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## A novel floating offshore wind turbine concept

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## CONCEPT SUMMARY

A novel concept for offshore wind turbines is presented:

- The foundation is floating and rotating.
- The rotating structure is directly connected to the generator, in the bottom of the construction.
- The foundation is connected to the sea bed with tensioned wires.
- The concept is particularly suitable for deep water condition.
- Simple VAWT rotor
- The thrust is balanced by the buoyancy.
- The torque is balanced by torque arms or by water brakes arrangement.
- There is high upscaling potential

## POTENTIAL ADVANTAGES

- Simple Design
- No pitch neither yaw control system
- No huge weight on the top (generator in the bottom, no nacelle)
- Simple power control (rpm control)
- Water brakes for overspeeding control
- Upscaling to large size wind turbines
- Possibility to tilt up the submerged part of the turbine for transportation or service, in particular built up of marine growths
- The counterweight in the bottom can be moved to control the tilt angle

## SUBCOMPONENTS

Five different solutions are possible to transfer the torque to the generator

- The generator is mounted in the bottom of the structure and fixed in it. The shaft is fixed to the torque arms
- The generator is fixed to the torque arms and the shaft is connected to the rotating structure
- The generator is fixed on the sea bed and the shaft is fixed to the rotating structure (suitable for shallow water)
- Two generators are placed in two turbine gondolas, external to the tubular structure. The turbine gondolas are directly connected to the generator shaft, and through the water flow due to the rotation they convert the rotor power to electricity
- The conversion of the power is obtained by a drag device, counter-rotating at the bottom of the structure

## DEVELOPMENTS

- Development of a coupled hydrodynamic and aerolastic code. (on going project)
- Concept test of a kW size prototype (2010)
- Upscaling (2011-2015)

## DIMENSIONS

|                                 | 2MW  | 20MW  |
|---------------------------------|------|-------|
| • Rotor radius (m)              | 40   | 120   |
| • Rotor height (m)              | 80   | 240   |
| • Total length(m)               | 161  | 345   |
| • Radius submerged structure(m) | 3    | 6.5   |
| • Weight (tons)                 | 2300 | 13000 |

## ROTOR AND BLADES

Blades can be produced by pultrusion of GRP. The rotor can be produced at a cost comparable to an horizontal axis wind turbine.

## SPECIFIC CHALLENGES

- Analysis of the friction of the submerged part, built up of marine growths
- Sealing of the shaft in the bottom
- Taking the torque forces



First configuration for the generator:

The generator is fixed to the tubular structure and it rotates at the same rotational speed of the rotor. The shaft is fixed to the anchoring system and is not rotating.



Second configuration for the generator:

The shaft is the terminal part of the tubular structure and it is rotating. The generator is fixed to the anchoring system.



Torque arms:

The thrust and the torque are transmitted to the bottom. To take the torque 3 rigid arms are necessary. The arms have to be dimensioned (in length and thickness) in order to take the maximum value of the torque.