VORYS

Vorys, Sater, Seymour and Pease LLP
Legal Counsel

52 East Gay Street
P.O. Box 1008
Columbus, Ohio 43216-1008

614.464.6400 | www.vorys.com

Founded 1909

Michael J. Settineri
Direct Dial (614) 464-5462
Direct Fax (614) 719-5146
Email mjsettineri@vorys.com

August 16, 2016

Ms. Barcy F. McNeal, Secretary
Public Utilities Commission of Ohio
180 E. Broad St., 11th Floor
Columbus, OH 43215-3793

Re: Ohio Power Siting Board - Case No. 16-1717-EL-BGA
Hardin Wind LLC
Application for a Third Amendment

Dear Ms. McNeal:

Accompanying this letter are hard and electronic copies of an application by Hardin Wind LLC, for a third amendment to its Certificate of Environmental Compatibility and Public Need issued in Case No. 13-1177-EL-BGN. This third amendment seeks only to use the 2.2 MW version of the Vestas V110 wind turbine model that was previously approved for the project at 2.0 MW. The original Application for a Third Amendment was electronically filed.

In accordance with Rule 4906-2-04 of the Ohio Administrative Code, we make the following declarations:

Name of the applicant:

Hardin Wind LLC
1251 Waterfront Place, 3rd Floor
Pittsburgh, PA 15222

Names and location of the facility:

Scioto Ridge Wind Farm
Roundhead, McDonald, Lynn and Taylor Creek Townships, Hardin County, Ohio
Richland and Rushcreek Townships, Logan County, Ohio

Name of authorized representative:

Michael J. Settineri
Vorys, Sater, Seymour and Pease LLP
52 E. Gay Street
Columbus, OH 43215
614-464-5462
mjsettineri@vorys.com

Notarized Statement:

See attached Affidavit of Chris Shears
Senior Vice President and Chief Development Officer, Hardin Wind LLC

Hardin Wind LLC is requesting a waiver from the Ohio Power Siting Board Rule 4906-3-11(B)(2)(a)(iii) to allow for newspaper notice of this application.

Very truly yours,

Michael J. Settineri
Attorney for Hardin Wind LLC

MJS/jaw
Enclosure

BEFORE THE OHIO POWER SITING BOARD

In the Matter of the Application of Hardin Wind LLC for a Third Amendment to its Certificate Issued in Case No. 13-1177-EL-BGN	))))	**Case No. 16-1717-EL-BGA**

CHIEF EXECUTIVE OFFICER'S AFFIDAVIT

STATE OF PENNSYLVANIA)
) SS:
COUNTY OF ALLEGHENY)

Now comes Chris Shears, Senior Vice President and Chief Development Officer of Hardin Wind LLC, having been first duly sworn, declares and states as follows:

1. He is the highest ranking executive officer in charge of the Scioto Ridge Wind Farm project in the Townships of Roundhead, McDonald, Lynn and Taylor Creek in Hardin County, Ohio, and the Townships of Richland and Rushcreek in Logan County, Ohio.

2. He has reviewed the Application for a Third Amendment to the Certificate to Construct a Wind-Powered Electric Generating Facility in Hardin County and Logan County, Ohio that was issued in Case No. 13-1177-EL-BGN.

3. To the best of his knowledge, the information and statements contained in the Application for a Third Amendment to the Certificate are true and correct and the Application for a Third Amendment to the Certificate is complete.

Chris Shears
Senior Vice President and Chief Development Officer
Hardin Wind LLC

Sworn to before me and signed in my presence this 12th day of August 2016.

Notary Public
My Commission Expires 10/9/19

COMMONWEALTH OF PENNSYLVANIA
NOTARIAL SEAL
Stephanie M. Ottey, Notary Public
City of Pittsburgh, Allegheny County
My Commission Expires Oct. 9, 2019
MEMBER, PENNSYLVANIA ASSOCIATION OF NOTARIES

8 10 2016 25249801

BEFORE THE OHIO POWER SITING BOARD

In the Matter of the Application	)	
of Hardin Wind LLC for a Third	)	Case No. 16-1717-EL-BGA
Amendment to its Certificate	)	
Issued in Case No. 13-1177-EL-BGN	)	

Application for a Third Amendment

to the Hardin Wind LLC Certificate

Granted March 17, 2014 in Case No. 13-1177-EL-BGN

Capacity Increase of Vestas V110 from 2.0 Megawatts to 2.2 Megawatts

Hardin Wind LLC (hereinafter referred to as the "Applicant"), a wholly-owned subsidiary of EverPower Wind Holdings, Inc., holds a certificate to construct a wind-powered electric generation facility (the Scioto Ridge Wind Farm) consisting of up to 105 wind-powered electric turbines, along with access roads, electrical interconnect, construction staging areas, operations and maintenance facilities, and a collection substation (collectively, the "Facility") to be located in Lynn, McDonald, Roundhead, and Taylor Creek Townships (Hardin County) and Richland and Rushcreek Townships (Logan County). The Ohio Power Siting Board (the "Board" or "OPSB") issued an Opinion, Order and Certificate in Case No. 13-177-EL-BGN on March 17, 2014 (the "Certificate") approving the Facility for construction and operation. The Board approved an amendment to the Certificate on November 12, 2015 in Case No. 14-1557-EL-BGA consisting of minor changes to a meteorological tower, a collector substation, seven access roads and twelve collection lines. The Board approved a second amendment to the Certificate on May 19, 2016 in Case No. 16-0725-EL-BGA for a capacity rating increase from the previously approved 2.0 megawatt ("MW") Gamesa G114 wind turbine model to 2.5 MW.

The project was originally approved for up to 172 turbine sites with the final number of installed turbines dependent on the megawatt ("MW") capacity of the final turbine model selected for the project. Since the original approval, the Applicant has provided notice to the Board of dropping 67 turbine sites, leaving only 105 approved turbine sites for this project. The turbine models currently approved for this project are the: REpower MM100 (2.05MW); REpower M122 (3.0 MW); Nordex N117 (2.4 MW); Vestas V110 (2.0 MW); Vestas V117 (3.3 MW); Gamesa G97 (2.0 MW); Gamesa G114 (2.0 MW, 2.5 MW); General Electric GE100 (1.7 MW); Suzlon S111 (2.1 MW); and the GE103 (1.7 MW).

Through this application, the Applicant is proposing a capacity increase to the already approved Vestas V110 turbine model. The manufacturer of that turbine model has successfully made technological improvements to the turbine, allowing the capacity to increase from 2.0 MW to 2.2 MW. Importantly, the V110 turbine's dimensions including rotor diameter and hub height remain the same. Both turbines will have a 95 meter hub height with a rotor diameter of 110 meters. The 2.2 MW version of the V110 model can be operated at the same operational maximum sound power output as the 2.0 MW version of the V110 model. The only change to the project, therefore, is the use of the V110 turbine at a 2.2 MW capacity in addition to the 2.0 MW design.

Because this application only seeks Board approval for a capacity rating increase (2.0 MW to 2.2 MW for the V110 model), no other aspects of the approved project are being modified. All approved turbine sites remain unchanged as well as the location of the project's collector substation, access roads and collection lines. The only change is the capacity increase for the V110 model. Of the currently approved turbines, the Vestas V117 has the highest nameplate capacity at 3.3 MW and if selected would result in a 91 turbine project. The turbines with the lowest nameplate capacity are the GE 100 and GE 103 at 1.7 MW and if selected would result in a 105 turbine project. As with the already approved V110 2.0 MW turbine, selection of the V110 2.2 MW turbine would result in a 105 turbine project.

The below information on the V110 2.2 MW turbine is being submitted in accordance with Board rule 4906-4-03. The only change to the project is the capacity increase from 2.0 MW to 2.2 MW for the V110 turbine model. All other information regarding the project previously submitted to the Board remains unchanged.

General Overview of the V110 2.2 MW Turbine

The V110 2.2 MW turbine represents advancements in Vestas' 2.0 MW platform of turbines. The V110 2.2 MW turbine incorporates technology enhancements that include a 2.2 MW generator along with a 54 meter blade. General information on both the V110 2.0 MW turbine and the V110 2.2 MW turbine is provided in Appendix A (turbine brochures). The benefit of the 2.2 MW turbine is improved energy production, which will lower the cost of energy for the project and improve its competitiveness.

Comparison Between V110 2.0 MW and 2.2 MW Turbines

The technical specifications for the V110 2.0 MW turbine and the V110 2.2 MW turbine are listed in the below table. Correspondence from the manufacturer confirming that the 2.2 MW turbine and the 2.0 MW turbine are virtually identical, with the exception of nameplate capacity, is attached as Appendix B.

Turbine Detail	**V110 2.0 MW Turbine**	**V110 2.2 MW Turbine**
Rated power	2.0 MW	2.2 MW
Wind class	IIIA	S
Rotor diameter	110 meters	110 meters
Swept area	9,503 square meters	9,503 square meters
Gearbox	2 helical stages and 1 planetary stage	2 helical stages and 1 planetary stage
Generator	Doubly fed	Doubly fed
Frequency	50 Hz / 60 Hz	50 Hz / 60 Hz
Hub Height	95 meters	95 meters

Importantly, because the V110 2.0 MW and 2.2 MW turbines have the same rotor diameter and hub height (total tip height of 492 feet), the setback calculation for the V110 turbine model remains the same (541 feet to the nearest property line and 937 feet to the nearest non-participating residential structure). The tallest hub height under consideration for the project remains at 328 feet (100 meters), found on the REpower MM100 and Gamesa G97; the largest rotor diameter under consideration for the project is still 400 feet (122 meters), found on the REpower M122. The maximum total turbine height (i.e., height at the highest blade tip position) of all the models under consideration remains 492 feet (150 meters), which is associated with the MM100, M122, N117, V110, V117 and G114 models. The Certificate allows for a property line setback of 541 feet and a non-participating residential structure setback of 950 feet. Like the approved V110 2.0 MW turbine and because it has the same overall dimensions, the V110 2.2 MW turbine will satisfy the approved project setbacks. The identical overall dimensions also means that shadow flicker produced by the V110 2.2 MW turbine will be identical to the already approved V110 2.0 MW turbine.

Sound Power Output Comparison

The Vestas wind turbines proposed for the Scioto Ridge Wind Farm project includes the Vestas V110 – 2.0 MW and V110 – 2.2 MW turbines with the same 95 meter hub height. The V110 – 2.0 MW and the V110 – 2.2 MW are physically identical, sharing the same components, tower heights, and rotor diameters; the V110 – 2.0 MW and the V110 – 2.2 MW therefore share the same safety characteristics. The V110 has been field-tested and Type Certified according to the IEC 61400 standard.

In addition, as described in the attached correspondence from the turbine manufacturer (Appendix B), both proposed wind turbines can be operated at the same maximum noise level of 106.0 dB(A) in a standard sound mode (Mode 0) operation, subject to +-2 dB(A) for IEC 61400-14 uncertainties. Both wind turbines can also be operated in noise reduced modes with a lower maximum noise level, if needed.

Safety Features

The V110 2.2 MW turbine has the same safety features as the V110 2.0 MW turbine, and as generally described in the project's initial application (see Appendix B). These features include sensors that capture outside temperatures, wind speed and direction, and turbine operating parameters such as component temperatures, pressure levels, blade vibrations and positioning. The 2.2 MW turbine also will have the same lightening protection system as the 2.0 MW turbine.

As required under the Certificate (condition 4 of the January 21, 2014 Joint Stipulation), the Applicant will submit the safety manual for the turbine selected for the project prior to construction. Representative safety manuals were provided in the project's initial application to the Board, and included a Vestas safety manual.

Additional questions about the proposed nameplate capacity increase for the V110 turbine model may be directed to the undersigned counsel or to Jason Dagger, Project Manager, Scioto Ridge Wind Farm. Given that this amendment presents no changes to the facility design, other than increasing the megawatt capacity from 2.0 to 2.2 MW for the V110 turbine model, the Applicant requests an expedited ruling on this application.

Respectfully submitted,

s/ Michael J. Settineri
Michael J. Settineri (0073369)
Stephen M. Howard (0022421)
Ryan D. Elliott (0086751)
VORYS, SATER, SEYMOUR AND PEASE LLP
52 East Gay Street
P.O. Box 1008
Columbus, Ohio 43216-1008
(614) 464-5462
(614) 719-5146 (fax)
mjsettineri@vorys.com

Attorneys for Hardin Wind LLC

APPENDIX A

Public
Document no.: 0051-0155 V00
2015-04-16

General specification

2.0/2.2MW V110/100 50/60Hz

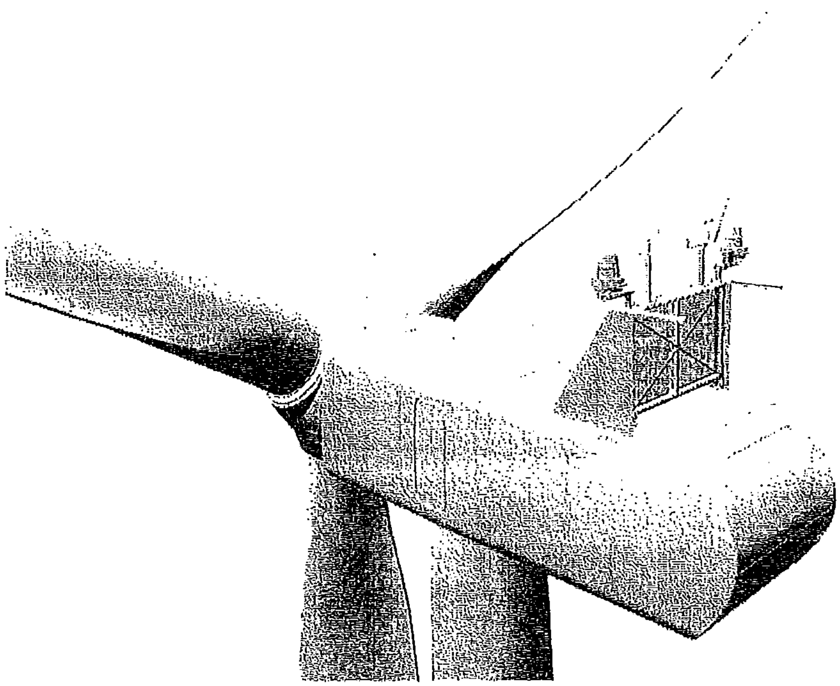

Table of contents

Recipient acknowledges that (i) this General Specification is provided for recipient's information only, and, does not create or constitute a warranty, guarantee, promise, commitment, or other representation (Commitment) by Vestas Wind Systems or any of its affiliated or subsidiary companies (Vestas), all of which are disclaimed by Vestas and (ii) any and all Commitments by Vestas to recipient as to this general specification (or any of the contents herein) are to be contained exclusively in signed written contracts between recipient and Vestas, and not within this document.

See general reservations, notes, and disclaimers to this general specification in section General reservations, notes, and disclaimers, p. 21.

1 Abbreviations and technical terms

Abbreviation	Explanation
AEP	Annual Energy Production
EMC	Electromagnetic Compatibility
HH	Hub Height
HV	High Voltage
LPS	Lightning Protection System
MASL	Meters Above Sea Level
MW	Megawatt
OH&S	Occupational Health & Safety
OVRT	Over Voltage Ride-Through
pu	Per unit
rpm	Revolutions per minute
SSR-P	Sub Synchronous Resonance Protection
UVRT	Under Voltage Ride-Through

Table 1-1: Abbreviations

Term	Explanation
None	

Table 1-2: Explanation of terms

2 General description

The Vestas 2.0MW series wind turbine is a pitch-regulated upwind turbine with active yaw, gearbox and a three-blade rotor. The turbine is available in two rotor diameters 100 or 110m with a generator rated at 2.0 or 2.2MW. The turbine utilises a microprocessor pitch control system called OptiTip® and the OptiSpeed™ (variable speed) feature. With these features, the wind turbine is able to operate the rotor at variable speed (rpm), helping to maintain output at or near rated power.

Rotor	Rating [MW]	Wind Class [IEC]	Hub Height [m]	
			50Hz	60Hz
V100	2.0	IIB	80, 95	80, 95
		IIC	80	80
	2.2	S	80, 95	80, 95
V110	2.0	IIIA	95	80, 95
	2.0	IIIB	95, 110, 120, 125	95, 110
	2.0	IIIC	80	80
	2.2	S	80, 95 110, 120, 125	80, 95

Table 2-1: Turbine variants and tower heights

3 Safety

The safety specifications in this safety section provide limited general information about the safety features of the turbine and are not a substitute for Buyer and Buyer's agents taking all appropriate safety precautions, including but not limited to (a) complying with all applicable safety, operation, maintenance, and service agreements, instructions, and requirements, (b) complying with all safety-related laws, regulations, and ordinances, (c) conducting all appropriate safety training and education and (d) reading and understanding all safety-related manuals and instructions. See section 3.11 Manuals and warnings for additional guidance.

3.1 Access

Access to the turbine from the outside is through the bottom of the tower. The door is equipped with a lock. Access to the top platform in the tower is by a ladder or service lift. Access to the nacelle from the top platform is by ladder. Access to the transformer room in the nacelle is controlled with a lock. Unauthorised access to electrical switchboards and power panels in the turbine is prohibited according to IEC 60204-1 2006.

3.2 Escape

In addition to the normal access routes, alternative escape routes from the nacelle are through the crane hatch.

The hatch in the roof can be opened from both the inside and the outside.

Escape from the service lift is by ladder.

3.3 Rooms/working areas

The tower and nacelle are equipped with connection points for electrical tools for service and maintenance of the turbine.

3.4 Climbing facilities

A ladder with a fall arrest system (rigid rail or wire system) is installed through the tower.

There are anchor points in the tower, nacelle, hub, and on the roof for attaching a full-body harness (fall arrest equipment).

Over the crane hatch there is an anchor point for the emergency descent equipment.

3.5 Moving parts, guards, and blocking devices

Moving parts in the nacelle are shielded.

The turbine is equipped with a rotor lock to block the rotor and drive train.

It is possible to block the pitch of the cylinder with mechanical tools in the hub.

3.6 Lighting

The turbine is equipped with light in tower, nacelle, and hub.

There is emergency light in case of the loss of electrical power.

3.7 Emergency stop buttons

There are emergency stop buttons in the nacelle and in the bottom of the tower.

3.8 Power disconnection

The turbine is designed to allow for disconnection from all its power sources during inspection or maintenance. The switches are marked with signs and are located in the nacelle and in the bottom of the tower.

3.9 Fire protection/first aid

A CO_2 (recommended) or ABC fire extinguisher and first aid kit must be available in the nacelle during all service and maintenance activities. A fire blanket must be available nearby for all those activities for which the respective work instruction requires it.

3.10 Warning signs

Additional warning signs inside or on the turbine must be reviewed before operating or servicing the turbine.

3.11 Manuals and warnings

The Vestas Corporate OH&S Manual and manuals for operation, maintenance, and service of the turbine provide additional safety rules and information for operating, servicing, or maintaining the turbine.

4 Type approvals

The turbine will be type-certified according to the certification standards listed below:

- IEC 61400-22

5 Operational envelope and performance guidelines

Actual climate and site conditions have many variables and must be considered in evaluating actual turbine performance. The design and operating parameters set forth in this section do not constitute warranties, guarantees, or representations as to turbine performance at actual sites.

The turbine can be equipped with different power generation components depending on the region which may influence the performance of the turbine. Consult Vestas Wind Systems for further details.

NOTE As evaluation of climate and site conditions is complex, it is necessary to consult Vestas for every project.

5.1 Climate and site conditions

Values refer to hub height and as determined by the sensors and control system of the turbine.

Extreme design parameters				
Wind climate	V100		V110	
	2MW	2.2MW	2MW	2.2MW
	IEC IIB	IEC S	IEC IIIA	IEC S
Ambient temperature range (standard turbine)	-30° to +50°C	-30° to +50°C	-30° to +50°C	-30° to +50°C
Ambient temperature interval (low temperature turbine)	-40° to +50°C	-40° to +50°C	-40° to +50°C	-40° to +50°C
Extreme wind speed (10-minute average)	42.5 m/s	42.5 m/s	37,5 m/s	37,5 m/s
Survival wind speed (3-second gust)	59.5 m/s	59.5 m/s	52,5 m/s	52,5 m/s

Table 5-1: Extreme design parameters

Average design parameters				
Wind climate	V100		V110	
	2MW	**2.2MW**	**2MW**	**2.2MW**
	IEC IIB	**IEC S**	**IECA**	**IEC S**
Annual average wind speed	8.5 m/s	7,5 m/s	7,5 m/s	6,5 m/s
Form factor, c	2.0	2,2	2,0	2,0
Turbulence intensity according to IEC 61400-1:2005, including wind farm turbulence (@15 m/s – 90% quartile)	16%	16%	18%	18%
Wind shear	0.20	0.20	0.20	0.20
Inflow angle (vertical)	8°	8°	8°	8°

Table 5-2: Average design parameters

5.1.1 Complex terrain

Classification of complex terrain according to IEC 61400-1:2005 Chapter 11.2.

For sites classified as complex, appropriate measures are to be included in the site assessment.

5.1.2 Altitude

The turbine is designed for use at altitudes up to 1500 metres above sea level as standard.

With altitudes above 1500 metres, special considerations must be taken regarding for example HV installations and cooling performance. Consult Vestas for further information.

5.1.3 Wind farm layout

Turbine spacing is to be evaluated site-specifically. Spacing below three rotor diameters (2D) may require sector-wise curtailment.

5.2 Operational envelope (temperature and wind)

Values refer to hub height and are determined by the sensors and control system of the turbine.

Operational envelope (temperature and wind)				
Wind climate	**V100**		**V110**	
	2MW	**2.2MW**	**2MW**	**2.2MW**
	IEC IIB	**IEC S**	**IECA**	**IEC S**
Ambient temperature interval (standard temperature turbine)	-20° to +40°C	-20° to +40°C[1]	-20° to +40°C	-20° to +40°C[1]
Ambient temperature interval (low temperature turbine)[1]	-30° to +40°C	-30° to +40°C[1]	-30° to +40°C	-30° to +40°C[1]
Cut-in (10 minute average)	3 m/s	3 m/s	3 m/s	3 m/s
Cut-out (10 minute average)	22 m/s	22 m/s	20 m/s	20 m/s
Re-cut in (10 minute average)	20 m/s	20 m/s	18 m/s	18 m/s

Table 5-3: Operational envelope (temperature and wind)

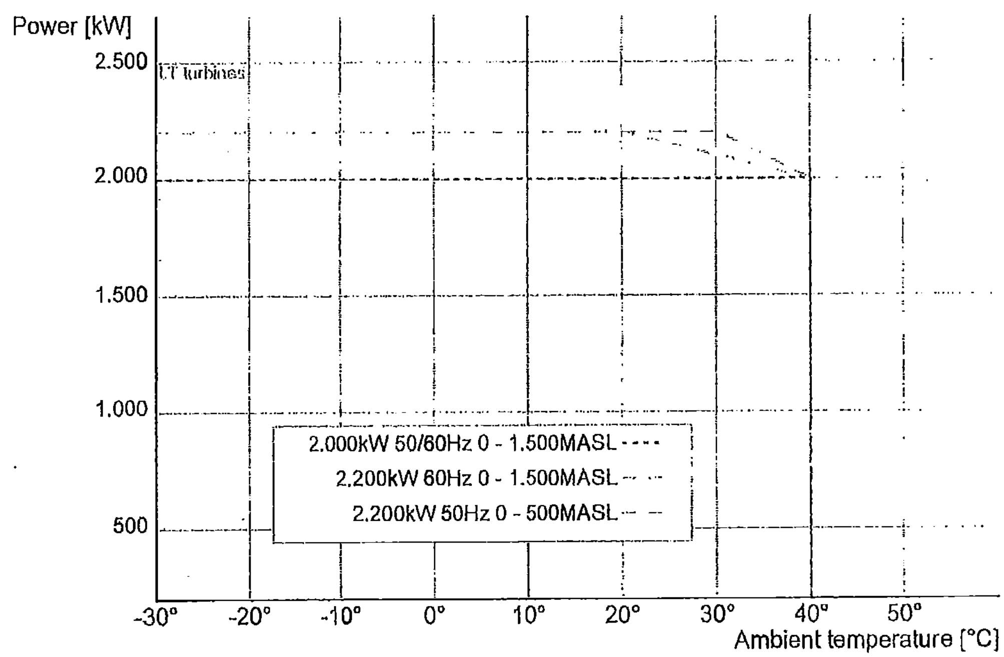

Figure 5-1: Temperature and de-rate curves

[1] Limitation in high temperature performance will apply for IEC S turbines

5.3 Operational envelope (grid connection)

Operational envelope (grid connection)		
Nominal phase voltage	$[U_{NP}]$	400 V
Nominal frequency	$[f_N]$	50 / 60Hz
Maximum frequency gradient	±4 Hz/sec.	
Maximum negative sequence voltage	3% (connection) 2% (operation)	
Minimum required short circuit ratio at turbine HV connection	5%	
Maximum short circuit current contribution	1.45 pu (peak)	

Table 5-4: Operational envelope (grid connection)

Generator and converter disconnecting values		
	50Hz	**60Hz**
Frequency is above [Hz] for 0.2 Seconds	53 Hz	63,6Hz
Frequency is below [Hz] for 0.2 Seconds	47 Hz	56,4Hz

Table 5-5: Generator and converter disconnecting values

NOTE Over the turbine lifetime, grid drop-outs are to occur at an average of no more than 50 times a year.

5.4 Reactive power capability

The turbine has a reactive power capability dependent on power rating as illustrated in Figure 5-2 and Figure 5-3.

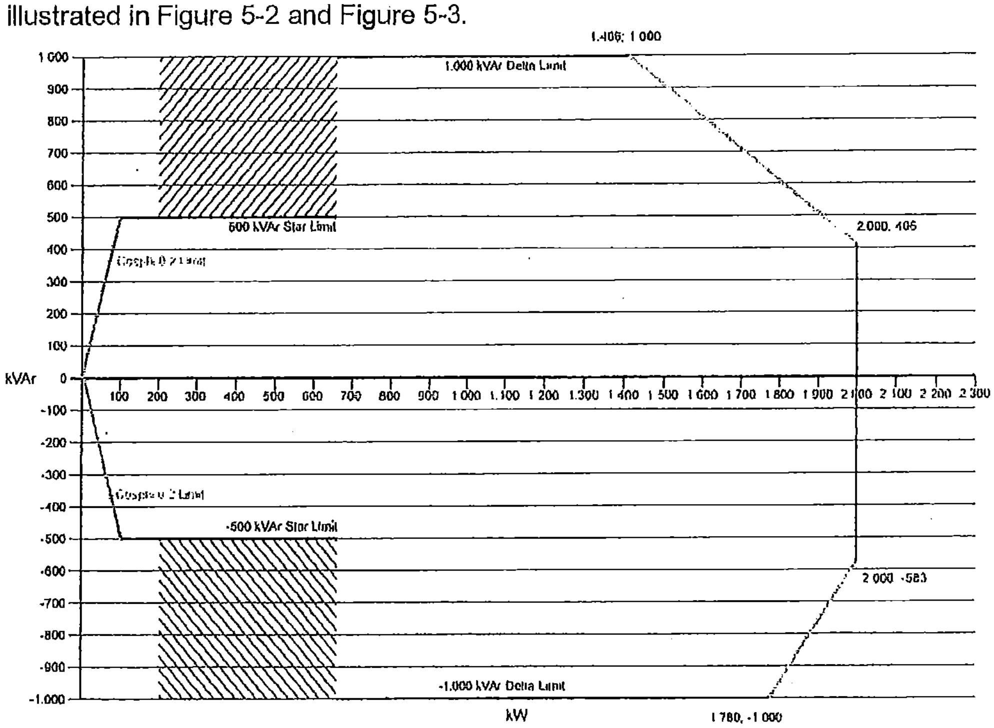

Figure 5-2: Reactive power capability for 2.0MW variants 50 and 60Hz

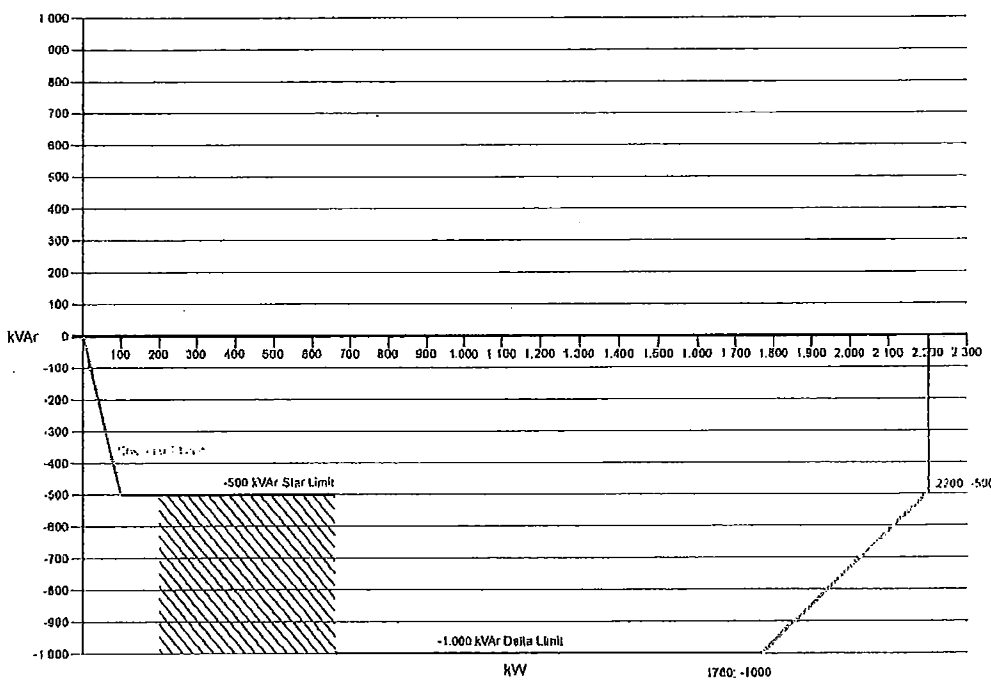

Figure 5-3: Reactive power capability for 2.2MW variants 50 and 60Hz

The above chart applies to the low-voltage side of the HV transformer. The turbine maximises active power or reactive power depending on grid voltage conditions.

5.5 Fault ride through

5.5.1 UVRT

The turbine is equipped with a reinforced converter system in order to gain better control of the generator during grid faults. The turbine control system continues to run during grid faults.

The pitch system is optimised to keep the turbine within normal speed conditions, and the generator speed is accelerated in order to store rotational energy and be able to resume normal power production faster after a fault and keep mechanical stress on the turbine at a minimum.

The turbine is designed to stay connected during grid disturbances within the UVRT curve in Figure 5-4, p. 12.

Power recovery time	
Power recovery to 90% of pre-fault level	Maximum 2 seconds

Table 5-6: Power recovery time

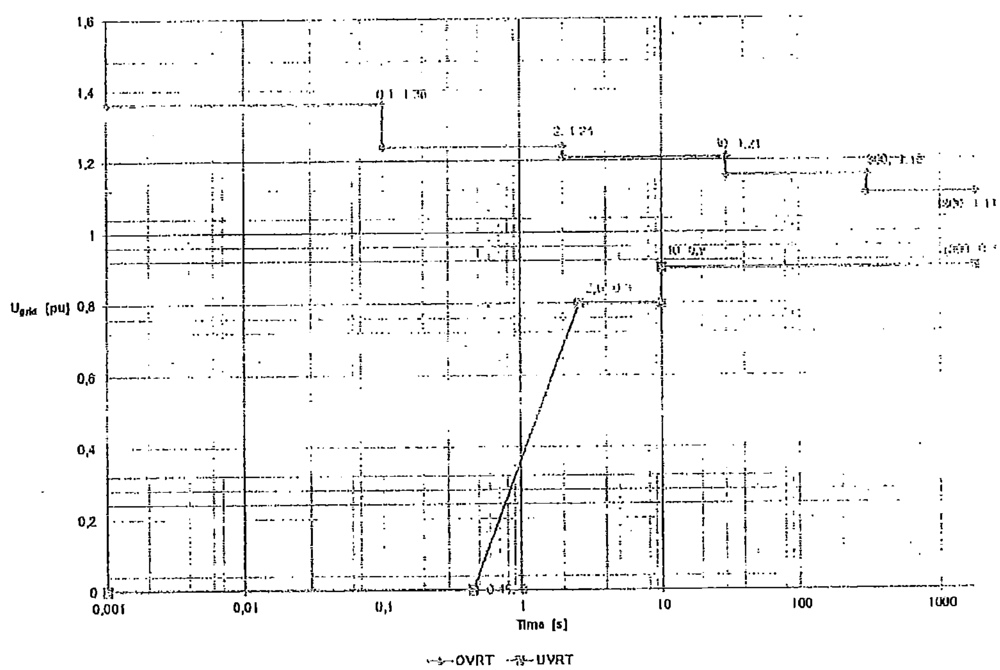

Figure 5-4: OVRT, UVRT curves for symmetrical and asymmetrical faults where U_{grid} represents grid voltage values

The turbine stays connected when the values are above UVRT (and protection) and below OVRT.

5.5.2 OVRT

The turbine is able to run with voltage levels above nominal within restricted time intervals.

The generator and the converter will be disconnected if the voltage level exceeds the OVRT curve shown in Figure 5-4.

5.5.3 Reactive current contribution

The reactive current contribution depends on whether the fault applied to the turbine is symmetrical or asymmetrical.

Symmetrical reactive current contribution

During symmetrical voltage dips the wind farm will inject reactive current to support the grid voltage. The reactive current injected is a function of the voltage measured at the low voltage side of the WTG transformer.

The default value gives a reactive current part of 1 p.u. of the nominal WTG current. Figure 5-5 indicates the reactive current contribution as a function of the voltage. The reactive current contribution is independent from the actual wind conditions and pre-fault power level.

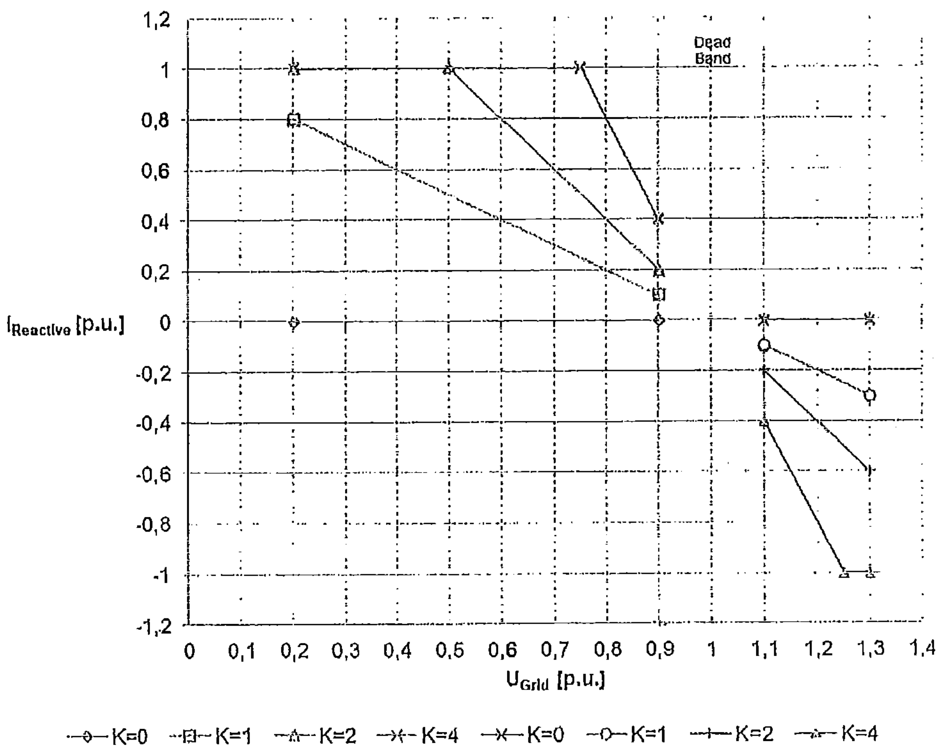

Figure 5-5: Reactive current contribution

Slope (K-factor), offset and dead band can be set freely to fulfil requirements to UVRT current injection.

Asymmetrical reactive current contribution

Current reference values are controlled during asymmetrical faults to ensure ride through.

5.5.4 Sub synchronous resonance protection

Turbine is equipped with fast-acting protection to shield the converter, generator and drivetrain from excessive voltages, currents and torques due to sub-synchronous resonance (SSR) caused by interaction between the turbine and the series-capacitor-compensated transmission lines. The generator and converter will be disconnected upon SSR detection by the turbine controller, according to Table 5-7: SSR protection time. SSR protections availability is depending on grid conditions at the specific sites.

SSR protection time	
Generator and converter disconnect	Maximum 100ms (including breaker response time)

Table 5-7: SSR protection time

5.6 Active and reactive power control

The turbine is designed for control of active and reactive power by means of the VestasOnline® SCADA system.

Maximum ramp rates for external control	
Active power[2]	0.1 pu/sec
Reactive power[2]	2.5 pu/sec

Table 5-8: Maximum ramp rates for external control data

To protect the turbine, active power cannot be controlled to values below the curve in Figure 5-6, p. 15.

[2] Limitations in duration of a power ramp may apply.

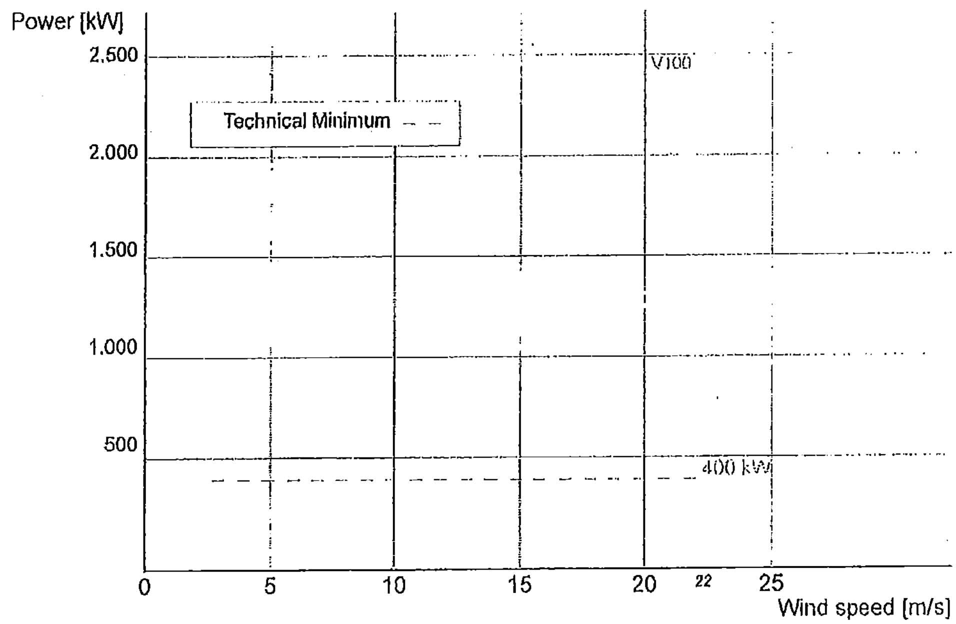

Figure 5-6: Minimum active power output related to wind speed

5.7 Voltage control

The turbine is designed for integration with VestasOnline® voltage control by utilising the turbine reactive power capability.

5.8 Frequency control

The turbine can be configured to perform frequency control by decreasing the output power as a linear function of the grid frequency (over frequency).

Dead band and slope for the frequency control function are configurable.

5.9 High voltage connection

5.9.1 Transformer

The step-up HV transformer is located in a separate locked room in the back of the nacelle.

The transformer is a three-phase, two-winding, dry-type transformer that is self-extinguishing. The windings are delta-connected on the high-voltage side unless otherwise specified.

The transformer comes in different versions depending on the market where it is intended to be installed.

- The transformer is as default designed according to IEC standards for both 50 Hz and 60Hz versions.
- For turbines installed in Member States of the European Union, it is required to fulfil the Ecodesign regulation No 548/2014 set by the European Commission.

5.9.2 HV Switchgear (Option)

As an option Vestas can deliver a gas insulated switchgear which is installed in the bottom of the tower as an integrated part of the turbine. Its controls are integrated with the turbine safety system which monitors the condition of the switchgear and high voltage safety related devices in the turbine. This ensures all protection devices are fully operational whenever high voltage components in the turbine are energised. The earthing switch of the circuit breaker contains a trapped-key interlock system with its counterpart installed on the access door to the transformer room in order to avoid unauthorized access to the transformer room during live condition.

The switchgear is available in two variants with increasing features – see *Table 5-9 - HV switchgear variants and features*. Beside the increase in features, the switchgear can be configured depending on the number of grid cables planned to enter the individual turbine. The design of the switchgear solution is optimized such grid cables can be connected to the switchgear even before the tower is installed and still maintain its protection toward weather conditions and internal condensation due to a gas tight packing.

The switchgear is available in an IEC version and in an IEEE version. The IEEE version is however only available in the highest voltage class.

HV Switchgear		
Variant	**Basic**	**Streamline**
IEC standards	○	⊙
IEEE standards	⊙	○
Vacuum circuit breaker panel	⊙	⊙
Overcurrent, short-circuit and earth fault protection	⊙	⊙
Disconnector / earthing switch in circuit breaker panel	⊙	⊙
Voltage Presence Indicator System for circuit breaker	⊙	⊙
Voltage Presence Indicator System for grid cables	⊙	⊙
Double grid cable connection	⊙	⊙
Triple grid cable connection	⊙	○
Preconfigured relay settings	⊙	⊙
Turbine safety system integration	⊙	⊙
Redundant trip coil circuits	⊙	⊙
Trip coil supervision	⊙	⊙
Pendant remote control from outside of tower (Option via ground controller)	⊙	⊙
Sequential energisation	⊙	⊙
Reclose blocking function	⊙	⊙
Heating elements	⊙	⊙
Trapped-key interlock system for circuit breaker panel	⊙	⊙
UPS power back-up for protection circuits	⊙	⊙
Motor operation of circuit breaker	⊙	⊙
Cable panel for grid cables (configurable)	○	⊙
Switch disconnector panels for grid cables – max three panels (configurable)	○	⊙
Earthing switch for grid cables	○	⊙
Internal arc classification	○	⊙
Supervision on MCB's	○	⊙

Table 5-9 - HV switchgear variants and features

5.10 Main contributors to own consumption

The consumption of electrical power by the wind turbine is defined as consumption when the wind turbine is not producing energy (generator is not connected to the grid). This is defined in the control system as Production Generator (zero).

The following components have the largest influence on the power consumption of the wind turbine:

Main contributors to own consumption	
Hydraulic motor	20 kW
Yaw motors 6 x 1.75 kW	10.5 kW
Oil heating 3 x 0.76 kW	2.3 kW
Air heaters (2 x 6 kW)	12 kW
Oil pump for gearbox lubrication	5.0 kW
Generator fans (included in generator efficiency)	7.0 kW
Average of measured no-load loss of the HV transformer	4.0 kW

Table 5-10: Own consumption data

6 Drawings

6.1 Structural design – illustration of outer dimensions

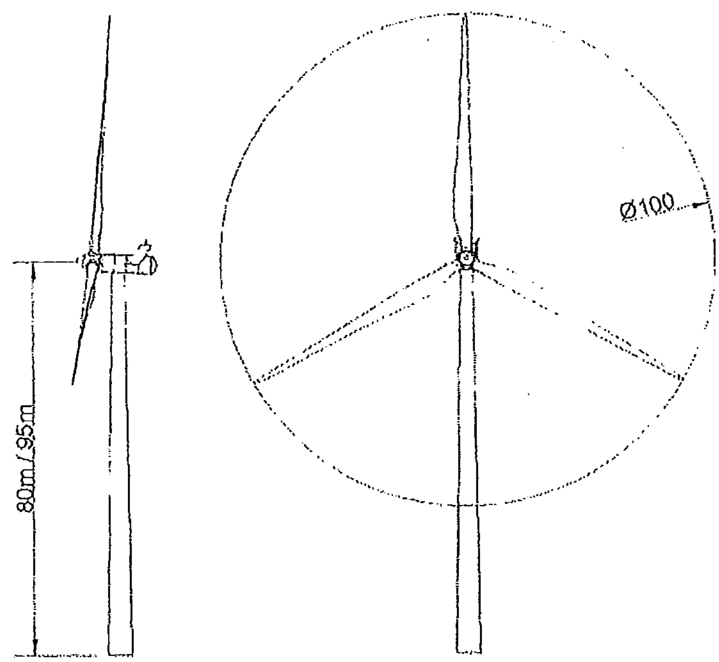

Figure 6-1: Illustration of outer dimensions for a V100 turbine

6.2 Structural design (side-view drawing)

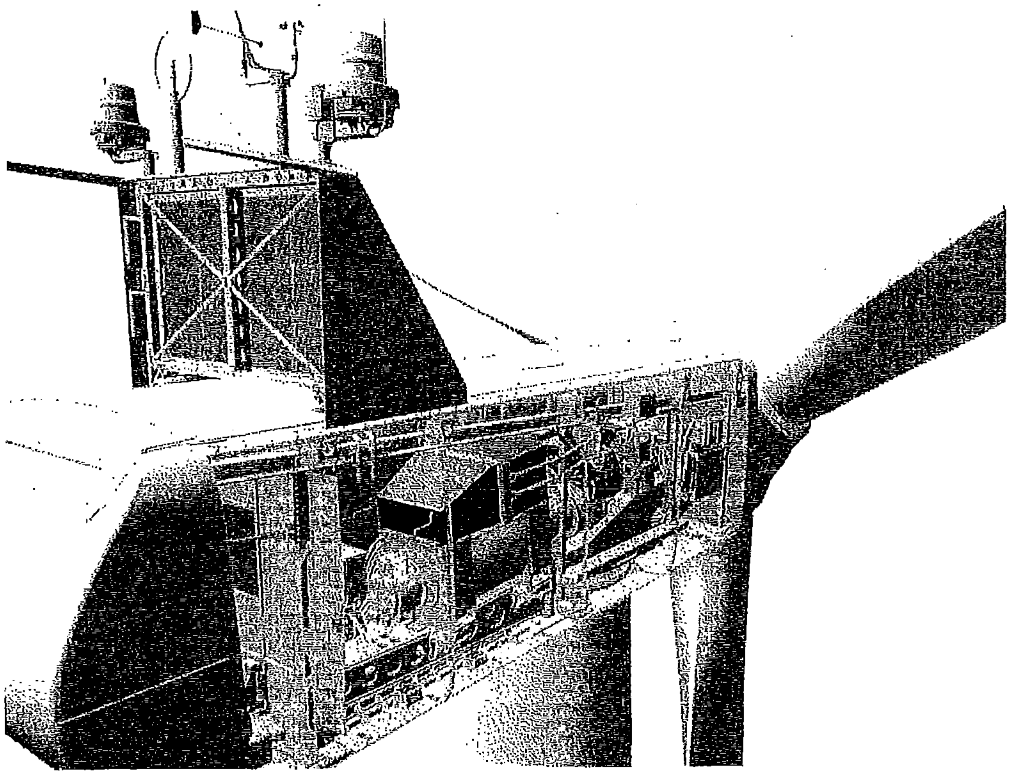

Figure 6-2: Side-view drawing

6.3 Turbine protection systems

6.3.1 Braking concept

The main brake on the turbine is aerodynamic. Braking the turbine is done by feathering the three blades. During emergency stop all three blades will feather simultaneously to full end stop, thereby slowing the rotor speed.

In addition there is a mechanical disc brake on the high-speed shaft of the gearbox. The mechanical brake is only used as a parking brake and when activating the emergency stop push buttons.

6.4 Overspeed protection

The generator rpm and the main shaft rpm are registered by inductive sensors and calculated by the wind turbine controller to protect against overspeed and rotating errors.

In addition, the turbine is equipped with a safety PLC, an independent computer module that measures the rotor rpm. In case of an overspeed situation, the safety PLC activates the emergency feathered position (full feathering) of the three blades independently of the turbine controller.

6.5 EMC system

The turbine and related equipment must fulfil the EU EMC-directive with later amendments:

- European Parliament Council directive 2004/108/EC of 15 December 2004 on the approximation of the laws of the Member States relating to electromagnetic compatibility.
- The EMC-directive with later amendments.

6.6 Lightning protection system

The LPS consists of three main parts.

- Lightning receptors.
- Down conducting system.
- Earthing system.

NOTE The LPS is designed according to IEC standards.

6.7 Earthing

The Vestas Earthing System is based on foundation earthing.

Document 0000-3388 'Vestas Earthing System' contains the list of documents pertaining to the Vestas Earthing System.

Requirements in the Vestas Earthing System specifications and work descriptions are minimum requirements from Vestas and IEC. Local and national requirements may require additional measures.

7 Environment

7.1 Chemicals

Chemicals used in the turbine are evaluated according to the Vestas Wind Systems A/S Environmental System certified according to ISO 14001:2004.

- Anti-freeze liquid to help prevent the cooling system from freezing.
- Gear oil for lubricating the gearbox.
- Hydraulic oil to pitch the blades and operate the brake.
- Grease to lubricate bearings.
- Various cleaning agents and chemicals for maintenance of the turbine.

8 General reservations, notes, and disclaimers

-
- The general specification document here described applies to the present design of the 2.0MW wind turbine series. Updated versions of the wind turbine, which may be manufactured in the future, may have a general specification document that differs from these general specifications. In the event that Vestas supplies an updated version of the wind turbine, Vestas will provide updated general specification applicable to the updated version.
- Vestas recommends that the grid be as close to nominal as possible with little variation in frequency.
- A certain time allowance for turbine warm-up must be expected following grid dropout and/or periods of very low ambient temperature.
- The estimated power curve for the different estimated noise levels (sound power levels) is for wind speeds at 10 minute average value at hub height and perpendicular to the rotor plane.
- All listed start/stop parameters (for example wind speeds and temperatures) are equipped with hysteresis control. This can, in certain borderline situations, result in turbine stops even though the ambient conditions are within the listed operation parameters.
- The earthing system must comply with the minimum requirements from Vestas, and be in accordance with local and national requirements, and codes of standards.
- This document, 'General Specifications', is not an offer for sale, and does not contain any guarantee, warranty, and/or verification of the power curve and noise (including, without limitation, the power curve and noise verification method). Any guarantee, warranty, and/or verification of the power curve and noise (including, without limitation, the power curve and noise verification method) must be agreed to separately in writing.

9 Appendices

9.1 Design codes – structural design

The structural design has been developed and tested with regard to, but not limited to, the following main standards:

Design codes – structural design	
Nacelle and hub	IEC 61400-1:2005 EN 50308 ANSI/ASSE Z359.1-2007
Bed frame	IEC 61400-1:2005
Tower	IEC 61400-1:2005 Eurocode 3

Table 9-1: Structural design codes

9.2 Design codes – mechanical equipment

The mechanical equipment has been developed and tested with regard to, but not limited to, the following main standards:

Design codes – mechanical equipment	
Gear	Designed in accordance with rules in ISO 81400-4
Blades	DNV-OS-J102 IEC 1024-1 IEC 60721-2-4 IEC 61400 (Part 1, 12, 22 and 23) DEFU R25 ISO 2813 DS/EN ISO 12944-2

Table 9-2: Mechanical equipment design codes

9.3 Design codes – electrical equipment

The electrical equipment has been developed and tested with regard to, but not limited to, the following main standards:

Design codes – electrical equipment	
High-voltage AC circuit breakers	IEC 60056
High-voltage testing techniques	IEC 60060
Power capacitors	IEC 60831
Insulating bushings for AC voltage above 1 kV	IEC 60137
Insulation coordination	BS EN 60071

Design codes – electrical equipment	
AC disconnectors and earth switches	BS EN 60129
Current transformers	IEC 60185
Voltage transformers	IEC 60186
High-voltage switches	IEC 60265
Disconnectors and fuses	IEC 60269
Flame retardant standard for MV cables	IEC 60332
Transformer	IEC 60076-11
Generator	IEC 60034
Specification for sulphur hexafluoride for electrical equipment	IEC 60376
Rotating electrical machines	IEC 34
Dimensions and output ratings for rotating electrical machines	IEC 72 and IEC 72A
Classification of insulation, materials for electrical machinery	IEC 85
Safety of machinery – electrical equipment of machines	IEC 60204-1

Table 9-3: Electrical equipment design codes

9.4 Design codes – I/O network system

The distributed I/O network system has been developed and tested with regard to, but not limited to, the following main standards:

Design codes – I/O network system	
Salt mist test	IEC 60068-2-52
Damp head, cyclic	IEC 60068-2-30
Vibration sinus	IEC 60068-2-6
Cold	IEC 60068-2-1
Enclosure	IEC 60529
Damp head, steady state	IEC 60068-2-56
Vibration random	IEC 60068-2-64
Dry heat	IEC 60068-2-2
Temperature shock	IEC 60068-2-14
Free fall	IEC 60068-2-32

Table 9-4: I/O network system design codes

9.5 Design codes – EMC system

To fulfil EMC requirements the design must be as recommended for lightning protection. See section 9.6 Design codes – lightning , p. 24.

Design codes – EMC system	
Designed according to	IEC 61400-1: 2005
Further robustness requirements according to	TPS 901795

Table 9-5: EMC system design codes

9.6 Design codes – lightning protection

The LPS is designed according to lightning protection level I:

Design codes – lightning protection	
Designed according to	IEC 62305-1: 2006 IEC 62305-3: 2006 IEC 62305-4: 2006
Non-harmonized standard and technically normative documents	IEC/TR 61400-24:2010

Table 9-6: Lightning protection design codes

9.7 Design codes – earthing

The Vestas Earthing System design is based on and complies with the following international standards and guidelines:

- IEC 62305-1 Ed. 1.0: Protection against lightning – Part 1: General principles.
- IEC 62305-3 Ed. 1.0: Protection against lightning – Part 3: Physical damage to structures and life hazard.
- IEC 62305-4 Ed. 1.0: Protection against lightning – Part 4: Electrical and electronic systems within structures.
- IEC/TR 61400-24. First edition. 2002-07. Wind turbine generator systems – Part 24: Lightning protection.
- IEC 60364-5-54. Second edition 2002-06. Electrical installations of buildings – Part 5-54: Selection and erection of electrical equipment – Earthing arrangements, protective conductors and protective bonding conductors.

9.8 Operational envelope conditions for power curve (at hub height)

Conditions for power curve (at hub height)	
Wind shear	0.00-0.30 (10 minute average)
Turbulence intensity	6-12% (10 minute average)
Blades	Clean
Rain	No
Ice/snow on blades	No
Leading edge	No damage
Terrain	IEC 61400-12-1
Inflow angle (vertical)	0 ±2°

Table 9-7: Conditions for power curve

9.9 Power curves, C_t values, and sound power levels

Power curve, C_t values and sound power levels for noise modes are defined in separate performance specifications for each variant. The documents will reference this General Specification to ensure correct traceability between performance data sheet and the General Specification.

The turbine can be equipped with different power generation components depending on the region which may influence the performance of the turbine. Consult Vestas Wind Systems for further details.

The Performance Specifications are listed below:

Performance specifications	Number
V100-2.2MW 50/60Hz	0051-0204
V110-2.2MW 50/60Hz	0051-0205
V100-2.0MW 50/60Hz	0051-0207
V110-2.0MW 50/60Hz	0051-0208

Table 9-8: Performance specifications

APPENDIX B

Vestas®

Memorandum

Date: August 9, 2016

To: Jim Sardonia, Director, Wind Resource, EverPower

From: Technical Sales North America, Vestas-American Wind Technology, Inc.

Pages: 1 of 1

Re: Scioto Ridge – 106.0 dB Sound Constraint

Vestas has developed onshore turbine platforms consisting of 2MW and 3MW nameplate variants. The 2MW platform includes wind turbines with various rotor diameters (90m, 100m, and 110m) and a standard nameplate of 2MW that, on the V100 and V110 machines, may be uprated in increments of 0.05 to 2.2 MW.

The Vestas wind turbines proposed for the Scioto Ridge, Ohio project include the Vestas V110-2.0 MW and V110-2.2 MW turbines with the same 95m hub height. The V110-2.0 MW and the V110-2.2 MW are physically identical, sharing the same components, tower heights, and rotor diameters; the V110-2.0 MW and the V110-2.2 MW therefore share the same safety characteristics. The V110 has been field-tested and Type Certified according to the IEC 61400 standard.

In addition, both the 2.0 MW and 2.2 MW turbines can be operated at the same maximum noise level of 106.0 dB(A) in a standard sound mode (Mode 0) operation, subject to +- 2 dB(A) for IEC 61400-14 uncertainties. As the operation of the turbine at 106.0 dBA, as opposed to 106.1 dBA, is accomplished via a minor change to the pitch curve, there will be no changes to the technical information for the turbine, including the power curve, the coefficient of the thrust curve, and acoustic emission data. Both wind turbines can also be operated in noise reduced modes with a lower maximum noise level if needed, which is primarily accomplished by reducing the speed of the rotor. Vestas will guarantee the sound output under its standard sound level warranty.

Please direct any questions or comments to Chelsea Stone, casea@vestas.com, and Gabe Garbarino, gagab@vestas.com.