

# **15th Power Systems Computation Conference 2005**

**(PSCC 2005 LIEGE)**

**Liege, Belgium  
22-26 August 2005**

**Volume 1 of 2**

ISBN: 978-1-61738-856-9

**Printed from e-media with permission by:**

Curran Associates, Inc.  
57 Morehouse Lane  
Red Hook, NY 12571



**Some format issues inherent in the e-media version may also appear in this print version.**

Copyright© (2005) by the Power Systems Computation Conference (PSCC)  
All rights reserved.

Printed by Curran Associates, Inc. (2010)

For permission requests, please contact the Power Systems Computation Conference (PSCC)  
at the address below.

Power Systems Computation Conference (PSCC)  
c/o Dr. G.M. Burt  
University of Strathclyde  
16 Richmond Street, Glasgow G1 1XQ  
Scotland, United Kingdom

Phone: 441 41 548 2268

Fax: 441 41 548 4872

[g.burt@strath.ac.uk](mailto:g.burt@strath.ac.uk)

**Additional copies of this publication are available from:**

Curran Associates, Inc.  
57 Morehouse Lane  
Red Hook, NY 12571 USA  
Phone: 845-758-0400  
Fax: 845-758-2634  
Email: [curran@proceedings.com](mailto:curran@proceedings.com)  
Web: [www.proceedings.com](http://www.proceedings.com)

# TABLE OF CONTENTS

Volume 1

## **SESSION 1: TECHNIQUES TO PREVENT MAJOR BLACKOUTS (INVITED SESSION)**

<b>Reducing Blackout Risk by a Wide-Area Control System (WACS): Adding a New Layer of Defense</b> .....	1
<i>Carson W. Taylor, Dennis C. Erickson, Robert E. Wilson</i>	
<b>A DSA-Integrated Shedding System for Corrective Emergency Control</b> .....	8
<i>G. Giannuzzi, R. Salvati, M. Sforza, A. Danelli, M. Pozzi, M. Salvetti</i>	
<b>Adaptive Corrective Control Strategies for Preventing Power System Blackouts</b> .....	16
<i>Xiaoming Wang, Wei Shao, Vijay Vittal</i>	
<b>Criticality in a Cascading Failure Blackout Model</b> .....	22
<i>Dusko Nedic, Ian Dobson, Daniel Kirschen, Benjamin Carreras, Vickie Lynch</i>	
<b>Reducing the Risk of Major Blackouts Through Improved Power System Visualization</b> .....	29
<i>Thomas Overbye, Douglas Wiegmann</i>	
<b>Adaptation of Relay Operations in Real-Time</b> .....	37
<i>Thomas Nye, Chen-Ching Liu, Michael Hofmann</i>	

## **SESSION 2: DISTRIBUTION SYSTEM PLANNING – TECHNICAL ISSUES**

<b>Statistical Short-Term Network Planning of Distribution System and Distributed Generation</b> .....	45
<i>Sami Repo, Hannu Laaksonen, Pertti Järventausta</i>	
<b>Long Term Multi-Stage Planning of Open Loop Distribution Networks Under Uncertainty</b> .....	53
<i>Minea Skok, Slavko Krajcar, Davor Skrlec</i>	
<b>The Reliability Analysis of Distribution Systems with Different Overvoltage Protection Solutions</b> .....	61
<i>Pirjo Heine, Matti Lehtonen, Arvo Oikarinen</i>	
<b>Integrated Energy Distribution System Planning: A Multi-Criteria Approach</b> .....	68
<i>Audun Botterud, Maria Catrinu, Ove Wolfgang, Arne T. Holen</i>	
<b>Optimal Location of Voltage Regulators in Radial Distribution Networks Using Genetic Algorithms</b> .....	75
<i>Jorge Mendoza, Enrique Lopez, Dario Morales, Rodrigo Lopez, Miguel Lopez, J. C. Vannier</i>	
<b>Anti-Fault Ability Evaluation of Distribution Systems</b> .....	82
<i>Jian Liu, Hongli Cheng, Jingqiu Xu</i>	

## **SESSION 3: MARKET MODELLING AND SIMULATION**

<b>A Comparison of Residual Demand Models for Oligopolistic Markets</b> .....	87
<i>Agustín R. Marulanda Guerra, Jose L. Martínez Ramos, Antonio Gómez Expósito</i>	
<b>A Framework for Electricity Market Monitoring</b> .....	93
<i>Teoman Güler, George Gross</i>	
<b>ARES: An Energy Price Simulation Model Including Strategic Behavior</b> .....	100
<i>Frédérique Verrier, Panagiota Tsamasfyrou, Samuel Scolari, Peter Borre Eriksen, Berit Bitsch Kristoffersen, Bjarne Donslund</i>	
<b>Application of Benders Decomposition to an Equilibrium Problem</b> .....	107
<i>Jordi Cabero, Álvaro Baíllo, Santiago Cerisola, Mariano Ventosa</i>	
<b>A Comparison of Nash Equilibria Analysis and Agent-Based Modelling for Power Markets</b> .....	114
<i>Thilo Krause, Göran Andersson, Damien Ernst, Elena V. Beck, Rachid Cherkaoui, A. Germond</i>	
<b>Simulation and Optimization of Markets for Electricity and EI-Certificates</b> .....	122
<i>Birger Mo, Ove Wolfgang, Anders Gjeldsvik, Sigurd Bjorke, Knut Dyrstad</i>	

## **SESSION 4: SIGNAL ANALYSIS AND SYSTEM IDENTIFICATION**

<b>Observer-Based Monitors for Electromechanical Dynamics in Power Networks</b> .....	129
<i>Ernst Scholtz, George Verghese, Bernard Lesieutre</i>	
<b>On-line Measurement of the Eigenvalues of Multi-Machine Power System by Use of SMES</b> .....	136
<i>Takenori Yonezu, Tanzo Nitta, Yasuyuki Shirai, Akihito Nakamaru, Katsuhiko Shibata</i>	

<b>Joint Time-Frequency Representation of Non-Stationary Signals in Electrical Power Engineering</b> .....	142
<i>Tadeusz Lobos, Tomasz Sikorski, Peter Schegner</i>	
<b>Assessing Nonlinearity and Non-Stationarity in Power System Behavior Using Higher Order Statistical Analysis Techniques</b> .....	149
<i>Emilio Barocio, R. J. Betancourt, J. Arroyo, Arturo Messina</i>	
<b>Evaluation of Compensation Devices of DC Arc Furnaces Using Advanced Spectrum Estimation Methods</b> .....	156
<i>Antonio Bracale, Guido Carpinelli, Zbigniew Leonowicz, Tadeusz Lobos, Jacek Rezmer</i>	
<b>PMU Based Power Oscillation Detection System and Its Application to Japanese Longitudinal Power System</b> .....	163
<i>Yutaka Ota, Hiroyuki Ukai, Koichi Nakamura, Yasunori Mitani, Masahide Hojo, Osamu Saeki</i>	

## **SESSION 5: OPERATION OF MEGA GRIDS (INVITED SESSION)**

<b>Distributed State Estimation for Mega Grids</b> .....	168
<i>Ali Abur</i>	
<b>Private Interconnectors to Facilitate Market Through a Regulated Priority Access: The GRTN's Experience on the Process of Implementation in Italy</b> .....	173
<i>Gabriele Manduzio, Claudio La Ianca, M. Rebolini, David Sapora, Antonio Serrani</i>	
<b>Towards the Creation of an Efficient European Internal Electricity Market: An Overview of the Last ETSO Contributions in the Field of Cross-Border Congestion Management</b> .....	180
<i>Juan Perez</i>	
<b>The Integration of Individual Electricity Markets Requires Stronger Coordination Among TSOs</b> .....	183
<i>Peter Van Roy, Diederik Aelbrecht, Hedwig D'Haeseleer</i>	
<b>Day Ahead Congestion Forecast for a Secure Operation of the European Transmission System</b> .....	190
<i>Jiri Vrsecky, Patrick Panciatichi</i>	
<b>Transfer Capability Computation with Security Constraints</b> .....	195
<i>Xiao-Ping Zhang</i>	

## **SESSION 6: DISTRIBUTION SYSTEM PLANNING – ECONOMIC ISSUES**

<b>Generalized Calculation Methodology of Technical Electric Power Losses in Distribution Network</b> .....	201
<i>Rimantas Deksnys, Robertas Staniulis, Andrius Sablinskas</i>	
<b>Optimal Operational Planning of Large Distribution Systems with Ant Colony Search</b> .....	207
<i>Enrico Carpaneto, Gianfranco Chicco</i>	
<b>A Hybrid Metaheuristic Method for the Planning of Medium-Voltage Distribution Networks</b> .....	214
<i>Tao Xiaohu, Hans-Jürgen Haubrich</i>	
<b>Long Term Cost Allocation Methodology for Distribution Networks with Distributed Generation</b> .....	220
<i>Paulo M. De Oliveira-De Jesus, Maria T. Ponce De Leão</i>	
<b>Capacitor Placement in Radial Distribution Networks Through a Linear Deterministic Optimization Model</b> .....	226
<i>Roberto Aguiar, Pablo Cuervo</i>	
<b>Asset Management in Distribution Systems Considering New Knowledge on Component Reliability and Damage Costs</b> .....	233
<i>Uwe Zickler, Andrei Machkine, Michael Schwan, Armin Schnettler, Xiang Zhang, Ernst Gockenbach</i>	

## **SESSION 7: BIDDING AND BIDDING STRATEGIES**

<b>Bidding in the Secondary Reserve Market from a Hydropower Perspective</b> .....	240
<i>Michael Martin Belsnes, Ingrid Honve, Olav Bjarte Fosso</i>	
<b>Simultaneous Bidding on Day-Ahead Auction Markets for Spot Energy and Power Systems Reserve</b> .....	247
<i>Derk Jan Swider</i>	
<b>Optimal Regulating Market Bidding Strategies in Hydropower Systems</b> .....	254
<i>Magnus Olsson, Lennart Söder</i>	
<b>Building Optimal Offer Curves for an Electricity Spot Market: A Mixed-Integer Programming Approach</b> .....	261
<i>Jose Maria Fernandez-Lopez, Álvaro Baíllo, Santiago Cerisola, Rafael Bellido</i>	
<b>Optimal Supply Bidding with Risk Management in an Electricity Pay-as-Bid Auction</b> .....	268
<i>Habib Rajabi Mashhadi, Javad Sadeh, Mohammad Amin Latifi</i>	

<b>Deriving Optimal Bid Functions Taking Into Account Inter-Temporal Restrictions</b> .....	N/A
<i>Heike Brand, Christoph Weber</i>	

## **SESSION 8: EMERGENCY SYSTEM CONTROL AND RESTORATION**

<b>Defense Schemes Against Power System Blackouts in China with High Load Growth</b> .....	275
<i>Yusheng Xue</i>	
<b>Congestion Management Using Coordinated Control of FACTS Devices and Load Shedding</b> .....	282
<i>Pavel Etingov, Nikolai Voropai, Alexandre Oudalov, A. Germond, Rachid Cherkaoui</i>	
<b>Load Shedding - An Efficient Use of LTC Transformers</b> .....	289
<i>Luciano Barboza, André Lerm, Roberto Salgado</i>	
<b>Identification of Multi Simultaneous Anomalies by Innovation Graph Approach</b> .....	296
<i>Suquan Zhou, Yibin Shi, Jingwen Zhao, Zhuo Liu</i>	
<b>Medium Voltage Network Reliability: Efficiency Oriented Supply Restoration Strategies</b> .....	303
<i>Andreas Theil, Gerhard Theil, Marta Theil</i>	
<b>A Genetic Algorithm for Optimizing Switching Sequence of Service Restoration</b> .....	309
<i>Isamu Watanabe, Ikuo Kurihara</i>	

## **SESSION 9: LOAD FREQUENCY AND WIDE AREA CONTROL**

<b>Analysis of Load Frequency Control Dynamics Based on Multiple Synchronized Phasor Measurements</b> .....	316
<i>Masahide Hojo, Kazuya Ohnishi, Tokuo Ohnishi, Yasunori Mitani, Osamu Saeki, Hiroyuki Ukai</i>	
<b>On Multi-Area Control in Electric Power Systems</b> .....	323
<i>Marek Zima, Damien Ernst</i>	
<b>Wide-Area Monitoring and Control for Power System Grid Security</b> .....	331
<i>Rene Avila-Rosales, Jay Giri</i>	
<b>A Simulation Tool to Study Wide-Area Control Systems</b> .....	338
<i>Sanjoy Sarawgi, Anjan Bose</i>	
<b>Economic Evaluation of Controllable Devices in the Slovenian Electric Power System - A Case Study</b> .....	344
<i>Christian Schaffner, Rafael Mihalic</i>	
<b>New Developments in the Application of Automatic Learning to Power System Control</b> .....	351
<i>Louis Wehenkel, Mevludin Glavic, Damien Ernst</i>	

## **SESSION 10: DISTRIBUTION SYSTEM OPERATION**

<b>Dynamic Programming for Optimal Sequencing of Operations in Distribution Networks</b> .....	359
<i>Pedro Carvalho, Luis Ferreira, Tiago Rojao</i>	
<b>Reconfiguration of Distribution Systems for Loss Reduction Using Tabu Search</b> .....	364
<i>Marcos Guimarães, Carlos Castro</i>	
<b>Distribution Probabilistic Load Flow Solution Considering Network Reconfiguration and Voltage Control Devices</b> .....	370
<i>Chun-Lien Su</i>	
<b>State Estimation Applied to Active Distribution Networks with Minimal Measurements</b> .....	377
<i>Vincent Thornley, Nick Jenkins, Sara White</i>	
<b>Fault Location in Distribution Systems with Distributed Generation</b> .....	384
<i>Cansin Evrenosoglu, Ali Abur</i>	
<b>Evaluation of Distribution System Losses Due to Load Unbalance</b> .....	389
<i>Luis Ochoa, Rade Ciric, Antonio Padilha-Feltrin, Gareth Harrison</i>	

## **SESSION 11: ANCILLARY SERVICES AND MARKETS**

<b>Valuation of Reactive Power Zonal Capacity Payments</b> .....	393
<i>Pablo Frias, David Soler, Tomas Gomez</i>	
<b>A New Approach to Assess the Value of Reactive Power Production</b> .....	400
<i>Hugo Moreno, Guillermo Gutierrez, Sophie Plumel, Patrick Bastard, Gerald B. Sheble</i>	
<b>Design of Frequency Regulation Service Market Based on Price and Demand Elasticity Bids</b> .....	407
<i>Haidan Zhao, Kankar Bhattacharya</i>	

<b>Utilizing Local Customer's Regulation Control Error in Bilateral Regulation Service</b> .....	414
<i>Le-Ren Chang-Chien</i>	
<b>Minimizing Regulation Costs in Multi-Area Markets</b> .....	420
<i>Elin Lindgren, Lennart Söder</i>	
<b>Determination of Interruptible Load as an Ancillary Service in a Coordinated Multi-Commodity Market</b> .....	427
<i>Peng Wang, Yong Liu, Yu Xiao</i>	

## **SESSION 12: FACTS**

<b>Wide-Area TCSC Controller Design in Consideration of Feedback Signals' Time Delays</b> .....	432
<i>Jiang Quanyuan, Zhao Bo, Zou Zhenyu, Cao Yijia</i>	
<b>Simultaneous Stabilization of Power Systems Equipped with Unified Power Flow Controller Using Particle Swarm</b> .....	438
<i>Ali Al-Awami, Youssef Abdel-Magid, Mohammad Abido</i>	
<b>Integrated Optimal FACTS Allocation with Power System Stability Constraint</b> .....	445
<i>Clodomiro Unsuhuay Vila, Rafael C. Leme, Antonio C. Zambroni De Souza, José W. Marangon Lima, Marcelo A. Tomin</i>	
<b>Impact of FACTS Controllers on System Loadability in Presence of Bilateral Contracts in a Competitive Environment</b> .....	451
<i>Daniele Memiti, Lina Guagliardi, Nadia Scordino, Nicola Sorrentino</i>	
<b>Basic Operation Characteristics of Capacitor Commutated Converters</b> .....	458
<i>Simon Jensen, B. Kühne, H. Huang</i>	
<b>A Linear Time Model of the Voltage Source Converter for STATCOM Applications</b> .....	465
<i>Angel L. Trigo-García, Sergio Ceballos, Jose M. Maza-Ortega</i>	

## **SESSION 41: SURVEY SESSION 1**

<b>Asset Management Techniques</b> .....	471
<i>Joachim Schneider, Armin Gaul, Claus Neumann, Jürgen Hogräfer, Wolfram Wellßow, Michael Schwan, Armin Schnettler</i>	

## **SESSION 13: SUBSTATION AUTOMATION, IEC 61850 (INVITED SESSION)**

<b>The Standard IEC 61850 - A Simple But Comprehensive Solution for Today's Power System Requirements</b> .....	482
<i>Rudolf Baumann, Klaus-Peter Brand</i>	
<b>IEC 61850 SCL - More Than Interoperable Data Exchange Between Engineering Tools</b> .....	488
<i>Wolfgang Wimmer</i>	
<b>IEC 61850 Process Connection - A Smart Solution to Connect the Primary Equipment to the Substation Automation System</b> .....	493
<i>Christoph Brunner</i>	
<b>Utilities and Industries of Today: Leading by Following IEC 61850</b> .....	499
<i>Clemens Hoga, Gordon Wong</i>	
<b>IEC 61850 Object Models of Multifunctional Protection Relays</b> .....	504
<i>Alexander Apostolov</i>	
<b>IEC 61850 Also Outside the Substation for the Whole Electrical Power System</b> .....	511
<i>Karlheinz Schwarz</i>	

## **SESSION 14: LOAD FLOW**

<b>Analog Emulation Using a Reconfigurable Classical Generator Model for Load Flow Analysis</b> .....	518
<i>Jeffrey Yakaski, Qingyan Liu, Chika Nwankpa</i>	
<b>Reconfigurable Transmission Line Model for Analog Power Flow Computation</b> .....	525
<i>Aaron St. Leger, Chika Nwankpa</i>	
<b>Performance Analysis of Load Flow Computation Using FPGA</b> .....	533
<i>Jeremy Johnson, Petya Vachranukunkiet, S. Tiwari, Prawat Nagvajara, Chika Nwankpa</i>	
<b>An Optimization Approach to Uncertainty Propagation in Boundary Load Flow</b> .....	540
<i>Andrija Saric, Branko Glisovic, Aleksandar Stankovic</i>	

<b>An Efficient Contingency Screening Scheme for ATC Assessment with Transient Stability Constraints</b> .....	547
<i>Masaki Nagata</i>	
<b>Shunt Reactive Power Compensation of Long Transmission Lines</b> .....	554
<i>Qi Wang, San Shing Choi</i>	

### **SESSION 15: RISK AND UNCERTAINTY**

<b>Transmission Contract for Risk-Hedging and Reliability Improvement in Deregulated Power System</b> .....	561
<i>Pathom Attaviriyanyupap, Akihiko Yokoyama</i>	
<b>Risk Assessment of Generation Investment</b> .....	568
<i>Jifeng Su, Felix F. Wu</i>	
<b>The Short-Term Uncertainty of System Marginal Price</b> .....	574
<i>Hua Zheng, Li Xie, Li-Zi Zhang</i>	
<b>Uncertainty Quantification in a Model Electric Energy Bidding Problem: A Multi-Criteria Decision Making Approach</b> .....	581
<i>Mei-Peng Cheong, Gerald B. Sheble, Daniel Berleant, Jianzhong Zhang, George Kahrmanis</i>	
<b>Spot Price Simulation and Volatility Analysis in the Future Iberian Electricity Market</b> .....	589
<i>Jorge Sousa, João Lagarto, Rui Pestana</i>	
<b>A Conic Optimal Power Flow with Uncertain Prices</b> .....	595
<i>Rabih Jabr</i>	

### **SESSION 16: VOLTAGE STABILITY AND CONTROL**

<b>A Hybrid Approach for Voltage Stability of Power Systems</b> .....	602
<i>Sylvain Leirens, Jean Buisson, Patrick Bastard, Jean-Louis Coullon</i>	
<b>Preventive Control Strategy for Maintaining Secure Voltage Stability Margins</b> .....	N/A
<i>Adriana Quintela, Carlos Castro</i>	
<b>Large-Scale Wind Power Integration, Voltage Stability Limits and Modal Analysis</b> .....	608
<i>Giuseppe Di Marzio, Olav Bjarte Fosso, Kjetil Uhlen, Magni Tor Pålsson</i>	
<b>Voltage Sensitivity Based Technique for Optimal Placement of Switched Capacitors</b> .....	615
<i>Manuel Rodríguez Montañés, J. M. Riquelme Santos, Esther Romero Ramos</i>	
<b>Dynamic Voltage Stability Analysis in Multi-Machine Power Systems</b> .....	621
<i>Lijun Cai, István Erlich</i>	
<b>Investigating the Influence of Control Systems of Multi-Infeed HVDC System on AC/DC Power System Voltage Stability by Modal Analysis Method</b> .....	627
<i>Guohong Wu, Tamotsu Minakawa, Toshiyuki Hayashi</i>	

### **SESSION 17: LOADFLOW AND TIME SERIES ANALYSIS**

<b>Advanced Probabilistic Power Flow Methodology</b> .....	634
<i>George Stefopoulos, A. P. Sakis Meliopoulos, George Cokkinides</i>	
<b>A Non-Linear Regression Model for Mid-Term Load Forecasting and Improvements in Seasonality</b> .....	641
<i>Alexander Bruhns, Gilles Deurveilher, Jean-Sebastien Roy</i>	
<b>Local Load Analysis with Periodic Time Series and Temperature Adjustment</b> .....	649
<i>Marcelo Espinoza, Bart De Moor, Caroline Joye, Ronnie Belmans</i>	
<b>A Continuous Loading Method to Estimate Limiting Static-Stability Operating Conditions of Electric Power Systems in Real Time</b> .....	656
<i>Vladimir Innokentevich Tarasov</i>	
<b>Stepwise Power Flow - A New Tool to Analyse Capacity Shortage and Reserve Requirements</b> .....	663
<i>Bjorn H. Bakken, Astrid Petterteig, Espen Haugan, Bjorn Walther</i>	
<b>System Dynamics Modeling for Electricity Generation Expansion Analysis</b> .....	670
<i>Juan José Sánchez, Efraim Centeno, Julian Barquin</i>	

### **SESSION 18: UNIT COMMITMENT**

<b>Decomposition Algorithm for Optimal Security-Constrained Power Scheduling</b> .....	677
<i>Jorge Martínez Crespo, Julio Usaola García, José L. Fernández</i>	

<b>Enhanced Merit Order and Augmented Lagrange Hopfield Network for Unit Commitment</b> .....	684
<i>Vo Ngoc Dieu, Weerakorn Ongsakul</i>	
<b>Unit Commitment with Environmental Considerations: A Practical Approach</b> .....	691
<i>João Catalão, Sílvio Mariano, Victor Mendes, Luís Ferreira</i>	
<b>Unit Commitment with Probabilistic Spinning Reserve Assessment Using Simulated Annealing</b> .....	696
<i>Dimitris Simopoulos, S. Kavatza</i>	
<b>An Integrated Dispatch Model of Gas Supply and Thermoelectric Systems</b> .....	703
<i>Oderson Mello, Takaaki Ohishi</i>	

Volume 2

<b>Handling a CO<sub>2</sub> Reservoir in Mid Term Generation Scheduling</b> .....	709
<i>Avella Fluvia Manel, Boukir Karima, Martinetto Pascal</i>	

**SESSION 19: NEW DEVELOPMENTS IN OVERCURRENT AND DISTANCE PROTECTION**

<b>Optimal Coordination of Overcurrent Relays in an Interconnected Power System</b> .....	716
<i>Javad Sadeh</i>	
<b>Fuzzy Logic Based Overcurrent Protection for MV Networks</b> .....	721
<i>Waldemar Rebizant, Daniel Bejmert, Janusz Szafran</i>	
<b>Fuzzy-Neuro Approach to Distance Protection for Transmission Line</b> .....	N/A
<i>Hassan Khorashadi-Zadeh</i>	
<b>The Impact of STATCOM on Distance Relay</b> .....	727
<i>Xiaoyao Zhou, Haifeng Wang, Raj K Aggarwal, Phil Beaumont</i>	
<b>New Method for Dynamical Correction of Frequency Insensitive Impedance Measurement Algorithms</b> .....	734
<i>Dominik Bak, Janusz Szafran, Waldemar Rebizant</i>	
<b>An Adaptive Median Post-Filter for Impedance Estimation Based on Differential Equation Algorithm</b> .....	740
<i>Rastko Zivanovic</i>	

**SESSION 20: TRANSIENT STABILITY ASSESSMENT & CONTROL**

<b>The Choice of SMES Control for Power System Transient Stability Improvement</b> .....	744
<i>Yuri V. Sharov, Vladimir A. Stroeve, Oleg N. Kuznetsov</i>	
<b>Global Control of Power System for Transient Stability Enhancement and Voltage Regulation</b> .....	750
<i>Guohua Zhang, Youyi Wang</i>	
<b>Power System Transient Stability Preventive Control Based on Optimal Power Flow</b> .....	757
<i>Yue Yuan, Lu Zuo, Junji Kubokawa, Hiroshi Sasaki</i>	
<b>A New Method for Transient Stability Assessment Based on Critical Trajectory</b> .....	763
<i>Naoto Yorino, Yoshifumi Kamei, Yoshifumi Zoka</i>	
<b>Application of an Advanced Transient Stability Assessment and Control Method to a Realistic Power System</b> .....	769
<i>Diego Cirio, Dario Lucarella, Giuliano Vimercati, Stefano Massucco, A. Morini, Federico Silvestro, D. Ernst, M. Pavella, L. Wehenkel</i>	
<b>Transient Stability Evaluation of a 12,000-Bus Power System Data Using TEPCO-BCU</b> .....	777
<i>Yasuyuki Tada, Tsuyoshi Takazawa, Hsiao-Dong Chiang, Hua Li, Jianzhong Tong</i>	

**SESSION 21: OPTIMAL POWER FLOW**

<b>Coupling OPF and Topology Optimization for Security Purposes</b> .....	786
<i>Fabrice Zaoui, Stéphane Fliscounakis, Robert Gonzalez</i>	
<b>Optimal Power Dispatch and Conversion in Systems with Multiple Energy Carriers</b> .....	793
<i>Martin Geidl, Göran Andersson</i>	
<b>An Optimal Power Flow with User-Defined Objective Functions and Constraints</b> .....	800
<i>Zulmar Machado Junior, Glauco Taranto, Djalma Falcão</i>	
<b>Umbrella Contingencies in Security-Constrained Optimal Power Flow</b> .....	807
<i>François Bouffard, Francisco Galiana, José Manuel Arroyo</i>	
<b>Economic Dispatch Algorithms for Thermal Unit System Involving Combined Cycle Units</b> .....	814
<i>Feng Gao, Gerald Sheble</i>	

<b>A Novel Particle Swarm Optimization Approach for Optimal Reactive Power Dispatch</b> .....	820
<i>Bo Zhao, Quanyuan Jiang, Chuangxin Guo, Yijia Cao</i>	

## **SESSION 22: POWER QUALITY**

<b>Power Quality Enhancement in an Isolated Power System Through Series Compensation</b> .....	827
<i>San Shing Choi, Tong Xun Wang, Eng Kian Sng</i>	
<b>An Improved Algorithm with High Accuracy for Non-Integer Harmonics Analysis Based on FFT Algorithm and Neural Network</b> .....	N/A
<i>Gongbao Wang, Dongyang Xiang, Weiming Ma</i>	
<b>Harmonic Analysis Model Based on 8-Port Representation for Korean High-Speed Railway System</b> .....	N/A
<i>Hanmin Lee, Gildong Kim, Kwanghae Oh, Gilsoo Jang, Saehyuk Kwon</i>	
<b>Estimating Voltage Quality in Distribution Systems Using CFA-Matrix Description for Non-Linear Loads</b> .....	834
<i>Cezary Dzienis, Andrzej Bachry, Zbigniew Styczynski</i>	
<b>An Orthogonal Decomposition of Apparent Power with Application to an Industrial Load</b> .....	840
<i>Hanoch Lev-Ari, Aleksandar Stankovic, Sergio Ceballos</i>	
<b>Control Schemes for Shunt Active Filters to Mitigate Harmonics Injected by Inverted-Fed Motors</b> .....	847
<i>Johann Petit-Suarez, Hortensia Amarís, Guillermo Robles</i>	

## **SESSION 23: FAULT LOCATION**

<b>On the Use of Continuous-Wavelet Transform for Fault Location in Distribution Power Networks</b> .....	854
<i>Alberto Borghetti, Sandro Corsi, Carlo Alberto Nucci, Mario Paolone, Lorenzo Peretto, Roberto Tinarelli</i>	
<b>Fast Fault Location Technique for Distribution Systems</b> .....	N/A
<i>Joni Coser, Jacqueline Rolim</i>	
<b>Transient Based Earth Fault Location in 110 kV Subtransmission Networks</b> .....	861
<i>Peter Imris, Matti Lehtonen</i>	
<b>Differential Equation Based Fault Location Algorithm for Series-Compensated Transmission Lines</b> .....	865
<i>Eugeniusz Rosolowski, Jan Izykowski, Murari Saha</i>	
<b>Fault Location Algorithm for Three-Terminal Transmission Lines: Distributed Time Domain Line Model</b> .....	872
<i>Ebadallah Kamyab, Javad Sadeh, Mohammad Hosain Javidi</i>	
<b>Accurate Algorithm for Locating Faults in Power Transmission Lines Under Saturation of Current Transformers</b> .....	879
<i>Jan Izykowski, Eugeniusz Rosolowski, Murari Saha, Przemyslaw Balcerek</i>	

## **SESSION 24: TRANSIENT STABILITY**

<b>New Mathematical Models to Represent Variable Speed Wind Generation Systems in Transient Stability Studies</b> .....	886
<i>Marcus Vinicius Alves Nunes, Joaõ Paulo Abreu Vieira, Ubiratan Holanda Bezerra, João Abel Peças Lopes</i>	
<b>A Solution of Dynamic Total Transfer Capability by Means of Transient Stability Constrained OPF with Three Phase Unbalanced Faults</b> .....	893
<i>Junji Kubokawa, Yue Yuan, Hiroshi Sasaki, Takumi Matsubara, Kimihiko Shimomura</i>	
<b>Power System Transient Stability Simulation Based on Bi-Directional Iteration</b> .....	N/A
<i>Xiao-Dong Yang, Da-Zhong Fang, T. S. Chung</i>	
<b>Developing New Trajectory Sensitivity Approach for Computation of Critical Fault Clearing Time</b> .....	N/A
<i>Da-Zhong Fang, Yi-Fei Qin, T. S. Chung</i>	
<b>PID Governor for Black Start</b> .....	900
<i>Atsushi Izena, Naoto Suzuki, Toshikazu Shimojo, Kaiichiro Hirayama, Nobuhiko Furukawa, Tachisa Kageyama</i>	

## **SESSION 42: SURVEY SESSION 2**

<b>Integration of Stochastic Generation in Power Systems</b> .....	906
<i>G. Papaefthymiou, P. H. Schavemaker, L. Van De Sluis, W. L. Kling, D. Kurowicka, R. M. Cooke</i>	

## **SESSION 25: RELIABILITY**

<b>Reliability Assessment of Deregulated Generating Systems Using Reliability Network Equivalent and Pseudo-Sequential Simulation Techniques</b> .....	917
<i>Yi Ding, Peng Wang, Lalit Goel, Qiuwei Wu</i>	
<b>Modelling of Ice Storms for Power Transmission Reliability Calculations</b> .....	922
<i>Elin Broström, Lennart Söder</i>	
<b>A Method for Analysing the Effect of Substation Failures on Power System Reliability</b> .....	929
<i>Liisa Pottonen, Urho Pulkkinen, Mikko Koskinen</i>	
<b>Markov Models for Reliability-Centered Maintenance Planning</b> .....	938
<i>Gerhard Theil</i>	
<b>Simplified Reliability Calculation of Electrical Networks by Automatic Determination of Relevant Outage Combinations</b> .....	945
<i>Song Cheng</i>	
<b>A Method for Extracting Reliability Importance Indices from Reliability Simulations of Electrical Networks</b> .....	952
<i>Patrik Hilber, Lina Bertling</i>	

## **SESSION 26: STATE ESTIMATION**

<b>Optimal Placement and Utilization of Phasor Measurements for State Estimation</b> .....	959
<i>Xu Bei, Yeo Jun Yoon, Ali Abur</i>	
<b>M-Arctan Estimator Based on Trust Region Method</b> .....	965
<i>Yacine Hassaine, Benoît Delourme, Pierre Hausheer, Patrick Panciatici, Eric Walter</i>	
<b>Topology Error Identification for Orthogonal Estimators Considering a Priori State Information</b> .....	972
<i>Antonio Simões-Costa, Elizete Lourenço, Fabio Vieira</i>	
<b>Static State Estimation of Power Systems Containing Series and Shunt FACTS Controllers</b> .....	979
<i>Enrique Zamora-Cardenas, Claudio Fuerte-Esquivel</i>	
<b>Assessment and Enhancement of Power System State Estimation Quality</b> .....	985
<i>Horia Crisciu, François Promel, Jozef Van Hecke</i>	
<b>Application of Genetic Algorithms for Planning Metering Systems in State Estimation</b> .....	992
<i>Milton Brown Do Coutto Filho, Julio Cesar Stacchini De Souza, Edwin Benito Mitacc Meza, Marcus Theodor Schilling, Charles De Capdeville</i>	

## **SESSION 27: MICROGRIDS AND DISTRIBUTION SYSTEMS WITH EMBEDDED GENERATION**

<b>Probabilistic Sizing of Wind and Hydrogen Power Systems for Remote Areas</b> .....	998
<i>Lars Nesje Grimsmo, Magnus Korpaas, Terje Gjengedal</i>	
<b>A Logistic Model for Assessment of Wind Power Combined with Electrolytic Hydrogen Production in Weak Grids</b> .....	1005
<i>Magnus Korpaas, Christopher J. Greiner, Arne T. Holen</i>	
<b>A Dynamic Programming Based Method for Developing Optimal Microgrid Architectures</b> .....	1012
<i>Joydeep Mitra, Shashi Patra, Satish Ranade</i>	
<b>MicroGrids Black Start and Islanded Operation</b> .....	1019
<i>João Abel Peças Lopes, Carlos Coelho Leal Moreira, Fernanda Oliveira Resende</i>	
<b>Agora: Distributed Tertiary Control of Distributed Resources</b> .....	1026
<i>Koen Vanthournout, Karel De Brabandere, Edwin Haesen, Jeroen Van Den Keybus, Geert Deconinck, Ronnie Belmans</i>	
<b>A Study on the Performance of Grid-Connected PV-ECS System Considering Meteorological Variation</b> .....	1033
<i>Md. Habibur Rahman, Koichi Nakamura, Susumu Yamashiro</i>	

## **SESSION 28: POWER SYSTEM DYNAMICS AND CONTROL**

<b>Excitation Control System Design of Superconducting Generator with High Response Excitation in Consideration of SMES Effect for Improving Stability in Multi-Machine Power System</b> .....	1040
<i>Worawut Sae-Kok, Akihiko Yokoyama, Tanzo Nitta</i>	

<b>Robust Power System Stabilizer Tuning Based on Multiobjective Design Using Hierarchical and Parallel Micro Genetic Algorithm</b> .....	1047
<i>Komsan Hongesombut, Sanchai Dechanupaprittha, Yasunori Mitani, Issarachai Ngamroo</i>	
<b>Design of Robust SMES Controller in a Multimachine Power System by Using Hybrid TS/EP</b> .....	1054
<i>Sanchai Dechanupaprittha, Komsan Hongesombut, Masayuki Watanabe, Yasunori Mitani, Issarachai Ngamroo</i>	
<b>An Approach for Tuning of Power System Stabilizers Based on the Wide Area Phasor Measurement</b> .....	1061
<i>Masayuki Watanabe, Takanori Izumi, Takuhei Hashiguchi, Yasunori Mitani</i>	
<b>Robust Decentralized Structure - Constrained Controller Design for Power Systems: An LMI Approach</b> .....	1068
<i>Getachew K. Befekadu, István Erlich</i>	
<b>Methods for Estimation of Counter Measures to Improve Oscillatory Stability in Power Systems</b> .....	1075
<i>Simon P. Teeuwesen, István Erlich, Mohamed A. El-Sharkawi</i>	

## **SESSION 29: DISTRIBUTED GENERATION 1**

<b>A Storage Management Algorithm for Improved Wind Generator Performance</b> .....	1081
<i>Chad Abbey, Géza Joos</i>	
<b>Evaluation of Wind Energy Sources Influence on Composite Generation and Transmission Systems Reliability</b> .....	1088
<i>Carmen Lucia Tancredo Borges, João Paulo Galvão</i>	
<b>Effects of Superconducting Generator on Mitigation of Voltage Fluctuation in Power Systems with Wind Power Generation</b> .....	1094
<i>Orie Sakamoto, Masaki Hashimoto, Masato Sonoda, Tanzo Nitta</i>	
<b>Opportunities for Energy Storage Associated to Wind Farms with Guaranteed Feed-in Tariffs in the Present French Law</b> .....	1100
<i>Fouad Abou Chacra, Patrick Bastard, Gilles Fleury, Régine Clavreul</i>	
<b>Power Flow Control by Mobile Agent-Based Management of Distributed Energy Resources</b> .....	1106
<i>Kenta Furukawa, Hiroumi Saitoh, Junichi Toyoda</i>	
<b>Optimal Operation of Dispersed Generation Under Uncertainty Using Mathematical Programming</b> .....	1112
<i>Edmund Handschin, Frederike Neise, Hendrik Neumann, Rüdiger Schultz</i>	

## **SESSION 30: VOLTAGE CONTROL**

<b>Loadability Limits and Emergency Countermeasures Against Voltage Collapse</b> .....	1119
<i>Michael Karystianos, Vassilis Nikolaidis, Costas Vournas</i>	
<b>Investigation of Parameters Affecting Voltage Security of the Hellenic Interconnected System</b> .....	1127
<i>George Christoforidis, John Kabouris, Costas Vournas, Thierry Van Cutsem</i>	
<b>Dynamic Performances of the Hierarchical Voltage Regulation: The Italian EHV System Case</b> .....	1134
<i>Alberto Berizzi, Marco Merlo, Paolo Marannino, Fabio Zanellini, Sandro Corsi, M. Pozzi</i>	
<b>On Continuation of Two-Parameter Local Bifurcations for Differential-Algebraic Equations and Its Application in Power Systems</b> .....	N/A
<i>Guo-Yun Cao, David John Hill, Hsiao-Dong Chiang</i>	
<b>Voltage Stability Security Margin Assessment Via Artificial Neural Networks</b> .....	N/A
<i>Alberto Jiménez, Carlos Castro</i>	
<b>Optimal Fuzzy Self-Organizing Structure for Voltage Security Margin Estimation</b> .....	1141
<i>Mazyar Mirhoseini Moghaddam, Hamid Khaloozadeh</i>	

## **SESSION 31: CONGESTION AND MARKETS**

<b>Linear Programming Approach for the Transition from Market-Generated Hourly Energy Programs to Feasible Power Generation Schedules</b> .....	1148
<i>Alberto Borghetti, Andrea Lodi, Silvano Martello, Michele Martignani, Carlo Alberto Nucci, Alessandro Trebbi</i>	
<b>Evolutionary Algorithms and Evolutionary Particle Swarms (EPSO) in Modeling Evolving Energy Retailers</b> .....	1155
<i>Vladimiro Miranda, Naing Win Oo</i>	
<b>Network Modeling for Congestion Management: Zonal Representation Versus Nodal Representation</b> .....	1162
<i>Jean-Baptiste Bart, Marc Andreewsky</i>	
<b>Real-Time Pricing System for Demand-Side Management in FRIENDS</b> .....	1168
<i>Shigeki Yoshikawa, Hiroyuki Kita, Eiichi Tanaka, Jun Hasegawa</i>	

<b>Financial Impacts of Congestion Relief Measures Under Electricity Deregulation</b> .....	1176
<i>Cherry Yuen, Jiuping Pan, Qianjin Liu</i>	
<b>Pay-as-Bid Auctions for a Firm Bilateral Status</b> .....	1184
<i>Ivana Kockar, Francisco Galiana, Daniel Kirschen</i>	

### **SESSION 32: ANALYSIS AND CONTROL OF POWER SYSTEM OSCILLATIONS**

<b>Higher-Order Normal Forms Analysis of Stressed Power Systems: A Non-Recursive Approach</b> .....	1191
<i>Ramon Jimenez, Irma Martinez, Arturo Messina, Emilio Barocio</i>	
<b>Analysis of Inter-Area Oscillations Via Non-Linear Time Series Analysis Techniques</b> .....	1198
<i>Daniel Ruiz-Vega, Arturo Messina, Gilberto Enríquez-Harper</i>	
<b>Comparative Analysis and Numerical Validation of Industrial-Grade Power System Simulation Tools: Application to Small-Signal Stability</b> .....	1205
<i>Keren Kaberere, Komla Folly, Mpumelelo Ntombela, Alexander Petroianu</i>	
<b>A Unified Framework for Nonlinear Dynamic Simulation and Modal Analysis for Control of Large-Scale Power Systems</b> .....	1212
<i>Bogdan Marinescu, Luis Rouco</i>	
<b>Robust Coordinated Design of PSS &amp; Statcom Controllers for Damping Power System Oscillation</b> .....	1219
<i>Saleh Bamasak, Mohammad Abido</i>	
<b>Performance Verification of TCSC Control and Protection Equipment Using RTDS</b> .....	1226
<i>M. Arunachalam, Lal Ghamandi, C. G. Rajiv, Babu Narayanan</i>	

### **SESSION 33: DISTRIBUTED GENERATION 2 (INVITED SESSION)**

<b>Primary Frequency Control Participation Provided by Doubly Fed Induction Wind Generators</b> .....	1233
<i>Rogério G. De Almeida, J. A. Peças Lopes</i>	
<b>Dynamic Conditioning of Stochastic Fluctuating Energy from Windparks</b> .....	1240
<i>Constantinos Sourkounis, Jan Wenske, Florian Richter</i>	
<b>Control Possibility for Offshore Wind Farms</b> .....	1245
<i>Ervin Spahic, Gerd Balzer</i>	
<b>Radial Basis Functions for Dynamic Security Assessment of Power Systems with Increased Wind Power Penetration</b> .....	1252
<i>Athanasios Gavoyannis, Emmanouil Voumvoulakis, Nikolaos Hatzigiorgiou</i>	

### **SESSION 34: SUBSYNCHRONOUS OSCILLATIONS**

<b>Frequency Scanning Program for SSR Studies Implemented to Function in Connection of PSS/E Power Flow Calculation Program</b> .....	1259
<i>Tuomas Rauhala, Pertti Järventausta, Harri Kuisti</i>	
<b>A Comparative Study of SSR Characteristics of TCSC and SSSC</b> .....	1266
<i>K. R. Padiyar, Nagesh Prabhu</i>	
<b>SSR Analysis with a New Analytic Model of Thyristor Controlled-Series Capacitor</b> .....	1273
<i>G. N. Pillai, D Jovcic</i>	
<b>Analysis Approaches of SSO Based on LDAE Model</b> .....	1279
<i>Chang Yu, Yixin Ni</i>	

### **SESSION 35: METHODS IN PROTECTION AND FAULT ANALYSIS**

<b>Reasoning Applied to Substation Data Extracted from Relays and Circuit Breakers</b> .....	1286
<i>Ching-Lai Hor, Peter A. Crossley</i>	
<b>An Adaptive, Self-Checking Algorithm for Controlled Fault Interruption</b> .....	1293
<i>Richard Thomas, Jaap Daalder, Carl-Ejnar Sölver</i>	
<b>A Methodology for Assessing the Influence of Instrument Transformer Characteristics on Power System Protection Performance</b> .....	1298
<i>Mladen Kezunovic, Bogdan Naodovic</i>	

## **SESSION 36: ELECTROMAGNETIC TRANSIENTS**

<b>Transient Impedance of the Vertical Grounding Electrode</b> .....	N/A
<i>Dragan Poljak, Vicko Doric, Ranko Goic</i>	
<b>EMTP Simulations of Induced Voltages to an Underground Gas Pipeline and Its Countermeasures</b> .....	1305
<i>Akihiro Ametani, Naotsugu Uchida, Hiroshi Isogai, Yuji Hosokawa</i>	
<b>Digital Simulation of Fault Arcs in Medium-Voltage Distribution Networks</b> .....	1310
<i>Mustafa Kizilcay, Piergiovanni La Seta</i>	
<b>New Control Technique for the Dynamic Voltage Restorer for Sensitive Low-Voltage Loads</b> .....	1317
<i>Piergiovanni La Seta, Mustafa Kizilcay, Liliana Oprea, Viktor Popescu</i>	

## **SESSION 37: MIXED SOURCE OPTIMISATION**

<b>Benchmarking of Hydropower Generation Planning</b> .....	1323
<i>Tarjei Kristiansen</i>	
<b>Power Generation Efficiency Improvement in Cascaded and Head-Dependent Reservoirs</b> .....	1330
<i>Silvio Mariano, João Catalão, Victor Mendes, Luís Ferreira</i>	
<b>Two-Station Equivalent of Hydro Power Systems</b> .....	1335
<i>Lennart Söder, Jonas Rendelius</i>	
<b>Short Term Optimization of Cogeneration Systems Considering Heat and Electricity Demands</b> .....	1342
<i>Guillaume Sandou, Stéphane Font, Sihem Tebbani, Arnaud Huret, Christian Mondon</i>	

## **SESSION 38: ADVANCED DYNAMIC SIMULATION METHODS**

<b>Combined Detailed and Quasi Steady-State Time Simulation for Large-Disturbance Analysis</b> .....	1349
<i>Thierry Van Cutsem, Marie-Eve Grenier, Daniel Lefebvre</i>	
<b>OVNI-NET: A Flexible Cluster Interconnect for the New OVNI Real-Time Simulator</b> .....	1356
<i>Tom De Rybel, Jorge Hollman, Jose Marti</i>	
<b>Software Implementation of Controller Representation in the OVNI Simulator</b> .....	1362
<i>Luis R. Linares, Mazana Armstrong, Jose Marti</i>	
<b>Analog Behavioral Models and the Design of Analog Emulation Engines for Power System Computation</b> .....	1368
<i>Michael Olaleye, Qingyan Liu, Chika Nwankpa</i>	

## **SESSION 39: SYSTEM PARAMETERS AND MONITORING**

<b>Frequency Measurement in Power Networks in the Presence of Harmonics Using Fourier and Zero Crossing Technique</b> .....	N/A
<i>Milenko Djuric, Zeljko Djuric</i>	
<b>New Method for the State Evaluation of the Zero-Sequence-System</b> .....	1374
<i>Gernot Druml, Olaf Seifert</i>	
<b>Monitoring of Oil Leakages of Circuit Breaker Hydraulic Drive</b> .....	1381
<i>Bartosz Rusek, Gerd Balzer</i>	
<b>Real-Time Transient Temperature Computation of Cables Including Moisture Migration Modelling</b> .....	1388
<i>Robert John Millar, Matti Lehtonen</i>	

## **SESSION 40: TRANSMISSION AND TRANSMISSION PLANNING**

<b>Transmission Cost Allocation in Pool Systems</b> .....	1396
<i>Julio Usaola</i>	
<b>Long Term Marginal Prices - Solving the Revenue Reconciliation Problem of Transmission Providers</b> .....	1403
<i>António Braga, João Saraiva</i>	
<b>A Framework for the Analysis of Transmission Planning in the Market Environment</b> .....	1410
<i>Javier Contreras, Verónica Bósquez, George Gross</i>	
<b>Application of a Data Mining Based Technique for the Evaluation of Transmission Expansion Plans</b> .....	1418
<i>Christophe Druet, Stefano Vassena, Patricia Rousseaux, Louis Wehenkel</i>	
<b>Author Index</b>	