POWERAFRICA 2007 – Conference and Exposition

"Power Engineering Africa towards 100GW"

July 16 - 20, 2007

University of Witwatersrand

Johannesburg, South Africa

Planning for Tutorials

General Guidelines

- There will be no payment/stipend to suppliers of tutorials. However, one presenter of each Tutorial will receive a complimentary conference registration. The corresponding author should inform Dr Ron Harley or Dr NL Diseko who that complimentary registration should go to, so that the Conference Secretariat might be informed ahead of time.
- IEEE reserves all rights and IEEE PES will publish the tutorials. We are proud to offer a total of 10 tutorials for the 2007 meeting.
- Registration by delegates for Tutorials includes a printed booklet (one for each Tutorial registered for) and lunches and tea/coffee.
- Presenters of tutorials should send their Power Point slides to Dr NL Diseko no later than **15 June 2007**. He will then print them, and copy them into a booklet. One booklet for each tutorial. Delegates will be handed these booklets. Booklets should all use a common front cover which is still being designed.
- Each tutorial is expected to last for about 3.5 hours on Thursday 19 July and 3.0 hours on Friday 20 July, plus a 30 minute coffee break. Use this to plan the number of slides you will need.
- Dr. NL Diseko is the Tutorial Coordinator, so please contact him or Dr. Ron Harley with any questions.
- No names of any commercial products may be used in the tutorial, and no form of advertising is allowed.

Tutorial Schedule

Tea, Coffee and Water Station: all day from 7 am onwards.

Sandwiches: 12:00 to 13:00 on Thursday and from 11:00 to 11:30 on Friday

Thursday 18:00: Chinese Dinner in the Chinese Pavilion, Exhibition Hall.

Friday 15:00: Local Organising Committee "The Great South African Braai, Wine and Malt" - WITS CLUB

All Tutorial participants are invited to join the conference delegates and supplier exhibits for the Thursday evening and Friday afternoon functions.

T1	Swarm Intelligence for Power Systems - Dr G K Venayagamoorthy & Dr R G Harley	Thur, 19 July	08:00 to 12:00
T2	1000 kV AC Technology - State Grid of China	Thur, 19 July	08:00 to 12:00
T3	HVDC For Power Transmission - Bo Westman, ABB Ludvika, Sweden.	Thur, 19 July	08:00 to 12:00
T4	Tap Changer Control & Paralleling - E T Jauch, Beckwith Electric Co. Inc.	Thur, 19 July	13:00 to 17:00
T5	Application of FACTS in 800 kV Transmission Systems - Per Halvarsson and Dr Lenmart Angquist, ABB Sweden.	Thur, 19 July	13:00 to 17:00
T6	800 kV HVDC Technology - China Southern Power Grid Co.	Thur, 19 July	13:00 to 17:00
T7	Incentive Based Regulation for Power Distribution - Robert Koch, Resources and Strategy Division, Eskom	Fri, 20 July	07:30 to 11:00
T8	Managing the Reliability of Ageing Power Transformers - Dr Alan Wilson, Doble Engineering Company	Fri, 20 July	07:30 to 11:00
T9	How to tell a good OHL design - Rob G Stephen, Eskom	Fri, 20 July	11:30 to 15:00
T10	New Developments in Renewable Energy Generation - Prof. J A Ferreira, Delft University of Technology, The Netherlands	Fri, 20 July	11:30 to 15:00

General notes:

Tutorials T2 and T5; T3 and T6; T 7 and T9, and T4 and T8 are stable partners.

Delegates are encouraged to register for both stable partner tutorials and ensure continuity of subject.

Note the early start on Friday so as to accommodate the afternoon function.

T1 Swarm Intelligence for Power Systems

Contributors

- Dr. Ganesh Kumar Venayagamoorthy *Senior Member*, *IEEE*
  Director of the Real-Time Power and Intelligent Systems Laboratory and Assistant Professor of Electrical and Computer Engineering, University of Missouri-Rolla, MO 65409, USA
  gkumar@ieee.org
- Dr. Ronald G Harley, *Fellow IEEE, Fellow IET, Fellow SAIEE*
  School of Electrical and Computer Engineering, Georgia Institute of Technology, Atlanta, USA and University of Kwa-Zulu Natal, Durban, South Africa.
  ron.harley@ece.gatech.edu

Major Topics

Swarm Intelligence - Particle Swarm Optimization, Ant Colony Optimization
Controller Tuning
Optimal Controller Design
FACTS and Capacitor Placement
Transmission Planning

Abstract

The objective of this tutorial is to expose researchers from the academia and industry to the field of swarm intelligence and its applications to power systems.

The electric power grid is a large complex system. It consists of synchronous generators, transformers, transmission lines, switches and relays, active/reactive compensators and controllers. Various control objectives, operation actions and/or design decisions in such a system require solving a multi-objective constrained optimization problem.

Swarm intelligence is the property of a system whereby the collective behaviours of simple agents interacting locally with each other, directly or indirectly, and their environment, cause coherent functional global patterns to emerge. A number of swarm intelligence algorithms exist today for solving multi-objective and constrained optimization problems. These algorithms adhere to a number of principles namely – proximity, quality, diversity, stability and adaptability. Some of these algorithms that have the potential and are promising in providing solutions to power system optimization problems, including optimal controller design and tuning such as power system stabilizers, capacitor and FACTS placement and transmission planning.

T2 1000kV AC Technology – State Grid of China

Awaiting information

T3 HVDC for Power Transmission

Abstract
This tutorial addresses the use of HVDC for increasing the power transmission capability of existing corridors, improving the stability margins on in existing grids, and for optimizing new corridors. Topics to be discussed include:

Fundamentals of HVDC transmission

Principles of conversion and inversion, waveforms, current and voltage control, main circuit design considerations.

Reactive power compensation and fault level issues

SCR, ESCR, harmonics, voltage control.

Multi-terminal schemes and tapping stations

Control and main circuit design implications.

Long distance transmission

800 kV HVDC, electrode design, reliability and availability**.**

First swing stability and power oscillation damping

Captive generators, frequency excursions, load shedding and braking.

Voltage sourced converters

Principles of operation, converter characteristics, city centre in-feeds, integration of renewable generation, supply of isolated loads, and tapping possibilities.

Bo Westman (b. 1957) graduated (M.Sc.) from Chalmers University in 1980 Gothenburg, Sweden. Mr. Westman is presently in HVDC Sales and Marketing in ABB Sweden. Mr. Westman has worked since 1980 at ABB in the design and project execution of HVDC systems.

Andrew Williamson (b. 1966) graduated (B.Sc) from University of the Witwatersrand, Johannesburg in 1987, and is currently a Consultant working for ABB South Africa in HVDC, FACTS devices and substations. He is a practicing professional engineer, the regular member for South Africa in Cigre SC B4, and a Senior Member of the SAIEE.

T 4 Tapchanger Controls & Paralleling
- Features, Benefits, and Effects on Failures & Volt/VAr Management

Abstract

This tutorial addresses advanced tapchanger control capabilities and applications, including transformer paralleling. Methods for reducing the effects of control action on premature transformer failures and techniques to improve system volt/VAr management affecting asset life are discussed. The interactions between distribution and transmission systems as well as power flows affected by control actions will also be presented. The importance of analyzing all possible circuit configurations in the determination of appropriate control feature use and setting will be established. A major tutorial section will investigate transformer paralleling methods and their proper application, setting and commissioning.

Participants will be invited to submit unique system or substation configurations for possible discussion in the tutorial.

Subjects under discussion will include:

Tapchanger Control Fundamentals
Understanding the fundamentals prepares the participant to recognize and correct basic application problems. Combinations of basic features are often used to solve complex system operation problems.

Applications
Reviewing different equipment applications and changing system conditions on a power system assists the participant in recognizing potential problems and possible misoperations. Unrecognized combinations of different equipment types can cause equipment damaging system operations. Examples include: transformer load tap changers (LTC), substation regulators (transformer or feeder), distribution feeder regulators, backup controls, and coordination with other distribution equipment (capacitors).

Features & Settings
Participants will learn the use of control features and the importance of proper settings. Examples used will alert the participants to methods of reducing tap changes and therefore minimizing contact damage and possible premature transformer failure.

Advanced Paralleling
The misapplication or misuse of paralleling techniques can result in numerous unnecessary tapchanger operations. In some applications, the result can be tap position “hunting” with many tap changes in rapid succession. The participant will be better prepared to choose the correct method and set and commission the equipment for optimum operation. The paralleling basics include: LTC transformers,

non-LTC transformer-regulator combinations, optional methods (master/follower, negative reactance, power factor, circulating current, VAr balancing), dissimilar transformer paralleling, and effects of station breaker operations.

Those who will benefit from this tutorial include transmission and distribution engineers, field engineers and technicians, transmission and distribution planners, substation project engineers, technical personnel and others who are responsible for initial control setup, periodic data reading, emergency or planned setting changes or would like to improve these processes.

Presenter Erwin T. Jauch
Consultant
Beckwith Electric Co., Inc.
6190-118th Avenue North, Largo, FL 33773-3724
Phone: 813-634-1422 Cell Phone: 727-798-0750
Fax: 727-546-0121

E-mail ***Jauchbt@aol.com***

E. Tom Jauch, (M06368161-1967) graduated from Bradley University in Peoria, IL in 1963. Tom has 42 years of utility experience including Central Illinois Light Company, General Electric's Electric Utility System's Engineering Department and Beckwith Electric Company. Tom is a former instructor in the Graduate School of Electrical Engineering at Rensselaer Polytechnic Institute and Union College in New York as well as Auburn University. Tom has authored numerous technical papers and magazine articles on power transformers, controls, and protective relaying including “Electric Utilities Systems and Practices” and the McGraw Hill “Standard Handbook for Electrical Engineers.” He is a Life Senior Member of the IEEE and the Power Engineering Society and is active in the Power Transformer Committee and the Substations Committee.

T5 Application of FACTS in 800kV Transmission Systems

Abstract

This tutorial addresses the use of FACTS controllers for 765 kV power transmission grids and the latest development of operational functionality of FACTS controllers for various grid disturbances. Further, the tutorial discusses the resonance condition known as Sub Synchronous Resonance (SSR) and Power Oscillation Damping (POD).

The use of Series Compensation in 765 kV networks, experience and reliability

Today Series Capacitors are used in several of the world 765 kV grids. The design of 765 kV series capacitors, several applications and operational experience will be presented.

Robustness of today's FACTS controllers

A FACTS controller is a highly dynamic and robust system if the design of the main circuit and the control system is designed in an appropriate way. The tutorial discusses the aspects of main circuit design and controller design.

FACTS controllers performance at grid disturbances

Obviously not all aspect of the power system is known at the time a new FACTS controller is installed. Especially the transient behaviour of the FACTS controller during transient faults such as line faults in the grid is discussed in this part of the tutorial.

Sub Synchronous Resonance issues, and means to mitigate those issues

When a large turbine generator is installed in the system, the mechanical resonance system of the generator, shaft and turbine system may interact with the transmission system, SSR. The condition for this and the possible mitigation is discussed.

Power Oscillation Damping, POD

POD may be a problem in an interconnected system. FACTS controllers may be used to provide damping. This part of the tutorial presents a recent example of such an application.

Per Halvarsson (b. 1960) received his technical education from Mälardalen University in 1987. Mr. Halvarsson is presently Manager of Business Development at ABB Power Technologies, Power Systems FACTS. Mr. Halvarsson has worked since 1981 at ABB in the development and application of FACTS systems. He is a CIGRE member.

Lennart Ängquist graduated (M.Sc.) from Lund Institute of Technology in 1968 and obtained his Ph. D. degree from the Royal Technology Institute (KTH) in Stockholm, Sweden. He has been employed by ABB (formerly ASEA) in various technical departments. He was working with industrial and traction motor drives 1974-1987 and thereafter with FACTS applications in power transmission systems. He has been involved in TCSC projects for power oscillation damping and SSR mitigation. He is also an adjunct professor at KTH.

T 6 800kV HVDC Technology – China Southern Power Grid Co.

Awaiting information.

T 7 Incentive-Based Regulation for Power Distribution - International Frameworks for Technical Performance Management

Abstract

Over the past decade there has been an increasing interest by Regulators throughout the world in integrating technical performance regulation into economic regulation of Transmission and Distribution companies. The specific schemes applied by regulators differ significantly from country to country, and are continually evolving as experience with the application of these schemes is gained.

This tutorial will provide a detailed overview of incentive-based regulation and the impact on technical performance management of electricity supply companies. It focuses strongly on actual case studies and experienced. Participants will engage with practical considerations in the development of incentive schemes. As the range of technical performance parameters targeted by Regulators is increasing, the tutorial will specifically address progress in the development of international standards and recommendations.

Main topics addressed

This tutorial will provide participants with a structured overview of:

1) Various drivers for technical performance regulation
2) The mechanisms available to regulators for managing technical performance
3) Technical performance indices (voltage continuity, voltage disturbances, and voltage quality)
4) An overview of the various schemes applied throughout the world
5) Experience with the application of these schemes (case studies)
6) The role and status of international standardization on power quality
7) Detailed considerations in the development of technical performance incentive schemes
8) Particular considerations for developing countries
9) Future developments (and core elements of the current debate)

Participants

Those who will benefit form this tutorial include: engineers responsible for asset creation, asset management, and system performance; Regulators; transmission and distribution managers; customers (users of electricity); suppliers of monitoring systems and equipment; and utility financial managers.

Presenter

Robert Koch was born in Johannesburg South Africa in March 1966. He received his B. Eng and M. Eng degrees from the University of Stellenbosch. He has been employed by Eskom since 1990, and is currently the Corporate Specialist (Power Quality) with Eskom's Resources & Strategy Division, as well as Eskom's National Quality of Supply Coordinator. Robert is convener of the CIGRE C4 Advisory Group AG C4.1 (Power Quality). He is also convener of IEC SC77A Working Group 8 and member of CIRED S2 (Power Quality). He has published over 90 technical papers and has consulted throughout the world to power companies, research organizations, and regulators. He is recipient of the SAIEE Young Achievers Award for his contributions to power quality management in South Africa, the SABS/NRS award for his contributions to power quality standardization, and of the CIGRE Technical Committee Award for his contributions to the work of Study Committee C4 (System Technical Performance). His main interests are System Technical Performance, Regulatory Performance Management, and Power Quality Management.

Contact details
Email: robert.koch@eskom.co.za
Mobile: +27 83 4544790
Phone: +27 11 4537287

T8 Managing the reliability of ageing power transformers

A significant activity for UK transformer specialists working for Doble Engineering Company is to undertake asset health reviews for a number of utilities. This is an ongoing process aimed at assessing the risks of future operation of the ageing transformer asset base. The approach follows the sequence that improved performance is achieved through an understanding of the condition of the installed assets. This is achieved in a variety of ways, from the knowledge base of troubles and failures, from a client network exchanging information on equipment performance and by developing condition assessment methodologies.

This tutorial will follow a sequence of presentations
(a) Identifying the failure and ageing modes of power transformers.
This leads us to the view that long term performance of large transformers is highly dependent on the build quality- the design and manufacturing capability of the factory- and the operational environment. In some cases common mode failures can be associated to a design limitation but the time to failure will be dependent on the environment of usage. This means that assessing remaining life and risks of use relates the individual transformer- and only in extreme cases associated with traditional views on thermal ageing of the winding paper insulation. It is with this knowledge that condition assessment strategies can be devised.

b) The condition assessment strategy.
The first step is to identify the relevant failure modes and then the linked diagnostic strategy. A good part of assessment can be achieved through a review of engineering information and a range of non-invasive diagnostics. An example of the latter is clearly routine oil testing. The next refinement is to build up from this with diagnostics undertaken in an outage. This enables the transformer and its accessories to be assessed. The outcome assessment is a measure of likelihood of failure in near, medium and long term. This may be used on an individual transformer basis, or compiled into an asset health review ranking in terms of risk factor for a population of units.

c) Condition assessment methods
This longer presentation element will describe individual failure modes and how diagnostics and their output are used to build up a picture of the condition. The three winding modes are thermal, dielectric, and mechanical, within the main tank are modes associated with the oil condition, the core and connections. Accessories include the tap changer, bushings and arresters. Examples of failures will be shown but the emphasis will be to describe experience with the key diagnostics- oil tests for dissolved gases and Furans, analysis methods for scoring gas quantities, power factor, winding resistance, core insulation, sweep frequency response, turns ratio, impedance and excitation currents.

(d) Case studies

These will describe how the assessment process has been applied to a range of developing failure modes- dielectric failure- a thermal failure- a mechanical failure, and bushing failure

T9 How to tell a good OHL design
- Optimisation of overhead Transmission lines

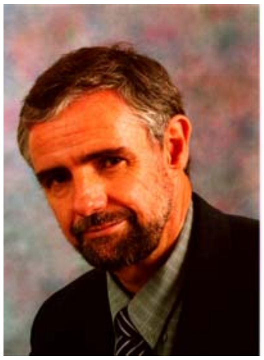
Abstract
A power line is a device that transmits power over long distances. The parameters of the line determine the power flow characteristics. Each line has a unique set of parameters that will best suit its position in the network as well as cater for emergency and normal loading. These parameters are generally described as the R, X and B values. Similar to other devices on the network, the line can be designed to meet any set of required parameters. Unlike other devices such as transformers, a transmission line is exposed to the elements and constructed over a large area. This enables other characteristics such as power flow limits to be determined. In addition each tower position is unique and the selection of each tower will determine, in part the optimization of the line. With the large amount of options that can be used in the line design, it is often very difficult to determine which tower, foundation and conductor bundle option should be used. This tutorial covers the parameters, the methods of line design that can be used to tailor make the design to suit the parameters, as well as an objective method to determine which line design should be used in any particular line project.

Main topics addressed
This tutorial will provide participants with a structured overview of:

1) Description of line parameters R, X and B
2) Calculation of R, X and B.
3) Line configurations that can be used to meet line parameters.
4) Line loading criteria and thermal limits
5) Conductor selection.
6) Tower selection
7) Description of the Appropriate Technology Indicator
8) Use of the ATI

Participants
Those who will benefit form this tutorial include: Line design engineers, network planners, Transmission tower designers, researchers and conductor and hardware manufacturers.

Presenter



Rob Stephen holds both MSc and MBA degrees and is knowledgeable in network and component designs, with specialities in the area of network planning, electrification and thermal rating of overhead lines. He was chairman of Cigre SCB2-12 (electrical aspects) for 9 years up to 1999 and was Special reporter of Cigre SCB2 (Overhead lines) in 1996. He was Line Technology Manager in Eskom from 1992 to 1995 and was instrumental in introducing the line optimization process. He was chairman of SCB2 on overhead lines in Cigre (2000-2004). He is the author of a number of international and local papers. At present he is responsible for the effective implementation of the Capital programme in Eskom Distribution. He is a Professional engineer, Fellow of the SAIEE and Honorary member of Cigre.

Contact details

Email: stepherg@eskom.co.za
Mobile: +27 83 326 2534
Phone: +27 31 563 0063

T10 New developments in renewable energy generation

Abstract

It is projected that the energy demand will increase by 50% by the year 2030. New and better technologies are required that will emit less CO_2 and that will decrease our dependence on fossil hydrocarbon fuel. A massive investment in renewable energy seems to be the only feasible solution today. The challenge is to identify the best technologies and gain an advantage of scale. This could be achieved with large production numbers, as for example with photovoltaics, or in the case of wind and wave energy large the individual generators generally give an economic benefit.

This tutorial will cover new developments in the large scale harvesting of renewable energy sources, focusing on the activities at the Delft University of Technology. The following topics will be discussed:

Some perspectives on renewable energy
An over view on the sources and availability of renewable energy. Electrons and protons (hydrogen) as energy carriers.

Developments in wind turbine technology
Economy of scale has driven the power rating of individual wind turbines from 50kW in 1985 to 5MW in 2005. Common generator configurations including the doubly fed induction generator with a gearbox and the direct drive generator with a power electronics frequency changer will be discussed. A new experimental wind generator that requires no mechanical movement will also be presented.

Large scale integration of wind energy into the grid
Controlling large wind parks and connecting them to the grid present a number of challenges, especially if they are located at sea. The issues will be discussed and possible solutions will be presented.

Wave energy generators
A survey of wave and tide generators are given and the Archimedes Wave Swing, a submerged wave generator will be discussed in detail.

The tutorial gives a technical introduction to new technologies and systems that will change power systems in the future. Managers, researchers and interested engineers will benefit from the presentation.

Presenter Prof. J.A. Ferreira
Electrical Power Processing Unit
EWI Faculty, Delft University of Technology
Mekelweg 4, 2628 CD Delft, The Netherlands
Tel: +31 15 2786220, Email: J.A.Ferreira@tudelft.nl

Braham Ferreira graduated from the Rand Afrikaans University, Johannesburg, South Africa, and worked in industry at ESD (Pty) Ltd from 1982-1985. From 1986 until 1997 he was at the Faculty of Engineering, Rand Afrikaans University, where he held the Carl and Emily Fuchs Chair of Power Electronics. Since 1998 he is a professor at the Delft University of Technology in The Netherlands. Dr. Ferreira is a fellow of the IEEE, was chairman of the South African Section of the IEEE and founding chairman of the IEEE Joint IAS/PELS/PES Benelux chapter. He is currently the treasurer of the IEEE PELS. He served as chairman of the CIGRE SC14 national committee of the Netherlands and was a member of the executive committee of the EPE Society.