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Multi-purpose Offshore Platforms for Ocean Energy and Aquaculture

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INTRODUCTION

Sharing of spatial planning and infrastructure can be of huge economic benefits for offshore industries. A typical example is the co-location of ocean energy platforms and aquaculture farms. This is of particular importance, as space constraints and over-exploitation of nearshore fishery resources can cause the migration of aquaculture farms to offshore sites in the near future.

As a case study, the detailed description of a multi-purpose platform (MPP) for a conceptual Scottish fish farm is presented. The design involves the retrofitting of a feed barge to accommodate a small wind turbine and solar panels to cater to the energy requirements of a closely co-located fish farm. This offers several advantages and the concept can be extended in the future to support larger wind turbines, with a view to supply the surplus power to remote island communities that are not grid-connected.

MULTI-PURPOSE OFFSHORE PLATFORMS

- an offshore structure able to exploit the synergies between ocean energy and aquaculture systems
- reduce costs by allowing multiple use of space and infrastructure, through co-located and shared technologies
- promote optimization of the marine spatial planning through efficient, sustainable, and ecological use of oceanic resources
- can provide secure, sustainable, and affordable source of energy, food, and jobs for remote, island communities

CONCEPT

A novel MPP is herein proposed for a conceptual Scottish offshore aquaculture farm. Feed barges are integral components of fish farms. They store the fish feed, house workers and can act as control rooms for the farming operations. The present work proposes the use of a feed barge to support an offshore wind turbine and solar photovoltaic cells to supply renewable energy for the aquaculture operations.

A conceptual description of the MPP supporting the wind turbine, with the basic dimensions, is given in Figure 1. The feed barge considered in the present work is based on the commercial barge AC 650 of AKVA, which can withstand a significant wave height of 6 m [1].

ADVANTAGES

Utilizing a feed barge to support the wind turbine has several advantages:

- economical, as the need for a separate support structure for the turbine is eliminated
- proven technology
- affords easier access for maintenance
- underwater cables are not required
- using a turbine of small mass will not significantly impact the configuration and dynamic properties of the barge
- provides a breakwater effect for the fish cages either on its own or in combination with floating wave energy converter arrays

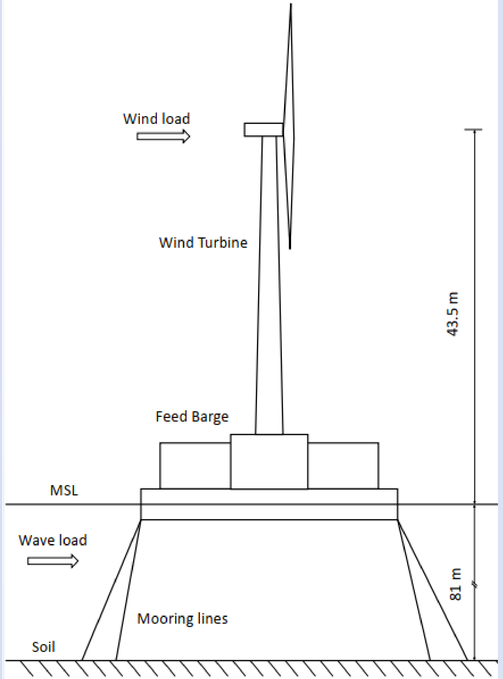

Fig. 1. Conceptual model of MPP

HYBRID ENERGY SYSTEM FOR AQUACULTURE

Details of the hybrid energy system (HES) supported on the barge for supplying power to an offshore fish farm is given in Table 1. The calculated farm energy demand for the Scottish case study is around 262.57 MWh/year with a daily average demand of 723.97 kWh/d [2].

Table. 1. HES Yearly Power Output [2]

Device	Wind turbine	Solar PV modules	Li-ion battery bank
No. of devices	4	230	6
Overall weight (kg)	5248	4370	18961
Rated power per device (W)	20000	250	74712 (h/day)
Power output (MWh/year)	196.90	52.51	27.57

The MPP can be used in combination with arrays of wave energy converters to reduce the influence of incident waves on fish cages, as shown in Fig. 2.

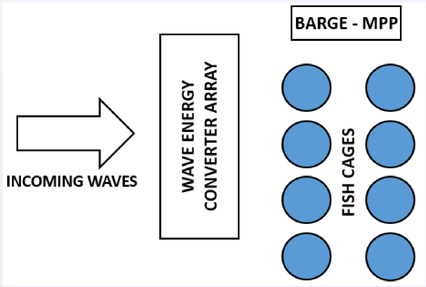

Fig. 2. Wave energy converters and MPP

CONCLUSIONS

- MPPs can significantly lower the costs for ocean energy and aquaculture through concerted spatial planning and sharing of infrastructure.
- A novel MPP is proposed for supplying renewable energy for offshore aquaculture operations making use of existing infrastructure (feed barges).

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