PORT RYERSE
WIND POWER PROJECT
WIND TURBINE SPECIFICATIONS REPORT

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Record of Revisions

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1.0 Introduction

1.1 PROJECT OVERVIEW

Boralex Inc. (Boralex), in association with UDI Renewables Corporation (UDI), is proposing to develop the Port Ryerse Wind Power Project (the Project) east of the hamlet of Port Ryerse in Norfolk County , Ontario, in response to the Government of Ontario's initiative to promote the development of renewable electricity in the province. The Project was awarded a Feed-In-Tariff (FIT) contract with the Ontario Power Authority (OPA) on February 25, 2011. Further information on the Project can be found on the Project-specific website at http://www.udi-canada.com. Boralex Inc. is a power producer whose core business is dedicated to the development and operation of renewable energy facilities. Further information on Boralex can be found at http://www.Boralex.com/en/.

The Renewable Energy Approval (REA) process for the Port Ryerse Project was originally initiated by UDI, with the assistance of M.K. Ince and Associates Ltd. Boralex is considering acquisition of the Project from UDI and retained Stantec Consulting Ltd. (Stantec) to complete the REA Application, as required under Ontario Regulation 359/09 - Renewable Energy Approvals under Part V.0.1 of the Act of the Environmental Protection Act (O. Reg. 359/09). According to subsection 6(3) of O. Reg. 359/09, the Project is classified as a Class 4 Wind Facility and will follow the requirements identified in O. Reg. 359/09 for such a facility.

The Project Study Area is generally bounded by i) Woolley and Gilbert Roads to the north; ii) Port Ryerse Road to the west; iii) Hay Creek to the east and iv) Avalon Lane to the south. The proposed Project Location includes all parts of the land in, on, or over which the Project is proposed. The Project Location, including all Project infrastructure, is sited on privately-owned lands, where landowners have entered into a lease agreement with Boralex/UDI. Permissions to access these properties have been obtained through verbal discussions with landowners, as a requirement of their signed agreements with Boralex /UDI.

Three wind turbine models were initially assessed as part of the REA process, the Siemens SWT 3.0 113, ENERCON E-92 2.35 MW and ENERCON E-82 E2 2.3MW; however one turbine model has been selected as the preferred alternative; the Siemens SWT 3.0 113.

The Project will include four Siemens SWT 3.0 113 wind turbine generators. The 3.0 MW turbines will be customized to a nameplate capacity of 2.5 MW for this Project. The total maximum installed nameplate capacity of all four turbines will not exceed 10 MW. Other basic components include step-up transformers located adjacent to the base of each turbine (step up voltage from approximately 0.69 kV to 27.6 kV), a 27.6 kV underground collector system, fibre optic data lines, a distribution substation, a permanent parking lot (if required), a meteorological tower and turbine access roads.

Temporary components during construction include laydown areas at the turbine locations and crane pads. No operations and maintenance building or transmission line is anticipated to be required for the Project. No Project components are located within municipal road Rights of Way (ROWs).

The 27.6 kV underground collector lines will transport the electricity generated from each turbine to the distribution substation located on private property east of Port Ryerse Road. Directional bore techniques will be used where the underground collector lines cross valleylands and watercourses. At the substation, a dip-pole connection will be made directly into the local distribution system.

1.2 REPORT REQUIREMENTS

This Wind Turbine Specifications Report is one component of the REA Application for the Project, and has been prepared in accordance with Item 13, Table 1 of O. Reg. 359/09 which sets out specific content requirements as provided in the **Table 1.1**.

Table 1.1: Wind Turbine Specifications Report Requirements: O. Reg. 359/09

Requirements	Completed	Section Reference
Provide specifications of each wind turbine, including:		
1. The make, model, name plate capacity, hub height above grade, rotational speeds.	✓	2.1
2. The acoustic emissions data, determined and reported in accordance with standard CAN/CSA-C61400-11-07, "Wind Turbine Generator Systems – Part II: Acoustic Noise Measurement Techniques", dated October 2007, including the overall sound power level, measurement uncertainty value, octave-band sound power level (linear weighted) and tonality and tonal audibility.	✓	2.1

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2.0 Wind Turbines

2.1 SIEMENS SWT-3.0-113 SPECIFICATIONS

The Project will consist of four Siemens SWT-3.0-113 wind turbine generators. The 3.0 MW turbines will be customized to a nameplate capacity of 2.5 MW for this Project. The total maximum installed nameplate capacity of all four turbines will not exceed 10 MW. The following table (**Table 2.1**) provides a description of the Siemens SWT-3.0-113 wind turbine which will be used for the Project. Additional turbine specifications are provided in **Appendix A**.

Table 2.1: Siemens SWT-3.0-113 - Wind Turbine Specifications

Operating Data	Specification
General	
Manufacturer	Siemens
Model	SWT 3.0 113
Name plate capacity (MW)	3.0 MW (customized to 2.5 MW)
Cut-in wind speed (m/s)	3-5 m/s (10.8 – 18 km/hr)
Cut-out speed (m/s)	25 m/s (90 km/hr)
Frequency (Hz)	50 or 60 Hz
Sound power (dBA)	102.5 dBA
Tonal audibility	<2dB
Rotor	
Blade length (m)	55 m
Rotor diameter (m)	113 m
Rotor swept area ($m^{2)}$	10,000 m^2
Rotational speed (rpm)	6.0 – 15.5 rpm
Tower	
Hub height (m)	99.5 m
Maximum total turbine height (m)	154.5 m

Please refer to **Appendix A** *Turbine Specifications from the Manufacturer* for additional acoustic emissions data, in accordance with the International Electrotechnical Commission (IEC) Standard 61400-11:2002 (equivalent to the CAN/CSA-C61400-11-07, "*Wind Turbine Generator Systems-Part II: Acoustic Noise Measurements Techniques*" (October 2007), for the Siemens SWT 3.0-113 turbine, with a maximum power rating of 2.5 MW.

Each wind turbine consists of the following key components:

- Concrete tower foundation;
- Steel tower sections;
- Nacelle (comprised of electrical generator and housing);
- Three rotor blades;

- Hub (the structure to where the blades attach);
- Power convertor;
- Step-up transformer; and,
- Electrical wiring and grounding.

The tower would be supported by a concrete foundation, approximately 3 m deep, depending upon subsurface conditions. Based on the subsurface conditions, one or more of the turbine foundations could use a form of pile foundations. The turbine tower consists of a tapered tubular steel tower. The tower has internal ascent and direct access to the yaw system and nacelle. The total tower height, with blades, is 154.5 m. Each tower will be made of steel and will be approximately 4 m in diameter at the base.

The tower supports the nacelle which houses the main components of the wind turbine (comprised of electrical generator and housing). The nacelle cover is made of glass-fibre reinforced plastic and is accessible from the tower via a hatch in the base frame. A step-up transformer, located adjacent to the base of each wind turbine, is required to transform the electricity created in the nacelle to a standard operating power line voltage (27.6 kV). The converter is located within the nacelle and controls the energy conversion in the generator by feeding power to and from the grid.

The 113 m rotor supports three blades, equipped with lightening protection, and a hub. The blade design comprises a strong structure to face high wind loads but also lightweight construction to minimize the load transmission of the nacelle. This is achieved by the use of glass-fibre reinforced plastic sandwich construction. The blades are 55 m in length. The pitch of the blades is adjustable, allowing maximum energy input from the wind and also acting as a braking system. They are designed to cut-out when wind speeds exceed 25 m/s (90 km/h).

A step-up transformer, adjacent to each turbine, is required to transform the electricity generated in the nacelle to a common collection system line voltage (0.69 kV to 27.6 kV). Each step-up transformer will be connected to the Project's collection system via 27.6 kV underground collector lines. The underground collector lines will carry the electricity to the distribution substation located on private property east of Port Ryerse Road where a dip-pole connection will be made directly from an underground line that terminates at the Project substation into the local distribution system. Turbine tower lighting would be in accordance with Transport Canada Regulations and Standards as described in the Design and Operations Report.

3.0 Closure

The Port Ryerse Wind Power Project Wind Turbines Specifications Report has been prepared by Stantec Consulting Ltd. for Boralex/UDI in accordance with Item 13, Table 1 of O. Reg 359/09.

This report has been prepared by Stantec for the sole benefit of Boralex/UDI, and may not be used by any third party without the express written consent of Boralex/UDI. The data presented in this report are in accordance with Stantec's understanding of the Project as it was presented at the time of reporting.

Respectfully submitted,

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4.0 References

O. Reg. 359/09. 2009. Ontario Regulation 359/09 made under the Environmental Protection Act Renewable Energy Approvals Under Part V.0.1 of the Act, as amended by O. Reg. 333/12 on November 2, 2012.

Appendix A

Turbine Specifications from Manufacturer

SWT-3.0-113
Technical Specifications

Rotor
Type ..... 3-bladed, horizontal axis
Position ..... Upwind
Diameter ..... 113 m
Swept area ..... 10.000 m²
Speed range ..... 6-15.5 rpm
Power regulation ..... Pitch regulation with variable speed
Rotor tilt ..... 6 degrees

Blade
Type ..... Self-supporting
Blade length ..... 55 m
Tip chord ..... 0.63 m
Root chord ..... 4.2 m
Aerodynamic profile ..... NB1-7, SWPNA1_XX12, FFAxxx
Material ..... GRE
Surface gloss ..... Semi-gloss, < 30 / ISO2813
Surface colour ..... Light grey, RAL 7035

Aerodynamic Brake
Type ..... Full span pitching
Activation ..... Active, hydraulic

Load-Supporting Parts
Hub ..... Nodular cast iron
Fixed shaft ..... Nodular cast iron
Nacelle bed frame ..... Nodular cast iron

Mechanical Brake
Type ..... Hydraulic disc brake
Position ..... Generator rear end
Number of callipers 3

Canopy
Type ..... Totally enclosed
Surface gloss ..... Semi-gloss, 25-45 / ISO-2813
Colour ..... Light grey, RAL 7035

Generator
Type ..... Synchronous, PMG
Nominal power ..... 3000 kW

Grid Terminals (LV)
Nominal power ..... 3000 kW
Voltage ..... 690 V
Frequency ..... 50 Hz or 60 Hz

Yaw System
Type ..... Active
Yaw bearing ..... Externally geared
Yaw drive ..... 8 (optional 10) electric gear motors
Yaw brake ..... Passive friction brake

Controller
Type ..... Microprocessor
SCADA system ..... WPS
Controller designation ..... SWTC, STC-1, SCS-1

Tower
Type ..... Cylindrical and/or tapered tubular
Hub height ..... 99.5 m or site-specific
Corrosion protection ..... Painted
Surface gloss ..... Semi-gloss, 25-45 / ISO2813
Colour ..... Light grey, RAL 7035

Operational Data
Cut-in wind speed ..... 3-5 m/s
Nominal power at ..... 12-13 m/s
Cut-out wind speed ..... 25 m/s
Maximum 3 s gust ..... 59.5 m/s (IEC version)

Weights (approximately)
Rotor ..... 66.700 kg
Nacelle ..... 73.000 kg

Siemens Wind Power A/S reserves the right to change the above specifications without previous notice.

SWT-3.0-113, Rev. 0, Max. Power 2500 kW
Contract Acoustic Emission, Hub Height 99.5 m
Port Ryerse - Ontario - Canada

Sound Power Levels
The warranted sound power level is presented with reference to the code IEC 61400-11:2002 with amendment 1 dated 2006-05 based on a hub height of 99.5 m and a roughness length of 0.05 m as described in the IEC code. The sound power levels (LWA) presented are valid for the corresponding wind speeds referenced to a height of 10 m above ground level.

Wind speed [m/s]	**4**	**5**	**6**	**7**	**8**	**9**	**10**	**11**	**12**	**Up to cut-out**
Max. Power 2500kW	95.3	99.7	102.4	102.5	102.5	102.5	102.5	102.5	102.5	102.5

Typical Octave Bands
Typical, not warranted octave band spectra are tabulated below referenced to 10 m height.

	Wind Speed (m/s)				
Octave band, centre frequency [Hz]	**6**	**7**	**8**	**9**	**10**
63	89.5	89.9	91.5	91.6	91.3
125	92.6	93.0	93.0	92.5	91.7
250	96.4	96.5	95.4	94.8	94.1
500	94.9	94.8	94.4	94.2	94.0
1000	95.0	94.9	95.0	94.9	95.2
2000	94.1	94.0	95.1	95.2	95.9
4000	91.2	91.8	91.8	93.6	93.9
8000	81.8	81.9	84.1	84.1	84.1

Table 2: Typical octave bands for 6-10 m/s, L_{WA} [dB(A) re 1 pW]

Tonality
Typical, not warranted tonal audibility for the SWT-3.0-113 wind turbine generators shall not exceed 2 dB as determined in accordance with IEC 61400-11:2002.

Measurement Uncertainty
A measurement uncertainty range of -1.5dB(A) and +1.5dB(A) is applicable.