

**Strong Breeze Wind Project
Wind Turbine Specifications
Report**

DRAFT REPORT



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**STRONG BREEZE WIND PROJECT
WIND TURBINE SPECIFICATIONS REPORT**

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Abbreviations

dB	decibel(s)
GE	General Electric
Hz	Hertz
IESO	Independent Electricity System Operator
LRP	Large Renewable Procurement
m	metre(s)
m/s	meters per second
m ²	meters squared
MW	megawatt(s)
NO mode	Normal operating mode (GE 3.6-137 and Vestas V136)
NRO mode	Noise-reduced operating mode (GE 3.6-137)
O. Reg.	Ontario Regulation
REA	Renewable Energy Approval
ROW	Right-of-way
rpm	rotations per minute
SO mode	Sound optimized mode
Stantec	Stantec Consulting Ltd.
the Project	Strong Breeze Wind Power Project
the Proponent	Strong Breeze Wind Power Partnership

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1.0 INTRODUCTION

1.1 PROJECT OVERVIEW

Strong Breeze Wind Power Partnership (SBWPP or the Proponent) is proposing to develop, construct, and operate the Strong Breeze Wind Power Project (the Project) in the Municipality of Dutton Dunwich, within Elgin County, Ontario. The Project was awarded a power purchase contract with the Independent Electricity System Operator (IESO) in March 2016. The Project requires a Renewable Energy Approval (REA) as per Ontario Regulation (O. Reg.) 359/09 (as amended May 2016) under Part V.0.1 of the Ontario *Environmental Protection Act*. Strong Breeze Wind Power Partnership has retained Stantec Consulting Ltd. (Stantec) to prepare the REA application, as required under O. Reg. 359/09.

The proposed Project is considered a Class 4 Wind Facility according to subsection 6 of O. Reg. 359/09. The Project will include up to 20 wind turbine generators each with a rated capacity between 3.0 MW and 4.2 MW depending on the make/model chosen. The REA application for the Project will include 20 turbine locations, but the actual number of turbines will be chosen during detailed design and the final maximum installed nameplate capacity will not exceed 57.5 MW. Other Project components include: access roads, electrical lines, substation, communication tower, meteorological tower(s), temporary construction areas, corner improvements, and an operations and maintenance building. The Project will connect to the existing 230 kilovolt (kV) transmission circuit located north of Aberdeen Line and west of Iona Road. A map showing the Project Location¹ is provided in **Appendix A, Figure 1**.

1.2 REPORT REQUIREMENTS

The purpose of the Draft Wind Turbine Specifications Report is to provide details (manufacturer, model, dimensions, name plate capacity, acoustic emissions and audibility, etc.) of the turbines proposed for the Project.

The Draft Wind Turbine Specifications Report is one component of the REA application for the Project, and has been prepared in accordance with O. Reg. 359/09 and the MOECC's *Technical Guide to Renewable Energy Approvals* (2017).

Table 1.1 summarizes the requirements of this report as specified under O. Reg. 359/09.

¹ The term "Project Location" is defined by O. Reg. 359/09 as: a part of land and all or part of any building or structure in, on or over which a person is engaging in or proposes to engage in the project and any air space in which a person is engaging in or proposes to engage in the project.

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Table 1.1: Wind Turbine Specifications Report Requirements (as per O. Reg. 359/09)

Requirements	Section Reference
Provide specifications of each wind turbine, including:	
1. The make, model, name plate capacity, hub height above grade and rotational speeds.	Section 2.2
2. The acoustic emissions data, determined and reported in accordance with the standard specified for the wind turbine in subsection 1 (6.1) [of O. Reg. 359/09]. The data shall also specify each wind turbine's overall sound power level, measurement uncertainty value, octave-band sound power levels (linear weighted) and tonality and tonal audibility.	Section 2.2

MOECC's *Technical Guide to Renewable Energy Approvals* (2017) states that proponents must complete and submit the Wind Turbine Specifications Checklist as part of the REA application. The Checklist has been modified to consider the various operating modes for two turbine makes/models. This information is provided in **Table 2.1** and **Table 2.2**.

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2.0 WIND TURBINES

2.1 GENERAL DESCRIPTION

The Project will include up to 20 wind turbine generators, each with a rated capacity between 3.0 MW and 4.2 MW depending on the make/model chosen.

Each wind turbine will consist of the following key components:

- reinforced concrete tower foundation
- tower comprised of tubular steel sections
- nacelle (comprised of electrical generator and housing)
- three rotor blades
- rotor/hub (the structure to which the blades attach)
- step-up transformer
- power converter and switchgear
- electrical wiring and grounding
- tower lighting
- Wind measurement system on nacelle (anemometer and vane)

Each tower will be supported by a concrete foundation the size and design of which will be confirmed following the completion of geotechnical investigations at each turbine location.

The tubular steel tower supports the nacelle (comprised of electrical generator and housing) and a rotor (consisting of three blades attached to a central hub). The nacelle cover is made of glass-fibre reinforced plastic and the nacelle is accessible from the tower via a hatch in the base frame.

A step-up transformer, is required to transform the electricity generated in the nacelle to a standard operating power line voltage (i.e., 34.5 kV). A power converter converts the collected energy from direct current to alternating current.

From each step-up transformer, underground electrical lines will carry the electricity to the municipal road rights-of-way, typically following the turbine access roads. Electrical lines in the ROWs will transport electricity to the Project's substation located north of Aberdeen Line and West of Iona Road.

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2.2 TURBINE SPECIFICATIONS

Currently, there are two wind turbine models being considered for the Project. On both turbine models, the rotor speed can be reduced and the blade pitch can be adjusted to lower the sound power level and reduce noise, optimizing the energy input from the wind while meeting the noise target. Adjusting the pitch of the blades can also act as a braking system.

The two turbine models under consideration are:

Option A - The Vestas V136 turbine model with normal operating mode (S0 mode) and a power rating of 3.6 MW, or its operational mode known as sound optimized mode (SO mode).

Option B – The General Electric (GE) 3.6-137 turbine model with normal operating mode (NO Mode) and a power rating of 3.63 MW, or its operational mode known as Noise-reduced operating mode (NRO mode).

Based on the MOECC's *Wind Turbine Specifications Checklist*, **Table 2.1** provides the turbine specifications of the Vestas V136 wind turbine and **Table 2.2** provides the turbine specifications for the GE 3.6-137 wind turbine.

Table 2.1: Wind Turbine Specifications – Vestas V136

Specification	Vestas S0 Mode	Vestas SO1 Mode	Vestas SO2 Mode
WIND TURBINE INFORMATION			
Manufacturer	Vestas	Vestas	Vestas
Model	V136	V136	V136
Turbine # (as per Draft Site Plan)	T1, T3-T6, T8-T14, T17, T19	T2, T7, T15, T16,	T18, T20
Hub height	112 m	112 m	112 m
OPERATING INFORMATION			
Speed regulation	pitch control	pitch control	pitch control
Rotational speeds for each wind speed bin at 4 m/s	5.6 rpm	5.6 rpm	5.6 rpm
Rotational speeds for each wind speed bin at 5 m/s	6.6 rpm	6.6 rpm	6.6 rpm
Rotational speeds for each wind speed bin at 6 m/s	7.9 rpm	7.9 rpm	7.9 rpm
Rotational speeds for each wind speed bin at 7 m/s	9.2 rpm	9.2 rpm	9.2 rpm
Rotational speeds for each wind speed bin at 8 m/s	10.5 rpm	10.5 rpm	10.5 rpm

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Table 2.1: Wind Turbine Specifications – Vestas V136

Specification	Vestas S0 Mode	Vestas S01 Mode	Vestas S02 Mode
Rotational speeds for each wind speed bin at 9 m/s	11.5 rpm	11.5 rpm	11.5 rpm
Rotational speeds for each wind speed bin at 10 m/s	11.7 rpm	11.7 rpm	11.7 rpm
Version software for control of wind turbine	Vestas multi-processor (VMP) controller	Vestas multi-processor (VMP) controller	Vestas multi-processor (VMP) controller
ROTOR INFORMATION			
Type	3 blade, horizontal, upwind turbine	3 blade, horizontal, upwind turbine	3 blade, horizontal, upwind turbine
Horizontal distance from rotor centre to tower axis	6.03 m	6.03 m	6.03 m
Diameter of rotor	136 m	136 m	136 m
Rotor control devices	hydraulic pitch	hydraulic pitch	hydraulic pitch
Blade modifications	trailing edge serrations / dino tails	trailing edge serrations / dino tails	trailing edge serrations / dino tails
Blade length	68 m	68 m	68 m
GEARBOX INFORMATION			
Type	geared wind turbine	geared wind turbine	geared wind turbine
Manufacturer	a Vestas-approved manufacturer	a Vestas-approved manufacturer	a Vestas-approved manufacturer
Model number	to be determined	to be determined	to be determined
GENERATOR INFORMATION			
Manufacturer	Vestas	Vestas	Vestas
Model number	V136-3.6	V136-3.6	V136-3.6
Nominal power	3.6 MW	3.6 MW	3.6 MW
SOUND DATA FOR TESTED WIND TURBINES²			
Overall sound power level IEC61400-11 test at 10 m height and windspeed of 4 m/s	102.1	102	101.9
Overall sound power level IEC61400-11 test at 10 m height and windspeed of 5 m/s	105.4	104.4	103.5
Overall sound power level IEC61400-11 test at 10 m height and windspeed of 6 m/s	105.5	104.4	103.5
Overall sound power level IEC61400-11 test at 10 m height and windspeed of 7 m/s	105.5	104.4	103.5

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Table 2.1: Wind Turbine Specifications – Vestas V136

Specification	Vestas S0 Mode	Vestas S01 Mode	Vestas S02 Mode
Overall sound power level IEC61400-11 test at 10 m height and windspeed of 8 m/s	105.5	104.4	103.5
Overall sound power level IEC61400-11 test at 10 m height and windspeed of 9 m/s	105.5	104.4	103.5
Overall sound power level IEC61400-11 test at 10 m height and windspeed of 10 m/s	105.5	104.4	103.5
Measurement uncertainty	0.8 dB	0.8 dB	0.8 dB
Grid terminal frequency of tester	60 Hz	60 Hz	60 Hz
OPERATING INFORMATION			
Swept area	14,527 m ²	14,527 m ²	14,527 m ²
Rated power output	3.60 MW	3.45 MW	3.45 MW
Aerodynamic brakes (yes/no)	Yes	Yes	Yes
Cut-in wind speed	3 m/s	3 m/s	3 m/s
Cut-out wind speed	22.5 m/s	22.5 m/s	22.5 m/s
Nominal power wind speed	12 m/s	12 m/s	12 m/s
ROTOR INFORMATION			
Aerodynamic profile of blade	infused structural airfoil shell	infused structural airfoil shell	infused structural airfoil shell
SOUND DATA FOR TESTED WIND TURBINES			
Maximum tonal audibility	less than or equal to 4 dB	less than or equal to 4 dB	less than or equal to 4 dB

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Table 2.2: Wind Turbine Specifications – GE 3.6-137

	GE NO Mode	GE NRO 103 Mode	GE NRO 104 Mode
WIND TURBINE INFORMATION			
Manufacturer	General Electric	General Electric	General Electric
Model	GE 3.6-137	GE 3.6-137	GE 3.6-137
Turbine # (as per Draft Site Plan)	T1, T3-T6, T8-T14, T17, T19	T18, T20	T2, T7, T15, T16
Hub height	110 m	110 m	110 m
OPERATING INFORMATION			
Speed regulation	pitch control	pitch control	pitch control
Rotational speeds for each wind speed bin at 4 m/s	6.7 rpm	6.7 rpm	6.7 rpm
Rotational speeds for each wind speed bin at 5 m/s	7.1 rpm	7.1 rpm	7.1 rpm
Rotational speeds for each wind speed bin at 6 m/s	8.2 rpm	8.2 rpm	8.2 rpm
Rotational speeds for each wind speed bin at 7 m/s	9.5 rpm	9.5 rpm	9.5 rpm
Rotational speeds for each wind speed bin at 8 m/s	10.7 rpm	10.7 rpm	10.7 rpm
Rotational speeds for each wind speed bin at 9 m/s	11.4 rpm	11.4 rpm	11.4 rpm
Rotational speeds for each wind speed bin at 10 m/s	11.6 rpm	9.9 rpm	9.5 rpm
Version software for control of wind turbine	GE Mark VIe WTG V5.4.0	GE Mark VIe WTG V5.4.0	GE Mark VIe WTG V5.4.0
ROTOR INFORMATION			
Type	3 blade, horizontal, upwind turbine	3 blade, horizontal, upwind turbine	3 blade, horizontal, upwind turbine
Horizontal distance from rotor centre to tower axis	4.349 m	4.349 m	4.349 m
Diameter of rotor	137 m	137 m	137 m
Rotor control devices	Individually powered and controlled electric blade pitch controls with high speed brake and rotor lock and low speed rotor lock	Individually powered and controlled electric blade pitch controls with high speed brake and rotor lock and low speed rotor lock	Individually powered and controlled electric blade pitch controls with high speed brake and rotor lock and low speed rotor lock

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Table 2.2: Wind Turbine Specifications – GE 3.6-137

	GE NO Mode	GE NRO 103 Mode	GE NRO 104 Mode
Blade modifications	trailing edge serrations / dino tails	trailing edge serrations / dino tails	trailing edge serrations / dino tails
Blade length	68.5 m	68.5 m	68.5 m
GEARBOX INFORMATION			
Type	geared wind turbine	geared wind turbine	geared wind turbine
Manufacturer	Winergy or Nanjing	Winergy or Nanjing	Winergy or Nanjing
Model number	to be determined	to be determined	to be determined
GENERATOR INFORMATION			
Manufacturer	General Electric	General Electric	General Electric
Model number	GE 3.6-137	GE 3.6-137	GE 3.6-137
Nominal power	3.63 MW	3.13 MW	3.29 MW
CALCULATED SOUND DATA WIND TURBINES³			
Overall sound power level IEC61400-11 test at 10 m height and windspeed of 4 m/s	97.8 dBA	97.4 dBA	97.4 dBA
Overall sound power level IEC61400-11 test at 10 m height and windspeed of 5 m/s	102.7 dBA	101.9 dBA	102.1 dBA
Overall sound power level IEC61400-11 test at 10 m height and windspeed of 6 m/s	105.7 dBA	103.0 dBA	103.9 dBA
Overall sound power level IEC61400-11 test at 10 m height and windspeed of 7 m/s	106.0 dBA	103.0 dBA	104.0 dBA
Overall sound power level IEC61400-11 test at 10 m height and windspeed of 8 m/s	106.0 dBA	103.0 dBA	104.0 dBA
Overall sound power level IEC61400-11 test at 10 m height and windspeed of 9 m/s	106.0 dBA	103.0 dBA	104.0 dBA
Overall sound power level IEC61400-11 test at 10 m height and windspeed of 10 m/s	106.0 dBA	103.0 dBA	104.0 dBA
Measurement Uncertainty	0.8	0.8	0.8
Grid terminal frequency of tester	N/A	N/A	N/A
OPERATING INFORMATION			
Swept area	14,741 m ²	14,741 m ²	14,741 m ²
Rated power output	3.63 MW	3.13 MW	3.29 MW
Aerodynamic brakes	Yes	Yes	Yes
Cut-in wind speed	3 m/s	3 m/s	3 m/s

³ Checklist requests "Sound Data for Tested Wind Turbines". At the time of writing this report the turbines have not yet been tested. The data provided has been calculated by GE for the purposes of this report.

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Table 2.2: Wind Turbine Specifications – GE 3.6-137

	GE NO Mode	GE NRO 103 Mode	GE NRO 104 Mode
Cut-out wind speed	25 m/s	25 m/s	25 m/s
Nominal Power Wind Speed	13 m/s	14.5 m/s	13.5 m/s
ROTOR INFORMATION			
Aerodynamic profile of blade	infused structural airfoil shell	infused structural airfoil shell	infused structural airfoil shell
Sound Data for Tested Wind Turbines			
Maximum tonal audibility	Less than or equal to 4 dB	Less than or equal to 4 dB	Less than or equal to 4 dB

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3.0 SIGN-OFF PAGE

This document entitled Strong Breeze Wind Project Wind Turbine Specifications Report was prepared by Stantec Consulting Ltd. ("Stantec") for the account of Strong Breeze Wind Power Partnership (the "Client") to support the approvals and permitting process for the Client's application for a Renewable Energy Approval for the Strong Breeze Wind Project in the Municipality of Dutton Dunwich, within Elgin County, Ontario. In connection thereto, this document may be reviewed and used by the federal, provincial and municipal government agencies participating in the approvals and permitting process in the normal course of their duties; and stakeholders may provide comment as part of the regulatory approvals process. Except as set forth in the previous sentence, any reliance on this document by any third party for any other purpose is strictly prohibited. The material in it reflects Stantec's professional judgment in light of the scope, schedule and other limitations stated in the document and in the contract between Stantec and the Client. The opinions in the document are based on conditions and information existing at the time the document was published and do not take into account any subsequent changes. In preparing the document, Stantec did not verify information supplied to it by others, unless otherwise stated therein. Any unauthorized use which a third party makes of this document is the responsibility of such third party. Such third party agrees that Stantec shall not be responsible for costs or damages of any kind, if any, suffered by it or any other third party as a result of decisions made or actions taken based on unauthorized use of this document.

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Accessed: April, 2017.

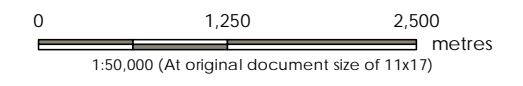
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**APPENDIX A:
FIGURES**

Legend

- Project Location
- 300 m from the Project Location
- Expressway / Highway
- Major Road
- Minor Road
- Existing Hydro Line
- Property Boundary
- Lot
- Municipal Boundary - Lower Tier



- Notes**
1. Coordinate System: NAD 1983 UTM Zone 18N
 2. Base features produced under license with the Ontario Ministry of Natural Resources and Forestry © Queen's Printer for Ontario, 2016.
 3. Orthoimagery © First Base Solutions, 2016. Imagery Date, 2010.



Project Location 160950885 REVA
 Municipality of Dutton Dunwich and Prepared by BCC on 2017-06-05
 County of Elgin Technical Review by ## on 2017-##-##
 Independent Review by ## on 2017-##-##

Client/Project
STRONG BREEZE WIND POWER PARTNERSHIP
STRONG BREEZE WIND PROJECT

Figure No. **1**
 Title **Project Location**
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