Research effort could help facilitate grid of the future

Researchers based at the University of Cardiff in the UK are developing technology that could form the basis of a pan-European grid of the future

by Andrew Williams

AN EU-funded project is investigating the use of multi-terminal (DC) grids to transmit electricity generated by offshore windfarms. The academics behind the project hope that it could form the basis of a future European 'supergrid' – a pan-European electricity transmission network that will support the integration of renewable energy on a large scale, facilitate a single European electricity market and allow the European Union to export sustainable energy technology and create new skilled jobs.

As Catherine Roderick, project officer for the multi-terminal DC grid for offshore wind (MEDOW) project at the Institute of Energy at Cardiff University explained, DC is more efficient than AC transmission, because less of the power gets lost along the way. However, she argues that we still need to develop a grid, rather than rely on single point-to-point connections, as grids are the best way to balance supply and demand of electrical power and to ensure reliability of the system when something goes wrong.

"We are investigating some of the major technical challenges of transmitting offshore wind power through DC grids with multi-terminal voltage source converter technologies," she explained. "We are studying the possible topologies, or formations, of DC grids as well as aspects relating to DC power flow, DC relaying protection, steady-state operation, dynamic stability, fault ride-through capability and impacts on DC grids on the operation of AC (onshore) grids."

Ms Roderick explained that high voltage DC (HVDC) transmission has already been used to transfer power from large offshore windfarms located far out at sea and that voltage source converter (VSC) HVDC has emerged as an attractive technology because of its provision of reactive power support as well as its small footprint and black-start capability.

A key advantage of VSC HVDC systems is that they operate with a nearly constant DC voltage and can change the direction of power flow without reversing the voltage polarity. Ms Roderick highlights the fact that the technology is not limited by the minimum power transfer requirement that exists in conventional current source converter HVDC.

"These features make VSC HVDC more suitable for multi-terminal HVDC, that is to say a meshed grid rather than single point-to-point connections," she told *OWJ*. "Multiple windfarms and onshore AC grids can be connected to a shared DC grid using multi-terminal HVDC to increase transmission flexibility and provide redundancy in case of a transmission system failure. The controllability of the converters allows for an optimal grid operation at both the AC and DC sides."

Ms Roderick believes that multi-terminal DC grid technologies are likely to form the basis of the proposed European supergrid, but she admits that "significant work" needs to be undertaken before either the technology or the supergrid can become a reality.

"Transmitting electrical power via DC also offers some key financial advantages," she said. "It has significantly fewer losses than AC transmission, which means that more of the power generated by wind turbines reaches the end user. DC cables are also smaller and lighter than AC cables and so cost less to install."

For Ms Roderick, the main challenges to be overcome in implementing a supergrid are "non-technical and legislative". She revealed that, according to Friends of the Supergrid, the critical timeline for introduction of new technology lies primarily in the solution of non-technical issues that will create a strong market growth and technology push.

In this light, she said, an early solution to these hurdles will influence the future roadmap to a greater extent than may be foreseen, due to the extended time constraints in planning and construction of new transmission capacity.

Looking ahead, Ms Roderick also pointed out that MEDOW has a number of private sector members, including Alstom Renewables, Control Intelligent de l'energia (Cinergia), EFACEC Energia – Máquinas e Equipamentos Eléctricos, Elia System Operator, China Electric Power Research Institute and National Grid. This means that project researchers benefit from constant steering and guidance from potential end users of the technologies they are investigating.

"Our researchers will be given training and support in applying for further European funding so as to be able to continue their work in this field and help to form a solid DC grids knowledge base in Europe," she concluded. **OWJ**

Researchers working on the MEDOW project hope that, in future, multi-terminal DC grids will transmit electricity