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Utilizing What We Know To Develop a New Source of Energy

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Abstract

There are growing incentives to develop offshore wind farms. As with the early oil field developments of 1900-1920, most of the wind developments to date have extended onshore designs and construction techniques to shallow waters. It is time to apply what we in the offshore oil and gas industry have learned to arrive at truly fit-for-purpose offshore solutions for wind farm development.

This paper describes the needs of a typical wind farm and how these differ from those of a typical offshore oil and gas project. It draws on recent AMEC experiences in the design and installation of offshore wind turbines in Europe and studies performed in Houston.

Information and expertise exists within the current oil and gas industry to allow safe and economical designs of offshore wind farms in depths where bottom-supported structures are economical choices. Consideration of the following, however, will lead to different solutions: each installation may require 100 or more structures, the ratios of axial loads to lateral loads are much lower, torsion loads are considerable and rotating blades will have significant dynamic effects. A proper design must take into account economics of scale (“design one, build 100”) and assembly-line-type planning for component fabrication, transportation, assembly, and installation.

The methods and application of technologies successfully used by the offshore oil and gas industry can advance the development of offshore wind energy projects. The tremendous amount of expertise, data, design technology and construction knowledge accumulated by the offshore oil and gas industry has the potential to aid a great leap forward for wind energy. While future research and data collection can help optimize the designs, there is no need to further delay projects by waiting on these results.

Introduction

The supply of energy is a topic of interest to people in every nation in the world. Usually the discussion begins by

modifying the word “energy” with words such as “cheap,” or “renewable,” or “clean,” or any of a myriad of modifiers that place some level of restriction on the supply of the energy. Inevitably, there is an argument against the siting of new energy sources. The public perceives a negative impact from the sight of large stacks associated with coal-fired power plants, domed concrete containment buildings associated with nuclear-fired power plants, large oil tanks behind earthen containment berms for oil fired power plants, and large dams blocking a natural stream for hydroelectric power plants. Visions of terrorist attacks, industrial explosions, environmental pollution, etc., can be easily conjured up by those opposed to development. It makes no difference whether the impact is real or perceived.

Wind energy, however, brings to mind an 18th century European windmill of the Don Quixote variety or a small propeller turning slowly on top of a steel column on a West Texas hilltop or across the plains of mid-America. What could be more picturesque? What could be more benign? Wind has become an icon for cheap (maybe), renewable (certainly), and clean (obviously) energy.

Activists who are opposed to these projects argue about noise pollution and land use. This is not a problem in the American West, where land is cheap and plentiful and neighbors are far removed. However, people live and the demand for energy is greatest on our coasts, where land is expensive, neighbors are close, and rich, potentially powerful people are concerned about the views from their expensive shore houses.

Offshore, where it is possible to use large floating construction equipment and where the noise generated by the blades is less of a factor, new, more economical, larger wind turbines are possible. Wind turbines with 126-meter diameter rotors producing 5 MW of electrical power are already available for offshore applications.

As was the case with the oil and gas industry, which began on land and advanced offshore about 50 years ago, it is now time for wind farms to move offshore. There are several advantages that are immediately apparent, even to structural engineers: no neighbors, no hills, no trees, and lots of wind. As the wind farms move into deeper waters, they can be made to largely disappear from sight.

The next major advance in wind power will be to take what 50 years of offshore oil and gas experience has taught us about offshore structures and facilities and use that knowledge as a basis for developing a new generation of wind turbine support structures. To the offshore engineer who has labored and battled offshore fabrication, installation, operation, and