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**IEEE POWER ENGINEERING SOCIETY
ENERGY DEVELOPMENT AND POWER GENERATING COMMITTEE**

**PANEL SESSION: STATUS OF INTERNATIONAL
INTERCONNECTIONS AND ELECTRICITY DEREGULATION IN
AFRICA**

IEEE 2004 General Meeting, Denver, 6-12 June 2004
Wednesday, June 9, 2004, Room Silver, 9:00 a.m.–5:00 p.m.

INTRODUCTION

Sponsored by: International Practices for Energy Development and Power Generation Subcommittee

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Track 1: Active Load Participation and Its Impact on Markets

On behalf of the Energy Development and Power Generation Committee, welcome to this Panel Session on Electricity Deregulation in Africa

The panel will review the present status and future prospect of electricity infrastructure from the viewpoint of Generation and Transmission Development, Global Deregulation trends and policies, Global Research and Development (R & D) and the Global transition to knowledge based economies. The panel will therefore attempt to evaluate models and policies that are near term, mid term and long term.

Interconnection of electric power systems of regions, states and individual territories is acquiring a growing scale of importance in world practice as previously recognized by this body. Examples of this influence and studies to date will be presented. Key to the presentations will be the focus on the projected development of power pools in various regions and their interconnections domestically and internationally. There are many benefits of this tendency because of the so-called system effects that lead to improving economical, ecological and technological efficiencies of the joint operation of electric power systems. The effort to limit GHG emission is one such major benefit. Another important benefit with institutional wide implications is the modeling of these initiatives. The raw resources data of these emerging energy initiatives integrated with global 'lessons learned' allows for the creation of dynamically linked knowledge bases and their derivatives. These in turn serve to efficiently drive these emerging initiatives while creating information density. The EPRI road Map initiative is one such example.

Africa, Asia and the Middle East are very favorable regions for electric power grid creation and using the above system effects on account of different levels of economic development in different countries of the region, different placement of fuel and energy resources, and consumers, etc. Therefore, the analyses of the present status and prospective trends of Africa, European and

Middle Eastern Electricity interconnections and efforts to improve efficiency and limit GHG emission and bridging the digital divide are very important problems.

The Session presents some results of studies in this area at this time.

Presenters and Titles of their Presentations are:

- 1) Pat Naidoo, Senior General Manager of Transmission, Eskom, Johannesburg, South Africa; I Musaba, W. Ballet, and A. Chicova, Harare, Zimbabwe. Towards Developing a Competitive Market for Regional Electricity Cross Border Trading: The case of the Southern Africa Power Pool (Paper 04GM0755).
- 2) A. Majeed H A Karim, Secretary to the Board of Directors, GCC Interconnection Authority (GCCIA), Kingdom of Saudi Arabia; N.H. Al Maskati, Deputy Chairman of Board of Directors, Kingdom of Saudi Arabia; and S. Sud, V.P. Energy Division, SNC–Lavalin Inc., Montreal, Canada. Status of the GCC Electricity Grid System Interconnection (Paper 04GM0660).
- 3) F. T. Sparrow, Brian H. Bowen, and Zuwei Yu, Power Pool Development Group, Purdue University, West Lafayette, IN, USA. Economic Benefits and Strategic New International Transmission in the Southern African Power Pool (SAPP) and West African Power Pool (WAPP) (Paper 04GM0758).
- 4) Wei-Jen Lee, Director, Energy Systems Research Center, University of Texas at Arlington, TX, USA. The Environmental Impact of Large Scale Hydroelectric Development: Lessons from Three Gorges (Paper 04GM0584).
- 5) B.K.Blyden, BBRM Investments, LLC, Elk Grove, CA, USA. African Power Pool Interconnections Development: A Foundation for Bridging the Digital Divide (Paper 04GM0927).
- 6) James Momoh, Director, National Science Foundation, Arlington, VA, USA. US/African Power Research and Education Activities: Challenges, Experiences and Opportunities (Paper 04GM1268).
- 7) Ahmed Faheem Zobaa, Cairo University, Giza, Egypt. Status of International Interconnections in North Africa (Paper 04GM0509).
- 8) Lori Pottinger, International Rivers Network, USA. Large Hydro-fueled Grid Schemes for Africa: A Recipe for Disaster? (Paper 04GM0481).
- 9) Moshin Chen, Professor Emeritus, Energy Systems Research Center, University of Texas at Arlington, TX, USA. The Energy Challenge (Paper 04GM1083).
- 10) Raymond Johnson, Engineering Consultant, BBRM Investments, Altadena, CA, USA. Impact of Privatization and Deregulation on Infrastructure Development in Africa (Paper 04GM0400).

- 11) Jan A de Kock, Potchefstroom University, South Africa. Status of International Interconnections and Electricity Deregulation in Africa—An Overview of the Current Status in Southern Africa (Paper 04GM1053).

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 on both the morning and afternoon sessions.

The Panel Session has been organized by Tom Hammons, Chair of International Practices for Energy Development and Power Generation (University of Glasgow, UK) and Bai Blyden, BBRM Investments, Elk Grove, CA, USA.

Tom Hammons and Bai Blyden moderate the Panel Session.

The first presentation is entitled: Towards Developing a Competitive Market for Regional Electricity Cross Border Trading: The case of the Southern Africa Power Pool. It has been prepared by Pat Naidoo, Senior General Manager of Transmission, Eskom, Johannesburg, South Africa; I Musaba, W. Ballet, and A. Chicova, Harare, Zimbabwe. Pat Naidoo will present it.

Pat Naidoo is Senior General Manager of Transmission, Eskom, Johannesburg, South Africa. He is a registered professional engineer, a graduate in Electrical Engineering from the University of Durban Westville in South Africa and a postgraduate with an MBA from Samford University in the USA. Presently, he is an engineering doctorate student with the University of Warwick in Coventry, United Kingdom.

Mr. Naidoo joined Eskom 19 years ago as an engineer in training. In 1990 he was promoted to Principle Engineer of Regional Engineering. In 1995, he was promoted to Senior Manager in charge of the Kwa -Zulu Natal and Free State Area of the Eskom National Grid. He was promoted to Senior General Manager of Eskom's Transmission Division. In 2001, Energy Trading was added to his accountabilities. In 2002, he was appointed as Technical Director on the board of Motraco, the Mozambique Transmission Company, a joint venture initiative between South Africa, Mozambique and Swaziland. In 2003, Mr. Naidoo participated in the planning for the Western Power Corridor; a joint venture between Eskom of South Africa, BPC of Botswana, Nampower of Namibia, ENE of Angola and SNEL of the Democratic Republic of Congo. This is focused on the development of 3500 MW of run of the river hydro generation and the transmission of the energy on two HVDC circuits over 3000 km.

The second presentation is on the status of the GCC Electricity Grid System Interconnection. A. Majeed H A Karim, Secretary to the Board of Directors, GCC Interconnection Authority (GCCIA), Kingdom of Saudi Arabia; N.H. Al Maskati, Deputy Chairman of Board of Directors, Kingdom of Saudi Arabia; and S. Sud, V.P. Energy Division, SNC-Lavalin Inc., Montreal, Canada have prepared it. Satish Sud will present it

Recognizing the benefits of interconnection of their power grids, the six Arab states of Bahrain, Kuwait, Oman, Qatar, Saudi Arabia, and the United Arab Emirates (UAE) had a study carried out in 1990 to define an Interconnection Project and to determine its feasibility. The present studies have re-confirmed the technical feasibility, and the economic and financial viability of the Project.

The study recommends an AC interconnection of the 50 Hz systems of Kuwait, Bahrain, Qatar, UAE and Oman with a back-to-back HVDC interconnection to the 60 Hz Saudi Arabian system. Steps are now being made to take the Project to market and work towards its implementation.

This will be examined and discussed in the presentation.

Nabeel Al-Maskati is Assistant Undersecretary for Planning and Projects at the Ministry of Electricity and Water in the Kingdom of Bahrain and the Vice Chairman of the Gulf Cooperation Council Interconnection Authority.

He is an Electrical Engineer and graduated in 1975 with a Bachelor Degree in Engineering from the American University of Beirut in Lebanon. He holds a PhD in Electrical Engineering from the University of Texas at Austin 1978. His field specialization is computer application in Power System Planning and Operation. Al-Maskati is a member of the Economic Development Institute of the World Bank and Vice Chairman of the Gulf Cooperation Council Interconnection Authority.

Satish Sud is Vice President of Power Systems in the Energy Division of SNC Lavalin, Canada. He is an electrical engineer with over 34 years of experience. and is responsible for the development and management of the Power Systems Group which undertakes electrical transmission and distribution projects, electrical system and energy studies, master plans, power sector reform and restructuring studies, and economic and financial studies. He has directed numerous electrical generation, transmission planning and system design studies, both in Canada and overseas. He was the project manager for the planning studies to determine the techno-economic feasibility of various interconnection projects where both AC and DC alternatives were considered. He has also developed master plans for electrification and national energy plans for several countries. He is a member of the Order of Engineers of Quebec, Institute of Electrical and Electronic Engineers and the Institution of Electrical Engineers (Fellow).

The third presentation is entitled: Economic Benefits and Strategic New International Transmission in the Southern African Power Pool (SAPP) and West African Power Pool (WAPP) It has been prepared by F. T. Sparrow, Brian H. Bowen, and Zuwei Yu, Power Pool Development Group, Purdue University, West Lafayette, IN, USA.

The Power Pool Development Group at Purdue University is collaborating with electricity utilities in 26 countries of Africa in the development of regional long-term capacity expansion planning decision support tools. In the case of the Southern African Power Pool (SAPP), the Purdue modeling team has been in partnership with the SAPP Planning Sub-Committee and

member utilities from the 12 countries that constitute the Southern African Development Community (SADC). With the West African Power Pool (WAPP), the team is working with the Secretariat of the 14 county member Economic Community of West African States (ECOWAS), and their respective utilities and WAPP coordinating working groups. Their studies will be summarized in the presentation. Professor Sparrow will make it ????

F.T. Sparrow has been professor of industrial engineering and economics at Purdue University since 1978. He has a Ph.D. in economics and operations research from the University of Michigan. He is director of the Purdue Power Pool Development Group (PPDG) and Center for Coal Technology Research (CCTR) with his interdisciplinary interests focusing on energy modeling and analysis. Honored as a Ford Foundation research professor, he is also a consultant to various agencies and utilities.

Brian H. Bowen is associate director of the Power Pool Development Group, PPDG, at Purdue University, where he received his Ph.D. in industrial engineering. Before his association with Purdue he worked in West Africa and Southern Africa for 17 years in engineering education and on energy (UK contracts). His research interests are in economic development and power pool cooperative infrastructures.

Dr. Zuwie Yu, is an associate professor of industrial engineering (by courtesy appointment) at Purdue University and is a senior analyst with Purdue's State Utility Forecasting Group (SUFG). His research is in energy system optimization and risk analysis. He received his PhD in electrical engineering with a minor in operations research from University of Oklahoma.

The fourth presentation considers environmental impact of large-scale hydroelectric development and the lessons from Three Gorges. It will be made by Wei-Jen Lee, Energy Systems Research Center, The University of Texas at Arlington, TX, USA

As a global recognition and concern over potential effects of climate change due to increasing levels of greenhouse gases in the atmosphere, hydroelectric power becomes one of the most favorable renewable energies with no greenhouse gases emission. Africa is the continent that is rich in potential hydropower. However, most of the schemes are not fully developed. There are general consents in the global community to develop hydroelectric power in this region to benefit both the local community and neighboring countries. This presentation discusses the issues that have been encountered at the "Three Gorges" development in China. The lessons will be valuable references for similar developments in Africa.

Wei-Jen Lee received his B.S. and M.S. degrees in Electrical Engineering from National Taiwan University, Taipei, Taiwan, in 1978 and 1980, respectively, and a Ph.D. degree in Electrical Engineering from the University of Texas at Arlington in 1985. Since then, he joined the Electrical Engineering Department at University of Texas at Arlington. He is currently a Professor of the Electrical Engineering Department and the Director of the Energy Systems research Center. He has been involved in research on power flow, transient and dynamic stability, voltage stability, short circuit, relay coordination, power quality analysis, and deregulation for utility companies.

The next presentation discusses African Power Pool Interconnections development and whether it is a foundation for bridging the digital divide. It has been prepared and will be given by Bai K Blyden, Engineering Consultant, BBRM Investments, CA, USA

The presentation will attempt to recommend and demonstrate an opportunity for African policy makers to utilize the information density created by the planning of some of these energy development initiatives to integrate with international R&D in the growing field of knowledge management.

The South African power pool (SAPP), West African power pool (WAPP) and the initiatives in North Africa with interconnections to the Middle East represent vast knowledge domains. Modeling the intent of these initiatives (i.e. a given power plant, series of plants or development projects in a given system) generates technical and societal 'impact' data across academia, industry and other sectors of society. Several studies will be cited to illustrate the growing importance of 'knowledge management' versus 'knowledge transfer' and the resulting possibilities.

In turn the principal studies on African interconnections are cited as foundation candidates toward building these knowledge bases. Contemporary events such as The California Energy Crisis and projects such as the Three Gorges Project in China and the Brazilian Hydro experience will also cited for their own internal experience.

Bai K Blyden is an Engineering Consultant, BBRM Investments, LLC, USA. He received the degree of MS.EE from Moscow Energetics Institute in 1979. He works as an Engineering Consultant in the US Power Industry where he resides. Mr. Blyden has worked on over thirty power plants and their associated interconnections throughout his career in various capacities of distribution planning, electrical control systems design, management and construction. He has been employed by the major AE firms including Bechtel, ABB Asea Brown Boveri, Stone & Webster and Gibbs & Hill. He is a member of the IEEE International Practices Subcommittee and serves as consultant to GENI (Global Energy Network International).

Bai Blyden is the author of several papers on African Energy Development published in various IEEE publications (1983-2000). He has lectured extensively on African Energy Development issues to Institutions and more recently to Investment groups. He was one of the early advocates of an all Africa Grid and presented a conceptual framework and technical analysis for a centralized African Power pool with links to North Africa at the first Region 8 IEEE conference held in Nairobi, Kenya, 1983.

The sixth presentation is entitled: US African Power Research and Education Activities: Challenges, Experiences and Opportunities. It will be prepared by James A. Momoh, Program Director, Electrical & Communication Systems (ECS), National Science Foundation, Arlington, VA, USA. Joe H. Chow, Rensselaer Polytechnic Institute, Troy, New York, USA will present it.

James A. Momoh received the B.S.E.E. degree from Howard University in 1975, the M.S.E.E. degree from Carnegie Mellon University in 1976, the M.S. in Systems Engineering from the

University of Pennsylvania in 1980 and the PhD in Electrical Engineering from Howard University in 1983. He is a former Chairman of Howard University Department of Electrical and Computer Engineering.

His current research activities are concentrated in stability analysis, power system security and development of computational tools for power system reliability assessment, optimal power flow for restructuring of the power industry, and intelligent system application of artificial neural networks, fuzzy logic and genetic algorithms to power system automation for utility firms, aerospace and naval systems.

Currently at NSF, he initiated the development of interdisciplinary program in Power Systems, Economics, Environmental and System theory for secured, efficient power networks. He is the coordinator of the US-Africa Research and Education Collaboration in Power/Energy, Information Technology (IT) and Environment, which have led to joint research efforts between US professors and their counterparts in Africa. He is a Fellow of the both IEEE and Nigerian Society of Engineers (FNSE) and a recipient of many numerous awards.

The seventh presentation discusses status of international interconnections in North Africa and has been prepared by Ahmed Zobaa, Cairo University, Egypt. Tom Hammons will present it.

Interconnections between neighboring utilities are becoming increasingly vital for the implementation of an open energy trading market and to increase the reliability of power systems. The power utilities of the Arab countries in North Africa and the Middle East have made considerable investments in extending transmission system interconnections and power-transfer corridors at various voltage levels to facilitate the cross-border trading of electric power. Progressive development of interconnections, either between neighboring countries or within separate island power systems in one country, can be affected by the distances separating capital cities, power pools, population density and the Sahara Desert. In the presentation this will be discussed and analyzed.

Ahmed Faheem Zobaa received the B.Sc. (hons), M.Sc. and Ph.D. degrees in Electrical Power & Machines from the Faculty of Engineering at Cairo University, Giza, Egypt, in 1992, 1997 and 2002. Currently, he is with the Department of Electrical Power & Machines, at Faculty of Engineering, Cairo University. He regularly reviews papers for eight IEEE Transactions especially IEEE/PES transactions and six journals in his areas of interest. He is author or co-author of many refereed Journal and Conference papers. His areas of research include harmonics, compensation of reactive power, power quality, photovoltaics, wind energy, education and distance learning. He is an Editorial Board member for the *International Journal of Power and Energy Systems*, and for *Electric Power Components & Systems*.

The next presentation is on large hydro-fueled grid schemes for Africa and discusses whether they are a recipe for disaster. Lori Pottinger, Campaigns Director, Africa Programs, International Rivers Network, Berkeley, CA, USA, will present it.

Numerous grand schemes to crisscross Africa with electricity grids are being planned today, with involvement by associations of African governments, foreign donors, the World Bank, and energy companies. Many of these plans rely heavily on new large hydropower projects. NEPAD, the Nile Basin Initiative and the Southern African Power Pool all propose many new large dams,

while including in their plans only modest investments in more sustainable energy supply or efficiency measures.

At a time when global warming threatens to make Africa's rivers even less reliable for economically feasible large hydro projects, and their waters more precious for other uses, the energy industry and governments should be looking to increase Africa's reliance on less risky forms of energy supply. In the presentation this will be discussed, analyzed, and evaluated.

This presentation will use the Nile Basin as a case study to discuss the problems with grid schemes that rely heavily on large hydro, and the reasons that good energy planning is imperative for Africa.

Lori Pottinger has worked for International Rivers Network since 1995. She is the editor of IRN's bimonthly publication, *World Rivers Review*, and the director for IRN's Africa programs. She has worked particularly closely on the massive Lesotho Highlands Water Project, the proposed Epupa Dam in Namibia, the Bujagali Dam proposed for the Nile in Uganda and others. Ms. Pottinger has a bachelor's degree in journalism from San Francisco State University, and a master's degree in landscape architecture from the University of California, Berkeley.

The ninth presentation is entitled: *The Energy Challenge* and has been prepared by Moshin Chen, Professor Emeritus, Director Energy Systems Research Center, University of Texas at Arlington, TX, USA. Tom Hammons and Bai Blyden will present it.

The electric utility industry is undergoing a time of uncertainty as the deregulation process develops. This phenomenon not only applies to the United States but to the entire world. After more than a decade, questionable restructuring results in countries such as the United Kingdom, New Zealand or Argentina (to name some of the pioneering cases), give a clear indication of the difficulties and risks involved in the process. Moreover some serious events have taken place in USA since the inception of the energy reform; notably the California crises in the Summer of 2000, which included the bankruptcy of major traditional utilities, followed by the Enron debacle a year later with its very unfavorable impact on the rest of the industry. In the presentation, this will be discussed and will be critically analyzed.

Mo-Shing CHEN is Professor of Electrical Engineering, and Director, Energy Systems Research Center, The University of Texas at Arlington, USA. His educational qualifications include a Ph.D. in Electrical Engineering, University of Texas at Austin, 1962. His fields of authority include analysis (including real-time) in transmission, distribution, generation, and electrical service. In consulting, his 21 consultancies include Consolidated Edison Company of New York, Inc., New York, New York; U.S. Bureau of Reclamation, Denver, Colorado; Texas Electric Service Company, Dallas, Texas; Taiwan Power Company, Taipei, Taiwan, Republic of China; Korea Electric Power Corporation, Seoul, Korea; Electric Power Research Institute, Beijing, China; Nanjing Automation Research Institute, Nanjing, China; and Central Electrical Power Research Institute of Japan.

He has 25 Honors including: Edison Electric Institute's First Power Engineering Educator Award, June 1976; Fellow, Institute of Electric and Electronics Engineers, 1978, Chinese Institute of Engineering, Achievement Award, 1978; IEEE Centennial Medal Award, 1984; Honorary Visiting Professor, Tsing Hua University, Beijing, China, 1990; Honorary Consulting Professor, Xi'an Jiaotong University, Xi'an, China 1989; and Honorary Doctor of Electrical Engineering, University of Nuevo Leon, Mexico, 1997.

The penultimate presentation is entitled: Impact of Privatization and Deregulation on Infrastructure Development in Africa. Raymond Johnson, Energy Consultant, EnergyCon, Inc., Altadena, CA, USA will present it

In an effort to increase the amount of investment funds available for infrastructure development, many Western governments and funding agencies such as the World Bank have been encouraging African countries to liberalize their regulatory policies. The theory is that privatization and deregulation of capital-intensive sectors such as energy will attract investment funds from private sources that will augment the resources available for infrastructure development in Africa. This will be discussed.

Raymond Johnson is the founder of EnergyCon, Inc, an international engineering consulting company. He is also an Energy Consultant with BBRM Investments, LLC, USA. He consulted on wholesale energy markets for various energy consulting and software companies, private power marketers and state and federal government energy agencies. Raymond has a Master of Arts degree in Electrical Sciences from Trinity College, Cambridge University, a Ph.D. in Electrical Engineering from Imperial College, London University and executive MBAs from the University of California, Berkeley and Columbia University, New York.

The final presentation discusses the status of international interconnections and electricity deregulation in Africa and gives an overview of the current status in southern Africa. It will be presented by Jan A de Kock, Potchefstroom University, South Africa.

The Southern African power system is in a state of flux. The grid is expanding and more interconnections are being made. However, vastness of the area and the low power consumption density in most African countries makes operation of the interconnection difficult. Some of the utilities are also being privatized to improve their financial and system performance.

The situation in the SAPP is steadily improving and a short-term energy market has been established between the various utilities. Key projects are also in the pipeline to improve the generation and transmission capabilities within the SAPP. This will be discussed.

Jan A de Kock holds a BEng (1985), MEng (1987) and PhD (1991) in Electrical Engineering from Stellenbosch University in South Africa. At present he is a Professor in Electrical Engineering at the Potchefstroom University for CHE in South Africa. His academic and consulting interests include power system dynamic performance, power quality, protection performance and optimization studies, improvements of generator dynamic response, induction and synchronous machine transient performance, and high speed bus transfer systems. He is the author of a number of papers and the co-author of a book.

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