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SIERRA DE LAS AGUAS WIND PARK IN CARRATRACA

The name of Carratraca comes from Arabic "Karr-al Krak", meaning "cleaning all marks". Hot springs and thermal baths have marked Carratraca's recent history, although it is well known that both the Romans and the Arabs were acquainted with these waters' healing properties.

Carratraca has been a reference in the health and wellness tourism industry for the past two centuries. Its water was found to have healing properties much earlier, though. Today's world-famous spa sits where Romans and Arabs had set before, all of them taking advantage of the mineral (sulfur water spa) and medicinal properties of the local springs. The village is perched on Sierra Blanquilla, amidst beautiful natural areas.

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The wind park has a maximum power output of 15,300 kWh (kilowatt-hour) at any given moment, and operates an average of between 2,000 and 3,000 hours per year. If it produces 15,300 kWh 8,760 hours per year, that would be 100%, and 3.000 hours per year would be 34.25%. It could supply a town of 5,000 complete homes of three or four members.

A Geodesic vertex or point is a marked point indicating an exact geographical point making up a triangle with other vertexes. It is at 949 metres above sea level. These points help to make topographical maps on scale. The Global Positioning System (GPS) uses the Geodesic points to determine the location of a point near the surface of the Earth.

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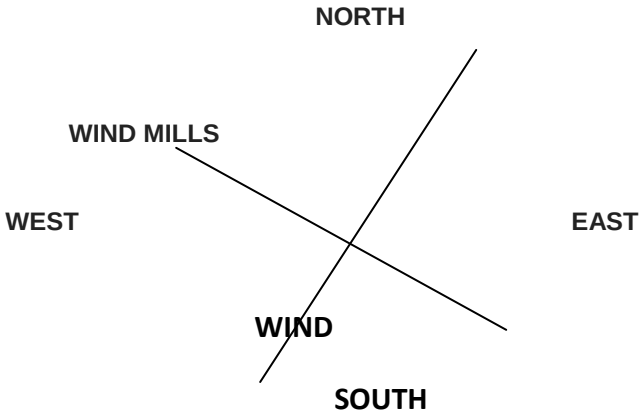
A wind turbine is a device that converts the wind's kinetic energy into electrical power.

The wind turbines are of the type with triple blades, horizontal axis, variable pitch wind system controlled by a motor and tubular tower (the blades have variable pitch wind). Ninety-five percent of those installed are of that kind.

Alignment of the wind mills: perpendicular to the prevailing wind directions



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The wind moves the blades, the blades move a gearbox, which is a speed multiplier to increase the speed of the turbine shaft to the generator. An increase in speed is needed because the turbine rotors turn at a much lower speed than is required by most electrical generators. The gearbox is next to the generator, and the generator raises the rotational speed to 1,600 RPM revolutions per minute. The windmill blades move between 20 and 26 RPM, which is usually what most wind turbines need to operate with maximum efficiency.

There is a cabinet inside the induction or synchronous generator, equipped with a power electronic system and connected to the grid, that is responsible for balancing the power generated in order to supply the current and voltage already balanced to the border point of the grid, which is in Alora. Current and voltage must be stabilized in each windmill and synchronized to the grid, so that they go through the underground power cables already stabilized to the substation in Alora.

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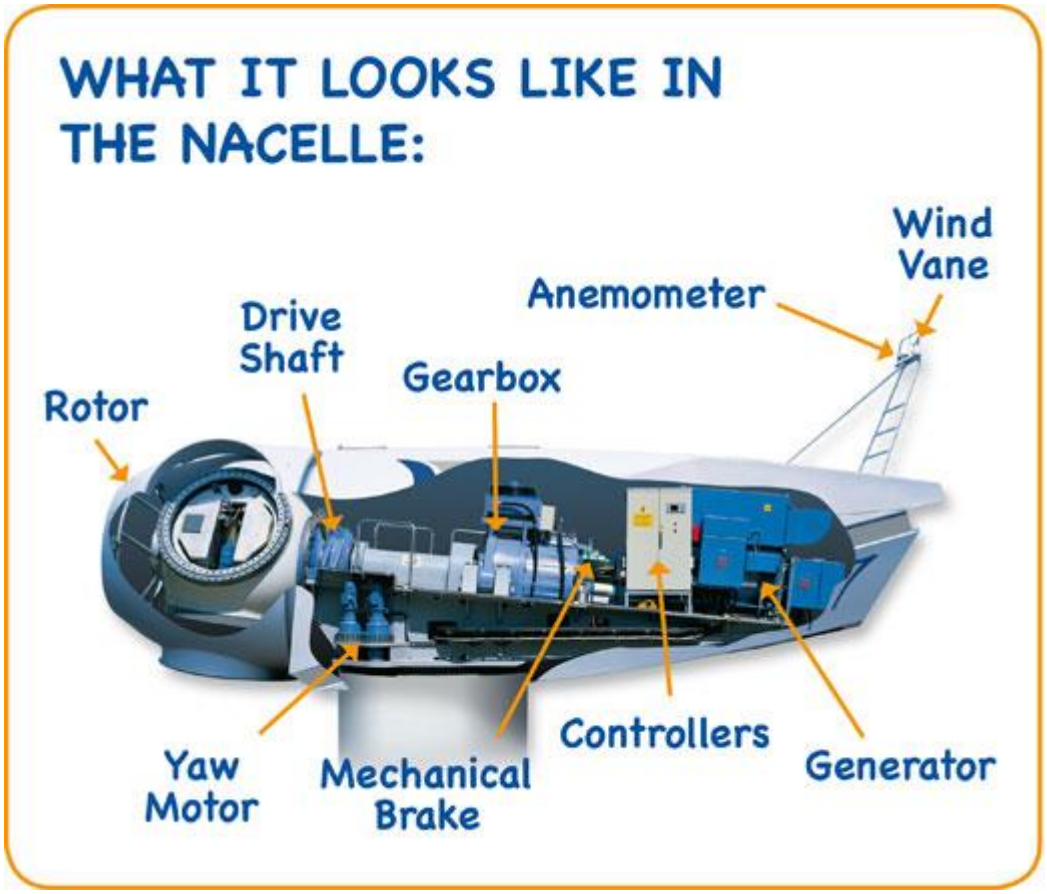

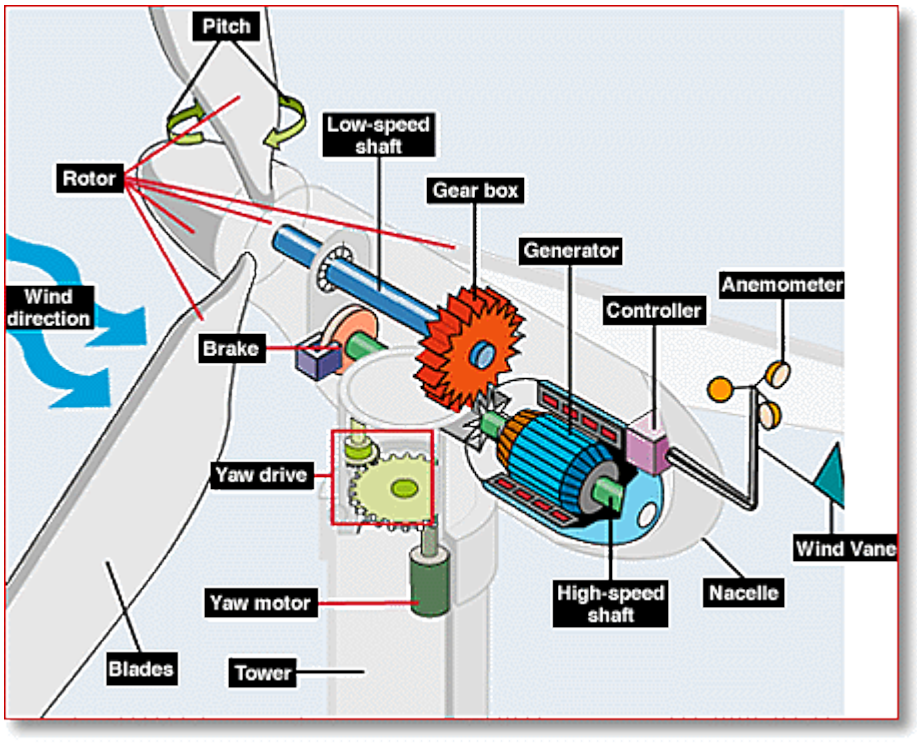

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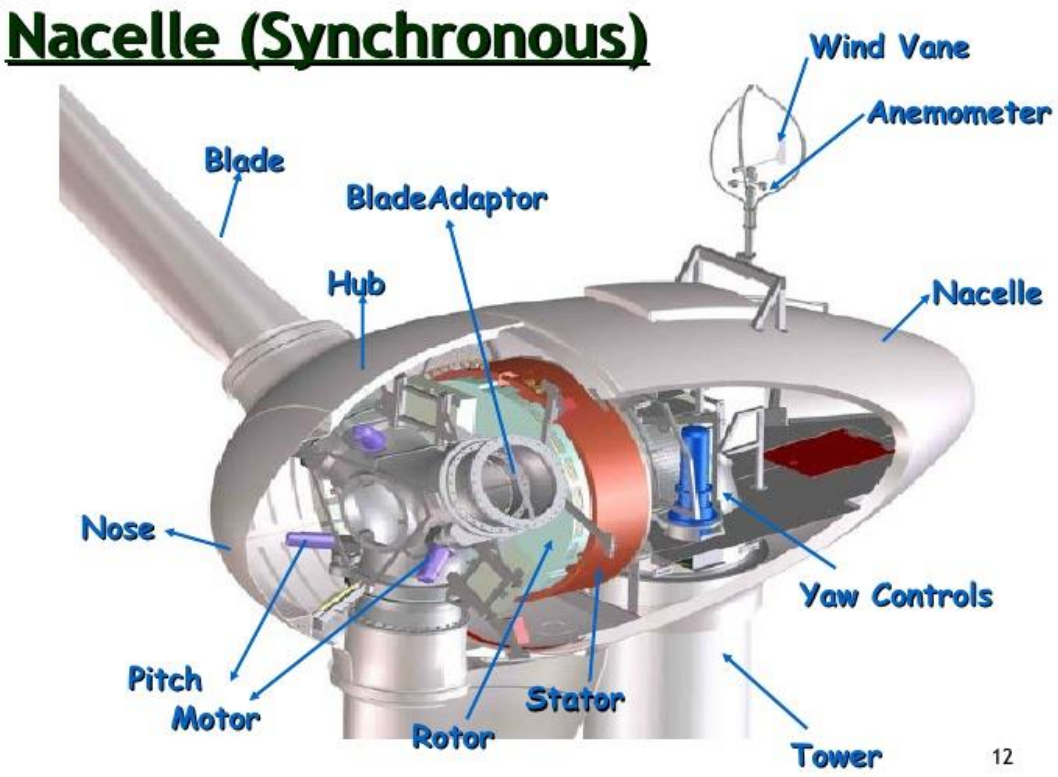

The wind mills have a problem of instability or unavailability when it is required, because they have to be disconnected when the wind is very strong or light. The operating range of wind speeds is between 4 (cut-in speed) and 25 m/s (cut-out speed) (metres per second); more or less than that, there is not production, as the structure can't support and can be damaged. The fluctuation of the wind power is because it changes from 8 megawatts per hour (a megawatt is 1,000 kilowatts per hour) to 9 or 10 megawatts in a few seconds due to wind speed change and wind direction. When there are high winds the turbines must be stopped to prevent damage. The wind turbines have several control systems, such as pitch, torque, stalling (regulating the blade angle), yawning (responsible for the orientation of the wind turbine rotor towards the wind) and braking controllers.

The prevailing winds are from the southwest and northeast. The alignment of the wind mills should be perpendicular to the prevailing wind directions.

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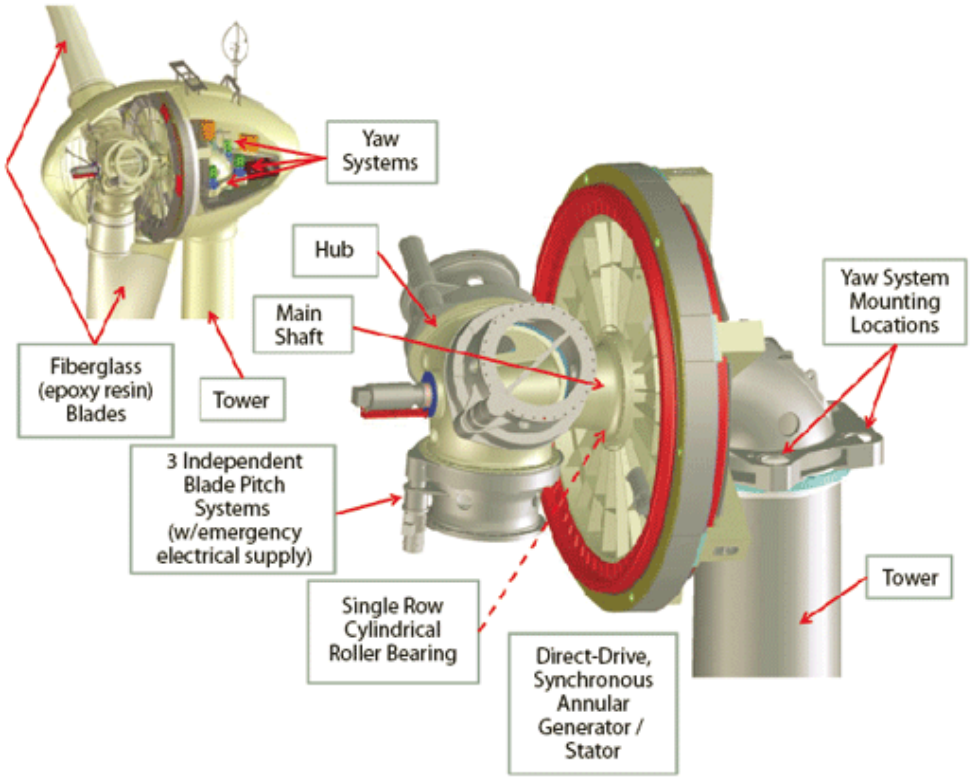
THE ROTOR HUB



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Movable parts in the rotor hub. The hub transmits the energy captured by the rotor blades to the main shaft. The hub is where the three blades are attached, which looks like an egg. It allows to transform the wind's linear kinetic energy to the rotational motion of the blades needed to turn the generator shaft.

When there is no wind the blades are switched off in flag position at 90°. In power position, the blades are at zero degrees, exposing the blade faces fully to the wind in order to take advantage of it. The wind mill sets the blade positions automatically, when there is no enough wind it is switched off and the blades are pitched at 90°, or flag position.

The wind turbine has a variable pitch wind system to control the wind speed, which makes the blades tune away from or into the wind as the captured power becomes too high, or too low; this is performed by rotating the blades, or part of them, with respect to its longitudinal axis.

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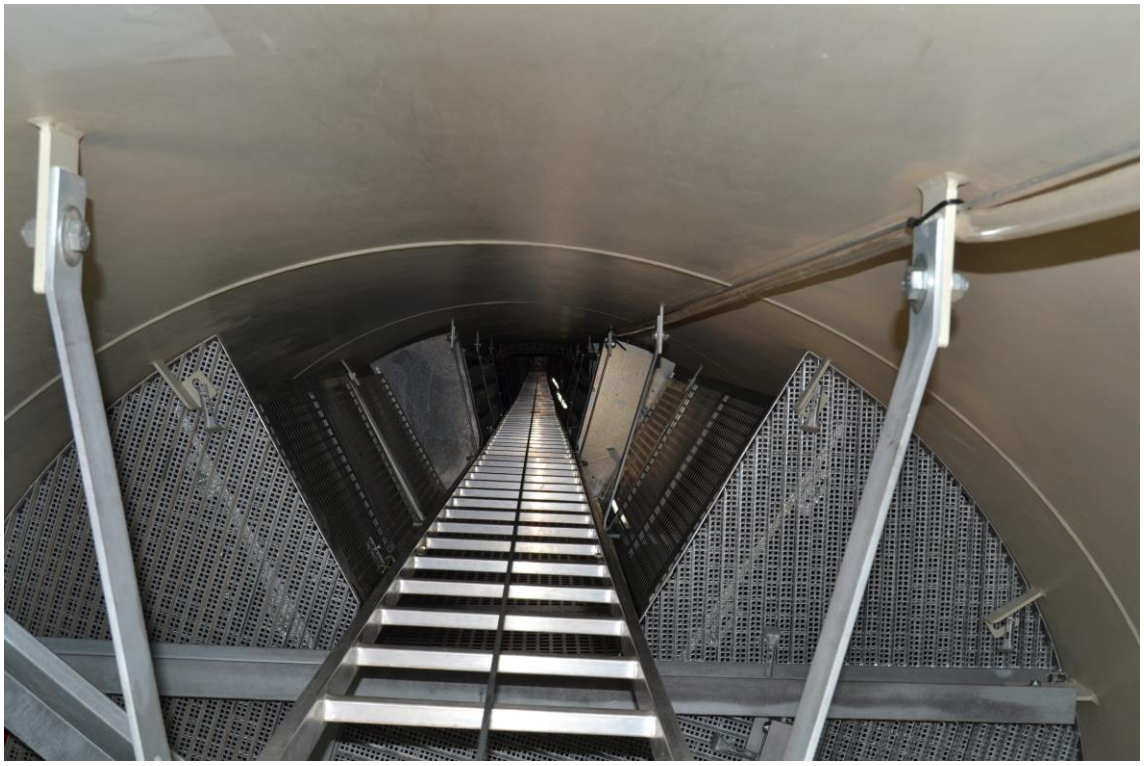

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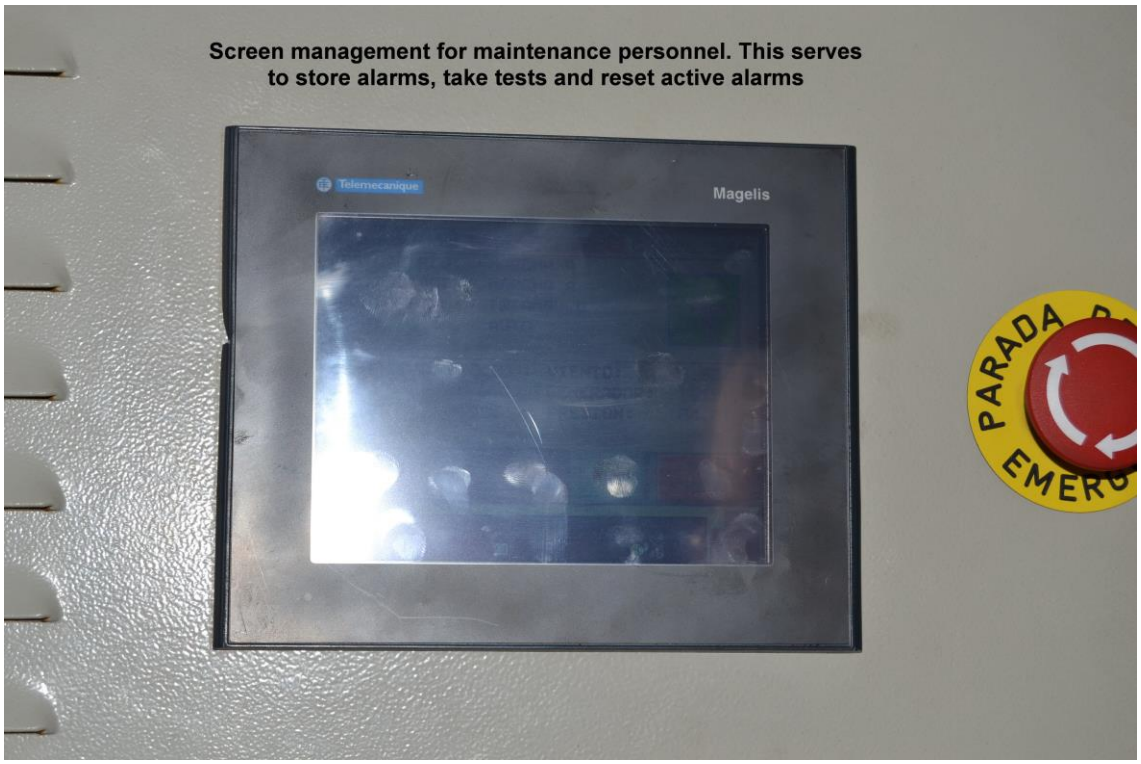

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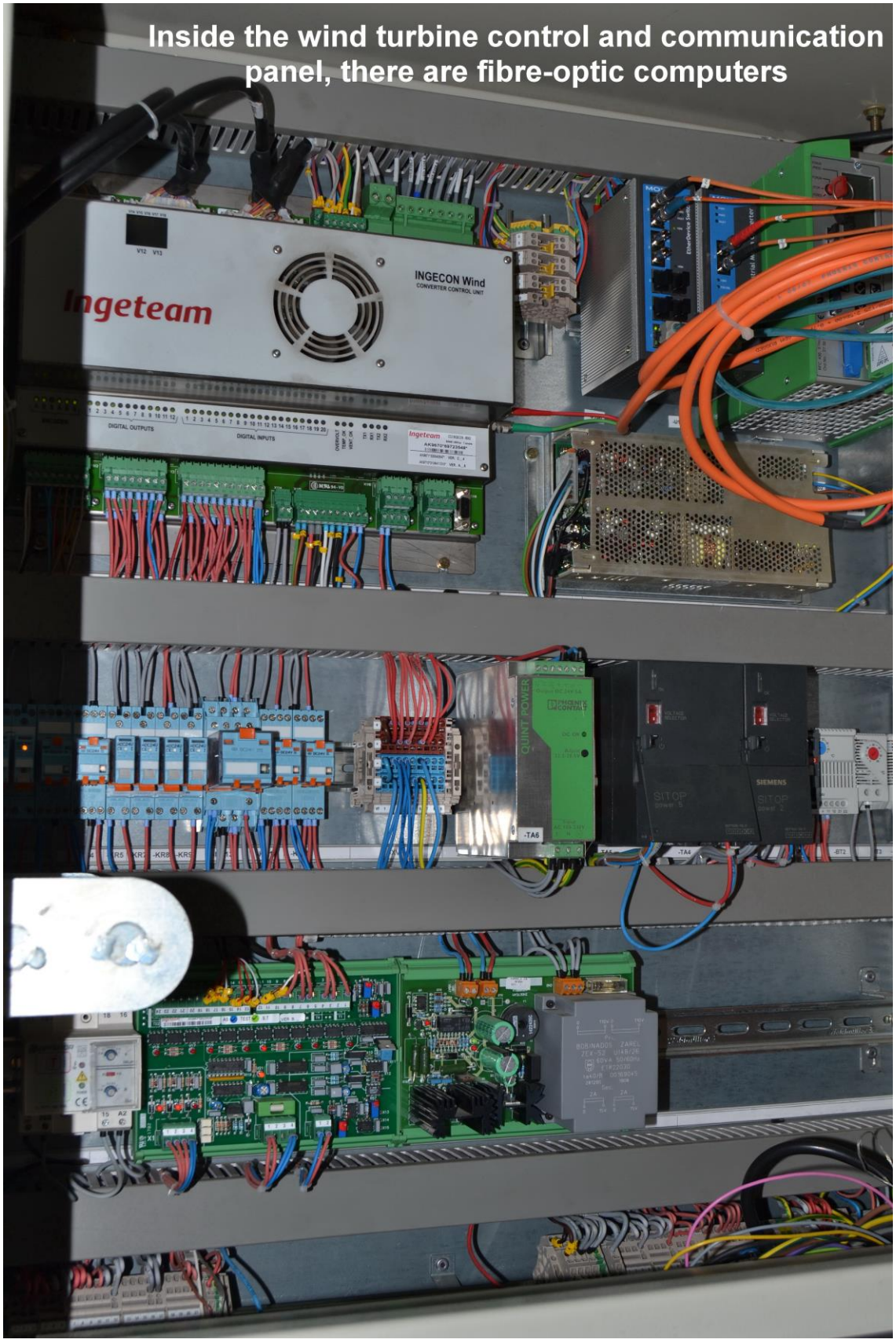

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The electricity goes to the substation through buried cables by environmental requirements, raising the voltage at each stretch in order to reduce power losses. Each turbine in a wind farm is equipped with a step-up transformer, which increases the turbine generator output voltage and decreases the current while maintaining the power. From the generator to its own transformer, electricity goes at 690 volts VAC (Voltage Alternating Current). In the windmill itself, voltage is raised to 30,000

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volts, and to 66,000 volts in the substation, which belongs to the wind park. From there it goes to the Endesa substation that is 9 kilometres in Álora, and from there Endesa distributes the fluid, for example from Álora to Cártama, where there is a transformer that reduces voltage to 20,000 volts. In turn, electricity goes to smaller transformers which reduce it to single-phase 220 volts going to homes, and to three-phase 380 volts going to industries.

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