1999 WINTER MEETING

31 January - 4 February 1999
New York City • New York • USA
VOLUME II

Power System Operations Committee

- Key Issues in Energy Trading (Panel) .................................................................................. 783
  Chair: E. DEHDASHTI
  Tuesday, February 2, 8:30 AM, Murray Hill B

- Congestion Management Practices .................................................................................. 784
  Chair: F. ALBUYEH
  Tuesday, February 2, 2:00 PM, Sutton South

- Operating Economics Subcommittee
  Chair: M. E. EL-HAWARY
  Wednesday, February 3, 9:00 AM, Beekman Parlor
  Optimal Scheduling of Spinning Reserve with Ramp Constraints ........................................ 785
  H. WU, H. B. GOOI

  Chair: D. SHIRMOHAMDADI
  Wednesday, February 3, 9:00 AM, Regent Parlor

- Control Center Issues – Y2K Experiences (Panel)
  Chair: P. TRAYNOR
  Wednesday, February 3, 9:00AM, Sutton North
  Y2K - What Utilities and Vendors are Doing to Protect Themselves Against Year 2000 Problems .......... 792

- Market Based System Control
  Chair: K. N. ZADEH
  Wednesday, February 3, 9:00 AM, Murray Hill B
  A Possible Framework for Market-Based Voltage/Reactive Power Control ............................. 794
  M. D. ILIC, C. N. YU
  Load Frequency Control with MWh Constraint and Regulation Margin ................................. 803
  T. HIYAMA, Y. YOSHIMUTA
  Power Exchange for Frequency Control (PXFC) .................................................................. 809
  M. D. ILIC, P. SKANTZE, C. N. YU, J. CARDELL, L. FINK

- OPERATION METHODS
  Chair: M. SHAHIDEPOUR
  Wednesday, February 3, 2:00 PM, Nassau A
  Clusters-Congestion Cluster-Based Markets for Transmission Management .......................... 821
  C. N. YU, M. D. ILIC
  Analysis of Bids and Re-bids of Generators in the Australian National Electricity Market ............. 833
  W. MIELCZARSKI, M. WIDJAJA
  Market Gaming and Market Power Mitigation in Deregulated Electricity Markets .................... 839
  D. A. LUSAN, Z. YU, F. T. SPARROW
  Towards On-Line Optimal Reactive Power Scheduling Using ANN Memory Model Based Method .................. 844
  B. VENKATESH, G. SADASIVAM, M. ABDULLA KHAN

- Outage Management Techniques and Experiences (Panel) ................................................ 849
  Chair: W. R. CASSEL
  Wednesday, February 3, 2:00 PM, Murray Hill A
  The Concept of Distribution Automation System in the Kansai Electric Power Co. .................. 850
  Y. MATSUMOTO, T. OOHASHI, Y. MATSUURA
Outage Management System Implementation and Operations Experience at Gulf Power Company ........................................... 854
S. CARTER, T. NIELSEN, K. GEISLER
Critical Success Factors for Outage Management Systems ........................................................................................................ 857
J. TRACEY, R. COUGH
Outage Management in ScottishPower ........................................................................................................................................... 860
D. Macfarlane
Outage Management Applications and Methods .............................................................................................................................. 866
R. HORN, P. JOHNSON
Selection and Implementation of an Outage Management System ................................................................................................. 870
H. TRAM

• Poster Session
  Chair: A. BOSE
  Thursday, February 4, 9:00 AM, Rhinelander Center
Trading Electrical Energy in Open Electricity Markets in Australia ........................................................................................................ 873
W. MIELCZARSKI, G. MICHALIK
Voltage Regulation and Energy Consumption in Electricity Markets ........................................................................................................ 879
W. MIELCZARSKI, G. MICHALIK

Power System Planning and Implementation Committee

• Noteworthy Topics in Power System Planning in a Deregulated Environment
  Chair: H. L. Willis
  Tuesday, February 2, 9:00 AM, Nassau B
PE-116-PWRS-0-08-1998 Coalition Formation in Transmission Expansion Planning ................................................................. 887
J. CONTRERAS, F. F. WU
M. W. DAVIS, A. H. GIFFORD, T. J. KRUPA
PE-026-PWRS-0-05-1998 Modeling the Impact of Substations on Distribution Reliability ................................................................. 889
R. E. BROWN, T. M. TAYLOR
Quickprop Algorithm for Transfer Capability Calculations ..................................................................................................................... 890
X. LUO, A.D. PATTON, C. SINGH

• Poster Session
  Chair: H. L. Willis
  Thursday, February 4, 9:00 AM, Rhinelander Center
Automatic Scheduling Method Using Tabu Search for Maintenance outage Tasks of Transmission and Substation System with Network Constraints ......................................................................................................... 895
T. SAWA, T. FURUKAWA, M. NOMOTO, T. NAGASAWA, T. SASAKI, K. DENO, T. MAEKAWA
Hedging Large-Scale Distribution system Investments Against Uncertainty ................................................................................................. 901
P.M.S. CARVALHO, L.A.F.M. FERREIRA, L.M.F. BARRUNCHO

Power System Instrumentation and Measurement Committee

• PSIM Meeting
  Chair: J. MCBRIDE
  Thursday, February 4, 2:00 PM, Nassau B
A Smart Method Makes DFT More Precise for Power System Frequency Estimation ................................................................. 909
J.Z. YANG, C.W. LIU
PE-463-PWRD-0-10-1998 Physical Time Domain Representation of Powers in Linear and Nonlinear Electrical Circuits ................................................................................................................................. 914
J. COHEN, F. DE LEON, L. M. HERNANDEZ

xvi
Power System Relay Committee

• Wide Area Protection and Emergency Control (Panel) ........................................ 917
  Chair: M. M. BEGOVIC
  Monday, February 1, 2:00 PM, Sutton South
  D. NOVESEL, M. BEGOVIC, C. TAYLOR, J. P. CLERFEUILLE, N. BHATT, D. KARLSSON

• PSRC Papers: Session I
  Chair: C. MOZINA
  Tuesday, February 2, 9:00 AM, Nassau A
  LAN Congestion Scenario and Performance Evaluation ......................................... 919
  J. T. TENGDIN, M. S. SIMON, C. R. SUFANA
  Intelligent Load Shedding Schemes for Industrial Customers with Cogeneration Facilities .................................................. 925
  A. MAIORANO
  Comparison of Digital Simulation and Field Test Results of Islanding Detection System for Synchronous Generators .................................................. 931
  J. MOTOHASHI, T. ICHINOSE, T. ISHIKAWA, C. NAKAZAWA, H. FUKAI, I. CHIHARA

• PSRC Papers: Session II
  Chair: J. L. MCELRAy
  Tuesday, February 2, 2:00 PM, Nassau A
  Fault Detection using Sequential Probability Ratio Test ........................................ 938
  X. R. LI, L. WANG
  New Control Scheme in the Local System Stabilizing Controller .................................................. 944
  Y. SATO, C. FUKUI, T. NAKAMURA, K. KANEHARA, K. MAEKAWA, M. KOJIMA
  Requirements for a Superconducting Fault Current in the Utility Bus-Tie Location .................................................. 950
  J. CERULLI

• Poster Session
  Chair: G. NAIL
  Wednesday, February 3, 9:00 AM, Rhinelander Center
  PE-191-PWRD-0-08-1998 A New Accurate Fault Locating Algorithm for Series Compensated Lines .................................................. 956
  M. M. SAHA, J. IZYKOWSKI, E. ROSOLOWSKI, B. KASZTENNY
  PE-327-PWRD-1-08-1998 Energy Variance Criterion and Threshold Tuning Scheme for High Impedance Fault Detection .................................................. 957
  K. Y. LIEN, S. L. CHEN, C. J. LIAO, T. Y. GUO, T. M. LIN, J. S. SHEN
  PE-418-PWRD-0-08-1998 High Speed Transmission Line Directional Protection Evaluation using Field Data .................................................. 958
  M. SANAYE-PASAND, O. P. MALIK
  PE-209-PWRD-1-08-1998 A Power Transformer Protection Technique with Stability During Current Transformer Saturation and Ratio-Mismatch Conditions .................................................. 959
  T. S. SIDHU, H. S. GILL, M. S. SACHDEV
  PE-247-PWRD-0-10-1998 A Novel Fault Classification Technique for Double-Circuit Lines Based on a Combined Unsupervised Supervised Neural Network .................................................. 960
  PE-170-PWRD-0-10-1998 Implementation & Laboratory Test Results of an Elman Network-Based Transmission Line Directional Relay .................................................. 961
  M. SANAYE-PASSAND, O. P. MALIK
  PE-418-PWRD-0-10-1998 A Two-Relay Differential Protective Scheme for Le-Blanc Transformers .................................................. 962
  K. C. LU, N. CHEN
Substations Committee

- **Turning Data into Knowledge at the Substation** (Panel)
  Chair: R. FARQUHARSON
  *Tuesday, February 2, 9:00 AM, Murray Hill A*
  Equipment Monitoring Selection as a Part of Substation Automation
  W. J. BERGMAN
  The Realities of Turning Data Into Knowledge
  L. SMITH
  Substation Maintenance Optimization Program at the Dayton Power and Light Company
  W. BUSH
  Practical On-Line Analysis for Substation Equipment Monitoring
  M. C. CANNON
  Transformer Monitoring and Diagnostics
  B. SPARLING

- **Computerized Training for Substation Engineers** (Panel)
  Chair: M. CLARK
  *Tuesday, February 2, 2:00 PM, Gramercy B*
  Re-engineering Relay Training
  A.T. GIUILIANTE
  Using Simulations to Provide Safety and Operations Training in the Electric Power Industry
  P. FRANK
  New Techniques for Substation Training
  S. VANGILDER

- **Poster Session**
  Chair: R. P. Keil
  *Wednesday, February 3, 9:00 AM, Rhinelander Center*
  Study of Overhead Ground-wire Shunting Rates during Grounding Failure, for 500kv Substation Grounding
  System Design
  H. MAKINO, H. ITAKURA

Surge Protective Devices Committee

- **SPD Paper Session**
  Chair: G. LEE
  *Thursday, February 4, 9:00 AM, Sutton Center*
  Thyristor Switched Arresters for Improved Protection of Power System Equipment
  P. S. S. Holenarsipur, D. J. CHRISTOFERSEN, N. MOHAN
  Switching and Fault Closed Transients in Electric Power Systems
  M. A. CHAPMAN, A. MARTINEZ, E. SABIR, K. XING, Z. WANG, Y. LIU
Transformers Committee

• Poster Session
  Chair: B. K. PATEL
  Wednesday, February 3, 9:00, Rhinelander Center
  Study of Propagation of Transformer Partial Discharge Pulses in the the Coupling Network for a 500 kV Substation ................................................................. 1000
  D. XUZHU, Z. DEHENG, L. YILU
  Avoiding the Use of Negative Inductances and Resistances in Modeling Three-Winding Transformers for Computer Simulations ......................................................... 1025
  P. S. S. HOLENARSIIPUR, N. MOHAN, V. D. ALBERSON, J. CHRISTOFERSEN
  Voltage Stresses in a Distribution Transformer Under Non-Ideal Switching Conditions ......................................................... 1031
  O. A. SOYSAL
  Development of Large Capacity Low-Noise Gas-Insulated Transformer ................................................................. 1036
  A. TAKIZAWA, Y. ONO, S. INAKA, K. KONNO, Y. NOZAKI, T. SUSUKI, S. YAMAZAKI, S. SAITO, T. SHIRONE

• Transformers Committee Meeting
  Chair: B. K. PATEL
  Wednesday, February 3, 2:00 PM, Regent Parlor
  PE-050-PWRD-0-08-1998 An Investigation of Zero Order Harmonics in Power Transformers .......... 1042
  D. E. WARNER, W. T. JEWELL
  PE-388-PWRD-0-08-1998 Evaluation of Flitch Plate Losses in Power Transformers ......................................................... 1043
  D. A. KOPPIKAR, S. V. KULKARNI, P. N. SRINIVAS, S. A. KHAPARDE, R. JAIN
  PE-166-PWRD-0-07-1998 An Improved Method of Measuring C, Power Factor of Resistance-Grade Bushings ................................................................. 1044
  D. ZENG
  PE-209-PWRD-0-08-1998 A Wavelet-based Differential Transformer Protection ......................................................... 1045
  M. GOMEZ-MORANTE, D. W. NICOLLETTI
  PE-053-PWRD-1-08-1998 Monitoring of Power Transformers Using the Transfer Function Method ......................................................... 1046
  T. LEIBFRIED, K. FESER
  FEM-Study on Converter Transformer Failures in the Celilo HVDC Converter Station ................................................................. 1047
  F. E. ELLIOT, B. E. LAVIER, W. P. KUEHN, A. KUECHLER
  Estimation of the Model Parameters in Equivalent Circuit Models of Potential Transformers ................................................................. 1053
  B. BAK-JENSEN, L. OSTERGAARD
  FRA Diagnosis Method: Simulation Applied to Feasibility Study and Efficiency Improvement ................................................................. 1059
  O. MOREAU, Y. GUILLOT, B. BARRE

Transmission and Distribution Committee

• HVDC and FACTS
  Chair: D. MCCALLUM
  Monday, February 1, 2:00 PM, Gibson Suite
  Circuit Analysis of a Thyristor Controlled Series Compensation ................................................................. 1067
  Z. XUEQIANG, C. CHEN
  A Converter Transformer with Series-Connected Line-Side Windings for a DC Link using Voltage Source Converters ................................................................. 1073
  T. NAKAJIMA, H. SUZUKI, K. IZUMI, S. SUGIMOTO, Y. YONEZAWA, Y. TSUBOTA
  Simulation Studies for a Control and Protection Scheme for Hybrid Multi-Terminal HVDC Systems ................................................................. 1079
  N. NOSAKA, Y. TSUBOTA, K. MATSUUKA, K. SAKAMOTO, H. NAKAMURA, M. TAKASAKI, H. KAWAZOE
• Distribution I

  Chair: J. SANTUK
  Monday, February 2, 2:00 PM, Clinton Suite

  PC-Based Remote Control and Fault Location System for Distribution Line ........................................... 1085
  T. I. CHOI, I. S. KOH, B. H. KIM, W. S. SONG, W. S. JANG

• Equipment for Improving Power Quality and Reliability

  Chair: A. KERI
  Monday, February 1, 2:00 PM, Madison Suite

  PE-105-PWRD-0-10-1998 The Impact of Generation Mix on Placement of Static VAR Compensators .............. 1091
  R. H. LASSETER, R. WANG

  Protection of ARC Furnace Supply Systems from Switching Surges ...................................................... 1092
  O. A. SOYSAL

  State of the Art of HTS Technology Applications for Large Applications: Power Current Programs and Future Expectations ......................................................... 1096
  J. CERULLI

• Harmonic Limits on Single Phase Equipment (Panel) ................................................................. 1101

  Chair: R. HURST
  Monday, February 1, 2:00 PM, Nassau B

  Cost Impacts of Implementing the IEC Harmonic Limits ................................................................. 1102
  R. GARDINIER

  IWC Approach to Standards Making ...................................................................................................... 1104
  J. R. KENNEDY

  Lower Order Harmonic Cancellation: Impact of Low-Voltage Network Topology .................................. 1106
  A. MANSOOR

  The Impact of Distribution System Design on Harmonic Limits .......................................................... 1110
  D. WARD

  Measurement of Harmonics Emitted by Low Voltage Equipment: Testing Requirements ...................... 1115
  A. E. EMANUEL

• Application of Custom Power Devices for Enhanced Power Quality (Panel) ........................................ 1126

  Chair: D. SABIN
  Tuesday, February 2, 9:00 AM, Sutton North

  Special Application Considerations for Custom Power Systems ......................................................... 1127
  S. NILSSON

  Improved Power Quality Solutions using Advanced Solid-State Switching and Static Compensation Technologies .................................................. 1132
  G. REED, M. TAKEDA, I. IYODA

  Field Demonstration Project of a Distribution System Static Compensation Used to Mitigate Voltage Flicker .................................................................................. 1138
  J. CLOUSTON, J. H. GURNEY

  Parallel Active Harmonic Filters: Economical Viable Technology ................................................... 1142
  C. A. GOUGLER, J. R. JOHNSON

  Multimode Battery Energy Storage System for Custom Power Applications ........................................ 1147
  R. S. THALLMAN, S. ECKROAD

• Distribution II

  Chair: P. NEDWICK
  Tuesday, February 2, 9:00 AM, Beekman Parlor

  Development of a Novel Hybrid Switch Device and Application to a Solid State Transfer Switch .......... 1151
  M. TAKETA, H. YAMAMOTO, T. ARITSUKA, I. KAMIYAMA, G. F. REED

  A New Configuration for Uninterruptible Distribution Systems ......................................................... 1157
  F. MUZI
Advances in Modeling and Simulation
Chair: A. IMECE
Tuesday, February 2, 9:00 AM, Madison Suite

P. WANG, R. BILLINTON

PE-410-PWRD-0-10-1998 A Multi-Objective Algorithm for Distribution Networks Restoration
D. S. POPOVIC; R. CIRIC

Using Voltage Sag and Interruption Indices in Distribution Planning
R. C. DUGAN, D. L. BROOKS, T. E. MCDERMOTT, A. SUNDARAM

Modelling of FACTS Devices
Chair: K. CLARK
Tuesday, February 2, 2:00 PM, Gibson Suite

STATCOM-STAtic Synchronous COMpensator: Theory, Modeling and Applications
K. K. SEN

Physical Experiments on a +10Kvar STATCOM Model
L. CHUN, W. ZHONGHONG, T. H. KIM, M. XIAOJUN, X. LINCHENG

A Decoupled Unified Power Flow Controller Model for Power Flow Considering Limit Resolution

Using a Miniature Model and EMTP Simulations to Evaluate New Methods to Control and Protect a Thyristor-Controlled Series Compensator
Y. TANAKA, H. TANIGUCHI, M. EGAWA, H. FUJITA, M. WATANABE, K. KONISHI

Distribution III
Chair: G. BAKER
Tuesday, February 2, 2:00 PM, Beekman Parlor

Overvoltage Protection for Distribution and Low-Voltage Equipment Experiencing Sustained Overvoltages Users Experiencing Sustained Secondary Overvoltages
G. L. GOEDDE, L. A. KOJOVIC, G. S. KNABE

STATCOM, an Efficient Means for Improved Flicker Mitigation
T. A. ARSSON, C. POUmarede

Application of 46kV 100MVA Smart Predictive Line Controller (SPLC) to AC Electric Arc Furnace
S. B. DEWAN, J. RAJD

Electric and Magnetic Fields and Their Mitigation
Chair: J. STEWART
Tuesday, February 2, 2:00 PM, Madison Suite

PE-051-PWRD-0-10-1998 3-D Modeling of Thin Conductive Sheets for Magnetic Field Shielding: Calculations and Measurements
B. A. CLAIRMONT, R. J. JORDAN

PE-159-PWRD-0-10-1998 Corona Caused Deterioration of ADSS Fiber-Optic Cables on High Voltage Lines
G. G. KARADY, G. BESZTERCEY, M. W. TUOMINEN

PE-274-PWRD-0-10-1998 Measurements and Simulations of Cable Shielding Against Magnetic Field Induction
C. F. YANG, J. T. HWANG, J. S. YANG, T. H. LEE
Harmonics and Power Quality: Session 1

Chair: A. EMANUEL
Wednesday, February 3, 9:00 AM, Nassau A

PE-180-PWRD-0-10-1998 A Detailed Instantaneous Harmonic and Reactive Compensation Analysis of Three-Phase AC/DC Converters, in abc and αβ Coordinates ........................................ 1223
A. NAVA-SEGURA, M. CARMONA-HERNANDEZ

PE-237-PWRD-0-10-1998 Factors Affecting the Commutation Reactance of Direct Connected Generator-Converter Units .............................................................. 1224
Q. N. DINH, J. ARRILLAGA

Distribution IV

Chair: T. SHORT
Wednesday, February 3, 2:00 PM, Beekman Parlor

Behavior of AC and DC Drives During Voltage Sags with Phase-Angle Jumps and Three-Phase Unbalance ................................................................. 1225
M. H. J. BOLLEN, R. A. A. de GRAAFE

Trend Capture in Power Quality Monitoring ........................................ 1231
M. BARAN, P. SHUBHANKAR, S PEELE

RMS Voltage Variation Statistical Analysis for a Survey of Distribution System Power Quality Performance .......................................................... 1235
D. D. SABIN, T. E. GREBE, A. SUNDARAM

Additions to the Method of Critical Distances for Stochastic Assessment of Voltage Sags ................................................................. 1241
M. H. J. BOLLEN

Operational Experience with a Superconducting Magnetic Energy Storage Device at Brookhaven National Laboratory, New York ................................................................. 1247
J. CERULLI

Poster Session

Chair: B. SHPERLING
Thursday, February 4, 9:00 AM, Rhinelander Center

Feasibility Assessment of Simultaneous Bilateral Transactions in a Competitive Energy Market ................................. 1253
G. A. HAMOUD

Switching-Level Simulation Model for SSSC with EMTP ........................................ 1259
B. M. HAN, J. K. PARK, S. I. MOON, G. G. KARADY

Harmonics and Power Quality - Session II

Chair: T. J. GENTILE
Thursday, February 4, 9:00 AM, Sutton South

PE-055-PWRD-0-10-1998 Field Tests of a Filter To Reduce Harmonic Currents in a Three Phase Fluorescent Lamp System ........................................ 1264
W. MIECZARSKI, W. B. LAWRENCE, J. SZCZEPANIK

System Harmonics Reduction Using Multipulse AC Fed PWM Voltage Source Inverters ........................................ 1265
F. WANG

An Expert System for Filter Optimum Location ........................................ 1269
A. BERIZZI, F. CASTELLI-DEZZA, A. SILVESTRI, D. ZANINELLI

Harmonic Signals in Saudi Arabia Industrial Plants ........................................ 1275
I. EL-AMIN, A. AL-SHEHRI
• Transmission and Distribution Committee Meeting
  Chair: B. R. SHPERLING
  Thursday, February 4, 9:00 AM, Regent Parlor
  What’s new in T&D? (Panel) ................................................................. 1280
  K. N. MORTENSEN
  Lightning Research Update Including New Uses of Lightning Data ................................................................. 1285
  V. LONGO, C. HICKMAN
  Unified Power Flow Controller on the AEP System: Commissioning and Operation ................................................................. 1287
  B. MEHRABAN, L. KOVALSKY

• Transients and Power Quality
  Chair: P. RIBEIRO
  Thursday, February 4, 9:00 AM, Murray Hill A
  On the Use of Wavelets for the Detection and Analysis of Power System Transients ................................................................. 1293
  V. M. REDDY, S. S. RAO, F. J. MERCEDE
  Evaluation of Transient Time Characteristics in the Presence of Capacitor Switching ................................................................. 1300
  C. J. DAFIS, C. O. NWANKPA, A. PETROPULU
  Variable Rate Power Disturbance Signal Compression using Embedded Zerotree Wavelet Transform Coding ................................................................. 1305
  J. CHUNG, E. J. POWERS, W. M. GRADY, S. C. BHATT
  A Wavelet-Based Procedure for Automatically Determining the Beginning and End of Transmission System Voltage Sags ................................................................. 1310
  A. C. PARSONS, W. M. GRADY, E. J. POWERS
  Implementation of a Fuzzy Logic Scheme for Q/V Control in Distribution Systems ................................................................. 1316
  G. RAMAKRISHNA, N. D. RAO

• Estimating the Lightning Performance of Transmission Lines (Panel)
  Chair: C. HICKMAN
  Thursday, February 4, 9:00 Gibson Suite
  Establishment of Estimation Lightning Density Method with Location System Data ................................................................. 1322
  M. SUZUKI, N. KATAGIRI, K. ISHIKAWA

• Overhead Conductor Dynamics (Panel)
  Chair: C. PON
  Thursday, February 4, 9:00, Clinton Suite
  Measurement of Frequency Response of Overhead Power Lines to Wind ................................................................. 1327
  R. ISHINO, T. ISHIKAWA

• FACTS
  Chair: M. I. HENDERSON
  Thursday, February 4, 2:00 PM, Gibson Suite
  PE-343-PWRD-0-10-1998 Operating Principles of Shunt STATCOM Based on 3-Level Diode-Clamped Converters ................................................................. 1333
  B.T. OOI, G. JOOS, X. HUANG
  PE-438-PWRD-0-10-1998 Line Current Balancing with a Unified Power Flow Controller ................................................................. 1334
  A. SONNENMOSE, P. W. LEHN