Harvesting High Wind Energy

SkySails for Wind Turbines

In the field of Wind Energy, SkySails Gmbh is one of the leading companies. It has invested some 50 million euros in technology development and manufacturing capability.

Its SkySails Power system is focused on harvesting electric power from the wind. It uses SkySail Power Units to be linked in wind parks, for power outputs matching the output of conventional electric power stations.

From purpose-built Launching Towers, the Sky Sails are launched into the air, where they hang stably, sailing in the wind. Their tethers are attached to the seabed by suction anchors.

Each tether is wound on a spool connected to a motor/generator. As the Sails pull away from the generator, electricity is produced. When the tether is at its maximum length, the Sails allow themselves to be pulled back in with minimum resistance, to re-start the cycle.

For maximum power output, the Sails are steered in a cork screw path to allow each Sail to generate lift as it glides through the air, just as an airplane wing would.

In this paper we describe this steering procedure in some more detail.
Additionally, we describe a proposed rail system by which the SkySails would be steered in a circular path,catching wind energy in a continuous way. The system generates electricity from this circular movement.

We will describe both SkySails Power systems, the wind parks and the single Wind Turbines, for a a 500 Megawatt power system, matching the capacity of conventional electric power stations.

Wind Park Farms

Each SkySails Power Unit for Wind Farms will have a capacity of around 3.5 Megawatt. They will be tether connected to their anchored Launching Tower. A heavy winch in the base of that tower hoists the Sail up to a height were the wind is strong enough the lift the Sail.

The strong wind pushes the Sail further, powering the reel winch. Its big motor/generator starts harvesting energy. At the end of its harvesting cycle, the Sail is pulled down. The Unit doesn't generate electricity during this time, and actually expends a small amount of energy to reel in the Sail. Then the generator acts as a motor.

Depending on the speed with which the SkySails are reeled in, about half of the SkySails are generating energy at any given time. This partial use of the SkySails Power Units arguably increases the necessary investments for a given power capacity.

In addition, the reciprocating movement of the swirling Power Units results in a rather dynamic pattern of currents. Steering, and harmonizing the paths and the power output of some hundreds reciprocating SkySails, is one of the challenges in the cable steered scheme.

To maximise the output of each Sail, they are flown in a cork screw pattern. This allows them to move quickly through the air, generating significant lift, while unreeling the cable at a modest pace. This relatively complicated path means that SkySails Power Units require a complicated steering system compared to their ship mounted SkySails cousins.

The development of SkySails technology for large scale electricity generation has these significant technological hurdles to overcome. In view of this, we propose to open the way to a 500 Megawatt SkySails power station, using a circular system of flexible guiding rails rather than the cables, enforcing corkscrew paths.

Wind Turbines

In our Turbine version of the SkySails Power system, all Sails fly between large rings. One set of Sails counter-rotates to the second set of Sails. Both tips of all Sails slide within circular rails, which are tethered to winches on the water, anchored to the seabed.

As the Sails slide along, they generate electric energy through magnets in the wing tips and coils in the rails. This energy can be transported to the land via DC-power cables in the seabed.

To keep the rail rings in position, the lengths of the tethers are controlled by winches. These winches float on the surface of the water while they stay connected to the seabed via suction anchors.

Because the Sails all fly in the same path, the effects they have on each other will be predictable and easily manageable. Also their power output is harmonized.

In effect, the two sets of Sails act as the rotor in one large rotary electrical generator, while the rails act as its stator. The Sails provide the forces to keep the system in the air and to generate electric power.

The Sails require very little by way of steering, as their path is a straightforward circle along the concentric circular guiding rails.

At the start the ring of sails floats on the water. To launch the system the generator acts as a motor, forcing the Sails to move over the water, until enough lift is generated to raise the system any further.

When the system is at several hundred metres height, it can be tilted, controlled by the winches, allowing the Sails to catch the wind. The airborne turbine is now ready to harness the energy of the wind.

The generator can be controlled by computer, from a distance. By adjusting the effective magnetic inductance of the stators, the voltage generated by each Sail can be harmonized. The equal DC-voltages can be combined easily, ready for distribution on land.

Conclusion

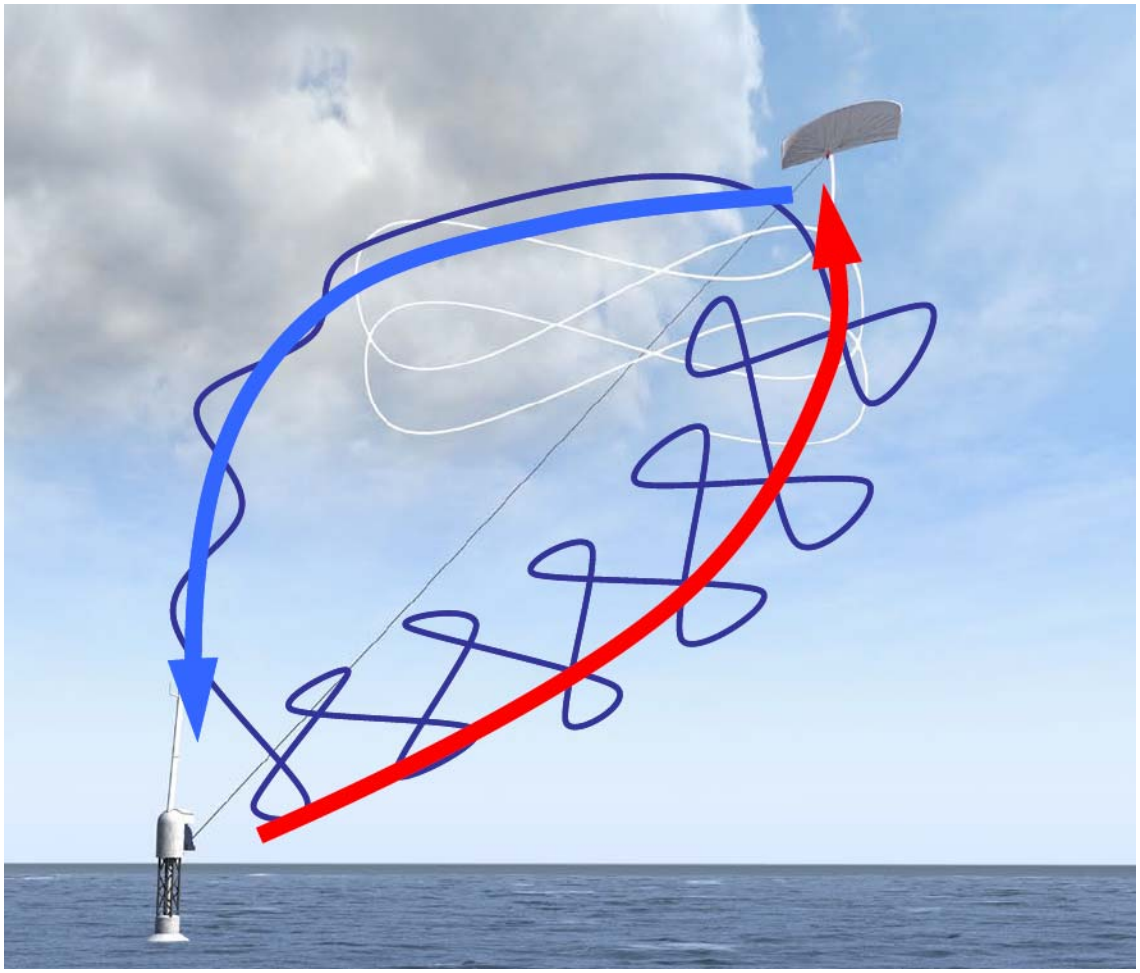
The two proposed system differ in style: one is chaotic, the other harmonic.

We advocate the KISS principle, 'keep it simple': use two times less SkySails; remove the need for solid launching towers; eliminate gearboxes and the many small scale generators; simplify the control system and eliminate chaotically moving elements and erratic energy flows.

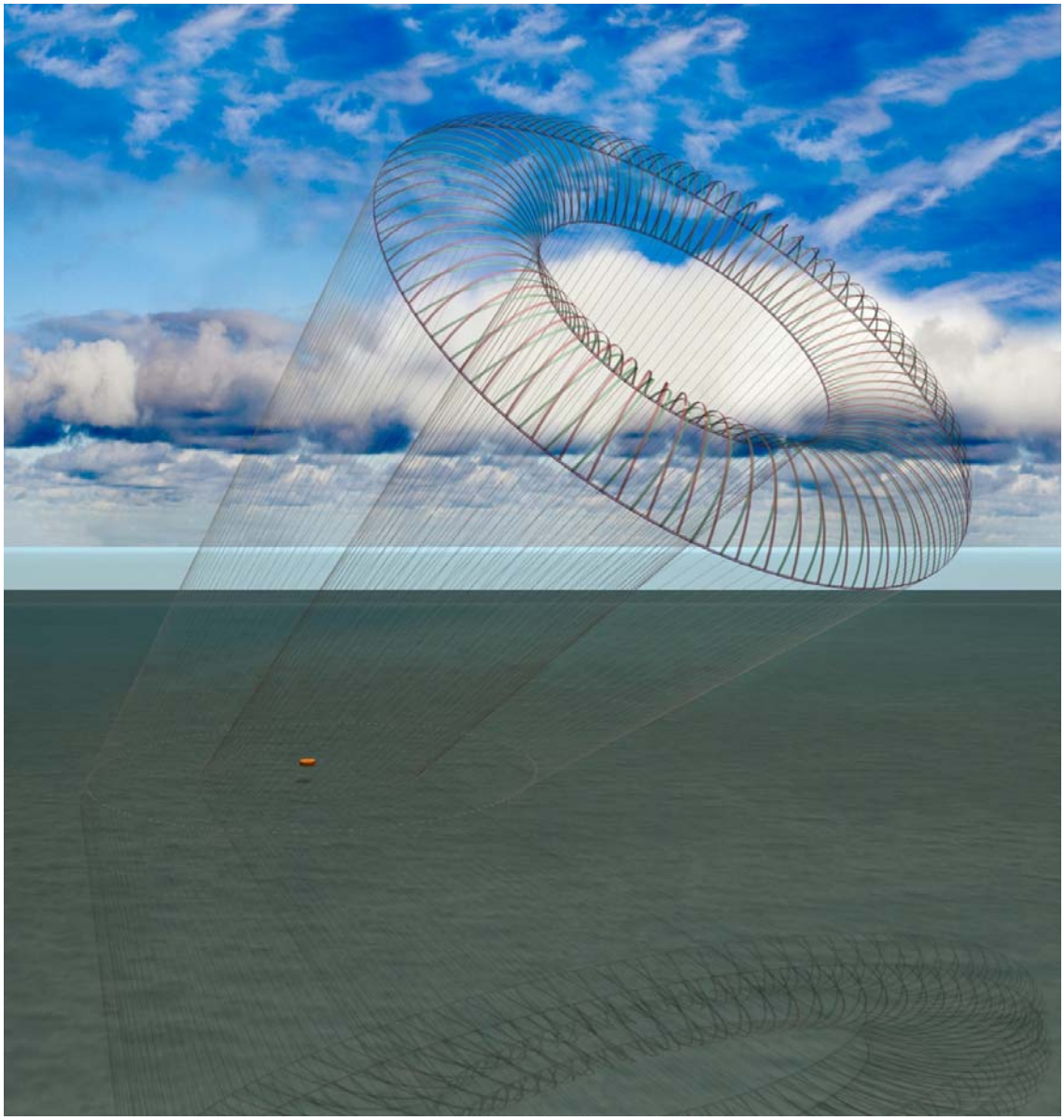
In this set-up, the heaviest and most expensive parts of the Power Park approach are not needed at all. We make the case that the single turbine approach will cost less, while providing a greater power output.

More details can be found in our extensive 'Report on Wind Energy'

Small part of a 500MW SkySails power park



Erratic movements of the tethered SkySails power units



SkySails harvesting 500MW, while sliding between two concentric, tethered rings