Senvion 3.0M122

[50Hz]

Product Description

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Disclaimer [European Market]

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Applicable Documents

The documents referred to in the table below are included for information only. Reference to them in this product description does not make them part of the contract.

Title	Document-No.
Electrical Properties according to FGW	D-3.5-GP.EL.05-A-*
Electrical Properties according to IEC	D-3.5-GP.EL.06-A-*
Fire safety Senvion	SD-0.0-ES.EI-4
General Information Lightning Protection, Earthing and Potential Equalization	GI-2.5-EC.LP.01-A-*
Internal Transformer System [3.XM/50Hz/Europe and Australia only] – Product Description	PD-3.1-EC.TS.01-A-*
Standard Conditions Of Use 3.0M122 [3.0M/122/50Hz]	SD-3.5-WT.SC.01-A-*
Standard Grid Conditions	SD-3.1-EC.GR.01-B-*

* If the products referred to in the table above are to be included within the project, the relevant product descriptions in their current version will be amended to the contract.

List of Abbreviations and Units

Abbreviations/Units	Description
ETS	External Transformer System
f_N	Nominal frequency
GL	Germanischer Lloyd
GRP	Glass-fibre reinforced plastic
HV	High voltage (nominal grid voltage ≥ 60 kV)
IEC	International Electrotechnical Commission
IGBT	Insulated Gate Bipolar Transistor
I_N	Nominal current
LV	Low voltage (nominal grid voltage ≤ 1 kV)
MV	Medium voltage (nominal grid voltage > 1 kV and < 60 kV)
n	Rated generator speed
NEC	National Electrical Code
PG	Nominal active power of the generator
P_N	Nominal active power of the WTG
PPE	Personal Protective Equipment
PT	Nominal active power of the transformer
RAL	German Institute for Quality Assurance and Certification e.V.
SCADA	Supervisory Control and Data Acquisition
U	Voltage
UL	Underwriters Laboratories
U_N	Nominal voltage
WTG	Wind Turbine Generator

1 General Information

The Senvion 3.XM series is the latest Senvion product platform for onshore wind turbines (WTG). It was developed on the basis of the continuous ongoing development and operating experience of more than 2000 installed wind turbines of the series MD and MM and the series 5M/6M. The development of the Senvion 3.XM series is based without change on the advantages of the MD and MM series, such as ease of maintenance, conservative design loads and powerful components that are adapted to the distribution of forces, environmental friendliness and excellent grid properties.

The first product in the series is the Senvion 3.4M104. This is a WTG with a nominal power of 3,370 kW on the medium voltage side of the transformer (corresponding to 3,400 kW on the low voltage side of the transformer). Another version in the series is the Senvion 3.2M114. This is a wind turbine with a nominal power of 3,170 kW on the medium voltage side of the transformer (corresponding to 3,200 kW on the low voltage side of the transformer) which is now also available with a rated power of 3,400 kW, as 3.4M114.

1.1 Technical Design

After intensive analysis of existing and new turbine and component technologies the design of the series Senvion 3.0M122 represents an evolutionary further development based on the experiences from the MD and MM series. The characteristics of the technical design of the Senvion 3.0M122 are therefore:

- Variable generator speed control system with a six pole doubly-fed asynchronous generator (DIFG)
- Ease of maintenance
- Liquid-cooled converter system
- Transport requirements similar to those of 2 MW wind turbines (e.g., series Senvion MM)
- Individual electric pitch adjustment with “fail-safe” design
- 3-point bearing of the drive train
- "Tilted cone" design and rotor blades pre-bent to the front for the best possible weight distribution and safe load transmission
- Reliable gearbox design
- Ladder-guided service lift (standard)
- Internal dry type cast resin transformer system with forced air cooling

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2 Mechanical System

2.1 Rotor

The rotor consists of three rotor blades that are flange-mounted on the cast hub via a pivoted double row four-point contact bearing. The rotor blades can thus be adjusted along their linear axis via electrical pitch drives that rotate with the blades. The electrical blade pitch is used to limit the rotational speed of the rotor and the power output. Furthermore, the pitch system is the main brake of the WTG. In order to ensure the continued operation of the blade adjustment in the event of a power failure or malfunction, each blade has its own, independent storage battery set that rotates with the blade.

In the partial load range, i.e. when the WTG is operated below the rated power, the turbine works at a constant blade pitch and variable speed to exploit the optimum rotor aerodynamics. Within the nominal load area, i.e. when the WTG has reached its maximum rotor speed, it operates with a constant nominal torque which is given by the generator. Changes of the wind speed are controlled by the blade pitch. Wind energy from strong gusts can be stored by an acceleration of the rotor and only then converted into damped electrical energy via the blade pitch and fed into the grid.

The use of the "tilted-cone" concept with a 4° tilted blade connection on the hub and pre-bent rotor blades in conjunction with a 5° incline of the whole drive train allow an extremely short overhang of the nacelle between the rotor and the tower. This provides a good weight balance of the whole nacelle and a safe load transfer into the tower top without transmitting a high flux of force over a long distance via the main frame.

In case of a major component replacement near the drive train the rotor may remain in the wind turbine (see also chapter 2.2.2 "Suspension Concept").

To assist with maintenance work at the rotor hub it is accessible directly from the nacelle through openings between the blade root connections.

Technical Data Rotor	
Rotor diameter	122 m
Swept area	11,689 m^2
Speed range	5.6 to 11.25 (+15 %) min^{-1}
Max. tip speed	71.9 m/s
Rotor axis inclination	5°
Rotor cone angle	4°
Sense of rotation	Clockwise (right)
Rotor position	Up-wind

2.1.1 Rotor Blades

The blade design of the Senvion 3.0M122 combines a rigid structure, capable of even withstanding strong gusts, with a lightweight construction to minimize the transfer of forces onto the nacelle. This is made possible by using a sandwich construction from glass-fiber reinforced plastic (GRP) with the necessary material properties.

The rotor blades of the Senvion 3.0M122 have been adjusted with a view to a high aerodynamic efficiency and reduction of noise emissions.

A special blade coating protects them against the negative effects of UV radiation and moisture. To prevent erosion the blade leading edges are further protected by additional measures (e.g., anti-erosion film etc.).

The rotor blades are in the blade color light gray (RAL 7035), a bright standard color for the tower and the nacelle also. This reduces the effects of reflections without affecting the power characteristic of the Senvion 3.0M122. The rotor blade can optionally have rotor blade markings applied.

Senvion SE reserves the right to select and modify, at its sole discretion, the manufacturer or type of blades without consulting the customer.

Technical Data Rotor Blade	
Number of rotor blades	3
Rotor blade length	59.8 m
Rotor blade material	Glass-fiber reinforced plastic (GRP) in sandwich construction
Rotor blade color	RAL 7035

2.1.2 Blade Pitch System

The rotor blades are connected to the rotor hub via the blade bearings in a pivotable manner and can be adjusted individually around the longitudinal axis using the pitch system. For this purpose each rotor blade has its own pitch system. The co-rotating blade pitch drives are designed as DC motors and act via the planetary gearbox and pinion on the external gearing of the bearing.

A quickly operating synchronizing controller is used to synchronize the individual pitch systems. To ensure safe operation also during grid failure or a fault, each rotor blade has its own co-rotating battery set.

Technical Data Blade Pitch System	
Principle	Electric individual blade pitch
Power control	Blade pitch and speed control
Maximum blade angle	91°
Pitch rate at safety shut-down	approx. 6-7 °/s
Pitch drives	DC motors, battery-buffered, synchronized

2.2 Nacelle

To meet the demand for an innovative wind turbine, the nacelle of the Senvion 3.0M122 has – as with all current Senvion wind turbines – been designed by a renowned designer. The result is an aerodynamically adapted design that, based on existing experience, offers improvements for service and maintenance. Maintenance can be performed with the nacelle closed, but it can also be partially opened for major component replacements.

The entry from the tower into the nacelle can be obtained via one hatch in the main frame. An additional maintenance platform has been installed to reach the components below the main frame.

The control cabinets of the converter system and the corresponding cooling system in the Senvion 3.0M122 are housed in the nacelle.

All systems can be operated via the control system from the nacelle. An emergency stop push-button has been installed for safety. All rotating/moving parts within the nacelle are generally protected by covers to prevent the risk of injury.

Glass-fibre reinforced plastic (GRP) has been chosen as material for the nacelle enclosure, as it offers a reliable protection and is lightweight. The nacelle enclosure also has the additional functions of noise insulation and maintaining the operating temperature.

2.2.1 Yaw System

The nacelle is connected to the tower via a four point contact bearing. The yaw system of the nacelle is provided by four electric gear motors. Hydraulic brake calipers hold the nacelle in the wind direction and the adjustment motors during idle free from loads that may e.g., result from an inclined air flow towards the rotor. In the de-energized state the brakes are engaged.

Electronic wind direction sensors with corresponding software control the activation times and the direction of rotation of the motors. They also ensure the automatic cable untwist if the wind turbine has rotated several times in the same direction during changed wind directions. If the yaw motors are active, the brakes are released.

Technical Data Yaw System	
Type	4 gear motors, 18 brake calipers
Yaw rate	0.4 °/s
Bearing	Four point bearing with external gearing

2.2.2 Suspension Concept

The drive train is supported at three points immediately above the head flange of the tower. The foreside suspension is carried out by a generously dimensioned spherical roller bearing. The two other suspension points are the torque arms of the gearbox which are balanced by elastomer bushings. The three point suspension allows a safe load transfer along with a significant tolerance of the drive train alignment.

2.2.3 Gearbox

The gearbox has been designed as a planetary/spur gearbox. The gearing has been adjusted for efficiency and noise emission. The torque support of the gearbox is supported by elastic bushings on the main frame which rest on the main frame on pads. The elastic suspension permits effective noise and vibration decoupling from the main frame. The gearbox design was carried out in accordance with the Senvion gearbox guidelines. These demand greater safety factors than e.g., the DIN/ISO or GL (Germanic Lloyd) guidelines. Furthermore, the gearbox is equipped with an electrical and a mechanical oil pump to ensure sufficient oil flow, even under idling conditions.

Technical Data Gearbox	
Type	Planetary/spur gear system
Nominal power	approx. 3,276 kW
Nominal torque	approx. 2,780 kNm
Gear ratio	1:106.6

2.2.4 Particle Counter

The particle counter is a standard component in all Senvion wind turbines (WEC).

The particle counter is a simple and highly efficient inline diagnosis sensor for identification of ferrous (FE) and non-ferrous (NFE) metal particles in the gearbox oil lubrication system. Based on an inductive measuring principle it detects metal particles in the oil flow which indicate abrasion or other abnormal component behavior.

Using a particle counter, WEC operators can systematically monitor the gearbox's condition and proactively schedule appropriate actions to eliminate potential failures which might lead to a component failure. Hence, it is a cost-effective means to effectively ensure a high level of operational readiness at the lowest possible costs.

A detailed functional description of the particle counter is available in the document "Particle Counter - General Information", see also chapter "Applicable Documents" in this document.

2.3 Tower

The tower has been designed as a concrete-steel hybrid tower. A door opening is provided in the tower base to allow for a weather-proof ascent inside the tower. The ascent to the nacelle is an integrated service lift. Each tower segment is equipped with platforms and emergency lighting.

The transformer is located in the tower base and is protected against unauthorized access. The wind turbine can also be operated via a control display from the tower base. To make the ascent to the upper sections of the wind turbine safe and comfortable, there is the using an integrated service lift.

The energy transmission within the tower takes place via shielded busbars that also contribute to minimizing electromagnetic interference.

Technical Data Tower	
Hub height*	89 m, 119 m, 139 m
Design	89 m: Tubular steel tower 119 m: Tubular steel tower 139 m: Concrete-steel hybrid tower
Diameter at the top flange	3.0 m

* The hub heights depend on the foundation design and extension.

2.4 Service Lift

Each Senvion 3.0M122 is equipped with a service lift. The service lift may be used by max. two persons and may not exceed a maximum load of 250 kg. The ladder-guided service lift has been designed for a comfortable transport as it contributes to a lower fatigue for the service personnel and thereby assists in maintenance work.

The ascent and descent with the service lift are via a stop/go push-button system using a dead man's switch installed in the service lift. Automatic operation is also possible for the transportation of materials and tools. In addition to the top tower platform below the nacelle, all other internal platforms, such as the lowest level above the electrical system, are accessible via the service lift. The service lift cables and safety cables are connected to the cross bracing at the top of the tower.

2.5 Chain Hoist

The nacelle also features a chain hoist, which can be used for maintenance tasks to lift tools or components weighing up to 500 kg. The back of the nacelle features a crane hatch which is secured with a safety gate. The chain hoist should not, under any circumstances, be used for lifting persons.

2.6 Corrosion Protection

All parts of the WTG are protected against corrosion and other environmental influences by a special multilayer coating. The coating system complies with requirements of DIN EN ISO 12944.

3 Electrical System

3.1 Principle of Operation

The system is equipped with a variable speed generator/converter system. This facilitates an operation of ± 40 % of the synchronous speed. The variable speed operation offers in connection with the electric pitch system very good results with regard to energy yield, efficiency, mechanical load, and quality of the power output. The system prevents overvoltages and load peaks to the best possible extent. The generator control enables an even power output with minimum fluctuation during partial load operation. During nominal load operation the wind turbine power output is almost constant. The principal ability to generate reactive power facilitates the targeted reactive power management in accordance with the requirements of the customer and the grid operator through optional products.

The principle of operation of this variable speed generator is based upon the concept of the asynchronous double-fed induction generator with a converter using IGBT technology. The system ensures the continuous power output by means of voltage and frequency values that have been adapted to the grid independently from the rotor speed. Speed and power adjust automatically to the prevalent wind conditions. The wind turbine is accordingly operated in the following operating ranges:

- The generator supplies 100 % of the electrical power to the energy supply grid in the sub-synchronous range (partial load range). Slip power which is fed from the generator via the slip rings of the generator to the rotor is provided additionally.
- The generator directly supplies approx. 83 % of the electrical power to the energy supply grid in the super-synchronous range (nominal load range). Management via the converter is not required in that context. The remaining approx. 17 % of the power is fed from the rotor via the converter into the energy supply grid.

Besides many other system benefits, the low losses, permitting a high total efficiency, and the excellent availability, resulting from the compact design with a minimum number of components, should be mentioned.

3.2 Technical Data of the Medium Voltage Side of the Wind Turbine

3.2.1 Standard Wind Turbine Configuration

The Senvion 3.0M122 standard design has been defined as shown in the following table.

Standard configuration at medium voltage side of the WTG

Parameter	Value
Nominal power	P_N = 2,970 kW on the medium voltage side of the transformer. This corresponds to a power of approx. 3,000 kW on the low voltage side of the transformer.
Power factor	cos φ ~ 1
Nominal voltage (MV side)	10 kV / 20 kV / 30 kV
Terminal voltage range (MV side)* of the wind turbine (cos φ = 1)	90 % ≤ U_N ≤ 110 %
Nominal frequency	f_N = 50 Hz
Nominal current at cos φ = 1 and nominal voltage	I = 174 A [10 kV] I = 86 A [20 kV] I = 57 A [30 kV]
Nominal generator speed	n = 1,200 rpm

NOTE: * The automatic tap changer of the wind farm transformer in the medium-voltage system must assure that line voltage does not drop below nominal voltage for a longer period of time. If the line voltage is below nominal voltage for a longer period of time, electrical power production could be reduced.

The Senvion wind turbine remains connected to the grid during stationary operation even with frequency fluctuations between 47.5 Hz and 52.0 Hz within a permissible voltage range. In the frequency range of 47.0 Hz to 47.5 Hz the Senvion wind turbine also remains connected to the grid for max. one minute. The following figure is a graphic depiction of both the stationary and dynamic frequency range in relation to the active power.

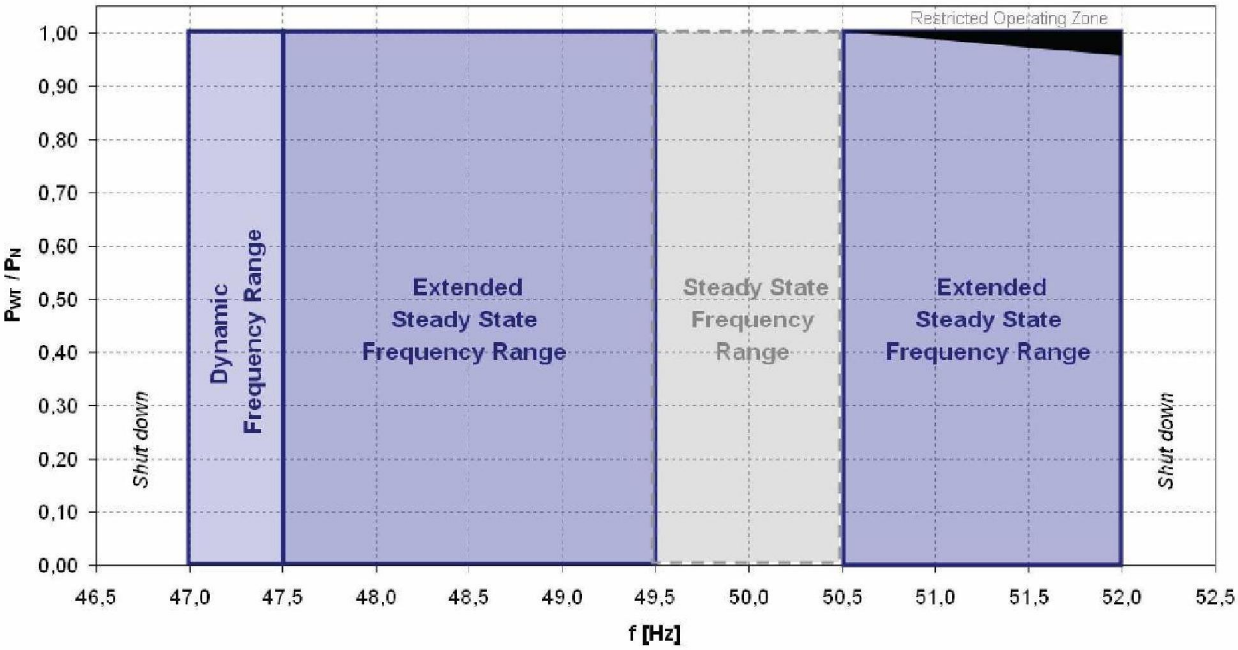

Fig. 3.2.1 - 1: Steady State & Dynamic Frequency Range

The standard protection configuration for the wind turbine for minimum and maximum frequencies are adjustable parameters that can be chosen in accordance with the permissible ranges shown in the figure above.

Within the "Restricted Operating Zone" (black area in the figure above) the active power output might be reduced. The reactive power range of the wind turbine can be limited in the extended stationary and dynamic frequency range. During extreme situations a disconnection from the grid is possible.

The capability and control options of the wind turbine or wind farm can be extended by adding optional Senvion Grid Products and/or Senvion SCADA products to contribute to compliance with project-specific grid requirements and control the wind farm as a power plant.

The electrical properties of the Senvion 3.0M122 are defined in the documents "Electrical Properties according to FGW" and "Electrical Properties according to IEC", see chapter "Applicable Documents" in this document.

The values in table above can be maintained if the grid quality matches the parameters specified in the document “Standard Grid Conditions", see chapter "Applicable Documents" in this document.

3.2.2 Standard Wind Turbine Grid Protection

The grid protection of the control system measures the current and voltage in each phase, guaranteeing a three-phase grid monitoring. The grid monitoring analyzes the currents, voltages and time graphs to disconnect the generator and converter from the grid for their own protection as soon as one of the events listed in the following table occurs.

Standard grid protection settings at medium voltage side of the WTG

Trigger criterion	Typical trigger value	Comment
Over voltage [U >] (symmetrical/asymmetrical)	$1.1*U_N$	Setting values shall be defined together with the responsible network operator
Under voltage [U <] (symmetrical/asymmetrical)	$0.9*U_N$	Setting values shall be defined together with the responsible network operator
Over Frequency [f >]	50.5 Hz	Setting values shall be defined together with the responsible network operator
Under Frequency [f <]	49.5 Hz	Setting values shall be defined together with the responsible network operator
Max. current asymmetry		Trigger period ≤ 5 s
Phase angle deviation	±6°	Without delay

The standard grid protection configuration can be adjusted project-specific dependent on the additionally acquired Senvion Grid Products. Without Grid Products the wind turbine will shut down immediately according to the above mentioned trigger values.

The standard protection configuration for the wind turbine for minimum and maximum frequencies are adjustable parameters that can be chosen in accordance with the permissible ranges shown in the figure of the previous chapter.

After one of the events in the table above occurs, the wind turbine automatically re-synchronizes with the grid as soon as it is available again.

3.3 Main Electrical Components

3.3.1 Generator

Technical Data Generator	
Concept	Asynchronous double-fed generator with rotor power recovery to the grid via the frequency converter. The stator winding is synchronised to the low-voltage side and is connected directly to the grid with a soft cut-in.
Nominal power/speed	P_G = ~3,600 kW at n = 1,200 rpm (±50 kW depending on manufacturer)
Speed range	n = 600 - 1,200 (dyn. +200) rpm To each speed a specific maximum power value is assigned whose average value may not be exceeded for design reasons.
Design	Double-fed asynchronous generator
Model	IM B3 according to DIN IEC 60034 code I IM 1001 according to DIN IEC 60034 code II
Size	630
Protection class	IP 54 (slip ring: IP 23)
Cooling	Cooling via air/air heat exchanger. Cooling air flow is generated by an external fan. Cooling air induction from the nacelle.

Technical Data Generator	
Sensors	PT 100 to monitor the bearing temperature PT 100 to monitor the winding temperature Brush wear warning
Miscellaneous	Covers prevent the contact with rotating components. Grounded generator housing to prevent static charges. To minimize vibration and noise emissions the generator is supported on the main frame on sound and vibration decoupled elements.

3.3.2 Converter

Technical Data Converter	
Concept	Frequency converter for double-fed induction generator with DC link.
Operating mode	Control/regulation of active and reactive power. Recovery of the rotor power via the generator and converter on the grid side inverter.
Power transistor	IGBTs
Protection class	IP 54, induction field: IP 21
Cooling	Air flow cooling of the converter housing. Liquid cooling system for IGBTs.

3.3.3 Transformer System

The transformer and the medium voltage switchgear are installed inside the tower. For the customer this has the advantage of no further planning permissions being required for an additional building.

For further details please see the document "Internal Transformer System [3.XM/50Hz/Europe and Australia only]".

3.4 Own Consumption

The own consumption of the wind turbine in standby mode is made up of the individual consumption of the following components:

- Control system (control computer and converter)
- Yaw system
- Hydraulic pump
- Heating for gearbox, generator and control cabinets
- Battery charger
- Pitch drive during different operating states
- Obstacle light

The own consumption is approx. 40 kW (10 minute average value). The requirement depends largely on the installation location of the wind turbine. The own consumption is particularly high if the wind speed is less than 4 m/s whilst temperatures are below freezing.

Consumption values may differ by several units dependent on location, near the coast or further inland. As a rough estimate between 8,300 and 16,000 kWh per annum may be assumed for locations with average wind speeds, with up or down deviations possible. These details do not take the requirement of connected components (e.g., transformer, auxiliary units and medium and low voltage cabling) into account.

4 Safety Device

4.1 General Safety

As all Senvion wind turbines, the Senvion 3.0M122 has been designed with a view to highest operational safety. This generally includes:

- Aerodynamic brake in fail-safe design through independent individual pitch adjustment
- Protection against the escape of fluid through labyrinths and collection containers
- Control-independent safety chains
- Covers for rotating components in the machine to protect individuals
- Generous space in the nacelle for maintenance and service
- Access to the rotor hub from inside the nacelle

4.2 Safety Chain

The safety chain is a hard-wired circuit in which all contacts for triggering an emergency stop are connected in series. If the safety chain is interrupted, the WTG shall stop immediately. A reset can only be done, when the cause for the interruption has been rectified (excepting emergency stops due to grid loss).

The following safety chain contacts can trigger an emergency stop:

- Emergency stop button on top box (nacelle)
- Emergency stop button on portable control unit (nacelle)
- Emergency stop button on the control cabinet in the tower base
- Overspeed switchgear for rotor speed
- Overspeed switchgear for gearbox speed
- Vibration switch
- Cam switch (azimuth revolutions counter)
- "Enable manual pitch" switch on the top box
- Hardware contact on the system management computer

4.3 Brakes

The brake system consists of the primary aerodynamic brake system and the secondary mechanical brake system.

Braking is aerodynamic by moving the rotor blades into the 90° position. Each individual adjustment device of the three rotor blades operates entirely independently. In case of a grid failure the adjustment motors are supplied by their independent battery sets.

The movement of a single rotor blade is sufficient to move the wind turbine into a safe speed range. This results in a triple redundant system.

The mechanical rotor holding brake system is installed at the high-speed shaft as an active system. It is activated if the primary safety systems fails partially or totally and stops the rotor in conjunction with the blade adjustment system. It is also used to fix the rotor once the aerodynamic braking system has stopped the rotor to secure it during maintenance work.

The brake systems are designed as fail-safe systems. This means that if only one of the brake system components fails or malfunctions the wind turbine immediately moves into a safe state.

4.4 Lightning Protection

The wind turbine is equipped with a lightning protection system designed by lightning protection experts and complies with protection class 1 required by the international standard IEC 61400-24 Edit.1 "Wind turbines - section 24: lightning protection" and IEC 62305-1 "Lightning protection - paragraph 1: General". The discharge is from the rotor over slip rings and dischargers on the tower. This way, the current of the bolt of lightning is discharged via foundation and/or deep grounding mechanisms into the ground.

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5 Control System

5.1 Cut-In/Cut-Out Strategy

The design parameters for the wind turbine operation are within the range of the following 10 minute average values of the wind speed:

Technical Data Cut-In/Cut-Out Strategy	
Cut-In wind speed	3.0 m/s
Rated wind speed	11.0 m/s
Cut-Out wind speed	22.0 m/s

5.2 Control System

The control system Senvion Control permits an integration of the Senvion 3.0M122 into the Senvion SCADA system Senvion SCADA Solutions. Senvion Control is a microprocessor-based control system. Optical fibers are used for signal transmission. The wind turbine must be equipped with SCADA Access Monitoring Advanced or Professional as default. SCADA Access Monitoring permits the direct access to the control system Senvion Control and other Senvion SCADA components installed at the location, such as Power Management Unit or Meteo Station. Dependent on the user access level SCADA Access Monitoring visualizes current operating data as well as data saved on the control device.

The control device is installed in the nacelle. An additional display permits operational control from the tower base.

Technical Data Control System	
Principle	Microprocessor
Signal transmission	Optical fiber
Remote monitoring	SCADA Access Monitoring

5.3 Measures in Case of Ice Accretion

As ice accretion on wind turbines, especially on rotor blades, may lead to an increased hazard to the environment, different measures can be taken in order to reduce this hazard caused by ice throw.

5.3.1 Ice Detection

Senvion wind turbines are equipped with a redundant and state-of-the-art ice detection system as assessed by TÜV Nord, which enables the turbine operating system to detect ice during operation as well as during stand still. This is realized by the following means:

- Comparison measurement of anemometers
- Analysis of the measured values during turbine operation
- Wind turbine protection by vibration monitoring

These monitoring functions trigger status codes in Senvion's turbine control system.

5.3.2 Turbine Behavior in Case of Ice Detection

In case of ice detection, the wind turbine automatically shuts down. The restart of the turbine is conducted automatically when icing conditions can be excluded.

If the absence of ice has been reported after a visual on-site inspection, it is also possible to restart the turbine manually under specific conditions.

Shutdown and restarting of the wind turbine are recorded in the operating computer's event protocol and are available for subsequent verification purposes.

The configuration of Senvion's measures in case of ice accretion can be adapted turbine specifically in case an annual wind turbine site assessment has been carried out and the resultant risk class allows different turbine behaviour.

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6 Dimensions and Weights

The Senvion 3.0M122 has been generally designed for ease of transport and erection. For this reason the weights are roughly within the range of the Senvion MM series. The option to install, and where necessary transport, the nacelle and drive train separately permits the use of comparable crane equipment as for the wind turbines of the 2 MW class (e.g. Senvion MM series).

6.1 Weights

Weights	
Rotor blade	approx. 15.0 t
Rotor hub (incl. pitch system)	approx. 25.0 t
Nacelle (excl. rotor and drive train)	approx. 58.0 t
Drive train	approx. 52.0 t

6.2 Dimensions

Dimensions Rotor Blade	
Length	approx. 59.8 m
Height	approx. 4.4 m

Dimensions Rotor Hub	
Diameter	approx. 4.2 m
Height	approx. 3.8 m

Dimensions Nacelle	
Length	approx. 13.1 m
Depth	approx. 4.2 m
Height	approx. 3.9 m

Dimensions Drive Train (rotor, bearing, shaft and gearbox)	
Length	approx. 6.7 m
Depth	approx. 3.3 m
Height	approx. 3.4 m