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Friedrich, D, Pimm, AJ and Shek, JKH (2016) Guest Editorial. IET Renewable Power Generation, 10 (10). pp. 1459-1460. ISSN 1752-1416

https://doi.org/10.1049/iet-rpg.2016.0914

Guest Editorial

The second annual Offshore Energy & Storage symposium (OSES 2015) was held at the University of Edinburgh, Scotland, on 1-3 July 2015. The conference attracted over 80 delegates from around the world, largely from the offshore energy research community, and consisted of 40 presentations spread over nine sessions, covering topics including energy storage, offshore renewables, grid integration, economics, policy, microgrids and island networks. There were also five keynote presentations from leading academics and the CEOs of several major energy businesses, and a panel discussion session, as well as a visit to the recently opened FloWave Ocean Energy Research Facility, housing a circular wave testing tank.

A selection of the best papers was made by the organising committee, and their authors were then invited to submit extended versions of the papers for peer review, and ultimately publication in this special issue. Many of the papers consider the grid integration of renewables using energy storage, which we believe shows the importance of this area in allowing further integration of low carbon technologies. This is particularly true for offshore generation technologies such as wave power, which present new challenges for the deployment and economics of renewable energy. Several of the papers introduce novel concepts with the potential to offer new ways of generating or storing energy, opening up new avenues for research.

The following topics are covered in this special issue:

- Offshore energy generation
- Grid integration
- Energy storage
- Economics

This selection on current topics in offshore renewable energy and storage presents an overview of the challenges and opportunities for offshore energy. We therefore believe that this special issue is of interest not only to readers working in the offshore energy area, but also to readers interested in bringing their expertise to the growing field of offshore renewable energy.

As Guest Editors, we would like to thank the authors for their paper submissions, as well as the large number of reviewers whose efforts have helped to maintain the high publication standards of IET Renewable Power Generation. We would also like to thank the IET Editorial Office for the help and support that has made this Special Issue possible. Finally, we would like to thank the Editor-in-Chief, David Infield, for providing us with this opportunity as well as patiently awaiting the completion of this Special Issue.

Offshore energy generation

Wave power absorption by a submerged balloon fixed to the sea bed

In the paper by Kurniawan and Greaves, the concept of absorbing wave energy using a submerged balloon attached to the seabed is investigated. A previously-developed numerical model is extended and used to show the power-absorption performance of seabed-mounted balloons, showing a broad-banded wave power absorption.

Dimensioning methodology for energy storage devices and wave energy converters supplying isolated loads

In the paper by Lafoz et al., a methodology is presented, using stochastic models, for sizing of an energy storage system for wave energy based on wave energy device type, load characteristics, and location. The paper applies the methodology to a 2-body point absorber device located in the Gulf of Mexico.

Grid integration

Joint optimisation of generation and storage in the presence of wind

Liu et al.'s paper presents a methodology for the optimal choice of renewable generation capacity and storage size so that costs are minimised while demand is met at all times. After analysing a case study with historical wind and demand data, the authors extend the optimisation framework to stochastic distribution-based resource and demand data. Thus the methodology can be used to design an integrated energy system which takes the uncertainty of future wind speed and demand into account.

Exploiting the thermal potential of deep seawater for compensating losses in offshore hydraulic wind power transmission pipelines

In the paper by Sant et al., the possibility of using hydraulics to transmit power to shore for offshore wind turbines is investigated. The paper explores the use of cold deep-seawater from below thermoclines as a method to reduce losses from fluid friction.

Energy storage

Segmented packed beds for improved thermal energy storage performance

In the paper by McTigue and White, a new design feature for pumped heat electricity storage is investigated: segmentation of the packed beds. The paper explores the optimal segmentation of both hot and cold packed beds and looks at the effects on efficiency and capital costs.

An approach to reduce the flow requirement for a liquid piston near-isothermal air compressor/expander in a compressed air energy storage system

In the paper by Li and Saadat, a compressed air energy storage system that uses a liquid piston compressor/expander is investigated. Combining a liquid piston with a solid piston actuated by a hydraulic intensifier is studied, and optimisation is carried out to show the potential effects on pump/motor size and mean efficiency.

Heat transfer performance of thermal energy storage components containing composite phase change materials

Zhao et al.'s paper presents experimental and numerical analysis of heat transfer in composite phase change material thermal energy storage systems. The validated numerical model enables optimisation of the configuration of the thermal energy storage component as well as the composition of the composite phase change material. In particular, the mass ratio of the thermal

conductivity enhancement material can be used to tune the heat transfer rate and heat storage density for the specific application.

Experimental analysis of buoyancy battery energy storage system

In the paper by Bassett et al., a buoyancy-based energy storage system is demonstrated through functional testing of the concept at 2 different scales. The development and integration of the system components is discussed along with the practicalities of scaling up for larger applications.

Rechargeable nickel–iron batteries for large-scale energy storage

In the paper by Abdalla et al., the effect of iron sulphide and copper composites on the electrochemical performance of NiFe batteries are investigated, with a focus on grid scale energy storage. In particular, the paper focuses on suppressing the evolution of hydrogen in the electrolyte in order to improve overall performance.

Economics

Energy storage and wind power: sensitivity of revenue to future market uncertainties

In the paper by Dunbar et al., a study on the sensitivity of storage revenue to uncertain market variables is presented. Interestingly, it is shown that increased wind generation could reduce opportunities for price arbitrage and lessen storage revenue.

Guest Editor Biographies

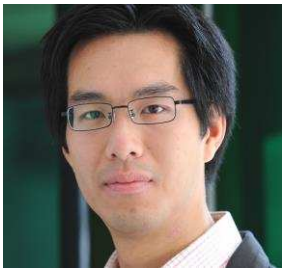
Daniel Friedrich, Chancellor's Fellow at The University of Edinburgh

Daniel Friedrich studied applied mathematics at the Universities of Auckland and Karlsruhe. In 2005 he worked at the Fraunhofer-Gesellschaft in Karlsruhe, Germany, before joining the Optoelectronics Research Centre at the University of Southampton where he obtained his PhD in mathematical modelling. In 2009 he joined the School of Engineering at the University of Edinburgh and, in 2013, he was appointed to a Chancellor's Fellowship in Mathematics for Engineering Applications. His research interests are in the mathematical modelling, simulation and optimisation of engineering processes in the wider energy area, particularly for dynamic systems. This includes the accurate and

efficient simulation of specific components as well as the simulation of integrated hybrid renewable energy systems.

Andrew J. Pimm, Research Fellow at The University of Leeds

Andrew J. Pimm received a degree in Mechanical Engineering at the University of Nottingham in 2007, and subsequently received a PhD from Nottingham in 2011, on underwater compressed air energy storage and fabric structure analysis. He subsequently worked at Nottingham for several years as a postdoctoral researcher investigating various aspects of grid-scale energy storage. In 2015 Dr Pimm joined the University of Leeds to work as a Research Fellow in the School of Chemical and Process Engineering. His research is mainly focused on energy storage, covering various aspects including the socioeconomics of distributed energy storage both within cities and co-located with renewables, along with compressed air energy storage and pumped storage.



Jonathan K. H. Shek, Chancellor’s Fellow at The University of Edinburgh

Jonathan K. H. Shek received the M.Eng. (Hons) and Ph.D. degrees from the University of Edinburgh, Edinburgh, U.K., in 2004 and 2009, respectively. In 2012, he was appointed to the position of Chancellor's Fellow within the Institute for Energy Systems at the University of Edinburgh. He has a background in power electronics and renewable energy. He is working in the area of power conditioning, condition monitoring, and control for renewable energy devices. Recently, he has led funded projects on control of wave energy arrays with energy storage, power converter and control for tidal current turbines, and grid integration of wind turbines for grid-connected and off-grid applications.