WIND TURBINES

PENDULAR WIND TURBINE 60 kW - 335 kW

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We are a design engineering firm, with our own technology, known in the solar energy world for our tracking systems.

From the start of our activity in 1992, one of our biggest challenges has been using wind energy in many different applications.

After years of research, developments and reflection, we have entered the world of power direct generation as manufacturers of wind-power generators.

We have worked to offer the market a different and innovative product, such as our pendular wind turbine with adjusted motor torque, which objective is offer lighter machines that deliver energy more uniformly being more tolerant to the network.

Building machines that suffer less fatigue, including mechanisms that provide them with a higher degree of freedom by using the wind force that makes the machine suffer to protect it by accommodating to new balanced operational positions (passive systems), is the philosophy behind our designs.

PRINCIPAL CHARACTERISTICS

The unique design of the ADES wind turbine includes three passive mechanical systems: a swivelling single-blade rotor, a pendulum power train and a self-steering nacelle. The design compensates, accumulates and reinstates wind speed variations, preventing them from affecting the evenness of generator rotation and subsequently diminishing structural overload and power peaks caused by wind gusts.

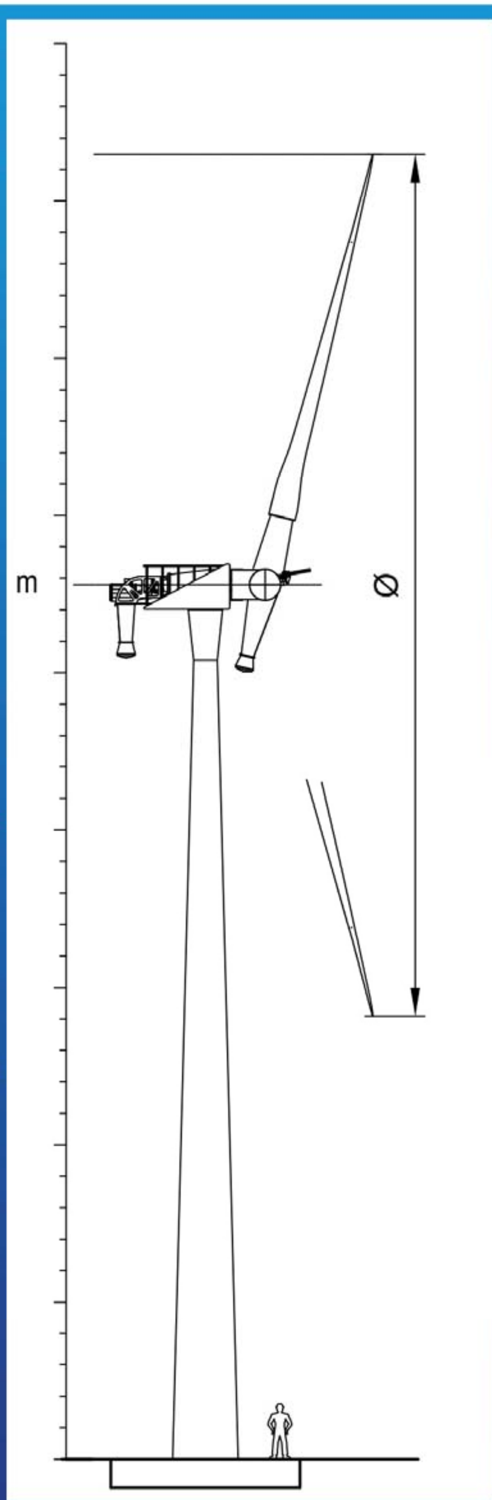
BENEFITS

By supplying high-quality energy with less structural loads, these turbines can be connected in new parks, in areas with weak networks and in parallel with other energy sources, as well as be used in the repowering of wind farms, taking advantage of the existing infrastructures.

PRODUCT UNDER PATENT

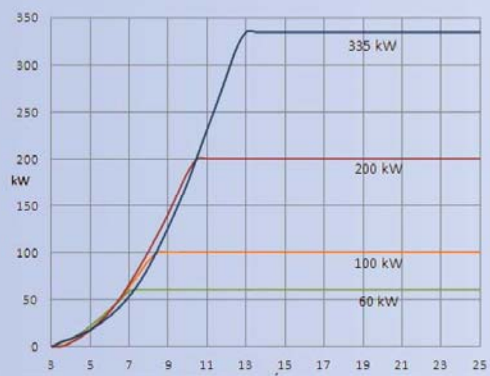
TECHNICAL DATA

POWER	60 kW	100 kW	200 kW	335 kW
Rated wind speed (m/s)	8	10	11	12
Cut-in speed (m/s)	3.5	3.5	3.5	3.5
Cut-out speed (m/s)	20		25	
Wind direction	Downwind			
ROTOR	Swivelling Single-blade			
• Rotor diameter (m)	29	29	36	36
• Material	Fibreglass prefilled with epoxy resin			
• Turbined area (m^2)	600	600	880	880
• Pitch	Variable			
• Speed (rpm)	50	60	50	55
• Max torque (kNm)	15	25	47	68
PENDULUM				
• Multiplication ratio	24	20.1	24.1	21.8
• Efficiency %	94 %			
• Lubrication	Oil bath			
GENERATOR	Squirrel-cage rotor			
• Number of poles	6			
• Voltage (V)	400			690
• Frequency (Hz)	50 / 60 (Opcional)			
• Protection class	IP54			
• Thermal class	F			
PORTABILITY	1+1 x 40' "open top" container			



ELECTRIC POWER STD CONDITIONS

Dirty blade - ρ = 1,225 kg/m³ - Tolerance ± 3 %



MECHANICAL SYSTEMS

All mechanical designs seek structures that are balanced, whether with regard to their supports or, if they rotate, with regard to their rotation axis.

As a result, these wind turbines have three mechanical systems that compensate the power peaks caused by wind gusts. The first consists of the swivelling single-blade rotor, the second is the pendulum formed by the power train, and the third the self-steering nacelle.

Thus, in our wind turbine, any disturbance caused by a wind gust is first absorbed by the swivelling rotor and then by the pendulum unit, whereupon the joint performance of both, along with its self-steering capacity, reduces the effect of the disturbance on the structure and the quality of power delivered by the fast shaft to a minimum.

TORQUE BALANCE

THE MASSES WEIGHT OR COUNTERWEIGHT

The joints between components can be rigid or have certain degrees of freedom. Disturbance causes the first to tense, whereas the second adapt to the disturbance by changing position, preventing tension.

One of the mechanical principles involved in our design consists in placing certain turbine components (generator, brake disc and switchgear) suspended like a pendulum from a bearing aligned with the rotor shaft. The pendular positioning of these elements allows them to move until their masses balance the rotor torque of the motor. This capacity releases the corresponding stress from the structure, the foundation and the terrain.

INERTIAL STABILITY: THE FLYWHELL

All the components that make up the power train have internal components that are rotating at different speeds and accumulate kinetic rotation energy that is much greater than that of the pendular unit itself.

As we understand inertia to be the property of a body that opposes any change of position or rotation or displacement speed, we can say that when the sum of the inertias of the rotating parts pertaining to the various components that make up the power train (shafts and gear assembly and/ or pulleys, if that were the case, brake disc and generator rotor) is greater than the inertia of the pendulum itself, the latter is the first to react against any disturbance to the torque, since it is the element with the least inertia.

All the above ensures that the rotating masses are minimally affected and so is the speed ratio delivered to the generator shaft.

THE PENDULUM

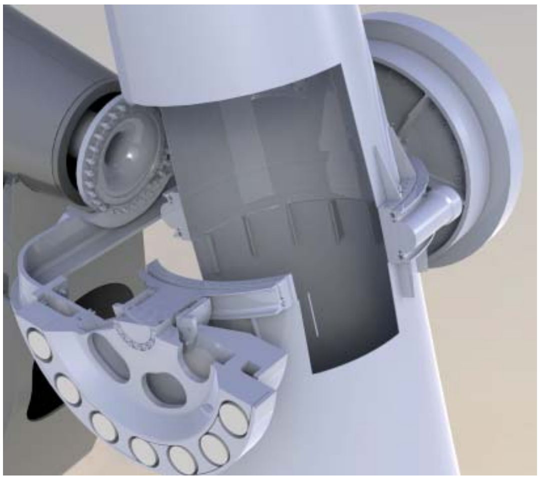
POWER ACCUMULATOR

On the other hand, the pendulum not only balances the torque, it also accumulates potential energy by its upward movement and releases it when it drops. Therefore, it acts as a regulator that tends to even out the amount of energy injected into the grid, attenuating peaks and softening power valleys.

Whenever torque is exerted on the turbine, the pendulum is tilted in a position of equilibrium appropriate for this torque. When torque increases due to a wind gust, the pendulum, due to its lower inertia, reacts by rising immediately, rotating in the same direction as the turbine rotor to a new position of equilibrium.

On the contrary, when the gust dies down and torque diminishes, the pendulum "falls" until it reaches a new position of equilibrium. While it falls, it rotates in the opposite direction to the turbine and returns the accumulated energy potentially to the generator rotor.

AREA VARIATION



THE SWIVELLING ROTOR

Another of the goals sought by our designs is to vary the area swept by the rotor in the event of any increase or decrease in wind speed, in order to compensate the peaks and valleys of the axial thrust and, subsequently, of the power captured.

The swept area depends on the sine of the dihedral angle traced by the rotor.Any increase or decrease of the same caused by an axial thrust will significantly affect the swept area, becoming the compensator of power peaks and valleys.

How can this swept area be modified?

This is achieved by designing the rotor as a swivelling rotor that adapts its dihedral angle until it finds dynamic equilibrium due, on the one hand, to the destabilising moment generated by the axial thrust and, on the other hand, to the stabilising moment generated by the misalignment of centrifugal forces of the blade and counterweight.

This floating to and from movement of the blade is the first wind gust buffer. When the gust comes, the dihedron is reduced and the area is decreased. When the gust dies down, the dihedron becomes larger and the area is increased. This buffer phenomenon improves power stability and reduces the impact on the turbine structure.

The blade and the counterweight are joined to the rotor yoke by a swivelling splice formed by the yoke and cardan cross joint for the transmission of torque and axial thrust for each angle of equilibrium, providing the entire unit with a degree of liberty that prevents tilting, caused by the different wind speeds that affect the blade at various heights from the ground.

WHY A SINGLE-BLADE?

As we know, the power in the axis of a rotating machine is the same as the product of the torque produced by the angular speed that is achieved there. For a specific power, if the speed of rotation is higher, the corresponding torque will be lower.

Since it is a compensated torque turbine, and considering the weights of the power train, we came to the conclusion that the rotor best adapted to these low torque conditions is the single-blade rotor, as the speed of rotation is higher than the one achieved with two and three-blade turbines.

These fast rotors eliminate alternating fatigue in the blades. By an adequate rotation speed and correct mass distribution (that places the blade`s centre of gravity where it interests us the most, at approximately 50% of its length) we ensure that centrifugal forces predominate over flector forces at any angle of rotation, so that the dominant force is traction. This eliminates the change of sign caused by the flector component and contributes to making the entire area of the blade bear the stress.

Another advantage is that the dihedron angle of the blade`s rotation movement tends to distance the blade from the tower depending on the radius, thus minimising the wake effect to be expected from a rotor that is downwind to the tower.

SELF-STEERING

These are self-steering turbines, that is, designed with a rotor downwind to the tower.

The steering force (axial thrust) is applied at a great distance from the steering axis, as it is along the bisection of the dihedron swept by the rotor, which guarantees high operational stability.

To position the machine when stopped, there is a braking gear that can be reversed. It has a pinion gear assembled on the interior carved ring of the bearing that holds the nacelle and governs its position until the machine reaches the minimum working speed. Once this happens, the motor brake is unlocked and the nacelle is freed.

This braking gear assembly is used to unwind the cables that form the loop inside the tower (when necessary), or to position the nacelle where desired, such as during maintenance operations.

POWER CONTROL

Control of power from the wind is performed by controlling the pitch angle of the blade: using a worm and ring gear operated by a hydraulic motor.

The angle is measured by an absolute position sensor.

LATTICE TOWER

Although the wind turbine can be installed on a conventional tubular tower, its special features allow it to be mounted on a lattice tower. This is mainly due to the fact that the motor torque of the turbine is absorbed by mechanical elements that prevent the bending moment from being transmitted to the tower. Therefore, the tower only bears wind stress and stress derived from the weight of the nacelle.

The lattice tower has many advantages over a tubular tower:

- Cost: lattice towers are much lighter and inexpensive than tubular towers; and their concrete footing is much more simple to place.
- Transport requirements: the tower is transported disassembled and therefore, does not require special transport vehicles that are very large and costly.
- Accessibility: due to the ease of transport, the wind turbine site accesses do not require special preparations, as frequently occurs with tubular towers.
- Wake effect: the wake effect of the lattice tower is practically null, so it does not affect the performance and durability of the wind turbine.

APPLICATIONS OF THE TECHNOLOGY

With all these qualities derived from their simplicity, reduced maintenance and the quality of power supplied, these turbines are adequate for installation in grids and/ or locations where turbines could not be used previously. They are also suitable for working alone or in parallel with other renewable energy sources such as:

- Isolated generation in electricity microgrids

Where the purpose is to stabilise weak or saturated grids through integration with other sources of renewable energy by including power storage that ensures consumer supply quality and continuity. Isolated generation can likewise be achieved with the supply being furnished in real time, by applying the same principle.

- Constant mechanical energy to specific applications (pumping, desalination)

The evenness of the rotation of the generator rotor produced by the inertial pendular design prevents water hammering in the water pipes.

- Areas with turbulent wind flows

The swivelling rotor and compensating pendulum are ideal for areas with turbulent winds or areas downwind of other turbines that, due to their distance, can disturb the wind flow of the same.

- Repowering wind farms

Since the structure is less overloaded, this turbine is more suitable to replace old turbines, as it increases the area swept by the rotor and uses the existing tower, footing and electrical infrastructure.

- New wind farms

The simplicity, energy quality, low cost and maintenance of these turbines make them highly suitable for new wind farms where the wind power ratio exceeds the level permitted currently.

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