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A CASE STUDY OF MULTI-USE OFFSHORE PLATFORMS

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Abstract

This work represents a theoretical case study of a multi-use platform (MUP). It is part of an on-going EU funded collaborative research project (MERMAID). European offshore wind farms aim to approach a capacity of 150 GW by 2030. Such ambition will require a seabed area of approximate 4000 to 5000 km^2 but with a small physical footprint (including cables) of 300 to 400 km^2. Theoretically, the remaining space can be used for other purposes such as aquaculture and wave energy. Accordingly, MERMAID aims at the multi-use of ocean space for energy extraction, aquaculture and platform related transport. This case study presents an innovative proof of concept to integrate aquaculture and wave energy technology at offshore wind farms. The proposed MUP case includes marine energy extraction (1000 MW wind farm plus a wave farm), an aquaculture farm, and the installation, operation and maintenance technologies for the MUP. The synergies and the disadvantages of the MUP compared to the offshore wind farm will be evaluated during the installation, operation, and maintenance phases.

Objectives

The proposed MUP case has, as its goal, the improvement of offshore wind economics and the reduction of conflicts with other maritime users. Accordingly, this case study encompasses the following four aspects:

- Installation, operation and maintenance of 100 units of future large 10 MW wind turbine.
- Innovative integration of aquaculture and wave energy technology at offshore wind farms.
- Installation, operation and maintenance solutions for MUP.
- The synergies and the disadvantages of the MUP compared to just an offshore wind farm.

The wind farm integration with aquaculture farm

One layout of the proposed 1000 MW wind farm is shown in Fig. 1 and it has two offshore substations and 100 fixed foundation 10 MW wind turbine units. The upper limit of the future large 10 MW wind turbine unit is chosen for the installation evaluation. The wind farm occupies an area of 138 km^2. As shown in Fig. 1, a total of 72 large areas contained within the offshore wind farm area have the potential to create high value aquaculture production, including utilization for mussel and seaweed and salmon production at deep water site.

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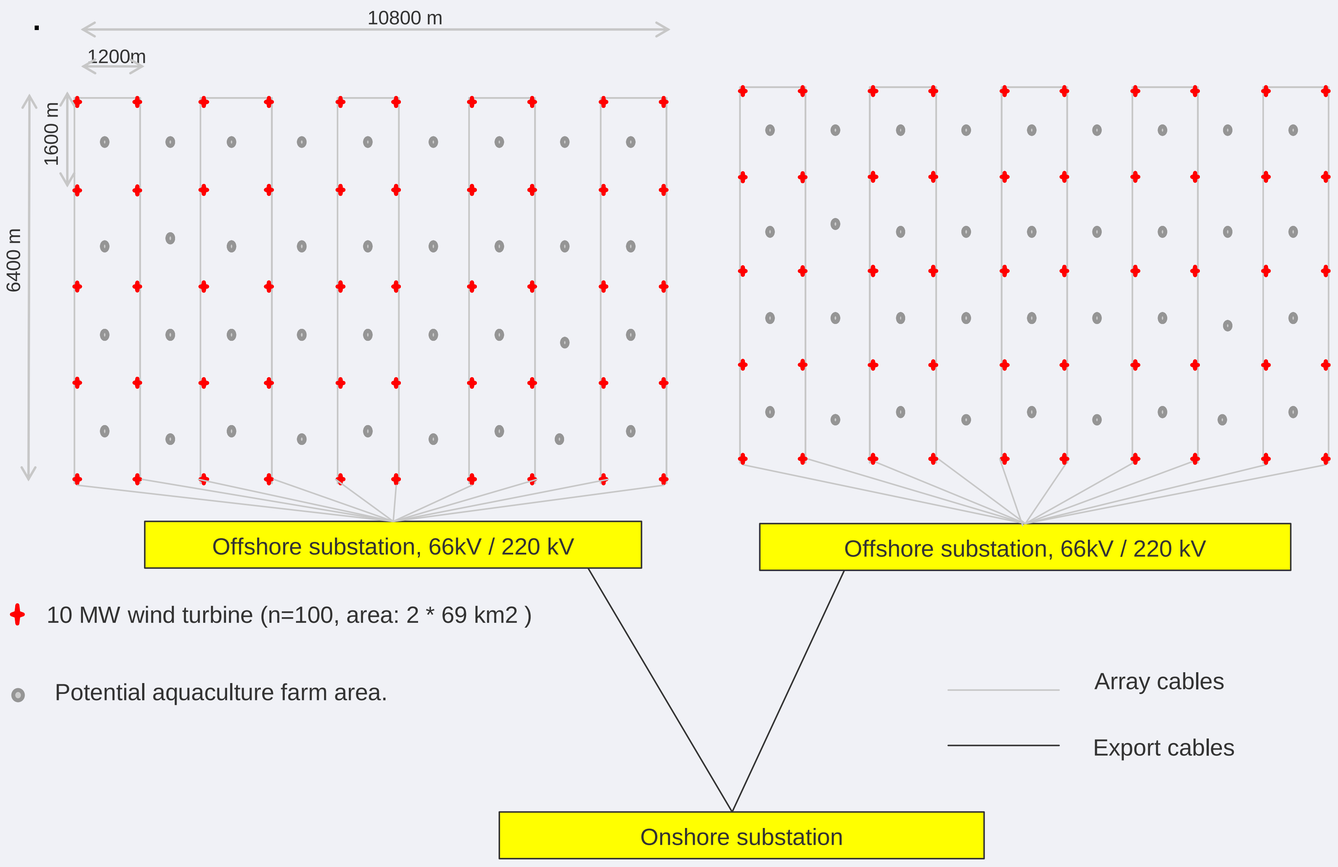

Fig. 1. Potential aquaculture areas within the 1000 MW offshore wind farm

Highlights of the MUP case study

First , the MUP case study plans to investigate the installation of the future large 10 MW wind turbine unit. A new type of installation vessel, shown in Fig. 2, is selected as an example to conduct the installation of 10 MW wind turbine foundations. The installation is performed in two operations: pre-piling and jacket installation. Standard jack-up vessels are utilized to simulate the turbine installation operations.

Fig. 2 A new installation vessel for 10 MW wind turbine foundation installation (courtesy NorWind / Ulstein)

Second, the aquaculture application includes two scenarios. In the partially integrated installation, the aquaculture farm is adjacent to or surrounds the wind farm. In the fully integrated installation, the aquaculture farm is contained within the wind farm area. The offshore wind farms may provide space and physical structures to support establishment of offshore environments for aquaculture.

Third, the synergies and disadvantages of a1000 MW wind farm integration with aquaculture farms will be evaluated with regard to the following three criteria: yield, cost and impact on the marine environment. The cost synergy includes the sharing of the infrastructure, installation, operation and staff accommodation during installation phase and also during the operation and maintenance phase. The cost also accounts for potential conflict risks from the system integration.

The MUP case will be eventually expanded to also include wave energy.

Conclusions

This on-going study case proposed an innovative integration of aquaculture and wave energy technology at offshore wind farms. The cost synergy of the proposed MUP has the potential to improve offshore wind power economics by the yield increase from the aquaculture productions and the wave energy. Furthermore, there is a cost reduction by sharing the infrastructures together with the installation, operation and maintenance. However, offshore aquaculture and wave energy technology are both in experimental stages; many challenges regarding the integration with offshore wind farm structures are still unresolved and under investigation.

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