Guest Editorial: Selected Papers from the 5th IET Renewable Power Generation Conference 2016

Pietro Tricoli, Mike O’Hare

The 5th IET Renewable Power Generation Conference was held in London on 21st–22nd September 2016. The conference offered a wide range of topics on renewable power generation, including photovoltaic systems, MPPT algorithms, wind power generation, wave and tidal energy, smart grids, HVDC and low frequency transmission, sensors, control and condition monitoring, provision of network services, operation and maintenance of renewable power sources, marketing design and operations, compliance with codes and standards. The conference reviewers have carefully selected a number of papers presented at the conference and have invited the authors to submit an extended version for publication in IET Renewable Power Generation journal. These papers went through a fresh round of rigorous peer review and 7 papers have been recommended for publication in this special issue entitled ‘Selected papers from the 5th IET Renewable Power Generation Conference 2016’. These include 4 papers on photovoltaic systems, 1 paper on wind integration and 2 review papers.

Photovoltaic systems

Simone Barcellona, Luigi Piegari, Vincenzo Musolino and Christophe Ballif have proposed a study on the economic viability of residential battery storage systems in grid-connected photovoltaic plants by using a methodology for optimising the size of the battery system. They have demonstrated that the identification of the optimal size minimising the total cost of the system is a trade-off between OPEX and CAPEX, which are mainly affected by the battery technology, usage profile, expected lifetime, and efficiency. The methodology has been applied to three typical low-voltage consumers in different countries in order to take into account the different legislative and tariff framework over Europe. The numerical results show that present costs of storage are still too high to make a business case, although a final decision should take into account that the battery system gives additional benefits on back-up services, voltage regulation and peak shaving which are currently not remunerated at residential level. The paper determines the necessary incentives to encourage the spreading of these systems.

Ahsan Rana, Mashhood Nasir, and Hassan Khan have presented research on string level optimisation of grid-tied solar photovoltaic systems to reduce partial shading loss. They have developed an analytical and simulation framework for improving performance ratio under partial shading conditions through alteration of string connections in a string-level inverter system. It has been shown that the losses due to partial shading are not proportional to the shaded area, but depend on the shading pattern, array configuration and the physical location of shaded modules in the array. The application of the proposed methodology has shown up to 4.6% higher performance ratio in winter months for a sample case of a 42.24 kWp system installed at Lahore University of Management Sciences, Pakistan.

Simon Wall, Xiao-Cong Hong, Long Sha and Jing-Ren Xie have presented a paper on high-efficiency voltage source inverter and active common mode filter with silicon insulated gate bipolar transistor and silicon carbide diodes for photovoltaic applications. The active common mode filter is controlled to reduce the photovoltaic ground current to acceptable levels, even when the inverter is connected directly to a low voltage grid with low impedance grounding. A prototype of 50 kW has demonstrated up to 0.3% efficiency improvement compared to a standard inverter with silicon diodes. A second commercial-grade prototype of 100 kW has demonstrated 98% weighted-average efficiency based on the method proposed by the California Energy Commission. Future work will look at transistors optimised for high-speed switching, optimised dc-dc boost converters.

Shady S. Refaat, Haitham Abu-Rub, Antonio P. Sanfilippo, and Amira Mohamed have analysed the impact of grid-tied large-scale photovoltaic system on dynamic voltage stability of electric power grids using the IEEE 30-bus test network. Two different scenarios of normal and load switching have been considered, with centralised photovoltaic power plants connected to the medium voltage level without voltage regulation. Simulation results of these scenarios have shown that voltage instability decreases when large-scale photovoltaic systems are used. The study has discussed the most contingency cases that affect the power system stability in the presence of large-scale photovoltaic systems with the intention to extend the analysis to other cases of line and generator outages.

Wind integration

Tiago Rodrigues, Pedro J. Ramirez, and Goran Strbac have presented a paper on risk-averse bidding of energy and spinning reserve by wind farms with on-site energy storage. They have proposed a novel two-stage stochastic mathematical programming model that allows considering different degrees of risk aversion when optimising the day-ahead energy and spinning reserve bidding strategy of a wind farm with on-site energy storage system. Uncertainty has been modelled through prices and wind generation forecasts, while the conditional-value-at-risk metric has been used to handle day-ahead profit risk. The paper shows relevant case studies providing evidence of the value of combined wind farm and energy storage system bidding not only through increased daily profits but also through reduced offer uncertainty which improves the position of a wind farm in the day-ahead markets.

Review papers

Ben McGITLON, Richard Crozier, Alasdair McDonald and Markus Mueller have presented a review paper on magnetic gear technologies and their applications in marine energy comparing geared and gearless systems. Although gearless systems have some operation and maintenance cost benefits from the elimination of a mechanical speed enhancement element, the resulting machines are large and expensive. Additionally, the fully rated converters required for direct drive machines show cumulatively similar downtime over extended operation periods to that of geared machines. The magnetic gear is a potentially ideal compromise having the benefits of both topologies. The paper has also demonstrated the conceptual applicability of the technology to four existing marine energy devices using existing proposed magnetic gear designs.

Rana Moei, Pietro Tricoli, Hassan Hemida and Charalampos Baniotopoulos have presented a review paper on condition
monitoring of semiconductor devices for wind turbines. The paper shows that there is a complex correlation between the variation of insulated gate bipolar transistor parameters and failure mechanisms and, therefore, an effective condition monitoring algorithm has to consider at the same time the simultaneous presence of the most common failures. The main issue of the state of the art condition monitoring systems is the trade-off between accuracy, complexity and implementation costs, especially for on-line monitoring. In the specific case of wind turbines, wind speed variations can cause errors in monitoring the health status of insulated gate bipolar transistors due to different load cycling and consequently thermal fluctuation of the semiconductor devices. Future condition monitoring systems are expected to combine several methods together and use cross-correlation techniques to discriminate different degradation mechanisms.

**Guest Editor Biographies**

**Pietro Tricoli**

![Dr Pietro Tricoli](image)

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![Mr Mike O'Hare](image)

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