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IEEE POWER ENGINEERING SOCIETY
ENERGY DEVELOPMENT AND POWER GENERATION COMMITTEE

PANEL SESSION: ENERGY ISSUES UNDER DEREGULATED ELECTRICITY ENERGY MARKETS

Room: 512e

(Loi Lei Lai and Tom Hammons)

IEEE 2006 General Meeting, Montreal, Canada, 18-22 June 2006
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Sponsored by: International Practices for Energy Development and Power Generation[#]

Chairs: Tom Hammons, University of Glasgow, Scotland, UK
Loi Lei Lai, City University, London, UK

Topic: Critical Infrastructure of the Power System

INTRODUCTION

On behalf of the Energy Development and Power Generation Committee, welcome to this Panel Session on Energy Issues under Deregulated Electricity Energy Markets.

This Panel Session deals with the current state and problems in the deregulated power markets. The use of distributed generation has increased the importance of the protection and various techniques will be evaluated. Due to increased use of digital devices that are very sensitivity to the power quality issue, the application of wavelet for power quality analysis for practical data will be reported. Also, a case study on harmonics generation from railway operation will be given. In order to promote further the use of renewables, it is essential to keep electricity generation costs down but power quality up. Some practical and novel methods will be discussed. It is essential to know the equilibrium market point to maximize profit and minimize cost. A number of ways will be looked at and the benefit in use of intelligent techniques will be presented with a real power market. Risk management is one of the top issues in the energy sector. The Insurance issue in energy risk will also be looked at.

The Panelists and Titles of their Presentations are:

1. Norman Tse, City University of Hong Kong, Hong Kong. Practical Application of Wavelet to Power Quality Analysis (paper 06GM0790)
2. Davor Vujatovic, Engineering Manager, EDF Energy, UK and Qingping Zhang, City University, London, UK. Harmonics Generated from Railway Operation (paper 06GM0852)

[#] Document prepared and edited by T J Hammons

3. Yuping Lu, Xin Yi and Xia Lin, Southeast University, China; and Ji'an Wu, Guodian Nanjing Automation Co. Ltd., Nanjing, China. An Intelligent Islanding Technique Considering Load Balance for Distribution Systems with DGs (paper 06GM0323)
4. Tze F. Chan, Hong Kong Polytechnic University, Hung Hom, Hong Kong and Loi Lei Lai, City University, London, UK. Three-Phase Induction Generator Operating on a Single-Phase System (paper 06GM0847)
5. Harald Braun, Xchanging, London, UK, and L L Lai, City University, London, UK. Insurance Issues for Energy Risk (paper 06GM0285)
6. Kit Po Wong and C Y Chung, Hong Kong Polytechnic University, Hong Kong. Evolutionary Computation Techniques for Power Market Equilibrium Determination (paper 06GM0804)
7. S N Singh, Indian Institute of Technology, Kanpur, India and I Erlich, University of Duisburg, Essen, Germany. Wind Power Trading Options in Competitive Electricity Market (paper 06GM0343)
8. Kwang Y Lee, Pennsylvania State University, USA. The Effect of DG using Fuel Cell under Deregulated Electricity Energy Markets (06GM1321)
9. Invited Discussers.

Each Panelist will speak for approximately 20 minutes. Each presentation will be discussed immediately following the respective presentation. There will be a further opportunity for discussion of the presentations following the final presentation.

The Panel Session has been organized by Tom Hammons (Chair of International Practices for Energy Development and Power Generation, University of Glasgow, UK) and Loi Lei Lai (Head, Energy Systems Group, City University, London, UK).

Loi Lei Lai and Tom Hammons will moderate the Panel Session.

The first presentation is entitled: Practical Application of Wavelet to Power Quality Analysis and has been prepared and will be presented by Norman C. F. Tse, City University of Hong Kong.

This presentation discusses a computational algorithm for identifying power frequency variations, sub-harmonics, integer harmonics and inter-harmonics, by using a wavelet-based transform. The continuous wavelet transform using the complex morlet wavelet is adopted to detect the harmonic frequencies presented in a power signal. The frequency detection algorithm is developed from the wavelet ridges and scalogram. A necessary condition is established to discriminate adjacent frequencies. The instantaneous frequency identification approach is applied for the determination of frequencies components presented in a power signal. An algorithm based on the Discrete Stationary Wavelet Transform is developed and discussed to determine the amplitudes of harmonic frequencies presented in the power signal from the coefficients computed by the continuous wavelet transform.

Norman, C. F. Tse graduated from the Hong Kong Polytechnic University (then Hong Kong Polytechnic) in 1985. He obtained his MSc degree from the University of Warwick in 1994. He is now working with the City University of Hong Kong as a Senior Lecturer on building LV electrical power distribution systems. His research interest is in power quality measurement, web-based power quality monitoring, and harmonics mitigation for low voltage electrical power distribution system in buildings.

The second presentation discusses harmonics generated from railway operation and has been prepared by Davor Vujatovic and Qingping Zhang. Davor Vujatovic is with the EDF Energy, Kent, UK and Qingping Zhang is with the City University, London, UK

This presentation discusses harmonics generated while typical high-speed railways are in operation. The solution in reducing harmonics by installation of power electronic compensators, especially static VAR compensator, in the railway system during railway infrastructure upgrading may not be an easy solution. Discussion will be given and a better approach will be proposed. To find effective solutions to balance the main drawback of SVC compensators, injection of harmonic currents into the railway catenary may be employed. This may not be practical due to their highly non-linear characteristics. Analysis of a large volume of data collected in a practical high-speed railway project has been carried out to study the harmonics content. Negative consequences of SVC to the both railway and grid system could be minimized by the discussed approach. This will be reviewed.

Davor Vujatovic is Engineering Manager of EDF Energy (Private Networks). He was Secretary of the DRPT 2000 International Conference on Electric Utility Deregulation and Reconstructing and Power Technologies that was co-sponsored by both the IEEE and IEE. He is a Member of the IEEE, IEE and CIGRE. His research interest is in studying impact of railway operation on power quality.

Qingping Zhang gained his BSc and MSc degrees both in Computer Science from Nankai University, Tianjin and Fudan University, Shanghai, China, respectively. Presently, he is working towards his PhD degree at City University London. His research interest is in computational intelligence application, in particular, the intelligent agent.

The third presentation will discuss an intelligent islanding technique considering load balance for distribution systems with DGs. Yuping Lu, Xin Yi, Ji'an Wu, and Xia Lin have prepared it.

The island is an important operation mode of distribution system with distributed generators. The principles of islanding will be presented. Based on the simplified model of distribution system, a new concept of cell is defined and an islanding mathematical model as well as a heuristic islanding algorithm through combining cells is proposed. The algorithm can well satisfy the constraint conditions while the process of islanding can achieve a feasible islanding scheme in a short time. Thus, the operation mode of distribution system can change swiftly under fault states. The load priority is utilized to enhance islanding algorithm to select load. Thus, the method ensures not only priority services for important loads, but also be compatible with the under-frequency load shedding. This will be discussed.

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Yuping Lu is working as a professor in Southeast University of China. His research interests are power system protection, especially digital relaying of generator-transformer unit, and protection and control technique in distribution system with DGs.

Xin Yi is pursuing his M.E. in Southeast University. His current research interest is protection and control of distribution system with DGs.

Ji'an Wu is working as chief engineer in Guodian Nanjing Automation Co.Ltd. His current research interest is Power System Protection

Xia Lin is pursuing her PhD in Southeast University. Her current research interest is protection and control of distribution system with DGs

The fourth presentation has been prepared by Chan (Hong Kong Polytechnic University, Hung Hom, Hong Kong) and Loi Lei Lai (City University, London, UK). It is entitled: Three-Phase Induction Generator Operating on a Single-Phase System.

The general principle of phase balancing for a three-phase induction generator operating on a single-phase power system is investigated and a practical phase-balancing scheme is proposed. A phasor diagram approach enables the conditions of perfect phase balance to be deduced. The feasibility of the phase-balancing schemes is verified by laboratory experiments on a small induction machine. This is discussed.

T. F. Chan is an Associate Professor at the Hong Kong Polytechnic University, where he has been since 1978. His research interests are self-excited a.c. generators, brushless a.c. generators, and permanent-magnet machines.

L. L. Lai is Head of Energy Systems Group at City University, London, UK. He is a Visiting Professor at Southeast University, Nanjing, China and a Guest Professor at Fudan University, Shanghai, China. He has authored/co-authored over 200 technical papers. In 1995, he received a high-quality paper prize from the International Association of Desalination, USA. Among his professional activities are his contributions to the organization of several international conferences in power engineering and evolutionary computing, and he was the Conference Chair of the IEEE/IEE International Conference on Power Utility Deregulation, Restructuring and Power Technologies 2000.

The fifth presentation discusses Insurance Issues for Energy Risk. Harald Braun, Xchanging, London, UK and Loi Lei Lai, City University, London has prepared it.

This presentation is a survey of insurance options for the deregulated energy market. Decision makers and engineers in the energy sector have a need for risk management and require up-to-date information of available risk transfer options from the insurance industry. This presentation will summarize the risks energy companies are facing and what cover is available. It also outlines some options that risk managers have, how deregulation is affecting the insurance industry and how new energy technologies are impacting the insurance market.

H. Braun is currently working as Insurance Software Architect and Application Designer for Xchanging, London, a business services processing company. He was a Senior Software Engineer at A.M. BEST International Ltd, London, from 1996 to 2000 and with ALTIO from 2000 till 2002, London, leading the development of new Internet technology software. He has held many different positions in industry and academia, among them Lecturer and Software Project Manager. His current research interests are claims and disaster predictions for the insurance industry.

L. L. Lai is Head of Energy Systems Group at City University, London, UK. Among his professional activities are his contributions to the organization of several international conferences in power engineering and evolutionary computing, and he was the Conference Chairman of the IEEE/IEE International Conference on Power Utility Deregulation, Restructuring and Power Technologies 2000.

The sixth presentation is on Evolutionary Computation Techniques for Power Market Equilibrium Determination. K. P. Wong, and C. Y. Chung, Computational Intelligence Applications Research Laboratory, Hong Kong Polytechnic University, Hong Kong have prepared it.

The presentation reviews the application of some evolutionary computation techniques for power market equilibrium determination. Competitive power markets are formulated as a Cournot game. Genetic algorithm and co-evolutionary computation techniques are adapted to numerically solve the optimization problem of finding the market equilibrium. A numerical example will be given that shows that the evolutionary computation approach is effective and that it provides a powerful means for electricity market analysis.

K.P. Wong received three Sir John Madsen Medals (1981, 1982 and 1988) from the Institute of Engineers Australia, the 1999 Outstanding Engineer Award from IEEE Power Chapter Western Australia and the 2000 IEEE Third Millennium Award. He has published numerous research papers in power systems and in the applications of artificial intelligence and evolutionary computation to power system planning and operations. His current research interests include evolutionary optimization in power, power market analysis, power system planning and operation in deregulated environment, power quality. He is an Editor-in-Chief of IEE Proceedings, Generation Transmission & Distribution. He is a Fellow of IEEE, IEE, HKIE and IEAust.

C.Y. Chung is an Assistant Professor in the Electrical Engineering Department of The Hong Kong Polytechnic University. His research interests include power system stability/control, computational intelligence applications and power markets.

The seventh presentation is on Wind Power Trading Options in a Competitive Electricity Market and has been prepared by S. N. Singh, Indian Institute of Technology, Kanpur, India and I. Erlich, University of Duisburg, Essen, Germany. S. N. Singh will present it.

Integration of wind power into the competitive electricity market presents challenges to power system planners and operators. It is not possible for wind generators to bid into the competitive electricity market due to high cost and intermittent nature of available power. This presentation analyses and proposes the pricing mechanism for wind power in the competitive electricity market. The both demand and supply side bidding scenarios with case studies are presented The impact of wind power in market mechanism such as market collusion, ancillary series and market power are also discussed. This paper could be a guideline for the policy makers and market operators to promote the wind power with system reliability and security.

S.N. Singh is an Associate Professor in the Department of Electrical Engineering of I.I.T. Kanpur, India and is presently on leave to carry out research as Humboldt Fellow at the University of Duisburg-Essen, Germany. Dr. Singh received several awards including Young Engineer Award 2000 of Indian National Academy of Engineering, Khosla Research Award, and Young Engineer Award of CBIP New Delhi (India). His research includes power system restructuring, FACTS, power system optimization and control, security analysis, ANN & Fuzzy-Neural applications in power system problems and transient stability.

I. Erlich worked in Hungary in the field of electrical distribution networks. In the period of 1991 to 1998, he worked with the consultancy company EAB in Berlin and the Fraunhofer Institute IITB Dresden respectively. Since 1998, he has been Professor and Head of the Institute of the Electrical Power Systems at the University of Duisburg-Essen, Duisburg, Germany. His major scientific interest is focused on power system stability and control, modeling and simulation of power system dynamics including intelligent system application.

The final presentation is on the Effect of DG using Fuel Cell under Deregulated Electricity Energy Markets. It has been prepared and will be given by Kwang Y. Lee, The Pennsylvania State University, USA.

A free market approach to buying and selling electricity is forecasted to drop the cost and introduce choice into what has been a monopoly industry. Deregulation has accelerated the

development of smaller generators and fuel cells will gradually become more attractive to mainstream electricity users as they improve in capability and decrease in cost. Some of the operating conflicts and the effect of distributed generation on power quality will be addressed. A Molten Carbonate Fuel Cell stack dynamic model was developed to analyze a spectrum of dynamic responses from slow to fast transients and a simplified process flow diagram of the Santa Clara Demonstration Project will be presented. The integration of Direct Carbonate Fuel Cell (internally reformed carbonate fuel cell) with a gas turbine is an emerging technology. Fuel cell-micro-turbine hybrid power plant can be interfaced with the utility grid via a three-phase inverter, controlling active and reactive power. This will be discussed.

Kwang Y. Lee has been with Michigan State, Oregon State, University of Houston, and Pennsylvania State University where he is now a Professor of Electrical Engineering and Director of Power Systems Control Laboratory. His interests include power system control, operation, planning, and intelligent system applications to power systems. Dr. Lee is a Fellow of IEEE, Associate Editor of IEEE Transactions on Neural Networks, and Editor of IEEE Transactions on Energy Conversion. He is also a registered Professional Engineer.

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9. Invited Discussers

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