



Introduction to Special Issue on Modern Power Systems & Sustainability

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Preamble: This special issue of the International Journal of Computing and Digital Systems (IJCDS) focuses on applications of modern power system and sustainable energy with attention to GCC. The special issue publishes selected papers from the 9th IEEE GCC 2017 conference, which has been held on May 9-10, 2017, Manama, Bahrain. The conference provided a forum for discussion among professionals from industries, academia and research institutions with the conference theme “Solutions for a Smarter Economy”. The conference offered an excellent opportunity for scientists, innovators, and engineers to interact, share experiences and present their latest research with peers in a multidisciplinary engineering background. This conference also included tutorials and workshops as well as an industrial exhibition. The conference had eight different tracks that covers important aspects related to electrical and electronics engineering. One of the main tracks was the Energy and Power Systems, which included topics related to Energy Efficiency, Power System Quality, Energy and Demand Side Management, Renewable Energy, Power System Protection, and Smart Grid & Micro Grid. The track has attracted papers by authors from several countries across the world. Each paper reviewed by three members of the technical program review committee, and the accepted papers were presented during the conference, only six papers have been selected to be submitted as extended versions in this special issue.

Keywords: Modern Power System, Renewable Energy, Energy Saving & Conservation, Deregulated Power System, Power System Reliability.

INTRODUCTION

The special issue of the Journal comprises six articles, which are selected from the papers that were presented during the 9th IEEE GCC conference May 8-10, Bahrain. The papers focus on the application of modern power systems and the integration of renewable energy, with special attention to GCC countries. There is a remarked increase to use of renewable energy for electricity production worldwide. This is driven by a commitment to reduce the dependency on fossil fuels and the associated environmental impact. GCC-along with many countries-countries have taken measures and initiatives to encourage the use of renewable energy in various forms. Such initiatives resulted in the wide development of smart and micro grid systems. Such systems require fast and modern tools of understating and analysis. This special issue is an effort towards the expansion of knowledge in the area of modern power systems.

The first paper is on “*Solar systems analysis and estimation for buildings in Bahrain and GCC countries*”, authored by Christine G. Georgantopoulou and Nikolaos S. Vasilikos [1]. The authors identify and present the fundamental parameters for the solar systems installation in GCC, the influence of the local environmental conditions, and the panels’ characteristics and efficiency for this certain region. An extended investigation is presented concerning the characteristics of the panels’ types, the orientation and tilt angle, the influence of dust, humidity and climate temperature, and the real efficiency of the panels’ estimation. The authors developed an alternative empirical approach, giving particular interest to the specific factors that are responsible for the efficiency drop. The paper concludes that the solar systems application are beneficial for Bahrain and the GCC region, if the installation is developed according to the specific climate conditions as the dust precedence in the atmosphere or the temperature on the cells during the operation.

The second paper is on “*Using Digital Signal Processing in Power System Overcurrent Relay Protection*” authored by Abdullah Al-Nujaimi, Abdulaziz Al-Muhanna, Omar Bamasq and Azzedine Zerguine [2]. This paper proposes to use the concept of Digital Signal Processing (DSP) to enhance the operation of digital relays. The objective is to improve



the reliability and security of the modern power systems. The article reports on the design and the modelling of an overcurrent relay in MATLAB/SIMULINK using modern DSP techniques. The performance of the modeled relay is compared with IEC standard and ETAP simulation studies. The results indicate that the operation time obtained for simulation method is close to IEC 255-3 standard.

The third article in this special issue is titled "*Performance Evaluation of a Tape-Wound Core Transformer using Meta-Model Based Scaling Laws*". Ahmed Tahir, Abdelsalam Elhaffar, Scott Sudhoff and Steve Pekarek authored the paper [3]. The article presents a multi-objective optimization techniques to study the design and performance of tape-wound transformers that are widely used in power electronics application. A per-unit T-equivalent circuit and magnetic equivalent circuit model are used to obtain the transformer scaled model. By using genetic-algorithms based multi-objective optimization and curve fitting techniques, the transformer meta-model is derived. The derived meta-model is used to study the effect of varying the frequency and rated power on the transformer performance. The study indicates that the efficiency improves as frequency increases which gives another advantage of operating the transformer at higher frequencies.

The fourth paper is "*Energy Conservation Awareness among Residential Consumers in Saudi Arabia*" It is authored by Omar K.M.Ouda, Samir El-Nakla, Chedly B. Yahya, Helen. P. Peterson and Mohamed Ouda [4]. The paper addresses the energy consumption and conservation measures in Saudi Arabia. This study measures the Saudi residential sector awareness of energy conservation best practices and the challenges facing the energy sector in the Kingdom. A questionnaire survey was designed and implemented. The survey quantitatively and qualitatively assessed consumers' awareness in billing, efficient appliances and lighting systems. The survey findings suggest that Saudi consumer behaviors in using energy are influenced by economic, educational, social, and cultural factors. The survey results show a very low awareness and appreciation to electricity conservation practices in their houses and highlight the need for an effective and comprehensive measures to improve conservation practices in the kingdom.

The fifth paper is "*Calculation of Participation Based Loss Factors using the Concept of Market Center in a Deregulated Power System*" is authored by Arunachalam Sundaram [5]. The article presents a new technique to determine the loss components of the Locational Marginal Prices in a deregulated electricity market. The paper proposes a participant based distributed slack power flow model where the losses are distributed to each participant instead of each bus. Case studies carried out using radial five bus system and IEEE 30 bus system indicate the effectiveness of the proposed model. The loss factors calculated by the proposed method are more suitable for the deregulated power system since they are calculated for each participant based on their distance from the Market Center and not bus wise as in existing techniques.

The sixth article in this special issues deals with the reliability of power system. The paper is titled "*Reliability/Cost Tradeoff for Interconnected Electric Power Systems*" [6]. It is authored by Abdullah M Al-Shaalan. The paper attempts to explore the effects of electric power systems interconnection upon enhancing their overall reliability levels and reducing their fixed and operating costs. From a technical perspective, the mutual reliability and cost benefits that could be attained from systems interconnection efforts primarily depend on the operating reserves, and operating conditions of each individual system. This is done by using unified measures for reliability evaluation, based on efficient and practical techniques, have been developed. The method is applied to three electric utilities in the Western part of Saudi Arabia, namely, Jeddah, Mecca, and Taif. The paper found that by applying the proposed measures, it is possible to evaluate the economical and technical advantages resulting from the mutual interconnection among those three electric utilities.

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Ibrahim El-Amin is a Professor of Electrical Engineering at the King Fahd University of Petroleum and Mineral since 1978. He received his Ph.D. and M.Sc degrees from the University of Manchester in 1978 and 1975, respectively, in electrical engineering with a specialization in HVDC power systems. He obtained his B.Sc. degree in electrical engineering from the University of Khartoum, Sudan, in 1971. His research interests include power systems, power system protection, power quality, DC transmission, power electronics, and the electricity deregulation. and renewable energy sources. Currently, Professor. El-Amin is the principal investigator of many research projects. His projects were funded by Ministry of Water, &Electricity, Saudi Electricity Company and KFUPM. Professor El-Amin has been very active in assessment and accreditation of academic programs since 1993. He chaired and coordinated ABET accreditation activities at KFUPM Dhahran. He is currently an ABET (USA) and NCAAA Program Evaluator. Professor El-Amin is a life Senior Member of the IEEE.



Amer Al-Hinai is the director of Sustainable Energy Research Center (SERC) and an associate professor in the Electrical & Computer Engineering Department at Sultan Qaboos University. During 2012-2016 he joined Masdar Institute of Science & Technology in Abu Dhabi, UAE. He was a faculty member at the Institute Center for Energy (iEnergy) and an assistant professor in the Electrical Engineering & Computer Science Department at the Masdar Institute. In addition, Dr. Amer has served as the Chairman and a member of the Authority for Electricity Regulation (AER) during 2011-2017. AER is the nation's electricity regulator in Oman. His areas of interest are in the control and operation of power systems, integration of renewable energy, microgrid, and energy conservation. Dr. Amer has served as the Chairman of the Energy Saving Committee at Sultan Qaboos University and has carried out more than 30 industry-funded research and 10 research grants.

He has published over 60 research papers in international journals and conferences and more than 35 technical reports. He received several awards such as His Majesty Trust Fund research award, "One of the Pioneers in the Engineering Practice in the Gulf", Fulbright Research Scholarship, and first prize for the technical competence paper at the 39th IECON. Dr. Amer Al-Hinai is an IEEE senior member and currently the Chairman of IEEE Oman Section.

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