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INTERFACING OFFSHORE WIND TURBINES TO MVDC COLLECTION GRIDS

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Abstract

As people around the globe continue to achieve higher standards of living and economic power, humanity must continually develop new energy resources to sustain the ever-growing demand for services such as transportation, communication, computing, entertainment, etc. To simultaneously satisfy the constraints placed on energy production by anticipated climate change, many nations are developing their offshore wind resources as an environmentally and economically acceptable source of sustainable energy for the future.

Offshore wind farms are being sited further from shore than ever before, with Germany's Global Tech I farm, placed in service just this year, constructed nearly 100 km out to sea. In addition, state-of-the-art wind turbine generators (WTGs) are available at 5 MW and 3.3 kV, requiring nearly 1 km of inter-turbine spacing, as in the case of Germany's Alpha Ventus farm. With 8 and 10 MW WTGs likely entering service in the near future, turbine spacing in excess of 1 km may be necessary for efficient operation.

This great distance to shore has made high voltage direct current (HVDC) a necessity in transporting offshore wind energy to onshore customers due to the lack of reactive power requirements and reduced cabling cost and complexity.

The growing inter-turbine spacing, combined with the necessity of using an HVDC link to shore makes the use of a medium voltage DC (MVDC) collection grid more suitable for aggregating WTG energy within the farm than the traditional MVAC alternative.

This work presents new power electronic solutions suitable for interfacing of next-generation offshore WTGs to MVDC collection grids with features such as resonant soft-switching, high input displacement power factor, and compact high-frequency isolation.

Biography

Michael T. Daniel received the B.S. degree in electrical engineering from Western New England University, Springfield, MA, in 2010 and the M.S. degree in electrical engineering from Northeastern University, Boston, MA, in 2012. He is currently pursuing the Ph.D. degree in electrical engineering at Texas A&M University, College Station, TX, where he served as chair of the IEEE PELS-PES-IAS Joint Student Chapter from 2013-2014. During his studies, Mr. Daniel has held internships with Northeast Utilities, Lawrence Livermore National Laboratory, and International Rectifier, and has been with the U.S. Navy as a Naval Reactors Engineer Officer Candidate since December 2014. His research interests include medium- and high-frequency resonant converters for utility-scale interfaces.