A new compact HVDC solution for offshore wind

RYAN LADD, PETER SANDEBERG – Every offshore wind installation must endure one of the most demanding environments on the planet: the open sea. In a constant battle with wind, waves and salt water they must stand firm and reliably transmit power back to the mainland, often many kilometers distant. Perhaps most challenging of all is the delivery and commissioning of these behemoths: Weighing sometimes over 20,000 tons they have to be transported and positioned by the world’s largest vessels and lifted by the world’s most powerful cranes. These are operations that can only be carried out in clement weather. ABB’s new offshore wind compact HVDC solution changes all this.
With demand for clean, reliable power increasing, wind turbines are becoming a common sight in many countries. However, on land, wind strength can change at a moment’s notice and air flows can be disturbed by the presence of hills, trees and cities. At sea, on the other hand, the wind is much more constant and can usually be relied upon to provide a predictable source of power. Also, the number of locations on land suitable for wind turbines is limited – for both practical and aesthetic reasons – whereas wind turbines out to sea are less visible and wind yield is significantly greater offshore. For these reasons, offshore wind turbine numbers are rising rapidly.

Offshore power generation and transmission present challenges, of course. The environment is harsh, facilities have to be accessed for maintenance and there are critical technical obstacles involved in transmitting power great distances under the sea. The problem of transmitting power great distances undersea is a common sight in many countries. However, on land, wind strength can change at a moment’s notice and air flows can be disturbed by the presence of hills, trees and cities. At sea, on the other hand, the wind is much more constant and can usually be relied upon to provide a predictable source of power. Also, the number of locations on land suitable for wind turbines is limited – for both practical and aesthetic reasons – whereas wind turbines out to sea are less visible and wind yield is significantly greater offshore. For these reasons, offshore wind turbine numbers are rising rapidly.

The huge savings in weight delivered by the new HVDC concept have been achieved by close collaboration between ABB’s top HVDC engineers and researchers. Innovative thinking has allowed a substantial reduction in the HVDC hardware installed on the platform and extensive studies and tests helped point the way to reduce redundancy while maintaining the required high levels of availability in the system. With improvements to layout and the elimination of excess space, this revolutionary new concept truly represents the next generation of offshore wind solutions.

Peter Sandeberg  
ABB Power Grids, Grid Systems  
HVDC Market Communications  
Västerås, Sweden  
peter.sandeberg@se.abb.com

Ryan Ladd  
ABB Power Grids, Grid Systems  
HVDC Market Communications  
Ludvika, Sweden  
ryan.ladd@se.abb.com

As well as advantages in fabrication, there are also substantial transportation benefits. There are very few vessels capable of transporting and installing the largest platforms but, with half the weight and the flexibility to distribute the modules between cargo carriers, the new concept represents a step change in logistical management.

A new modular HVDC concept for offshore

Although HVDC is an established technology and has been around for over 60 years, its application offshore is relatively recent. The first offshore HVDC wind project was energized in 2009 and every installation since then has differed significantly from its predecessors, a phenomenon common in a rapidly evolving technology.

The experience and insight gained from implementing HVDC in offshore situations have enabled ABB to come up with a new offshore wind compact solution – one that reduces the weight and volume of the platform by over 50 percent compared to previous designs. Also, the new ABB offshore HVDC solution allows the AC substation platforms currently necessary in the wind farm to be eliminated since the wind turbine generators can now be connected directly to the HVDC platform via a 66kV collection grid. Eliminating the AC substation platform potentially increases the total weight saving further, up to a total of 70 percent compared to a conventional setup and reduces operational costs by removing the long-term maintenance of these stations. The new HVDC concept is based upon a modular product structure that provides the flexibility to accommodate different customer specifications. The optimized base-level platform contains everything needed for a fully operational HVDC platform but if for example, there is need for living quarters, a helipad, a more powerful crane or other options, the concept allows them to be easily added – without designing and fabricating an entirely new platform from scratch.

Modular design, of course, has other advantages. Each module can be produced individually, in parallel with others and in more diverse and smaller workshops, as opposed to the traditional fabrication of the entire topside platform in a dedicated yard. This greatly increases the number of suitable suppliers, which provides a more competitive environment and significantly reduces the risks inherent in all such megaprojects.

A solution for the future

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