

Multiple Unit Floating Offshore Windfarms (MUFOWs)

In the 1990's, efforts to develop offshore wind farms have concentrated primarily on seabed-mounted turbines, where each wind turbine is mounted on a support structure that is fixed to a foundation on the seabed. However, for both technical and economic reasons, seabed-mounted offshore wind farm developments are restricted to relatively shallow waters (less than ~25m). Although northern European countries such as Belgium, The Netherlands, Germany, Denmark and the UK are fortunate in that they have large areas of shallow seas, in many other areas (such as the northern North Sea, parts of the Irish Sea and the Baltic and most of the Mediterranean Sea) the seabed falls away steeply leaving very little room for seabed-mounted turbines. If these regions are to benefit significantly from offshore wind energy, floating turbines will be needed. In addition, floating wind farms would allow exploitation of the huge wind resource that exists far offshore in deep water areas. These areas are expected to experience higher wind speeds and less turbulent conditions than in the nearshore/coastal zone.

The Multiple Unit Floating Offshore Windfarm (MUFOW) concept [1] was originally developed by W.S. Atkins Consultants Ltd., University College London (UCL) and the Netherlands Energy Research Foundation (ECN). The basic idea of the MUFOW is to mount an array of wind turbines on a single floating structure. Several wind turbines are spaced out along a large semi-submersible vessel (see Figure 1) that is anchored to the seabed. In each case the main structural "pontoons" of the vessel remain submerged at all times which means that overall the vessel has a low motion response to waves. This makes the MUFOW structure less susceptible to dynamic and fatigue loads and affords the vessel additional stability.

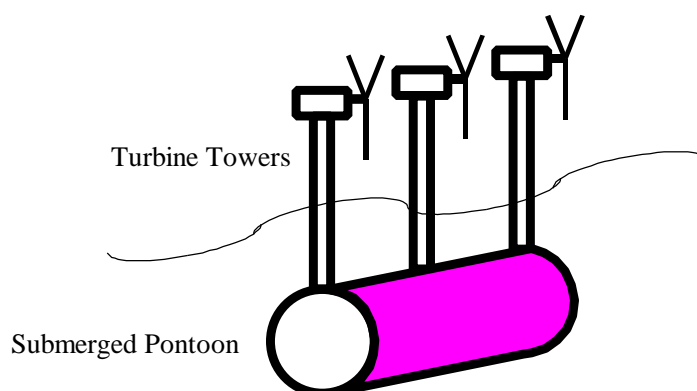
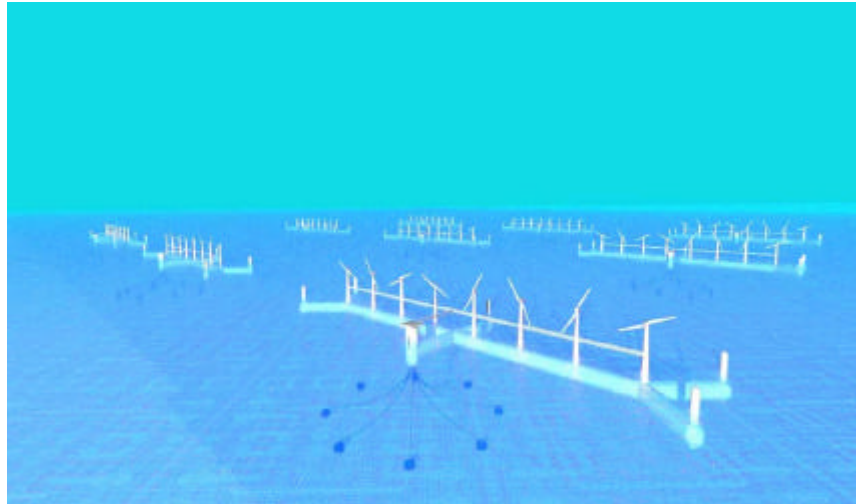


Figure 1 The semi-submersible concept

Each MUFOW vessel would be fitted with up to 8 wind turbines, with a number of hull layouts possible. These include V-shape, linear and kinked vessels, all of which could weathervane about a pivoting turret. Alternatively, non-weathervaning vessels could be used which are based on polygon or star shapes and which would not rotate to face into the wind. The hull could be fabricated of reinforced concrete which should make it relatively cheap and straightforward to construct. The pontoons and towers could be cast in a number of small segments that are then assembled to form the hull. The turbines could be mounted in position in the relative shelter of the construction site. The completed vessel could then be towed to the deployment site where it will be attached to its permanent mooring.

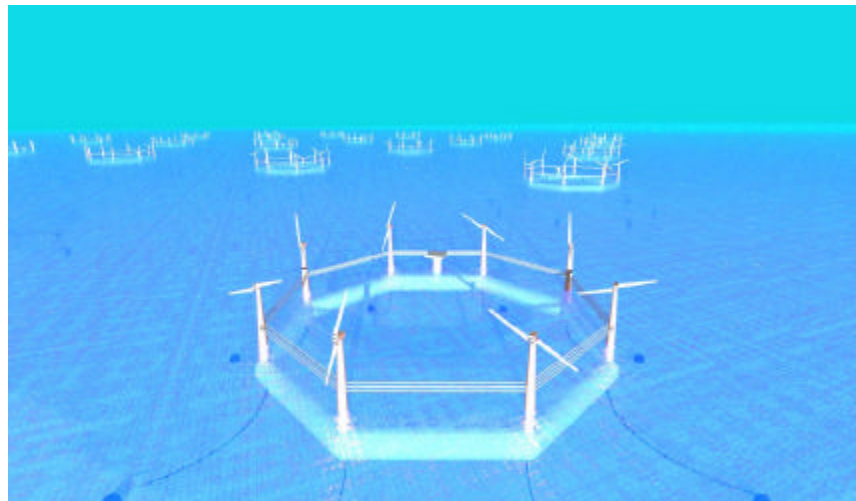
It is unlikely to be feasible to deploy a single vessel at a site, so there would probably be an array of MUFOW vessels that make up each development. Each MUFOW vessel would be several hundred meters across and would need to be surrounded by a clearance/exclusion area. Therefore, an offshore wind development made up of an array MUFOW vessels is likely to cover several km² of sea area.

Figures 2 and 3 show impressions of two MUFOW vessel layouts.



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Figure 2 Artist impression of weathervaning MUFOWs



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Figure 3 Artist impression of non-weathervaning MUFOWs

In 2000, University College London and CLRC Rutherford Appleton Laboratory completed an EPSRC funded research project investigating the MUFOW concept [2]. Their results showed that although it would be technically feasible to develop floating offshore wind farms made up of arrays of MUFOW vessels, the schemes would not be economically viable in the current form, even at the most favourable northern European, nearshore sites. However, future developments in deep water mooring and submarine power transmission technologies could significantly reduce MUFOW development infrastructure costs.

References:

- [1] Multiple Floating Offshore Wind Farm (MUFOW), N Barltrop, Wind Engineering Vol. 17 No. 4, pp. 183 – 188, 1993
- [2] Floating offshore wind farms – an option?, A R Henderson et al, Proceedings of OWEMES 2000, Siracusa, April 2000, pp. 505 – 519, 2000