattern HV Maintenance procedure which outlines the tasks and frequencies for maintenance of onsite electrical systems. All other onsite maintenance will be carried out to ensure reliability of the wind farm.

TRIPPING MATRIX

P & C SCHEMES / EQUIPMENT	500 kV Line L1 (87L)	500 kV TTR From HONI	SPS (GR)	GEO	500 kV Cir Bkr T10B0 Failure	500 kV Cir Bkr T20B0 Failure	500 kV Tfmrs T10 & T20 (87T)	230 kV Cir Bkr T20L20 Failure	230 kV Line L20 (87L)	230 kV Tfmr T21 (87T)	34.5 kV Tfmr Sec CB B10T10 Failure	34.5 kV Tfmr Sec CB B20T21 Failure	34.5 kV Bus B10 (87B)	34.5 kV Bus B20 (87B)	34.5 kV Grd Tfmr GT10 (50, 51 & 51N)	34.5 kV Feeder Circuit Bkr Failure
500 kV Transformer Circuit Breaker – T10B0	T / IBF	T / IBF		O	ET	T	T / IBF T10				T				T	
500 kV Transformer Circuit Breaker – T20B0	T / IBF	T / IBF		O	T	ET	T / IBF T20	T								
500 kV Tfmr Motorized DSs – T10B0-B0 & T20B0-B0				O	T	T										
230 kV Transformer Circuit Breaker – T20L20				O		T	T / IBF T20	ET	T / IBF	T / IBF		T				
34.5 kV Transformer Sec. Circuit Breaker: B10T10				O	T		T / IBF T10				ET		T / IBF		T / IBF	T
34.5 kV Transformer Sec. Circuit Breaker: B20T21				O				T	T / IBF	T / IBF		ET		T / IBF		T
34.5 kV Collector Circ Bkrs: B10F10 to B10F14			T / IBF	O							T		T		T	
34.5 kV Collector Circ Bkrs: B20F20 to B20F24			T / IBF	O								T		T	T	
34.5 kV Station Serv Tfmr Circ Bkr: B10T11													T		T	
34.5 kV Station Serv Tfmr Circ Bkrs: B20T22														T	T	
34.5 kV Reactive Device Circ Bkrs: - If required			T / IBF								T	T	T	T	T	T
Send Signal to HONI:	TTS		S	S	TTS	TTS										

T – TRIP	**BF – BREAKER FAILURE**	**GR – GENERATION REJECTION**	**GEO – GENERATOR END OPEN**
ET – EARLY TRIP	**TTR – TRANSFER TRIP RECEIVE**	**SPS – SPECIAL PROTECTION SYSTEM**	**S – SEND STATUS SIGNAL to HONI**
IBF – INITIATE BREAKER FAILURE	**TTS – TRANSFER TRIP SEND**	**LEO – 500 kV LINE END OPEN**	**O – BREAKER or DISC SWITCH OPEN**

HONI ASHFIELD SS

HONI

K2 WIND

500kV TRANSMISSION LINE L1
50M OVERHEAD RIGID BUS

90-L1
800kV, 3000A
1800kV BIL,
70kA MOM.

SAD
STATION CLASS
DUTY 420kV
MCOV 335kV

CVT10

TO MAINTENANCE (DIAL-UP LINES)

TO TELEDUTY (TEL LEASE LINES)

TO TELEDUTY (TEL LEASE LINES)

TO HVDC LIGHTING LIMITED PARTNERSHIP

SERVER PANEL BY SIEMENS

TO HONI ASHFIELD SS 500kV TRANSMISSION LINE DIFFERENTIAL RELAYS

HONI TRANSFER TRIP "A" COMMUNICATION SYSTEM

HONI TRANSFER TRIP "B" COMMUNICATION SYSTEM

DIAL-UP LINE

ENTERGIE NETWORKS (DIAL-UP LINES)

TO

DSU / FRAD

MODEM

MODEM & SECURITY GATEWAY

STATION SERVER SEL-3354

GMS PANEL BY SIEMENS

FROM SEL & GE RELAYS

TRANSFER TRIP "A" PROTECTION

TRANSFER TRIP "B" PROTECTION

STATION TELEPHONE

BUS B0

T10B0-B0
800kV, 3000A
1800kV BIL,
70kA MOM.

T10B0
575kV, 3000A,
1800kV BIL, 63kA,
2 CYCLE

A87T-50-51
GE 160

A50BF-51
GE C60

DFR
TESLA 3000

B87T-52-51
SEL 487E

B50BF-51
SEL 352

8A10
STATION CLASS
DUTY 420kV
MCOV 335kV

T10
105/140/175MVA
@ 65°C RISE
530kV-34.5kV
Z=7.5% ON
105MVA BASE

B10T10
38kV, 3000A,
200kV BIL, 31.5kA

B50BF-51
GE C60

DFR
TESLA 3000

SIEMENS
GMS PANEL

B10T10-B10
38kV, 3000A
200kV BIL, 130kA Mom.

SA11
STATION CLASS

VT10

38kV, 3000A, 150kV BIL, 31.5kA SWITCHGEAR BUS "B10"

REACTOR (MAIN)

REACTOR (ALTERNATE)

TELEPHONE INTERFACE

B1T11

B10T15

B10T14

B10T13

B10T12

B10T11

B10T10

FEEDER PROTECTION GE F60

87B-51
GE B90

GRD. TFMR. PROTECTION GE F60

210-ZAC
GROUNDING TRANSFORMER

CCT #5

CCT #4

CCT #3

CCT #2

CCT #1

TO HONI ASHFIELD SS.

NEXT WTG

WTG (TYPICAL)

T11
STATION SERVICE TRANSFORMER

ATS10

ATS11

REVENUE METER

T12

"A1" AC PANELBOARD

"A2" AC PANELBOARD

"B1" AC PANELBOARD

BC10 BATTERY CHARGER

BB10 BATTERY BANK

BB11 BATTERY BANK

BC11 BATTERY CHARGER

BC12 BATTERY CHARGER

BC13 BATTERY CHARGER

MTS10

"A" DC PANELBOARD

"B" DC PANELBOARD

FROM HYDRO ONE DISTRIBUTION LINE

T20B0-B0
800kV, 2000A
1800kV BIL,
70kA MOM

T20B0
575kV, 2000A,
1800kV BIL, 63kA,
2 CYCLE

A87T-50-51
GE 160

A50BF-51
GE C60

DFR
TESLA 3000

B87T-56-51
SEL 487E

B50BF-51
SEL 352

5A20
STATION CLASS
DUTY 420kV
MCOV 335kV

T20
96/128/160MVA
538kV-230kV
+800/-1050kV BIL
Z=7.8% ON
96 MVA BASE

5A21
STATION CLASS
DUTY 256kV
MCOV 209kV

T20L20-T20
245kV, 1200A
1050kV, 40kA

VT20

T20L20
245kV, 1200A
1050kV BIL, 40kA
3 CYCLE

B87L-21-51
SEL 311L

B50BF-51
SEL 451

A87L-21-51
GE L90

A50BF-51
GE C90

DFR
TESLA 3000

T20L20-L20
245kV, 1200A
1050kV, 40kA

5A22
STATION CLASS
DUTY 258kV
MCOV 209kV

CONTINUED ON SHEET 002

TRANSMISSION LINE L20
TO TRANSFORMER T21

TO
SEL 311L IN
230kV SUBSTATION

TO
GE L90 IN
230kV SUBSTATION

B. J. NICHOLSON
100161408
27/Aug/12
LICENSED PROFESSIONAL ENGINEER
PROVINCE OF ONTARIO

REV	DDMMMYY	REVISION / ISSUE DESCRIPTION	DRN	CHK	APP	APP	APP
H	27AUG12	MINOR CHANGES - ISSUED TO IESO	RS	FC	BJN	JHM	
G	23AUG12	MINOR CHANGES - ISSUED TO IESO	RS	FC	BJN	JHM	
F	15AUG12	CHANGED 130kV TO 230kV	RS	FC	BJN	JHM	
E	05JUL12	CAPACITOR BANKS & STATCOM REMOVED	RS	FC	BJN	JHM	
D	29SEP11	MINOR CHANGES - ISSUED TO IESO	RS	FC	BJN	JHM	
C	22SEP11	MINOR CHANGES - ISSUED TO CLIENT	RS	FC	BJN	JHM	
B	16SEP11	MINOR CHANGES - RE-ISSUED FOR REVIEW	RS	FC	BJN	JHM	
A	26AUG11	ISSUED FOR REVIEW	RS	FC	BJN	JHM	

REF	NUMBER	TITLE
		REFERENCES

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PRELIMINARY

APPROVED FOR _____

CLIENT PROJECT MGR. DEPARTMENT MGR. PROJECT MGR.

PROJECT PHASE

PROJECT NO.	ACTIVITY NO.
161973	
SCALE	PACKAGE CODE
NTS	

	BY	DDMMMYY
DSN	B.J.N.	18AUG11
DRN	R.S.	19AUG11
CHK	F.C.	26AUG11
APP	J.H.M.	26AUG11

K2 WIND ONTARIO LIMITED PARTNERSHIP

AREA: K2 WIND PROJECT

SUBJECT: 500kV SUBSTATION SINGLE LINE DIAGRAM SHEET 1 OF 2

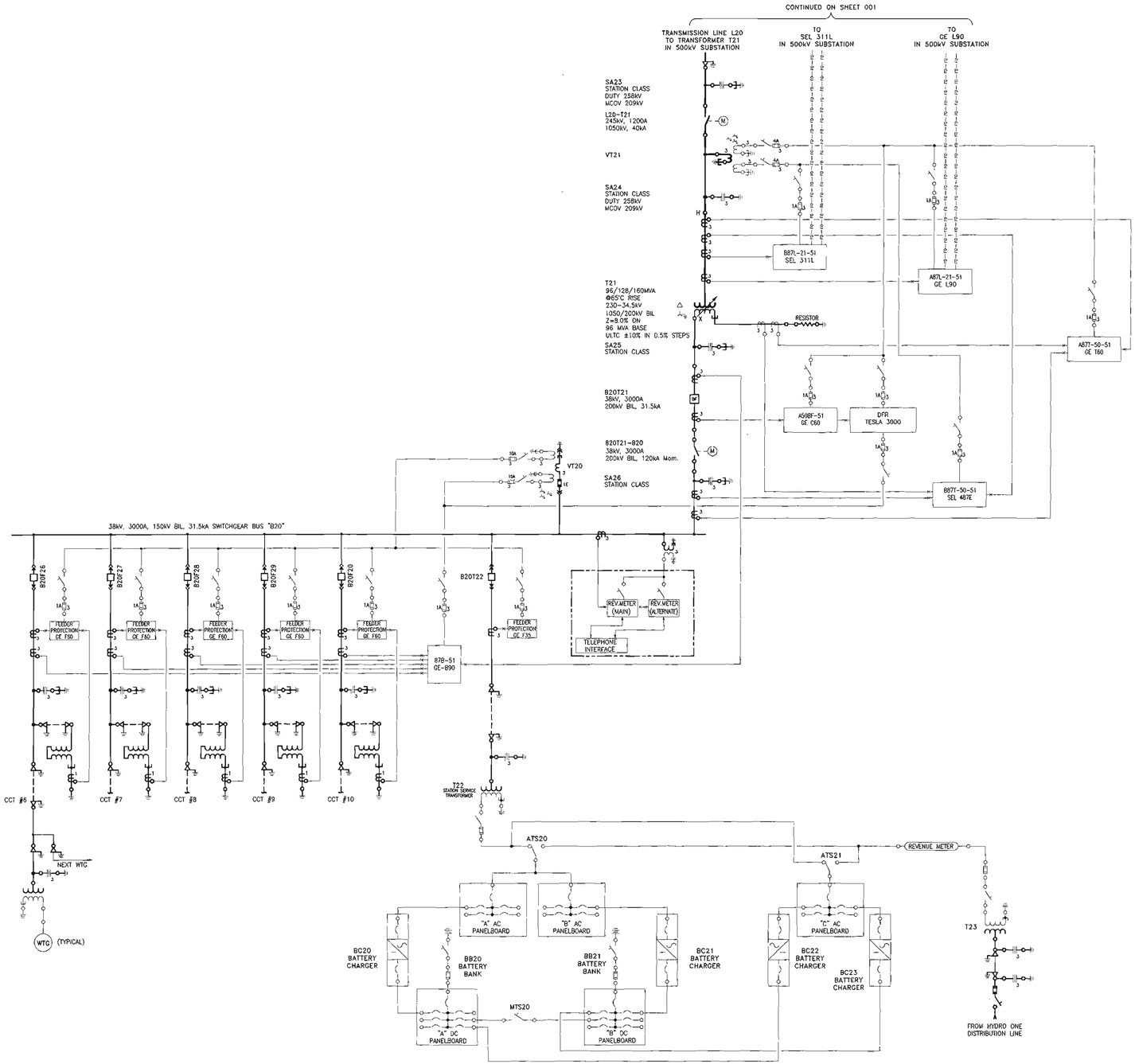
CLIENT DWG. NO.

DRAWING NO. A1-161973-00-141-0656-001

REV. H

amec

SAVED: 27-Aug-12 9:40 AM USER: SHAHBAZIAN, RAZMIK PLOTTED: 27-Aug-12 9:40 AM



REV	DDMMMYY	REVISION / ISSUE DESCRIPTION	DRN	CHK	APP	APP	APP	APP
H	27AUG12	MINOR CHANGES - ISSUED TO IESO	RS	FC	BJN	JHM		
G	23AUG12	MINOR CHANGES - ISSUED TO IESO	RS	FC	BJN	JHM		
F	15AUG13	CHANGED 150kV TO 230kV	RS	FC	BJN	JHM		
E	27JUN12	CAPACITOR BANKS & STATCOM REMOVED	RS	FC	BJN	JHM		
D	29SEP11	MINOR CHANGES - ISSUED TO IESO	RS	FC	BJN	JHM		
C	22SEP11	MINOR CHANGES - ISSUED TO CLIENT	RS	FC	BJN	JHM		
B	16SEP11	MINOR CHANGES - RE-ISSUED FOR REVIEW	RS	FC	BJN	JHM		
A	26AUG11	ISSUED FOR REVIEW	RS	FC	BJN	JHM		

REF	NUMBER	TITLE
		REFERENCES

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CLIENT PROJECT MGR. DEPARTMENT MGR. PROJECT MGR.

PROJECT PHASE

PROJECT NO.	ACTIVITY NO.
161973	

SCALE	PACKAGE CODE
NTS	

	BY	DDMMMYY
DSN	B.J.N.	18AUG11
DRN	RS	19AUG11
CHK	F.C.	26AUG11
APP	J.H.M.	26AUG11

K2 WIND ONTARIO LIMITED PARTNERSHIP

AREA: K2 WIND PROJECT

SUBJECT: 230kV SUBSTATION SINGLE LINE DIAGRAM SHEET 2 OF 2

CLIENT DWG. NO.

DRAWING NO.: A1-161973-00-141-0656-002

REV.: G

LICENSED PROFESSIONAL ENGINEER
B. J. NICHOLSON
27 AUG 12
PROVINCE OF ONTARIO

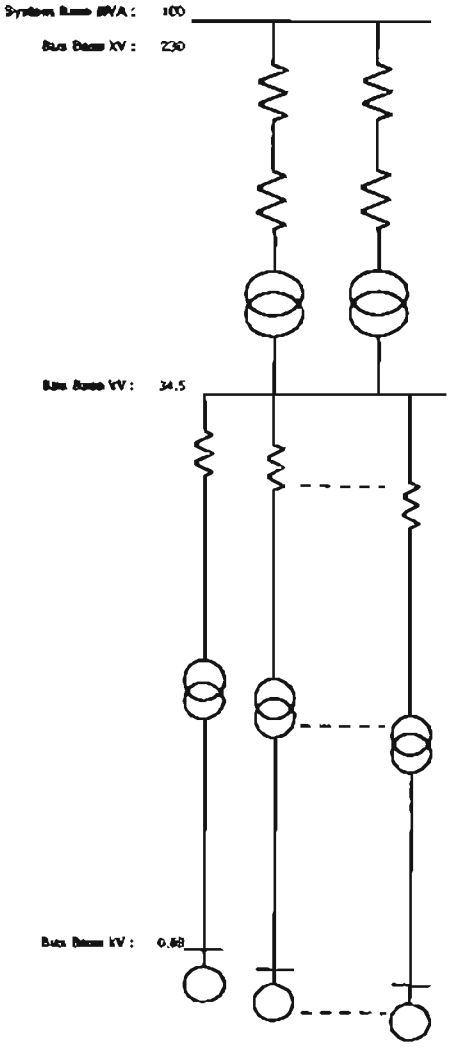
PLOTTED: 27-Aug-12 9:48 AM USER: SHAHBAZIAN, RAZMIK
SAVED: 27-Aug-12 9:47 AM

K2 Wind Turbine Locations and Power Ratings

Feeder ID	Turbine ID	X (m)	Y (m)	Rated power (kW)
Circuit 1				
B10F11	200	450069	4851493	1903
B10F11	201	450229	4851903	2030
B10F11	202	449443	4852755	1903
B10F11	204	449101	4853160	1903
B10F11	205	449406	4853172	1903
B10F11	206	449199	4853517	2030
B10F11	207	445595	4853991	2300
B10F11	219	446527	4856681	2300
B10F11	225	450599	4856895	1903
B10F11	226	450331	4859151	2126
B10F11	227	450035	4859261	1824
B10F11	228	449697	4859327	1903
B10F11	231	451718	4861031	2030
B10F11	232	452040	4861032	1903
B10F11	235	451953	4861469	1903
B10F11	314	445927	4853859	2300
# of Turbines	16		Subtotal (kWs)	32164
Circuit 2				
B10F12	208	449193	4855164	1903
B10F12	209	448798	4855199	1903
B10F12	212	448318	4855502	1903
B10F12	213	449347	4855577	1903
B10F12	214	447699	4853050	1903
B10F12	215	447982	4855855	1903
B10F12	216	448629	4856016	1903
B10F12	217	448267	4856000	1903
B10F12	218	449596	4856514	1903
B10F12	221	449592	4857740	1903
B10F12	223	449643	4858049	1903
B10F12	230	450822	4860486	1824
B10F12	354	448296	4852955	1903
B10F12	355	448030	4853186	1903
# of Turbines	14		Subtotal (kWs)	26563
Circuit 3				
B10F13	245	452350	4862765	1903
B10F13	246	452644	4862507	1824
B10F13	247	452896	4862922	2126
B10F13	248	452124	4863008	1824
B10F13	249	452664	4863125	2030
B10F13	253	453103	4863497	1903
B10F13	261	454832	4864741	1903
B10F13	273	454770	4884340	1903
B10F13	274	454124	4865896	1903
B10F13	276	454401	4866273	1824
B10F13	277	453573	4866245	1903
B10F13	283	453850	4866500	1903
B10F13	301	455326	4867385	2030
B10F13	305	454565	4867531	1903
# of Turbines	14		Subtotal (kWs)	26882
Circuit 4				
B10F14	229	448407	4861873	2030
B10F14	233	449009	4861401	1903
B10F14	237	448697	4861743	1903
B10F14	257	444818	4864314	1903
B10F14	263	444486	4865005	2126
B10F14	264	444907	4865047	1903
B10F14	270	444808	4865389	1903
B10F14	272	444346	4865785	1903
B10F14	295	444298	4867170	1903
B10F14	296	444632	4867170	1903
B10F14	299	445047	4867337	1903
B10F14	360	444603	4863989	1824
B10F14	379	446038	4863431	1824
B10F14	380	444754	4861772	2030
# of Turbines	14		Subtotal (kWs)	26961
Circuit 5				
B10F15	236	449375	4861731	1903
B10F15	238	448206	4862179	2221
B10F15	239	449078	4861851	1903
B10F15	252	448017	4865555	1824
B10F15	260	445492	4864730	1903
B10F15	262	448826	4864993	1903
B10F15	265	445555	4865078	1824
B10F15	266	445229	4865118	1903
B10F15	269	449207	4865217	1903
B10F15	271	448470	4865410	1824
B10F15	275	447782	4865249	1903
B10F15	280	446291	4866337	1903
B10F15	282	447748	4866449	2030
B10F15	373	447693	4865691	1824
# of Turbines	14		Subtotal (kWs)	26771

Feeder ID	Turbine ID	X (m)	Y (m)	Rated power (kW)
Circuit 6				
B20F26	210	448212	4862930	2030
B20F26	251	448106	4863267	1824
B20F26	254	448390	4863624	1824
B20F26	289	447281	4866949	1903
B20F26	291	447004	4867074	1903
B20F26	309	444574	4867752	1903
B20F26	312	444424	4868091	1903
B20F26	313	444979	4868333	1903
B20F26	315	444856	4868703	1903
B20F26	334	444196	4870282	2221
B20F26	336	444731	4870544	1824
B20F26	338	444414	4870526	2030
B20F26	349	443358	4873865	1903
B20F26	350	443674	4873854	2126
# of Turbines	14		Subtotal (kWs)	27200
Circuit 7				
B20F27	323	448152	4869619	1903
B20F27	325	447844	4869827	1903
B20F27	332	448132	4870157	1903
B20F27	335	449579	4870379	1903
B20F27	339	449482	4870600	1903
B20F27	340	449894	4870969	2030
B20F27	341	450254	4871110	1903
B20F27	342	449778	4871359	1903
B20F27	343	450567	4871372	1903
B20F27	344	450219	4871563	1903
B20F27	345	449632	4871787	1903
B20F27	346	450079	4871964	1903
B20F27	347	449169	4872096	1903
B20F27	348	448708	4872653	2126
# of Turbines	14		Subtotal (kWs)	26992
Circuit 8				
B20F28	211	448141	4866122	1824
B20F28	279	448361	4866429	1903
B20F28	285	448089	4866595	1903
B20F28	288	446444	4866948	1903
B20F28	294	448059	4867123	1903
B20F28	300	448825	4867373	1824
B20F28	306	448543	4867522	1824
B20F28	308	448385	4867736	1903
B20F28	317	447144	4869137	1903
B20F28	318	446342	4869269	1903
B20F28	319	445951	4869417	1903
B20F28	326	446426	4869875	1903
B20F28	327	446060	4869832	1903
B20F28	362	446386	4869573	1824
# of Turbines	14		Subtotal (kWs)	26328
Circuit 9				
B20F29	256	449977	4864166	1903
B20F29	259	449882	4864644	2030
B20F29	267	450282	4865124	1903
B20F29	281	451953	4866439	1903
B20F29	284	451128	4866599	1903
B20F29	286	450448	4866861	1903
B20F29	290	452317	4867020	1903
B20F29	292	451357	4866977	2030
B20F29	297	452041	4867227	1903
B20F29	298	450581	4867214	1903
B20F29	304	452597	4867447	1903
B20F29	307	448682	4867545	2030
B20F29	311	448951	4867924	1903
# of Turbines	13		Subtotal (kWs)	25120
Circuit 10				
B20F20	240	453690	4866821	1824
B20F20	302	451091	4867420	1903
B20F20	310	451335	4867817	1903
B20F20	320	453297	4869343	1903
B20F20	321	453702	4869366	1903
B20F20	322	453004	4869482	1903
B20F20	324	452488	4869763	2300
B20F20	328	453691	4869855	1903
B20F20	329	450203	4869995	1903
B20F20	330	453321	4870110	1903
B20F20	333	452764	4870250	1903
B20F20	337	450501	4870616	1903
B20F20	374	454008	4869833	1824
# of Turbines	13		Subtotal (kWs)	24978
Total # of Turbines	140		**Total (kWs)**	269957

K2 Wind - 270MW
Facility Equivalent Model



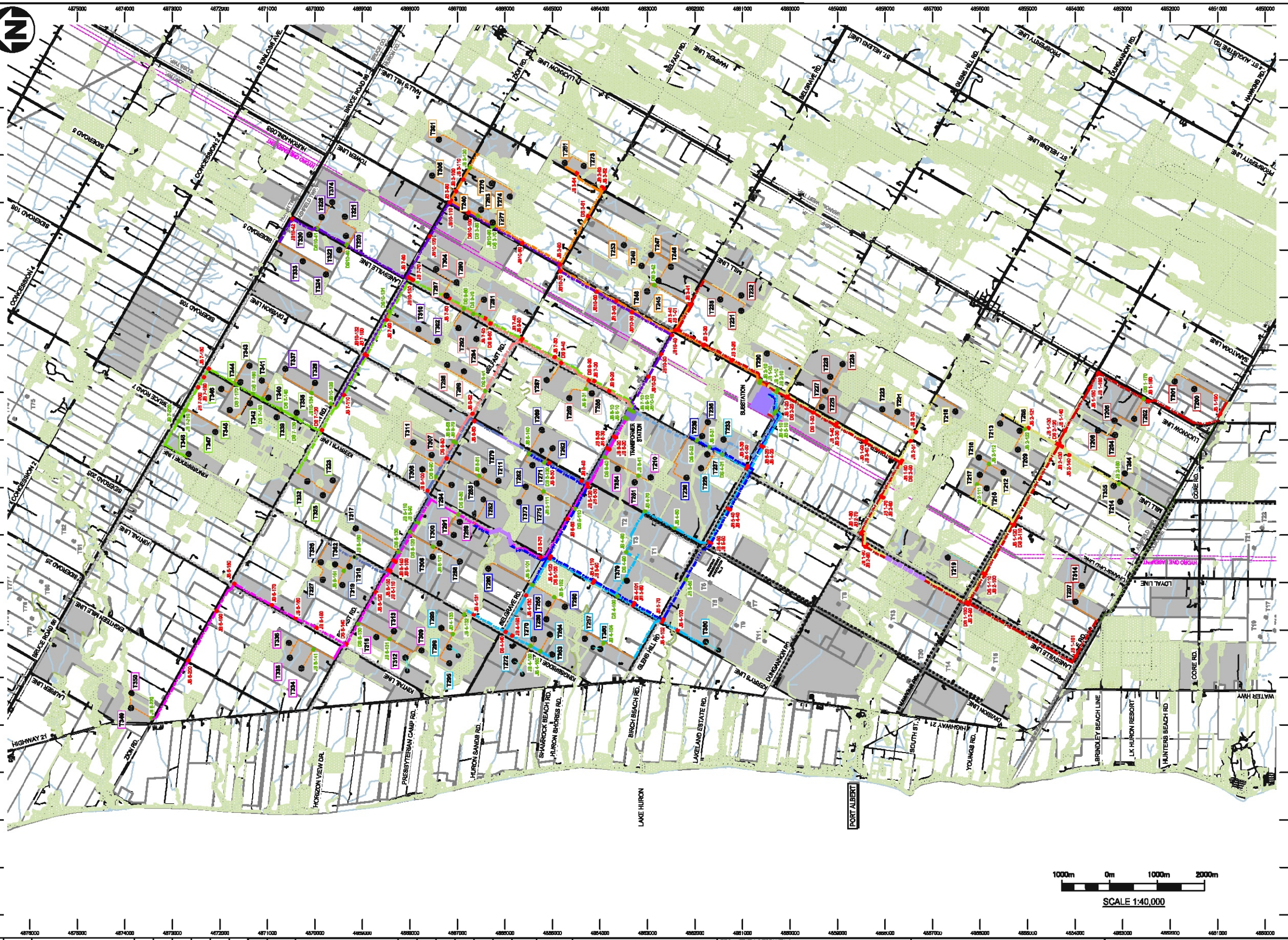
		R_{eq} pu	X_{eq} pu	B_{eq} pu
Equivalent Line				
L20-OH		0.000E+00	0.000E+00	0.000E+00
L20-UG		7.438E-04	2.37DE-03	1.565E-01
Main Substation Transformer				
T10		0.0016	0.0708	
T20		0.0016	0.0708	

Equivalent Collector Circuit Impedances						R_{eq} pu	X_{eq} pu	B_{eq} pu
Circuit #	CL1	with	16	WTGs in circuit :	16 Siemens 1.93	0.0588	0.0591	0.0275
Circuit #	CL2	with	14	WTGs in circuit :	14 Siemens 1.93	0.0835	0.0924	0.0208
Circuit #	CL3	with	14	WTGs in circuit :	14 Siemens 1.93	0.0622	0.0533	0.0176
Circuit #	CL4	with	14	WTGs in circuit :	14 Siemens 1.93	0.0716	0.0786	0.0222
Circuit #	CL5	with	14	WTGs in circuit :	14 Siemens 1.93	0.0611	0.0759	0.0223
Circuit #	CL6	with	14	WTGs in circuit :	14 Siemens 1.93	0.0722	0.0730	0.0218
Circuit #	CL7	with	14	WTGs in circuit :	14 Siemens 1.93	0.0600	0.1149	0.0231
Circuit #	CL8	with	14	WTGs in circuit :	14 Siemens 1.93	0.0517	0.0849	0.0170
Circuit #	CL9	with	13	WTGs in circuit :	13 Siemens 1.93	0.0325	0.0313	0.0121
Circuit #	CL10	with	13	WTGs in circuit :	13 Siemens 1.93	0.0671	0.1106	0.0237
Total Equivalent Impedance of all Collector Circuits:			140		Siemens 1.93	0.0054	0.0077	0.2083

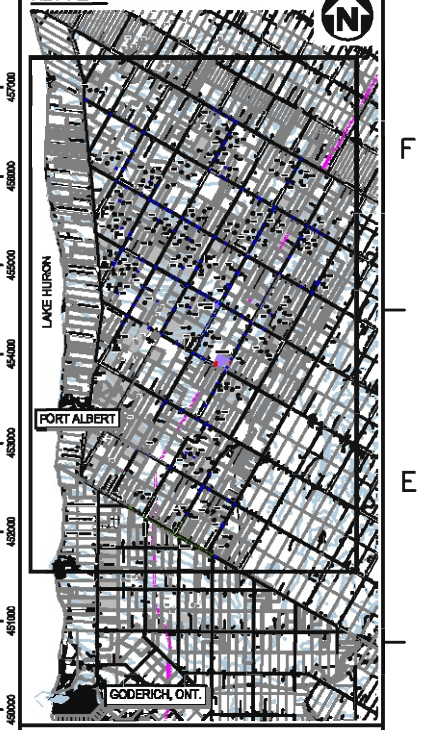
Equivalent WTG Transformer Impedances			R_{eq} pu	X_{eq} pu
Circuit #	CL1	Equivalent WTG Transformer Impedance	0.0097	0.0567
Circuit #	CL2	Equivalent WTG Transformer Impedance	0.0097	0.0567
Circuit #	CL3	Equivalent WTG Transformer Impedance	0.0097	0.0567
Circuit #	CL4	Equivalent WTG Transformer Impedance	0.0097	0.0567
Circuit #	CL5	Equivalent WTG Transformer Impedance	0.0097	0.0567
Circuit #	CL6	Equivalent WTG Transformer Impedance	0.0097	0.0567
Circuit #	CL7	Equivalent WTG Transformer Impedance	0.0097	0.0567
Circuit #	CL8	Equivalent WTG Transformer Impedance	0.0097	0.0567
Circuit #	CL9	Equivalent WTG Transformer Impedance	0.0097	0.0567
Circuit #	CL10	Equivalent WTG Transformer Impedance	0.0097	0.0567
Total Equivalent Impedance of all WTG Transformers			0.0309	0.1803

Equivalent Generators						MW	MVA
Circuit #	CL1	with	16	WTGs in circuit :	16 Siemens 1.93	30.86	30.86
Circuit #	CL2	with	14	WTGs in circuit :	14 Siemens 1.93	27.00	27.00
Circuit #	CL3	with	14	WTGs in circuit :	14 Siemens 1.93	27.00	27.00
Circuit #	CL4	with	14	WTGs in circuit :	14 Siemens 1.93	27.00	27.00
Circuit #	CL5	with	14	WTGs in circuit :	14 Siemens 1.93	27.00	27.00
Circuit #	CL6	with	14	WTGs in circuit :	14 Siemens 1.93	27.00	27.00
Circuit #	CL7	with	14	WTGs in circuit :	14 Siemens 1.93	27.00	27.00
Circuit #	CL8	with	14	WTGs in circuit :	14 Siemens 1.93	27.00	27.00
Circuit #	CL9	with	13	WTGs in circuit :	13 Siemens 1.93	25.07	25.07
Circuit #	CL10	with	13	WTGs in circuit :	13 Siemens 1.93	25.07	25.07
Total Power Output						270.00	270.00

MW Check OK



KEY PLAN



LEGEND

- T100 — TURBINE LOCATION & TURBINE NAME
- WATERBODY
- WETLAND
- PARTICIPANT PROPERTY
- WOODED AREA
- FARM BUILDING
- EXISTING TRANSMISSION LINE CORRIDOR
- EXISTING MAJOR ROADS
- EXISTING 1Φ DISTRIBUTION LINE
- EXISTING 3Φ DISTRIBUTION LINE
- EXISTING KINGSBRIDGE I COLLECTOR LINE
- PROPOSED UNDERGROUND CABLE
- PROPOSED 34.5kV UNDERGROUND OR OVERHEAD COLLECTOR LINE & CIRCUIT No.
- PROPOSED SUBSTATION
- PROPOSED TRANSFORMER STATION
- PROPOSED TRANSMISSION LINE
- PROPOSED JUNCTION BOX LOCATION — IN R.O.W. LIMIT, — ON PARTICIPANT PROP.

NOTES

1. COORDINATES SHOWN ON THIS DRAWING ARE BASED ON NAD 83, ZONE 17.
2. UNDERGROUND COLLECTOR LINE & JUNCTION BOX LOCATIONS ARE PRELIMINARY ONLY AND MAY CHANGE DUE TO DETAILED DESIGN REQUIREMENTS.
3. TURBINE LOCATIONS WERE PROVIDED BY CAPITAL POWER. TURBINE LOCATIONS ARE BASED ON CAPITAL POWER LAYOUT #194.
4. LOCATION OF EXISTING OVERHEAD LINES ARE PRELIMINARY ONLY AND REQUIRE SITE CONFIRMATION FOR ACTUAL FINAL LOCATIONS.
5. NEW UNDERGROUND COLLECTOR LINES TO BE LOCATED INSIDE MUNICIPAL/COUNTY ROAD RIGHT OF WAY LIMIT UNLESS NOTED OTHERWISE. COLLECTOR LINES ARE SHOWN OUTSIDE OF ROAD ALLOWANCE FOR CLARITY.
6. ON PARTICIPANT PROPERTIES, ALL UNDERGROUND & FIBRE OPTIC CABLES TO BE LOCATED INSIDE BUILDABLE AREA LIMIT. FOR BUILDABLE AREA LIMIT SEE INDIVIDUAL PROPERTY LAYOUT DRAWINGS.

REV	DD/MM/YY	REVISION / ISSUE DESCRIPTION	DRN	CHK	APP	APP	APP	APP
F	2011.11.12	REVISED COLLECTOR LAYOUT (LAYOUT 194)	MJHALL	BJH	RY	JHM		
E	27/SEP/11	ISSUED FOR EBA APPLICATION	CK	BJH	JHM			
D	21/SEP/11	MINOR CHANGE TO COLLECTOR SYSTEM	RS	BJH	JHM			
C	09/SEP/11	ISSUED FOR EBA APPLICATION	MJHALL	BJH	JHM			
B	07/JUL/11	ISSUED FOR EBA APPLICATION	MJHALL	BJH	JHM			
A	2011.07.11	ISSUED FOR INFORMATION (LAYOUT 165)	MJHALL	BJH	JHM			

REF	NUMBER	TITLE
		REFERENCES

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PRELIMINARY

CLIENT PROJECT MGR. | DEPARTMENT MGR. | PROJECT MGR.

PROJECT PHASE

PROJECT NO.	ACTIVITY NO.
161973	
SCALE	PACKAGE CODE
1:40,000	

	BY	DD/MM/YY
DSN	BJH	JULY'11
DRN	MJHALL	JULY'11
CHK	BJH	JULY'11
APP	JHM	JULY'11

K2 WIND ONTARIO LIMITED PARTNERSHIP

AREA 00 — K2 WIND POWER PROJECT

SUBJECT

SITE PLAN
UNDERGROUND COLLECTOR LAYOUT
SIEMENS SWT 2.3MW,
140 TURBINES

CLIENT DWG. NO.

DRAWING NO. A1-161973-00-141-0064

REV. F

SAVED: 01-Aug-12 3:08 PM | PLOTTED: 23-Aug-12 11:48 AM | USER: HALL, MICHAEL (MJHALL)

TAB D-c-1

CUSTOMER IMPACT ASSESSMENT REPORT 2ND ADDENDUM

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

-2ND ADDENDUM-

CUSTOMER IMPACT ASSESSMENT

K2 WIND

270 MW WIND TURBINE GENERATION CONNECTION

FINAL

Revision: 0

Date: December 4, 2012

Issued by: **Transmission System Development Division**
Hydro One Networks Inc.

Prepared by:

Alessia Dawes, P.Eng
Network Management Engineer
Transmission System Development
Hydro One Networks Inc.

Reviewed by:

John Sabiston, P.Eng
Manager, Transmission Planning
Transmission System Development
Hydro One Networks Inc.

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Disclaimer

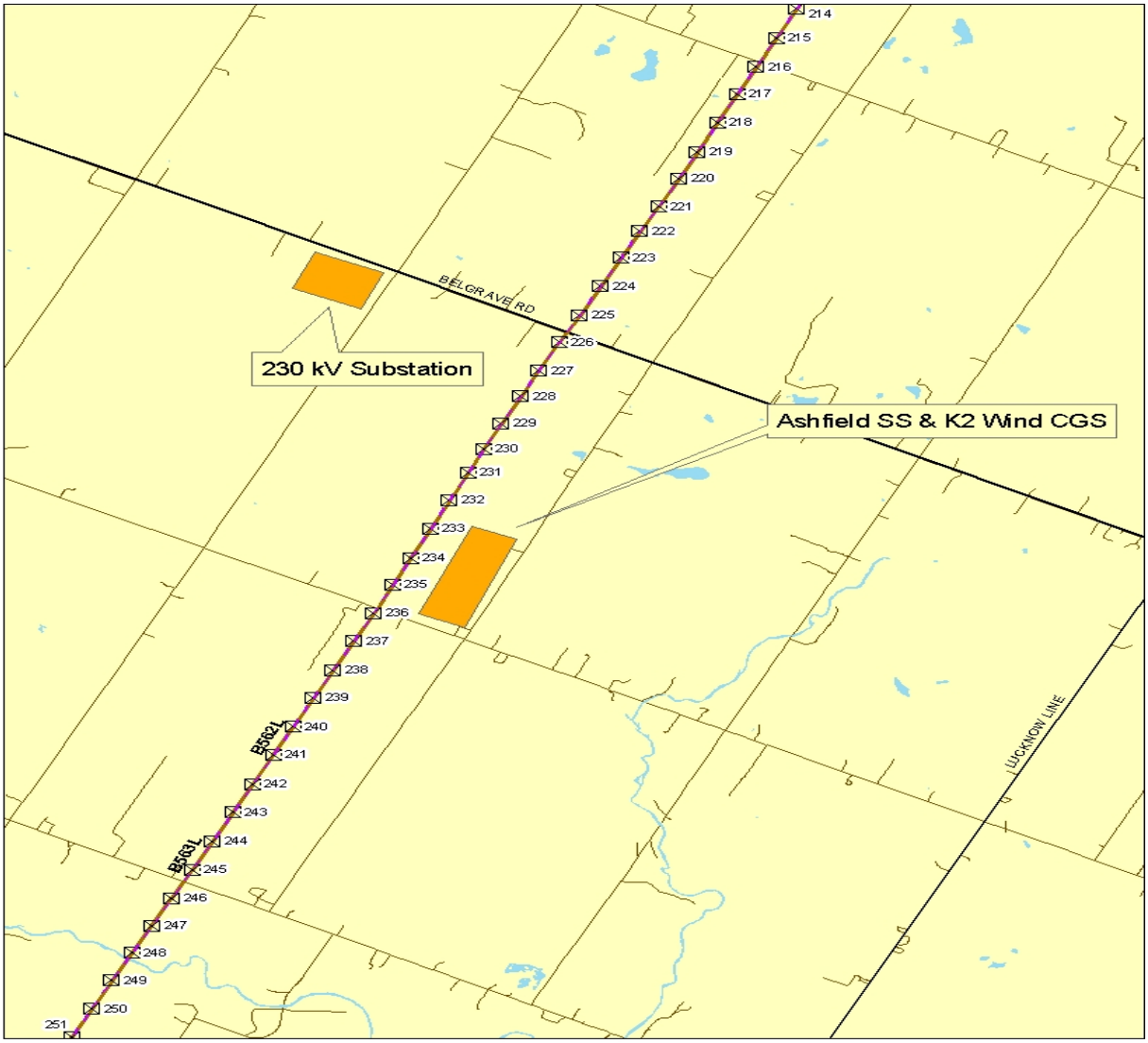
This Customer Impact Assessment was prepared based on information available about the connection of the proposed K2 Wind Ontario L.P. – K2 Wind project. It is intended to highlight significant impacts, if any, to affected transmission customers early in the project development process and thus allow an opportunity for these parties to bring forward any concerns that they may have. Subsequent changes to the required modifications or the implementation plan may affect the impacts of the proposed connection identified in Customer Impact Assessment. The results of this Customer Impact Assessment are also subject to change to accommodate the requirements of the IESO and other regulatory or municipal authority requirements.

Hydro One shall not be liable to any third party which uses the results of the Customer Impact Assessment under any circumstances whatsoever for any indirect or consequential damages, loss of profit or revenues, business interruption losses, loss of contract or loss of goodwill, special damages, punitive or exemplary damages, whether any of the said liability, loss or damages arises in contract, tort or otherwise. Any liability that Hydro One may have to K2 Wind in respect of the Customer Impact Assessment is governed by the Agreement between K2 Wind Ontario L.P. and Hydro One dated December 7, 2011.

2ND ADDENDUM: CUSTOMER IMPACT ASSESSMENT
K2 WIND
270 MW WIND TURBINE GENERATION CONNECTION

1.0 INTRODUCTION

K2 Wind Ontario L.P. is to develop a 270 MW wind energy generation facility. The wind energy facility, known as K2 Wind, will be constructed in the Municipalities of Ashfield-Colborne and Wawanosh, Ontario. The interconnection station to Hydro One will be located in the Municipality of Ashfield. K2 Wind is proposing to connect to Hydro One's transmission system through two new step-up transformers via a new 500 kV switching station that will sectionalize circuit B563L, approximately 61.5 km from Bruce B SS. The switching station will be called Ashfield Switching Station (SS). Ashfield SS interconnection station will be located just east and adjacent to Hydro One's B562/563L Right-Of-Way (ROW) as shown in Map 1. The earliest expected in-service date of the generation facility is May 2014.



Map 1: K2 Wind connection to Hydro One's Network (circuit B563L is on the East side of the ROW)

In accordance with section 6 of the Ontario Energy Board's Transmission System Code, Hydro One Networks Inc (Hydro One) is to carry out a Customer Impact Assessment (CIA) study to assess the impact of the proposed generator connection on existing customers in the affected area.

The original CIA was issued to potentially impacted customers on February 24, 2012. The original CIA indicated that overvoltage conditions at Ashfield SS would be mitigated by installing a shunt reactor. After detailed engineering analysis in the spring of 2012, it had been concluded that managing this overvoltage by installing equipment capable of handling the overvoltage is sufficient. The first addendum dated June 15, 2012 highlighted any impacts to customers due to the removal of this reactor. In August 2012, K2 Wind submitted a revised Single Line Diagram of their collector system. The major revisions include utilizing a 230 kV underground cable instead of a 138 kV underground cable and the location of some wind turbine generators which in turn changed the collector system arrangement. This 2nd addendum reflects K2 Wind's impact to customer voltage and short circuit levels at existing customer stations.

A Draft version of this report was issued to potentially impacted customers on October 29, 2012. No comments or questions were received. Since this time, IESO has recalculated the static reactive requirements of the K2 Wind project to be 12 MVar @ 34.5 kV (as opposed to 25 MVar @ 34.5 kV which was used is this CIA study). As the required amount of reactive power compensation (12 MVar) is quite small as compared with the project's reactive capability that it makes its installation impractical, the IESO has considered that the reactive power requirements are satisfactory met without the additional 12 MVar of reactive compensation. Hydro One does not expect this change to impact their transmission customers and therefore this 2nd Addendum for the K2 Wind project can be finalized.

This study does not evaluate the overall impact of the K2 Wind project on the bulk electricity system. The impact of the new generator on the bulk electricity system is the subject of the System Impact Assessment (SIA) issued by the Independent Electricity System Operator (IESO).

The study does not evaluate the impact of the K2 Wind project on the network Protection and Control facilities. Protection and Control aspects are reviewed during the Protection Impact Assessment, which is part of the SIA. Protection and Control aspects are again reviewed, in detail, during the preparation of the connection cost estimate and will be reflected in the Connection and Cost Recovery Agreement.

1.2 Proposed Connection: K2 Wind

1.2.1 Wind Farm

The proposed K2 Wind project consists of 140 Siemens 2.3 MW Wind Turbine Generators (WTG). The maximum output of the WTG will be curtailed to a total generation output capability of 270 MW. Appendix A, Figures 1 & 2 shows an overview of the proposed connection arrangement.

The K2 Wind project consists of 10 groups of thirteen to sixteen WTG. Each group of wind turbines is placed on a 34.5 kV feeder. Each feeder is protected by a circuit breaker before connecting onto a 34.5 kV bus at either K2 Wind Customer Generation Station (CGS) or the intermediate 230 kV substation.

Five 34.5 kV feeders will connect onto a 34.5 kV bus at K2 Wind CGS while the other five feeders will connect onto a 34.5 kV bus at the intermediate 230 kV substation. At the 230 kV substation, the power will be transformed to 230 kV via one 230/34.5 kV, 96/128/160 MVA transformer. From the

230 kV substation, a new 5.1 km, customer-owned 230 kV underground cable will connect into K2 Wind CGS.

At K2 Wind CGS the power will be transformed to 500 kV via two transformers: (1) 530/34.5 kV, 105/140/175 MVA transformer and (2) 530/230 kV, 96/128/160 MVA transformer. The 500 kV bus at K2 Wind CGS will connect to a new Hydro One 500 kV switching station to be named Ashfield SS. Please see Appendix A, Figure 3.

- The wind farm's dynamic Var compensation is provided via their Siemens 2.3 MW WTG. The WTG are designed to supply or absorb reactive power to or from the transmission grid to regulate and stabilize the voltage. In addition, it was determined in the System Impact Assessment that this project is deficient in static VAr compensation. Therefore a 12 MVAr at 34.5 kV shunt capacitor is to be installed on the K2 Wind CGS B10 bus and a 13 MVAr at 34.5 kV shunt capacitor is to be installed on the K2 Wind's intermediate 230 kV substation B20 bus were used in this study.

1.2.2 Connection to Hydro One's 500 kV Transmission System

K2 Wind will connect its generated power via 500 kV Hydro One owned interconnection station called Ashfield SS. The K2 Wind CGS 530/34.5 kV and 530/230 kV transformers will connect via 2-500 kV breakers and 3 motorized disconnect switches onto a 500 kV ring bus at Ashfield SS, Appendix A, Figure 3. This ring bus will split Hydro One's existing 500 kV circuit B563L from Bruce B SS to Longwood TS into 2 sections: Bruce B SS x Ashfield SS (B563A) and Ashfield SS x Longwood TS (A565L). This sectionalizing will occur approximately 61.5 km from Bruce B SS, near tower numbers 234 and 235 of existing B563L. Both Ashfield SS and K2 Wind CGS will be adjacent or as close as possible to Hydro One's existing ROW to limit the additional exposure to Hydro One's 500 kV system. In addition, it was determined in the System Impact Assessment that Ashfield SS will experience overvoltage during certain system configurations.

To manage the overvoltage concerns at Ashfield SS, Hydro One is proposing to construct Ashfield SS with equipment capable of withstanding the overvoltage. This additional capability will forego a previous requirement of a shunt reactor.

1.3 Customers in the Study Area

The primary focus of this study was on customers supplied from stations directly connected to existing circuit B563L and in the local area. Affected customers are show in Table 1.

Table 1: Transmission customers connected in the study area

Station	Customer
Bruce A TS	Bruce Power L.P.
Bruce B SS	Bruce Power L.P.
Bruce Heavy Water Plant B TS	Bruce Power L.P.
Douglas Point TS	Hydro One Networks Inc. (Distribution) Westario Power Inc.
Longwood TS	Hydro One Networks Inc. (Distribution) Middlesex Power Distribution Corp.

2.0 METHODOLOGY & CRITERIA

2.1 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 of electricity to customers. Two relevant aspects of Power System Analysis were used for this assessment, namely:

a. Load Flow Studies: An AC load flow program was used to set up a base case with K2 Wind.

b. Short-Circuit Studies: A Short Circuit Analysis program was used to determine the impact of K2 Wind on customers at their points of connection to Hydro One.

2.2 Study Assumptions

Summer 2014 conditions were assumed in this study, along with the following assumptions.

- Load Data – study area demand scaled to its 2014 peak & operating at historical power factors
- Transmission Data – all transmission system elements in-service; new Bruce x Milton double circuit line in-service; Nanticoke TS & Detweiler TS SVC's in-service
- Generation Data – all new committed embedded and transmission connected renewable generation as part of the Feed-In-Tariff (FIT) program including Samsung phase 1, 2 and 3 projects; all 8 Bruce GS units in-service; all existing Bruce area wind at 100% rating output.

Note: Load flow base cases provided by IESO

2.3 Planning Criteria

2.3.1 Voltage Limitations

To establish the adequacy of Hydro One transmission system for the incorporation of the proposed K2 Wind generation facilities, the following post-fault voltage criteria were applied. As per "IESO Ontario Resource and Transmission Assessment Criteria", Issue 5.0 (ORTAC)

http://www.ieso.ca/imoweb/pubs/marketAdmin/IMO_REQ_0041_TransmissionAssessmentCriteria.pdf

- The loss of a single power system element 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 or 2nd power system element 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) ;
- Voltages below 50 kV shall be maintained in accordance with Canadian Standard Association document CAN-3-C235-83.

2.3.2 Short Circuit Limitations

Appendix 2 of the Transmission System Code (TSC) specifies the maximum symmetrical three phase and single line to ground short circuit levels. These limits are summarized in Table 2. Short circuit levels were compared to the TSC limits and also to existing breaker ratings at effected stations to ensure equipment capability.

Table 2: Transmission System Code Symmetrical Short Circuit Limits

Nominal Voltage (kV)	Max. 3 Phase Fault (kA)	Max. SLG Fault (kA)
500	80(1)	80(1)
230	63	80(1)
115	50	50
44	20(3)	19(2,3)
27.6 (4-wire)	17(3)	12(3)
27.6 (3-wire)	17(3)	0.45(3)
13.8	21(3)	10(3)

Notes:

(1) Usually limited to 63kA

(2) Usually limited to 8 kA

(3) 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 un-modeled synchronous motors and data inaccuracies.

In order to reflect realistic operating conditions, short circuit studies are run assuming the following conditions:

- Base case assumes existing & committed generating facilities in-service.
- Pre-fault voltage of 550.00 kV at 500 kV stations
- Pre-fault voltage of 250.00 kV at 220 kV stations
- Pre-fault voltage of 127.00 kV at 115 kV stations
- Pre-fault voltage of 46.00 kV at 44 kV stations
- Pre-fault voltage of 29.00 kV at 27.6 kV stations
- Pre-fault voltage of 14.2 kV at 13.8 kV stations

2.4 Operating Conditions

Normal operating conditions are such that K2 Wind will solely generate onto sectionalized circuit B563L (into Ashfield SS). When K2 Wind 500 kV transformer breakers T10B0 and T20B0 that connect to the 500 kV ring bus at Ashfield SS are taken out service, K2 Wind will not generate onto Hydro One's systems, transmission nor distribution.

3.0 SHORT CIRCUIT RESULTS

Short-circuit studies were carried out to assess the fault contribution when the 270 MW K2 Wind generating facility is connected and generating into Ashfield SS.

The anticipated fault levels after the incorporation of all committed and proposed generation in the Bruce area are shown in Table 5.

Table 3: Anticipated Fault Levels Resulting from FIT3 and Samsung Phase 2 & 3 contracts*

Station	Symmetrical Fault Level (kA)		Asymmetrical Fault Level (kA)	
	3-Phase	L-G	3-Phase	L-G
Bruce B SS 500 kV	37.87	42.57	55.60	64.93
Bruce A TS 500 kV	38.12	42.70	55.81	64.50
Bruce A TS 230 kV	44.50	56.01	59.56	**80.62****
BHWP B TS 13.8 kV A	19.80	1.98	21.29	1.98
BHWP B TS 13.8 kV B	19.79	1.98	20.59	1.98
Douglas Point TS 44 kV	14.93	6.98	15.67	8.25
Longwood TS 500 kV	20.82	22.04	25.31	28.02
Longwood TS 230 kV	38.42	46.11	47.1	59.76
Longwood TS 27.6 kV	15.44	10.8	17.97	13.59

*Includes existing, committed and proposed generation projects in the Bruce Transmission Area as per applications received by August 2012

Observations made from the short-circuit study results in Table 5 above may be summarized as follows:

It can be observed from Table 5 that the anticipated fault levels at the stations shown are below the maximum symmetrical three-phase and single line-to-ground fault values set out in Appendix 2 of the *Transmission System Code* (TSC). In addition, with the exception of Bruce A TS 230 kV bus**, the anticipated fault levels are within Hydro One's breaker ratings.

**Note: The asymmetrical fault current at Bruce A 230 kV before and after the incorporation of the projects will exceed the interrupting capability of the existing breakers. To address this issue in the long term, Hydro One has planned to replace the Bruce 230 kV breakers to improve fault current interrupting capability. Before the circuit breakers are replaced, temporary operational mitigation measures have been developed by Hydro One in collaboration with the IESO. K2 Wind has no impact on this issue.

Conclusion

The short-circuit level increases at Bruce A TS, Bruce B SS, BHWP B TS, Douglas Point TS and Longwood TS are acceptable to Hydro One and are below Hydro One's 5 % TSC margin limit.

4.0 VOLTAGE ANALYSIS

Load flow studies were carried out to analyze the impact of the new facilities on the voltage performance of Hydro One customers in the affected area.

Local voltage impact was assessed using load flow contingency analysis. The incorporation of K2 Wind at full output was used to assess voltage change during peak summer loading conditions.

The following contingencies were used to assess the voltage impact:

a) A single contingency loss of K2 Wind generation
b) A single contingency loss of Bruce B SS x Ashfield SS 500 kV circuit
c) A single contingency loss of Ashfield SS x Longwood TS 500 kV circuit
d) A double contingency loss of Ashfield SS x Longwood TS circuit and K2 Wind generation (due to Breaker Failure B/F), with Evergreen SS x Longwood TS 500 kV circuit out of service pre-contingency
e) A double contingency loss of Bruce B SS x Ashfield SS circuit and K2 Wind generation (due to Breaker Failure B/F), with Bruce A TS x Evergreen SS 500 kV circuit out of service pre-contingency

Basic Assumptions:

- New 500 kV switching station Evergreen SS will sectionalize companion circuit B562L approximately 36.5 km from Longwood TS to incorporate another wind energy project known as Adelaide/Bornish/Jericho Wind Energy Centre(s)/Cedar Point Wind Power Project.
- This generation project is deficient in static VAr compensation as per the IESO System Impact Assessment hence a 12 MVAr at 34.5 kV shunt capacitor is to be located on the K2 Wind CGS B10 bus and a 13 MVAr at 34.5 kV shunt capacitor is to be located on the K2 Wind's intermediate 230 kV substation B20 bus were used in this study.
- ULTC – Under Load Tap Changer
- For the period of time labeled "After ULTC", the switching of reactive devices such as reactors and capacitors is implemented.

Results are shown in Appendix A, Tables 1 – 5 and the impact to *existing* customers is summarized below:

- Table A1: For the loss of the proposed generator the maximum voltage change is -0.17% at Longwood TS 27.6 kV bus before ULTC operation and is -0.20% at Longwood TS 27.6 kV bus after ULTC operation. Note the voltage at the Ashfield SS 500 kV bus will exceed the maximum voltage of 550 kV as per the Ontario Resource and Transmission Assessment Criteria. To mitigate this, equipment installed at Ashfield SS will be capable of handling the over-voltage.

- Table A2: For the loss the 500 kV circuit between Bruce B SS and Ashfield SS the maximum voltage change is -0.13% at Bruce B SS 500 kV bus before ULTC operation and is -0.13% at Bruce B SS 500 kV bus after ULTC operation.

- Table A3: For the loss of the 500 kV circuit between Ashfield SS and Longwood TS, the maximum voltage change is -1.00% at Longwood TS 500 kV bus before ULTC operation and is –1.00% at Longwood TS 500 kV bus after ULTC operation.

- Table A4: Given the 500 kV circuit from Evergreen SS to Longwood TS is out of service, for the loss of the 500 kV circuit between Ashfield SS and Longwood TS with a breaker failure at

Ashfield SS which disconnects the wind farm, the maximum voltage change is -1.97% at Longwood TS 500 kV bus before ULTC operation and is -1.98% at Longwood TS 500 kV bus after ULTC operation.

- Table B5: Given the 500 kV circuit from Bruce A TS to Evergreen SS is out of service, for the loss of the 500 kV circuit between Bruce B SS and Ashfield SS with a breaker failure at Ashfield SS which disconnects the wind farm, the maximum voltage change is -0.37% at Longwood TS 27.6 kV bus before ULTC operation and is -0.41% at Longwood TS 27.6 kV bus after ULTC operation.

Conclusion

Load flow studies thus confirmed that the incorporation of 270 MW of wind generation between Bruce B SS and Longwood TS will not result in substantial change in the voltage profile of customers supplied from these stations and in the local electrical area. Following the worst contingency, the voltage changes are well within the voltage decline guideline for customer buses of less than 10% and 5% voltage change before- and after- transformer tap-changer operation. Note the voltage level at Ashfield SS is highly dependent on the connection of the wind turbine generators as they stabilize the 500 kV station voltage within the maximum permissible voltage level. Equipment installed at Ashfield SS will be capable of handling over-voltages observed when the wind farm is unavailable (disconnected from Ashfield SS).

7.0 CONCLUSIONS AND RECOMMENDATIONS

This 2nd Addendum: Customer Impact Assessment (CIA) presents results of short circuit and voltage performance study analyses. The report has confirmed that K2 Wind can be incorporated without adverse impact on customers supplied from Bruce B SS and Longwood TS and in the local electrical area provided that the required facilities are installed. No additional facilities are required beyond those previously identified by the IESO by issue of the original SIA and its subsequent Addendums and those identified by Hydro One by issue of the original CIA and its subsequent addendum.

All customers are required to check to ensure that the equipment and grounding system at their stations/facilities meet the expected increase in fault level.

APPENDIX A:

VOLTAGE PERFORMANCE RESULTS

Table 1: Loss of K2 Wind

Bus	Initial Voltage (kV)	Before ULTC (kV)	% Change	After ULTC (kV)	% Change
Bruce A TS 500 kV	548.19	548.87	0.12	548.83	0.12
Bruce A TS 230 kV	247.12	247.29	0.07	247.28	0.07
Bruce B SS 500 kV	548.93	549.65	0.13	549.61	0.13
BHWP B TS 13.8 kV A bus	14.53	14.54	0.07	14.54	0.07
BHWP B TS 13.8 kV B bus	14.52	14.53	0.07	14.53	0.07
Douglas Point TS 44 kV	46.13	46.16	0.07	46.16	0.07
Ashfield SS 500 kV	550.00	**551.88***	0.34	**551.82***	0.33
Longwood TS 500 kV	545.65	545.66	0.00	545.54	-0.02
Longwood TS 230 kV	244.82	244.42	-0.16	244.35	-0.19
Longwood TS 27.6 kV	29.03	28.99	-0.17	28.98	-0.20

*****Overvoltage at Ashfield SS will be managed by installing equipment capable of handling it

Table 2: Loss of Bruce B SS x Ashfield SS

Bus	Initial Voltage (kV)	Before ULTC (kV)	% Change	After ULTC (kV)	% Change
Bruce A TS 500 kV	548.19	547.56	-0.12	547.55	-0.12
Bruce A TS 230 kV	247.12	246.96	-0.06	246.96	-0.06
Bruce B SS 500 kV	548.93	548.20	-0.13	548.19	-0.13
BHWP B TS 13.8 kV A bus	14.53	14.52	-0.06	14.52	-0.06
BHWP B TS 13.8 kV B bus	14.52	14.51	-0.06	14.51	-0.06
Douglas Point TS 44 kV	46.13	46.10	-0.06	46.10	-0.07
Ashfield SS 500 kV	550.00	550.00*	0.00	550.0*	0.00
Longwood TS 500 kV	545.65	545.36	-0.05	545.35	-0.05
Longwood TS 230 kV	244.82	244.70	-0.05	244.69	-0.05
Longwood TS 27.6 kV	29.03	29.02	-0.05	29.02	-0.05

* Wind Turbine Generators will assist in controlling the voltage at the 500 kV bus (as per the turbine reactive power capability curves provided in the generator application)

Table 3: Loss of Ashfield SS x Longwood TS

Bus	Initial Voltage (kV)	Before ULTC (kV)	% Change	After ULTC (kV)	% Change
Bruce A TS 500 kV	548.19	547.31	-0.16	547.31	-0.16
Bruce A TS 230 kV	247.12	246.89	-0.09	246.89	-0.09
Bruce B SS 500 kV	548.93	548.11	-0.15	548.10	-0.15
BHWP B TS 13.8 kV A bus	14.53	14.52	-0.09	14.52	-0.09
BHWP B TS 13.8 kV B bus	14.52	14.50	-0.09	14.50	-0.09
Douglas Point TS 44 kV	46.13	46.08	-0.09	46.08	-0.09
Ashfield SS 500 kV	550.00	550.00*	0.00	550.00*	0.00
Longwood TS 500 kV	545.65	540.21	-1.00	540.21	-1.00
Longwood TS 230 kV	244.82	242.79	-0.83	242.79	-0.83
Longwood TS 27.6 kV	29.03	28.79	-0.86	28.79	-0.86

* Wind Turbine Generators will assist in controlling the voltage at the 500 kV bus (as per the turbine reactive power capability curves provided in the generator application)

Table 4: Loss of Ashfield SS x Longwood TS & 270 MW of K2 Wind while Evergreen SS x Longwood TS Out-of-Service

Bus	Initial Voltage (kV)	Before ULTC (kV)	% Change	After ULTC (kV)	% Change
Bruce A TS 500 kV	547.67	546.80	-0.16	546.79	-0.16
Bruce A TS 230 kV	246.97	246.74	-0.09	246.74	-0.09
Bruce B SS 500 kV	548.44	547.56	-0.16	547.55	-0.16
BHWP B TS 13.8 kV A bus	14.52	14.51	-0.09	14.51	-0.10
BHWP B TS 13.8 kV B bus	14.51	14.49	-0.09	14.49	-0.10
Douglas Point TS 44 kV	46.10	46.06	-0.10	46.06	-0.10
Ashfield SS 500 kV	550.00	549.28	-0.13	549.27	-0.13
Longwood TS 500 kV	543.38	532.69	-1.97	532.60	-1.98
Longwood TS 230 kV	243.96	239.55	-1.81	239.50	-1.83
Longwood TS 27.6 kV	28.93	28.39	-1.88	28.38	-1.90

Table 5: Loss of Bruce B SS x Ashfield SS & 270 MW of K2 Wind while Bruce A TS x Evergreen SS Out-of-Service

Bus	Initial Voltage (kV)	Before ULTC (kV)	% Change	After ULTC (kV)	% Change
Bruce A TS 500 kV	547.07	546.15	-0.17	546.13	-0.17
Bruce A TS 230 kV	246.84	246.61	-0.09	246.60	-0.09
Bruce B SS 500 kV	547.98	546.94	-0.19	546.91	-0.19
BHWP B TS 13.8 kV A bus	14.51	14.50	-0.09	14.50	-0.10
BHWP B TS 13.8 kV B bus	14.50	14.49	-0.09	14.49	-0.10
Douglas Point TS 44 kV	46.07	46.03	-0.09	46.03	-0.10
Ashfield SS 500 kV	550.00	548.13	-0.34	547.93	-0.38
Longwood TS 500 kV	542.01	540.82	-0.22	540.62	-0.26
Longwood TS 230 kV	243.46	242.60	-0.35	242.50	-0.39
Longwood TS 27.6 kV	28.87	28.76	-0.37	28.75	-0.41

Figure 1: K2 Wind Project: K2 Wind CGS (drawing from generator)
Figure 1 for reference only.

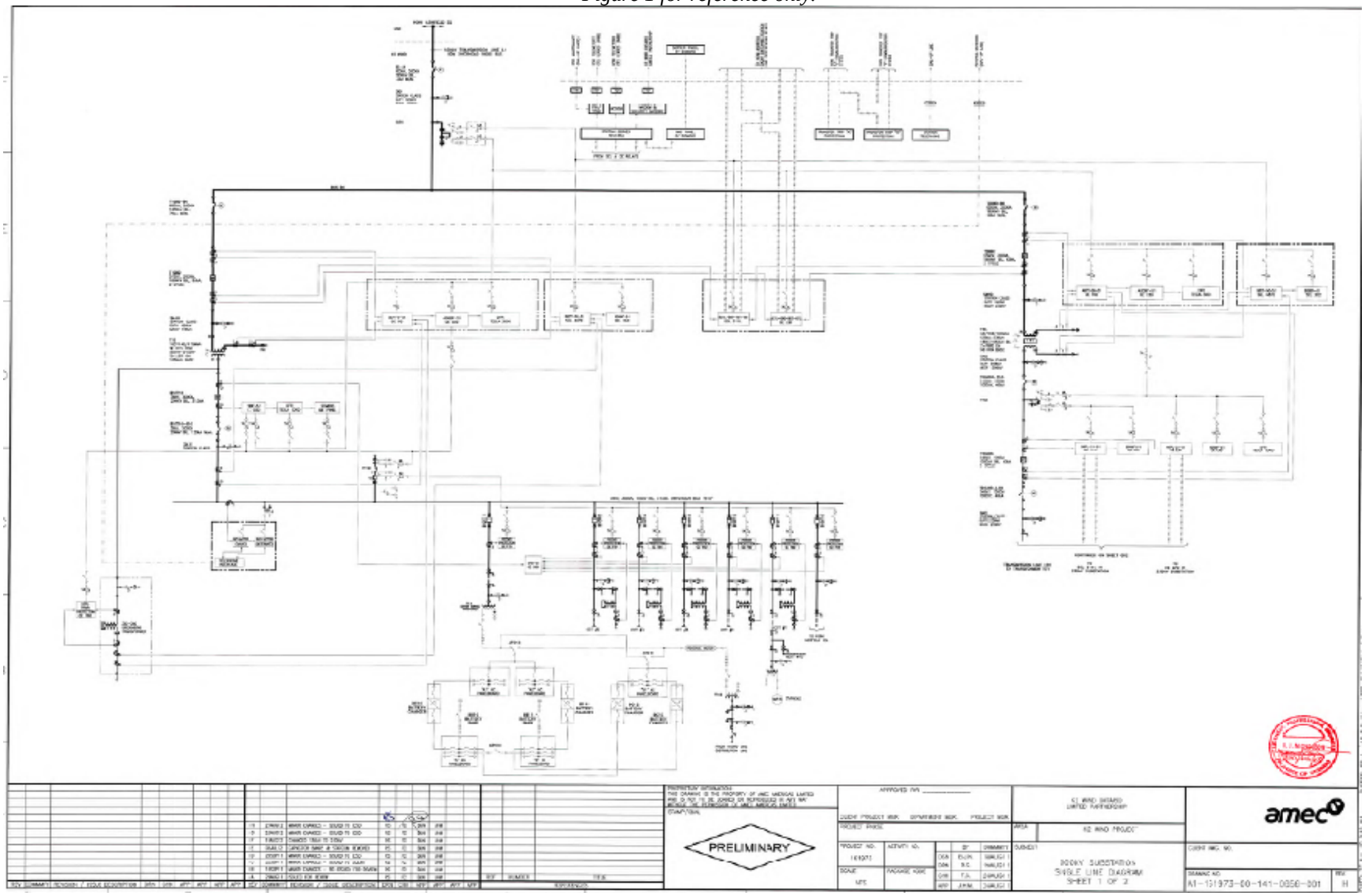


Figure 2: K2 Wind Project: Intermediate 230 kV substation (drawing from generator)
Figure 2 for reference only

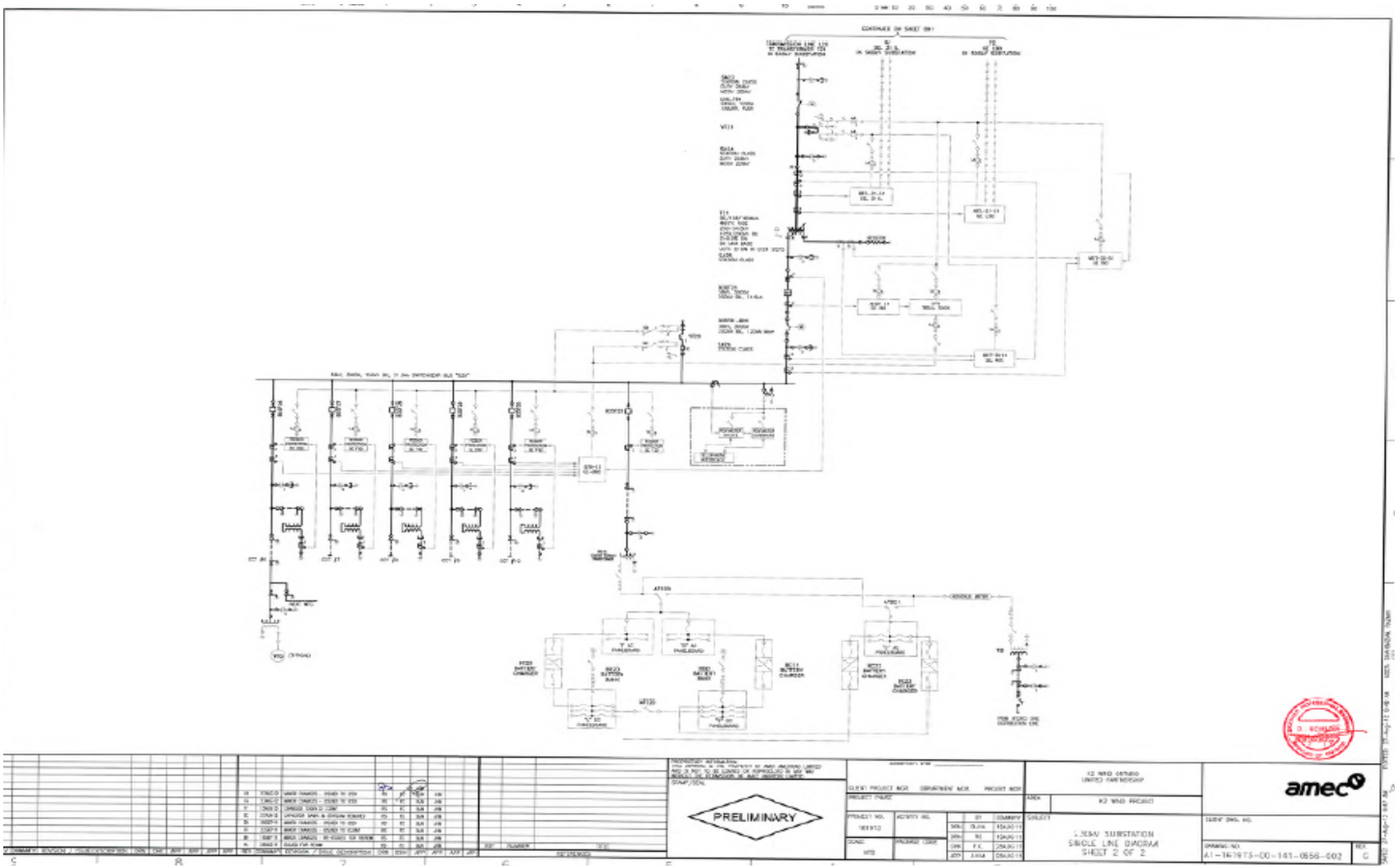
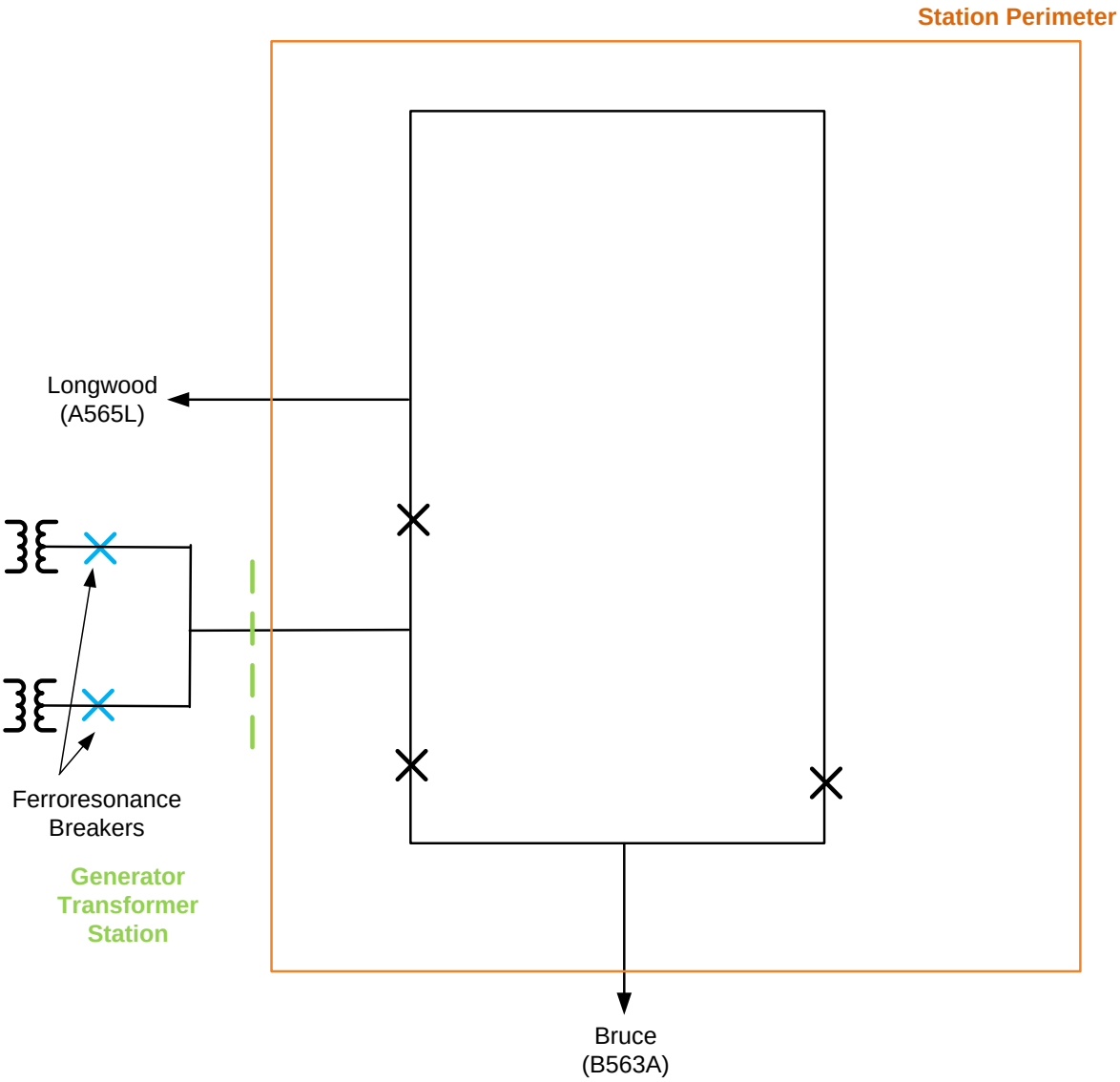


Figure 3: Ashfield Switching Station



TAB D-T-1

SYSTEM IMPACT ASSESSMENT REPORT 2ND ADDENDUM

REPORT

Power to Ontario.
On Demand.

System Impact Assessment Report 2nd Addendum

CONNECTION ASSESSMENT & APPROVAL PROCESS

Final Report

CAA ID: **2011-452**
Project: **K2 Wind**
Applicant: **K2 Wind Ontario Limited Partnership**

Market Facilitation Department
Independent Electricity System Operator

Date: December 7, 2012

Document ID	IESO_REP_0769
Document Name	System Impact Assessment Report Addendum
Issue	Final Report
Reason for Issue	First Issue
Effective Date	December 7, 2012

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System Impact Assessment Report

Acknowledgement

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

Disclaimers

IESO

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

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

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

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

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

Hydro One

The results reported in this report are based on the information available to Hydro One, at the time of the study, suitable for a System Impact Assessment of this 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 facilities on load and generation customers.

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

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

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

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Executive Summary

Conditional Approval for Connection

K2 Wind Ontario Limited Partnership (the "connection applicant") is developing a new 270 MW wind power generating farm, K2 Wind ("the project"), in Huron County, Ontario. The project will be connected to Ashfield SS, a new switching station that will be built by sectionalizing circuit B563L, about 61.5 km from Bruce B SS. The project will use Siemens SWT-2.3-101 wind turbines and is expected to be in-service by May 1, 2014.

This addendum updates the System Impact Assessment (SIA) "K2 Wind" (CAA ID 2011-452) originally issued on February 24, 2012 and the first addendum released on June 15, 2012 for K2 Wind ("the project").

K2 Wind is proposing the following modifications to the project:

- Transformer T20 modified from a 530/138 kV transformer to a 530/230 kV transformer
- Transformer T21 modified from a 138/34.5 kV transformer to a 230/34.5 kV transformer
- The underground circuit L20 will be modified from a 138 kV to a 230 kV circuit
- Breaker T20L20 and switches T20L20-T20, T20L20-L20 and L20-T21 originally rated at 138 kV are to be modified to 230 kV rated equipment
- Breakers T10B0 and T20B0 originally rated with a symmetrical short circuit rating of 63 kA to be modified to 50 kA.
- Modification of equivalent collector impedances and number of turbines on each collector circuit.

This assessment concludes that the proposed changes are expected to have no material adverse impact on the reliability of the integrated power system. Therefore, the IESO recommends that a *Notification of Conditional Approval for Connection* be issued for the K2 Wind project subject to implementation of the requirements outlined in this report.

IESO Requirements for Connection

Transmitter Requirements

The following requirements are applicable for the transmitter for the incorporation of the project and they supersede those presented in the original SIA and previous addendum:

(1) Hydro One is required to review the relay settings of the 500 kV sectionalized circuits of B563L and any other circuits affected by the project, as per solutions identified in the PIA.

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.

(2) The transmitter shall modify the existing Bruce Special Protection Scheme (BSPS) to incorporate the new project and the new switching station. The BSPS shall be expanded to recognize the disconnection of the circuits in the Bruce x Longwood corridor. A description of the modifications to the BSPS has to be provided to the IESO in a timely manner to allow for the required approvals of the BSPS to be obtained. A Facility Description Document (FDD) describing the functionality of the expanded BSPS has to be provided to the IESO during the market entry /facility registration process.

(3) Equipment at Ashfield SS must be able to withstand a maximum continuous rating greater than or equal to 554 kV. Fault interrupting devices at Ashfield SS must be able to interrupt fault currents at voltages as high as 554 kV.

(4) The circuit breakers at Ashfield will have a short circuit symmetrical rating of at least 50 kA at a maximum continuous operating voltage of 570 kV. This rating is sufficient in meeting the short circuit levels at Ashfield SS. If any future system changes results in an increased fault level higher than the capability of the fault interrupting devices, these fault interrupting devices must be replaced with higher rated equipment capable of withstanding the increased fault level up to the maximum fault level specified in Appendix 2 of the Transmission System Code.

Connection Applicant Requirements

The following requirements are applicable to the connection applicant for the incorporation of the project and they supersede those presented in the original SIA and addendum.

Specific requirements:

(1) This project will be required to participate in the Bruce Special Protection Scheme (BSPS). Special protection system facilities must be installed at the project to accept a single pair (A & B) of G/R signals from the BSPS, and disconnect the project from the system with no intentional time delay when armed for G/R following a triggering contingency. These special protection system facilities must also comply with the NPCC Reliability Reference Directory #7 for Type 1 special protection systems. In particular, if the SPS is designed to have ‘A’ and ‘B’ protection at a single location for redundancy, they must be on different non-adjacent vertical mounting assemblies or enclosures. Two independent trip coils are required on the breakers selected for G/R. The applicant must provide two dedicated communication channels, separated physically and geographically diverse, between the project and the Bruce NGS.

To disconnect the project from the system for G/R, simultaneous tripping of the 500 kV breakers T10B0 and T20B0, 230 kV breaker T20L20, and 34.5 kV breaker B10T10 shall be initiated, with no breaker failure response. After being tripped by the BSPS, the closing of the breakers is not permitted until approval is obtained from the IESO. Alternative solutions to disconnect the project from the system for G/R may be acceptable upon the approval of the IESO.

(2) The project 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 collector impedance parameters provided by the connection applicant, a static compensation device of 5 MVar@ 34.5kV installed at the B10 bus and 7 MVar@ 34.5 kV installed on the B20 bus would satisfy the reactive power requirement. As the required amount of reactive power compensation is quite small as compared with the project's reactive capability and it makes its installation impractical, the IESO considers that the reactive power requirements are satisfactorily met without the additional 12 MVar of reactive compensation.

The main transformer ULTC shall be adjusted, manually or automatically, to regulate the collector bus voltage such that it is within normal range and close to about 1 pu. The IESO may require automatic control for this ULTC if manual adjustment is too slow.

The connection applicant must be able to confirm its reactive capability as studied in this SIA during the commission tests.

(3) The wind farm voltage control system shall be designed as per the philosophy described in Section 6.4 of the original SIA. The connection applicant is required to provide a finalized copy of the functional description of the wind farm control systems for the IESO's approval before the project is allowed to connect.

(4) The connection applicant shall ensure that the equipment within the facility has the capability to operate under the condition when the voltage at Ashfield SS is as high as 554 kV.

(5) The 500 kV circuit breakers at K2 will have a short circuit symmetrical rating of 50 kA at a maximum continuous operating voltage of 575 kV. This rating is sufficient in meeting the short circuit levels at K2. If any future system changes results in an increased fault level higher than the capability of the fault interrupting devices, these fault interrupting devices must be replaced with higher rated equipment capable of withstanding the increased fault level up to the maximum fault level specified in Appendix 2 of the Transmission System Code.

General Requirements: The connection applicant shall satisfy all applicable requirements and standards specified in the Market Rules and the Transmission System Code. The following requirements summarize some of the general requirements that are applicable to the proposed project, and presented in detail in Appendix B of this report.

(1) The connection applicant shall ensure that the project has 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 project 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%. The generation project shall respond to system frequency decline by temporarily boosting its active power output for some time (i.e. 10 s) by recovering energy from the rotating blades, if this technology is available.

(2) The connection applicant shall ensure that the project has the capability to supply continuously all levels of active power output for 5% deviations in terminal voltage.

The proposed project shall 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.

The proposed project shall have the capability to 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 $\Delta V/\Delta Q_{max}$ shall be adjustable to 0.5%. The response of the generation project for voltage changes shall be similar or better than that of a generation project with a synchronous generation unit and an excitation system that meets the requirements of Appendix 4.2.

(3) The generation project shall have the capability 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.

(4) The connection applicant shall ensure that the 500kV equipment is capable of continuously operating between 490 kV and a maximum continuous voltage of 554 kV.

Protective relaying must be set to ensure that transmission equipment remains in-service for voltages between 94% of the minimum continuous value and 105% of the maximum continuous value.

(5) The connection applicant shall ensure that the connection equipment is designed to be fully operational in all reasonably foreseeable ambient temperature conditions. The connection equipment must also be designed so that the adverse effects of its failure on the IESO-controlled grid are mitigated. This includes ensuring that all circuit breakers fail in the open position.

(6) The connection applicant shall install at the project a disturbance recording device with clock synchronization that meets the technical specifications provided by the transmitter.

(7) The connection applicant shall ensure that all equipment within their facility has the capability to withstand the fault levels in the area. If any future system changes results in an increased fault level higher than the equipment's capability, the connection applicant is required to replace the equipment with higher rated equipment capable of withstanding the increased fault level, up to maximum fault level specified in Appendix 2 of the Transmission System Code.

Appendix 2 of the Transmission System Code states that the maximum rated interrupting time for the 500 kV breakers must be $\leq$ 2 cycles. Thus, the connection applicant shall ensure that the installed breakers meet the required interrupting time specified in the Transmission System Code. Fault interrupting devices must be able to interrupt fault currents at the maximum continuous voltage.

(8) The connection applicant shall ensure that the new protection systems at the project are designed to satisfy all the requirements of the Transmission System Code and any additional requirements identified by the transmitter.

As currently assessed, the projects are not part of the Bulk Power System (BPS). However, being 500 kV connected facilities, the projects are designated as essential to the power system by the IESO and as such must meet the TSC requirements for essential elements.

The protection systems within the generation project must only trip the appropriate equipment required to isolate the fault.

The autoreclosure of the high voltage breakers at the connection point must be blocked. Upon its opening for a contingency, the high voltage breaker must be closed only after the IESO approval is granted.

Any modifications made to protection relays 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.

(9) The connection applicant shall ensure that the telemetry requirements are satisfied as per the applicable Market Rules requirements. The determination of telemetry quantities and telemetry testing will be conducted during the IESO Facility Registration/Market Entry process.

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

(11) The proposed project must be compliant with applicable reliability standards set by the North American Electric Reliability Corporation (NERC) and the North East Power Coordinating Council (NPCC) that are in effect in Ontario as mapped in the following link: http://www.ieso.ca/imoweb/ircp/orcp.asp.

(12) The connection applicant will be required to be a restoration participant. Details regarding restoration participant requirements will be finalized at the Facility Registration/Market Entry Stage.

(13) 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 at least seven months before energization to the IESO-controlled grid. This includes both PSS/E and DSA software compatible mathematical models. The models and data may be shared with other reliability entities in North America as needed to fulfill the IESO's obligations under the Market Rules, NPCC and NERC rules.

The connection applicant must also 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. The evidence must be supplied to the IESO within 30 days after completion of commissioning tests. 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.

(14) 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 SIA), may be imposed in the future. The connection applicant is encouraged to follow developments and updates through the following link: http://www.ieso.ca/imoweb/consult/consult_se91.asp.

Rationale for Conditional Approval for Connection

The following conclusions supersede those presented in the original SIA and previous Addendum.

1. The proposed connection arrangement for the project is acceptable to the IESO.
2. The asymmetrical fault current at Bruce A 230 kV switchyard before and after the incorporation of the project will exceed the interrupting capability of the existing breakers. Hydro One has planned to replace the Bruce 230 kV breakers to improve fault current interrupting capability in the long term. Before the circuit breakers are replaced, temporary operational mitigation measures have been developed by Hydro One in collaboration with the IESO.
3. The project is connecting in the Bruce Area where transmission connected generation projects participate in the Bruce Special Protection Scheme (BSPS).

4. The functions of the proposed wind farm control system meet the requirements in the Market Rules except that the inertia emulation control function is commercially unavailable. The connection applicant shall install this function in the future once it is commercially available for the proposed type of wind turbine generator.
5. Under some outage conditions, i.e. the project out of service, the voltage at the 500 kV Ashfield SS may exceed the generally applicable maximum voltage levels specified in the Ontario Resource and Transmission Assessment Criteria. This will be addressed by installing equipment at Ashfield SS capable of operating at a maximum continuous operating voltage of at least 554 kV or greater.
6. Circuit S2S will be required to operate open-loop under certain conditions after the integration of the committed generation in the Bruce Area to prevent thermal overloading.
7. The WTGs of the project and the power system are expected to be transiently stable following recognized fault conditions.
8. The proposed WTGs are expected to remain connected to the grid for recognized system contingencies which do not remove the project by configuration.
9. Protection adjustments identified by the Hydro One in the Protection Impact Assessment (PIA) to accommodate the project have no adverse impact on the reliability of IESO-controlled grid.
10. The relay margins on the affected circuits after the incorporation of the project conform to the Market Rules' requirements.
11. In the event of high flows eastward towards Toronto, there is a low probability of congestion that may require the connection applicant to curtail its output.

1. Data Verification

1.1 Connection Arrangement

The revised configuration is shown in Figure 2, Appendix A, will not reduce the level of reliability of the integrated power system and is, therefore, acceptable to the IESO

The original configuration is shown in Figure 1, Appendix A. The following changes have been made to the original configuration:

- Transformer T20 modified from a 530/138 kV transformer to a 530/230 kV transformer with a impedance change from 8.0% to 7.8% on 96 MVA base
- Transformer T21 modified from a 138/34.5 kV transformer to a 230/34.5 kV transformer with no impedance change or change in characteristics.
- The underground circuit L20 will be modified from a 138 kV to a 230 kV circuit with a change in impedance.
- Breaker T20L20 and switches T20L20-T20, T20L20-L20 and L20-T21 originally rated at 138 kV are to be modified to 230 kV rated equipment.
- Breakers T10B0 and T20B0 originally rated with a symmetrical short circuit rating of 63 kA to be modified to 50 kA.
- Modification of equivalent collector impedances.
- The number of turbines on each collector circuit, maximum continuous output on each collector circuit, and collector impedances have been modified as per Table 1.

Table 1: Maximum continuous output and number of turbines per collector circuit

Circuit	Unit	# of Turbines	Total Output (MW)
C1	G1	16	32.22
C2	G2	14	26.56
C3	G3	14	26.88
C4	G4	14	26.96
C5	G5	14	26.77
C6	G6	14	27.20
C7	G7	14	26.99
C8	G8	14	26.33
C9	G9	13	25.12
C10	G10	13	24.98

Hydro One has informed the IESO that the nomenclature for the lines along the Bruce to Longwood corridor will be named as follows due to sectionalization of B562L and B563L:

- 500 kV section between Bruce and Evergreen to be named B562E.
- 500 kV section between Evergreen and Longwood to be named E564L
- 500 kV section between Bruce and Ashfield SS to be named B563A
- 500 kV section between Ashfield SS and Longwood to be named A565L

1.2 Step-Up Transformers

The following tables summarize the new data for transformer T20 and transformer T21. Note, the specifications for the 500/34.5 transformer T10 have remained unchanged.

Table 2: Transformer T20 data

Transformation	Rating(MVA) (ONAN/ONAF/ONAF)	Positive Sequence Impedance (pu)	Configuration			Zero Sequence Impedance (pu)	Tap
			H	X	Y		
530/230 kV	96/128/160 MVA	j0.078 S_B= 96 MVA	Yg	Yg	Delta	0.001+j0.08 S_B= 96 MVA	OLTC 543.25kV

Table 3: Transformer T21 data

Transformation	Rating(MVA) (ONAN/ONAF/ONAF)	Positive Sequence Impedance (pu)	Configuration			Zero Sequence Impedance (pu) S_B= 96 MVA	Tap
			H	X	Y		
230/34.5 kV	96/128/160 MVA	j0.078 S_B= 96 MVA	Delta	Yg	NA	0.01+j0.070	ULTC@HV: 20 steps, 1% each

1.3 Collector System

The following table summarizes the new collector system impedances.

Table 4: Equivalent impedance of collector circuits

Circuit	Unit	Positive- Sequence Impedance (*) (pu, S_B=100 MVA)			Zero- Sequence Impedance (*) (pu, S_B=100 MVA)		
		R	X	B	R	X	B
C1	G1	0.0688	0.0591	0.0275	-	-	-
C2	G2	0.0835	0.0924	0.0208	-	-	-
C3	G3	0.0622	0.0533	0.0176	-	-	-
C4	G4	0.0716	0.0786	0.0222	-	-	-
C5	G5	0.0611	0.0769	0.0223	-	-	-
C6	G6	0.0722	0.0730	0.0218	-	-	-
C7	G7	0.0600	0.1149	0.0231	-	-	-
C8	G8	0.0517	0.0849	0.0170	-	-	-
C9	G9	0.0325	0.0313	0.0121	-	-	-
C10	G10	0.0671	0.1106	0.0237	-	-	-

(*) Zero-sequence impedance has not been provided. Typical data was assumed for the SIA. The applicant needs to provide these data during the IESO Market Entry process.

1.4 Intermediate Transmission Line

The following table summarizes the revised impedance for circuit L20 as a result of the equipment change from 115 kV to 230 kV.

Table 5: Impedance of 230 kV transmission line circuit specifications

Circuit	Positive Sequence Impedance (pu, SB=100 MVA)			Zero Sequence Impedance (pu, SB=100 MVA)		
	R	X	B	R	X	B
L20	0.000747 pu	0.00237 pu	0.1587 pu	0.00169 pu	0.001013 pu	0.1587 pu

1.5 Connection Equipment

Sections 1.5.1 and 1.5.2 summarize the specifications of the switches and breakers that have been modified from 138 kV to 230 kV equipment. Section 1.5.3 summarizes the specifications of the 500 kV breakers that have been modified from 63 kA short circuit symmetrical rating to a rating of 50 kA. Section 1.5.4 summarizes the Ashfield SS breaker specifications that have been confirmed and provided by Hydro One. Specifications for all other switches and breakers outlined in the original SIA remain unchanged.

1.5.1 K2 230 kV Switches

Table 6: Specifications for 230 kV Switches

Identifier	Maximum Voltage Rating	Continuous Current Rating	Short Circuit Symmetrical Rating
T20L20-T20	250 kV	1200 A	40 kA
T20L20-L20	250 kV	1200 A	40 kA
L20-T21	250 kV	1200 A	40 kA

1.5.2 K2 230 kV Breaker

Table 7: Specifications for 230 kV T20B0 breaker

Identifier	Maximum Voltage Rating	Interrupting time	Continuous Current Rating	Short Circuit Symmetrical Rating
T20B0	250 kV	50 ms	1200 A	20 kA

1.5.3 K2 500 kV Breakers

Table 8: Specifications for 500 kV circuit breakers

Identifier	Maximum Voltage Rating	Interrupting time	Continuous Current Rating	Short Circuit Symmetrical Rating
T10B0	575 kV	33 ms	2000 A	50 kA
T20B0	575 kV	33 ms	2000 A	50 kA

The 500 kV breakers at K2 will have a short circuit symmetrical rating of 50 kA at a maximum continuous operating voltage of 575 kV. This rating is sufficient in meeting the short circuit levels at K2. If any future system changes results in an increased fault level higher than the capability of the fault interrupting devices, these fault interrupting devices must be replaced with higher rated equipment capable of withstanding the increased fault level up to the maximum fault level specified in Appendix 2 of the Transmission System Code.

1.5.4 Ashfield SS 500 kV Breaker

Table 9: Specifications for 500 kV Ashfield breakers

Maximum Voltage Rating	Interrupting time	Continuous Current Rating	Short Circuit Symmetrical Rating
570 kV	33 ms	4000 A	50 kA

2. Short Circuit Assessment

Fault level studies were repeated by the transmitter to examine the effect of the project on fault levels at existing facilities in the surrounding area. Studies were performed to analyze the fault levels with and without the project and other recently committed generation projects in the system.

This assessment concluded that:

(1) The interrupting capabilities of the 500 and 230 kV circuit breakers of the project are adequate for the anticipated fault levels.
(2) With the exception of the Bruce A 230 kV switchyard, the interrupting capability of the lowest rated circuit breakers near the project will not be exceeded after the incorporation of the project.
(3) The modified connection arrangement does not result in a significant difference in short circuit levels from those observed in the original SIA.

Short circuit study was carried with the assumptions documented in the original SIA report.

Table 10: Fault Levels at facilities near the project

Station	Before the Project		After the Project and other committed projects		Lowest Rated Circuit Breaker (kA)
	3-Phase	L-G	3-Phase	L-G	
*Symmetrical Fault (kA)**					
Bruce A 230 kV	42.97	54.36	44.50	56.01	60**
Bruce B 500 kV	36.97	41.6	37.90	42.56	60
Longwood 500 kV	20.10	21.0	20.81	22.04	63
Longwood 230 kV	37.45	44.8	38.42	46.11	63
Ashfield 500 kV	-	-	16.65	14.14	50
K2 500 kV	-	-	16.65	14.14	50
K2 230 kV	-	-	3.63	5.40	20
*Asymmetrical Fault (kA)**					
Bruce A 230 kV	57.65	78.45***	59.56	80.62 **	72.6***
Bruce B 500 kV	54.32	63.58	55.60	64.93	95.1
Longwood 500 kV	24.43	26.74	25.31	28.02	68.9
Longwood 230 kV	45.82	58.05	47.10	59.76	78
Ashfield 500 kV	-	-	20.47	18.22	Unknown*****
K2 500 kV	-	-	20.47	18.22	50****
K2 230 kV	-	-	5.09	7.52	26

* Based on a pre-fault voltage level of 550 kV for 500 kV buses, 250 kV for 230 kV buses, and 127 kV for 115 kV buses. For Ashfield 500 kV and K2 500 kV buses, the pre-fault voltage was assumed to be 570 kV.

**The asymmetrical fault level is based on a breaker contact parting time of 44 ms.

***Three lower rated Bruce A 230 kV breakers (D1L81, K1L82 and L23T25) are scheduled to be replaced by December 2012 (see CAA ID#2010-EX511). The listed lowest rated circuit breaker value for Bruce A 230 kV assumes these breakers being replaced.

****The symmetrical rating was used as the asymmetrical rating was not provided by the applicant.

***** The transmitter to provide the asymmetrical rating of the 500 kV circuit breakers during the IESO Market Entry process.

The results also show that the line-to-ground asymmetrical fault current at Bruce A 230 kV before and after the incorporation of the project and other committed projects will exceed the interrupting capability of the existing breakers. This issue has been investigated in the 2nd SIA addendum for the project of Bruce G1 and G2 restart (CAA ID 2004-163), where the IESO has identified a requirement to replace all the Bruce 230 kV breakers with higher fault current interrupting capability and assessed potential mitigation measures for this issue until these circuit breakers are replaced. Hydro One has planned to replace the Bruce 230 kV breakers.

3. System Impact Studies

3.1 Reactive Power Capability

The reactive power capability test was repeated to ensure that the project is still capable of injecting and withdrawing up to 33% of its rated active power at the connection point (± 89.1 MVar). Results indicate that a total of 12 MVar of additional static reactive compensation would meet this requirement.

3.1.1 Dynamic Reactive Power Capability

In the original SIA, it was concluded that the Siemens SWT-2.3-101 WTGs can deliver the IESO required dynamic reactive power at rated terminal voltage. Thus there is no need to install additional dynamic reactive power device.

3.1.2 Static Reactive Power Capability

The total amount of static reactive required was determined through two tests. The first test determines the amount of static reactive compensation required to help maintain typical low and high voltages at the connection point. This test allows for the aid of under load tap changer action from transformer(s). The second test determines the amount of static reactive compensation required at the facility in order to provide the full reactive capability requirements at the connection point under a ± 10% change voltage change at the connection point without the aid of under load tap changer action from transformer(s). The test which yields the larger static reactive compensation will determine the required amount that must be installed at the project.

(a) Static reactive compensation test: maintain typical high and low voltages

The reactive power capability in lagging power factor of the project was assessed under the following assumptions:

- typical low voltage of 545 kV at the connection point;
- maximum active power output from the equivalent WTG;
- maximum reactive power output (lagging power factor) from the equivalent WTG, unless limited by the maximum acceptable WTG terminal voltage. The reactive capability is adjusted based on the terminal voltage as per the reactive capability diagram shown in the original report.
- maximum WTG voltage is 1.05;
- 500/34.5 kV and 500/230 kV transformers on 543.25 kV fixed tap position;
- 0.690/34.5 kV GSU transformers on Feeders 1 to 5 on 1.05 pu fixed tap position;
- 0.690/34.5 kV GSU transformers on Feeders 6 to 10 on 1.05 pu fixed tap position;
- the 230/34.5 kV step-up transformer ULTC is available to adjust the LV voltage as close as possible to 1 pu voltage.

The reactive power capability in leading power factor of the project was assessed under the following assumptions:

- typical high voltage of 550 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, unless limited by the minimum acceptable WTG terminal voltage; The reactive capability is adjusted based on the terminal voltage as per the reactive capability diagram shown in the original report.
- minimum acceptable WTG voltage is 0.9, as per WTG voltage capability;
- 500/34.5 kV and 500/138 kV transformers on 543.25 kV tap position;
- 0.690/34.5 kV GSU transformers on Feeders 1 to 5 on 1.05 pu tap position;
- 0.690/34.5 kV GSU transformers on Feeders 6 to 10 on 1.05 pu tap position;
- the 230/34.5 kV step-up transformer ULTC is available to adjust the LV voltage as close as possible to 1 pu voltage.

The results of the above test are summarized in Table 11 below and show that the reactive power withdrawal and injection requirements can be met with the installation of 12 MVars (7 MVar installed on the B20 bus and 5 MVar installed on the B10 bus).

Table 11: K2 Wind reactive power capability at the connection point

Operation	Collector Bus Voltage (pu)		LV bus Voltage of 500/230 kV transformer (pu)	Generator Terminal Voltage (pu)		Reactive Power Injection at Connection Point (Mvar)			500 kV Bus Voltage (kV)
	Bus B10	Bus B20		Max (G1-G5)	Max (G6-G10)	From G1-G5	From G6-G10	Total	
Lagging PF*	1.04	1.00	1.046	1.04	0.995	47.2	43.4	90.7	545
Leading PF**	0.98	1.03	0.973	0.905	0.95	48.2	48.6	96.7	550

* 230/34.5 kV transformer tap required to be at the 253 kV position
** 230/34.5 kV transformer tap required to be at the 207 kV position

(b) Static reactive compensation test: impact of ± 10% voltage change

The reactive power capability in lagging power factor of the project was assessed under the following assumptions:

- A voltage of 492.75 kV at the connection point (10% voltage decline from average voltage of 547.5 kV) ;
- maximum active power output from the equivalent WTG;
- maximum reactive power output (lagging power factor) from the equivalent WTG, unless limited by the maximum acceptable WTG terminal voltage. The reactive capability is adjusted based on the terminal voltage as per the reactive capability diagram shown in the original report.

- WTG terminal voltage determined by executing Siemens_PPVPFQC_IPLAN_VS_2M3_3M0_3M6_WTG_Ver_01_PSSE_Ver_29_30.IRF file provided by Siemens
- 500/34.5 kV and 500/230 kV transformers on 543.25 kV fixed tap position;
- 0.690/34.5 kV GSU transformers on Feeders 1 to 5 on 1.05 pu fixed tap position;
- 0.690/34.5 kV GSU transformers on Feeders 6 to 10 on 1.05 pu fixed tap position;
- the 230/34.5 kV step-up transformer fixed at the 234.6 kV tap position.

The reactive power capability in leading power factor of the project was assessed under the following assumptions:

- A voltage of 602.25 kV at the connection point (10% voltage rise from the average voltage of 547.5 kV) ;
- minimum (zero) active power output from the equivalent WTG;
- maximum reactive power consumption (leading power factor) from the equivalent WTG, unless limited by the minimum acceptable WTG terminal voltage; The reactive capability is adjusted based on the terminal voltage as per the reactive capability diagram shown in the original report.
- WTG terminal voltage determined by executing Siemens_PPVPFQC_IPLAN_VS_2M3_3M0_3M6_WTG_Ver_01_PSSE_Ver_29_30.IRF file provided by Siemens
- 500/34.5 kV and 500/138 kV transformers on 543.25 kV tap position;
- 0.690/34.5 kV GSU transformers on Feeders 1 to 5 on 1.05 pu tap position;
- 0.690/34.5 kV GSU transformers on Feeders 6 to 10 on 1.05 pu tap position;
- the 230/34.5 kV step-up transformer fixed at the 234.6 kV tap position.

The results of the above test are summarized in Table 12 below and show that the reactive power withdrawal and injection requirements can be met with the WTG reactive capability. Therefore, no additional reactive compensation is needed.

Table 12: K2 Wind reactive power capability at the connection point

Operation	Collector Bus Voltage (pu)		LV bus Voltage of 500/230 kV transformer (pu)	Generator Terminal Voltage (pu)		Reactive Power Injection at Connection Point (Mvar)			500 kV Bus Voltage (kV)
	Bus B10	Bus B20		Max (G1-G5)	Max (G6-G10)	From G1-G5	From G6-G10	Total	
Lagging PF	0.961	1.007	0.962	0.98	1.02	59.3	54.7	114	492.5
Leading PF	1.060	1.006	1.076	0.98	0.93	74.4	43.5	117.9	602.0

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 project'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 and results from Test 1 and Test 2 above, an amount of 5 MVar of static reactive power compensation at the B10 collector bus and 7 MVar of static reactive power compensation at the B20 collector bus would meet the reactive power requirements at the connection point. As the required amount of reactive power compensation is quite small as compared with the project's reactive capability and it makes its installation impractical, the IESO considers that the reactive power requirements are satisfactorily met without the additional 12 MVar of static compensation.

The connection applicant needs to provide "as-built" data during the IESO Market Entry process. The IESO will review the required amount of static reactive power compensation at that time. Should the amount of static reactive compensation significantly differ from what was determined in this SIA, the IESO may require the connection applicant to install additional static reactive devices.

The capability of the project to provide the full range of reactive capability will require the ULTC tap positions of the 230/34.5 kV transformer to be changed in response to system conditions. Thus, the IESO requires that the 230/34.5 kV transformer ULTC be adjusted, manually or automatically, to regulate the collector bus voltage such that it is within its normal range and close to about 1 pu. This would facilitate the WTG's ability to provide full reactive support in response to system conditions. The IESO may require automatic control for this ULTC if manual adjustment is too slow.

3.2 Thermal Analysis

It was determined that the thermal analysis and conclusions presented in the original SIA are still valid and therefore, a repeat of study was not necessary for this addendum.

The original SIA concluded that there are no local area pre-contingency or post-contingency thermal overload issues after the incorporation of the project.

3.3 Voltage Analysis

It was determined that the voltage analysis and conclusions presented in the original SIA are still valid and therefore, a repeat of study was not necessary for this addendum.

The original SIA concluded that all voltage declines are within 10% and that the voltage at Ashfield SS may be as high as 553 kV for the loss of the project. This is not a concern as the 500 kV equipment at Ashfield SS will have a maximum continuous rating of 570 kV.

3.4 Transient Stability Performance

The transient stability analysis performed under the new project configuration shows that the project will not cause any transient instability or undamped oscillations.

Transient stability simulations were completed to determine if the power system will be transiently stable with the incorporation of the project under the new project configuration for recognized fault conditions in the vicinity of the project. In particular, rotor angles of generators at Bruce GS, Greenfield GS, Saunders GS and YEC GS were monitored. The peak load base case with conditions described in the original SIA was used to perform the transient analysis. A list of contingencies that were simulated are summarized in Table 13. The protection changes proposed in the Protection Impact Assessment (PIA) were part of the assumptions for the analysis.

Table 13: Simulated contingencies for transient stability

ID	Contingency	Location	Fault Type	Fault Clearing Time (ms)		BRS/ LRSS (ms)*	Reclosure Time (ms)
				Local	Remote		
SC1	B560V+B561M	Willow Creek	LLG	66	91	124	10s for B560V 15s for B561M
SC2	B563A	Bruce	3 ph	66	91		15 s
SC3	A565L	Ashfield	3 ph	66	100		15 s
SC4	A565L	Longwood	3 ph	75	91		15 s
SC5	A565L+E564L	Longwood	LLG	75	91		10 for E564L 15 for A565L
SC6	B563A+B562E	Bruce	LLG	66	91		10 for B562E 15 for B563A
SC7	LV side of 500/34.5 kV transformer	K2	3 ph	Un-cleared		N/A	N/A
SC8	LV side of 500/230 kV transformer	K2	3 ph	Un-cleared		N/A	N/A

*Denotes the Bruce Reactor Switching and Longwood Reactor Switching Schemes.

Figure 3 to Figure 18 in Appendix A show the transient responses of the rotor angles and bus voltages. The transient responses show the generators remain synchronized to the power system and the oscillations are sufficiently damped following all simulated contingencies.

It can also be concluded that the protection adjustments proposed in the PIA report have no material adverse impact on the IESO-controlled grid in terms of transient stability.

3.5 Voltage Ride-Through Capability

As presented in this section, the proposed WTGs are able to remain connected to the grid for recognized system contingencies that do not remove the project by configuration under the new project configuration.

The LVRT capability of the WTG was re-assessed with the new configuration under the simulated contingency presented in Table 14. LVRT settings of the SWT-2.3-101 were provided in the original SIA.

The LVRT capability of the WTGs was assessed based on the terminal voltages of the WTGs under simulated contingencies in Table 14. These contingencies resulted in the lowest transient voltages at the

project.

Table 14: Simulated contingencies for LVRT

Contingency	Location	Fault Type	Fault Clearing Time(ms)		BRS/ LRSS (ms)*	Reclosure Time
			Local	Remote		
B560V+B561M	Willow Creek	LLG	66	91	124	10s for B560V 15s for B561M
B563A	Ashfield	3 ph	66	91		15 s
A565L	Ashfield	3 ph	66	100		15 s
B563A+B562E	Bruce	LLG	66	91		10s for B562E 15s for B563A
B563A	Bruce	LG+BF at H5L563	179	91		N/A
Longwood T3	Longwood	LG+BF at HL563	203	98		N/A

*Denotes the Bruce Reactor Switching and Longwood Reactor Switching Schemes.

The terminal voltage response of the WTG at collector C1 is shown in Figure 19 , Appendix A. It shows that at worst, the terminal voltages of the WTGs drop as low as 0.09 pu and recovers to 0.9 pu in about 0.16779 ms after the fault inception. As compared with the voltage ride through capability of the SWT-2.3-101, the proposed WTGs are able to remain connected to the grid for recognized system contingencies that do not remove the project by configuration.

However, when the project is incorporated into the IESO-controlled grid, if actual operation shows that the WTGs trip for contingencies for which they are not removed by configuration, the IESO will require the voltage ride-through capability be enhanced by the applicant to prevent such tripping.

The voltage ride-through capability must also be demonstrated during commissioning by monitoring several variables under a set of IESO specified field tests and the results should be verifiable using the PSS/E model.

3.6 Relay Margin

Due to high relay margin observed in the original SIA, it was determined that a repeat of study was not necessary for this addendum.

The original SIA concluded that the impedance trajectory on circuits B563A and A565L do not penetrate the relay characteristic and has a margin of greater than 20%, thereby meeting the Market Manual requirement. Therefore, the protection adjustments proposed in the PIA report have not material adverse impact on the IESO-controlled grid.

Appendix A: Figures

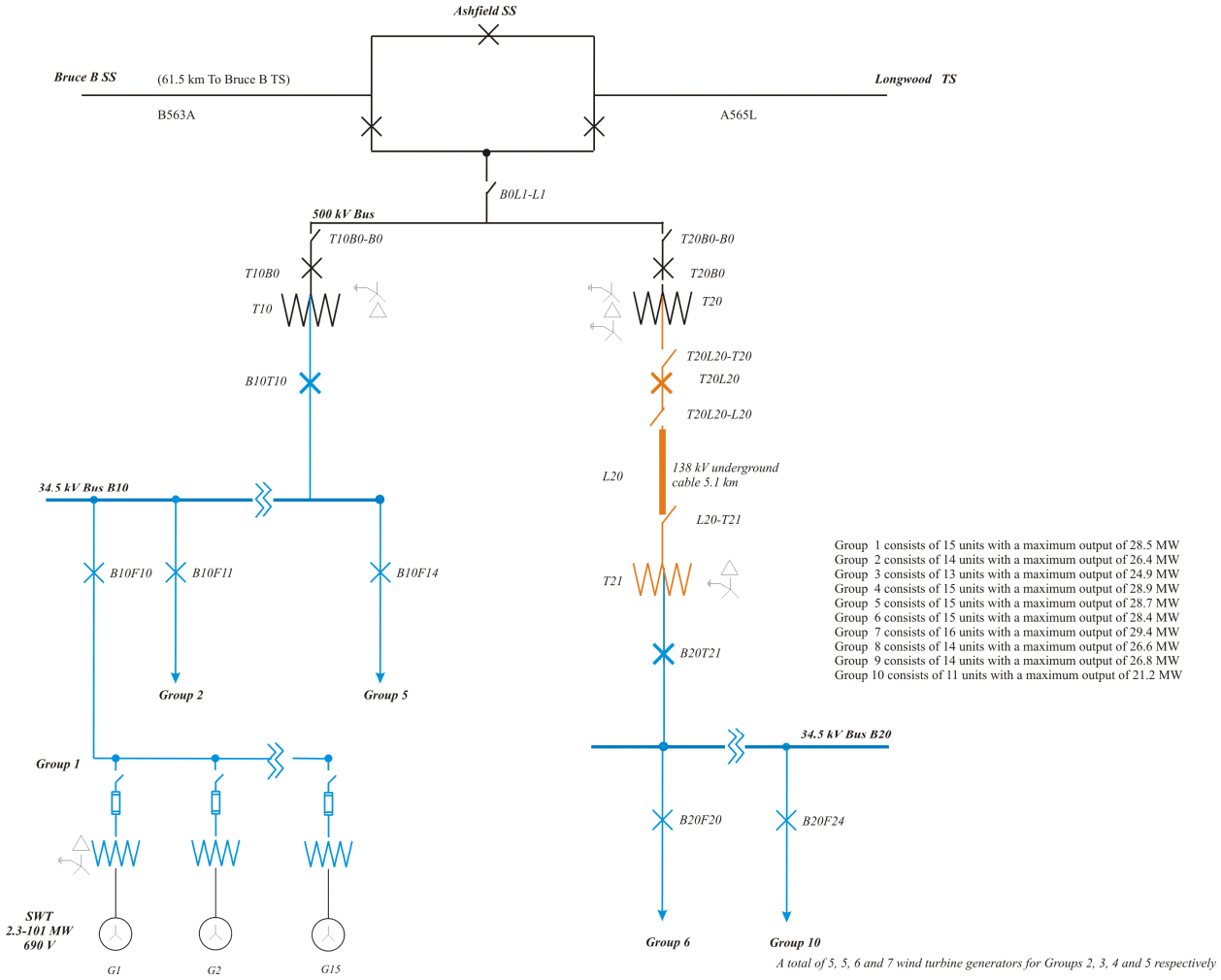


Figure 1: Original K2 Wind Configuration

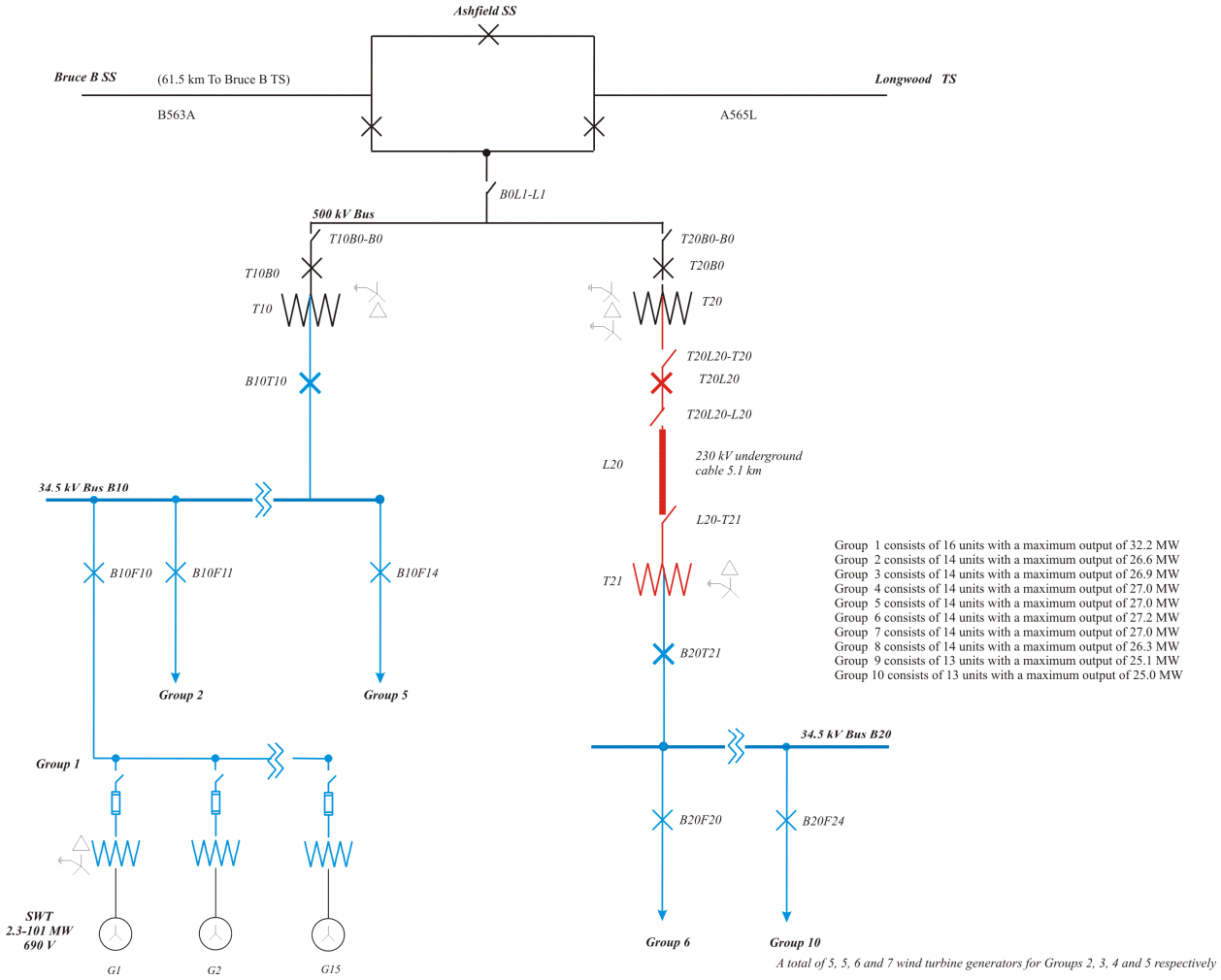


Figure 2: Modified K2 Wind Configuration

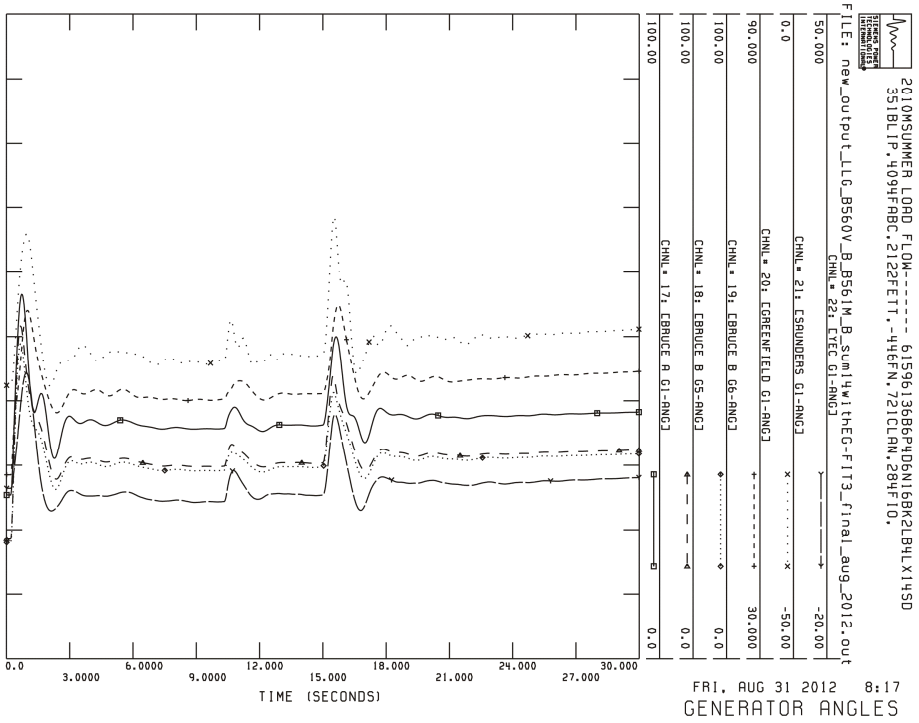


Figure 3 Major generator angle responses following a LLG fault on circuits B560V and B561M at Willow Creek Junction – with reclosure

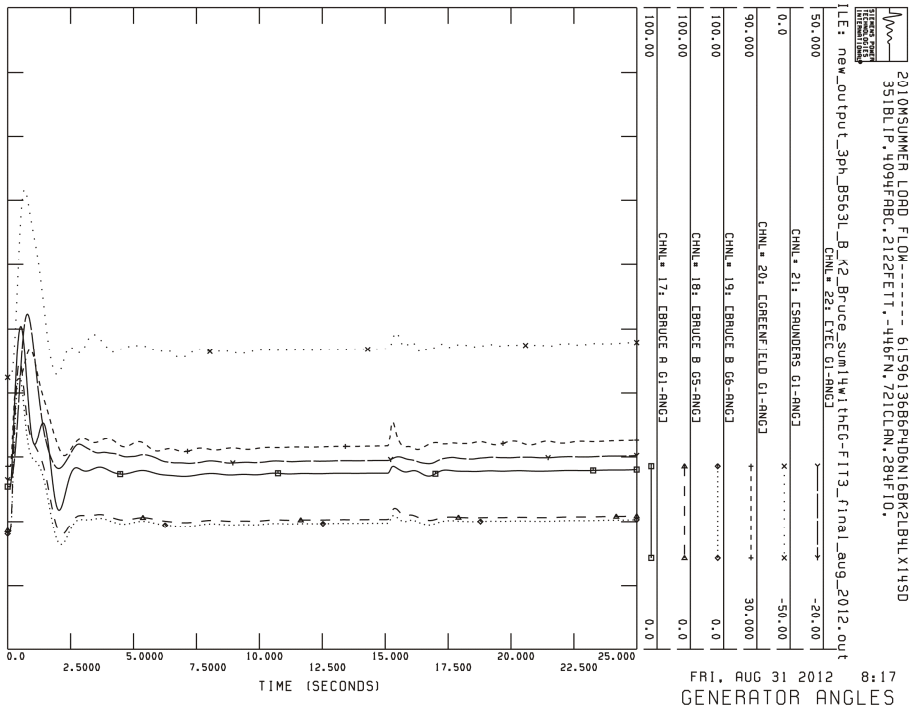


Figure 4: Major generator angle responses following a 3 phase fault on circuit B563A at Bruce – with reclosure

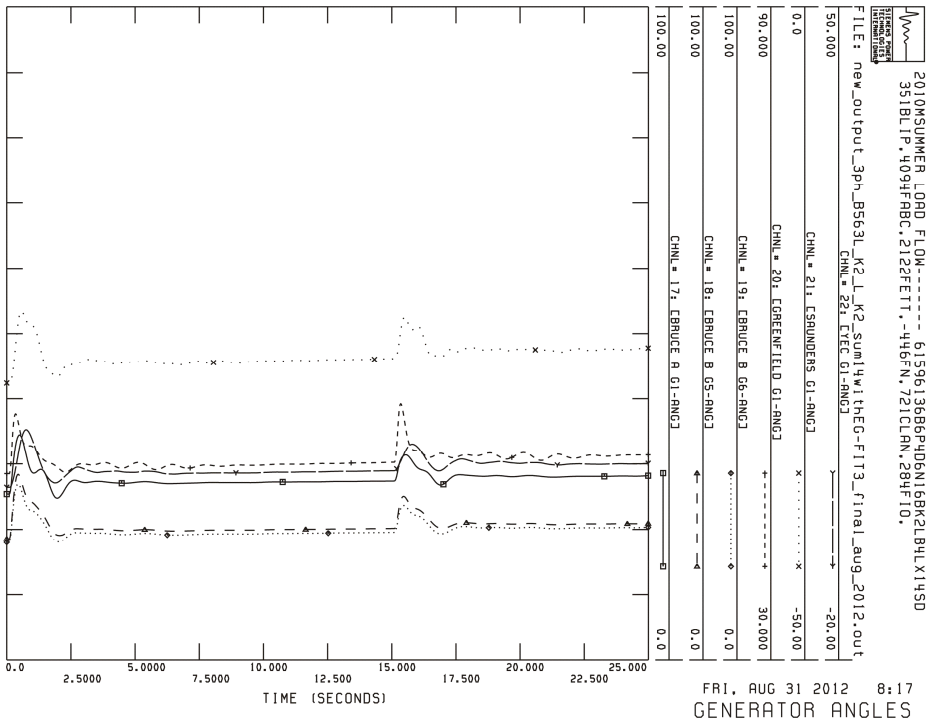


Figure 5: Major generator angle responses following a 3 phase fault on circuit A565L at Ashfield – with reclosure

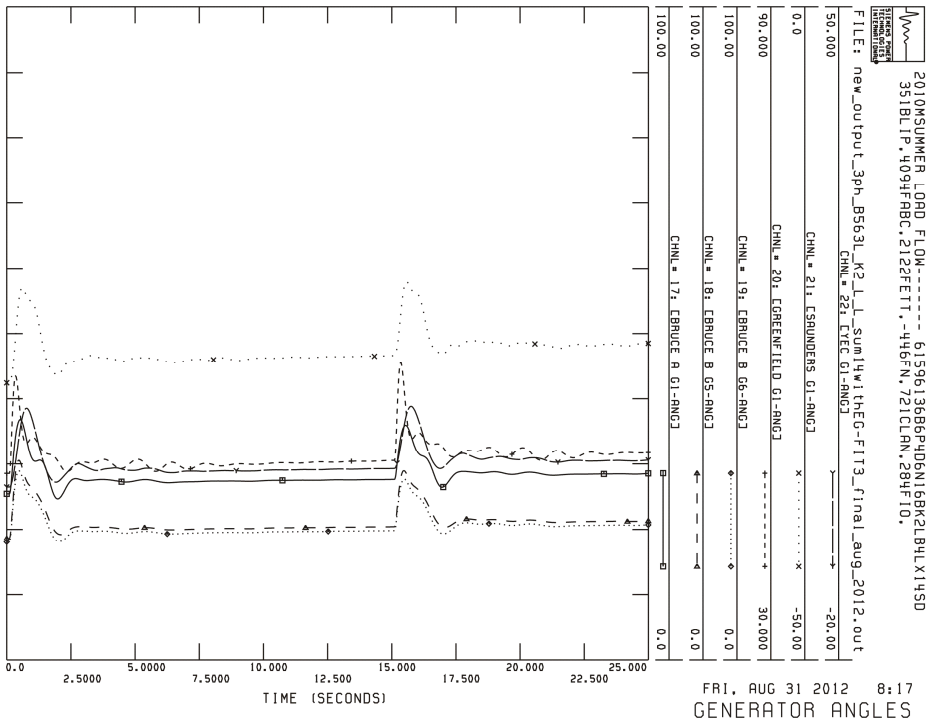


Figure 6: Major generator angle responses following a 3 phase fault on circuit A565L at Longwood – with reclosure

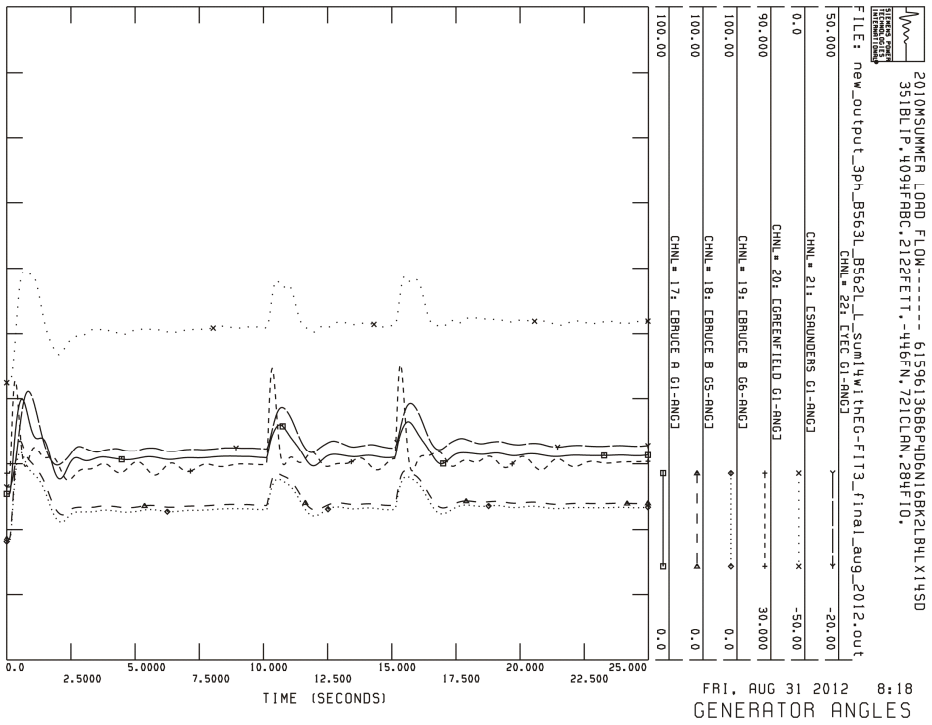


Figure 7: Major generator angle responses following a LLG fault on circuits A565L+E564L at Longwood – with reclosure

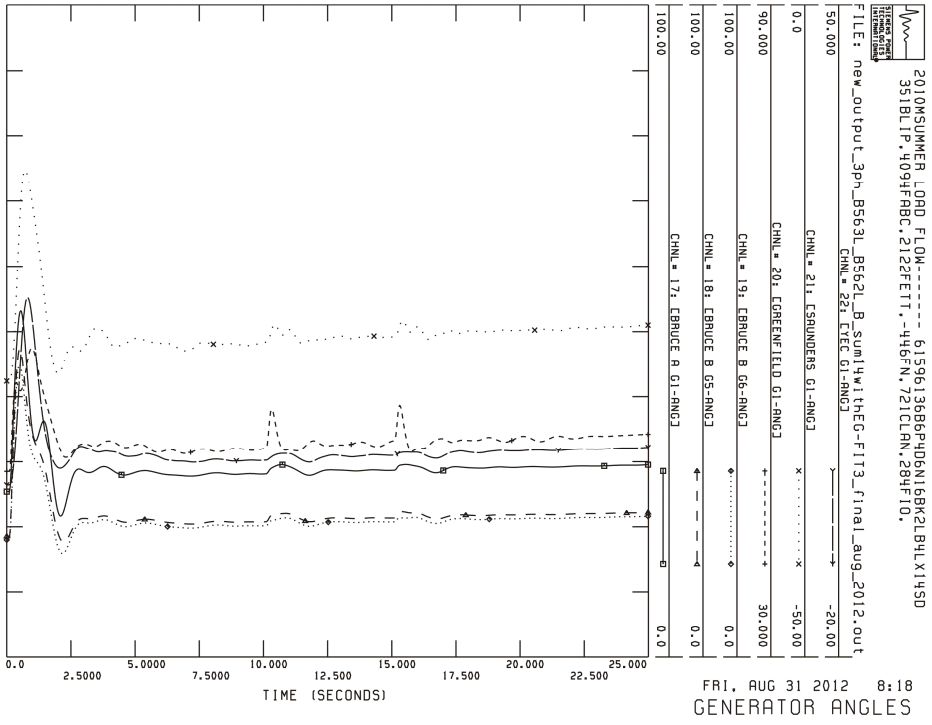


Figure 8 Major generator angle responses following a LLG fault on circuits B563A+B562E at Bruce – with reclosure

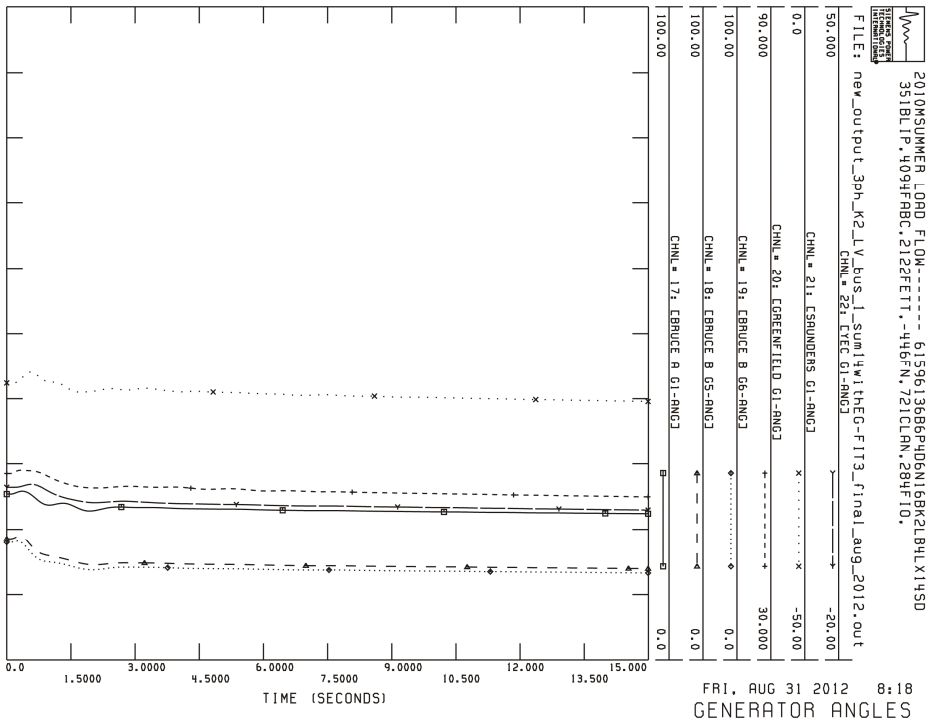


Figure 9 Major generator angle responses following an uncleared LLG fault on LV side of 500/34.5 kV transformer at K2 with no reclosure

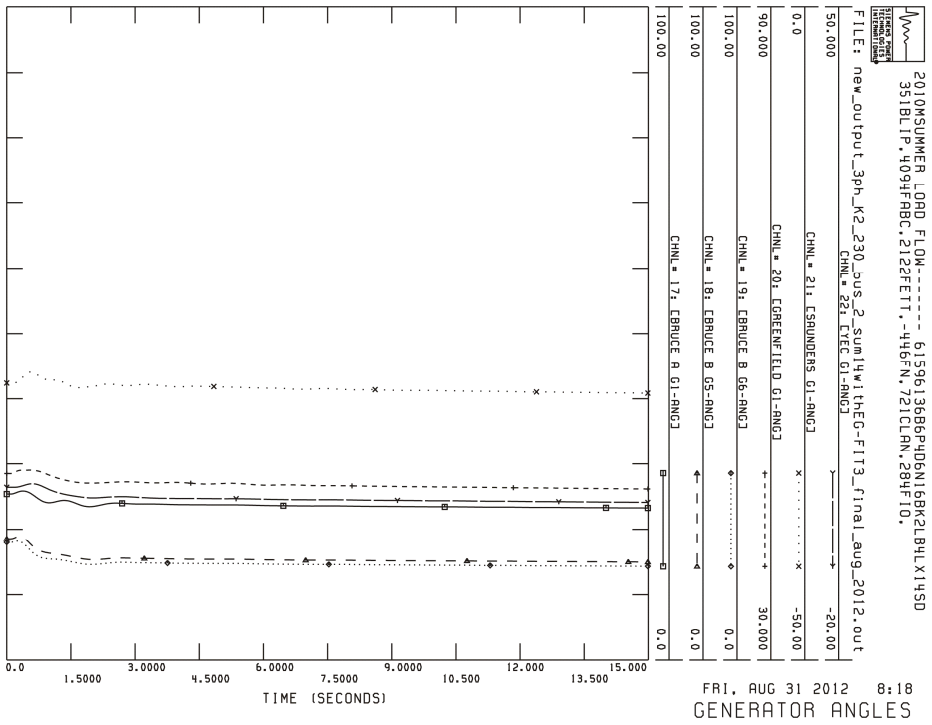


Figure 10: Major generator angle responses following a 3 phase uncleared fault on LV side of 500/230 kV transformer at K2

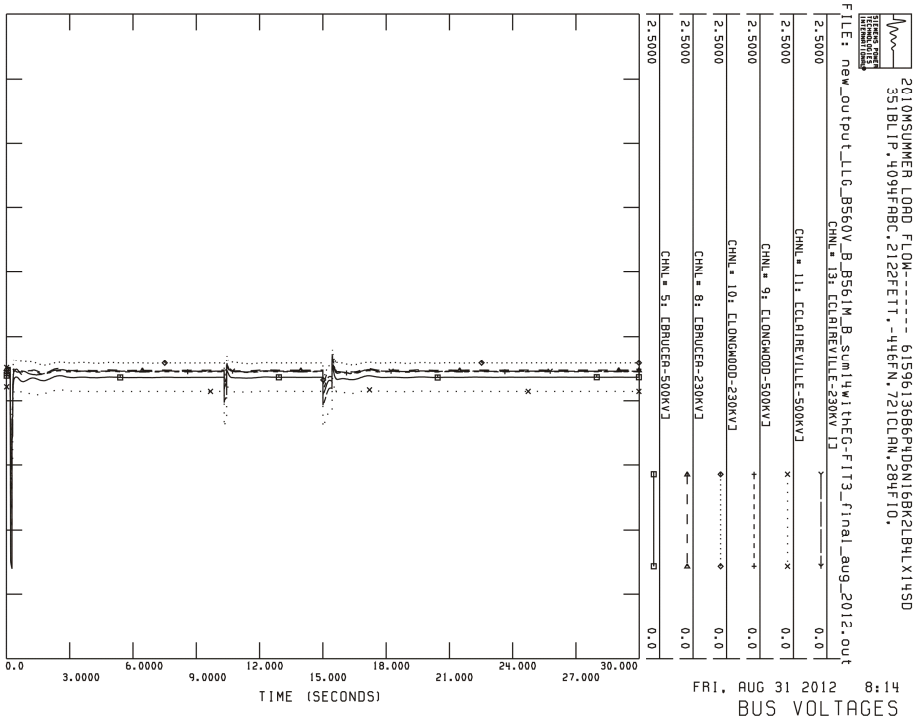


Figure 11: Voltage responses following a 3 phase fault on circuits B560V and B561M at Willow Creek Junction – with reclosure

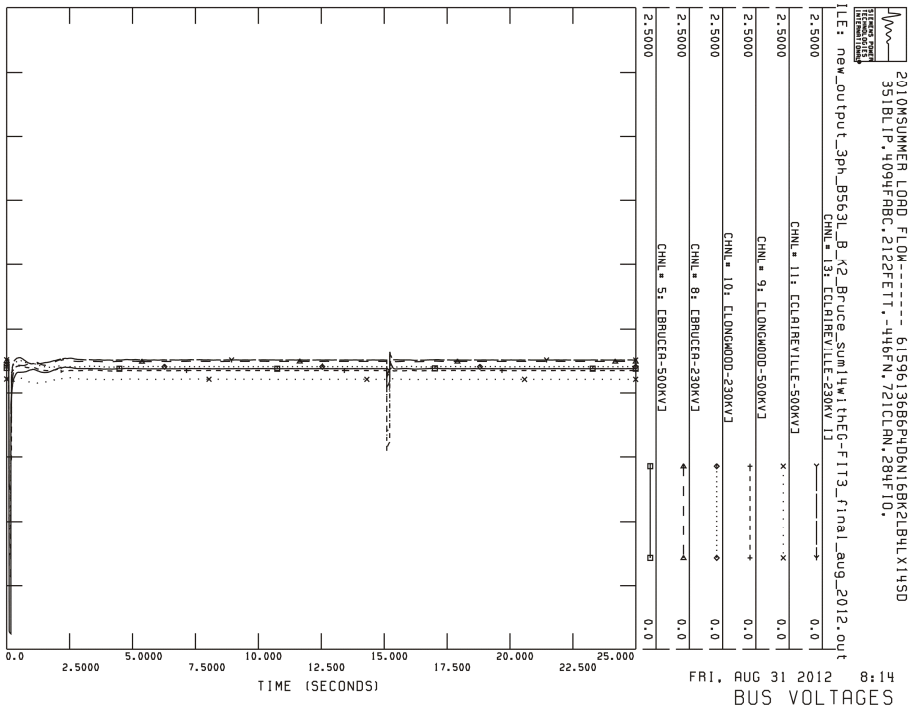


Figure 12: Voltage responses following a 3 phase fault on circuit B563A at Bruce – with reclosure

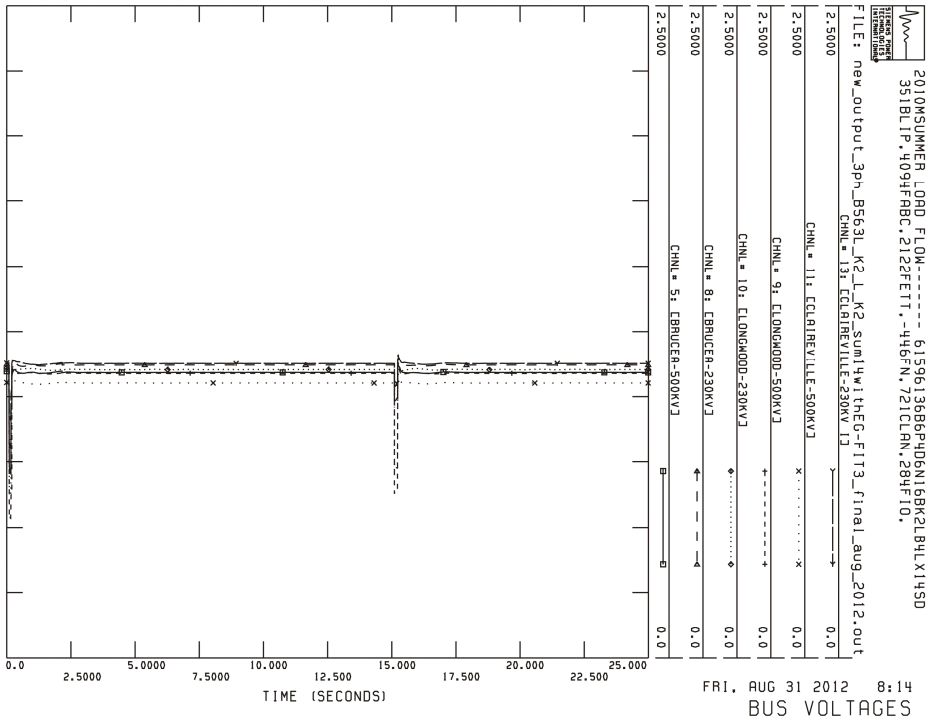


Figure 13: Voltage responses following a 3 phase fault on circuit A565L at Ashfield – with reclosure

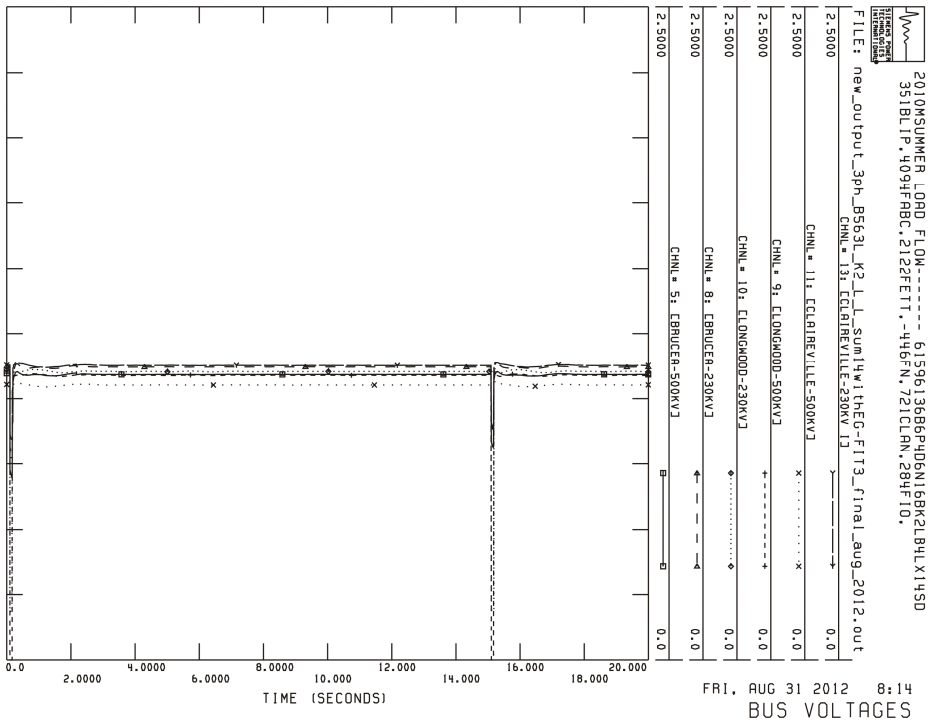


Figure 14: Voltage responses following a 3 phase fault on circuit A565L at Longwood – with reclosure

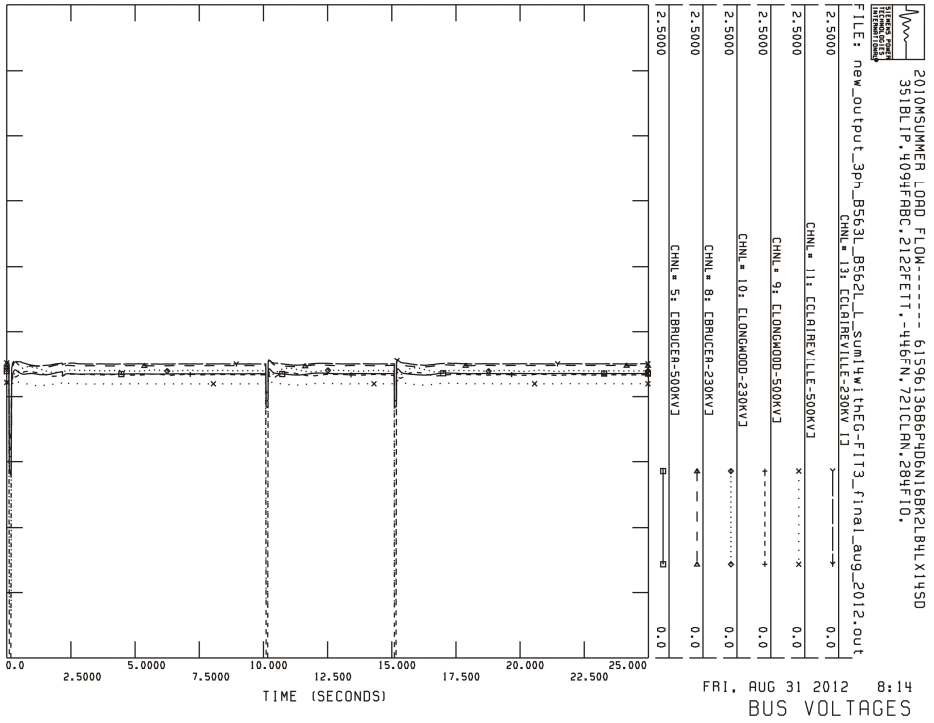


Figure 15: Voltage resposnes following a LLG phase fault on circuits A565L+E564L at Longwood with reclosure

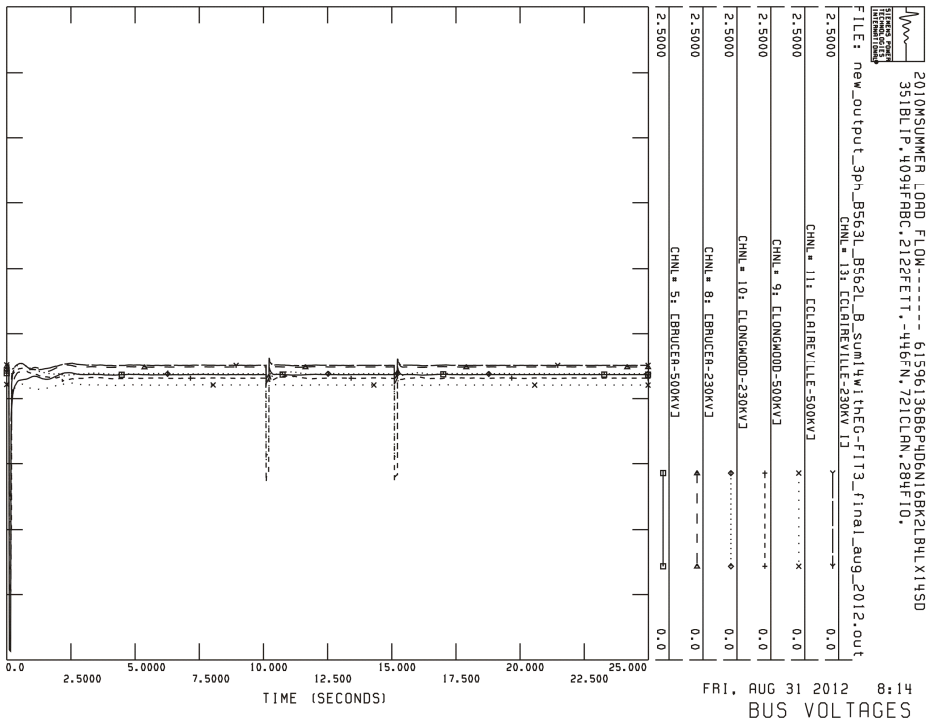


Figure 16: Voltage responses following a LLG phase fault on circuits B563A+B562E at Bruce – with reclosure

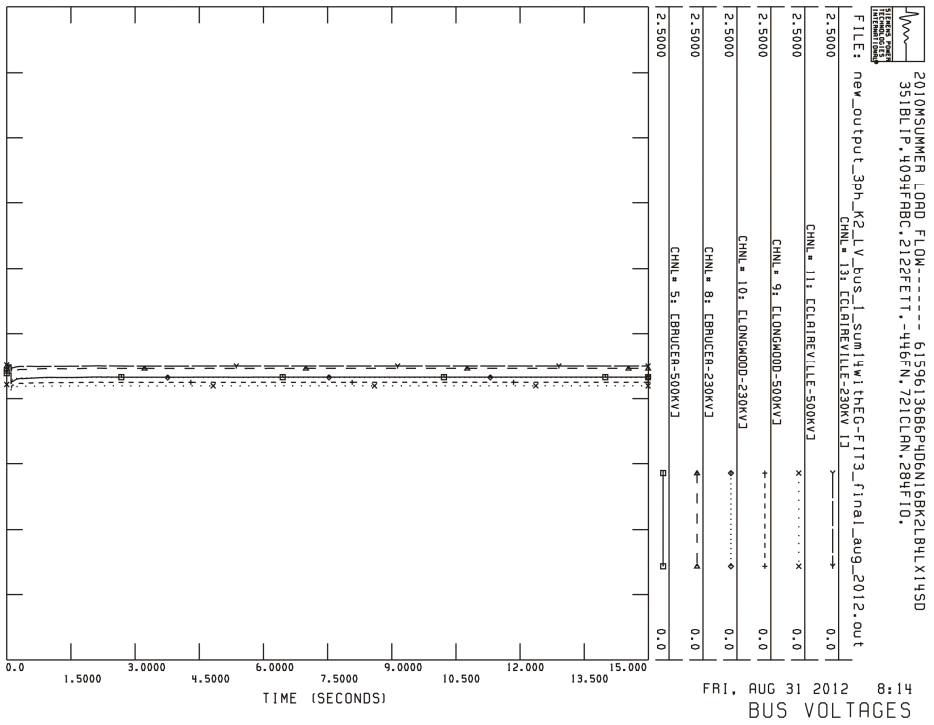


Figure 17: Voltage responses following a 3 phase uncleared fault at the LV side of the 500/34.5 kV transformer at K2

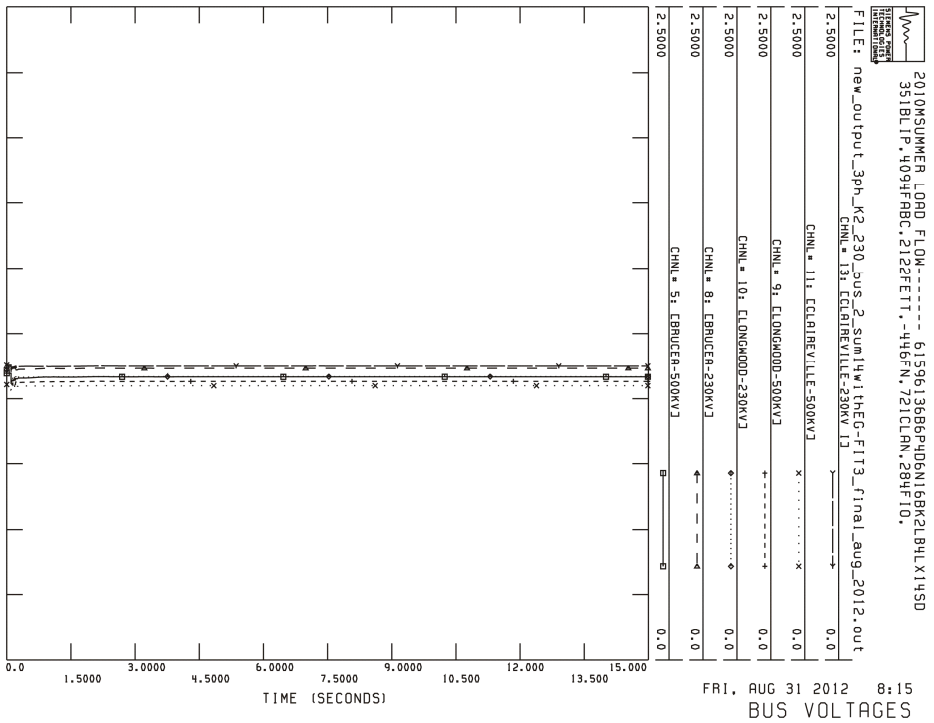


Figure 18: Voltage responses following a 3 phase uncleared fault at the LV side of the 500/230 kV transformer of K2

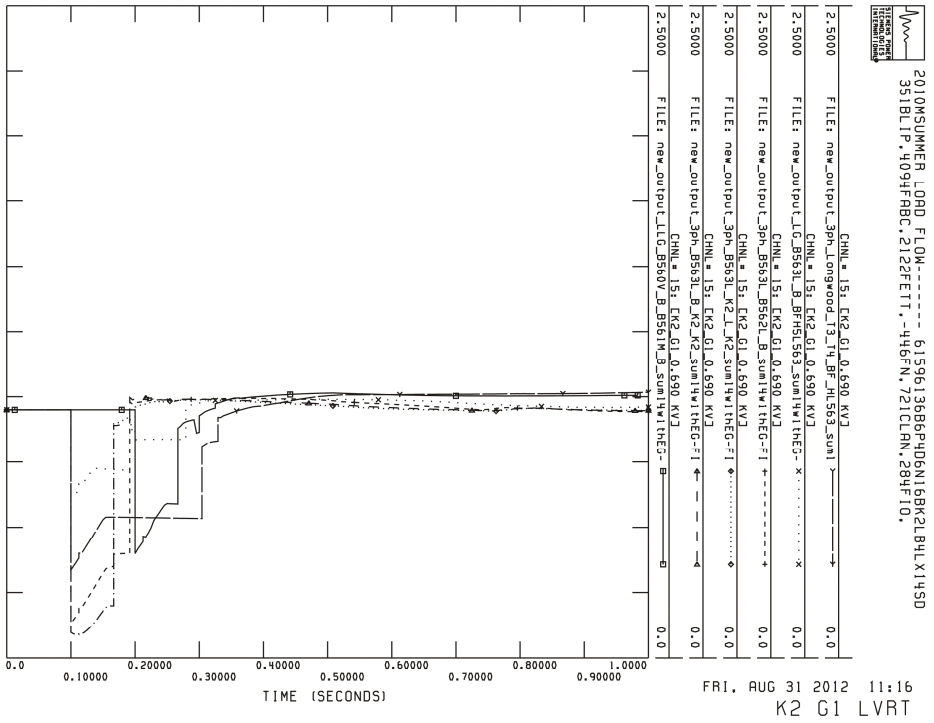


Figure 19: K2 WTG Feeder 1 generation terminal voltages for studied contingencies

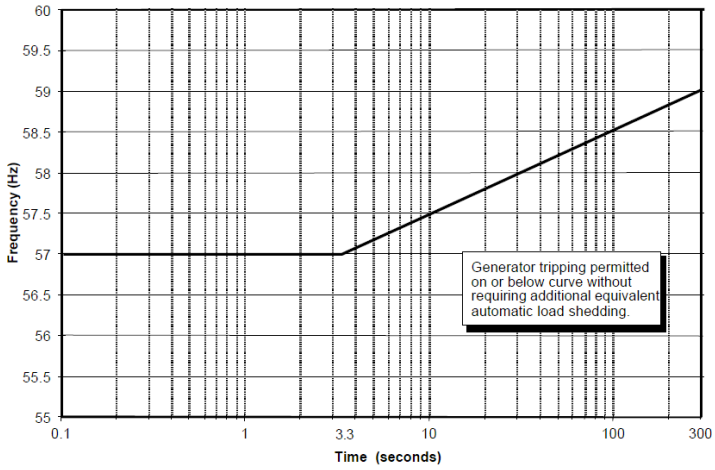
- End of Document -

Appendix B: General Requirements

The connection applicant shall satisfy all applicable requirements and standards specified in the Market Rules and the Transmission System Code. The following sections highlight some of the general requirements that are applicable to the proposed project.

a. Frequency/Speed Control

As per Appendix 4.2 of the Market Rules, the connection applicant shall ensure that the generation project has the capability to 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), as shown in the following figure.



The project 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%. The generation project shall respond to system frequency decline by temporarily boosting its active power output for some time (i.e. 10 s) by recovering energy from the rotating blades. This usually refers to “inertia emulation control” function within the wind farm control system. It is not required for wind facilities to provide a sustained response to system frequency decline. The connection applicant will need to indicate to the IESO whether the function of inertia emulation control is commercially available for the proposed type of wind turbine generator at the time when the wind farm comes into service. If this function is available, the connection applicant is required to implement it before the new project can be placed in-service. If this function is commercially unavailable, the IESO reserves the right to ask the connection applicant to install this function in the future, once it is commercially available for the proposed type of wind turbine generator.

b. Reactive Power/Voltage Regulation

The generation project is directly connected to the IESO-controlled grid, and thus, the connection applicant shall ensure that the project has the 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;

- 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 project in excess of the maximum allowable losses. If generators do not have dynamic reactive power capabilities, dynamic reactive compensation devices must be installed to make up the deficient reactive power;
- 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 $\Delta V/\Delta Q_{max}$ shall be adjustable to 0.5%. The response of the generation project for voltage changes shall be similar to or better than the response of a generation project with a synchronous generation unit and an excitation system that meets the requirements of Appendix 4.2.

c. Voltage Ride Though Capability

The generation project shall have the capability 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.

d. Voltage

Appendix 4.1 of the Market Rules states that under normal operating conditions, the voltages in the 500 kV system are maintained within the range of 490 kV to 550 kV. Thus, the IESO requires that the 500 kV equipment in Ontario must have a maximum continuous voltage rating of at least 550 kV.

e. Connection Equipment Design

The connection applicant shall ensure that the connection equipment is designed to be fully operational in all reasonably foreseeable ambient temperature conditions. The connection equipment must also be designed so that the adverse effects of its failure on the IESO-controlled grid are mitigated. This includes ensuring that all circuit breakers fail in the open position.

f. Disturbance Recording

The connection applicant is required to install at the project a disturbance recording device with clock synchronization that meets the technical specifications provided by the transmitter. The device will be used to monitor and record the response of the project to disturbances on the 500 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 the transmitter.

g. Fault Level

The Transmission System Code requires the new equipment to be designed to withstand the fault levels in the area where the equipment is installed. Thus, the connection applicant shall ensure that the new equipment at the facility is designed to withstand the fault levels in the area. If any future system changes result in an increased fault level higher than the equipment's capability, the connection applicant is required to replace the equipment with higher rated equipment capable of withstanding the increased fault level, up to maximum fault level specified in the Transmission System Code. Appendix 2 of the Transmission System Code establishes the maximum fault levels for the transmission system. For the 500 kV system, the maximum 3 phase and single line to ground symmetrical fault levels are 80 kA (usually limited to 63 kA).

Appendix 2 of the Transmission System Code states that the maximum rated interrupting time for the 500 kV breakers must be $\leq$ 2 cycles. Thus, the connection applicant shall ensure that the installed breakers meet the required interrupting time specified in the Transmission System Code. Fault interrupting devices must be able to interrupt fault currents at the maximum continuous voltage.

h. Protection System

The connection applicant shall ensure that the protection systems are 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 the existing protection systems.

Facilities that are essential to the power system must be protected by two redundant protection systems according to section 8.2.1a of the TSC. These redundant protections systems must satisfy all requirements of the TSC, and in particular, they must not use common components, common battery banks or common secondary CT or PT windings. As currently assessed by the IESO, this project is not on the current Bulk Power System list, however it is considered essential to the power system due to its 500 kV connection and as such must meet the TSC requirements for essential elements.

The protection systems within the generation project must only trip the appropriate equipment required to isolate the fault. After the project begins commercial operation, if an improper trip of the 500 kV circuits emanating from Ashfield SS occurs due to events within the project, the project may be required to be disconnected from the IESO-controlled grid until the problem is resolved.

The autoreclosure of the high voltage breakers at the connection point must be blocked. Upon its opening for a contingency, the high voltage breaker must be closed only after the IESO approval is granted.

Any modifications made to protection relays 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

i. Telemetry

According to Section 7.3 of Chapter 4 of the Market Rules, the connection applicant shall provide to the IESO the applicable telemetry data listed in Appendix 4.15 of the Market Rules on a continual basis. As per Section 7.1.6 of Chapter 4 of the Market Rules, the connection applicant shall also provide data to the IESO in accordance with Section 5 of Market Manual 1.2, for the purposes of deriving forecasts of the amount of energy that the project is capable of producing. The determination of telemetry quantities will be completed during the IESO Facility Registration/Market Entry process.

The data shall be provided with equipment that meets the requirements set forth in Appendix 2.2, Chapter 2 of the Market Rules and Section 5.3 of Market Manual 1.2, in accordance with the performance standards set forth in Appendix 4.19 subject to Section 7.6A of Chapter 4 of the Market Rules.

As part of the IESO Facility Registration/Market Entry process, the connection applicant must 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.

j. Revenue Metering

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

k. Reliability Standards

Prior to connecting to the IESO controlled grid, the proposed project must be compliant with the applicable reliability standards established by the North American Electric Reliability Corporation (NERC) and reliability criteria established by the Northeast Power Coordinating Council (NPCC) that are in effect in Ontario. A mapping of applicable standards, based on the proponent's/connection applicant's market role/OEB license can be found here: http://www.ieso.ca/imoweb/ircp/orcp.asp

This mapping is updated periodically after new or revised standards become effective in Ontario.

The current versions of these NERC standards and NPCC criteria can be found at the following websites:
http://www.nerc.com/page.php?cid=2|20
http://www.npcc.org/documents/regStandards/Directories.aspx

The IESO monitors and assesses market participant compliance with a selection of applicable reliability standards each year as part of the Ontario Reliability Compliance Program. To find out more about this program, write to orcp@ieso.ca or visit the following webpage: http://www.ieso.ca/imoweb/ircp/orcp.asp

Also, to obtain a better understanding of the applicable reliability compliance obligations and 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 by contacting rssc@ieso.ca. The RSSC webpage is located at:
http://www.ieso.ca/imoweb/consult/consult_rssc.asp.

l. Restoration Participant

According to the Market Manual 7.8 which states restoration participant criteria and obligations, the connection applicant will be required to be a restoration participant. Details regarding restoration participant requirements will be finalized at the Facility Registration/Market Entry Stage.

m. Facility Registration/Market Entry

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 includes both PSS/E and DSA software compatible mathematical models representing the new equipment for further IESO, NPCC and NERC analytical studies. The models and data may be shared with other reliability entities in North America as needed to fulfill the IESO's obligations under the Market Rules, NPCC and NERC rules. The connection applicant may need to contact the software manufacturers directly, in order to have the models included in their packages. This information should be submitted at least seven months before energization to the IESO-controlled grid, to allow the IESO to incorporate this project into IESO work systems and to perform any additional reliability studies.

As part of the IESO Facility Registration/Market Entry process, the connection applicant must provide evidence to the IESO confirming that the equipment installed meets the Market Rules requirements and matches or exceeds the performance predicted in this assessment. This evidence shall be either type tests done in a controlled environment or commissioning tests done on-site. In either case, the testing must be done not only in accordance with widely recognized standards, but also to the satisfaction of the IESO. Until this evidence is provided and found acceptable to the IESO, the Facility Registration/Market Entry process will not be considered complete and the connection applicant must accept any restrictions the IESO may impose upon this project's participation in the IESO-administered markets or connection to the IESO-controlled grid. The evidence must be supplied to the IESO within 30 days after completion of commissioning tests. Failure to provide evidence may result in disconnection from the IESO-controlled grid.

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

n. Other Connection Requirements

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 SIA), may be imposed in the future. The connection applicant is encouraged to follow developments and updates through the following link:
http://www.ieso.ca/imoweb/consult/consult_se91.asp

Appendix C: PIA Report

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

PROTECTION IMPACT ASSESSMENT

K2 WIND FARM PROJECT

270 MW WIND FARM GENERATION CONNECTION

Date: Oct 26, 2012
P&C Planning Group Project # PCT-306-PIA

Prepared by:
Hydro One Networks Inc.

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Disclaimer

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

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

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

PROTECTION IMPACT ASSESSMENT
K2 WF PROJECT
270 MW WIND GENERATION CONNECTION

1.0 INTRODUCTION

1.1 Protection Impact Assessment

This PIA study is prepared for the IESO to assess the potential impact of the proposed Wind Farm on the existing transmission protection. The primary focus of this study is on protecting Hydro One system equipment while meeting IESO System Reliability Criteria. This PIA is based on potentially connecting all new generators proposed in application ID: CAA ID 2011-452.

1.2 Description of Proposed Connection to the Grid

K2 Wind Ontario Limited Partnership proposes to construct a 270 MW, 60 Hz wind generation station. This connection is intended to be established through a new HONI switching station (Ashfield SS), as shown in Figure 1. Ashfield SS will be connected to the HONI's Bruce B SS x Longwood TS 500 kV circuit B563L approximately 61 km from Bruce B SS as shown in Figure 1 below.

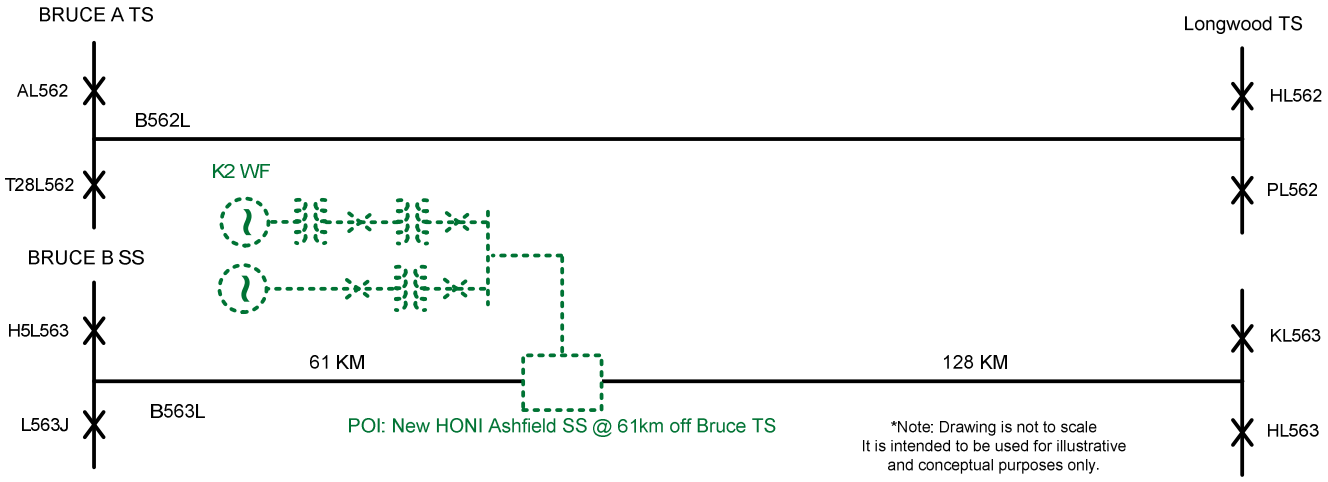

Figure 1: K2 WF Connection to HONI Transmission System

1.3 Assumptions

Ashfield SS will consist of a 500 kV ring bus as shown in Figure 2.

2.0 PROTECTION

2.1 General

The connection of the Wind Farm will result in the need for revision of protection settings, creation of a new switching station Ashfield SS with a sectionalizing ring bus, and addition of telecommunication infrastructure.

2.2 Specific Protection Requirements

Due to the existing protection scheme which is not suitable to readily accommodate the wind farm, the new switching station Ashfield SS will have to be installed and the new protections will be required. Protection work to be performed is described in this section.

2.2.1 Bruce B SS

The 'A' group relay and the 'B' group relay shall be upgraded to standard line distance relays. The relays shall meet NPCC physical separation requirements. The existing Permissive Overreaching scheme shall be maintained, but modified to accommodate the Ashfield SS as the terminal station.

Zone 1 shall be adjusted to cover 80% of the new line impedance and Zone 2 shall be adjusted to cover 125% of the line impedance. The revised settings are presented in the Appendix.

For the case where the line segment between the Ashfield SS and Longwood TS is open and the infeed from the wind farm is low, a fault close to Ashfield SS will not be seen by Ashfield SS protection or by Bruce B SS Zone 1 protection. This may result in delayed fault clearing by the operation of timed zone 2 protection at Bruce B SS (400 ms). This scenario will require implementation of a weak end infeed (WEI) relay logic which will be elaborated in the Appendix E of HONI planning specification.

All protection signals previously transmitted to Longwood TS will have to be transmitted to Ashfield SS. Conversely, all protection signals previously received from Longwood TS will be received from Ashfield SS.

Breakers H5L563 and L563J are protected by single BF electromechanical relays. The upgrade of the line protection relays will trigger BF protection upgrading as well. The BF protections shall be upgraded to fully redundant 'A' and 'B' standard breaker protection IEDs meeting NPCC separation requirements.

2.2.2 Longwood TS

The 'A' group relay and the 'B' group relay shall be upgraded to standard line distance relays. The relays shall meet NPCC physical separation requirements. The existing Permissive Overreaching scheme shall be maintained, but modified to have Ashfield SS as the terminal station.

Zone 1 shall be adjusted to cover 80% of the new line impedance and Zone 2 shall be adjusted to cover 125% of the line impedance. The revised settings are presented in the Appendix.

For the case where the line segment between Ashfield SS and Bruce B SS is open and the infeed from the wind farm is low, a fault close to Ashfield SS will not be seen by Ashfield SS protection or by Longwood Zone 1 protection. This may result in delayed fault clearing by the operation of timed zone 2 protection at Longwood TS (400 ms). This scenario will require implementation of a weak end infeed (WEI) relay logic which will be elaborated in the Appendix E of HONI planning specification.

Breakers KL563 and HL563 are protected by single BF electromechanical relays. These BF protections shall be upgraded to fully redundant 'A' and 'B' standard breaker protection IEDs meeting NPCC separation requirements.

2.2.3 Ashfield SS

Line B563L will be sectionalized into two line segments. Line segment between Bruce B SS and Ashfield SS will be approximately 61 km. Line segment between Ashfield SS and Longwood TS will be approximately 128 km. It is recommended to protect both line segments by using distance protection scheme.

Ashfield SS shall be fully compliant with NPCC D4. This configuration is shown in Figure 2.

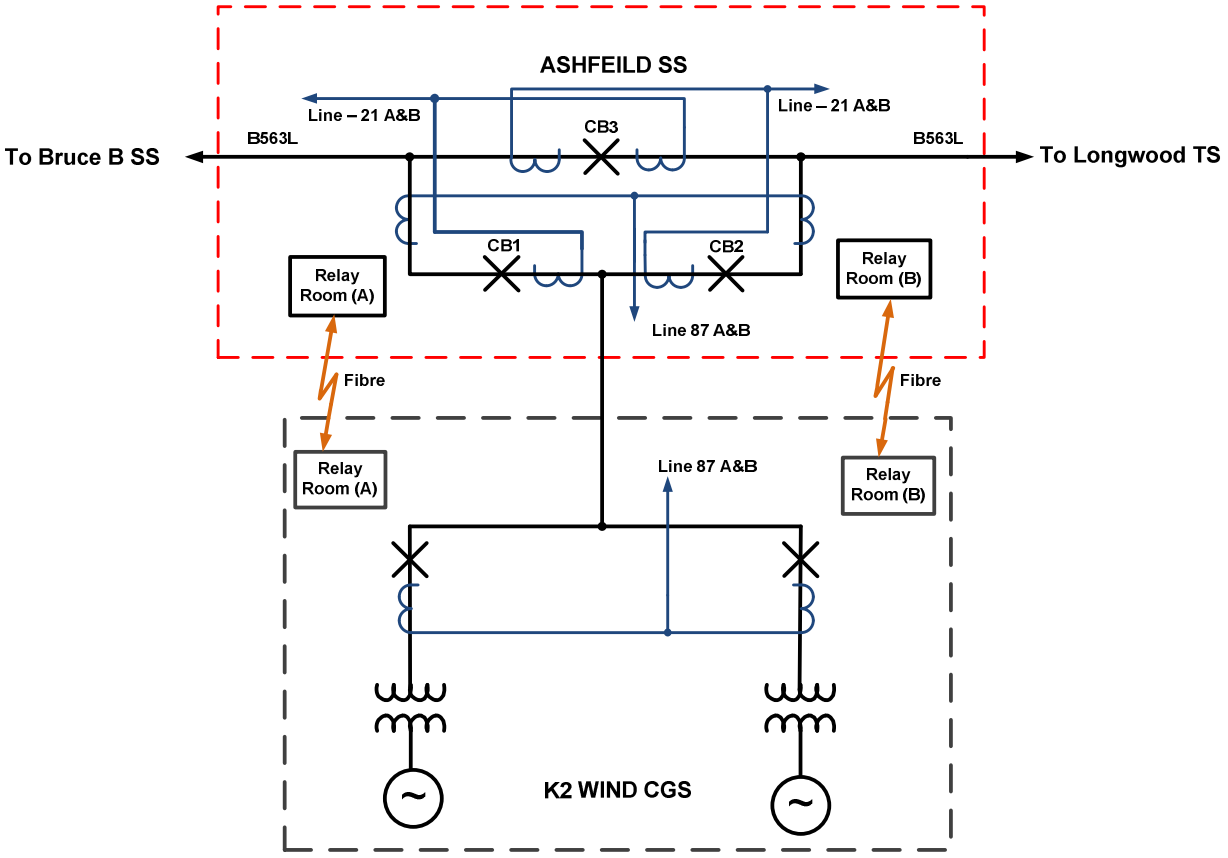

Figure 2: Ashfield SS Ring Bus Configuration

2.2.3.1 Three 500 kV Breakers

500 kV breakers will be installed at Ashfield SS. The 'A' and 'B' Breaker Failure, alarms, status, Reclose and Trip/Close protection devices for the new 500kV breakers shall be installed with standard IEDs meeting NPCC D4 separation requirements.

2.2.3.2 500 kV Line from Ashfield SS to Bruce B SS (previously part of B563L)

Distance protection scheme shall be implemented. New 'A' and 'B' line distance relays shall be installed meeting NPCC D4 separation requirements. Permissive Overreaching Scheme shall be implemented having Bruce B SS as the terminal station. Zone 1 will be set to cover 80% of the new line impedance and Zone 2 will be set to cover 125% of the line impedance. The revised settings are presented in the Appendix.

2.2.3.3 500 kV Line from Ashfield SS to Longwood TS (previously part of B563L)

Line distance protection scheme shall be implemented. New 'A' and 'B' line distance relays shall be installed meeting NPCC D4 separation requirements. Permissive Overreaching Scheme shall be implemented having Longwood TS as the terminal station. Zone 1 will be set to cover 80% of the

new line impedance and Zone 2 will be set to cover 125% of the line impedance. The revised settings are presented in the Appendix.

2.2.3.4 500 kV Line from Ashfield SS to K2 Wind Farm 500 kV Substation

The New 'A' and 'B' line differential protections shall be installed with standard IEDs meeting requirements of NPCC Directory D4 with input from HONI NPCC Task Force for System Protection (TFSP) representative.

Special Studies Group have identified possibility of restrike in the 500 kV breakers at Ashfield SS during radial connection of the Wind Farm to Longwood terminal coincident with a l-g fault on 500 kV circuit. Close in fault at Longwood terminal will not be seen by zone 1 protection at Ashfield SS. As a result the terminal breakers at Longwood will open first. When Ahsfield's breaker opens it will be subjected to Transient Recovery Voltage while interrupting capacitive current of 500 kV line. Similar will apply to the 500 kV breaker at Wind Farm Substation.

To reduce the probability of the restrike for the above conditions, simultaneous energization of the trip coils of the breaker at Ashfield SS and the equivalent 500 kV breakers at the Wind Farm Substation will be required. Both breakers, connected in series will share the overvoltage condition. Tripping of both series breakers will have to occur within quarter of a cycle (4 ms) in order to provide a margin before the over voltage reaches its peak. The requirement for simultaneous opening of the switching station and wind farm breakers does not apply to the operating scenarios other than the above described radial feed.

Simultaneous tripping can be achieved by sending a trip signal to the Wind Farm Substation via DC Remote Trip link in parallel with a trip signal to the breaker at Ashfield SS.

2.2.3.5 CTs and CVTs

Three-phase CVT with dual secondaries and standard relaying and metering accuracy shall be required for each new line termination of the ring bus of Ashfield SS.

CVT(s) are required for reclosing on the new line segments between Ashfield SS and Bruce B SS and between Ashfield SS and Longwood TS.

AC current for the line, bus and breaker failure protections shall be supplied by CTs located in the bushings of the new 500 kV breakers.

2.3 Tele-Protection

New digital MW and PLC (main and alternate) facilities shall be installed at Ashfield SS in order to establish necessary connections for teleprotection. The links shall be established to both Bruce TS and Longwood TS.

The proponent is responsible for establishing the communication links ('A' & 'B' redundant and fully separated with geographic path diversity) to Ashfield SS.

DC Remote Trip circuit based on metallic pair will be required between Ashfield SS and Wind Farm Substation for Remote Trip protection.

The sections listed below are outside the scope of a Protection Impact Assessment that deals exclusively with protections and teleprotections. However, should this become a project it will be addressed according to IESO Market Rules in the future in an Appendix E of a Transmission Planning Specification.

3.0 SCADA/RTU

4.0 POWER SYSTEM MONITORING

5.0 REVENUE METERING

6.0 CYBER SECURITY

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

7.0 STATION REQUIREMENTS

8.0 UPDATE DATABASES AND DOCUMENTATION

APPENDIX – EXISTING AND REVISED SETTINGS

A.1 Existing Settings

Tables 1 summarizes the existing settings for Zones 1 and 2 on B563L

Table 1 Existing "A" and "B" Protection Settings on B563L

Station	Zone	Reach (km)	Comments
Bruce B SS	1	150	Set at 80% of the line impedance to Longwood TS
	2	240	Set at 125% of the line impedance to Longwood TS
Longwood TS	1	150	Set at 80% of the line impedance to Bruce B SS
	2	240	Set at 125% of the line impedance to Bruce B SS

A.2 Expected Settings

Table 2 shows the expected revised settings (accurate calculations shall be performed at the design stage).

Table 2 Expected New Settings Required for B563L

Station	Zone	Reach (km)	Comments
Ashfield SS to Bruce B SS	1	48	Set at 80% of the line impedance to Bruce B SS
	2	76	Set at 125% of the line impedance to Bruce B SS
Ashfield SS to Longwood TS	1	102	Set at 80% of the line impedance to Longwood TS
	2	160	Set at 125% of the line impedance to Longwood TS
Bruce B SS to Ashfield SS	1	48	Set at 80% of the line impedance to Ashfield SS
	2	76	Set at 125% of the line impedance to Ashfield SS
Longwood TS to Ashfield SS	1	102	Set at 80% of the line impedance to Ashfield SS
	2	160	Set at 125% of the line impedance to Ashfield SS

TAB D-y-1

NOTIFICATION OF ADDENDUM OF CONDITIONAL APPROVAL TO CONNECTION PROPOSAL

December 7, 2012

Power to Ontario.
On Demand.

Mr. Colin Edwards
Director
55 Standish Court
Mississauga, Ontario L5R 4BR

Dear Mr. Edwards :

K2 Wind
Notification of Addendum of Conditional Approval to Connection Proposal
CAA ID Number: 2011-452

Thank you for the updated information regarding the proposed *K2 Wind*.

From the new information provided, we have concluded that the proposed changes at *K2 Wind* 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** for the modification detailed in the attached addendum to the System Impact Assessment (SIA) report. Any material changes to your proposal may require re-assessment by the IESO in accordance with Market Manual 2.10, and may nullify your conditional approval.

Final approval to connect the facility to the IESO-controlled grid will be granted upon successful completion of the IESO **Facility Registration/Market Entry** process including, without limitation, satisfactory completion of the requirements set out in the addendum to the SIA report. During this process you will be expected to demonstrate that you have fulfilled the requirements and that the facility you have installed is materially unchanged from the proposal assessed by the IESO. The document entitled Market Entry: A Step-by-Step Guide describes the key steps in the **Facility Registration/Market Entry** process. In order to initiate this process, please contact Market Entry at market.entry@ieso.ca at least eight months prior to your energization date.

For further information, please contact the undersigned.

Yours truly,

Michael Falvo

Michael Falvo
Manager – Market Facilitation
Telephone: *(905) 855-6209*
Fax: *(905) 855-6319*
E-mail: *mike.falvo@ieso.ca*
cc: *IESO Records*

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

TAB H-1-1

PROJECT DESCRIPTION REPORT