Will 66 kV Become the Norm in Offshore Wind Energy?

The offshore wind industry is poised to grow by leaps and bounds in the coming years as nations seek out solutions to greenhouse gas emissions using better sources of renewable energy that are cost competitive with fossil fuels. With the development of mega offshore wind farms like the London Array and more like it to come, many are looking to alternative voltage levels for the collection of offshore energy. Though a medium voltage of 33kV is currently the most practical for offshore wind farms, this requires stepping the power up to high voltage (such as 110kV) at an offshore substation and then transmitting it on land at 132 kV in the UK, for instance.

But this configuration requires costly offshore substation installation and extensive lengths of expensive cabling. The difficulties of accessing these remote substations further complicate the production of offshore wind energy. As such, many in the industry are looking for ways to reduce the cost of producing offshore energy by shifting to higher voltage array technology. The hope is that not only will this reduce capital costs, it will also preserve more of the generated energy to make wind farms that much more efficient.

Cutting Cable and Substation Costs with 66 kV

Perhaps ones of the greatest benefits of using 66 kV as opposed to a lower voltage is that it reduces the number of substations required. Further, 66 kV technology can drastically reduce the quantity of cable required, which will have a substantial cost benefit.

The 66kV floating substation at Fukushima Kizuna; Image via Marubeni

The UK Carbon Trust believes that making the switch to 66 kV could cut offshore wind power costs by 1.5% on its own.[i] According to another analysis, the capital costs of installing 33 kV cable further offshore is lower compared to 66 kV cable in the short term. However, over the lifetime of the wind farm, depending on distance from shore and taking load losses into consideration, higher voltage arrays generate substantial cost reductions.[ii]

Acting on this conviction, the Carbon Trust has recently

launched a competition aimed at putting the development of 66 kV cables on the fast track for offshore wind projects. In particular, they're hoping to have the technology polished in time for Round 3 offshore wind power projects in the UK which are to commence 2015. [iii] They estimate that more than 6,000 km of cable and over 6,000 turbine transformers and switchgear will be required for Round 3 offshore wind installations in the UK alone, representing a significant market opportunity. The manufacturers that can perfect 66 kV cable designs will have a distinct competitive advantage.[iv]

The Carbon Trust competition, dubbed "The Race for 66 kV" is part of their Offshore Wind Accelerator and will provide an award of £300,000 for two or more cable suppliers once they are able to design and qualify their lines. The winners will be judged based on the lifecycle cost of the cable design as well as time it takes to complete the qualification of the cable.[v]

As Phil De Villiers, Head of Offshore Wind at the Carbon Trust recently commented, "We are helping the industry cut the costs of offshore wind through a number of innovation projects."[vi]

Achieving Greater Power Transmission with 66 kV

As we've already discussed, the transition from 33kV to 66 kV provides several important cost benefits to the wind industry. Beyond offering the opportunity to construct fewer substations, higher voltage also helps to reduce system losses through more efficient transport of energy, and may provide the opportunity to develop larger arrays.

For instance, one study has shown that with high 66 kV voltage, a 18.4% reduction of the capacity of RPC is achievable compared to 33 kV.[vii] According to the Carbon Trust, switching from 33kV to 66 kV will also achieve a substantial increase in transmittable power. By their estimates, the increase could be more than 100%.[viii] Additionally, researchers have recently determined that a higher voltage system permits the construction of much larger arrays with a higher number of turbines per array. By one estimate, a 66 kV radial feeder could accommodate up to 65 MW of generation, which is nearly double of what can be accommodated by a 33 kV radial feeder.[ix]

If indeed higher voltage will help the industry reduce power losses while also offering the opportunity to develop even larger arrays, developers will no doubt pursue the technology with great interest.

Current Developments in 66 kV for Offshore Wind

Indeed, many developers have already shown interest. In fact, there are many big players participating in the push to 66 kV as the best way forward for intra-array voltage, especially in offshore applications. Developers such as RWE Innogy, ScottishPower Renewables, Eon, Dong, Statkraft, SSE, Vattenfall, and

Statoil – representing 77% of the UK's current licensed wind power capacity – are hoping the move toward 66 kV will take place before 2015 – or as soon as possible.[x]

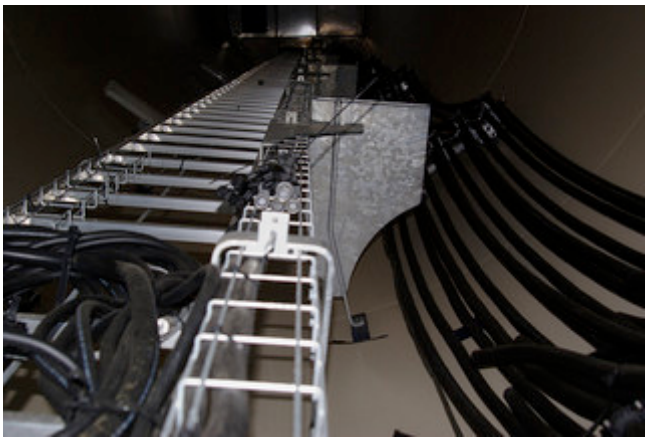

Image Via Flickr: vaxomatic

What's more, researchers in the industry have developed several ways for higher voltage equipment to be accommodated with current structures or turbines. For instance, existing systems could be made to use higher voltage by placing the transfer and switchgear outside of support structures, or placing all equipment inside the tower, or placing only the transformer on the platform.

As the transformer and switchgear technology needed to work with 66 kV is already commercially available through companies like CG Global, Schneider, ABB, and Siemens, there would be no R&D time required to get this kind of equipment into the rotation of offshore wind farms. This makes the use of 66 kV technology particularly attractive in an industry that is in a constant state of innovation and without a standard, tried and true method of doing things.

The only component that requires additional development is that of 66 kV intra-array cables, though suppliers such as Prysmian and Nexan have already developed designs that are in the process of being qualified and certified.

There's already a 66 kV substation in demonstration mode in Japan at the Fukushima Kizuna site. Their 66 kV floating substation on an advanced spar form came online on November 11, 2013 and will be undergoing safety, reliability, and economic potential testing as researchers collect information on everything from hydrographic data to meteorological data to performance data during the experiment. Tests on this facility will be run from now until 2015 with the aim of developing a design they can use for offshore wind power generation in Japan.[xi]

Where 66 kV is Headed in the Offshore Wind Industry

It looks as though, at least in some markets (the UK in particular), 66 kV will play a more active role in offshore wind farms in the coming year. If the testing and assessments currently being conducted in that region continues to generate positive results, no doubt the technology will spread to other markets. However, if the industry wants to realize the benefits of higher voltage arrays, they will need to pay

special attention to challenges such as implementation, particularly as it relates to dry type transformers and cabling. That said, as turbine manufacturers and transformer manufacturers come together to exchange ideas and collaborate on solutions, the technology shows a lot of promise.

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Maryruth can't help but seek out the keys to environmental sustainability - it's the fire that gets her leaping out of bed every day. With green writing interests that range from sustainable business practices to net-zero building designs, environmental health to cleantech, and green lifestyle choices to social entrepreneurism, Maryruth has been exploring and writing about earth-matters and ethics for over a decade. You can learn more about Maryruth's work on JadeCreative.com.

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