

Impact of Foundation Selection on Wind Turbine Design and Operations

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Summary

Nearly all foundations in European waters are either monopiles or jackets, and there is a mature supply chain for the fabrication and installation of these types of support structures. The U.S. offshore industry is just getting started, and a consideration of a broad array of foundation solutions is warranted because of the specific conditions in the U.S. including water depths, seabed characteristics, and industrial capacity. The type of selected foundation has a huge impact on the design, operation, and repowering of offshore wind plants. This paper examines some of influences.

1. U.S. Market for Foundations

The U.S. is at the cusp of commercial scale development of its offshore wind resource with sufficient lease areas for 40 GW of power generation, and with increasing government requirements for delivering energy from offshore wind that are now approaching 10 GW. There are several factors affecting what type of foundation and support structure make the most sense for U.S. coastal waters, and these considerations are regionally dependent.

2. Non-Traditional Foundation Options for the U.S.

With consideration of the conditions in U.S. waters, the U.S. Department of Energy (DOE) funded demonstration projects to advance different foundation solutions. One of these is a suction bucket solution that is being demonstrated in Lake Erie, which is one of the Great Lakes along the U.S./Canadian border. See

<http://www.leedco.org/> and Figure 1. Two of the critical factors for Lake Erie are that there are deep soft sediments, and that foundations must be designed to resist large lateral loads from moving ice sheets.



Fig. 1 LEEDCO Suction

Bucket

Another DOE funded project is the development of a concrete floating foundation led by the University of Maine. See <http://maineaquaventus.com/> The U.S. has great interest in floating solutions because the

water depths on its West Coast make fixed-bottom solutions impractical.



Fig. 2: Aqua Ventus 1:8 Scale Demonstration

There are of course many other options for both floating and fixed-bottom foundations, all of which provide different advantages as well as design and operational challenges.

3. Impact of Foundation Type on Design and Operation

The type of selected foundation has an enormous effect on all aspects of design and operation. This is being explored by research conducted at Tufts University where some of the effects being considered include fatigue demands, durability, inspection requirements, safety, lifespan extension, local fabrication capacity, installation window, installation vessel requirements, staging and port facilities, impact of boulders, impact on marine habitats, removal, impact on fisheries, rotational and flexural stiffness, certification requirements, impacts of standards and regulations, and many others.

The presentation will explore selected findings from this ongoing study, and also introduce U.S. research efforts for advancing offshore wind energy development.

