Floating Turbines Design Considerations

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Abstract

Floating platforms are considered as the practical solution for offshore wind in deepwater (depth>50m). This work investigates the concept of Submersible Turbine (ST) that was developed as a modification of the current floating platforms, for reducing the Levelized Cost Of Energy (LCOE), especially the cost of maintenance and optionally the cost of installation. The cost reduction is achieved by lowering the nacelle close to sea level for maintenance and installation.

Objectives

The purpose of this work is to modify the design of the floating platforms in order to enhance its operational efficiency and reducing LCOE.

Methods

A provisional prototype was designed and investigated. The selected type for investigation was TLP (Tension Leg Platform) whose figure is given below, although the developed concept is applicable in a quite similar way for the other types of floating platforms (spar or semi-submersible).

The first aspect that was discussed for the prototype was the maintenance procedures. The new design is intended to enable the maintenance crew to carry out most of the maintenance operations (preventing maintenance, repairs, components’ replacements, etc) on the deck of the service vessel rather than at the operational height of the nacelle.

The maintenance concept: The height of the floator and the tower (as one piece) is controlled by water ballasting. The height control enables the 2 states that are depicted in the figure below. In the operational state (right) the turbine is erected. In the maintenance state (left) the turbine is immersed till the nacelle is close to the sea level.

Conclusions

The ST concept may contribute to a reduction of the LCOE by the following benefits.
1) savings in maintenance:
- The personal accessibility to the upper devices becomes easy as no climbing and the associated safety procedures are required.
- The working room for all the maintenance operations becomes spacious, unlimited and easy to work. In fact the technicians work in a workshop environment with no restriction regarding auxiliary equipments.
- The replacements of the upper components (like gear, generator, transformer, etc) becomes easier, faster and cheaper. No huge crane is required.
2) saving in installation:
- The concept may be applied in a similar way for the installation process at the site. This option, however, should be considered against the option of installing the turbine in the harbor and towing to the site by tug vessels.
3) enhancing energy production:
- Due to the easier maintenance, the intervals between the maintenance operations will probably be shortened, reducing the failure rate and the downtime.
- The aerodynamic efficiency is enhanced due to more frequent renewing of blades’ surfaces.