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March 20, 2017

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

Re: OPSB Case No. 17-759-EL-BGA
Application for a Fourth Amendment to the
Scioto Ridge Project

Dear Ms. McNeal:

Accompanying this letter are hard and electronic copies of an application by Hardin Wind LLC, for a fourth amendment to its Certificate of Environmental Compatibility and Public Need for the Scioto Ridge Wind Farm Project, issued in Case No. 13-1177-EL-BGN. This fourth amendment seeks to use the 3.4 MW version of the RePower (now Senvion) wind turbine model that was previously approved for the project at 3.0 MW and to use the 3.6 MW version of the Nordex N117 wind turbine model previously approved at 2.4 MW. The original Application for a Fourth 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 Michael Current
Chief Financial 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
Vorys, Sater, Seymour and Pease LLP
Attorneys 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 Fourth Amendment to its Certificate Issued in Case No. 13-1177-EL-BGN	))))	**Case No. 17-0759-EL-BGA**

OFFICER'S AFFIDAVIT

STATE OF PENNSYLVANIA)
) SS:
COUNTY OF ALLEGHENY)

Now comes Michael Current, Chief Financial 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 Fourth 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 Fourth Amendment to the Certificate are true and correct and the Application for a Fourth Amendment to the Certificate is complete.

Michael Current
Chief Financial Officer
Hardin Wind LLC

Sworn to before me and signed in my presence this 14th day of March 2017.

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

BEFORE THE OHIO POWER SITING BOARD

In the Matter of the Application	**)**	
of Hardin Wind LLC for a Fourth	**)**	**Case No. 17-0759-EL-BGA**
Amendment to its Certificate	**)**	
Issued in Case No. 13-1177-EL-BGN	**)**	

Application for a Fourth Amendment

to the Hardin Wind LLC Certificate

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

Addition of Available Turbine Models with Request for Expedited Ruling

March 20, 2017

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. Finally, the Board approved a third amendment to the Certificate on October 25, 2016 in Case No. 16-1717-EL-BGA to add the Vestas 110 model with a 2.2 MW nameplate capacity as an available turbine for the project.

The project was 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 (2.05 MW); REpower M122 (3.0 MW); Nordex N117 (2.4 MW); Vestas V110 (2.0 MW and 2.2 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 Repower M122 (3.0 MW) turbine – from 3.0 MW to 3.4 MW (this model is now known as Senvion). The Applicant is also proposing to increase the capacity of the Nordex N117 turbine to allow for the 3.6 MW version. These turbines represent and include advances in technology while keeping all of the proposed turbines below the maximum height of the tallest turbine currently approved and at operational sound power output levels that are less than the sound power output level for the G97 turbine upon which operational sound modeling for the project was based.

Because this application only seeks Board approval for a capacity rating increases, no other aspects of the approved project will be modified through approval of the application. 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

increases for the M122 turbine and the Nordex N117 turbine. 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. If the Nordex N117 3.6 MW turbine is selected, it would result in a 83 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.

The below information on the Senvion M122 3.4 MW turbine and the Nordex N117 3.6 MW turbine is being submitted in accordance with Board rule 4906-4-03. The only changes to the project are the proposed turbine capacity increases. All other information regarding the project previously submitted to the Board remains unchanged.

General Overview of the Senvion M122 Turbine

The Senvion M122 3.4 MW turbine represents advancements in Senvion's 3.0 platform of turbines. The benefit of the 3.4 MW turbine is improved energy production, which will lower the cost of energy for the project and improve its competitiveness. General information on the M122 3.4 MW turbine is attached as Appendix A to this Application.

Comparison Between Senvion M122 3.0 MW and 3.4 MW Turbines

The technical specifications for the Senvion M122 3.0 MW and 3.4 MW turbines are listed in the below table.

Turbine Detail	M122 3.0 MW Turbine	M122 3.4 MW Turbine
Rated power	3.0 MW	3.4 MW
Wind class	IIIa	S
Rotor diameter	122 meters	122 meters
Swept area	11,690m2	11,690m2
Gearbox	Planetary/spur gearbox	Planetary/spur gearbox
Generator	Double-fed asynchronous generator	Induction generator
Frequency	50 Hz	50 Hz
Hub Height	89 meters	89 meters

Importantly, because all of the proposed Senvion M122 turbines have the same rotor diameter and hub height (total tip height of 492 feet), the setback calculation for the M122 turbine model remains the same (541 feet to the nearest property line and 950 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 (now Senvion) 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. Like the approved M122 3.0 MW turbine and because it has the same overall dimensions, the M122 3.4 MW turbine will not exceed the approved project setbacks. The identical overall dimensions also means that shadow flicker produced by the M122 3.4 MW turbine will be identical to the already approved M122 3.0 MW turbine.

Sound Power Output Comparison

The M122 wind turbines proposed for the Scioto Ridge Wind Farm project all have a maximum sound power output of 104.5 dBA +/- 1.0 dBA, less than the G97 2.0 MW turbine upon which project operational sound modeling was based. The G97 2.0 MW turbine was modeled at 105.8 dBA +/- 2.0 dBA. All M122 wind turbines can be operated in noise reduced modes with a lower maximum noise level, if needed.

Safety Features

The M122 3.4 turbine has the same safety features as the M122 3.0 MW turbine, and as generally described in the project's initial application (see pages 50-53). 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 new proposed M122 turbine also will have the same lightening protection system as the M122 3.0 MW turbine.

General Overview of the Nordex N117 Turbine

The Nordex N117 3.6 MW turbine takes advantage of technological advances in the Nordex turbine models and allow the Project to utilize Nordex's higher capacity turbine model. The benefit of the 3.6 MW turbine is improved energy production, which will lower the cost of energy for the project and improve its competitiveness. General information on the N117 3.6 MW turbine is attached as Appendix A to this Application.

Comparison Between Nordex N117 2.4 MW and 3.6 MW Turbines

The technical specifications for the Nordex N117 2.4 MW and 3.6 MW turbines are listed in the below table.

Turbine Detail	N117 2.4 MW Turbine	N117 3.6 MW Turbine
Rated power	2.4 MW	3.6 MW
Wind class	IIIa	IIa
Rotor diameter	117 meters	117 meters
Swept area	10,715 meters	10,715 meters
Gearbox	3-stage gearbox	Multi-stage gearbox
Generator	Double-fed asynchronous generator	Double-fed induction generator
Frequency	50/60 Hz	50/60 Hz
Hub Height	91 meters	91 meters

Importantly, because the proposed N117 turbines have the same rotor diameter and hub height (total tip height of 492 feet), the setback calculation for the N117 turbine model remains the same (541 feet to the nearest property line and 942 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 (now Senvion) 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. Like the approved N117 2.4 MW turbine and because it has the same overall dimensions, the N117 3.6 MW turbine will not exceed the approved project setbacks. The identical overall dimensions also means that shadow flicker produced by the N117 3.6 MW turbines will be identical to the already approved N117 2.4 MW turbine.

Sound Power Output Comparison

The 3.6 MW Nordex 117 wind turbine proposed for the Scioto Ridge Wind Farm project has a maximum sound power output of 105 dBA +/- 2.0 dBA, less than the G97 2.0 MW turbine upon which project operational sound modeling was based. The G97 2.0 MW turbine was modeled at 105.8 dBA +/- 2.0 dBA. All Nordex N117 wind turbines can also be operated in noise reduced modes with a lower maximum noise level, if needed.

Safety Features

The N117 MW 3.6 turbine has the same safety features as the N117 2.4 MW turbine, and as generally described in the project's initial application (see pages 50-53). 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 new proposed N117 turbines also will have the same lightening protection system as the 2.4 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.

Additional questions about the proposed nameplate capacity increase for the M122 and N117 turbine models may be directed to the undersigned counsel or to Seth Wilmore, Director, Environmental Affairs, Scioto Ridge Wind Farm. Given that this amendment presents no changes to the facility design, other than increasing the megawatt capacity of already approved turbine models, the Applicant requests an expedited ruling on this application.

Respectfully submitted,

s/ Michael J. Settineri
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APPENDIX A – TURBINE INFORMATION

Pioneering. Progress. Onshore.

The Senvion 3.XM series.

SENVION
wind energy solutions

Our portfolio, our outcome, our service for your success.

Our modular product portfolio matches your local requirements.

Our technology has to prove itself every day under real-world conditions. Thanks to our diverse product portfolio, we are able to answer your project needs, handle specific influences such as hot or cold temperatures, fulfill challenging sound requirements, and match high expectations in terms of grid connectivity.
With the right configuration from one of the largest product portfolios on the market, you can count on a stable income – even with unstable project conditions.

Our proven outcome secures your profitable income.

Our company relies on more than 25 years of experience, and throughout that time we have been able to adapt our tried-and-tested concepts to new developments. Our proven evolutionary design approach can be seen in the high availability of our turbine fleet and its reliable and robust performance. To make sure that you get the security you need for your project planning, we allow our power performance to be validated by the independent advisor DNV GL. This evidence successfully demonstrates the accuracy of our power curve.
With us as your experienced partner, you can put even your complex projects onto a sustainable and profitable path.

Our comprehensive service solutions ensure your turbine availability.

The high reliability of our turbines is the result of farsighted planning. Well-thought-out constructions enable access to all parts – even to the hub. Furthermore, our 700 service employees – part of a nationwide network of easily reachable service centers – care about seamless availability. Our conservative design approach allows them to operate effectively and safely, no matter how stable the conditions may be.
We offer more than 25 years of experience and 24-hour remote monitoring to match your individual requirements.

Experience is the best foundation.
6,700 wind turbine installations.

Over 25 years in the business, more than 6,700 wind turbine installations worldwide with a combined output of more than 13,9 gigawatts and uncompromising engineering skills have all earned Senvion one of the best reputations in the wind energy industry. We are highly ambitious: we constantly aim to improve not only our own turbines, but also to set new standards for the entire market.

Our answer to your challenge.

We develop, produce and supply wind turbines to suit almost any location, with a rated power ranging from 2 to 6.2 megawatts. A quarter of a century of pioneering work has taught us that the more energy we invest in our work, the higher the yield for you. We offer a wide range of onshore wind turbines with different hub heights, ensuring we can deliver the best possible results for you in any wind class.

Our expertise for your project.

Whether a single wind turbine or a whole wind farm, we take a personal interest in your project and keep an eye on every detail right from the start. We can offer customised solutions for blade production, foundation design, transport, installation, service and maintenance for your individual project. Our engineers are more than willing to listen to your suggestions and come up with the ideal solution in consultation with you, whilst paying due attention to the requirements of the market concerned.

Intelligent technology for reliable operations.

Our wind turbines have to cope with highly diverse requirements and operate reliably and safely even in extreme climate conditions, in difficult terrain or densely populated regions. To ensure that they do so, they come with intelligent technologies. As our wind turbines have built up a proven track record of efficiency and reliability over many years, we are in a position to offer contractual warranties for compliance with the specified performance curves, technical availability and site-specific noise emission limits.

- **Innovative blade design:** in-house development and production of the rotor blades improves rotor aerodynamics and enables high energy yield combined with low noise emission.
- **Highly developed pitch system:** DC electric motors allow the blades to be pitched quickly and efficiently. This delivers a high energy yield in all operating conditions and also permits a controlled shutdown at any time – even during a power failure, thanks to battery backup.
- **Reliable lightning protection:** our wind turbines are equipped with internal and external lightning protection according to IEC protection class I.
- **Optional extras:** noise restrictions, shadow flicker, bat protection and other aspects all mean that your wind turbines have to be adjusted to suit your particular location. You can therefore choose from a range of additional options to suit your individual project circumstances.
- **Triple certification:** we set benchmarks when it comes to occupational health and safety, environmental management and quality management – as evident from our certification (OHSAS 18001, ISO 14001 and ISO 9001).

"Our growing product portfolio allows us today to present the solutions of tomorrow."

Anna Petersen,
Programm Manager 3.XM

The Senvion 3.XM series.
More power in the 3 megawatt class.

The 3.XM series is the flagship of our onshore portfolio. With its different turbine types and four rotor sizes, it offers outstanding flexibility and economic efficiency – even in challenging conditions. Eleven different hub heights make it suitable for a wide range of locations. High versatility explains the success of the 3.XM series – more than 750 of these turbines are now in use around the world equipped with a doubly fed induction generator.

The tried-and-tested technology featured in our new Next Electrical System (NES) and Eco Blade Control (EBC) turbine platforms opens a new chapter in the success story of our 3.XM-class turbines – making us ready for any challenges the future may bring.

A tried-and-tested basic platform with a highly efficient drive train concept.

The 3.XM series features a well-proven modular technology concept. It builds on our highly successful MM series, whose global sales have already exceeded 4,500 wind turbines. At the heart of the wind turbine is an integrated drive train concept to ensure perfect interaction of all the different components: from the aerodynamically optimized rotor blade, combined planetary spur gear and compact generator right through to the transformer. This flawless interplay delivers high energy yields while keeping sound emissions low.

3.4M104

3.4M104 – our answer to challenging locations.

Our 3.4M104 was developed with high-wind onshore locations in mind. With a rotor surface of 8,495 m² and hub heights between 73 and 100 meters, it guarantees excellent economic efficiency. The 3.4M104 also served as the platform on which all other turbine types in the 3.XM series were developed.

The NES platform – an electrical system for any grid requirements.

Our turbines, which are equipped with the Next Electrical System (NES), already fulfil the grid requirements of tomorrow. All NES turbines are based on the tried and tested MM and 3.XM series construction concept.

3.6M114

3.6M114 NES – huge output even in the most challenging conditions.

We've increased the nominal power of the 3.6M114 NES to 3,600 kW, a boost of 200 kW compared to the previous model. That raises annual energy yields by up to 2.4 % at mean wind speeds of 8.5 m/s. With a range of tower heights, this model is suitable for locations with severe height restrictions yet keeps energy generation costs impressively low. This new turbine's suitability for many different wind conditions is shown by its certification for the wind classes, namely IEC IIA and IEC S, i.e. turbines designed for extreme conditions.

3.4M122

3.4M122 NES – best for mid-speed winds.

Along with an increase in nominal power to 3,400 kilowatts, the successor to the 3.2M122 is also certified for wind class IEC S based on IEC IIA and locations in wind zone 4. The energy yield at mid-speed winds and a hub height of 139 meters is up to 2.4 percent higher. This new system provides improvements in two essential areas. Firstly, it further increases the efficiency of energy production and secondly, it helps integrate renewable energies more sustainably into power networks, by improving electrical capabilities.

3.6M140

3.6M140 EBC – a power boost for the leading model.

The predecessor of this model, the 3.4M140 Eco Blade Control (EBC), already offered a yield more than 20 percent higher than other turbines in the 3 MW class. The latest increase in nominal power to 3,600 kilowatts enables a further 3 percent potential increase in yield. Moreover, the turbine is suitable for locations assigned wind classes IEC IIIA and IEC S based on IEC IIB. The new hub height of 160 meters has a higher energy yield to match and enables efficient operation even in locations with low winds.

- Eco Blade Control
- Next Electrical System (NES) for future grid requirements
- Extended operational lifespan of 25 years
- An aeroacoustically optimized 68.5 m blade with a low maximum sound power level of 104.0 dB(A)
- Extended operational range for wind class IEC S based on IEC IIB
- New hub heights up to 160 m

The EBC platform – dependable, durable and suitable for higher wind classes.

The 3.4M140 Eco Blade Control generation of turbines, based on the EBC platform, was introduced in 2015. It boasts high yields at low-wind locations, an outstanding operational lifespan of 25 years, and a low sound power level. Now Senvion is offering even more power and expanding the EBC portfolio with a turbine for higher wind classes.

1 Generator/frequency converter

- Variable speed range for optimum yields
- Fully encapsulated generator with air-air heat exchanger
- Optimum temperature inside generator, even at high ambient temperatures
- Water-cooled converter power electronics for optimised cooling
- The converter and controllers are located in the tower base, leaving even more space in the nacelle and making operation that much easier

2 Gear system

- Planetary/spur gear
- Satisfies stringent demands in terms of service life and operating smoothness in line with Senvion gear specifications
- Elastomeric torque arm bearing for structure-borne sound insulation
- Low temperature thanks to efficient oil cooling system
- Three-stage oil filter system for excellent oil quality

3 Rotor blade

- Individual blade profiles for optimal aerodynamics of the rotor
- Robust aerodynamic design guarantees best possible performance, even in difficult wind conditions or when dirty
- Proven quality, tested statically and dynamically in accordance with IEC specifications
- Fully integrated lightning protection in accordance with IEC protection class I

4 Pitch system

- Virtually maintenance free electrical system
- High-quality, large blade bearing with permanent track lubrication and external gearing
- Integrated deflector in the spinner as protection from the elements
- Maximum reliability through redundant blade angle detection with two independent measuring systems
- Fail-safe design with independent drive and control systems for each rotor blade

5 Rotor bearing and rotor shaft

- High quality spherical roller bearing with bearing with perfectly fitted bearing housing and permanent lubrication for maximum service life
- Rotor shaft aligned with transfer of torque

6 Azimuth

- Four-point contact bearing with external gearing, powered by top quality high-performance gear motors
- Holding brakes with hydraulic pressure accumulator for fail-safe function relieve drive systems when inoperative and stabilise nacelle
- Minimum stress on the drive trains thanks to low friction of four-point bearing and brake release during wind tracking

7 Holding brake

- Generously dimensioned disc brakes hold rotor safely
- Soft brake function for minimum wear of gearbox

8 Tower

- Natural frequency of tower higher than rotational speed of rotor (rigid design) ensures minimum stress on tower and nacelle
- No speed restrictions, as no frequency interference
- Maximum component safety thanks to L-shaped flange and stress-optimised door opening

Bus-bar (in the tower)

- Prevents electrical interference in the turbine
- Complies with VDE regulations (German Association for Electrical, Electronic and Information Technologies)
- Best possible protection in case of short circuit or fire

Lightning protection

- Internal and external lightning protection zone concept in compliance with IEC norms
- External lightning protection via blade receptors and air terminal rod on the weather vane
- Reliable protection of bearings via defined lightning paths
- GRP coupler for galvanic isolation of generator system from gearbox
- Surge protector for electrical system
- Insulated bearing shells reliably protect generator

3.XM top technology in detail.
SCADA Solutions system.

SCADA Solutions tell you exactly what's going on in your turbine.

To enable comprehensive monitoring and efficient control of your wind turbine or wind farm, we provide you with a customised package of software and hardware products. Our SCADA Solutions system (Supervisory Control and Data Acquisition) involves highly diverse applications, which can be combined to form exactly the package you need. SCADA also stands for user-friendliness, high-level security and easy system integration. The benefit for you is that it also ensures a high level of operating hours throughout the entire service life of the turbines.

SCADA Access is a full-service application for web-based, encrypted access to your wind farm or to individual turbines. The connection of different types of turbines and software systems to a central superordinate SCADA system is provided by our interfaces und communication products, which enable direct data transmission via OPC DA, FTPS and IEC 61400-25 protocols. Our premium application, Windfarm Management, is a powerful SCADA system for wind farms of up to 250 wind turbines.

Individual service for your wind turbine.

We want you to enjoy reliable, long-term yields – which are both flexible and calculable. Accordingly, we offer a range of different service packages to match your individual requirements, in the same way as our turbine solutions for specific projects. You can choose between a modular standard agreement and a full-maintenance contract (Integrated Service Package) with either a time-based availability warranty or a yield-based warranty*. Contracts which run for up to 20 years in combination with more than two decades of maintenance experience give your investment the reliability you need. Our service is fast, comprehensive and effective: around 700 fully qualified employees who undergo regular advanced training attend to wind turbines with a combined total output of more than 8 gigawatts. A convincing argument not only for our customers, but also for their banks.

* The production warranty under the full-maintenance contract is only available for wind farms with a minimum of five wind turbines and is subject to specific project conditions.

Why our products match your requirements.

- **We satisfy the grid conditions in all major markets.**

  When connecting your wind turbines to the grid, we can draw on the experience acquired from installation of more than 6,100 turbines worldwide, in both the onshore and offshore sectors. Our new electrical system (NES) is our reply today to the demands of tomorrow. We have extended the electrical capabilities of our successful 3.XM platform, responding with a broader frequency and voltage range to what are expected to be more stringent grid connection regulations. Simulations and structural recommendations in the early design phase allow us to integrate the system into the power grid specifically for each site and to respond flexibly and efficiently to new grid requirements.
  We guarantee the maximum performance people have come to expect of us, at all times, using cross-platform components.

- **Our technology has proved successful for two and a half decades.**

  Our guiding principle is "Innovation through Evolution", which is why all Senvion turbines are based on tried-and-tested platforms which have been systematically modified and enhanced. This means that each turbine concentrates not only 25 years of experience in the wind energy business, but also the entire expertise we have accumulated during the project development and sale of the preceding series.

- **We optimise our portfolio to cope with all wind speeds.**

  Our turbines produce maximum yield for you no matter what wind speeds are involved. We can do so because we are constantly modifying and improving our product range.

  - A nominal output upgrade allows the 3.4M122 to offer yield benefits in combination with our new electrical system.
  - The 3.4M140 and 3.6M140 with Eco Blade Control (EBC) feature an aero-acoustically optimized 68.5 m blade to achieve maximum yield results at sites with low and medium wind speeds.
  - In response to higher grid requirements the 3.4M114 and its power upgrade to 3.6 MW are now available with our Next Electrical System (NES).
  - The 3.4M104 guarantees maximum yield in strong wind zones.

- **Our wind turbines set standards when it comes to noise emission.**

  Noise emission depends to a great extent on the speed of the rotor blade tips. Our integrated drive train concept allows the use of compact generators at low rotor speeds. Thanks to this technology and aerodynamically optimised blades, even turbines with large rotor diameters operate very quietly in optimum conditions. Specific turbine control is also available for additional reduction of noise emission to satisfy the limits in different countries.

"By successfully implementing and erecting numerous prototypes we have managed to establish our product portfolio in the market according to plan."

Falko Mertens,
Project Development Manager

- **We connect you to any customer control centre.**

  Our SCADA Solutions system (Supervisory Control and Data Acquisition) consists of high-performance software and hardware products, including various interfaces and communications applications which facilitate transmission of the operating data from your wind turbine to our customer control centre at the wind farm or alternatively to any external institution.

- **Our turbines permit easy maintenance – right from the start.**

  Shorter downtimes and lower financial risks – these are the targets we have in mind right at the start of the development process. Our turbines are designed for ease of maintenance so that the service engineers can carry out inspections and maintenance work on the individual components reliably and without risks, thus ensuring maximum safety.

- **Success through innovative towers and smart logistical concepts.**

  Senvion offers wind power plants with various hub heights suitable for all wind conditions:

  - Steel Towers 59–119 metres – time-tested solution for locations on land and at sea.
  - Hybrid Towers 139–160 metres (and soon even taller) – profitable operation even in extremely low-wind areas.
  - High Steel Towers 130 and 139 metres – rapid construction and impressive returns due to modular design.

Our references.

Location: Near Zeewolde,
Provinz Flevoland, Netherlands

WTG type: 36 x 3.4M104

Total output: 122 MW

Production: 218,000 MWh per year

Operator: Nuon (part of Vattenfall)

Princess Alexia Wind Farm (Zuidlob), Netherlands

On Wednesday 11th September 2013 in perfect weather Princess Beatrix of the Netherlands, the former Queen inaugurated the Zuidlob wind farm. The wind farm is the biggest onshore wind farm erected by Senvion in Europe so far. On top of that, it is a premiere with Vattenfall, too: Zuidlob is the first onshore cooperation with the energy company. Senvion and Vattenfall have previously worked together on offshore wind farms Ormonde and alpha ventus.

Our references.

Location: Hollich near Burgsteinfurt, Germany

WTG type: 8 x 3.0M122 with 139 m

Total output: 23.8 MW

Production: 63,297 MWh per year

Operator: Windstromgemeinschaft & Windpark Hollich GmbH & Co. KG

Link: www.windpark-hollich.de

Bürgerwindpark Hollich, Germany

The citizen wind farm in Hollich is a great example for renewable Energy with more than 200 local shareholders in Steinfurt. The windfarm constantly grows and now contains 16 Senvion windmills of different size. These Senvion mills have an energy production of approximately 87.000.000 kWh per year. It covers the energy demand of circa 25.260 average households in Germany. Related to the energy usage mix in Germany circa. 48 kt of CO_2 could be saved per year.

Location: Meer, Belgium

WTG type: 3 x 3.2M114 with 143 m hub height and hybrid tower

Total output: 9.6 MW

Operator: Storm

Meer, Belgium

The Senvion 3.2M114 turbines at 143 metres hub height installed in Meer wind farm are the tallest turbines ever constructed in Belgium. Senvion is responsible for the construction of the foundations and the delivery and installation of three Senvion 3.2M114 wind turbines. The commissioning is planned for end 2015.

Location: Venti di Nurra Windfarm, Italy

WTG type: 3 x 3.2M114

Total output: 9.5 MW

Production: 23,100 MWh per year

Operator: Elettrostudio Energia

Windpark Venti di Nurra, Italy

The wind farm realized with Elettrostudio Energia represents a new milestone for Senvion in the Italian wind market. In fact, “Venti di Nurra” is not only the first wind farm in Sardinia for Senvion but also the first Italian project realized with the 3.2M114 turbines. The plant is located around 4 km far from the coast in a favourable position for the wind’s exploitation for most of the year in the north-west area of Sardinia.

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Status 09/2016

Date 12.03.2017

3.4M122

Design data

Nominal power	3,400 kW (LV-side)
Cut-in wind speed	3 m/s
Nominal wind speed	12 m/s
Cut-out wind speed	22 m/s
Operating temperature range	-20 – +40 °C

Rotor

Diameter	122 m
Rotor area	11,690 m²
Rotor speed	6.1 – 11.3 1/min (+15 %)
Power control	Electrical pitch

Rotor blade

Blade length	59.8 m
Type	Glass fibre-reinforced plastic (GFRP)
Max. chord width	3.9 m

Gear system

Type	Three-stage planetary / spur gearbox
Gear ratio	i = approx. 127
Type of suspension	Three-point contact suspension

Weight

Rotor blade	Approx. 15 t
Nacelle without drive train	Approx. 46 t
Rotor Hub	Approx. 26 t

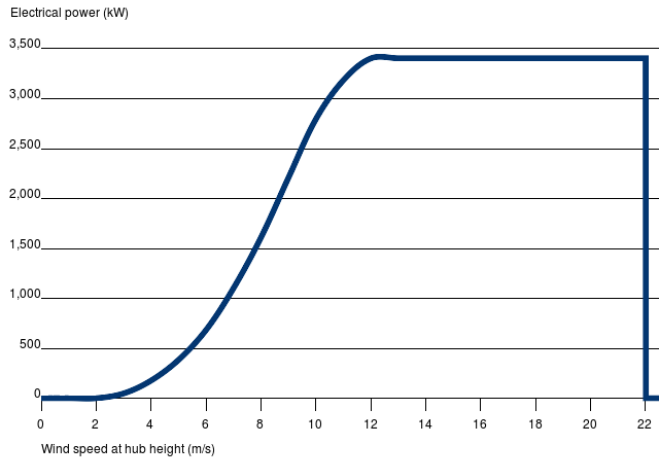
Electrical system

Nominal power	3,400 kW (LV-side)
Nominal voltage	10/20/30 kV
Nominal frequency	50 Hz
Generator	Induction generator (squirrel cage rotor)
Generator protection class	IP 54
Stator voltage	580 V
Speed range	735 – 1,356 1/min
Converter type	Full converter with DC intermediate circuit
Transformer	Internal Transformer (ITS)

Sound power level

Maximum sound power level	104.5 db (A)

Power curve



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SENVION
wind energy solutions

Sales document

Technical description

Wind turbine class K08 delta

N117/3600

K0801_074760_EN

Revision 02 / 2016-06-03

- Translation of the original document -

Document is published in electronic form.

Signed original at Nordex Energy GmbH, Engineering.

Technical modifications

This document was created with utmost care, taking into account the currently applicable standards.

However, due to continuous development, the figures, functional steps and technical data is subject to change without prior notice.

Copyright

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1. Structure

The wind turbine (WT) Nordex N117/3600 is a speed-variable wind turbine with a rotor diameter of 116.8 m and a nominal power of 3600 kW. The wind turbine is designed for 50 Hz or 60 Hz. The wind turbine is designed for class IIA according to IEC 61400-1 and for class 3 according to DIBt.

The wind turbine Nordex N117/3600 consists of the following main components:

- Rotor, with rotor hub, three rotor blades and the pitch system
- Nacelle with drive train, generator and yaw system
- Medium-voltage transformer (MV transformer) and medium-voltage switchgear (MV switchgear)

1.1 Tower

The Nordex N117/3600 is erected on tubular steel towers with various hub heights. The cylindrical tower has a conical top section and consists of 3 or 4 sections. Corrosion protection of the tubular steel tower is ensured by a tower surface coating system according to ISO 12944. A service lift, the vertical ladder with fall protection system as well as resting and working platforms inside the tower allow for a weather-protected ascent to the nacelle.

The Nordex N117/3600 turbine can also be erected on a hybrid tower. The bottom part of the hybrid tower consists of a concrete tower and the top part of a tubular steel tower with two sections. The size and the design of the foundation depend on the ground conditions at the intended site. The tubular steel tower is bolted to the anchor cage embedded in the foundation.

Switch cabinets are integrated in the tower base, which contain important components of the electronic controls, the turbine PC, frequency converter, low-voltage main switch, fuses, the transformer for auxiliary power in the tower base and outputs to the transformer and to the generator. The frequency converter is equipped with a water cooling system. The water heated in the frequency converter is cooled in a water/air heat exchanger. It is located on the outer tower wall.

The MV transformer and MV switchgear may be located in a separate transformer substation near the wind turbine. For the transformer in the tower (TIT) variant, the MV transformer and MV switchgear can also be located in the tower base. In this case, the components in the tower base of the tubular steel tower are arranged on three different levels:

- The MV transformer on the foundation
- The MV switchgear on the first tower platform
- The switch cabinet with frequency converter on the second tower platform

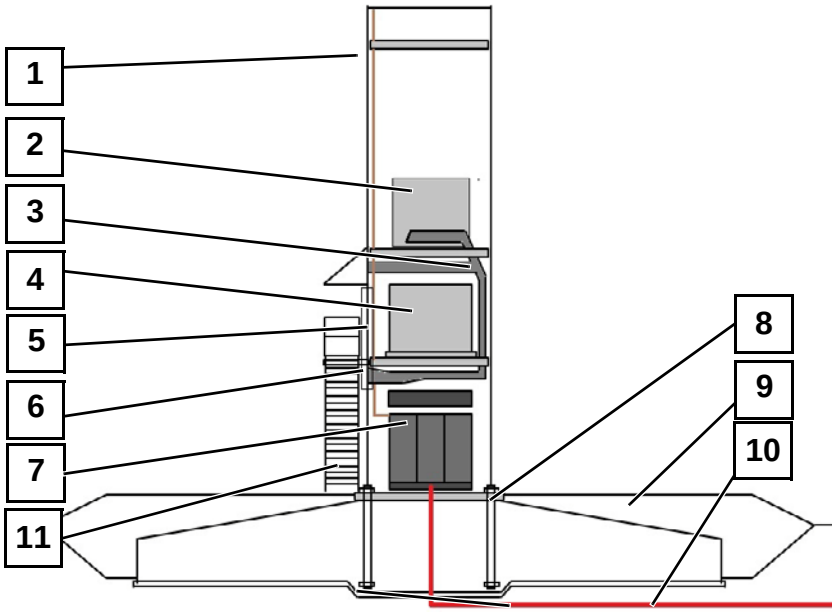

Fig. 1 Sectional view of the tower base, variant with transformer inside tower (TIT)

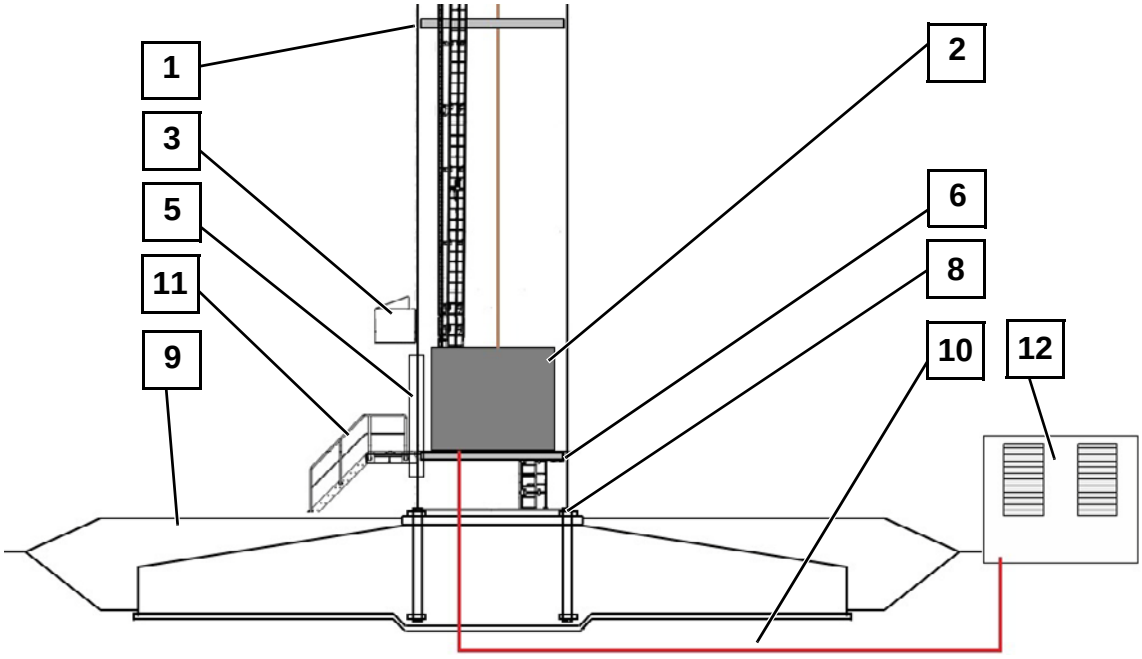

Fig. 2 Sectional view of the tower base, variant with transformer outside tower (TAT), less than 134 m hub height

1	Second tower platform	2	Switch cabinet/converter	3	Ventilation/cooling
4	MV switchgear (TIT)	5	Tower door	6	First tower platform
7	Transformer (TIT)	8	Anchor bolt	9	Soil backfill
10	Power cables in conduits	11	Tower stairs	12	Transformer substation with switchgear (TAT)

1.2 Rotor

The rotor consists of the rotor hub with three pitch bearings and three pitch drives for blade adjustment as well as three rotor blades.

The **rotor hub** consists of the base element, support structure and spinner. The base element consists of a stiff cast structure, to which the pitch bearings and the rotor blades are assembled. The rotor hub is covered with the spinner which enables the direct access from the nacelle into the rotor hub.

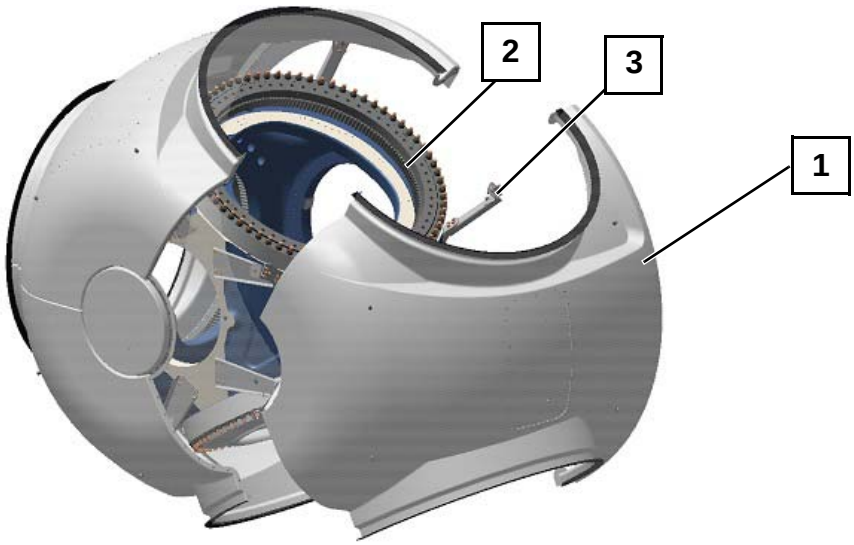

Fig. 3 Rotor hub and spinner of Nordex delta generation wind turbines

1 Spinner segment
2 Rotor hub
3 Spinner support structure

The **rotor blades** are made of high-quality glass-reinforced and carbon-fiber reinforced plastics. The rotor blade is statically and dynamically tested in accordance with the guidelines IEC 61400-23 and GL IV-1 (2010). If requested by the customer, the rotor blades can be equipped with serrations, which optimize the sound power level.

The **pitch system** serves to adjust the pitch angle of the rotor blades set by the control system. For each individual rotor blade the pitch system comprises an electromechanical drive with 3-phase motor, planetary gear and drive pinion, as well as a control unit with frequency converter and emergency power supply. Power supply and signal transfer are realized through a slip ring in the nacelle.

1.3 Nacelle

The nacelle contains essential mechanical and electrical components of the wind turbine. The nacelle can be pivoted on the tower.

The **rotor shaft** is mounted in the rotor bearing in the nacelle. A rotor lock is integrated in the rotor bearing, with which the rotor can be reliably locked mechanically.

The **gearbox** increases the rotor speed until it reaches the speed required for the generator.

The bearings and gearings are continuously lubricated with oil. A 2-stage pump enables the oil circulation. A combined filter element with integrated coarse and fine filter removes solids. The control system monitors the contamination of the filter element. An additional offline filtration with a super fine filter can be installed as an option.

The gear oil used for lubrication also cools the gearbox. The temperatures of the gearbox bearings and the oil are continuously monitored. If the optimum operating temperature is not yet reached, a thermal bypass directs the gear oil directly back to the gearbox. If the operating temperature of the gear oil is exceeded it is cooled down.

The gearbox cooling is realized with an oil/water cooler that is installed directly at the gearbox. The heated cooling water is cooled together with the cooling water of the generator in a passive cooler on the roof of the nacelle.

The **generator** is a 6-pole doubly-fed induction machine. An air/water heat exchanger is mounted on the generator. The cooling water is recooled together with the cooling water of the gearbox heat exchanger in a passive cooler on the nacelle roof.

The mechanical **rotor brake** supports the aerodynamic braking effect of the rotor blades as soon as the rotor speed falls below a defined value and finally stops the rotor. The aerodynamic braking effect of the rotor is achieved by adjusting the rotor blades perpendicular to the rotation direction. The rotor brake consists of a brake caliper which acts on the brake disk mounted behind the gearbox.

The **yaw drives** optimally rotate the nacelle into the wind. The four yaw drives are located on the machine frame in the nacelle. A yaw drive consists of an electric motor, multi-stage planetary gear, and a drive pinion. The drive pinions mesh with the external teeth of the yaw bearing.

Being positioned properly, the nacelle is locked by means of a hydraulic and an electric brake system. It consists of several brake calipers which are fastened to the machine frame and act on a brake disk. In addition, the electric motors of the yaw drives are equipped with an electrically actuated holding brake.

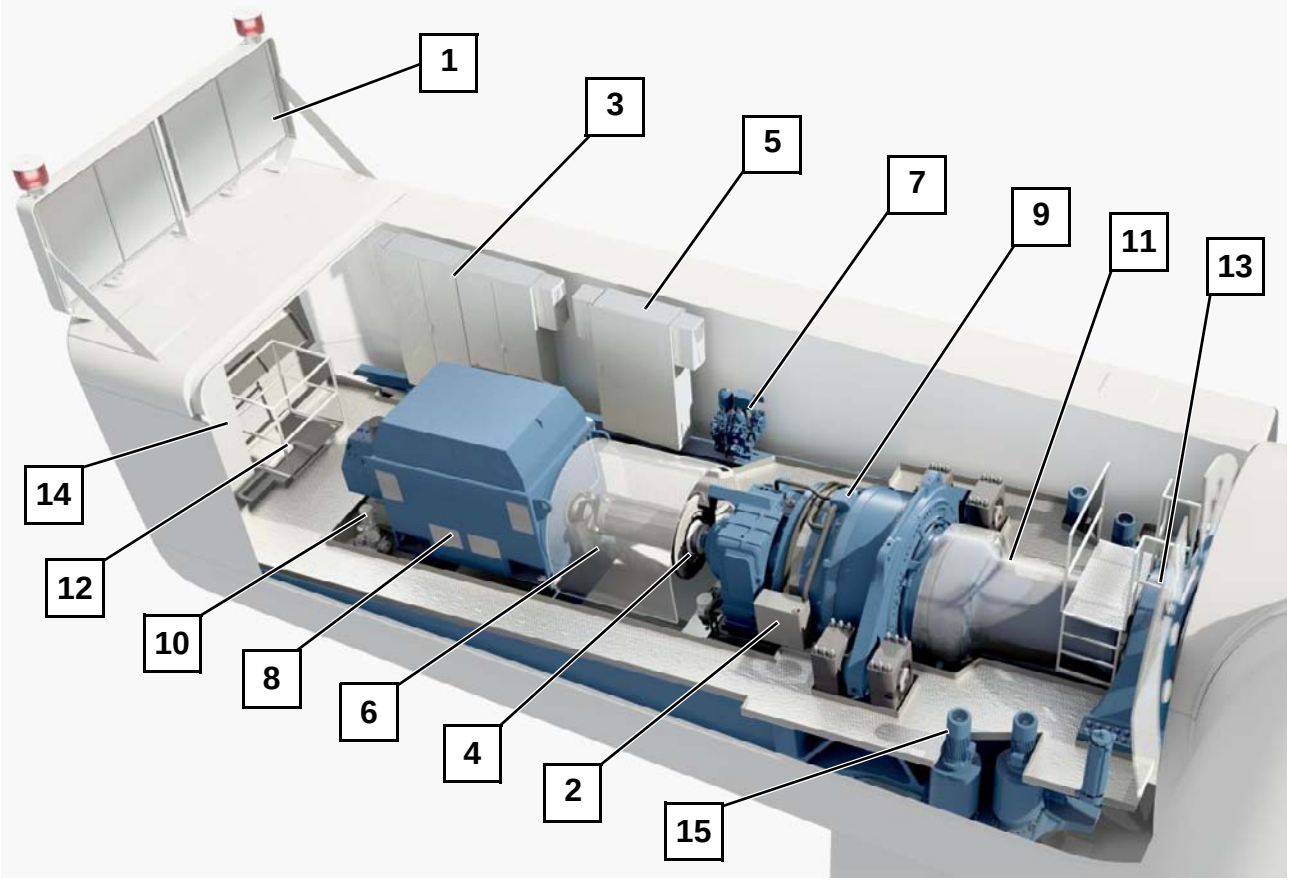

Fig. 4 Nacelle layout drawing

1	Heat exchanger	2	Gear oil cooler
3	Switch cabinet 2	4	Rotor brake
5	Switch cabinet 1	6	Coupling
7	Hydraulic unit	8	Generator
9	Gearbox	10	Cooling water pump
11	Rotor shaft	12	Hatch for on-board crane
13	Rotor bearing	14	Switch cabinet 3
15	Yaw drives		

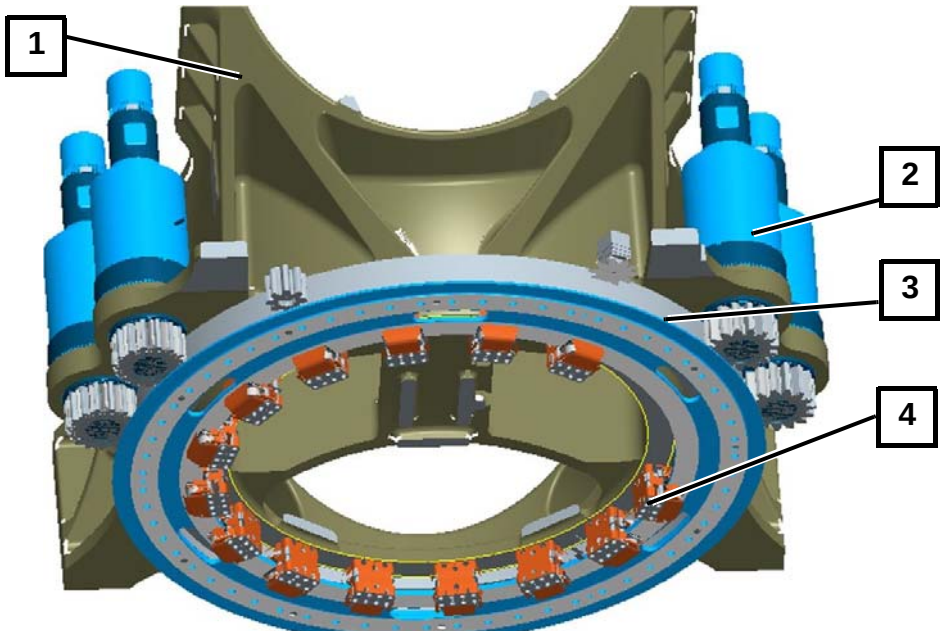

Fig. 5 Components of the yaw system

1 Machine frame
2 Yaw drives meshing with yaw bearing teeth
3 Yaw bearing
4 Brake calipers

The **hydraulic unit** provides the oil pressure required for the operation of the rotor brake and the yaw brakes.

1.4 Auxiliary systems

The rotor bearing, generator bearing, pitch gearing, pitch bearing races and yaw gearing are each equipped with an **automatic lubrication unit**.

Some of the switch cabinets in the nacelle and the tower base of the wind turbine are equipped with **air conditioning units**.

Gearbox, generator, hydraulic unit and all switch cabinets are equipped with **heaters**.

An electric **chain hoist** is installed in the nacelle which is used for lifting tools, components and other work materials from the ground into the nacelle. A second, movable **overhead crane** is used for carrying the materials within the nacelle.

Various options of additional equipment are available for the wind turbine.

Cooling system

Gearbox and generator are cooled by a coupled oil/water circulation. At startup the lightly heated gear oil is directly fed back into the gearbox via a thermal bypass and only directed into the plate-type heat exchanger after reaching operating temperature.

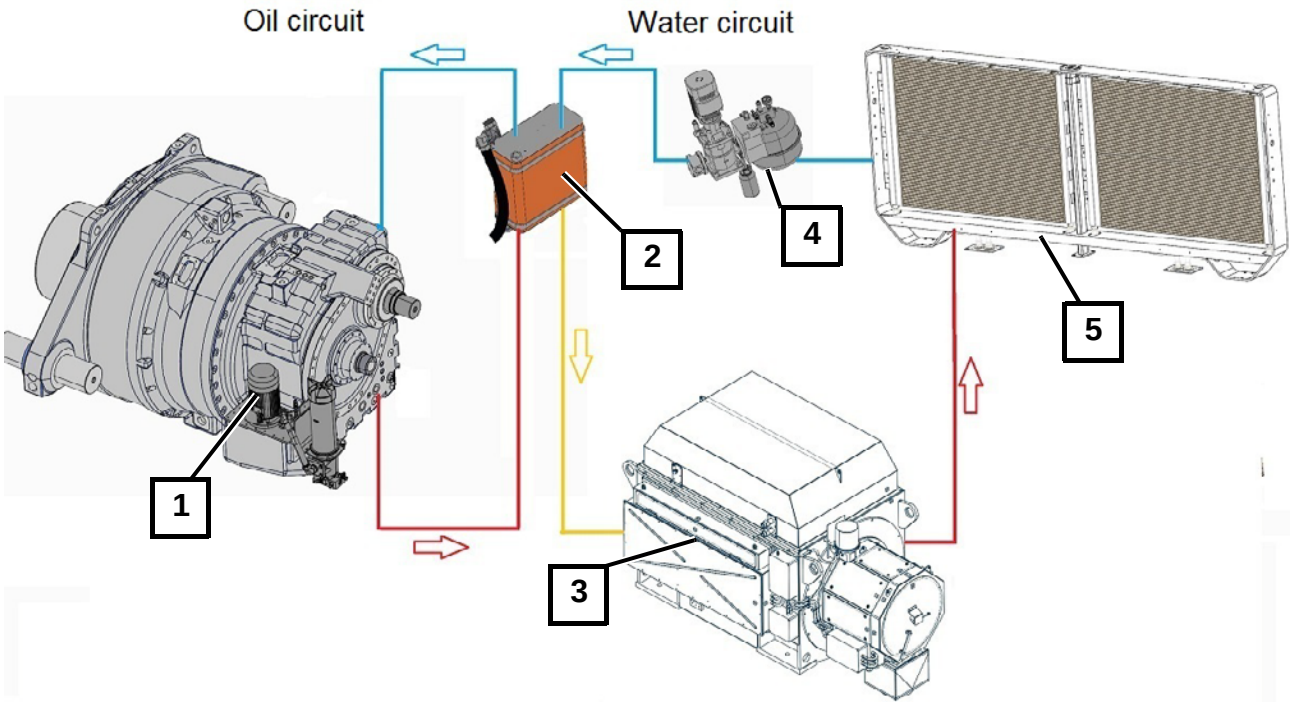

Fig. 6 Schematic diagram of gearbox cooling and generator cooling

1 Gearbox with oil pump
2 Plate-type heat exchanger
3 Generator
4 Water pump
5 Passive cooler

The converter in the tower base is cooled by a water/glycol mixture. A pump conveys the mixture through main converter and heat exchanger. The heat exchanger is equipped with a 2-stage fan that is operated depending on the water temperature.

2. Functional principle

The turbine operates automatically. A programmable logic controller (PLC) continuously monitors the operating parameters using various sensors, compares the actual values with the corresponding setpoints and issues the required control signals to the WT components. The operating parameters are specified by Nordex and are adapted to the individual location.

When there is no wind the WT remains in idle mode. Only various auxiliary systems are operational or activated as required: e.g., heaters, gear lubrication or PLC, which monitors the data from the wind measuring system. All other systems are switched off and do not use any energy. The rotor idles. When the cut-in wind speed is reached, the wind turbine will change to the mode 'Ready for operation'. Now all systems are tested, the nacelle turns into the wind and the rotor blades turn into the wind. When a certain speed is reached, the generator is connected to the grid and the WT produces energy.

At low wind speeds the WT operates at part load. During this the rotor blades remain fully turned into the wind (pitch angle 0°). The power produced by the WT depends on the wind speed.

When the nominal wind speed is reached, the WT switches over to the nominal load range. If the wind speed continues to increase, the speed control changes the rotor blade angle so that the rotor speed and thus the power output of the WT remain constant.

The yaw system ensures that the nacelle is always optimally aligned to the wind. To this end, two separate wind measuring systems located at the height of the hub measure the wind direction. Only one wind measuring system is used for the control system, while the second system monitors the first and takes over in case the first system fails. If the measured wind direction deviates too greatly from the alignment of the nacelle, the nacelle is yawed into the wind.

The wind energy absorbed from the rotor is converted into electrical energy using a doubly-fed induction machine with slip ring rotor. Its stator is directly connected to the MV transformer, and its rotor via a specially controlled frequency converter. This offers a significant advantage enabling the generator to be operated in a defined speed range near its synchronous speed.

Safety systems

Nordex wind turbines are equipped with extensive equipment and accessories to provide for personal and turbine safety and ensure continuous operation. The entire turbine is designed in accordance with the Machinery Directive 2006/42/EC and certified as per IEC 61400. For details on the safety devices refer to the current safety manual.

If certain parameters concerning turbine safety are exceeded, the WT will cut out immediately and is put into a safe state. Depending on the cut-out cause, different brake programs are tripped. In case of external causes, such as excessive wind speeds or if the operating temperature is not met, the wind turbine is softly braked by means of rotor blade adjustment.

Lightning protection/surge protection and electromagnetic compatibility (EMC)

The lightning and overvoltage protection of the wind turbine is based on the EMC-compliant lightning protection zone concept and meets the IEC 61400-24 standard. The lightning protection system meets the requirements of lightning protection class I.

The interdisciplinary EMC and lightning protection concept of the wind turbine is based on a basic concept of EMC and lightning protection zones and the resulting three subconcepts:

- External lightning protection
- Internal lightning protection
- EMC (electromagnetic compatibility)

The wind turbine with the electrical equipment, consumers, the measurement, control, protection, information and telecommunication technology meets the EMC requirements according to IEC 61400-1, item 10.11.

Grid type

The 660-V network of the wind turbine is an IT system with insulation monitor. The transformer's neutral point is not grounded.

Using a 660-V/400-V auxiliary transformer, a grid to supply the auxiliary drives, lighting, heating and control unit is created. The 400-V network is available as a TN-S system and is operated with residual-current monitor.

Auxiliary power of the wind turbine

The power required by the wind turbine in ‘stand-by mode‘ calculates from the individual consumption of the following components:

- Control system (operation control computer and converter)
- Yaw system
- Pitch system
- Hydraulic unit
- Circulation pumps of the cooling systems
- Heaters and fans
- Auxiliary systems (service lift, obstacle lights, options, etc.)

Based on the existing operating experience, a coincidence factor of 0.5 and a power factor (cos phi) of 0.85 can be assumed. The connection power under consideration of the factors mentioned above is located at a maximum value of 55 kW. The annual energy requirement (power consumption from the grid) of a site with average wind speed is approx. 15000 kWh/year. However, the annual energy requirement depends very much on the location and should be determined specifically. The "anti-icing" option is not included in this consideration.

3. Technical data

Design	
Design temperature	Standard -20 °C to +45 °C CCV -40 °C…+45 °C
Operating temperature range	-20 °C to +40 °C*
Operating temperature range CCV	-30 °C to +40 °C*
Stop	Standard: -20 °C, restart at -18 °C CCV: -30 °C, restart at -28 °C
Max. height above MSL	2000 m**
Certificate	According to IEC 61400-1 and DIBt
Type	3-blade rotor with horizontal axis Up-wind turbine
Output control	Active single blade adjustment
Nominal power	3600 kW*/**
Nominal power starting at wind speeds of (at air density of 1.225 kg/m^3)	Approx. 11.5 m/s
Operating speed range of the rotor	7.9...14.1 rpm
Nominal speed	12.6 rpm
Cut-in wind speed	3 m/s
Cut-out wind speed	25 m/s
Cut-back-in wind speed	22 m/s
Calculated service life	At least 20 years

*Nominal power is reached up to defined temperature ranges. Limited project-specific operating ranges are possible and must be agreed to with Nordex.

**At installation altitudes above 1000 m, the nominal power is reached up to defined temperature ranges.

Towers			
Hub height	91 m	106 m	141
Designation	TS91	TS106	TCS141
Wind class	DIBt 3 / IEC IIA	DIBt 3 / IEC IIA	DIBt 3 / IEC IIA
Number of tower sections	3	4	Concrete part + 2 steel sections

Rotor	
Rotor diameter	116.8 m
Swept area	10715 m^2
Nominal power/area	336 W/m²
Rotor shaft inclination angle	5°
Blade cone angle	3.5°

Rotor blade	
Material	Glass-reinforced and carbon-fiber reinforced plastics
Total length	57.3 m
Total weight per blade	Approx. 10.6 t

Rotor shaft/rotor bearing	
Type	Forged hollow shaft
Material	42CrMo4 or 34CrNiMo6
Bearing type	Spherical roller bearing
Lubrication	Continuous and automatic with lubricating grease
Rotor bearing housing material	EN-GJS-400-18-LT

Mechanical brake	
Type	Actively actuated disk brake
Location	On the high-speed shaft
Disk diameter	920 mm
Number of brake calipers	1
Brake pad material	Sintered metal

Gearbox	
Type	Multi-stage planetary gear + spur gear stage
Gear ratio	50 Hz: i = 92.9 60 Hz: i = 110.8
Lubrication	Forced-feed lubrication
Oil type	VG 320

Gearbox	
Max. oil temperature	75 °C
Oil change	Change, if required

Electrical system	
Nominal power P_{nG}	3600 kW
Nominal voltage	3 x AC 660 V ± 10 % (specific to grid code)
Nominal current I_{nG} at S_{nG}	3521 A
Nominal apparent power S_{nG} at P_{nG}	4025 kVA
Power factor at P_{nG}	1.00 as default setting 0.9 underexcited (inductive) up to 0.9 overexcited (capacitive) possible
Frequency	50 and 60 Hz

NOTE

The nominal power is subject to system-specific tolerances and varies by ± 100 kW. Practice has shown that negative deviations occur rarely and in most cases are <25 kW. For precisely complying with external power specifications the nominal power of the individual wind turbine can be parameterized accordingly. Alternatively, the wind farm can be parameterized accordingly using the Wind Farm Portal®.

Generator	
Degree of protection	IP 54 (slip ring box IP 23)
Nominal voltage	660 V
Frequency	50 and 60 Hz
Speed range	50 Hz: 730 to 1325 rpm 60 Hz: 876 to 1578 rpm
Poles	6
Weight	Approx. 10.6 t

Gearbox cooling and filtration	
Type	1st cooling circuit: Oil circuit with oil/water heat exchanger and thermal bypass 2nd cooling circuit: Water/air together with generator cooling
Filter	Coarse filter 50 µm Fine filter 10 µm
Flow rate	Stage 1: approx. 75 l/min Stage 2: approx. 150 l/min
Offline filter (optional)	5 µm

Generator cooling system	
Type	Water circuit with water/air heat exchanger
Flow rate	Approx. 160 l/min
Coolant	Water/glycol-based coolant

Converter cooling system	
Type	Water circuit with water/air heat exchanger and thermal bypass
Coolant	Water/glycol-based coolant

Pitch system	
Pitch bearing	Double-row four-point contact bearing
Lubrication of gearing and race	Automatic lubrication unit with grease
Drive	3-phase motor incl. spring-actuated brake and multi-stage planetary gear
Emergency power supply	VRLA batteries

Hydraulic system	
Hydraulic oil	VG 32
Oil quantity	Approx. 25 L
Thermal protection	Integrated PT100

Yaw drive	
Motor	Asynchronous motor
Gearbox	4-stage planetary gear

Yaw drive	
Number of drives	4
Lubrication	Oil, ISO VG 150
Yaw speed	Approx. 0.5 °/s

Yaw brake	
1st type	Disk brake with hydraulic brake calipers
Brake pad material	Organic
Number of brake calipers	14
2nd type	Electric spring-applied brake on every driving motor

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Noise level, Power curves, Thrust curves

Nordex N117/3600

Operational modes

Noise level - Nordex N117/3600

Standard mode

Basis: The specified sound power levels are expected values in terms of statistics. Results of single measurements will be within the confidence interval according to IEC 61400-14 [4].

Wind turbine data:

Operational mode: Standard mode

Rotor diameter: 117 m

Remarks:

Verification according to: Measurements are to be carried out by a measuring institute accredited for noise emission measurements at wind turbines according to ISO/IEC 17025 [3] at the reference position as defined in IEC 61400-11 [1]. The data analysis must be carried out according to the preferred method 1 of IEC 61400-11 [1]. The tonal penalties in the vicinity of wind turbines K_{TN} based on these measurements are to be determined according to „Technische Richtlinien für Windenergieanlagen“ [2].

Tonality: The noise can be tonal in the vicinity of wind turbines. The specified sound power level includes potential tonal penalties according to „Technische Richtlinien für Windenergieanlagen“ [2], without taking account any tonality $K_{TN} \leq 2$ dB.

[1] IEC 61400-11 ed. 2: Wind Turbine Generator Systems - Part 11: Acoustic Noise Measurement Techniques; 2002-12

[2] Technische Richtlinie für Windenergieanlagen - Teil 1: Bestimmung der Schallemissionswerte, Revision 18; FGW 2008-02

[3] ISO/IEC 17025: General requirements for the competence of testing and calibration laboratories; 2005-08

[4] IEC 61400-14, Wind turbines - Part 14: Declaration of apparent sound power level and tonality values, first edition, 2005-03

Noise level - Nordex N117/3600

Standard mode

Standardized wind speed $v_{S(10m)}$ [m/s]	Apparent sound power level					
	hub height 91 m		hub height 106 m		hub height 141 m	
	L_{WA} [dB(A)]	v_H [m/s]	L_{WA} [dB(A)]	v_H [m/s]	L_{WA} [dB(A)]	v_H [m/s]
3.0	94.0	4.3	94.0	4.3	94.0	4.5
4.0	96.0	5.7	96.4	5.8	97.0	6.0
5.0	101.5	7.1	101.9	7.2	102.7	7.5
6.0	104.5	8.5	104.5	8.7	104.5	9.0
7.0	105.0	9.9	105.0	10.1	105.0	10.5
8.0	105.0	11.3	105.0	11.6	105.0	12.0
9.0	105.0	12.8	105.0	13.0	105.0	13.5
10.0	105.0	14.2	105.0	14.5	105.0	15.0
11.0	105.0	15.6	105.0	15.9	105.0	16.5
12.0	105.0	17.0	105.0	17.3	105.0	18.0

Summary: Application for a Fourth Amendment to Certificate electronically filed by Mr. Michael J. Settineri on behalf of Hardin Wind LLC