



**ST. COLUMBAN WIND PROJECT**  
**WIND TURBINE SPECIFICATIONS REPORT**

***DRAFT***

Stantec File No. 160960649  
March 2012

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## 1.0 Introduction

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### 1.1 PROJECT OVERVIEW

St. Columban Energy LP is proposing to develop, construct, and operate the 33 megawatt (MW) St. Columban Wind Project (the Project) in the Municipality of Huron East (Huron East), Municipality of Morris-Turnberry (Morris-Turnberry), and Township of Howick (Howick), County of Huron (Huron County), in response to the Government of Ontario's initiative to promote the development of renewable electricity in the province.

The overall Project Study Area is comprised of two sections – the Wind Project Study Area and the Interconnection Line Study Area. The Wind Project Study Area is bordered on the north by Winthrop Road, on the south by Huron Road/Highway 8, on the east to the west of Perth Road 180 and on the west by Maple Line. In addition, the Interconnection Line Study Area includes the path along which an approximately 43 kilometre (km) underground electrical interconnection line is proposed to extend from the Wind Project to a transformer station and one of two connection points to the existing Hydro One Networks Inc. (HONI) electrical distribution system as described in Section 3.3.2 of this report.

The proposed Project Location for this report includes all parts of the land in, on or over which the Project is proposed (the 'construction area' for the Project). The proposed Project Location and Project Study Areas are shown in Appendix A, Figures 1-3.

The basic components of the Project include:

- 15 Siemens SWT 2.3-101/SWT 2.3-113 wind turbine generators with a maximum installed nameplate capacity of 33 MW. To be conservative, two turbine models were assessed as part of the Renewable Energy Approval (REA) process – the SWT 2.3-113 (113m blade span) and the SWT 2.3-101 (101m blade span). For the noise assessment, the SWT 2.3-101 was assessed, due to its higher noise level. For potential impacts to the natural environment, and property line setback assessments, the SWT 2.3-113 was assessed, due to its longer blade length. This conservative approach ensured the 'worst case scenario' was assessed;
- A 34.5 kV underground power line collector system;
- A 27.6 kV underground power line collector system;
- Fibre optic cabling laid with the underground collector lines;
- Turbine access roads;
- Crane pads;

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- Two connection points to the existing electrical system;
- Two unserviced electrical control buildings;
- A 34.5kV - approximately 43 km underground electrical interconnection line; and,
- A 44 kV/34.5 kV 15/20 MVA transformer station.

Temporary components during construction include work and storage areas at the turbine locations and along the underground electrical interconnection line. The electrical power line collector system will transport the electricity generated from the Project to two points of common coupling where the Project will connect to the HONI local distribution system.

St. Columban Energy LP retained Stantec Consulting Ltd. (Stantec) to prepare the REA application with input from Zephyr North Ltd., and Archaeological Services Inc. The REA application is a requirement 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.

This draft Wind Turbine Specifications Report has been prepared in accordance with O. Reg. 359/09, and is one component of the REA application for the Project. An Environmental Screening Report (ESR) was prepared, and a Notice of Completion was submitted in the fall of 2009. The current REA application will draw heavily on information included in the ESR, supplemented with new information when necessary, to maintain compliance with the new Regulation.

**1.2 REPORT REQUIREMENTS**

The purpose of the Wind Turbine Specifications Report is to provide the public, aboriginal communities, municipalities, and regulatory agencies with an understanding of the technical specifications of the wind turbine generators to be utilized for the Project.

The Wind Turbine Specifications Report has been prepared in accordance with Item 13, Table 1 of O.Reg.359/09 which sets out specific content requirements for the Wind Turbine Specifications Report as provided in the following table (Table 1.1).

**Table 1.1: Wind Turbine Specifications Report Requirements (as per O. Reg. 359/09 – Table 1)**

Requirements	Completed	Section Reference
Provide specifications of each wind turbine, including make, model, name plate capacity, hub height above grade, rotational speeds and acoustic emissions data, including the sound power level and frequency spectrum, in terms of octave-band power levels.	✓	2.0

## 2.0 Technical Specifications

### 2.1 WIND TURBINES

The Project is made up of St. Columban 1 (SC1 - 18 MW) and St. Columban 2 (SC2 - 15 MW) which in aggregate combines 15, Siemens SWT 2.3-101/SWT 2.3-113 wind turbine generators with a maximum installed nameplate capacity of 33 MW. A summary of the basic specifications of the turbine model is provided in Table 3.1 below.

A complete description of the general specifications for this turbine model is found in the manufacturer's information provided as Attachment A. Acoustic data is also provided in the Noise Assessment Report contained within the Design and Operations Report.

**Table 2.1: Basic Wind Turbine Specifications**

Manufacturer	Siemens	Siemens
Model	SWT 2.3-113	SWT 2.3-101
Name plate capacity (MW)	2.3 MW	2.3 MW
Hub height above grade	99.5 m	99.5 m
Blade length	55 m	49 m
Full blade diameter	113 m	101 m
Blade sweep area	10,000 m <sup>2</sup>	8,000 m <sup>2</sup>
Speed range	6-13 rpm	6-16 rpm
Sound Power Level	Refer to Noise Report	Refer to Noise Report
Frequency spectrum	60 Hz	60 Hz

### 2.2 WIND TURBINE LOCATIONS

The wind turbines will be located at the locations and coordinates provided in Table 2.2 below.

**Table 2.2: Turbine Coordinates (preliminary)**

Turbine ID	St. Columban 1 (SC1) or 2 (SC2)	Collector System/Connection Voltage	Easting (X)	Northing (Y)
1	SC1	34.5/44kV	475688	4819174
2	SC1	34.5/44kV	475982	4819564
3	SC1	34.5/44kV	476068	4820809
4	SC2	27.6/27.6 kV	476439	4821386
5	SC2	27.6/27.6 kV	477290	4822643
6	SC2	27.6/27.6 kV	474695	4824004
7	SC2	27.6/27.6 kV	475642	4823294
8	SC2	27.6/27.6 kV	476421	4822936
9	SC2	27.6/27.6 kV	476794	4824481
10	SC2	27.6/27.6 kV	476414	4824755
11	SC1	34.5/44kV	473668	4819851
12	SC1	34.5/44kV	473905	4820309
13	SC1	34.5/44kV	474447	4820173
14	SC1	34.5/44kV	474574	4819899
15	SC1	34.5/44kV	478016	4820440

### **3.0 Signatures**

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The St. Columban Wind Project 'Turbine Specifications Report' has been prepared by Stantec for St. Columban Energy LP in accordance with Item 13, Table 1 of O. Reg. 359/09.

This report has been prepared by Stantec for the sole benefit of St. Columban Energy LP, and may not be used by any third party without the express written consent of St. Columban Energy LP. 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.

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**Stantec**

**ST. COLUMBAN WIND PROJECT**  
WIND TURBINE SPECIFICATIONS REPORT

# **Attachment A**

## **Turbine Specifications**



# The new standard for moderate wind conditions

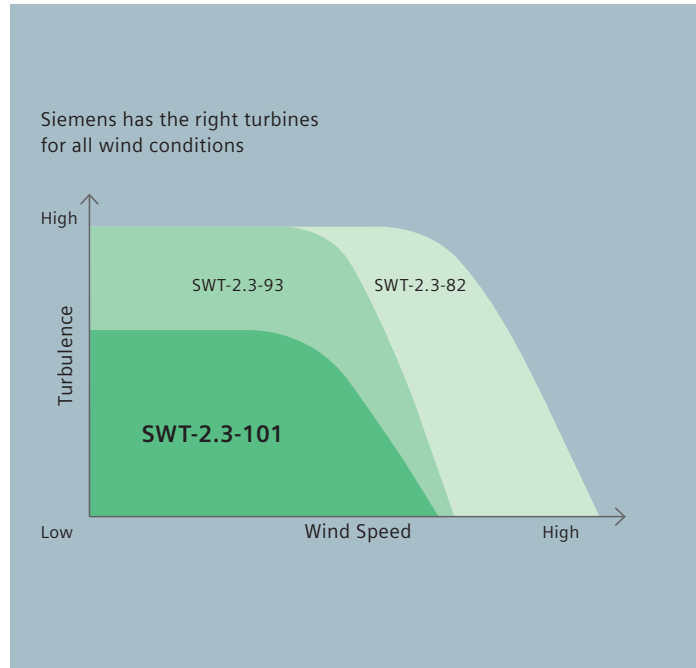
Siemens Wind Turbine SWT-2.3-101

Answers for energy.

**SIEMENS**







## Your trusted partner

Siemens has been a major driver of innovation in the wind power industry since the early 1980s when wind turbine technology was still in its infancy.

Technology has changed with the times, but Siemens' commitment to providing its customers with proven wind turbine solutions remains the same.

The combination of robust and reliable turbines, highly efficient solutions for power transmission and distribution and a deep understanding of the entire energy market ensures that Siemens will continue to be a leading supplier.

Siemens' record, when it comes to on-time delivery, is impeccable. Long-lasting customer relationships, based on the successful installation of wind turbines, provide for a sound, sustainable and profitable investment.

Drawing on 140 years of experience in the energy sector, a strong focus on renewables and a global network of highly skilled and trained employees, Siemens has proven itself to be a trustworthy and reliable business partner. And will continue to be in the future.

## Harvest more energy from sites with moderate wind conditions

The Siemens SWT-2.3-101 turbine is designed to deliver unparalleled performance and reliability, making it especially suited to areas with moderate wind conditions.

The SWT-2.3-101 turbine offers low energy production costs and joins Siemens' 2.3-MW product family, which has proven availability that is among the highest in the industry. The 101-meter rotor is specifically designed to optimize the energy output in areas with moderate wind conditions. The turbine is also ideal for all types of grid connections in most major markets.

The SWT-2.3-101 is designed to last. The robust and reliable design offers a high yield with low maintenance costs. The turbine is backed by advanced condition monitoring and diagnostics, which constantly examine the turbine. Any change in a turbine's performance is promptly addressed by an experienced after-sales service team either remotely or in the field.

If you desire a better return on investment and superior availability, take a closer look at the SWT-2.3-101 turbine.



## Superior performance gives higher yields

### Optimum energy at moderate wind conditions

#### Harvesting more energy

The SWT-2.3-101 wind turbine is designed to increase the energy returns from sites with moderate wind conditions. Advanced blade technology also allows for quieter operation. The B49 blade with a rotor diameter of 101 meters and pitch regulation optimizes power output and increases control over the energy output.

#### High availability

Currently, the Siemens fleet of 2.3-MW wind turbines sets the industry standard for availability. The SWT-2.3-101 will build on the reputation for reliability that the market has come to expect from a Siemens Wind turbine.

#### High yield with minimal maintenance

Siemens optimizes the return on investment in its wind turbines through intelligent maintenance that ensures the turbine to deliver high yield with low operational costs.

The rugged structural design, combined with an automatic lubrication system, internal climate control and a generator system without slip rings contributes to exceptional reliability. The innovative design of the SWT-2.3-101 allows for longer service intervals.

### Superior grid compliance

The Siemens NetConverter® system is designed for maximum flexibility in the turbine's response to voltage and frequency variations, fault ride-through capability and output adjustment. The advanced wind farm control system provides state-of-the-art fleet management.

### Proven track record

Siemens has a proven track record of providing reliable turbines that last. The world's first offshore wind farm in Vindeby, Denmark, was installed in 1991 and is still fully operational. In California, Siemens installed over 1,100 turbines between 1983 and 1990, with 97% still in operation today. Siemens takes its commitment to reliability seriously and prides itself on the long lifespan that its turbines have demonstrated.



## No compromise on reliability

**SWT-2.3-101: Newest member of the extremely reliable product family**

### Designed for life

Siemens turbines are designed to last. The robust design of the SWT-2.3-101 allows for trouble-free output throughout the complete lifecycle of the turbine.

The blades are made of fiberglass-reinforced epoxy in Siemens' proprietary IntegralBlade® manufacturing process. The blades are cast in one piece in a closed process, which eliminates the traditional weaknesses found at glue joints in other manufacturers' blades. Like the turbine itself, the blades are designed to last.

Climate control within the turbine protects vital equipment from the outside environment. The turbine also offers controlled-wear strategies for critical components, which results in a further reduction of maintenance costs.

### Safety first

Safety is at the heart of all Siemens operations. From production to installation, operation and service, Siemens strives to set the standard in safety.

The fail-to-safe capabilities within a turbine, combined with Siemens' superior lightning protection system, are designed to enhance security for the turbine.

### Advanced operations support

Given the logistical challenges associated with servicing wind farms, Siemens has equipped its turbines with a Turbine Condition Monitoring (TCM) system that reduces the need for on-site servicing.

Continuous monitoring of turbines allows for the discovery of small faults before they become major problems.

The TCM system continuously checks the external and internal condition of the wind turbine. Twenty-four hours a day, seven days a week precise measurements are taken of vibrations in the gearbox, the generator and the main shaft bearings. The system instantly detects deviations from normal operating conditions.

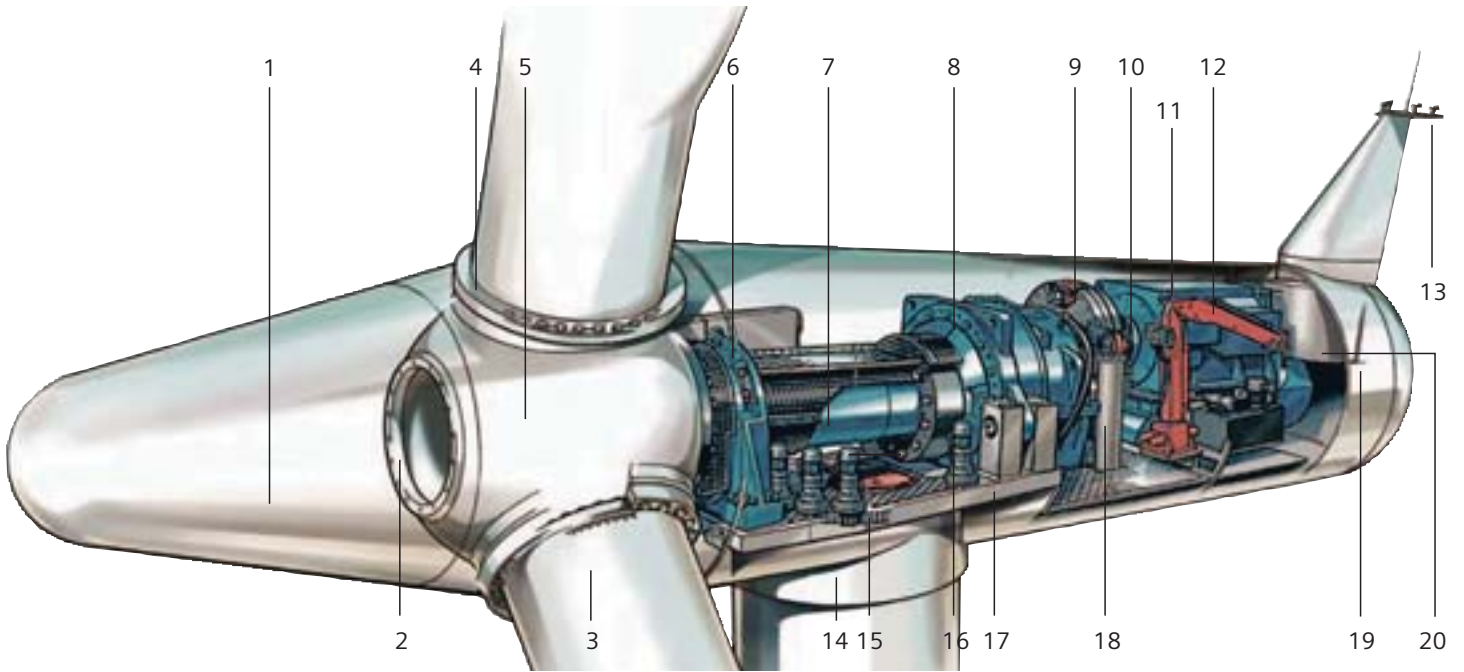
Using the knowledge gained from monitoring thousands of turbines over the years, Siemens' experts are exceptionally skilled at analyzing and predicting faults within a turbine. This allows Siemens to proactively plan the service and maintenance of the turbines as each fault can be categorized and prioritized based on the severity of the fault. Siemens can then determine the most appropriate course of action to keep the turbine running at its best.

# Technical specifications



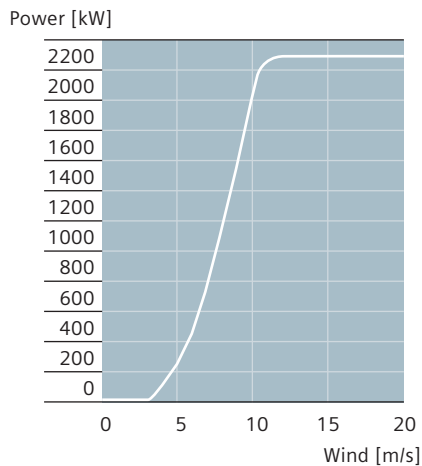
Rotor	
Diameter	101 m
Swept area	8,000 m <sup>2</sup>
Rotor speed	6-16 rpm
Power regulation	Pitch regulation with variable speed
Blades	
Type	B49
Length	49 m
Aerodynamic brake	
Type	Full-span pitching
Activation	Active, hydraulic
Transmission system	
Gearbox type	3-stage planetary/helical
Gearbox ratio	1:91
Gearbox oil filtering	Inline and offline
Gearbox cooling	Separate oil cooler
Oil volume	Approximately 400 l
Mechanical brake	
Type	Hydraulic disc brake
Generator	
Type	Asynchronous
Nominal power	2,300 kW
Voltage	690 V
Cooling system	Integrated heat exchanger

Yaw system	
Type	Active
Monitoring system	
SCADA system	WebWPS
Remote control	Full turbine control
Tower	
Type	Cylindrical and/or tapered tubular
Hub height	80 m or site-specific
Operational data	
Cut-in wind speed	3-4 m/s
Rated power at	12-13 m/s
Cut-out wind speed	25 m/s
Maximum 3 s gust	55 m/s (standard version) 60 m/s (IEC version)
Weights	
Rotor	62 tons
Nacelle	82 tons
Tower for 80-m hub height	162 tons



### Sales power curve

The calculated power curve data are valid for standard conditions of 15 degrees Celsius air temperature, 1013 hPa air pressure and 1.225 kg/m<sup>3</sup> air density, clean rotor blades and horizontal, undisturbed air flow. The calculated curve data are preliminary.



### Nacelle arrangement

- |                    |                            |
|--------------------|----------------------------|
| 1. Spinner         | 10. Coupling               |
| 2. Spinner bracket | 11. Generator              |
| 3. Blade           | 12. Service crane          |
| 4. Pitch bearing   | 13. Meteorological sensors |
| 5. Rotor hub       | 14. Tower                  |
| 6. Main bearing    | 15. Yaw ring               |
| 7. Main shaft      | 16. Yaw gear               |
| 8. Gearbox         | 17. Nacelle bedplate       |
| 9. Brake disc      | 18. Oil filter             |
|                    | 19. Canopy                 |
|                    | 20. Generator fan          |

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The required technical options should therefore  
be specified in the contract.



SIEMENS

# SWT - 2.3 - 113

Turning moderate wind into maximum results

[www.siemens.com/energy](http://www.siemens.com/energy)

Answers for energy.



# At the leading edge of evolution

The new Siemens SWT-2.3-113 wind turbine is the ultimate choice for low to moderate wind conditions. The revolutionary direct drive generator and the new, optimized Quantum Blade are paired to extract as much energy as possible from the wind.

Efficient. Quiet. Robust and reliable. The Siemens SWT-2.3-113 is the new benchmark wind turbine for low to medium wind speeds. As a result of more than 30 years of research and development, it is designed to harvest more energy out of moderate wind conditions than anyone thought possible.

## Proven design

The SWT-2.3-113 is built around the same revolutionizing direct drive generator as the SWT-3.0-101. The direct drive turbine offers exceptional reliability and efficiency – with only 50% of the parts normally required for a conventional wind turbine. By using the same proven design and sharing the majority of components with its larger sibling, production costs and lead times can be kept down.

## Unique aerodynamics

The Quantum Blade combines exceptional aerodynamic performance with patented manufacturing technology. Based on innovative aerodynamic solutions in the root and tip sections, the Quantum Blade offers maximum efficiency at low to medium wind speeds.

## Maximum availability

Simplicity is the ultimate sophistication. With the simple and robust direct drive concept with 50% fewer parts, the SWT-2.3-113 wind turbine is designed for maximum availability. Furthermore, the spacious nacelle and the ergonomic working conditions facilitate serviceability and contribute to minimizing downtime for scheduled maintenance.

“

You cannot change the wind.  
It may be strong, it may be light.  
This leaves it up to us to extract  
as much energy as we can from it.

*Anne Schannong Vinther, Quality Engineer*



# Innovation for efficiency

Siemens direct drive technology and the new Quantum Blade represent groundbreaking wind turbine design and technology. The result of these two key innovations is a turbine with maximum efficiency and reliability, which helps to enable a solid return on investment.

## Maximized performance with 50% fewer parts

The Siemens direct drive design incorporates a permanent magnet generator with fewer moving parts than ever before.

The simple permanent magnet design offers increased efficiency directly by minimizing energy losses and indirectly by reducing maintenance needs. The outer rotor arrangement leads to a more compact and lightweight generator, making transportation and installation easier and faster.

## The B55 Quantum Blade

The new generation of Siemens wind turbine blades is lighter than previous designs but retains the superior

strength known from earlier generations of blades. Thanks to unique airfoils and redesigned tip and root sections, the blade offers superior performance at low to medium wind speeds. The root section uses Siemens “flatback” profiles to minimize root leakage and provide higher lift. The tip has also undergone a fine-tuning process to give enhanced lift and acoustic performance.

## One-piece moulding

Like other Siemens blades, the new Quantum Blades are manufactured in Siemens proprietary IntegralBlade® process. Each blade is moulded in one single production step from fiberglass-reinforced epoxy resin, resulting in a stronger, lighter blade without any joints.



## Lower noise

With a low 105 dB noise level, the SWT-2.3-113 is one of the quietest wind turbines on the market. As a result, this turbine type has an extremely high ratio of energy output per noise affected area, resulting in fewer disturbances to people and wildlife.

## Superior grid compliance

The Siemens NetConverter® is designed for maximum flexibility in the turbine's response to voltage and frequency variations, fault ride-through capability and output adjustment. The advanced wind farm control system provides state-of-the-art fleet management.

# Technical specification

## Rotor

- Type: 3-bladed, horizontal axis
- Position: Upwind
- Diameter: 113 m
- Swept area: 10,000 m<sup>2</sup>
- Speed range: 6–13 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: NB 1-7, SWPNA1\_XX12, FFAxxx
- Material: GRE
- Surface gloss: Semi-mat, <30 / ISO2813
- Surface colour: Light grey, RAL 7035

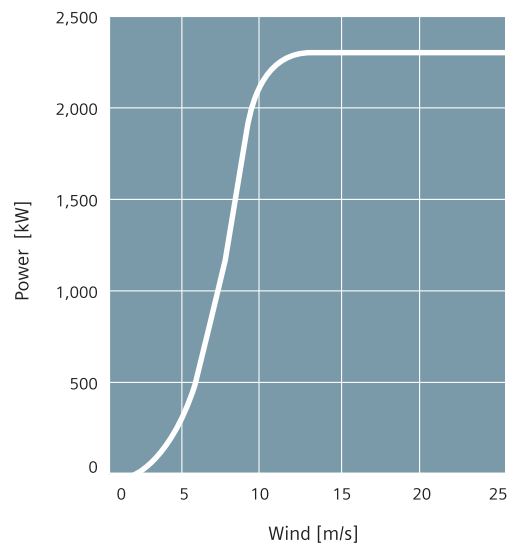
## Aerodynamic brake

- Type: Full span pitching
- Activation: Active, hydraulic

## Load-supporting parts

- Hub: Nodular cast iron
- Main shaft: Cast
- Nacelle bed plate: Cast

## Sales power curve



## Mechanical brake

- Type: Hydraulic disc brake
- Position: Generator rear end
- Number of callipers: 3

## Canopy

- Type: Totally enclosed
- Surface gloss: Silk mat, 30–40 / ISO2813
- Colour: Light grey, RAL 7035

## Generator

- Type: Synchronous, PMG
- Nominal power: 2,300 kW

## Grid terminals (LV)

- Nominal power: 2,300 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: Silk mat, 30–40 / ISO2813
- Colour: Light grey, RAL 7035

## Operational data

- Cut-in wind speed: 3 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
- Tower: Site-specific

### 1 Quantum Blade

- Unique design and manufacturing process
- IntegralBlade® one-piece moulding for maximum strength
- Optimized aerodynamics for low to medium wind conditions
- Increased length for higher energy yield
- Blade root – designed for minimized root leakage and increased lift

### 2 Direct drive generator

- Permanent magnet design
- Totally enclosed, easy to handle and lightweight design
- Optimum reliability and efficiency

### 3 Nacelle

- Solid, compact and lightweight structure
- Spacious, ergonomic design – maximum serviceability
- 50% fewer parts compared to geared turbines

### 4 Cooling

- Simple and robust LiquidLink® water cooling system
- Top-mounted passive cooling radiators
- High-efficient two-stage cooling as function of power



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